Hazus: Flood Global Risk Report

Region Name: Cromwell

Flood Scenario: CromwellAll

Print Date: Monday, January 6, 2020

Disclaimer:

This version of Hazus utilizes 2010 Census Data.
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 Flood. These results can be improved by using enhanced inventory data and flood hazard information.

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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 approximately 13 square miles and contains 276 census blocks. The region contains over 6 thousand households and has a total population of 14,005 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 5,160 buildings in the region with a total building replacement value (excluding contents) of 2,442 million dollars. Approximately 89.44% of the buildings (and 76.00% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 5,160 buildings in the region which have an aggregate total replacement value of 2,442 million 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	1,856,214	76.0%
Commercial	413,463	16.9%
Industrial	97,739	4.0%
Agricultural	8,584	0.4%
Religion	38,782	1.6%
Government	6,778	0.3%
Education	20,896	0.9%
Total	**2,442,456**	**100%**

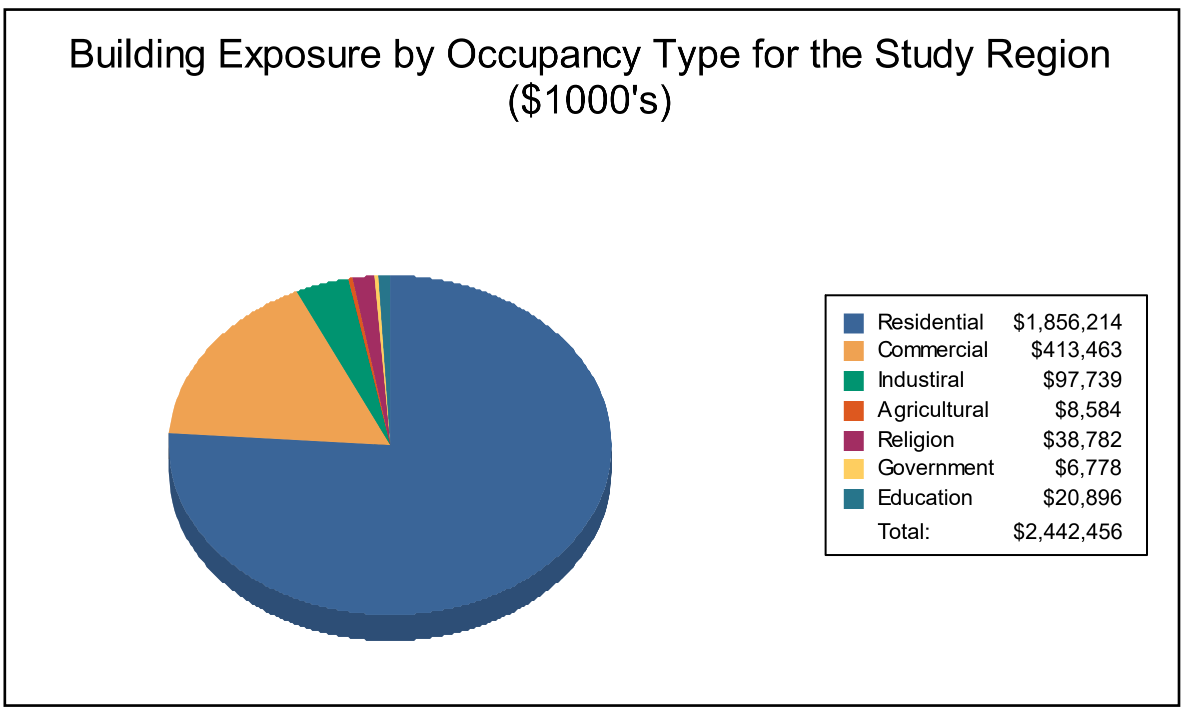
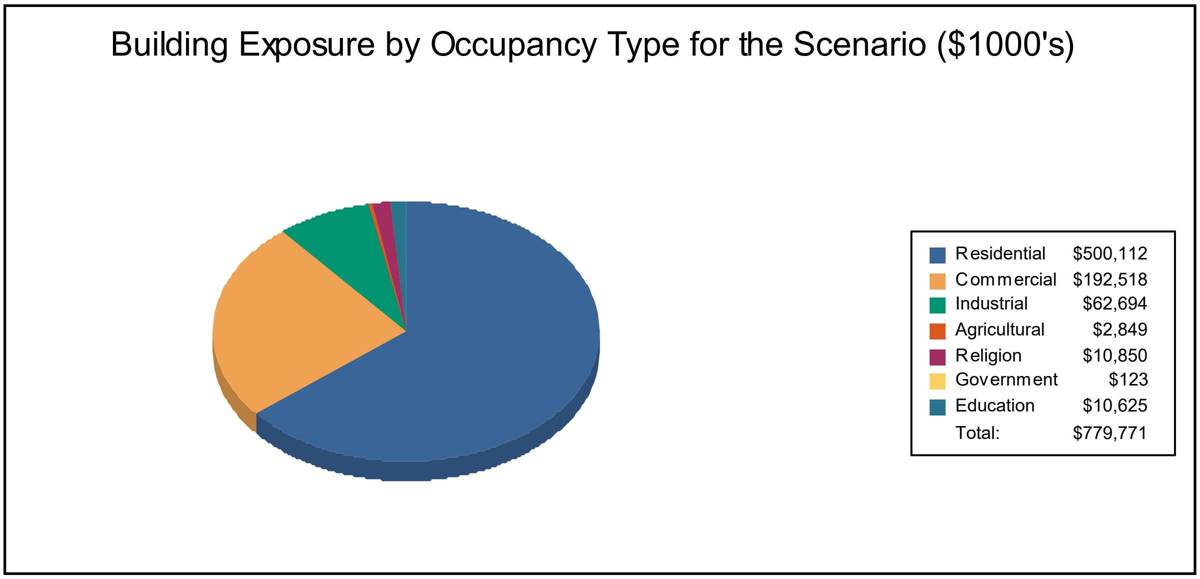


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	500,112	64.1%
Commercial	192,518	24.7%
Industrial	62,694	8.0%
Agricultural	2,849	0.4%
Religion	10,850	1.4%
Government	123	0.0%
Education	10,625	1.4%
Total	**779,771**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 7 schools, 3 fire stations, 1 police station and 1 emergency operation center.

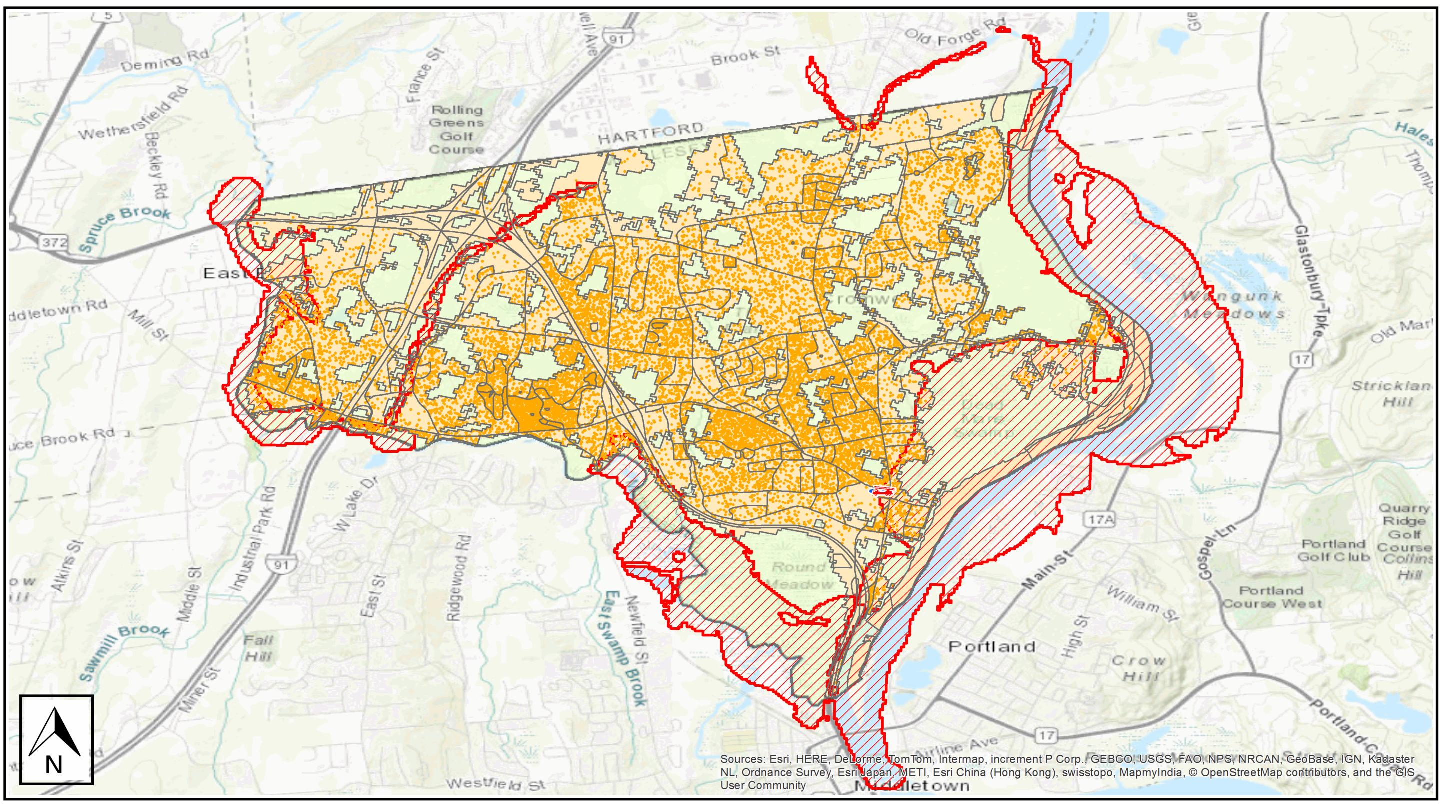
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Cromwell
Scenario Name:	CromwellAll
Return Period Analyzed:	10
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 46 buildings will be at least moderately damaged. This is over 28% of the total number of buildings in the scenario. There are an estimated 29 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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.

Total Economic Loss (1 dot = $300K) Overview Map

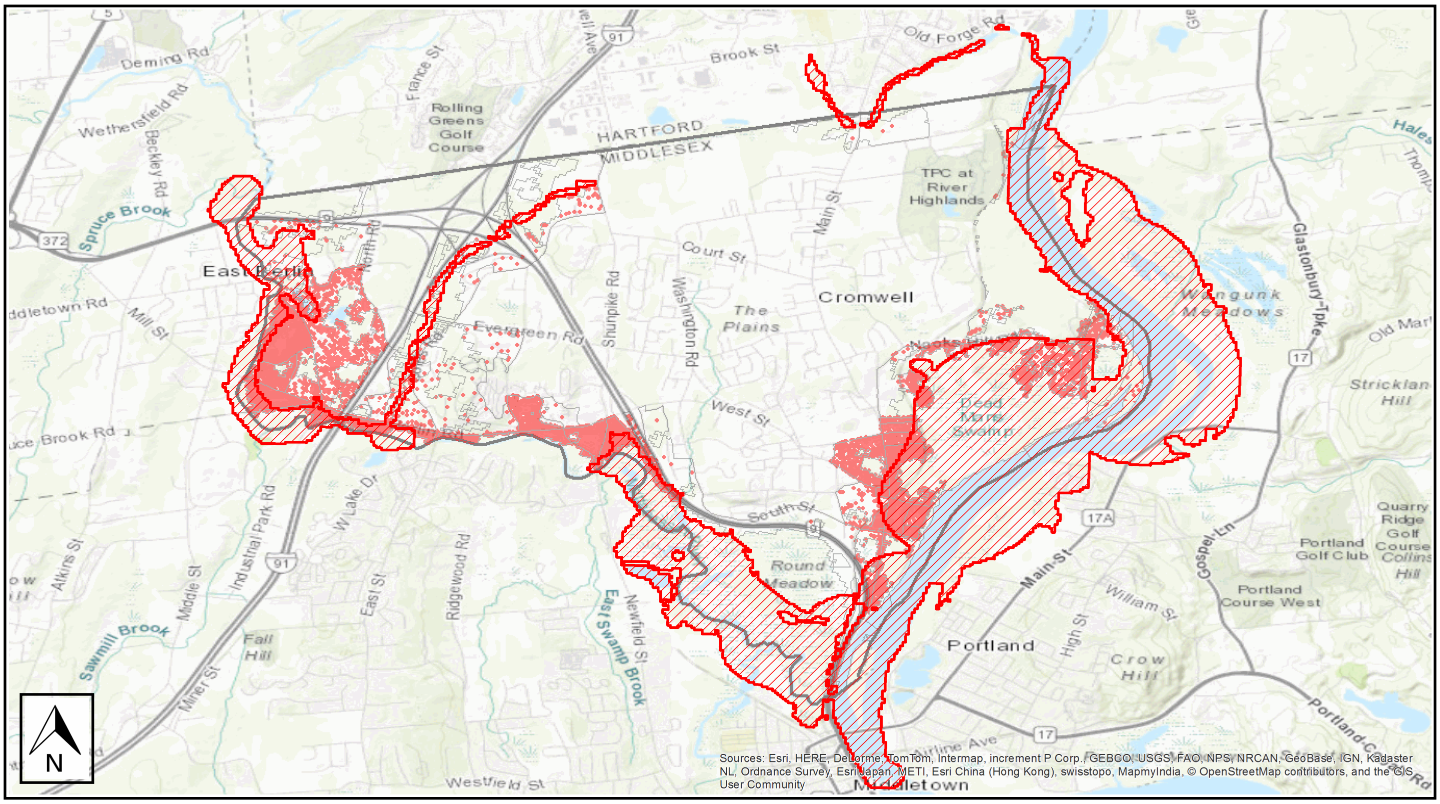


Table 3: Expected Building Damage by Occupancy

Occupancy	1-10 Count	1-10 (%)	11-20 Count	11-20 (%)	21-30 Count	21-30 (%)	31-40 Count	31-40 (%)	41-50 Count	41-50 (%)	>50 Count	>50 (%)
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	2	100	0	0	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	6	12	5	10	3	6	4	8	5	10	29	56
Total	**8**		**5**		**3**		**4**		**5**		**29**	

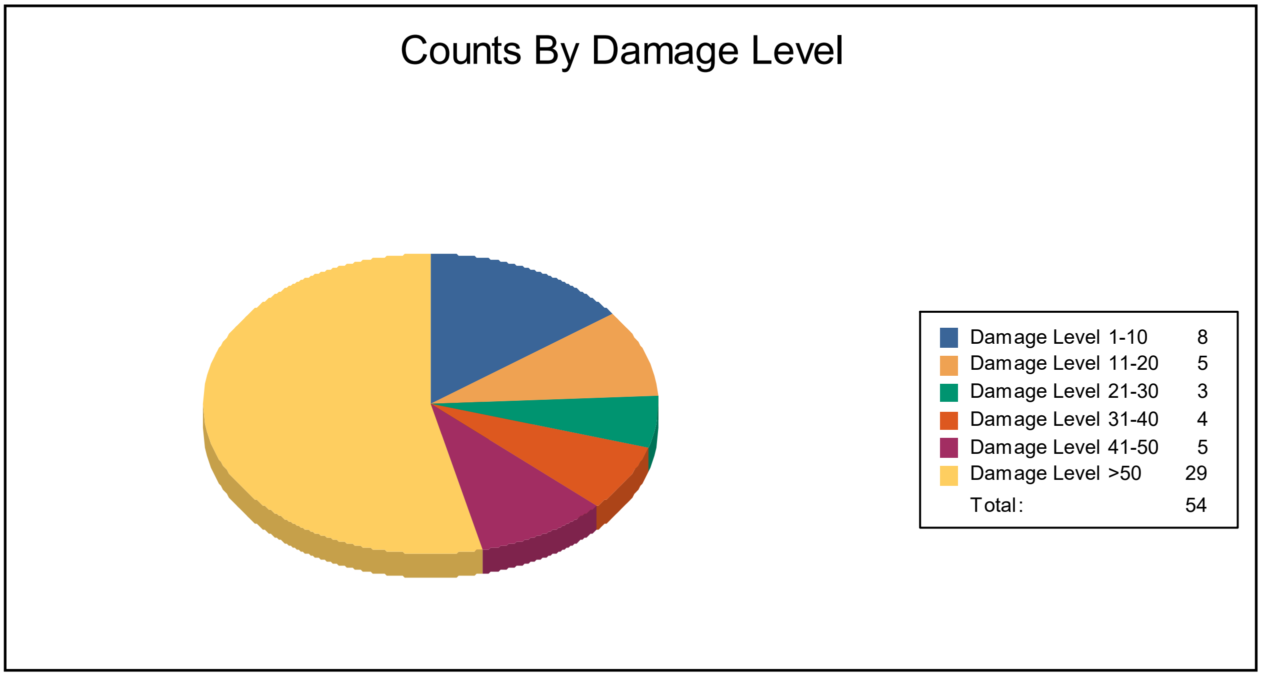


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	0	0	0	0	0	0	0	0	0	0	0	0
Steel	2	100	0	0	0	0	0	0	0	0	0	0
Wood	6	12	5	10	3	6	4	8	5	10	29	56

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
Emergency Operation Centers	1	0	0	0
Fire Stations	3	0	1	1
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	7	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

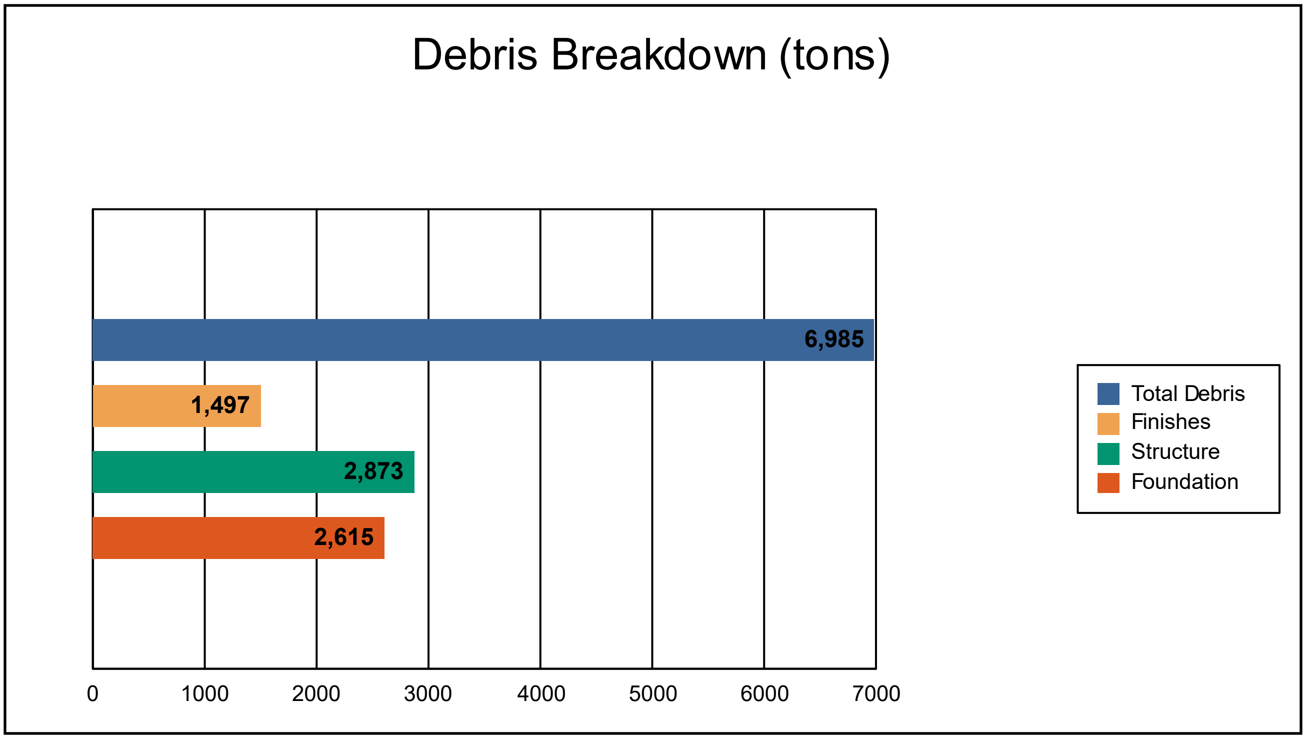
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(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.

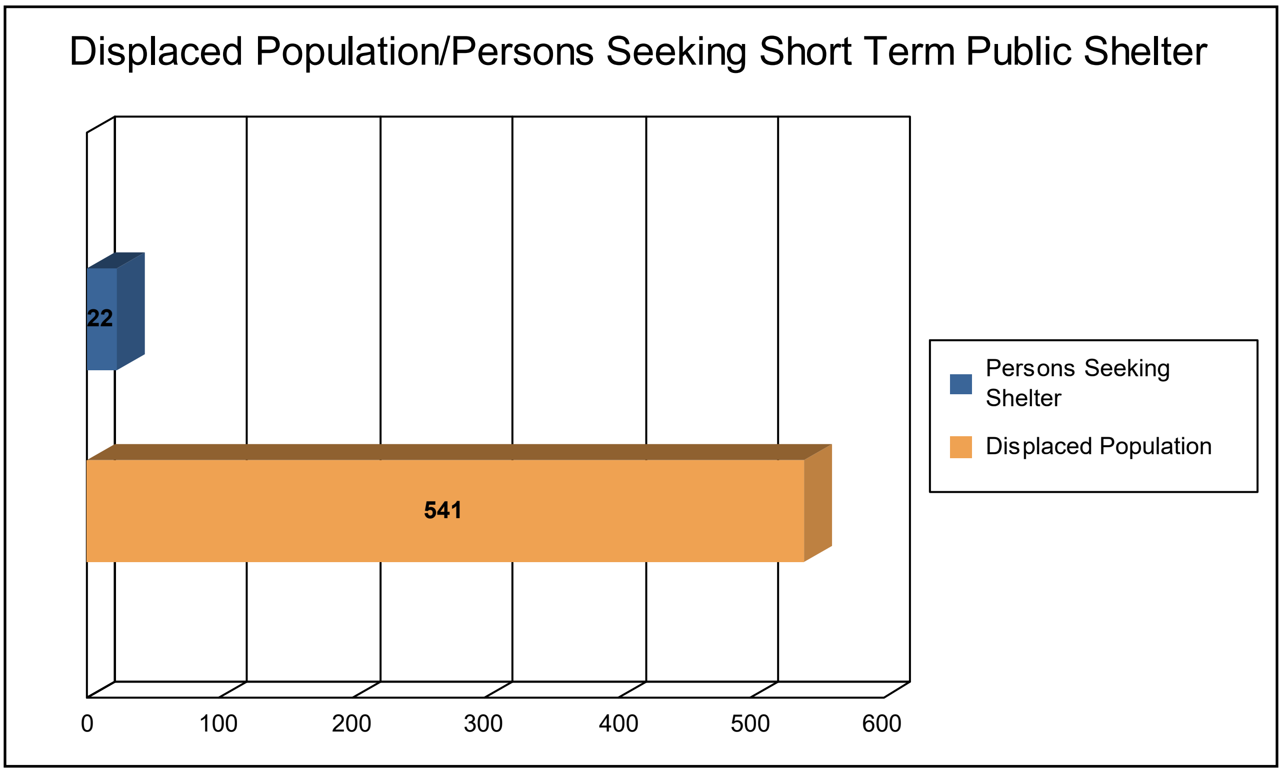


The model estimates that a total of 6,985 tons of debris will be generated. Of the total amount, Finishes comprises 21% of the total, Structure comprises 41% of the total, and Foundation comprises 37%. If the debris tonnage is converted into an estimated number of truckloads, it will require 280 truckloads (@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 180 households (or 541 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 22 people (out of a total population of 14,005) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 115.99 million dollars, which represents 14.87 % of the total replacement value of the scenario buildings.

Building-Related Losses

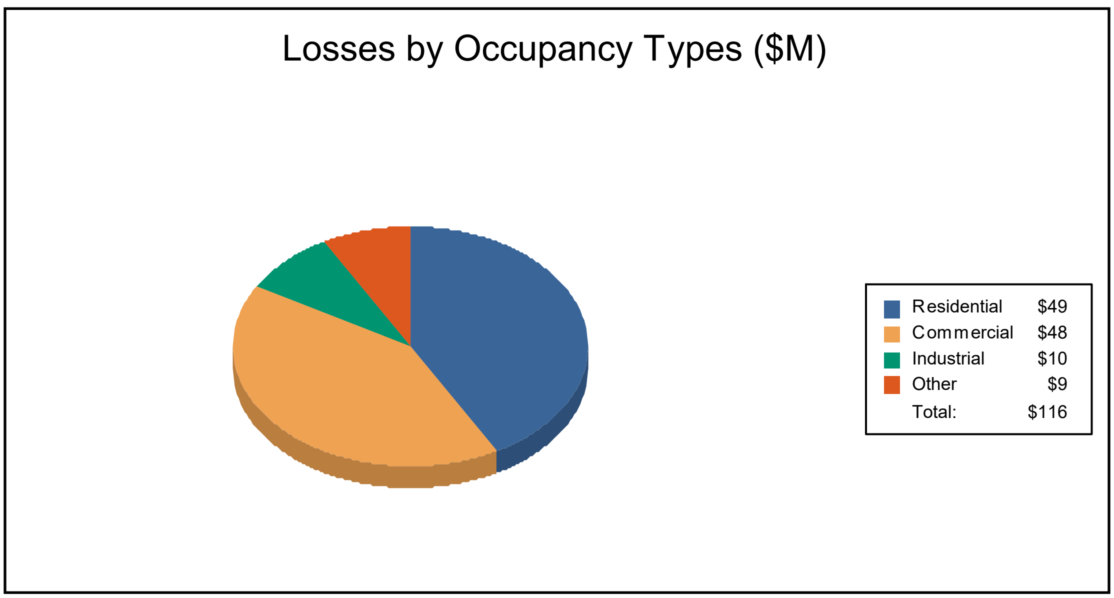
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 66.68 million dollars. 43% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 41.83% 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	24.99	4.99	3.13	0.86	33.98
	Content	12.15	12.43	5.53	1.83	31.94
	Inventory	0.00	0.19	0.49	0.07	0.76
	Subtotal	**37.15**	**17.62**	**9.16**	**2.76**	**66.68**
Business Interruption						
	Income	1.35	12.97	0.27	1.80	16.38
	Relocation	3.29	2.76	0.17	0.78	7.00
	Rental Income	3.56	2.04	0.04	0.04	5.68
	Wage	3.17	12.77	0.25	4.07	20.25
	Subtotal	**11.37**	**30.54**	**0.72**	**6.68**	**49.31**
ALL	**Total**	**48.52**	**48.16**	**9.88**	**9.44**	**115.99**



Appendix A: County Listing for the Region

Connecticut

- Middlesex

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Middlesex	14,005	1,856,214	586,242	2,442,456
Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**
Total Study Region	**14,005**	**1,856,214**	**586,242**	**2,442,456**

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Note:
Appendix A contains a complete listing of the counties contained in the region.

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There are an estimated 5,160 buildings in the region with a total building replacement value (excluding contents) of 2,442 million dollars. Approximately 89.44% of the buildings (and 76.00% of the building value) are associated with residential housing.

Building Inventory

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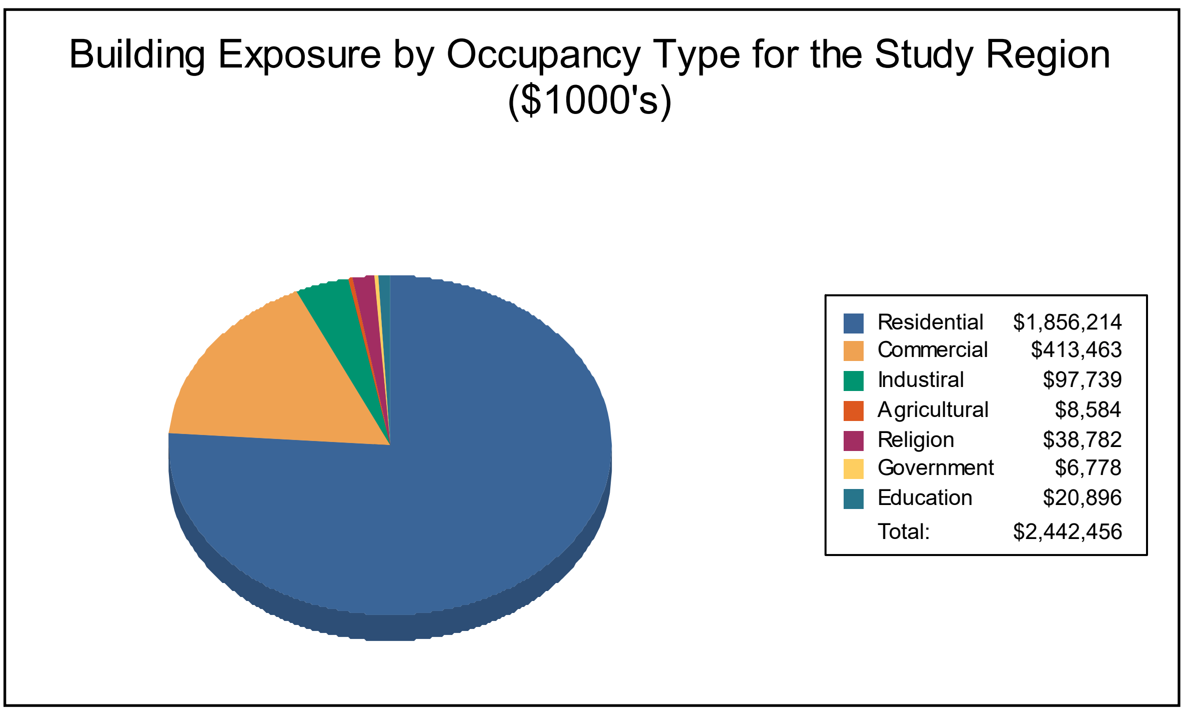

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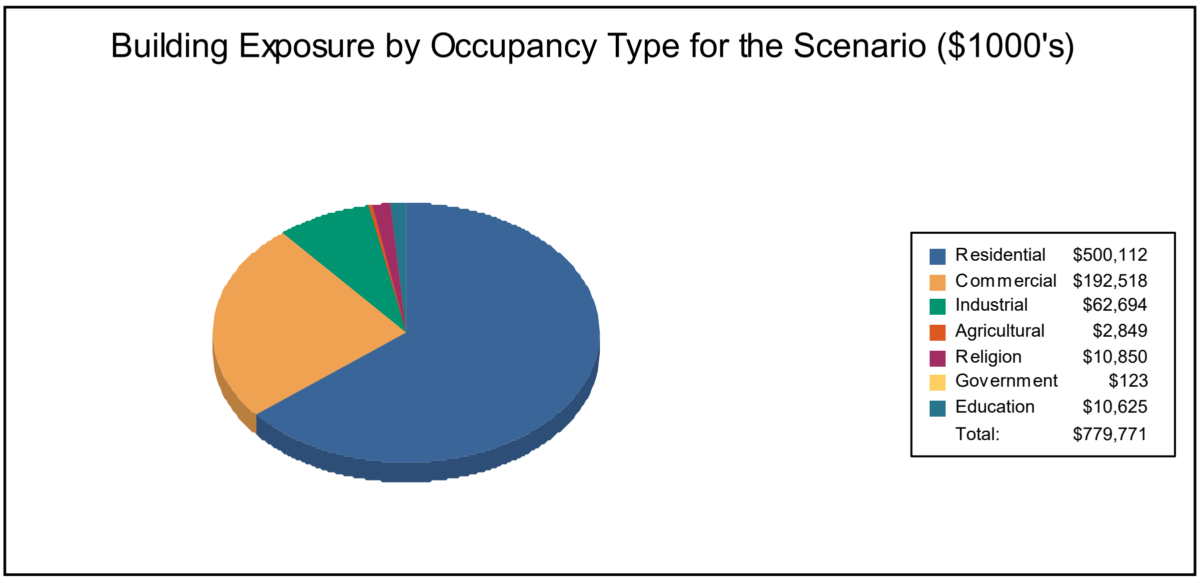


Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 7 schools, 3 fire stations, 1 police station and 1 emergency operation center.

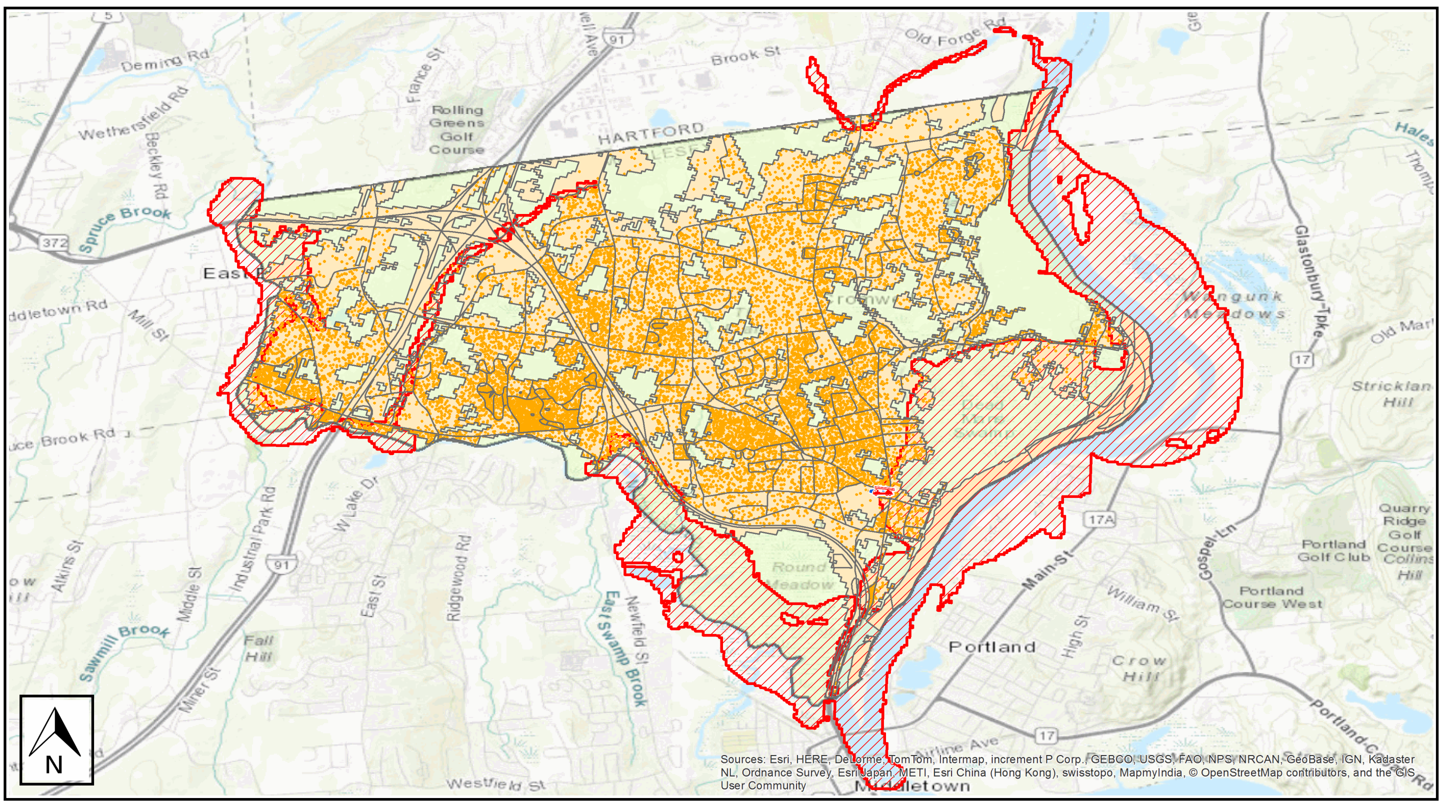
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Cromwell
Scenario Name:	CromwellAll
Return Period Analyzed:	25
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 54 buildings will be at least moderately damaged. This is over 37% of the total number of buildings in the scenario. There are an estimated 33 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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.

Total Economic Loss (1 dot = $300K) Overview Map

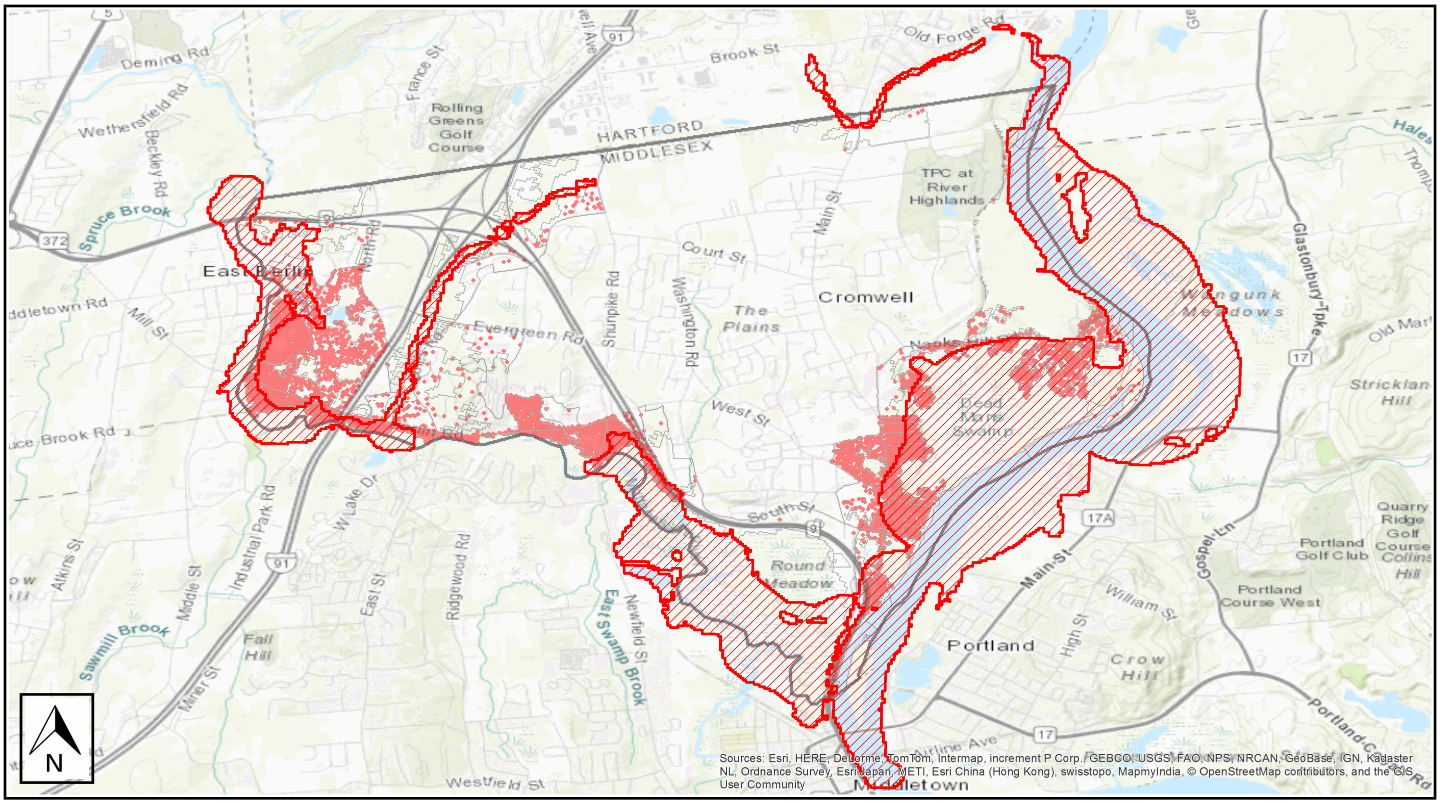


Table 3: Expected Building Damage by Occupancy

Occupancy	1-10 Count	1-10 (%)	11-20 Count	11-20 (%)	21-30 Count	21-30 (%)	31-40 Count	31-40 (%)	41-50 Count	41-50 (%)	>50 Count	>50 (%)
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	3	75	1	25	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	8	13	9	15	3	5	3	5	5	8	33	54
Total	**11**		**10**		**3**		**3**		**5**		**33**	

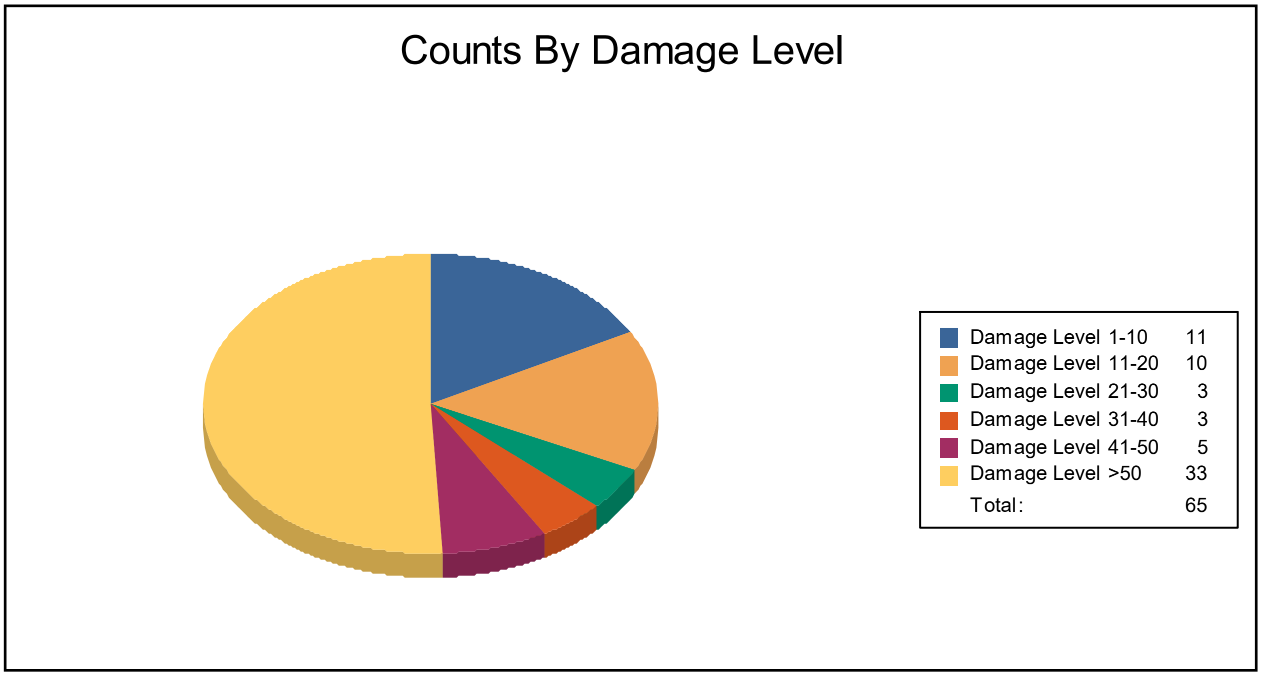


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	0	0	0	0	0	0	0	0	0	0	0	0
Steel	2	67	1	33	0	0	0	0	0	0	0	0
Wood	8	13	9	15	3	5	3	5	5	8	33	54

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
Emergency Operation Centers	1	0	0	0
Fire Stations	3	0	1	1
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	7	0	0	0

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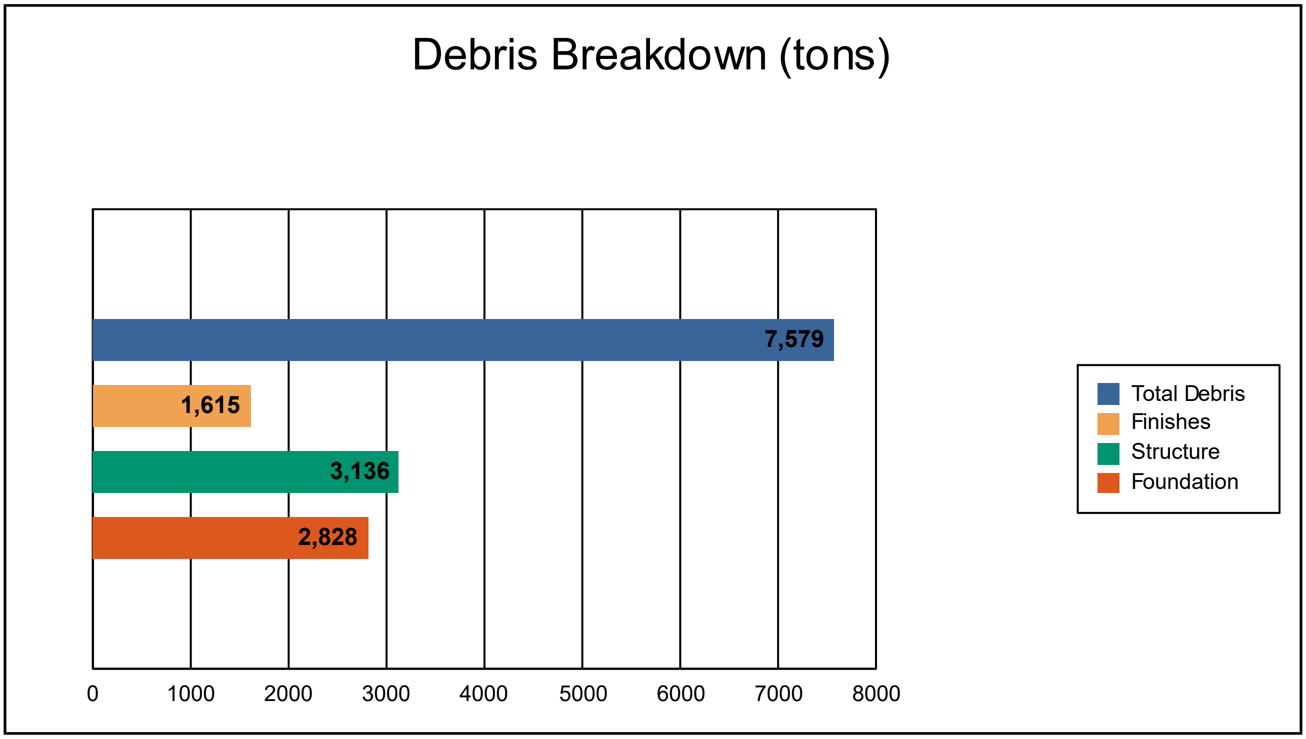
Induced Flood Damage

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.

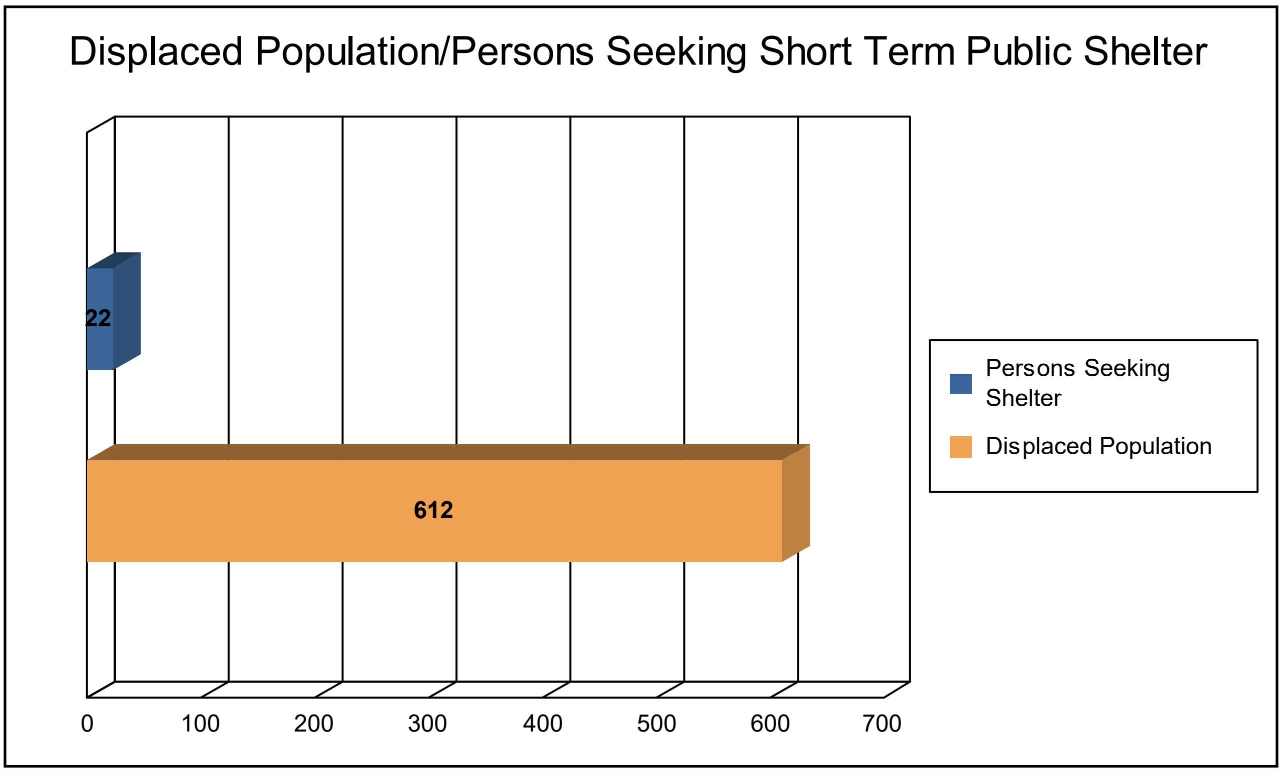


The model estimates that a total of 7,579 tons of debris will be generated. Of the total amount, Finishes comprises 21% of the total, Structure comprises 41% of the total, and Foundation comprises 37%. If the debris tonnage is converted into an estimated number of truckloads, it will require 304 truckloads (@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 204 households (or 612 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 22 people (out of a total population of 14,005) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 137.42 million dollars, which represents 17.62 % of the total replacement value of the scenario buildings.

Building-Related Losses

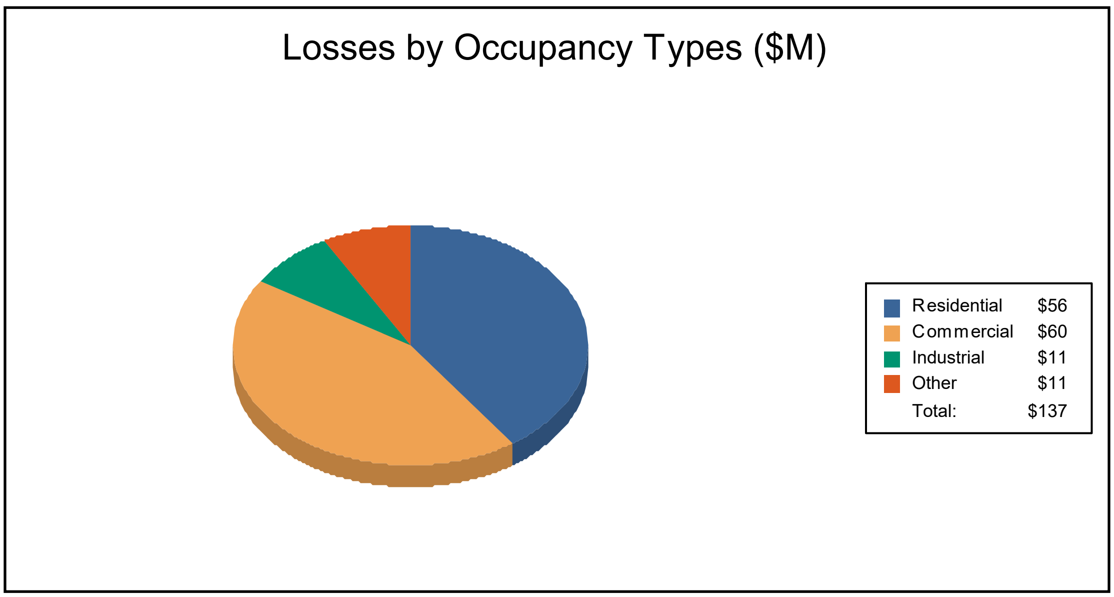
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 79.18 million dollars. 42% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 40.40% 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	27.97	6.34	3.43	1.08	38.81
	Content	13.80	16.61	6.17	2.89	39.47
	Inventory	0.00	0.27	0.56	0.08	0.90
	Subtotal	**41.77**	**23.22**	**10.15**	**4.04**	**79.18**
Business Interruption						
	Income	1.73	15.49	0.28	1.90	19.41
	Relocation	3.63	3.35	0.18	0.79	7.96
	Rental Income	4.32	2.48	0.04	0.04	6.88
	Wage	4.06	15.33	0.27	4.31	23.98
	Subtotal	**13.75**	**36.66**	**0.79**	**7.05**	**58.24**
ALL	**Total**	**55.51**	**59.88**	**10.94**	**11.09**	**137.42**



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Connecticut

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Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**
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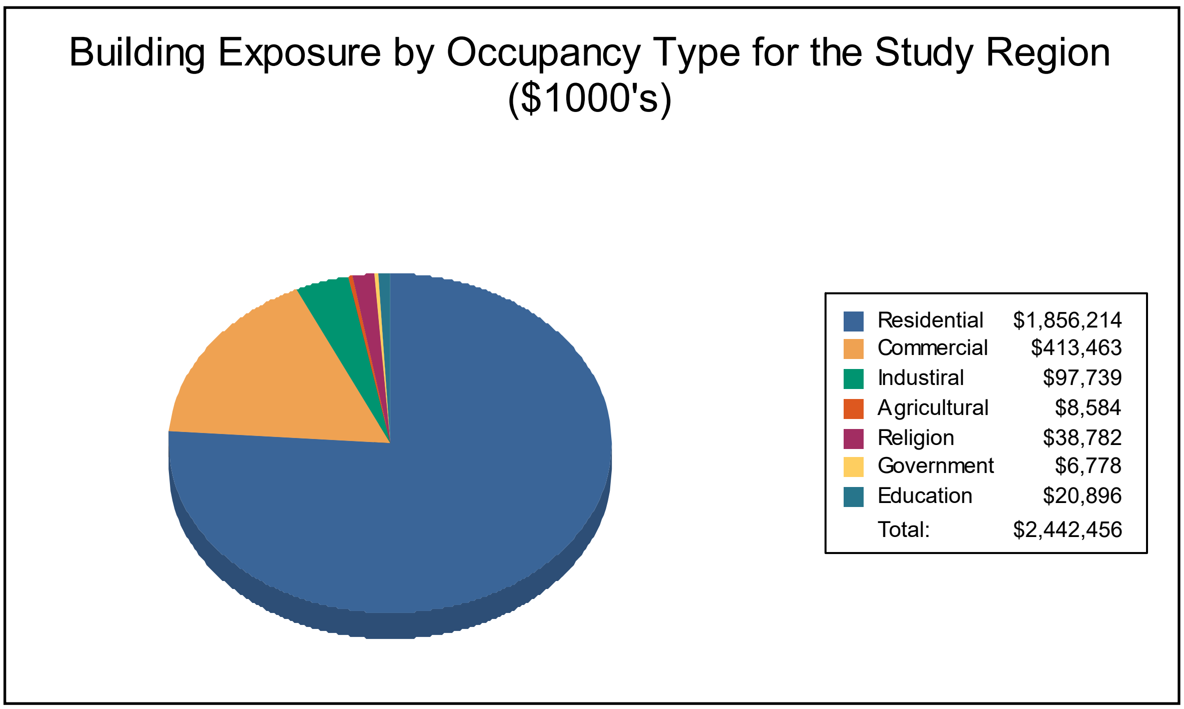

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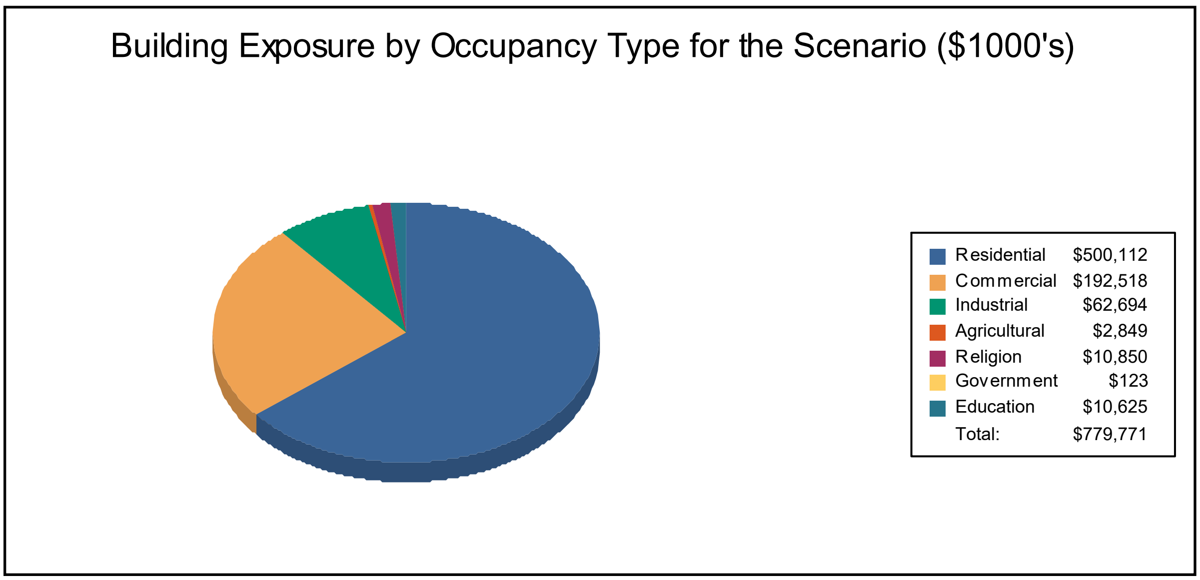
Education	10,625	1.4%
Total	**779,771**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 7 schools, 3 fire stations, 1 police station and 1 emergency operation center.

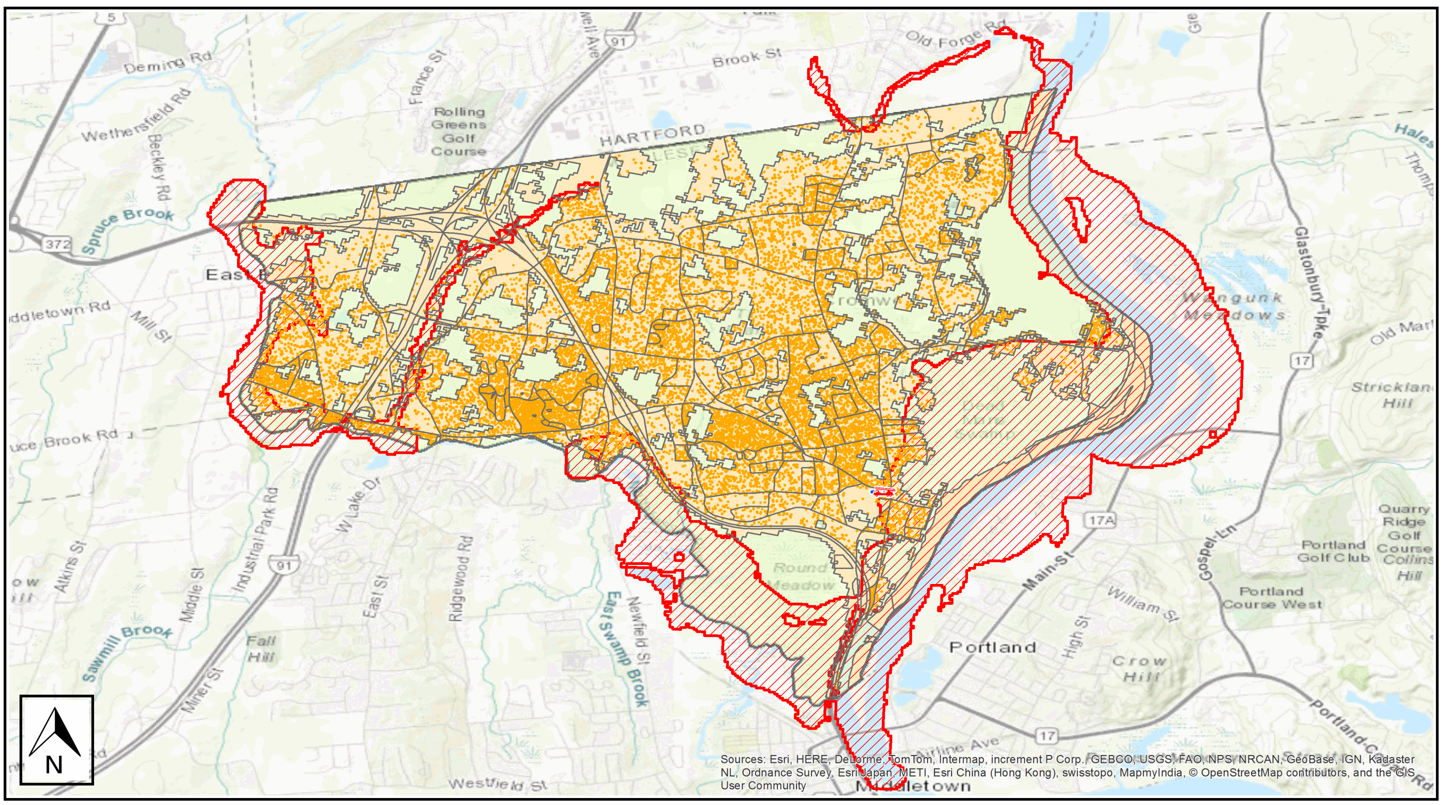
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Cromwell
Scenario Name:	CromwellAll
Return Period Analyzed:	50
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 65 buildings will be at least moderately damaged. This is over 39% of the total number of buildings in the scenario. There are an estimated 40 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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.

Total Economic Loss (1 dot = $300K) Overview Map

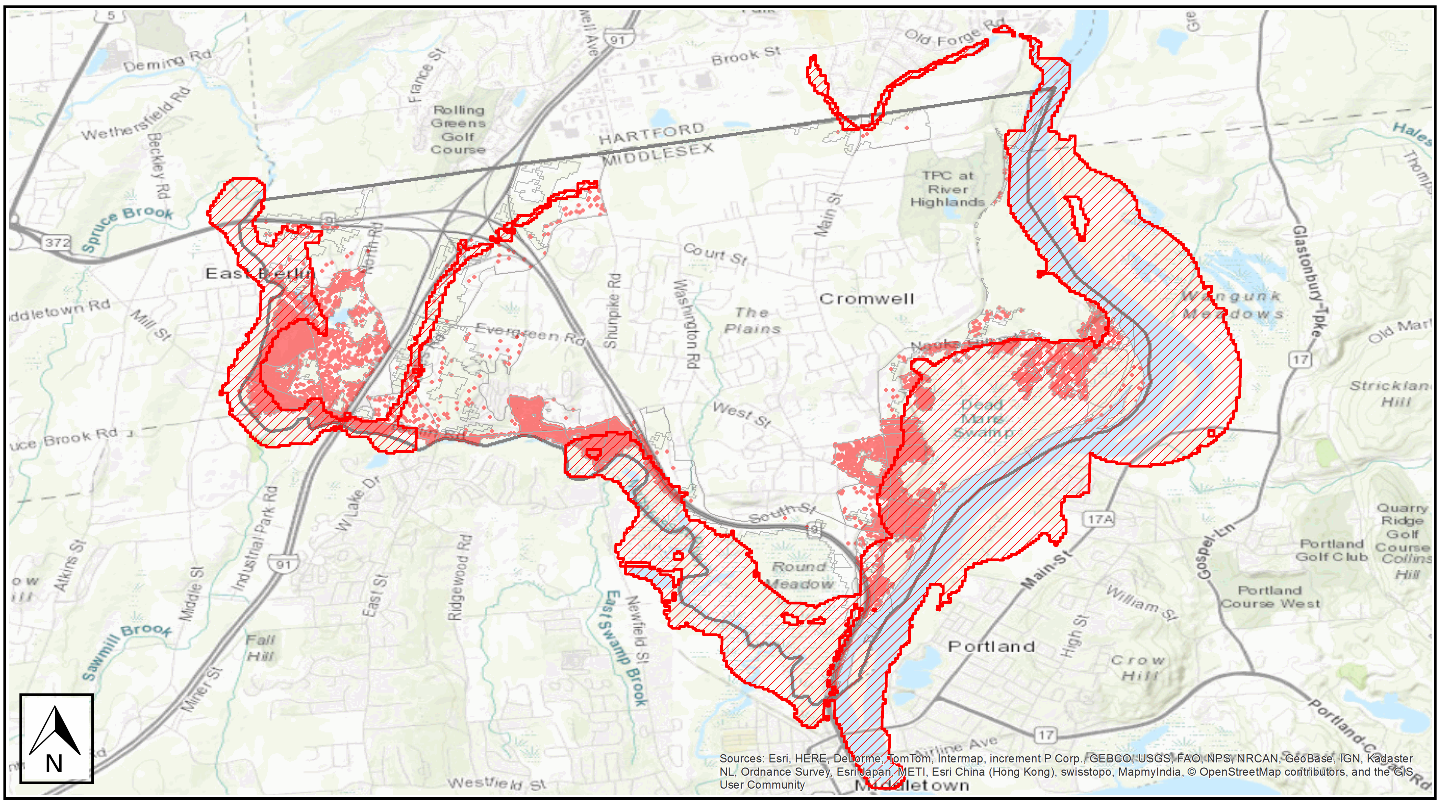


Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	2	67	1	33	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	10	14	13	18	4	5	2	3	5	7	40	54
Total	**12**		**14**		**4**		**2**		**5**		**40**	

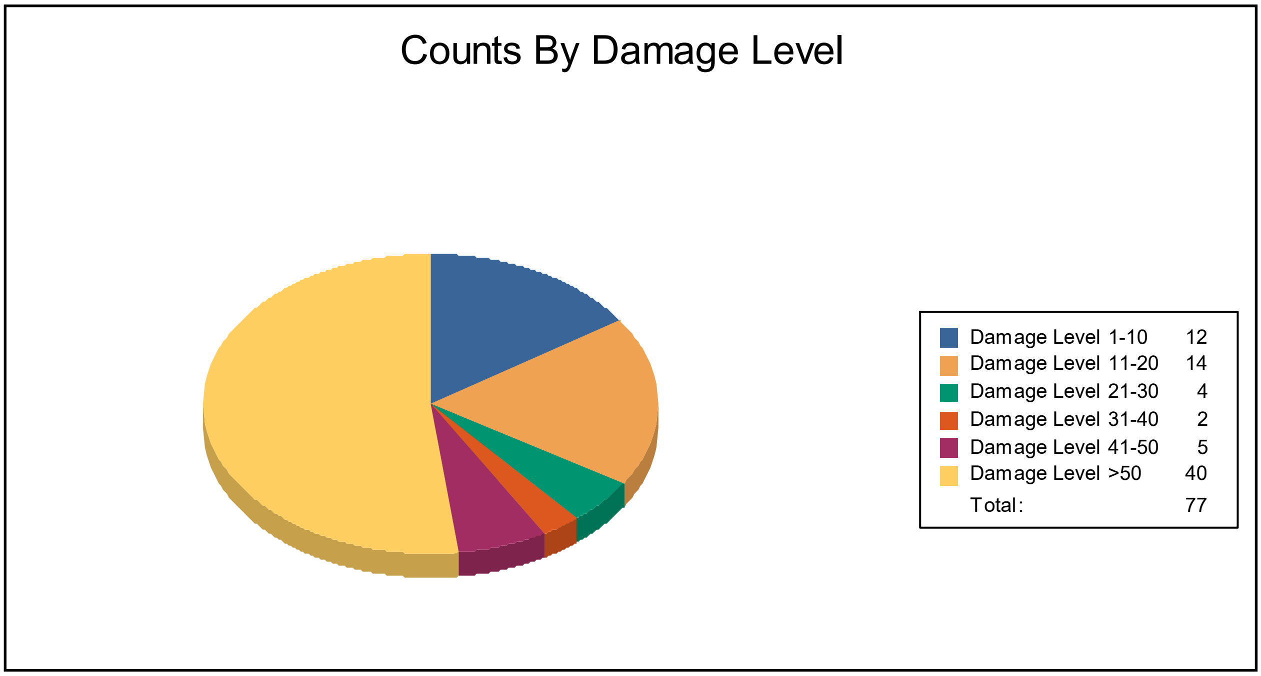


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	0	0	0	0	0	0	0	0	0	0	1	100
Steel	2	67	1	33	0	0	0	0	0	0	0	0
Wood	10	14	13	18	4	5	2	3	5	7	39	53

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
Emergency Operation Centers	1	0	0	0
Fire Stations	3	0	1	1
Hospitals	0	0	0	0
Police Stations	1	0	1	1
Schools	7	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

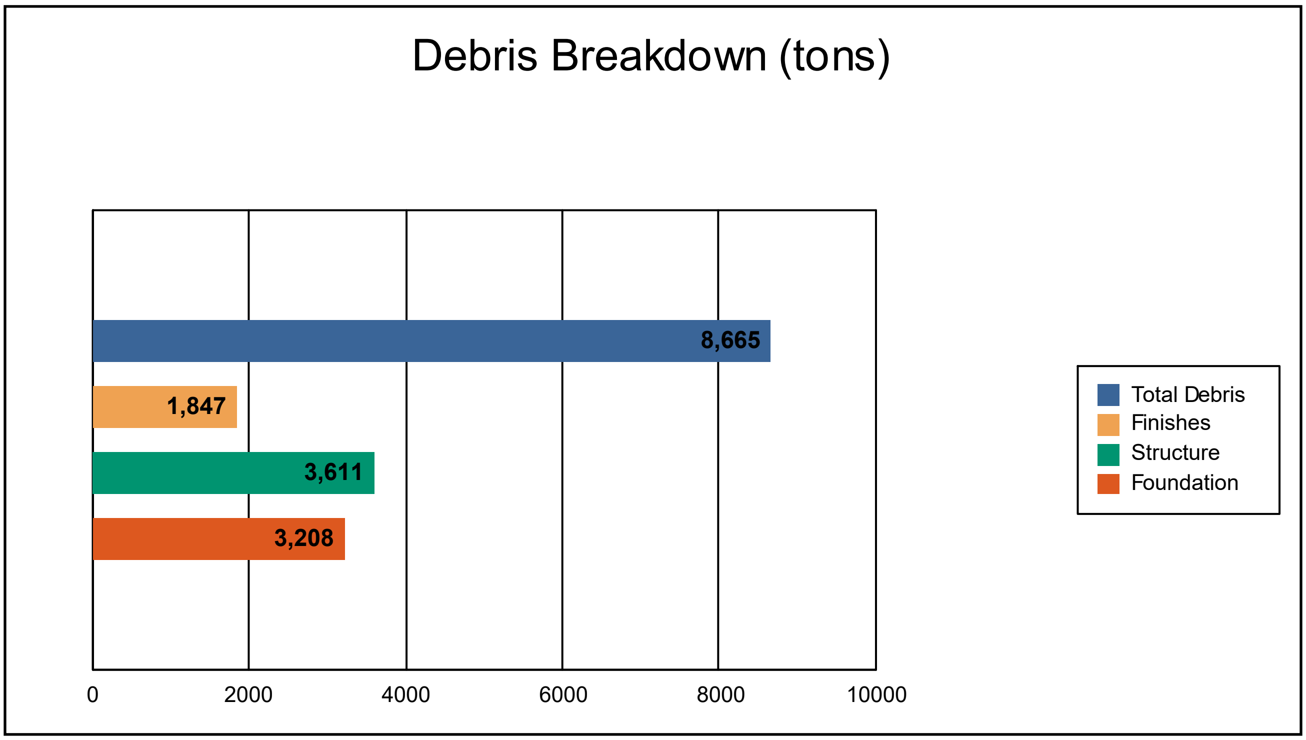
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(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.

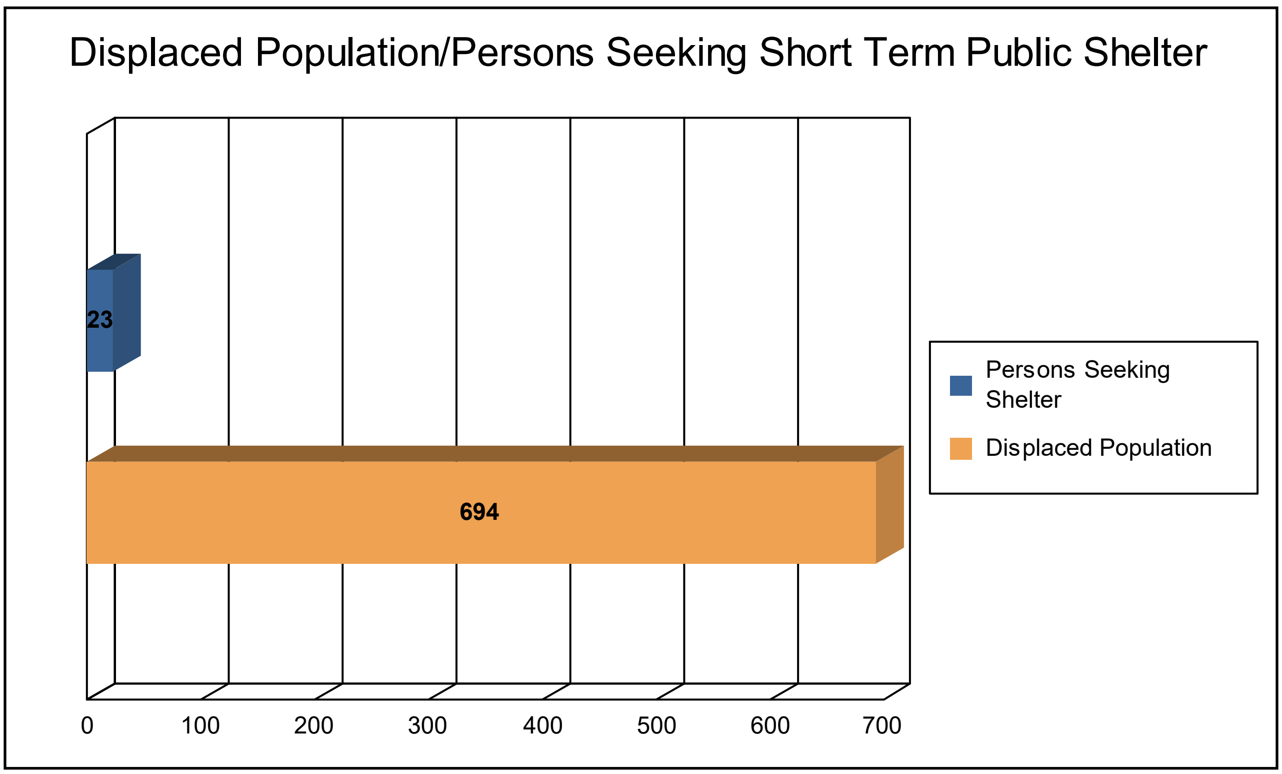


The model estimates that a total of 8,665 tons of debris will be generated. Of the total amount, Finishes comprises 21% of the total, Structure comprises 42% of the total, and Foundation comprises 37%. If the debris tonnage is converted into an estimated number of truckloads, it will require 347 truckloads (@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 231 households (or 694 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 23 people (out of a total population of 14,005) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 170.77 million dollars, which represents 21.90 % of the total replacement value of the scenario buildings.

Building-Related Losses

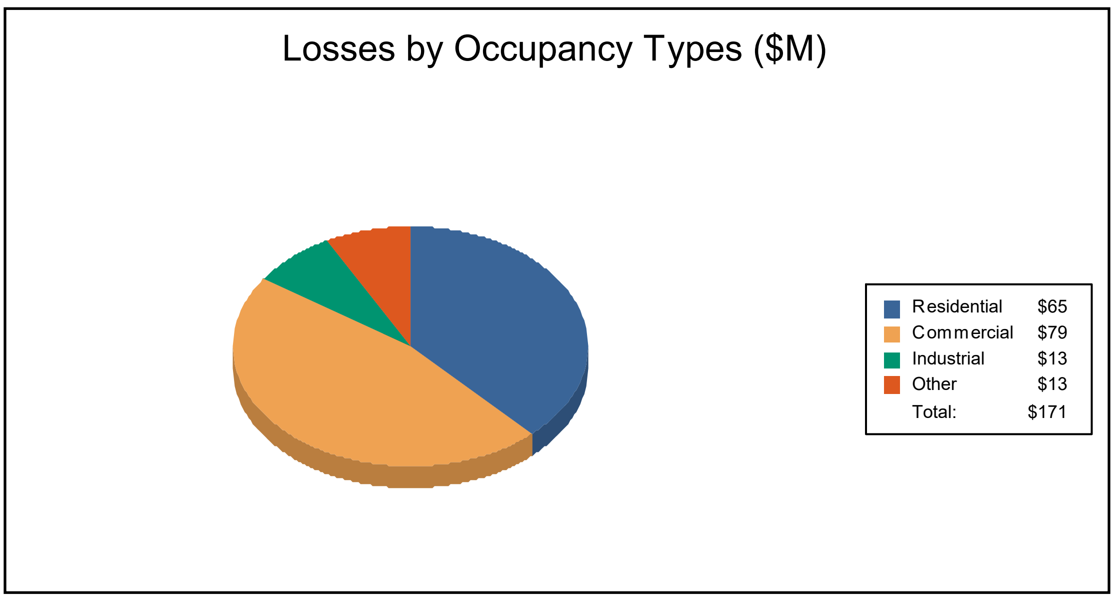
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 97.49 million dollars. 43% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 37.99% 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	31.99	8.44	4.14	1.43	46.00
	Content	16.15	22.33	7.54	4.34	50.35
	Inventory	0.00	0.37	0.68	0.09	1.14
	Subtotal	**48.14**	**31.14**	**12.36**	**5.85**	**97.49**
Business Interruption						
	Income	2.21	19.87	0.35	2.02	24.44
	Relocation	4.10	4.58	0.23	0.83	9.74
	Rental Income	5.25	3.39	0.06	0.04	8.73
	Wage	5.17	20.30	0.34	4.54	30.36
	Subtotal	**16.73**	**48.14**	**0.98**	**7.43**	**73.28**
ALL	**Total**	**64.87**	**79.28**	**13.34**	**13.28**	**170.77**



Appendix A: County Listing for the Region

Connecticut

- Middlesex

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Middlesex	14,005	1,856,214	586,242	2,442,456
Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**
Total Study Region	**14,005**	**1,856,214**	**586,242**	**2,442,456**

Hazus: Flood Global Risk Report

Region Name: Cromwell

Flood Scenario: CromwellAll

Print Date: Monday, January 6, 2020

Disclaimer:

This version of Hazus utilizes 2010 Census Data.
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 Flood. These results can be improved by using enhanced inventory data and flood hazard information.

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 approximately 13 square miles and contains 276 census blocks. The region contains over 6 thousand households and has a total population of 14,005 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 5,160 buildings in the region with a total building replacement value (excluding contents) of 2,442 million dollars. Approximately 89.44% of the buildings (and 76.00% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 5,160 buildings in the region which have an aggregate total replacement value of 2,442 million 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	1,856,214	76.0%
Commercial	413,463	16.9%
Industrial	97,739	4.0%
Agricultural	8,584	0.4%
Religion	38,782	1.6%
Government	6,778	0.3%
Education	20,896	0.9%
Total	**2,442,456**	**100%**

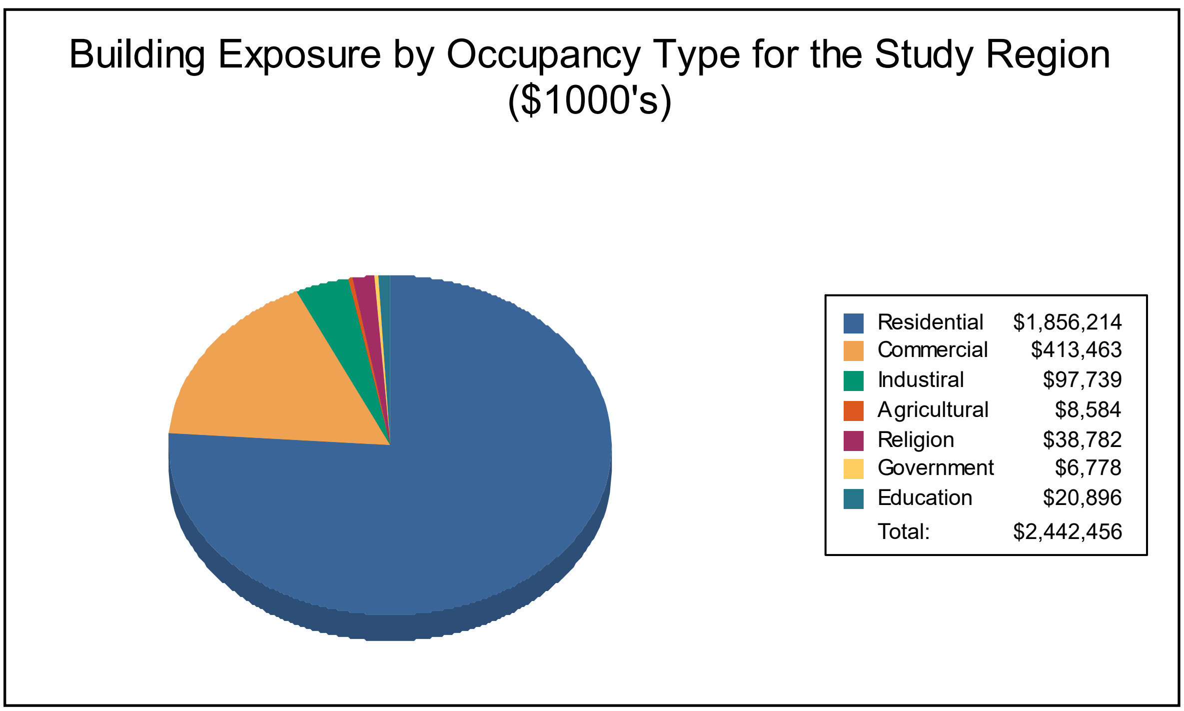
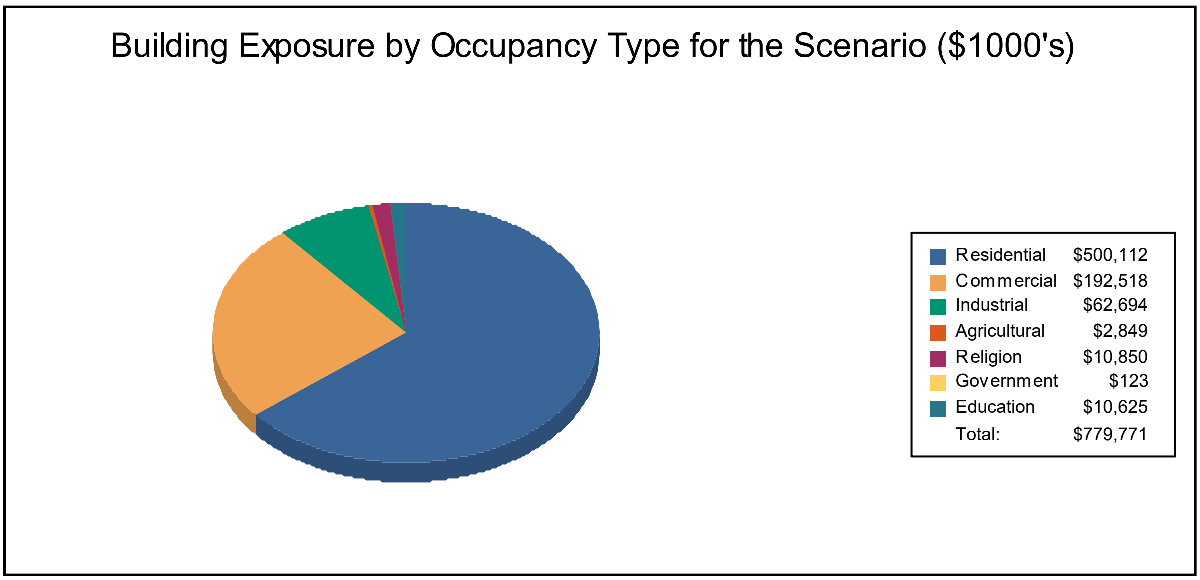


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	**Exposure ($1000)**	**Percent of Total**
Residential	500,112	64.1%
Commercial	192,518	24.7%
Industrial	62,694	8.0%
Agricultural	2,849	0.4%
Religion	10,850	1.4%
Government	123	0.0%
Education	10,625	1.4%
Total	**779,771**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 7 schools, 3 fire stations, 1 police station and 1 emergency operation center.

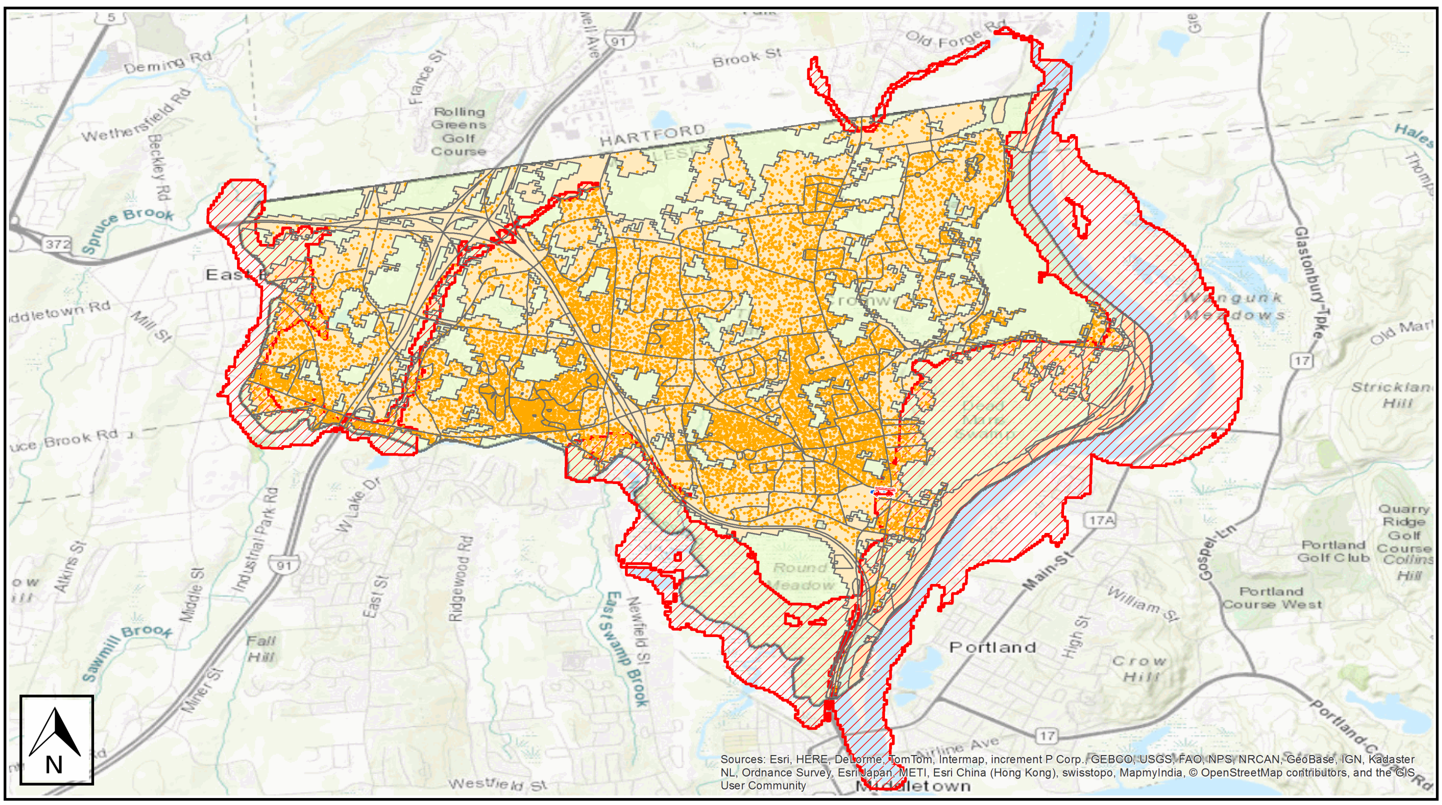
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Cromwell
Scenario Name:	CromwellAll
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 72 buildings will be at least moderately damaged. This is over 42% of the total number of buildings in the scenario. There are an estimated 44 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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.

Total Economic Loss (1 dot = $300K) Overview Map

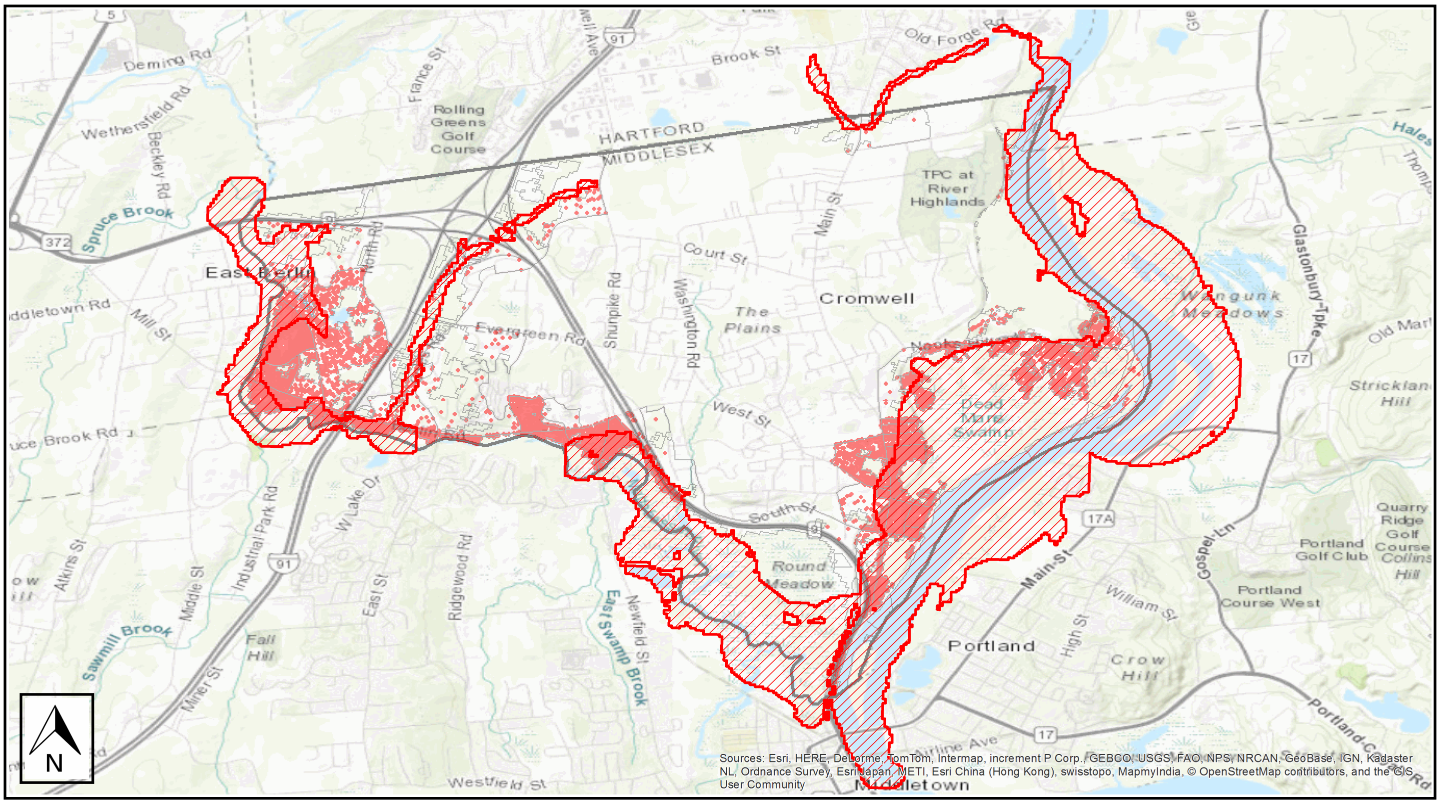


Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	3	50	3	50	0	0	0	0	0	0	0	0
Education	1	100	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	10	13	14	18	5	6	2	3	4	5	44	56
Total	**14**		**17**		**5**		**2**		**4**		**44**	

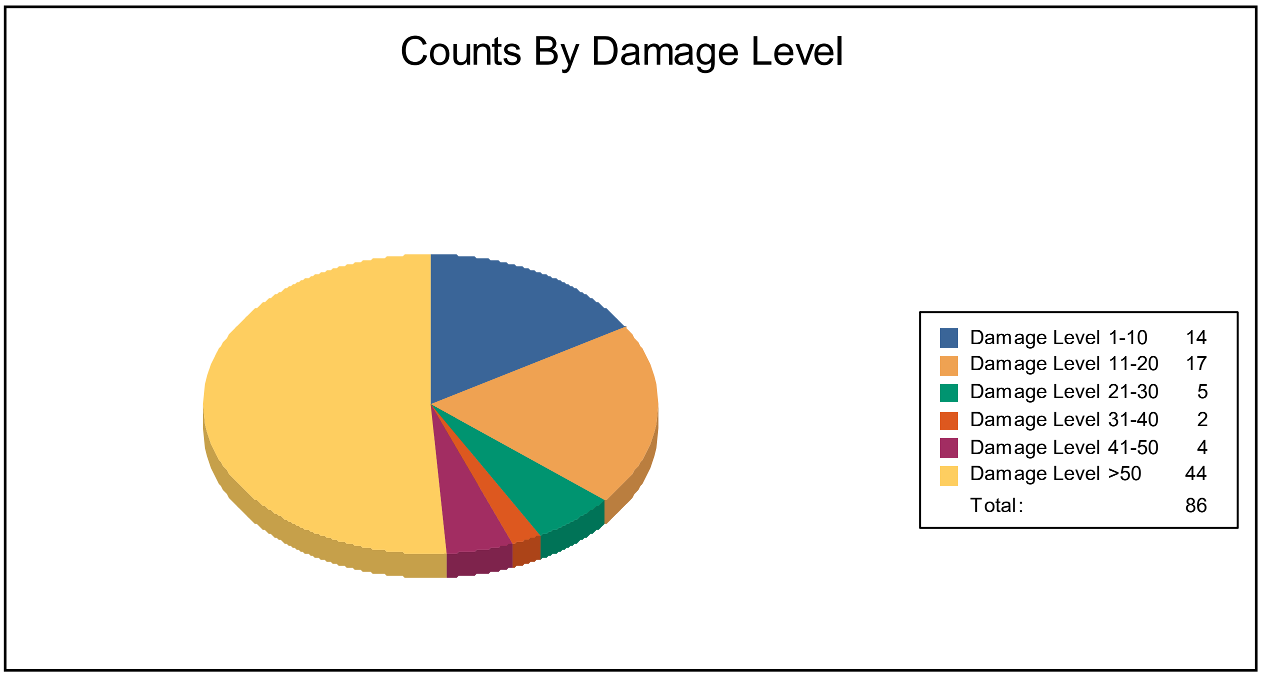


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	2	67	0	0	0	0	0	0	0	0	1	33
Steel	3	60	2	40	0	0	0	0	0	0	0	0
Wood	9	12	14	18	5	6	2	3	4	5	43	56

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
Emergency Operation Centers	1	0	0	0
Fire Stations	3	0	1	1
Hospitals	0	0	0	0
Police Stations	1	0	1	1
Schools	7	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

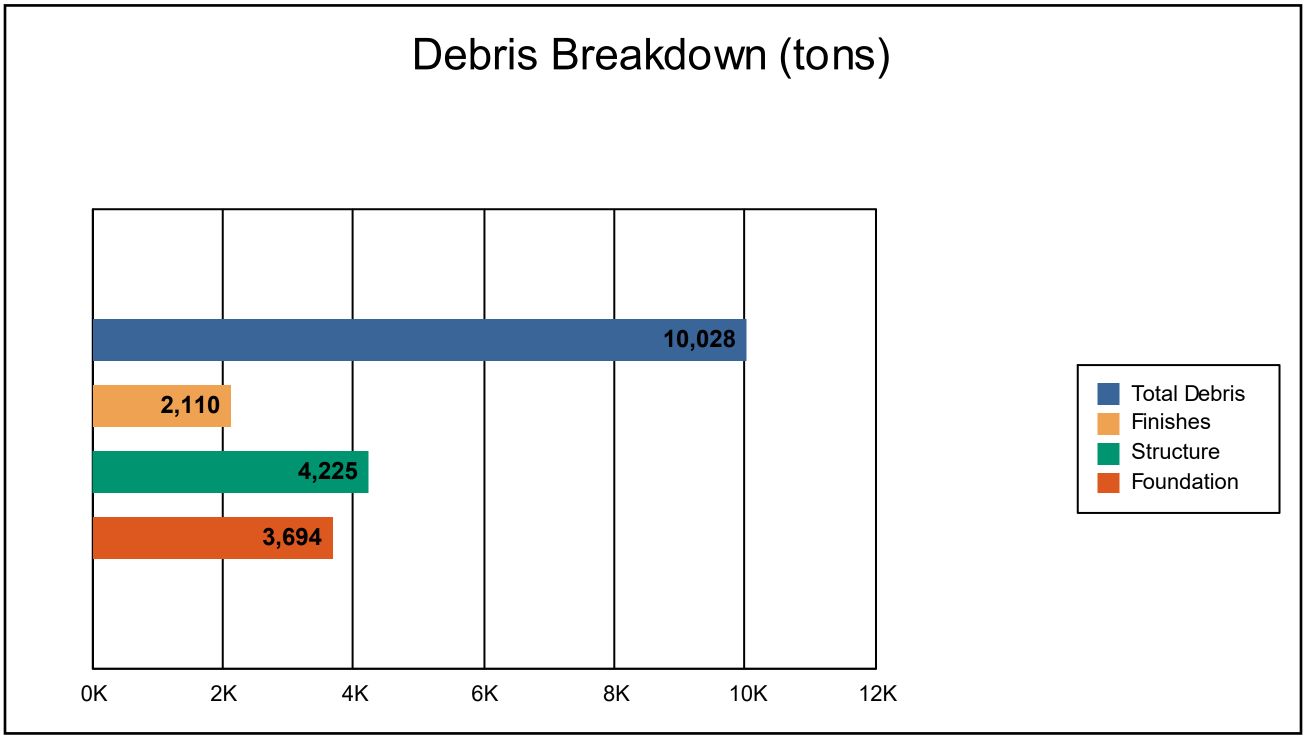
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(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.

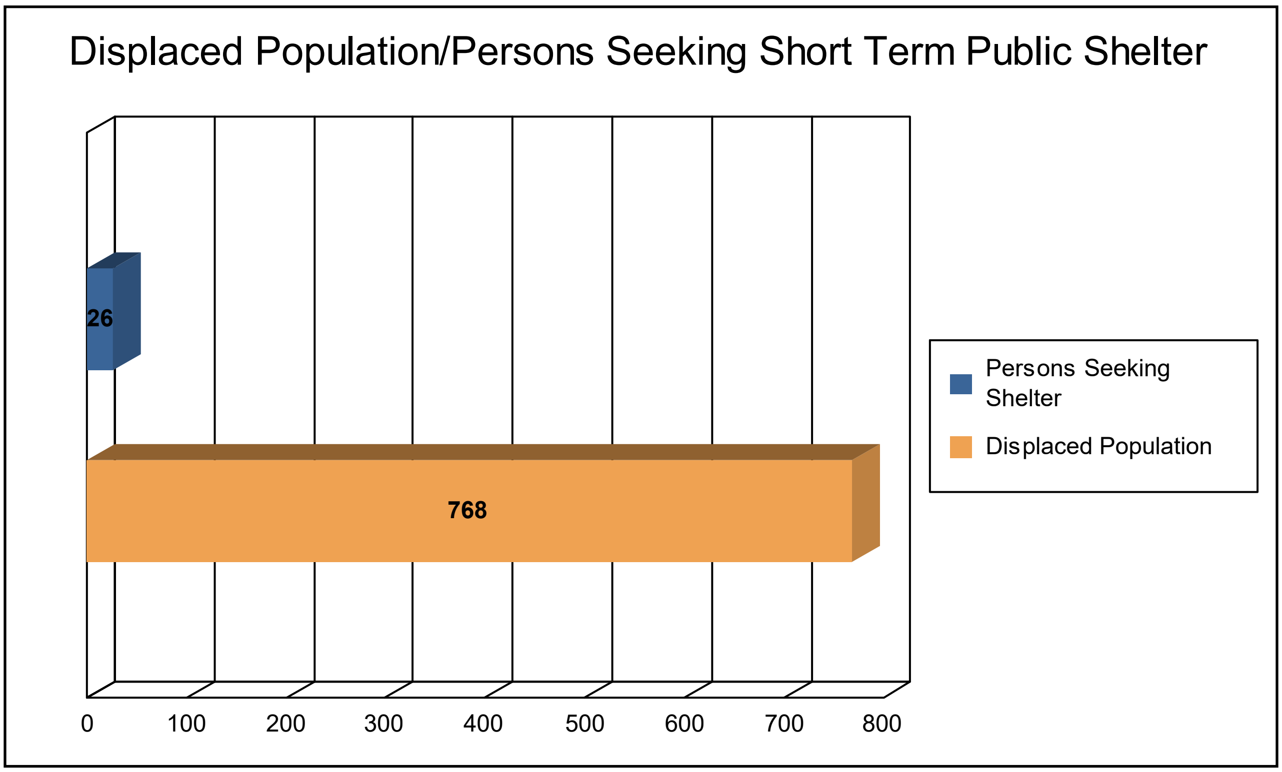


The model estimates that a total of 10,028 tons of debris will be generated. Of the total amount, Finishes comprises 21% of the total, Structure comprises 42% of the total, and Foundation comprises 37%. If the debris tonnage is converted into an estimated number of truckloads, it will require 402 truckloads (@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 256 households (or 768 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 26 people (out of a total population of 14,005) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 192.10 million dollars, which represents 24.63 % of the total replacement value of the scenario buildings.

Building-Related Losses

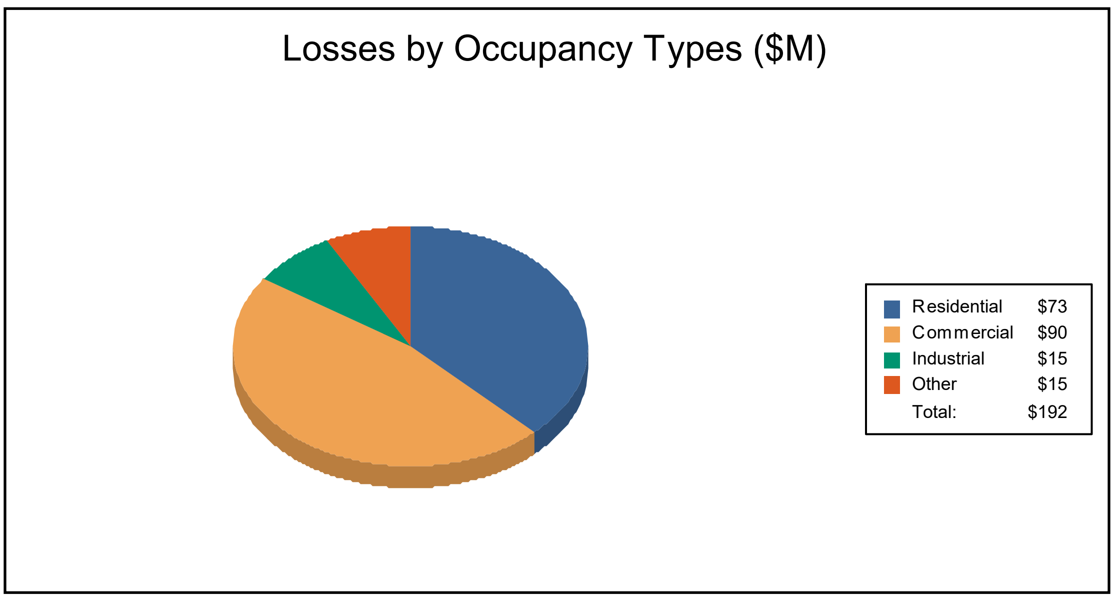
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 112.82 million dollars. 41% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 37.78% 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	36.09	10.33	4.69	1.68	52.79
	Content	18.47	26.43	8.58	5.23	58.72
	Inventory	0.00	0.44	0.77	0.10	1.31
	Subtotal	**54.56**	**37.20**	**14.04**	**7.01**	**112.82**
Business Interruption						
	Income	2.36	21.50	0.42	2.12	26.40
	Relocation	4.50	5.06	0.26	0.85	10.68
	Rental Income	5.62	3.74	0.06	0.04	9.46
	Wage	5.54	22.04	0.39	4.77	32.75
	Subtotal	**18.02**	**52.34**	**1.13**	**7.79**	**79.28**
ALL	**Total**	**72.58**	**89.54**	**15.17**	**14.80**	**192.10**



Appendix A: County Listing for the Region

Connecticut

- Middlesex

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Middlesex	14,005	1,856,214	586,242	2,442,456
Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**
Total Study Region	**14,005**	**1,856,214**	**586,242**	**2,442,456**

Hazus: Flood Global Risk Report

Region Name: Cromwell

Flood Scenario: CromwellAll

Print Date: Monday, January 6, 2020

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
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 Flood. These results can be improved by using enhanced inventory data and flood hazard information.

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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 approximately 13 square miles and contains 276 census blocks. The region contains over 6 thousand households and has a total population of 14,005 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B .

There are an estimated 5,160 buildings in the region with a total building replacement value (excluding contents) of 2,442 million dollars. Approximately 89.44% of the buildings (and 76.00% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 5,160 buildings in the region which have an aggregate total replacement value of 2,442 million 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
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Commercial	413,463	16.9%
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Agricultural	8,584	0.4%
Religion	38,782	1.6%
Government	6,778	0.3%
Education	20,896	0.9%
Total	**2,442,456**	**100%**

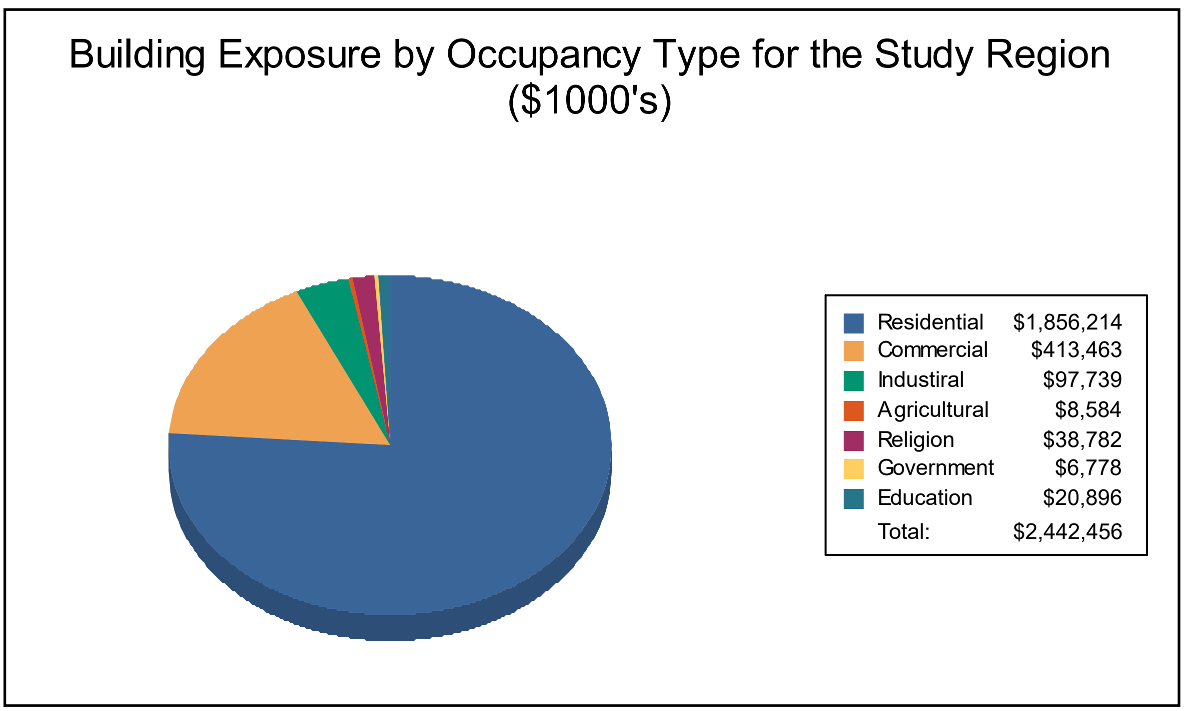

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	500,112	64.1%
Commercial	192,518	24.7%
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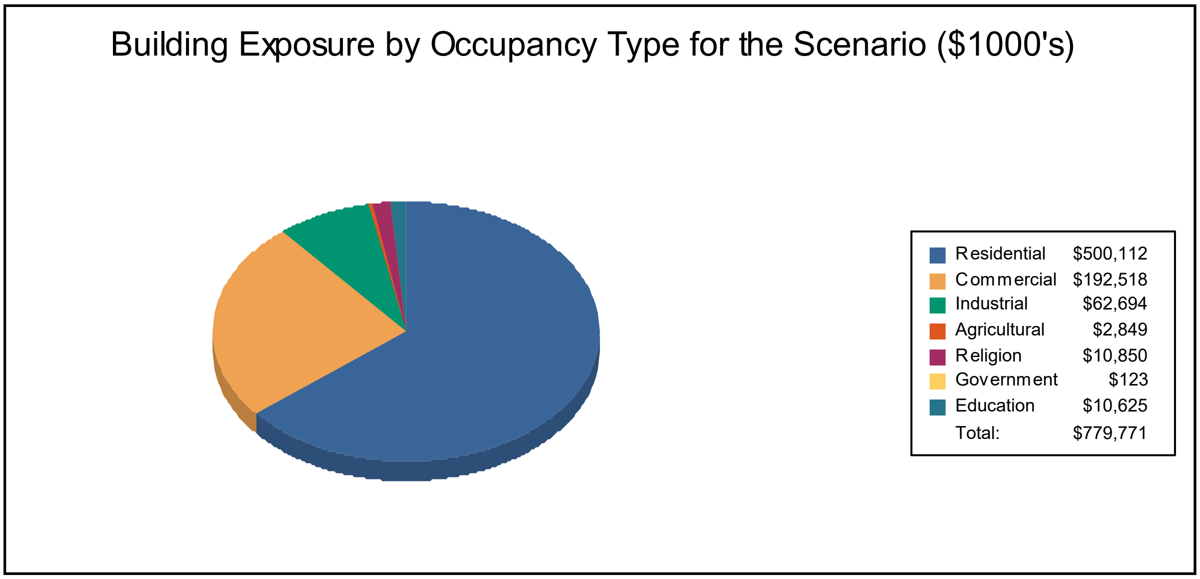
Agricultural	2,849	0.4%
Religion	10,850	1.4%
Government	123	0.0%
Education	10,625	1.4%
Total	**779,771**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 7 schools, 3 fire stations, 1 police station and 1 emergency operation center.

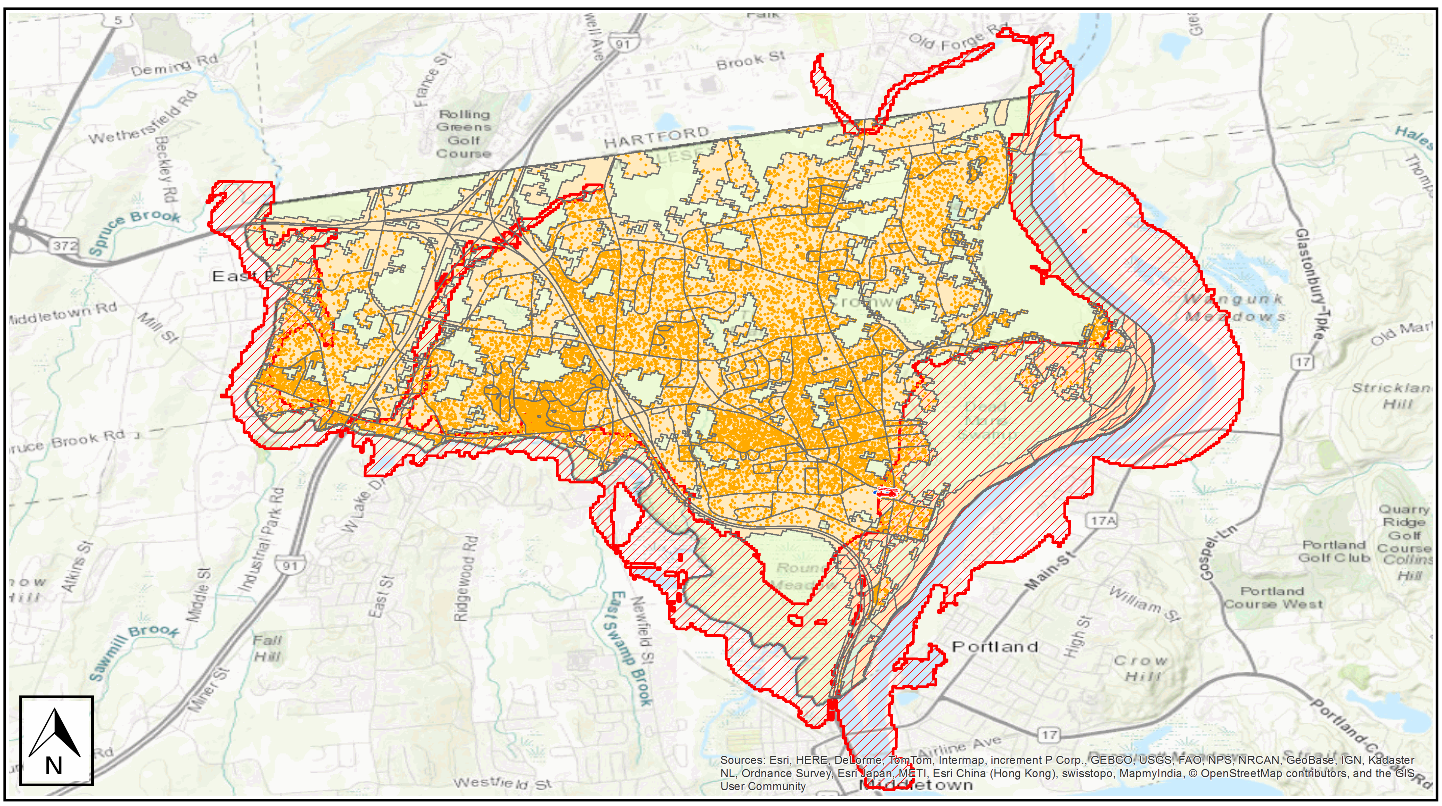
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Cromwell
Scenario Name:	CromwellAll
Return Period Analyzed:	500
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 119 buildings will be at least moderately damaged. This is over 55% of the total number of buildings in the scenario. There are an estimated 54 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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.

Total Economic Loss (1 dot = $300K) Overview Map

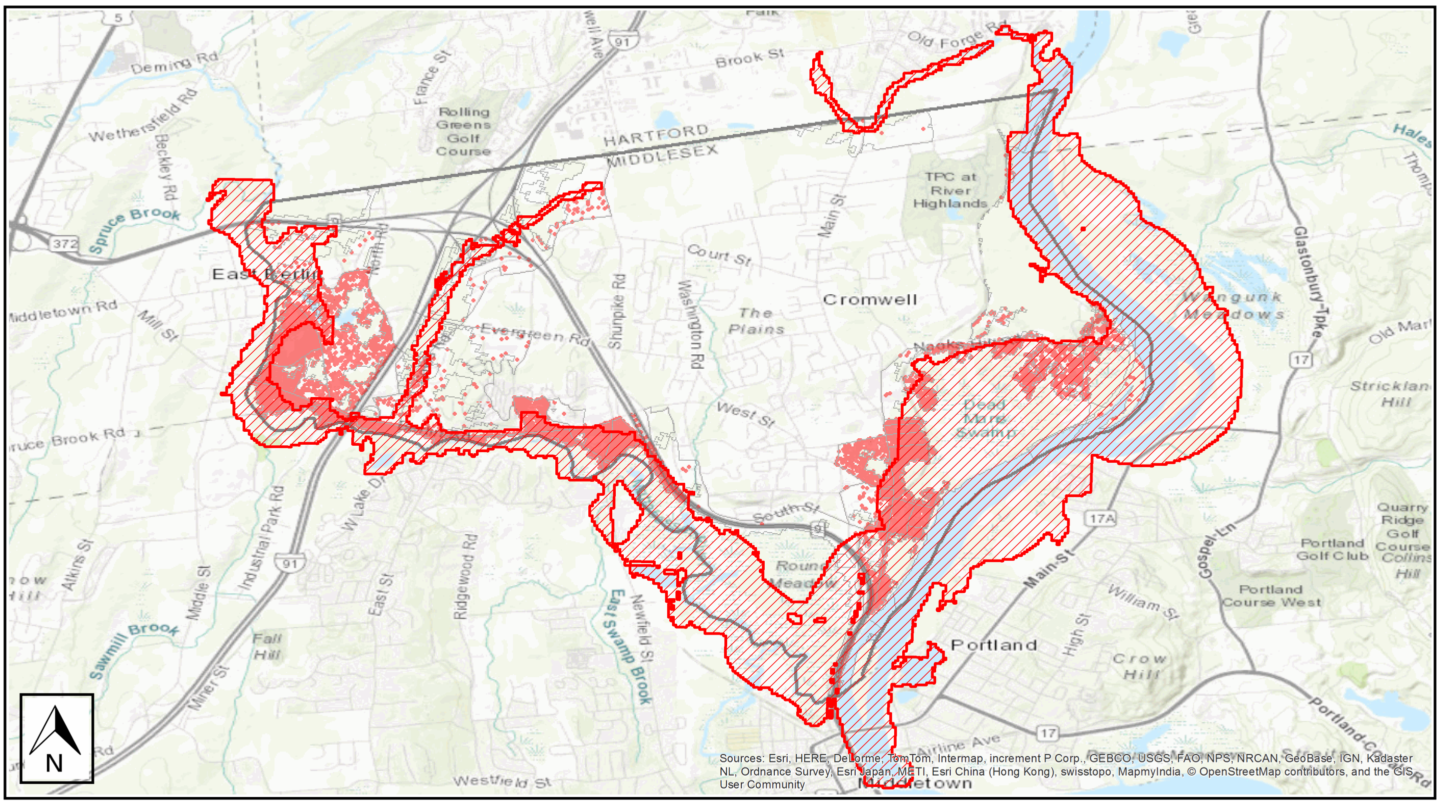


Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	2	15	11	85	0	0	0	0	0	0	0	0
Education	1	100	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	24	18	33	25	12	9	5	4	4	3	54	41
Total	**27**		**44**		**12**		**5**		**4**		**54**	

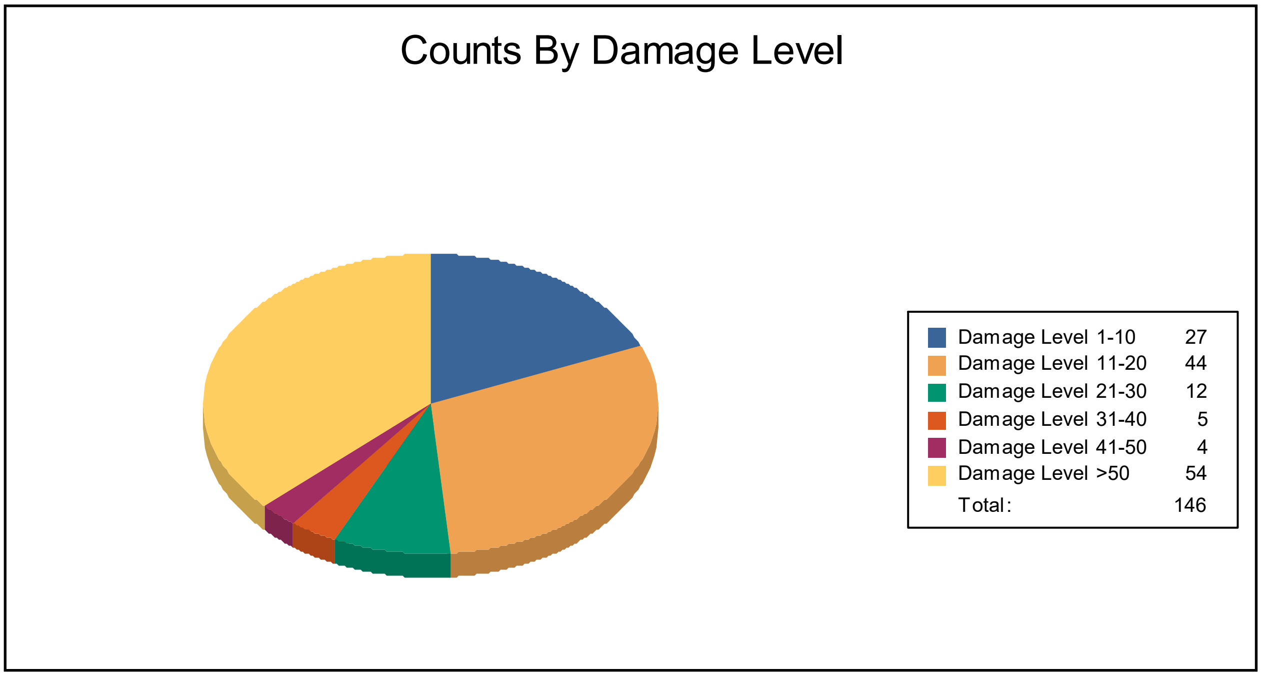


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	0	0	3	75	0	0	0	0	0	0	1	25
Steel	1	17	5	83	0	0	0	0	0	0	0	0
Wood	24	18	36	27	12	9	5	4	4	3	53	40

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
Emergency Operation Centers	1	0	0	0
Fire Stations	3	0	1	1
Hospitals	0	0	0	0
Police Stations	1	0	1	1
Schools	7	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.

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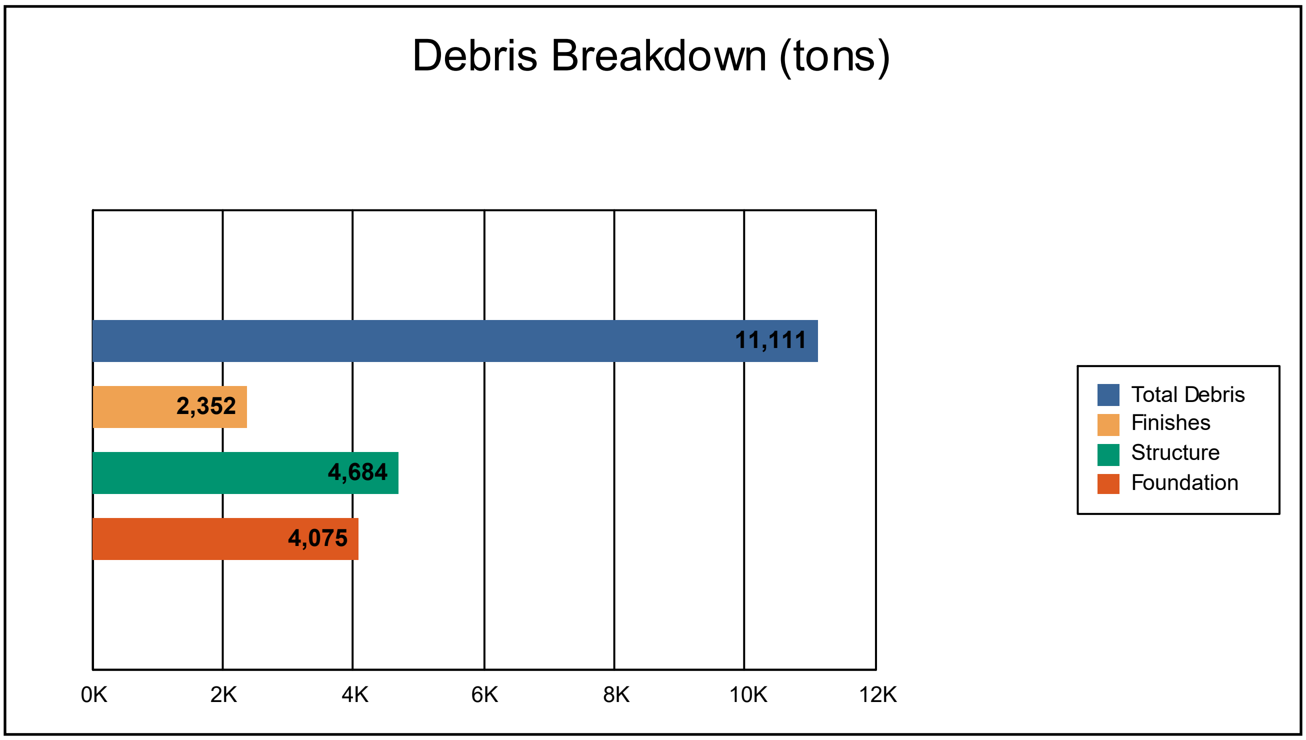
Induced Flood Damage

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 11,111 tons of debris will be generated. Of the total amount, Finishes comprises 21% of the total, Structure comprises 42% of the total, and Foundation comprises 37%. If the debris tonnage is converted into an estimated number of truckloads, it will require 445 truckloads (@25 tons/truck) to remove the debris generated by the flood.

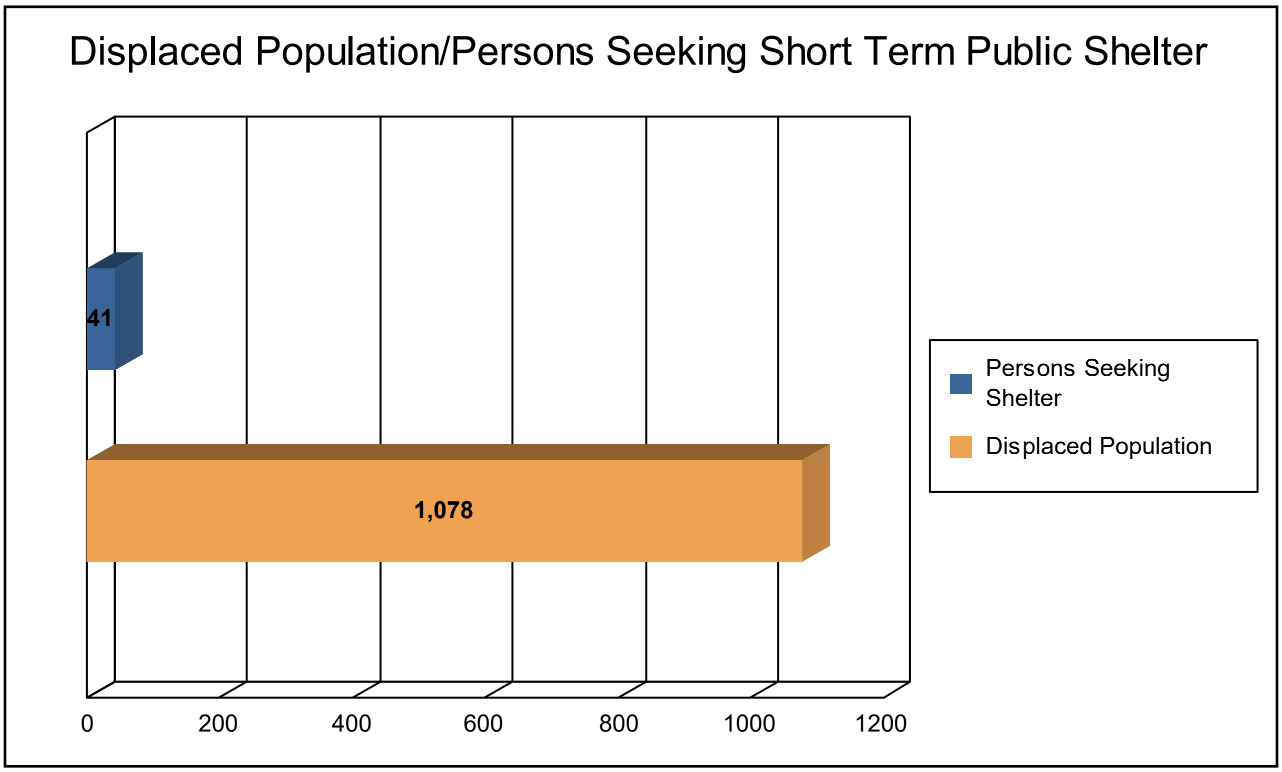
FEMA

RiskMAP
Increasing Resilience Together

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 359 households (or 1,078 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 41 people (out of a total population of 14,005) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 272.73 million dollars, which represents 34.98 % of the total replacement value of the scenario buildings.

Building-Related Losses

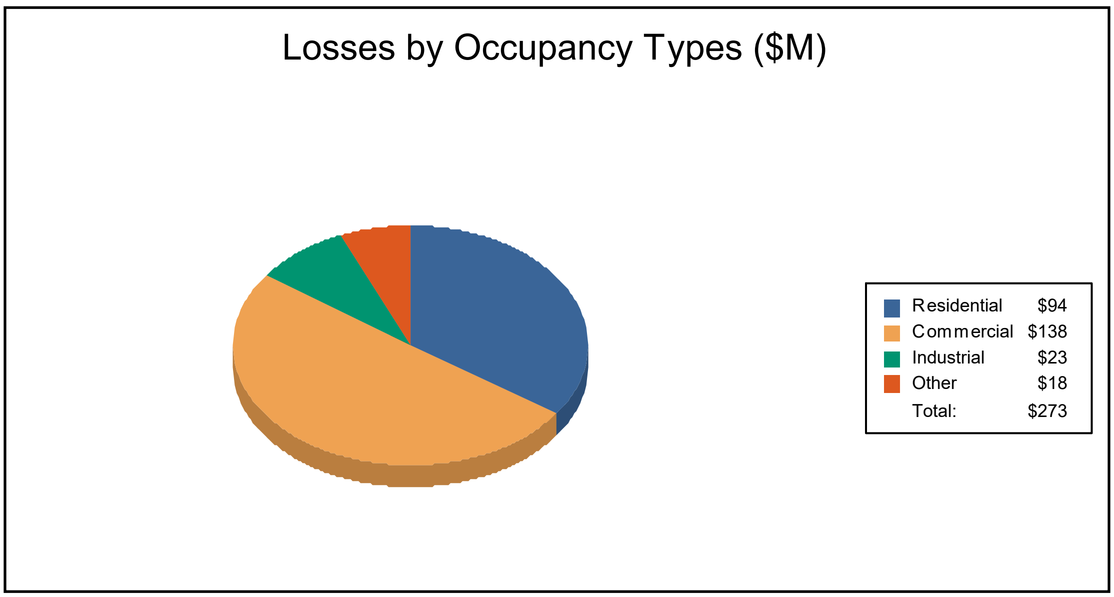
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 160.75 million dollars. 41% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 34.60% 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	45.67	15.67	6.52	2.14	70.00
	Content	23.78	44.83	13.17	6.93	88.70
	Inventory	0.00	0.73	1.21	0.11	2.05
	Subtotal	**69.45**	**61.22**	**20.90**	**9.18**	**160.75**
Business Interruption						
	Income	3.27	30.16	0.86	2.31	36.59
	Relocation	6.16	7.59	0.49	0.87	15.11
	Rental Income	7.83	5.55	0.12	0.05	13.55
	Wage	7.67	33.18	0.67	5.21	46.73
	Subtotal	**24.92**	**76.48**	**2.14**	**8.43**	**111.98**
ALL	**Total**	**94.37**	**137.70**	**23.04**	**17.61**	**272.73**



Appendix A: County Listing for the Region

Connecticut

- Middlesex

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Middlesex	14,005	1,856,214	586,242	2,442,456
Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**
Total Study Region	**14,005**	**1,856,214**	**586,242**	**2,442,456**

Hazus: Hurricane Global Risk Report

Region Name: Cromwell

Hurricane Scenario: Probabilistic 10-year Return Period

Print Date: Tuesday, October 1, 2019

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 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 12.95 square miles and contains 3 census tracts. There are over 5 thousand households in the region and a total population of 14,005 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,442 million dollars (2014 dollars). Approximately 89% of the buildings (and 76% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 5,160 buildings in the region which have an aggregate total replacement value of 2,442 million (2014 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.

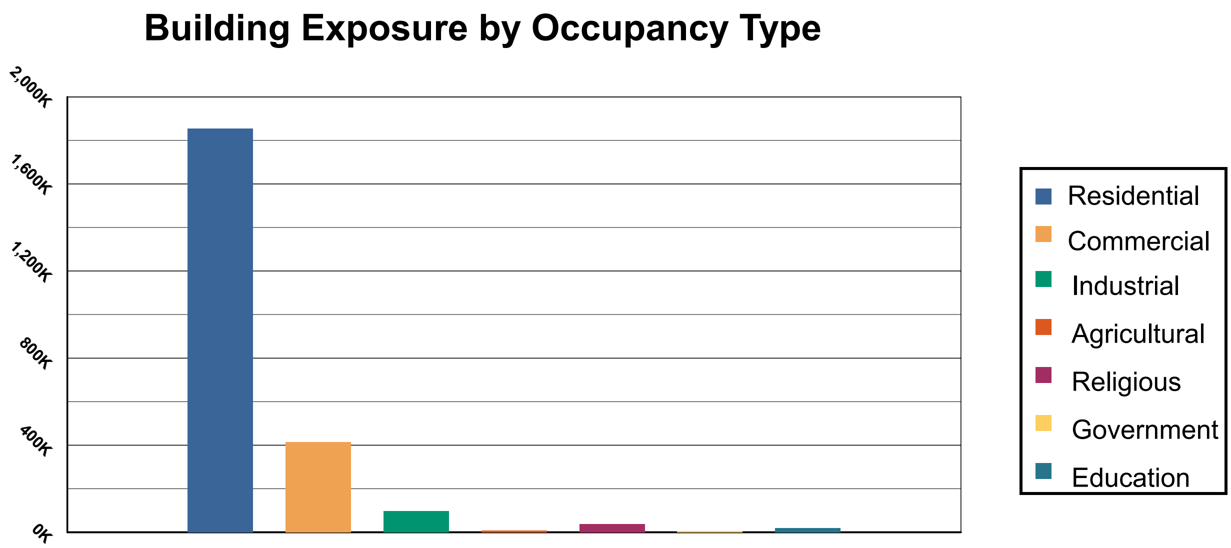


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,856,214	76.00 %
Commercial	413,463	16.93%
Industrial	97,739	4.00%
Agricultural	8,584	0.35%
Religious	38,782	1.59%
Government	6,778	0.28%
Education	20,896	0.86%
Total	**2,442,456**	**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 7 schools, 3 fire stations, 1 police stations and 1 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 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.

Expected Building Damage by Occupancy

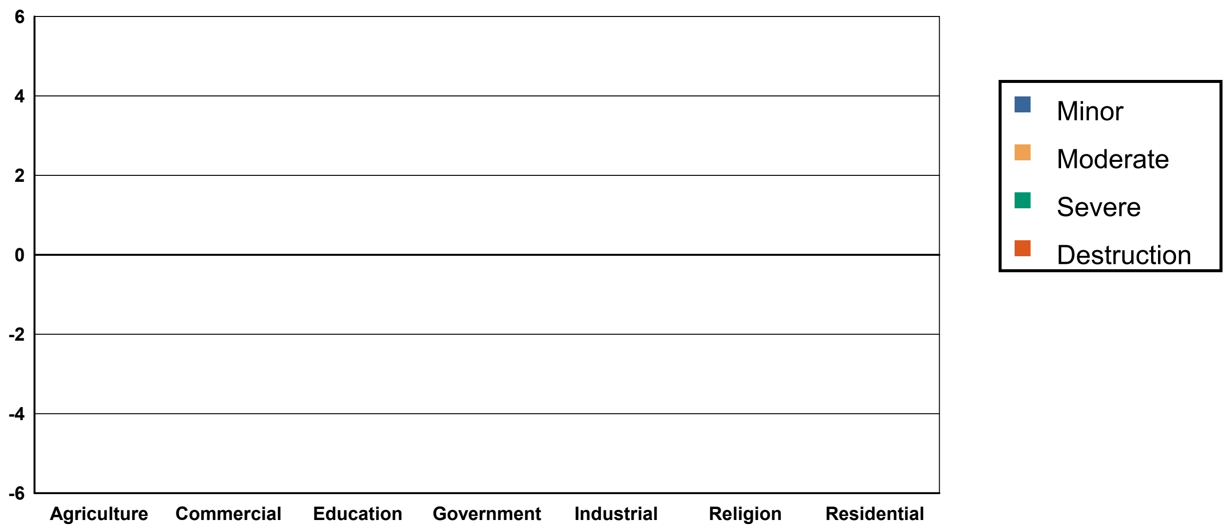


Table 2: Expected Building Damage by Occupancy : 10 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	24.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	371.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Education	13.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Government	5.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Religion	32.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential	4,615.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**5,160.00**		**0.00**		**0.00**		**0.00**		**0.00**	

Table 3: Expected Building Damage by Building Type : 10 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	38	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	324	100.00	0	0.00	0	0.00	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	232	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	4,373	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 by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

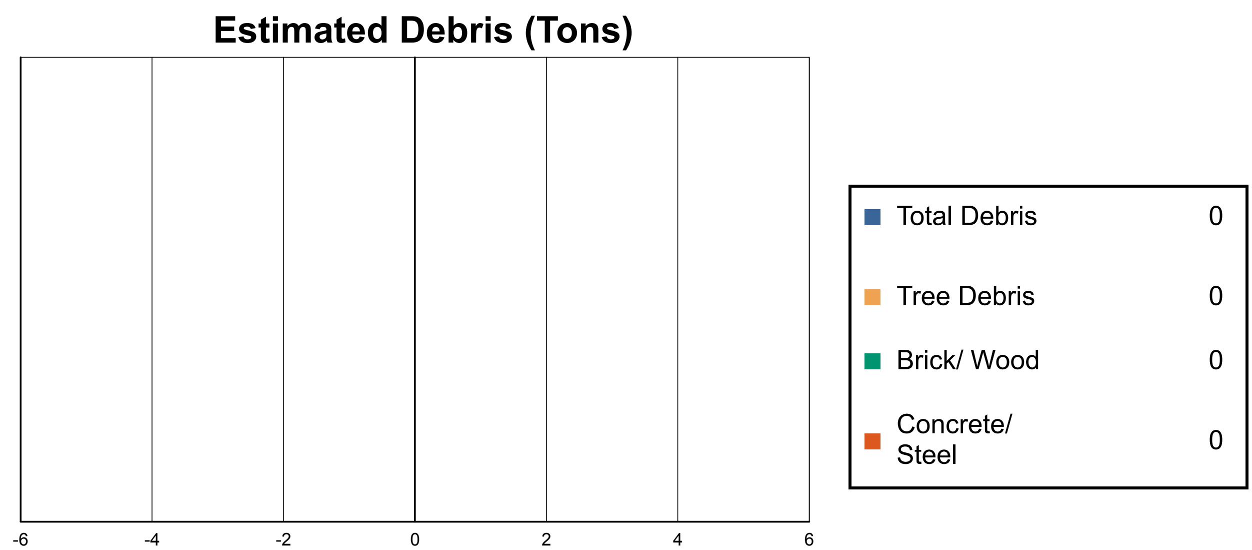
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

Classification	Total	# Facilities: Probability of at Least Moderate Damage > 50%	# Facilities: Probability of Complete Damage > 50%	# Facilities: Expected Loss of Use < 1 day
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	7	0	0	7

Induced Hurricane Damage

Debris Generation

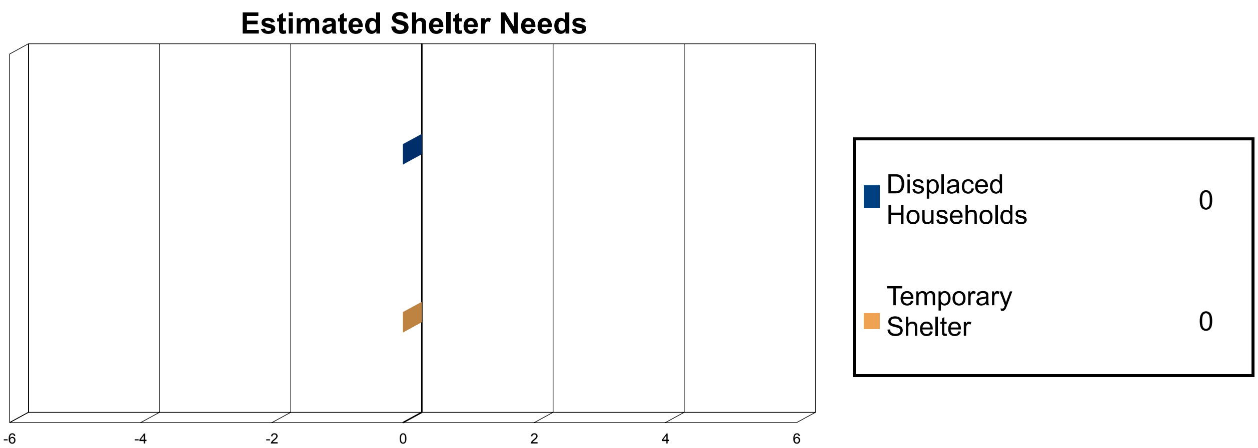


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling 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 14,005) will seek temporary shelter in public shelters.

Economic Loss

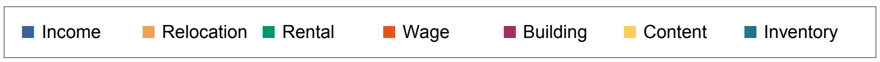
The total economic loss estimated for the hurricane is 0.0 million dollars, which represents 0.00 % of the total replacement value of the region's buildings.

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 5 below provides a summary of the losses associated with the building damage.

**Loss by Business Interruption Type (left)
and Building Damage Type (right)**



Loss Type by General Occupancy

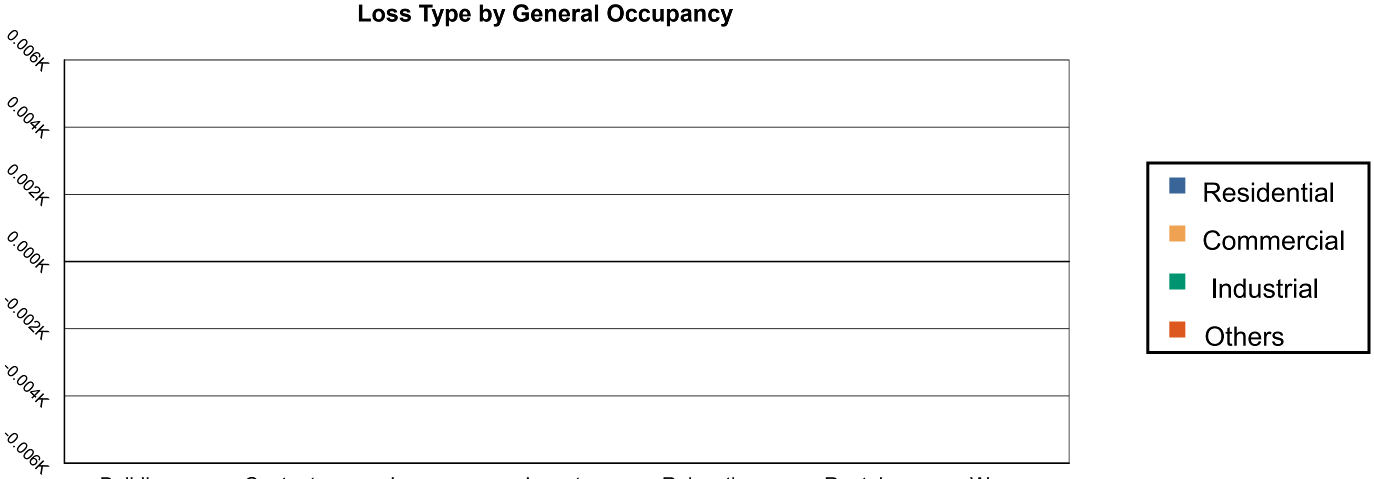


Table 5: Building-Related Economic Loss Estimates

(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
- Middlesex

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
Middlesex	14,005	1,856,214	586,242	2,442,456
Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**
Study Region Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**

Hazus: Hurricane Global Risk Report

Region Name: Cromwell

Hurricane Scenario: Probabilistic 20-year Return Period

Print Date: Tuesday, October 1, 2019

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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 12.95 square miles and contains 3 census tracts. There are over 5 thousand households in the region and a total population of 14,005 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,442 million dollars (2014 dollars). Approximately 89% of the buildings (and 76% of the building value) are associated with residential housing.

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General Building Stock

Hazus estimates that there are 5,160 buildings in the region which have an aggregate total replacement value of 2,442 million (2014 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.

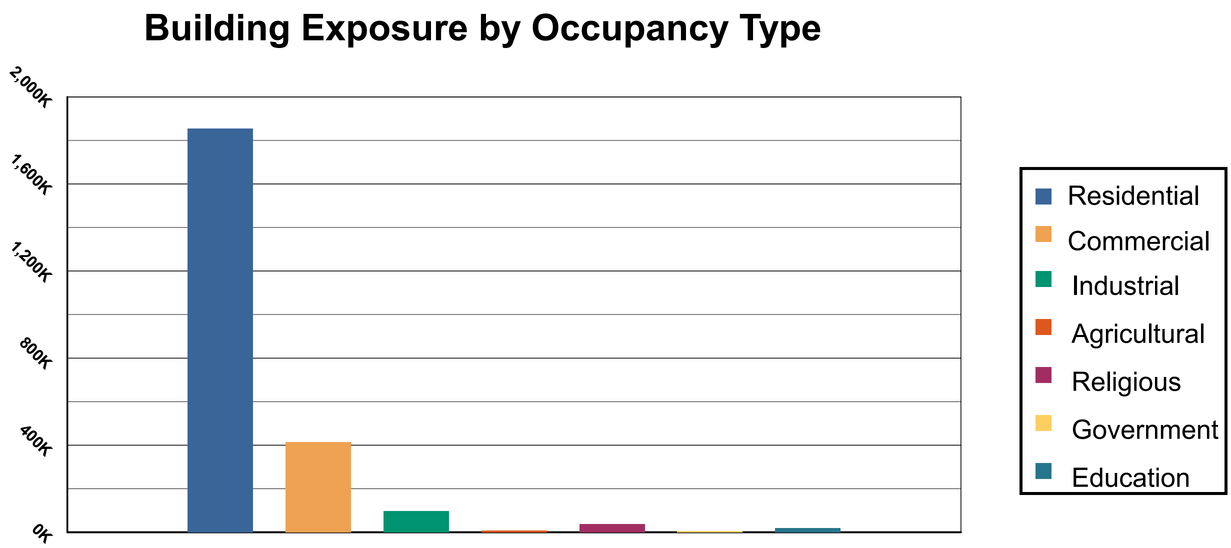


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,856,214	76.00 %
Commercial	413,463	16.93%
Industrial	97,739	4.00%
Agricultural	8,584	0.35%
Religious	38,782	1.59%
Government	6,778	0.28%
Education	20,896	0.86%
Total	**2,442,456**	**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 7 schools, 3 fire stations, 1 police stations and 1 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 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.

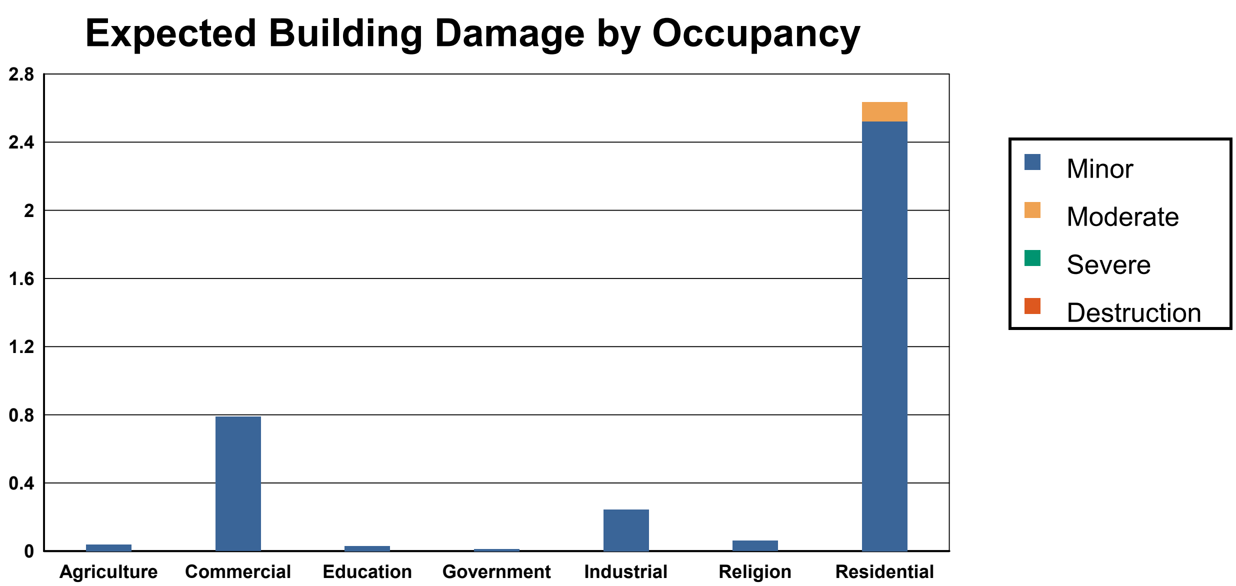


Table 2: Expected Building Damage by Occupancy : 20 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	23.96	99.84	0.04	0.16	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	370.21	99.79	0.79	0.21	0.00	0.00	0.00	0.00	0.00	0.00
Education	12.97	99.76	0.03	0.24	0.00	0.00	0.00	0.00	0.00	0.00
Government	4.99	99.75	0.01	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	99.76	99.76	0.24	0.24	0.00	0.00	0.00	0.00	0.00	0.00
Religion	31.94	99.81	0.06	0.19	0.00	0.00	0.00	0.00	0.00	0.00
Residential	4,612.37	99.94	2.52	0.05	0.11	0.00	0.00	0.00	0.00	0.00
Total	**5,156.19**		**3.70**		**0.11**		**0.00**		**0.00**	

HAZUS EARTHQUAKE · WIND · FLOOD · TSUNAMI

FEMA

Table 3: Expected Building Damage by Building Type : 20 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	38	99.70	0	0.30	0	0.00	0	0.00	0	0.00
Masonry	323	99.67	1	0.33	0	0.01	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	231	99.75	1	0.25	0	0.00	0	0.00	0	0.00
Wood	4,372	99.98	1	0.01	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 by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

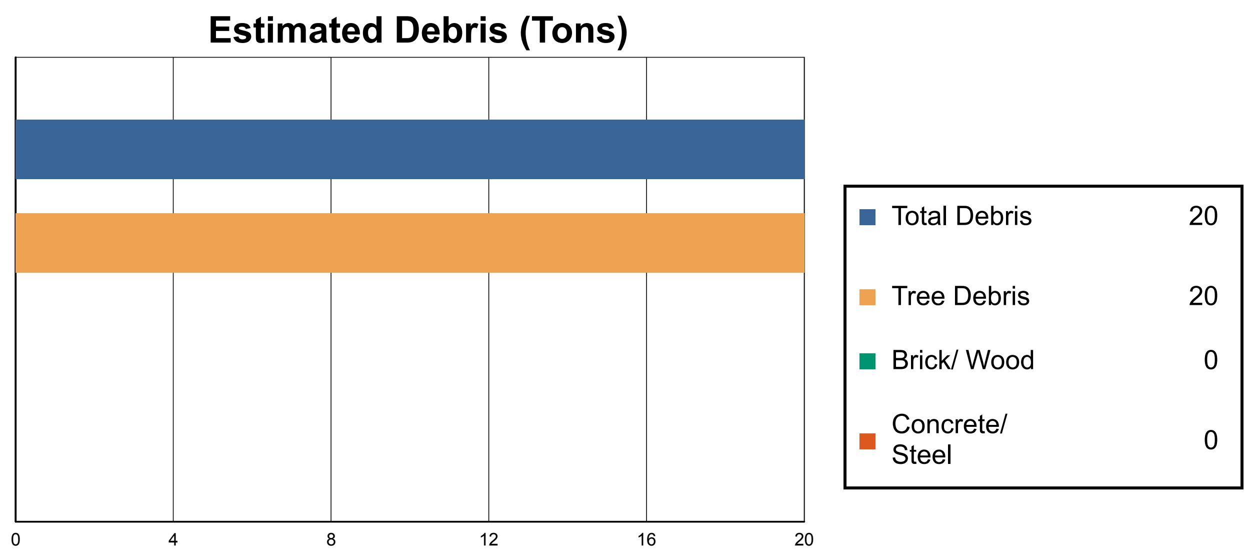
<u>**Thematic Map of Essential Facilities with greater than 50% moderate**</u>

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**
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	7	0	0	7

Induced Hurricane Damage

Debris Generation

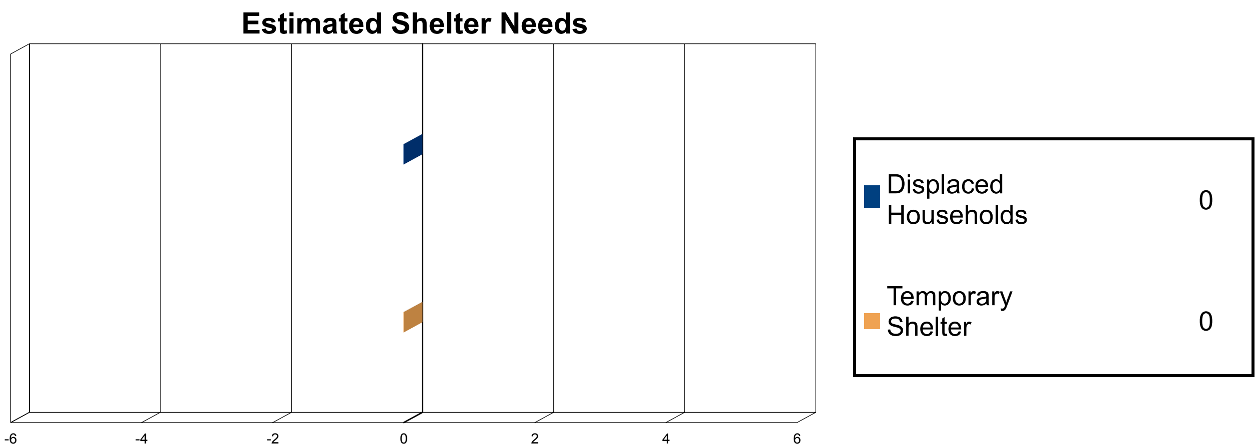


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 20 tons of debris will be generated. Of the total amount, 12 tons (60%) is Other Tree Debris. Of the remaining 8 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 8 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 14,005) will seek temporary shelter in public shelters.

Economic Loss

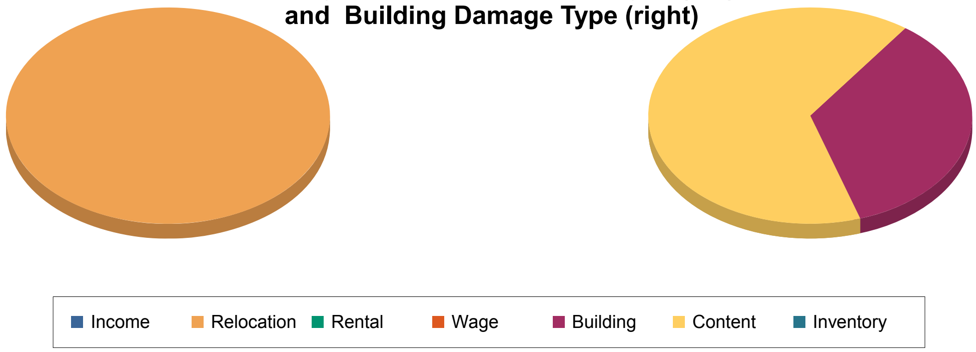
The total economic loss estimated for the hurricane is 0.0 million dollars, which represents 0.00 % of the total replacement value of the region's buildings.

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. 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 100% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left)
and Building Damage Type (right)



Loss Type by General Occupancy

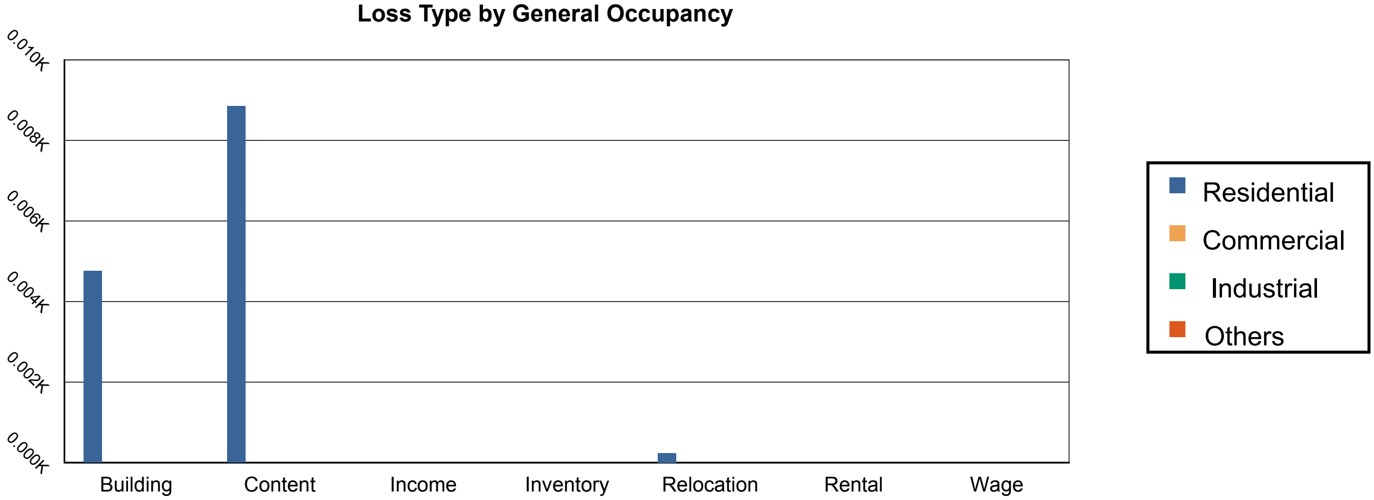


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	4.76	0.00	0.00	0.00	4.76
	Content	8.85	0.00	0.00	0.00	8.85
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**13.61**	**0.00**	**0.00**	**0.00**	**13.61**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.24	0.00	0.00	0.00	0.24
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.24**	**0.00**	**0.00**	**0.00**	**0.24**

Total

Total	**13.85**	**0.00**	**0.00**	**0.00**	**13.85**

Appendix A: County Listing for the Region

Connecticut
- Middlesex

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
Middlesex	14,005	1,856,214	586,242	2,442,456
Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**
Study Region Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**

Hazus: Hurricane Global Risk Report

Region Name: Cromwell

Hurricane Scenario: Probabilistic 50-year Return Period

Print Date: Tuesday, October 1, 2019

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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 12.95 square miles and contains 3 census tracts. There are over 5 thousand households in the region and a total population of 14,005 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,442 million dollars (2014 dollars). Approximately 89% of the buildings (and 76% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 5,160 buildings in the region which have an aggregate total replacement value of 2,442 million (2014 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.

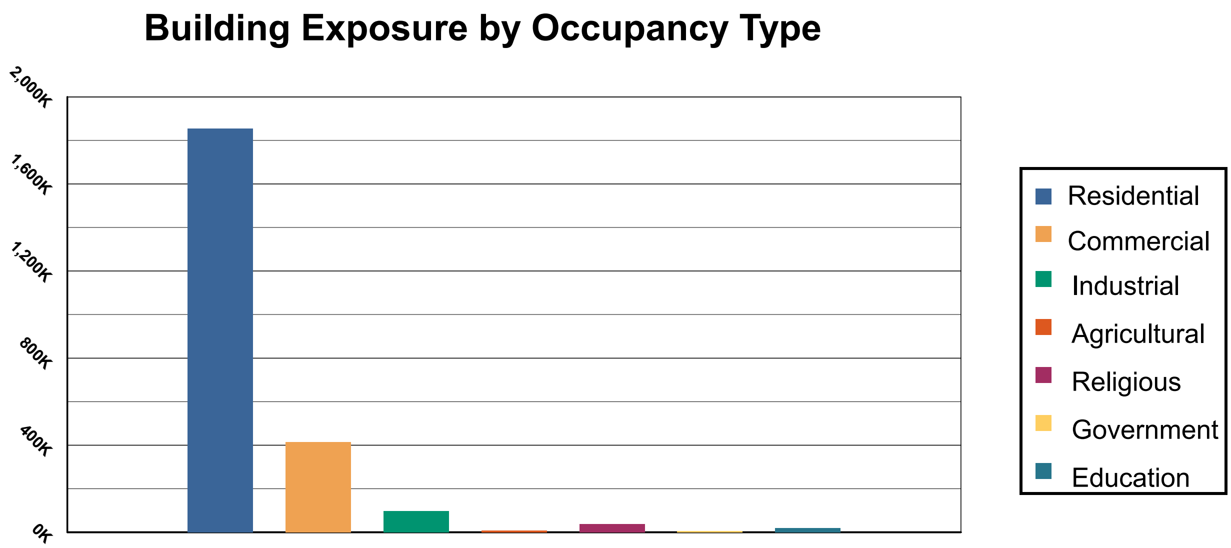


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,856,214	76.00 %
Commercial	413,463	16.93%
Industrial	97,739	4.00%
Agricultural	8,584	0.35%
Religious	38,782	1.59%
Government	6,778	0.28%
Education	20,896	0.86%
Total	**2,442,456**	**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 7 schools, 3 fire stations, 1 police stations and 1 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 1 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 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.

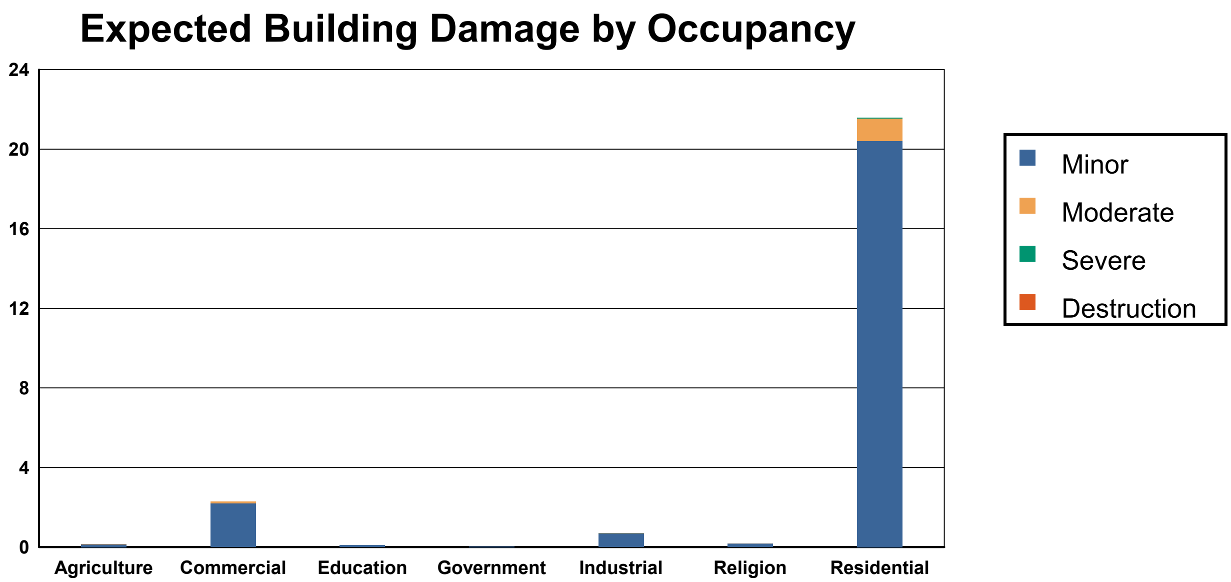


Table 2: Expected Building Damage by Occupancy : 50 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	23.86	99.42	0.13	0.56	0.01	0.03	0.00	0.00	0.00	0.00
Commercial	368.70	99.38	2.22	0.60	0.08	0.02	0.00	0.00	0.00	0.00
Education	12.91	99.30	0.09	0.70	0.00	0.00	0.00	0.00	0.00	0.00
Government	4.96	99.28	0.04	0.72	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	99.29	99.29	0.70	0.70	0.01	0.01	0.00	0.00	0.00	0.00
Religion	31.83	99.46	0.17	0.53	0.00	0.01	0.00	0.00	0.00	0.00
Residential	4,593.42	99.53	20.41	0.44	1.12	0.02	0.05	0.00	0.00	0.00
Total	**5,134.97**		**23.76**		**1.22**		**0.05**		**0.00**	

Table 3: Expected Building Damage by Building Type : 50 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	38	99.10	0	0.89	0	0.00	0	0.00	0	0.00
Masonry	320	98.64	4	1.24	0	0.12	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	230	99.29	2	0.68	0	0.02	0	0.00	0	0.00
Wood	4,360	99.69	13	0.30	0	0.01	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 by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

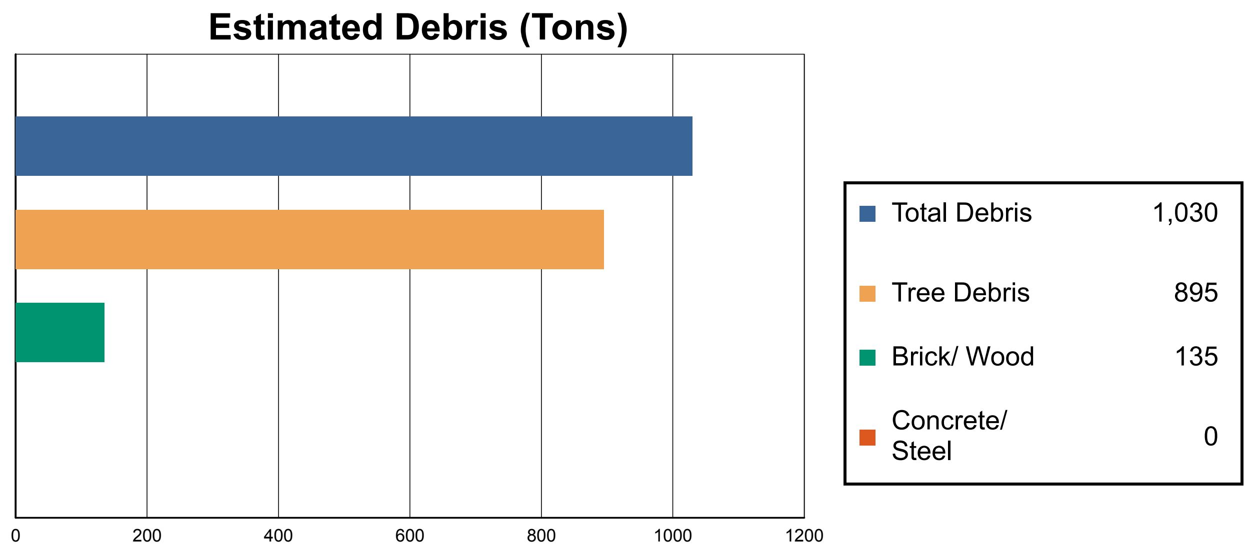
Thematic Map of Essential Facilities with greater than 50% moderate

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**
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	7	0	0	7

Induced Hurricane Damage

Debris Generation

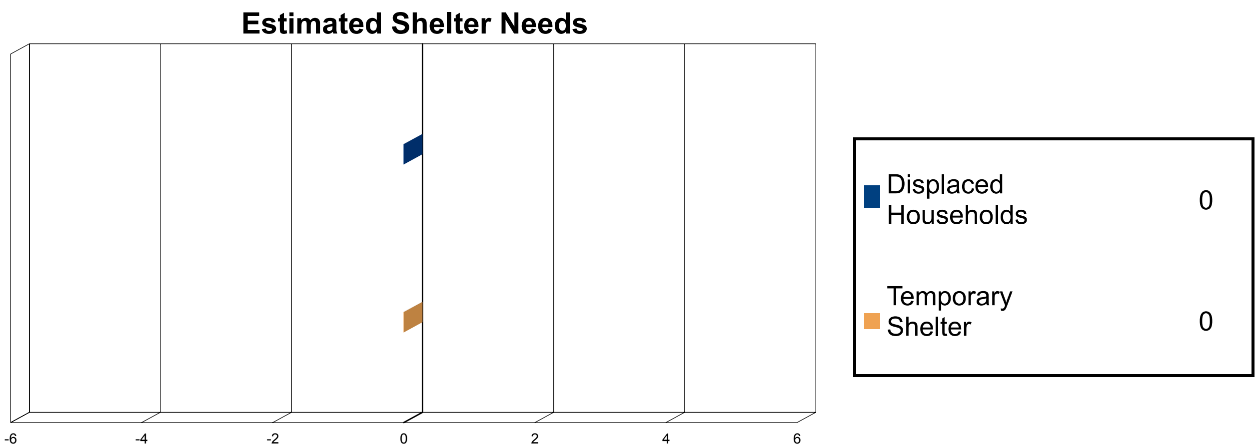


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 1,030 tons of debris will be generated. Of the total amount, 523 tons (51%) is Other Tree Debris. Of the remaining 507 tons, Brick/Wood comprises 27% 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 5 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 372 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 14,005) will seek temporary shelter in public shelters.

Economic Loss

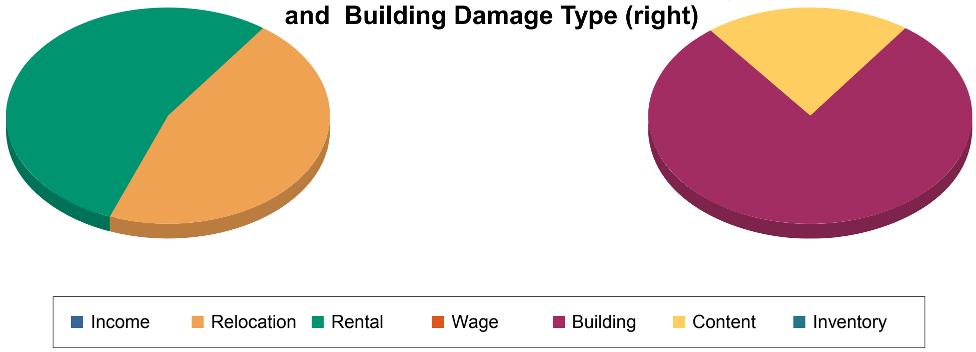
The total economic loss estimated for the hurricane is 3.2 million dollars, which represents 0.13 % of the total replacement value of the region's buildings.

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. 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 97% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left) and Building Damage Type (right)



Loss Type by General Occupancy

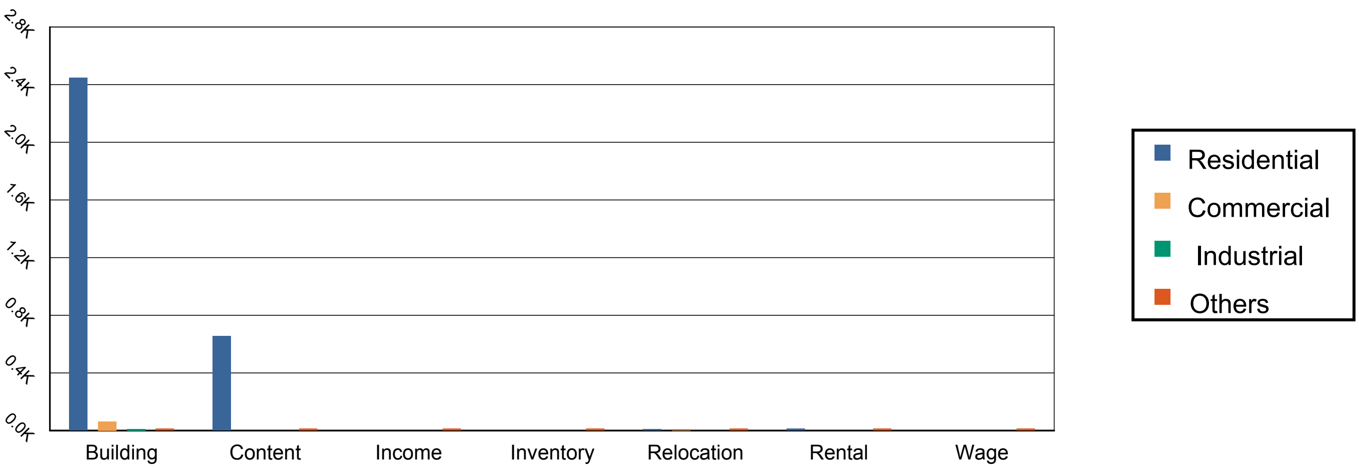


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	2,447.15	63.38	11.62	13.10	2,535.26
	Content	656.00	0.00	0.00	0.00	656.00
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**3,103.15**	**63.38**	**11.62**	**13.10**	**3,191.25**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	9.87	1.25	0.00	0.05	11.17
	Rental	13.27	0.00	0.00	0.00	13.27
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**23.15**	**1.25**	**0.00**	**0.05**	**24.44**

Total

	Total	**3,126.30**	**64.63**	**11.62**	**13.15**	**3,215.70**

Appendix A: County Listing for the Region

Connecticut
- Middlesex

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
Middlesex	14,005	1,856,214	586,242	2,442,456
Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**
Study Region Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**

Hazus: Hurricane Global Risk Report

Region Name: Cromwell

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Tuesday, October 1, 2019

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General Description of the 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 12.95 square miles and contains 3 census tracts. There are over 5 thousand households in the region and a total population of 14,005 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,442 million dollars (2014 dollars). Approximately 89% of the buildings (and 76% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 5,160 buildings in the region which have an aggregate total replacement value of 2,442 million (2014 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.

Building Exposure by Occupancy Type

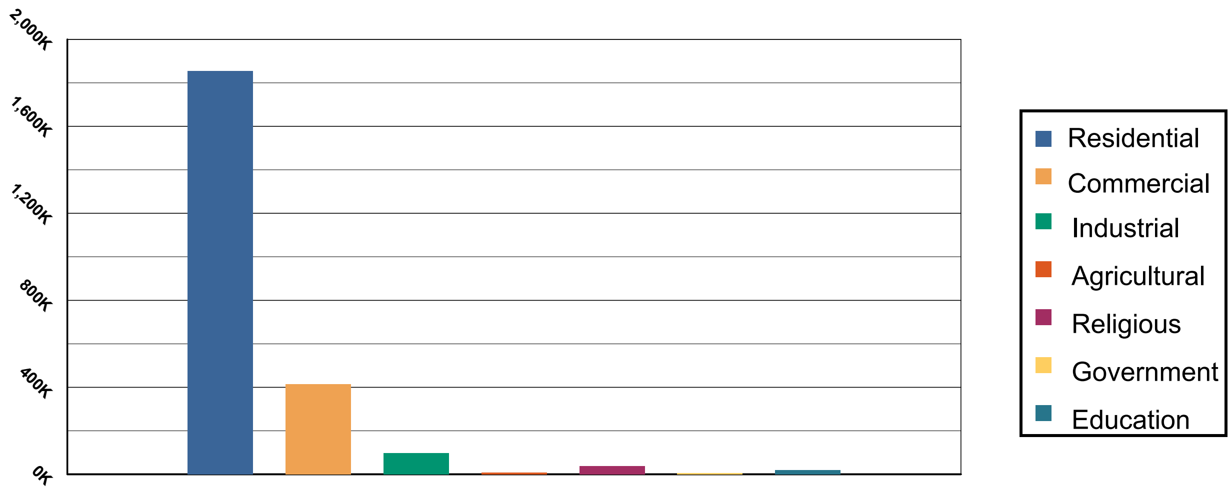


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,856,214	76.00 %
Commercial	413,463	16.93%
Industrial	97,739	4.00%
Agricultural	8,584	0.35%
Religious	38,782	1.59%
Government	6,778	0.28%
Education	20,896	0.86%
Total	**2,442,456**	**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 7 schools, 3 fire stations, 1 police stations and 1 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 11 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 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.

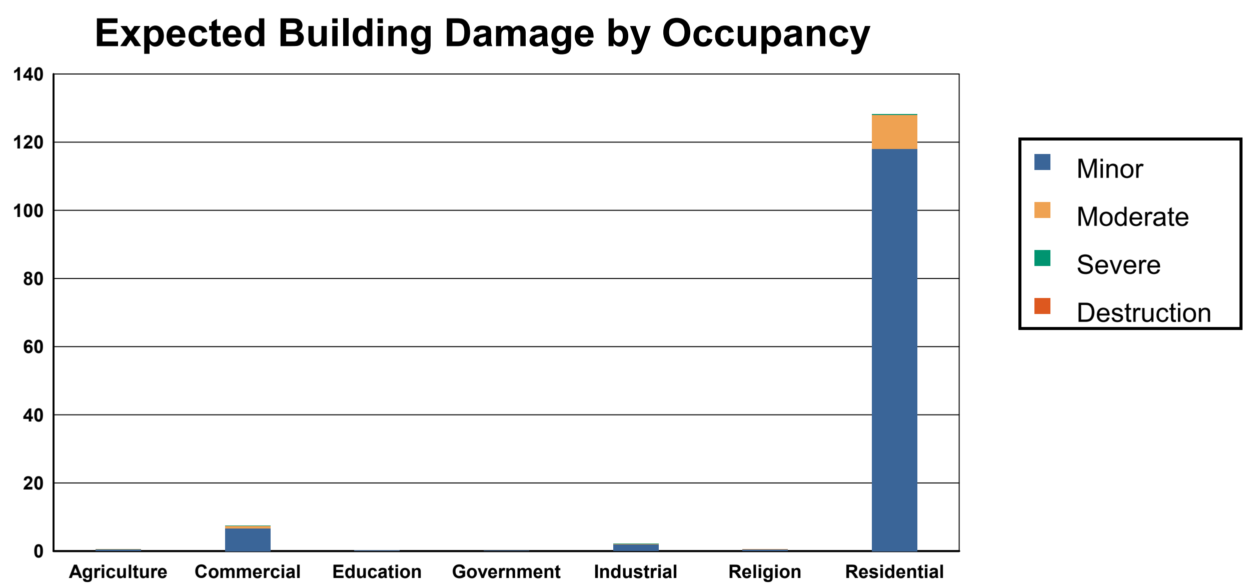


Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	23.40	97.51	0.52	2.15	0.06	0.26	0.02	0.07	0.00	0.00
Commercial	363.46	97.97	6.70	1.81	0.78	0.21	0.05	0.01	0.00	0.00
Education	12.73	97.95	0.26	1.99	0.01	0.05	0.00	0.00	0.00	0.00
Government	4.90	97.96	0.10	1.99	0.00	0.04	0.00	0.00	0.00	0.00
Industrial	97.84	97.84	2.03	2.03	0.11	0.11	0.02	0.02	0.00	0.00
Religion	31.40	98.12	0.58	1.82	0.02	0.06	0.00	0.00	0.00	0.00
Residential	4,486.73	97.22	118.01	2.56	10.07	0.22	0.20	0.00	0.00	0.00
Total	**5,020.46**		**128.19**		**11.05**		**0.30**		**0.00**	

Table 3: Expected Building Damage by Building Type : 100 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	37	97.44	1	2.48	0	0.07	0	0.00	0	0.00
Masonry	309	95.32	12	3.68	3	0.98	0	0.02	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	227	97.87	4	1.87	1	0.24	0	0.02	0	0.00
Wood	4,271	97.66	99	2.26	4	0.08	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 by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

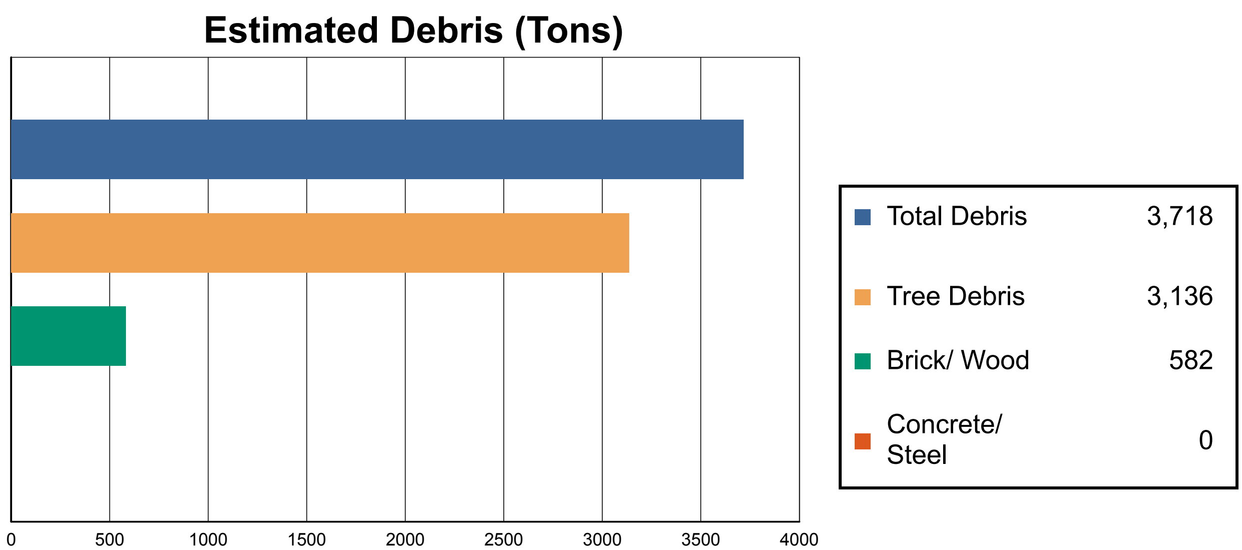
Thematic Map of Essential Facilities with greater than 50% moderate

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**
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	7	0	0	7

Induced Hurricane Damage

Debris Generation

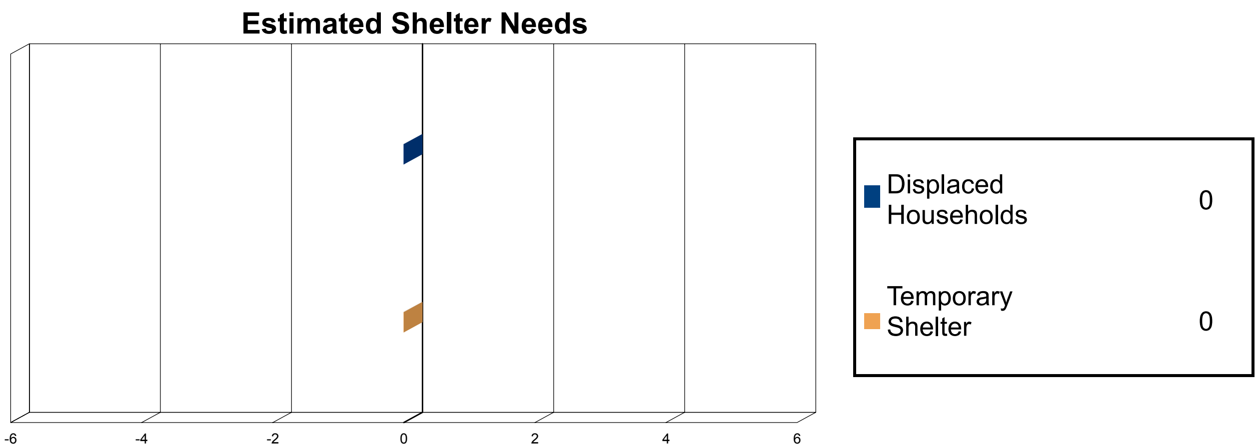


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 3,718 tons of debris will be generated. Of the total amount, 1,851 tons (50%) is Other Tree Debris. Of the remaining 1,867 tons, Brick/Wood comprises 31% 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 23 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 1,285 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 14,005) will seek temporary shelter in public shelters.

Economic Loss

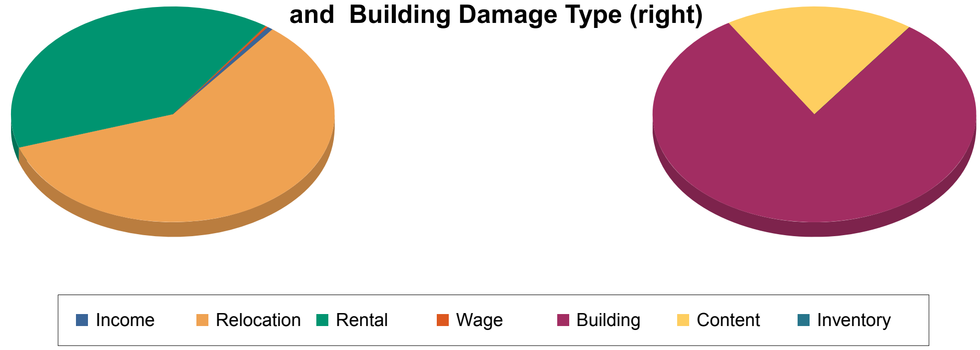
The total economic loss estimated for the hurricane is 10.1 million dollars, which represents 0.41 % of the total replacement value of the region's buildings.

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 10 million dollars. 4% 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 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left)
and Building Damage Type (right)



Loss Type by General Occupancy

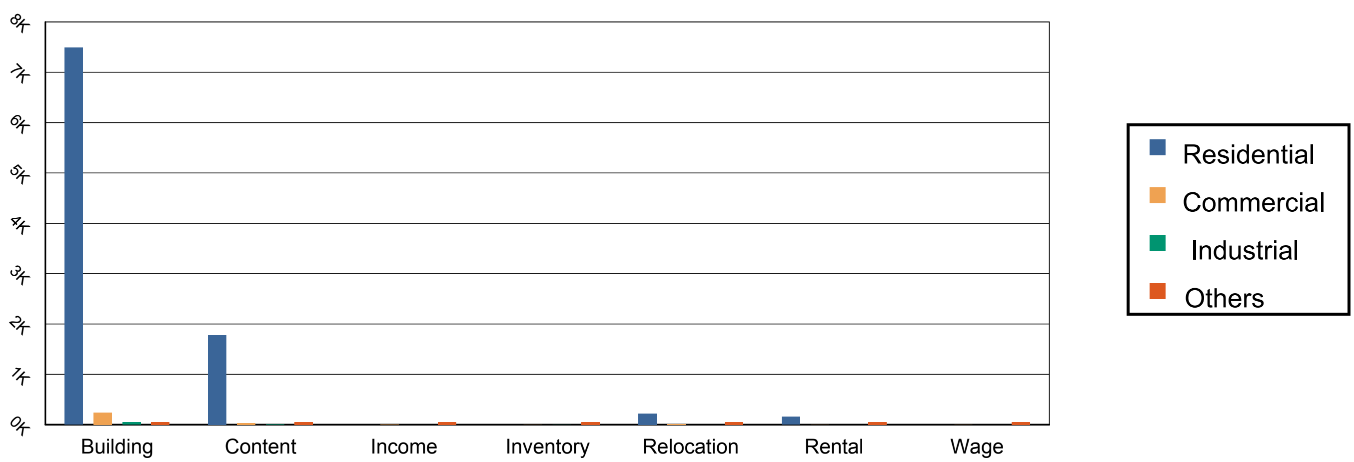


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	7,485.21	242.84	48.56	47.26	7,823.87
	Content	1,782.30	33.02	9.65	2.98	1,827.95
	Inventory	0.00	1.58	1.70	0.15	3.44
	Subtotal	**9,267.51**	**277.45**	**59.91**	**50.39**	**9,655.25**
Business Interruption Loss						
	Income	0.00	2.63	0.00	0.00	2.63
	Relocation	221.07	13.45	0.25	0.43	235.20
	Rental	155.85	1.17	0.00	0.00	157.03
	Wage	0.00	0.93	0.00	0.00	0.93
	Subtotal	**376.93**	**18.18**	**0.25**	**0.43**	**395.79**

Total

Total	**9,644.44**	**295.63**	**60.16**	**50.82**	**10,051.04**

Appendix A: County Listing for the Region

Connecticut
- Middlesex

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
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Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**
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Hazus: Hurricane Global Risk Report

Region Name: Cromwell

Hurricane Scenario: Probabilistic 200-year Return Period

Print Date: Tuesday, October 1, 2019

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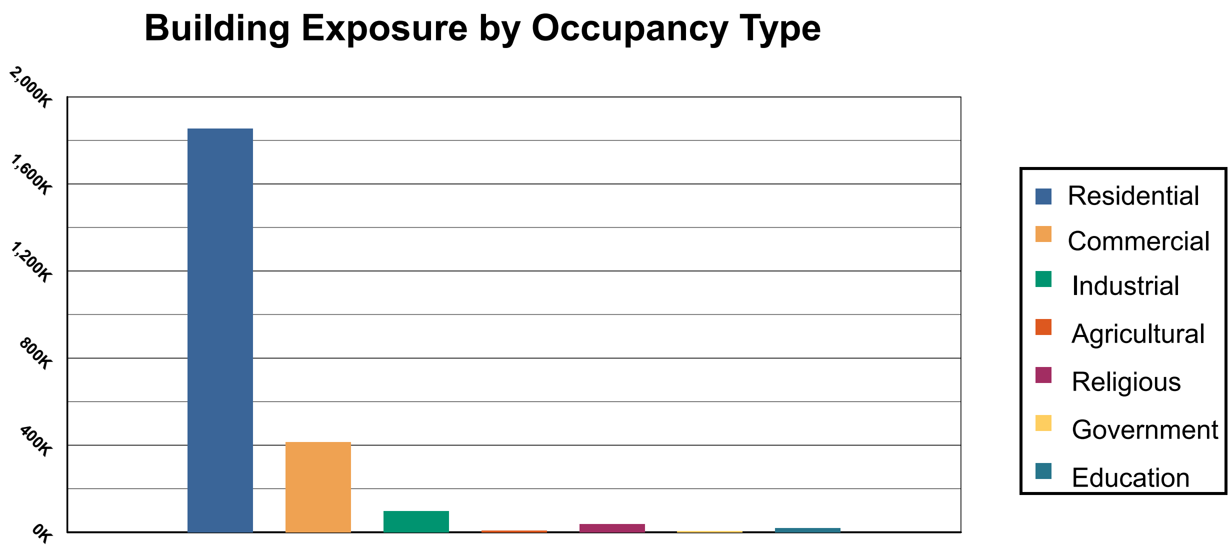
General Building Stock

Hazus estimates that there are 5,160 buildings in the region which have an aggregate total replacement value of 2,442 million (2014 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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Education	20,896	0.86%
Total	**2,442,456**	**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 7 schools, 3 fire stations, 1 police stations and 1 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 1% 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 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.

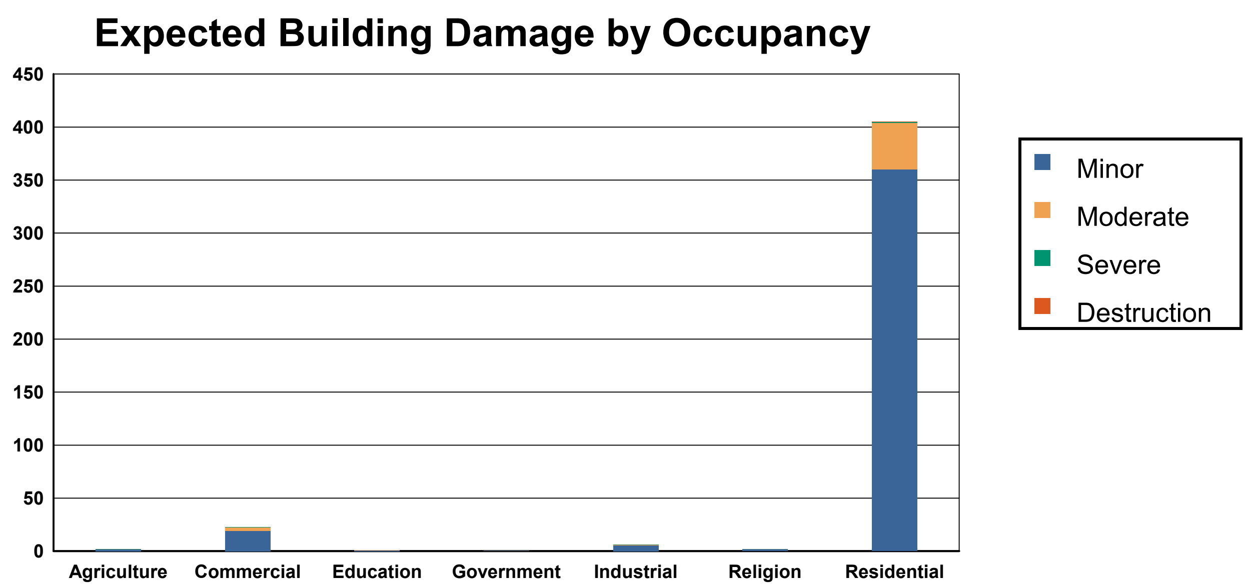


Table 2: Expected Building Damage by Occupancy : 200 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	22.05	91.89	1.53	6.39	0.29	1.19	0.12	0.50	0.01	0.03
Commercial	348.18	93.85	19.00	5.12	3.33	0.90	0.49	0.13	0.00	0.00
Education	12.23	94.05	0.71	5.44	0.06	0.49	0.00	0.01	0.00	0.00
Government	4.71	94.21	0.27	5.30	0.02	0.48	0.00	0.01	0.00	0.00
Industrial	93.75	93.75	5.37	5.37	0.72	0.72	0.16	0.16	0.01	0.01
Religion	30.09	94.03	1.77	5.55	0.13	0.41	0.01	0.02	0.00	0.00
Residential	4,209.74	91.22	360.06	7.80	44.05	0.95	0.82	0.02	0.33	0.01
Total	**4,720.74**		**388.71**		**48.60**		**1.60**		**0.35**	

Table 3: Expected Building Damage by Building Type : 200 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	35	92.92	2	6.35	0	0.73	0	0.01	0	0.00
Masonry	286	88.35	26	8.10	11	3.44	0	0.11	0	0.01
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	218	93.87	11	4.90	2	1.05	0	0.18	0	0.00
Wood	4,023	92.01	327	7.48	21	0.49	1	0.02	0	0.01

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 by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

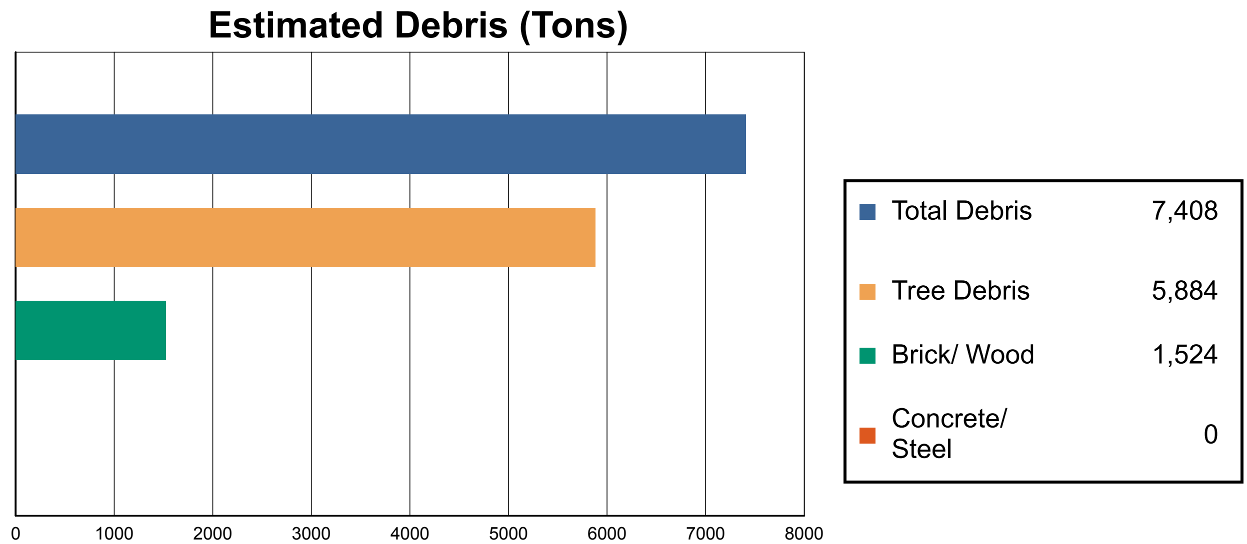
Thematic Map of Essential Facilities with greater than 50% moderate

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**
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	7	0	0	7

Induced Hurricane Damage

Debris Generation



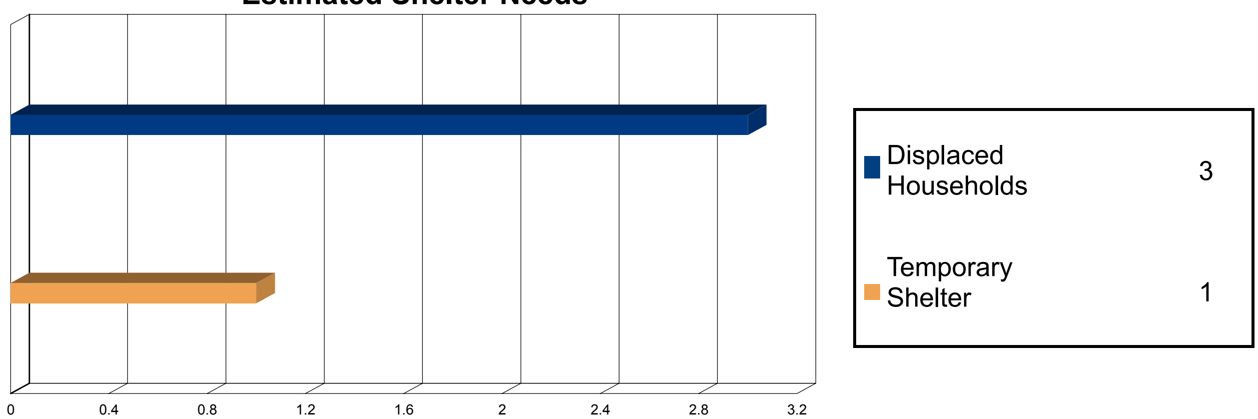
Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 7,408 tons of debris will be generated. Of the total amount, 3,473 tons (47%) is Other Tree Debris. Of the remaining 3,935 tons, Brick/Wood comprises 39% 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 61 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 2,411 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

Estimated Shelter Needs



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 3 households to be displaced due to the hurricane. Of these, 1 people (out of a total population of 14,005) will seek temporary shelter in public shelters.

Economic Loss

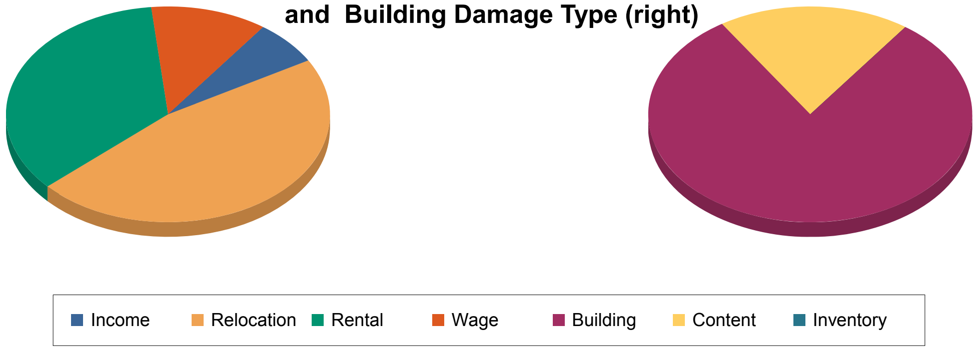
The total economic loss estimated for the hurricane is 21.9 million dollars, which represents 0.90 % of the total replacement value of the region's buildings.

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 22 million dollars. 5% 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 92% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left)
and Building Damage Type (right)



Loss Type by General Occupancy

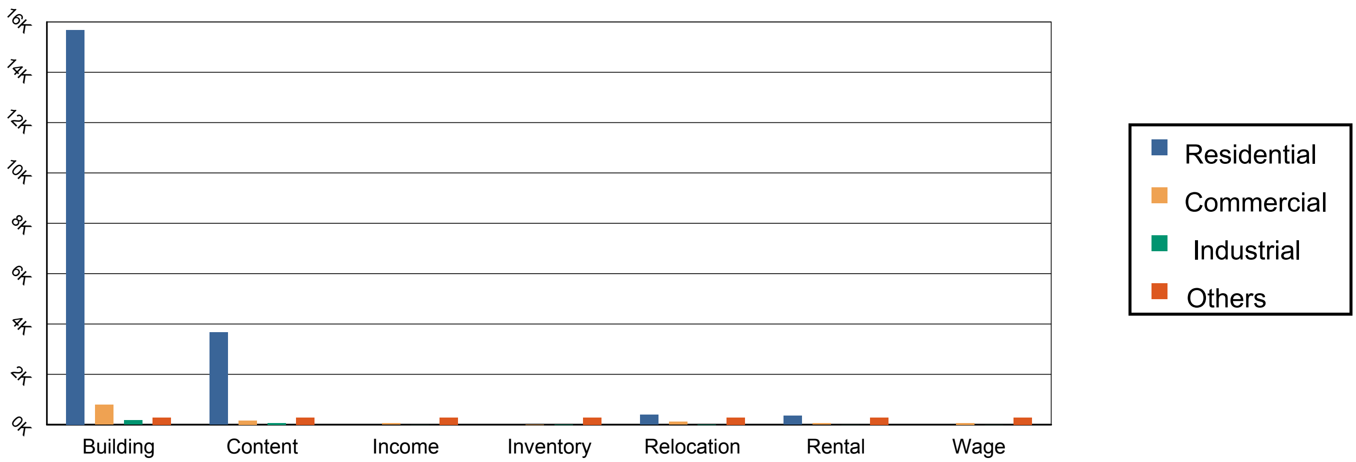


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	15,672.42	792.86	178.55	149.74	16,793.56
	Content	3,666.22	165.43	73.96	26.11	3,931.73
	Inventory	0.00	7.19	11.29	0.92	19.41
	Subtotal	**19,338.64**	**965.48**	**263.80**	**176.77**	**20,744.69**
Business Interruption Loss						
	Income	0.00	51.49	1.09	23.88	76.46
	Relocation	398.47	113.18	5.37	21.07	538.10
	Rental	347.80	51.32	0.85	1.76	401.73
	Wage	0.00	70.53	1.78	62.39	134.70
	Subtotal	**746.27**	**286.51**	**9.09**	**109.11**	**1,150.99**

Total

Total	**20,084.91**	**1,252.00**	**272.90**	**285.88**	**21,895.68**

Appendix A: County Listing for the Region

Connecticut

- Middlesex

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
Middlesex	14,005	1,856,214	586,242	2,442,456
Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**
Study Region Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**

Hazus: Hurricane Global Risk Report

Region Name: Cromwell

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Tuesday, October 1, 2019

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 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 12.95 square miles and contains 3 census tracts. There are over 5 thousand households in the region and a total population of 14,005 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,442 million dollars (2014 dollars). Approximately 89% of the buildings (and 76% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 5,160 buildings in the region which have an aggregate total replacement value of 2,442 million (2014 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.

Building Exposure by Occupancy Type

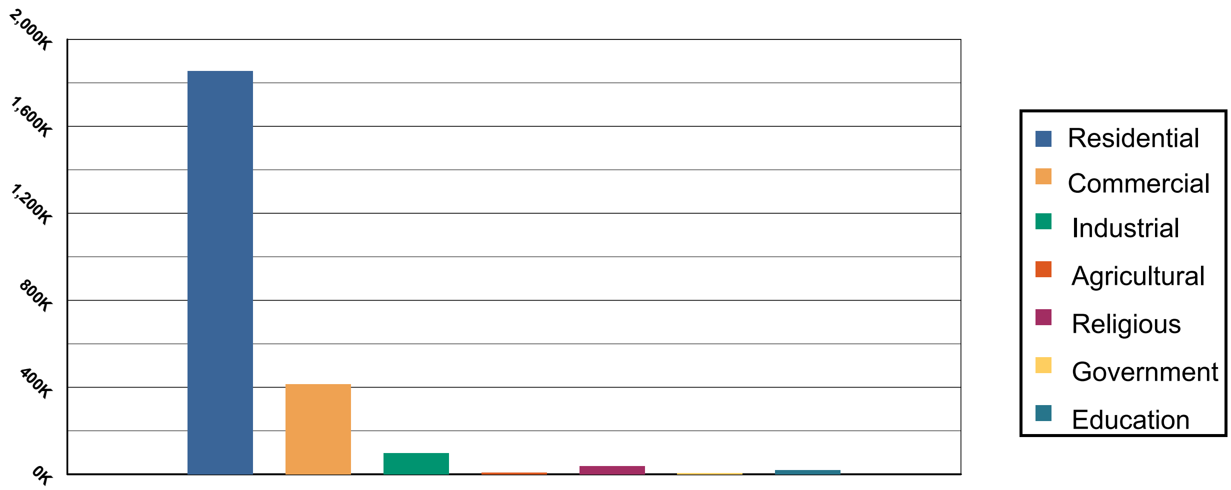


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,856,214	76.00 %
Commercial	413,463	16.93%
Industrial	97,739	4.00%
Agricultural	8,584	0.35%
Religious	38,782	1.59%
Government	6,778	0.28%
Education	20,896	0.86%
Total	**2,442,456**	**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 7 schools, 3 fire stations, 1 police stations and 1 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 195 buildings will be at least moderately damaged. This is over 4% of the total number of buildings in the region. There are an estimated 5 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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.

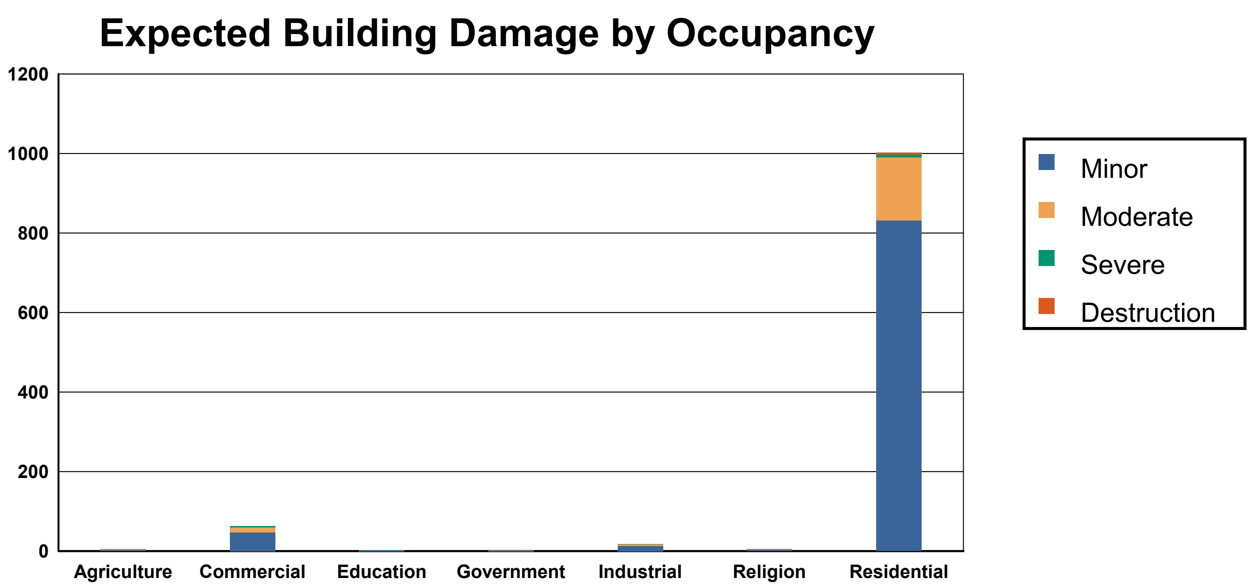


Table 2: Expected Building Damage by Occupancy : 500 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	18.74	78.10	3.68	15.34	1.03	4.28	0.49	2.04	0.05	0.23
Commercial	307.68	82.93	46.65	12.57	13.98	3.77	2.68	0.72	0.02	0.00
Education	10.69	82.21	1.80	13.88	0.47	3.65	0.03	0.26	0.00	0.00
Government	4.12	82.49	0.68	13.59	0.18	3.67	0.01	0.25	0.00	0.00
Industrial	82.26	82.26	12.95	12.95	3.91	3.91	0.81	0.81	0.07	0.07
Religion	26.41	82.52	4.63	14.46	0.91	2.83	0.06	0.19	0.00	0.00
Residential	3,612.71	78.28	832.14	18.03	158.34	3.43	7.13	0.15	4.69	0.10
Total	**4,062.61**		**902.53**		**178.81**		**11.23**		**4.83**	

Table 3: Expected Building Damage by Building Type : 500 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	31	80.63	6	14.51	2	4.68	0	0.18	0	0.00
Masonry	243	74.85	51	15.63	29	8.99	2	0.48	0	0.06
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	192	82.84	27	11.73	10	4.42	2	1.01	0	0.01
Wood	3,472	79.40	787	18.00	103	2.36	6	0.15	4	0.10

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 by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

Thematic Map of Essential Facilities with greater than 50% moderate

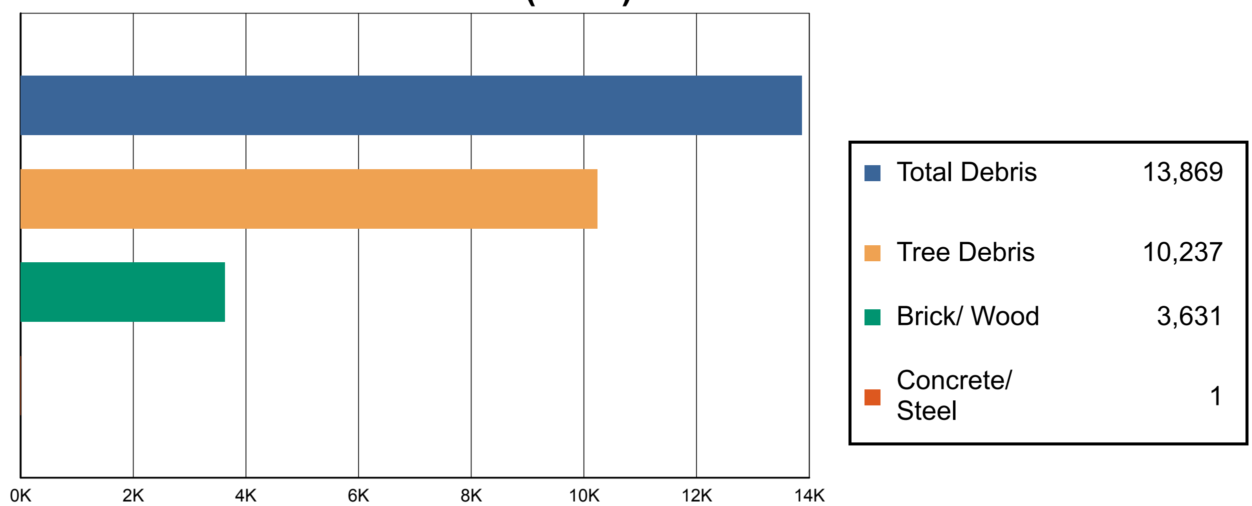
Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	7	0	0	1

Induced Hurricane Damage

Debris Generation

Estimated Debris (Tons)

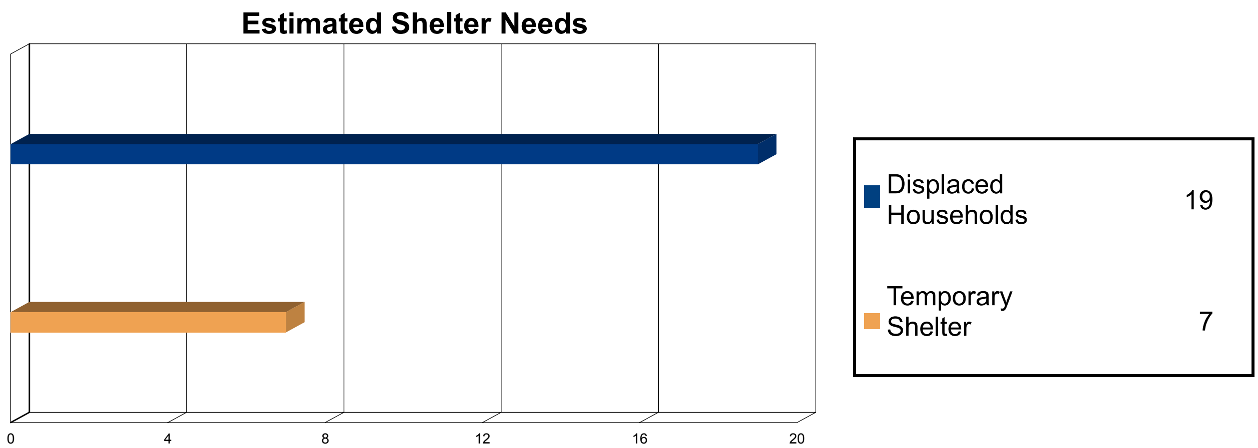


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 13,869 tons of debris will be generated. Of the total amount, 6,037 tons (44%) is Other Tree Debris. Of the remaining 7,832 tons, Brick/Wood comprises 46% 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 145 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 4,200 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 19 households to be displaced due to the hurricane. Of these, 7 people (out of a total population of 14,005) will seek temporary shelter in public shelters.

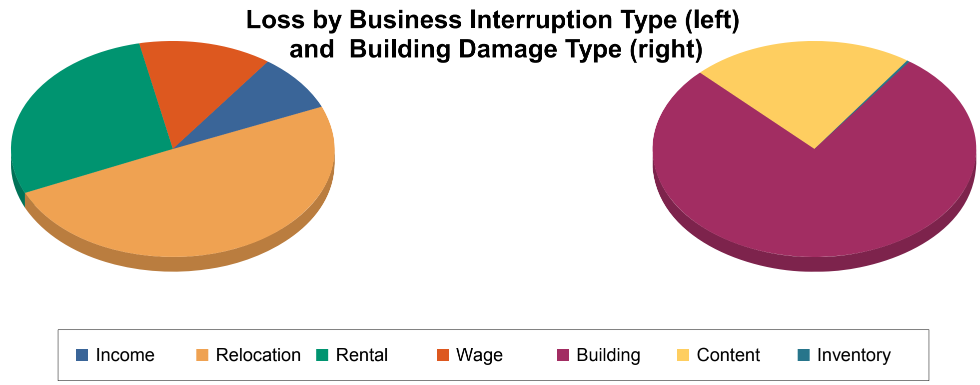
Economic Loss

The total economic loss estimated for the hurricane is 52.5 million dollars, which represents 2.15 % 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 52 million dollars. 8% 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 87% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.



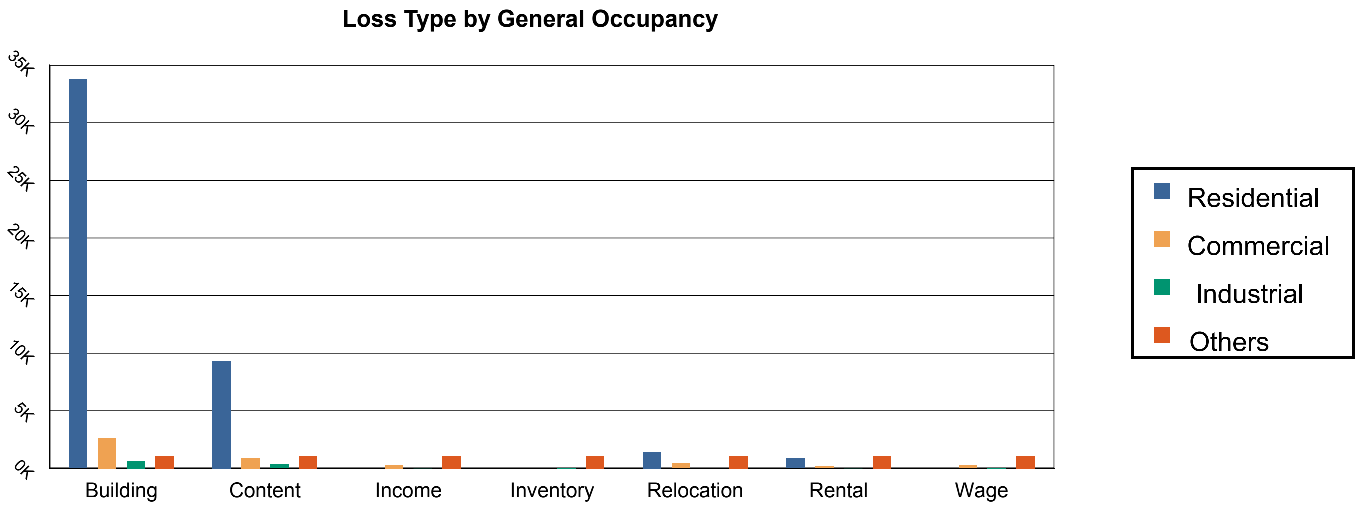


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	33,794.83	2,666.88	660.36	525.12	37,647.19
	Content	9,296.02	914.75	385.06	148.89	10,744.72
	Inventory	0.00	40.83	57.07	4.42	102.32
	Subtotal	**43,090.84**	**3,622.47**	**1,102.49**	**678.43**	**48,494.23**
Business Interruption Loss						
	Income	0.00	272.06	10.33	61.61	344.00
	Relocation	1,400.52	440.34	39.22	90.61	1,970.69
	Rental	900.65	207.32	6.79	7.99	1,122.75
	Wage	0.00	294.23	13.85	223.08	531.15
	Subtotal	**2,301.17**	**1,213.94**	**70.19**	**383.28**	**3,968.59**

Total

Total	45,392.02	4,836.41	1,172.68	1,061.71	52,462.82

Appendix A: County Listing for the Region

Connecticut
- Middlesex

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
Middlesex	14,005	1,856,214	586,242	2,442,456
Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**
Study Region Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**

Hazus: Hurricane Global Risk Report

Region Name: Cromwell

Hurricane Scenario: Probabilistic 1000-year Return Period

Print Date: Tuesday, October 1, 2019

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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 12.95 square miles and contains 3 census tracts. There are over 5 thousand households in the region and a total population of 14,005 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,442 million dollars (2014 dollars). Approximately 89% of the buildings (and 76% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 5,160 buildings in the region which have an aggregate total replacement value of 2,442 million (2014 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.

Building Exposure by Occupancy Type

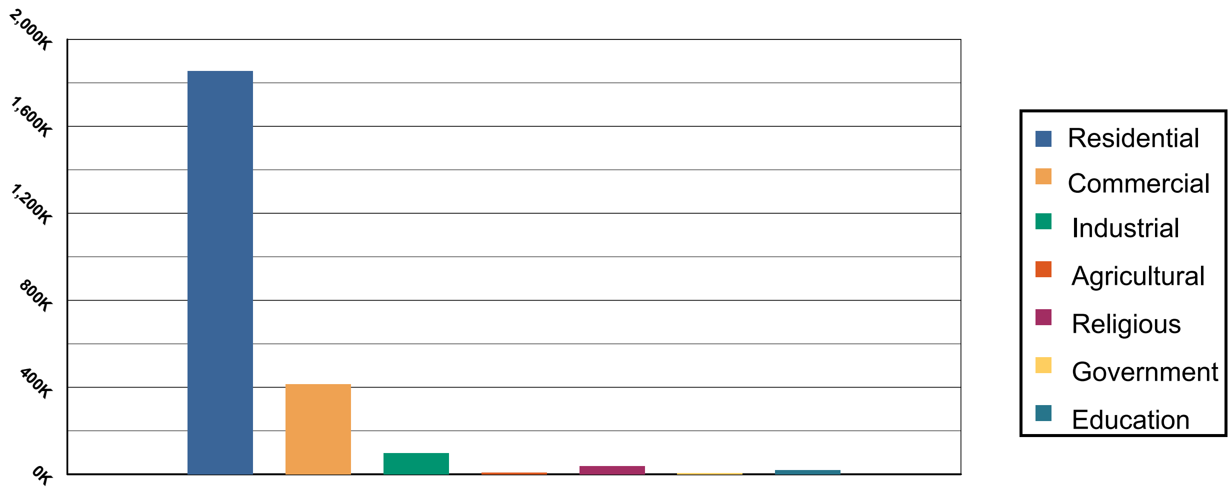


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,856,214	76.00 %
Commercial	413,463	16.93%
Industrial	97,739	4.00%
Agricultural	8,584	0.35%
Religious	38,782	1.59%
Government	6,778	0.28%
Education	20,896	0.86%
Total	**2,442,456**	**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 7 schools, 3 fire stations, 1 police stations and 1 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 408 buildings will be at least moderately damaged. This is over 8% of the total number of buildings in the region. There are an estimated 16 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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.

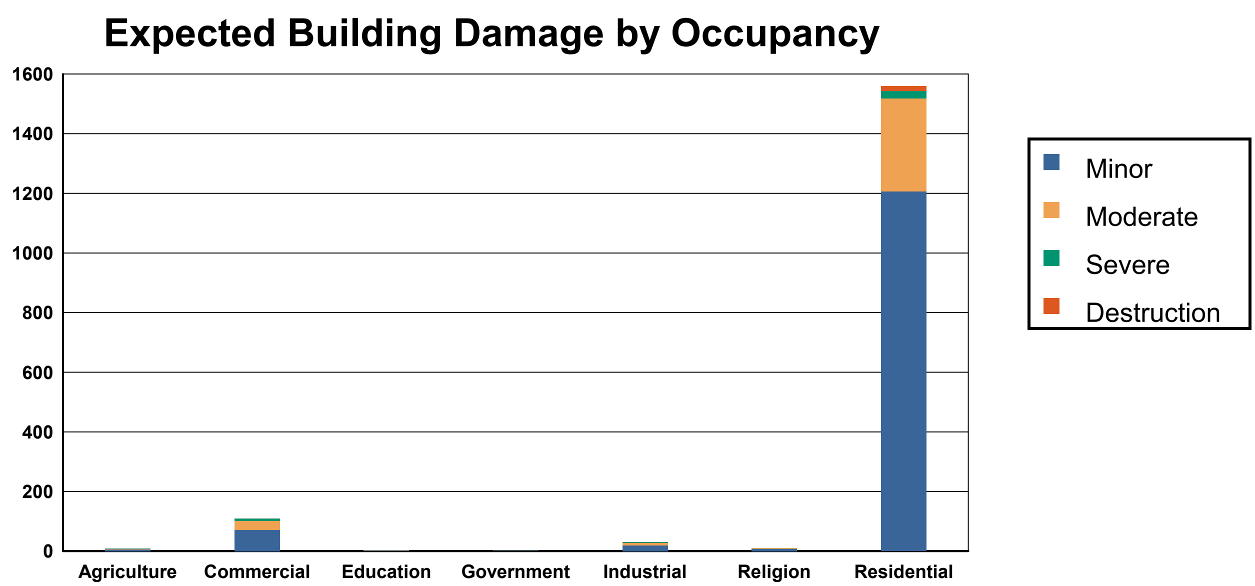


Table 2: Expected Building Damage by Occupancy : 1000 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	15.75	65.63	5.31	22.13	1.88	7.85	0.92	3.83	0.14	0.56
Commercial	262.46	70.74	70.98	19.13	30.71	8.28	6.79	1.83	0.06	0.02
Education	9.17	70.52	2.60	20.00	1.09	8.41	0.14	1.07	0.00	0.00
Government	3.55	71.09	0.97	19.48	0.42	8.39	0.05	1.04	0.00	0.00
Industrial	70.25	70.25	18.91	18.91	8.66	8.66	2.02	2.02	0.17	0.17
Religion	22.61	70.65	6.96	21.74	2.19	6.84	0.24	0.77	0.00	0.00
Residential	3,055.65	66.21	1,206.91	26.15	312.50	6.77	24.06	0.52	15.88	0.34
Total	**3,439.44**		**1,312.63**		**357.45**		**34.22**		**16.25**	

Table 3: Expected Building Damage by Building Type : 1000 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	26	67.67	8	20.51	4	10.99	0	0.83	0	0.00
Masonry	202	62.24	68	20.97	50	15.46	4	1.16	1	0.16
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	164	70.65	40	17.37	22	9.49	6	2.46	0	0.03
Wood	2,950	67.45	1,163	26.59	223	5.10	22	0.50	15	0.35

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 by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

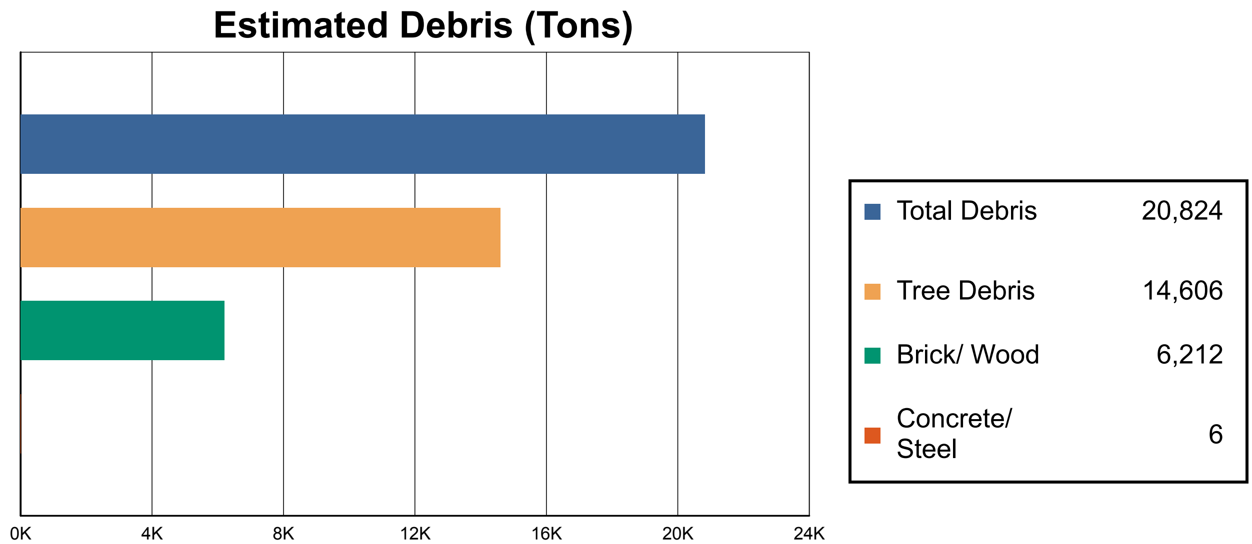
Thematic Map of Essential Facilities with greater than 50% moderate

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**
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	7	0	0	0

Induced Hurricane Damage

Debris Generation



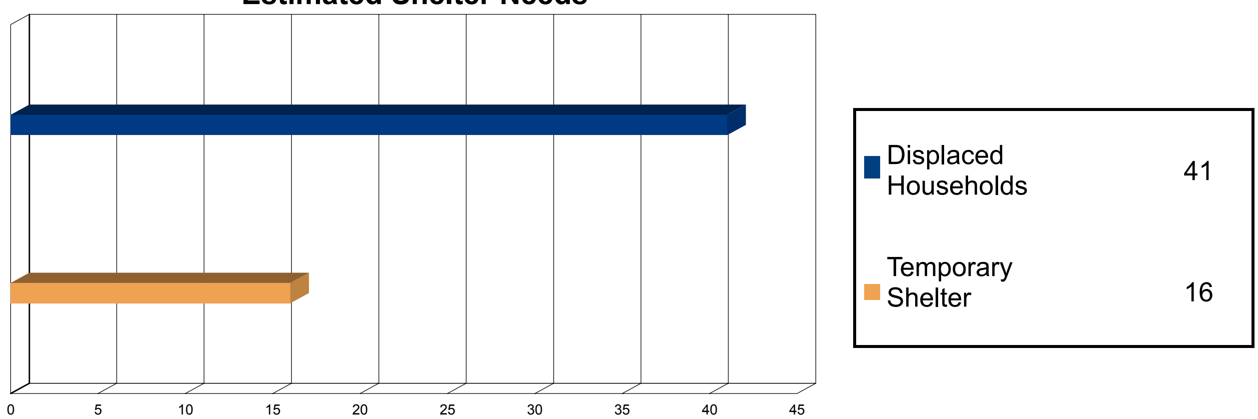
Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 20,824 tons of debris will be generated. Of the total amount, 8,636 tons (41%) is Other Tree Debris. Of the remaining 12,188 tons, Brick/Wood comprises 51% 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 249 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 5,970 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

Estimated Shelter Needs



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 41 households to be displaced due to the hurricane. Of these, 16 people (out of a total population of 14,005) will seek temporary shelter in public shelters.

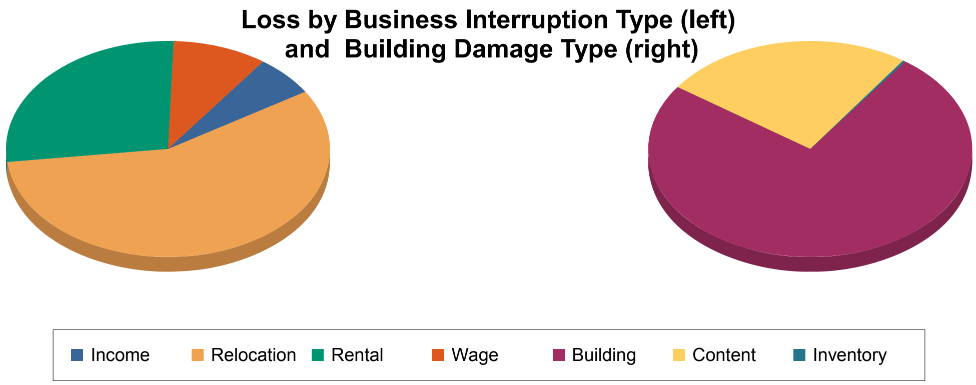
Economic Loss

The total economic loss estimated for the hurricane is 97.7 million dollars, which represents 4.00 % 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 98 million dollars. 9% 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 84% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.



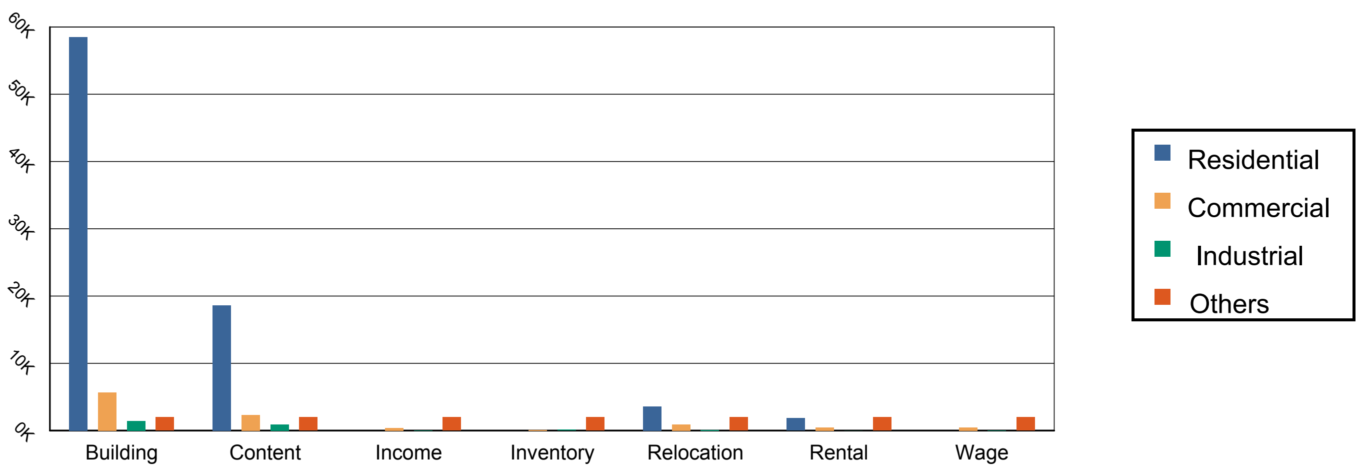


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	58,486.94	5,698.34	1,466.94	1,051.56	66,703.78
	Content	18,625.99	2,346.44	946.23	366.83	22,285.49
	Inventory	0.00	100.85	132.85	9.21	242.91
	Subtotal	**77,112.93**	**8,145.63**	**2,546.02**	**1,427.60**	**89,232.18**
Business Interruption Loss						
	Income	0.00	423.36	20.51	75.45	519.31
	Relocation	3,613.31	939.13	96.51	183.41	4,832.36
	Rental	1,857.76	456.10	15.01	15.13	2,344.01
	Wage	0.00	484.60	28.20	293.17	805.97
	Subtotal	**5,471.07**	**2,303.20**	**160.22**	**567.16**	**8,501.65**

Total

Total	82,584.00	10,448.83	2,706.24	1,994.76	97,733.84

Appendix A: County Listing for the Region

Connecticut
- Middlesex

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
Middlesex	14,005	1,856,214	586,242	2,442,456
Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**
Study Region Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**

Hazus: Hurricane Global Risk Report

Region Name: Cromwell

Hurricane Scenario: UN-NAMED-1938-4

Print Date: Tuesday, October 15, 2019

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
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.

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 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 12.95 square miles and contains 3 census tracts. There are over 5 thousand households in the region and a total population of 14,005 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,442 million dollars (2014 dollars). Approximately 89% of the buildings (and 76% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 5,160 buildings in the region which have an aggregate total replacement value of 2,442 million (2014 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.

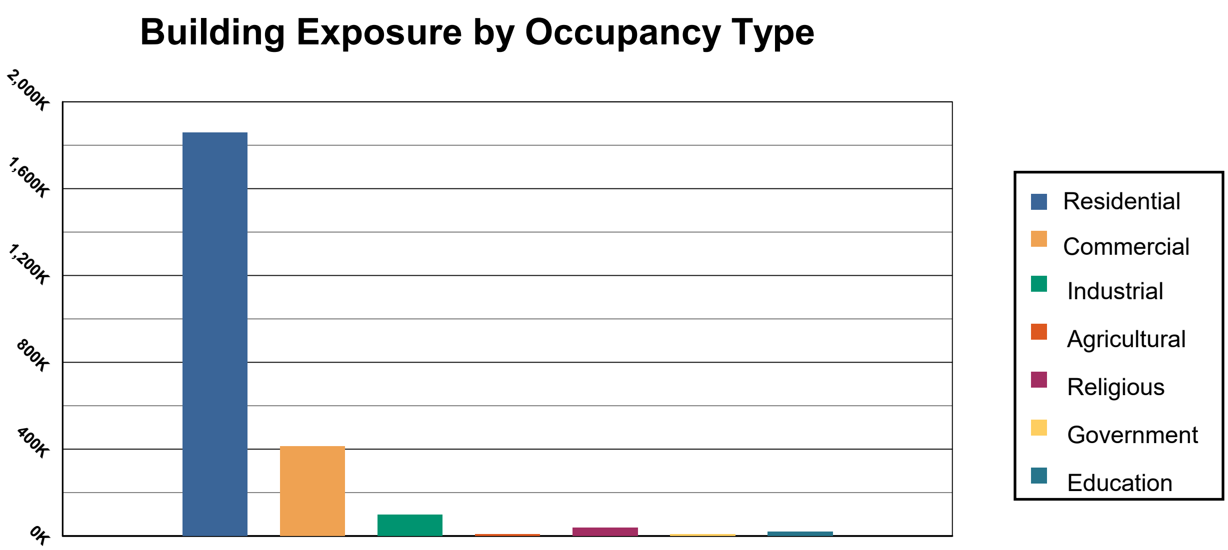


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,856,214	76.00%
Commercial	413,463	16.93%
Industrial	97,739	4.00%
Agricultural	8,584	0.35%
Religious	38,782	1.59%
Government	6,778	0.28%
Education	20,896	0.86%
Total	**2,442,456**	**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 7 schools, 3 fire stations, 1 police stations and 1 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:	109 mph

Building Damage

General Building Stock Damage

Hazus estimates that about 348 buildings will be at least moderately damaged. This is over 7% of the total number of buildings in the region. There are an estimated 13 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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.

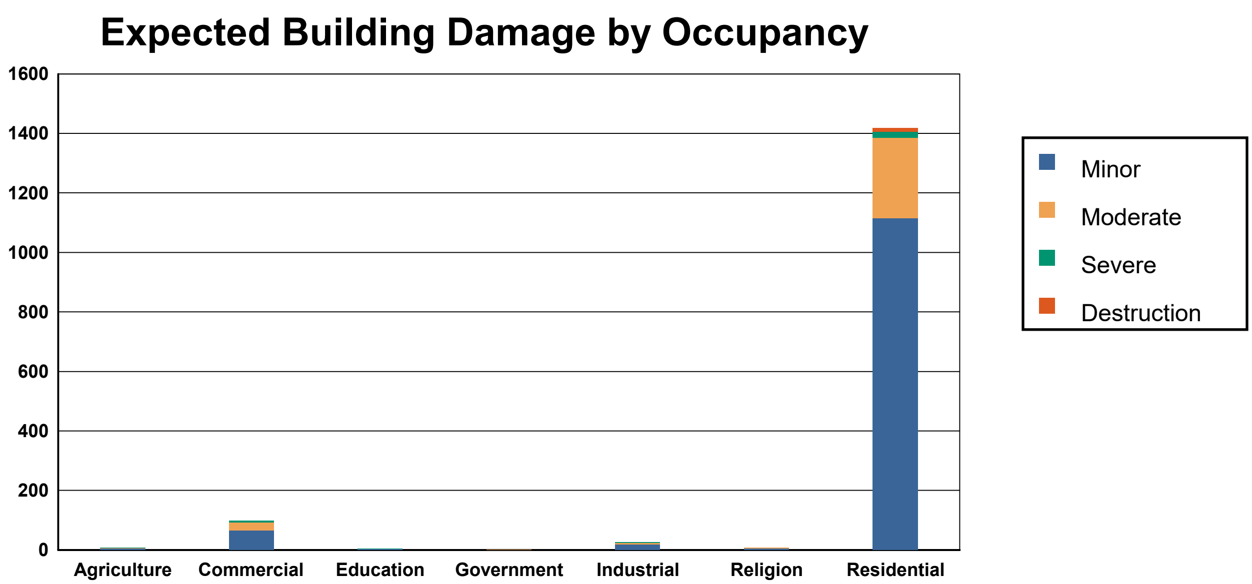


Table 2: Expected Building Damage by Occupancy

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	16.55	68.97	4.90	20.40	1.64	6.84	0.80	3.32	0.11	0.47
Commercial	273.88	73.82	65.37	17.62	26.17	7.05	5.53	1.49	0.05	0.01
Education	9.59	73.80	2.40	18.44	0.91	6.99	0.10	0.77	0.00	0.00
Government	3.72	74.38	0.90	17.92	0.35	6.95	0.04	0.75	0.00	0.00
Industrial	73.43	73.43	17.48	17.48	7.32	7.32	1.63	1.63	0.14	0.14
Religion	23.62	73.82	6.38	19.95	1.82	5.67	0.18	0.56	0.00	0.00
Residential	3,197.75	69.29	1,115.85	24.18	270.43	5.86	18.67	0.40	12.30	0.27
Total	**3,598.54**		**1,213.28**		**308.64**		**26.94**		**12.60**	

Table 3: Expected Building Damage by Building Type

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	27	70.99	7	19.18	4	9.24	0	0.60	0	0.00
Masonry	212	65.34	64	19.73	45	13.85	3	0.95	0	0.13
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	171	73.78	37	16.08	19	8.11	5	2.01	0	0.02
Wood	3,084	70.52	1,071	24.50	189	4.33	17	0.39	12	0.27

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 by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

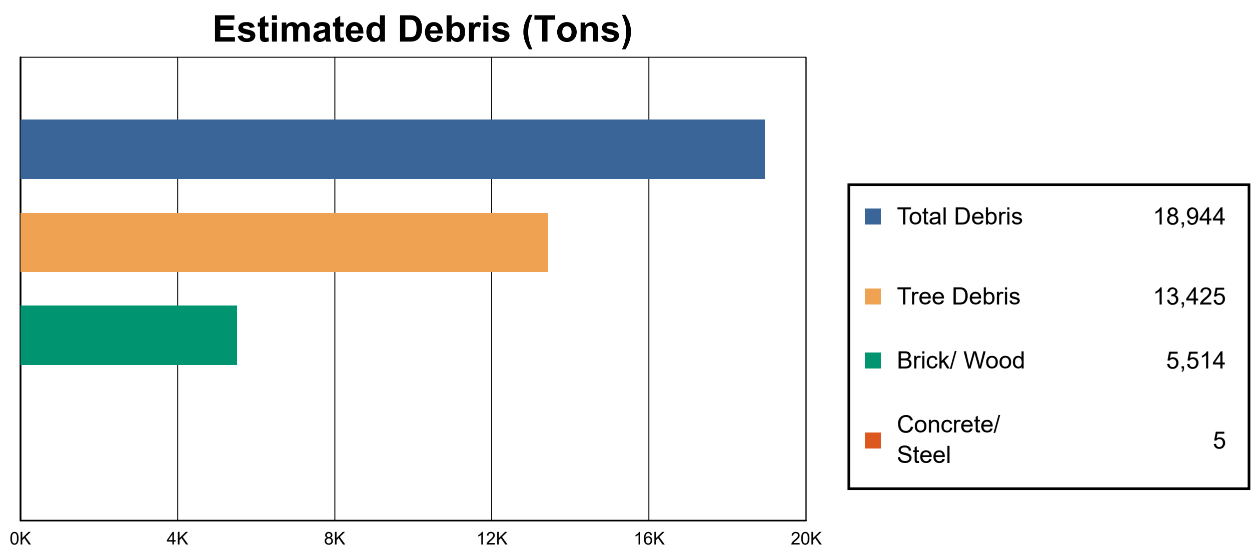
Thematic Map of Essential Facilities with greater than 50% moderate

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**
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	7	0	0	0

Induced Hurricane Damage

Debris Generation

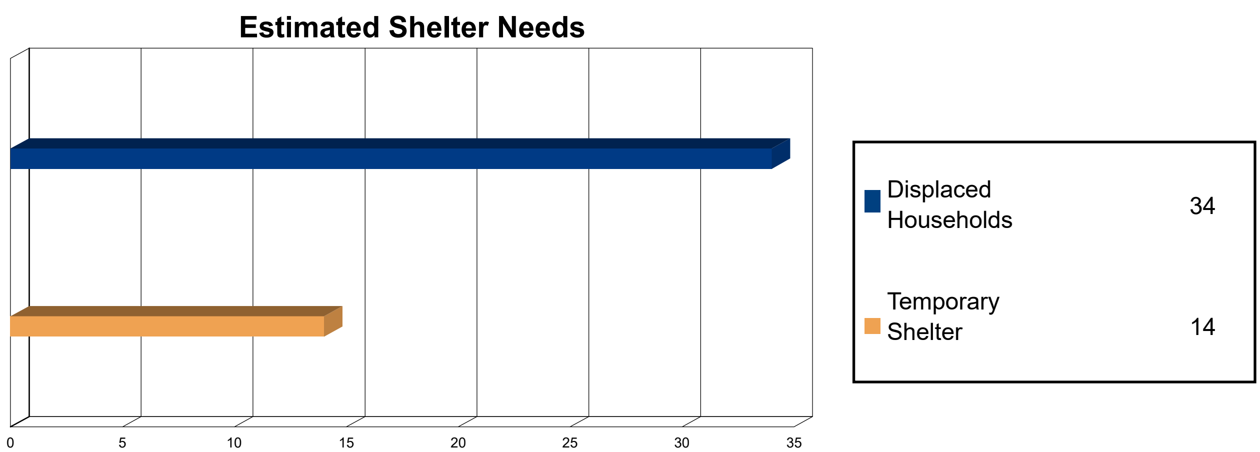


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 18,944 tons of debris will be generated. Of the total amount, 7,936 tons (42%) is Other Tree Debris. Of the remaining 11,008 tons, Brick/Wood comprises 50% 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 221 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 5,489 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 34 households to be displaced due to the hurricane. Of these, 14 people (out of a total population of 14,005) will seek temporary shelter in public shelters.

Economic Loss

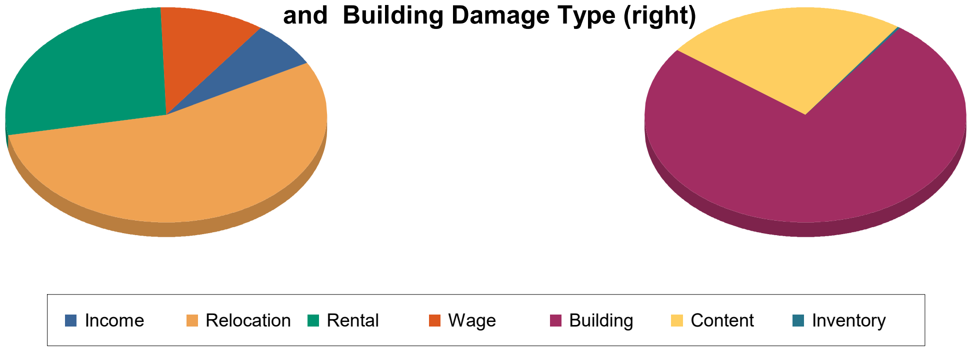
The total economic loss estimated for the hurricane is 85.0 million dollars, which represents 3.48 % of the total replacement value of the region's buildings.

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 85 million dollars. 9% 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 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left) and Building Damage Type (right)



Loss Type by General Occupancy

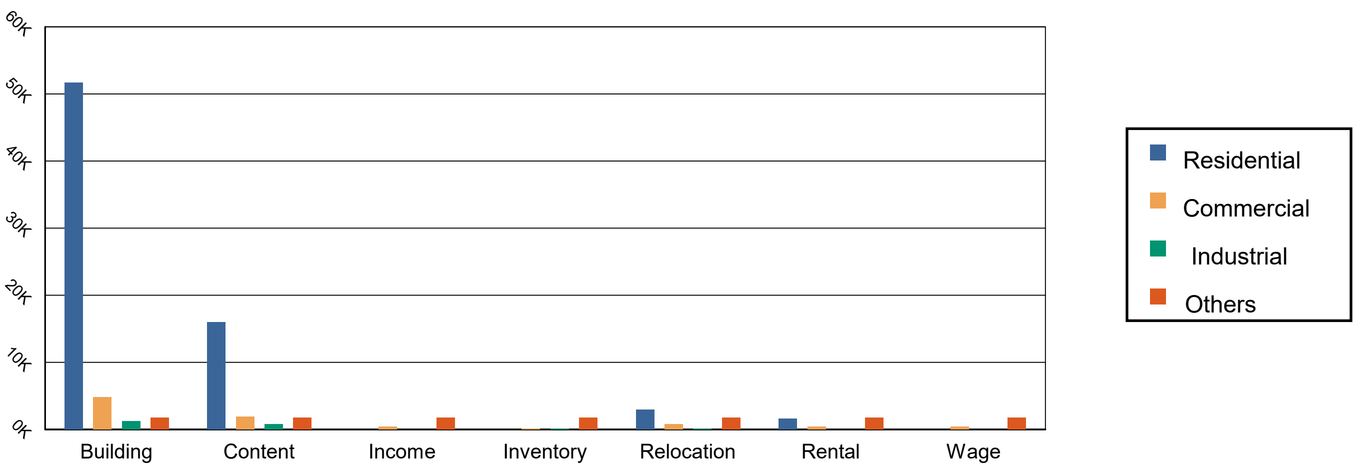


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	51,673.21	4,820.69	1,243.65	886.11	58,623.66
	Content	15,956.41	1,907.70	785.66	292.81	18,942.58
	Inventory	0.00	81.96	110.78	7.79	200.52
	Subtotal	**67,629.63**	**6,810.35**	**2,140.09**	**1,186.70**	**77,766.76**
Business Interruption Loss						
	Income	0.00	400.37	17.64	76.81	494.81
	Relocation	2,959.46	797.06	80.26	155.45	3,992.24
	Rental	1,582.28	383.62	12.56	12.95	1,991.41
	Wage	0.00	453.58	23.83	281.89	759.30
	Subtotal	**4,541.74**	**2,034.64**	**134.28**	**527.10**	**7,237.76**

Total

Total	**72,171.37**	**8,844.98**	**2,274.37**	**1,713.80**	**85,004.52**

Appendix A: County Listing for the Region

Connecticut

- Middlesex

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
Middlesex	14,005	1,856,214	586,242	2,442,456
Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**
Study Region Total	**14,005**	**1,856,214**	**586,242**	**2,442,456**

Hazus: Earthquake Global Risk Report

Region Name: Cromwell

Earthquake Scenario: EastHaddam

Print Date: October 16, 2019

Disclaimer:

This version of Hazus utilizes 2010 Census Data.

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 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-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) 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 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 12.95 square miles and contains 3 census tracts. There are over 5 thousand households in the region which has a total population of 14,005 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,442 (millions of dollars). Approximately 89.00 % of the buildings (and 76.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,151 and 90 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 5 thousand buildings in the region which have an aggregate total replacement value of 2,442 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 85% 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 beds. There are 7 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 1 hazardous material sites, no military installations and no 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 1,241.00 (millions of dollars). This inventory includes over 54.68 miles of highways, 32 bridges, 377.79 miles of pipes.

Table 1: Transportation System Lifeline Inventory

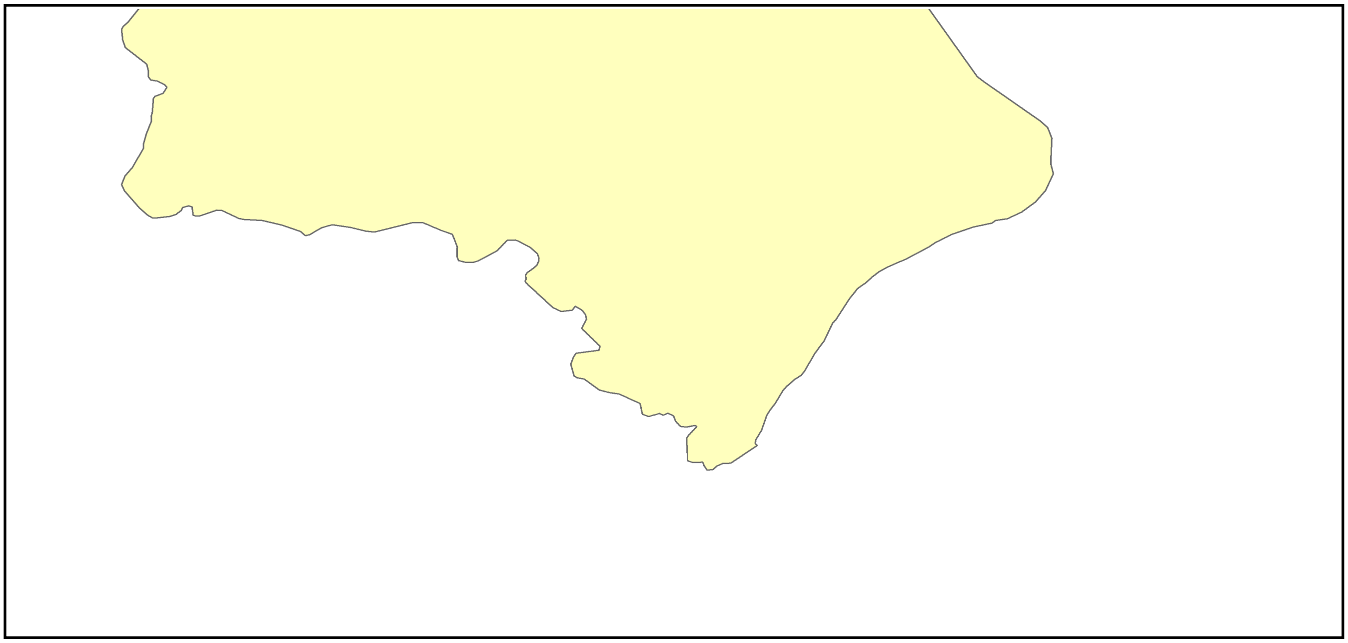
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	32	521.4156
	Segments	63	613.7627
	Tunnels	0	0.0000
		Subtotal	**1135.1783**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	5	16.4387
	Tunnels	0	0.0000
		Subtotal	**16.4387**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**1,151.60**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.0858
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.0858**
Waste Water	Distribution Lines	NA	3.6515
	Facilities	1	76.5900
	Pipelines	0	0.0000
		Subtotal	**80.2415**
Natural Gas	Distribution Lines	NA	2.4343
	Facilities	1	1.2535
	Pipelines	0	0.0000
		Subtotal	**3.6878**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**90.00**

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	EastHaddam
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)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 1,300 buildings will be at least moderately damaged. This is over 25.00 % of the buildings in the region. There are an estimated 178 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.

Damage Categories by General Occupancy Type

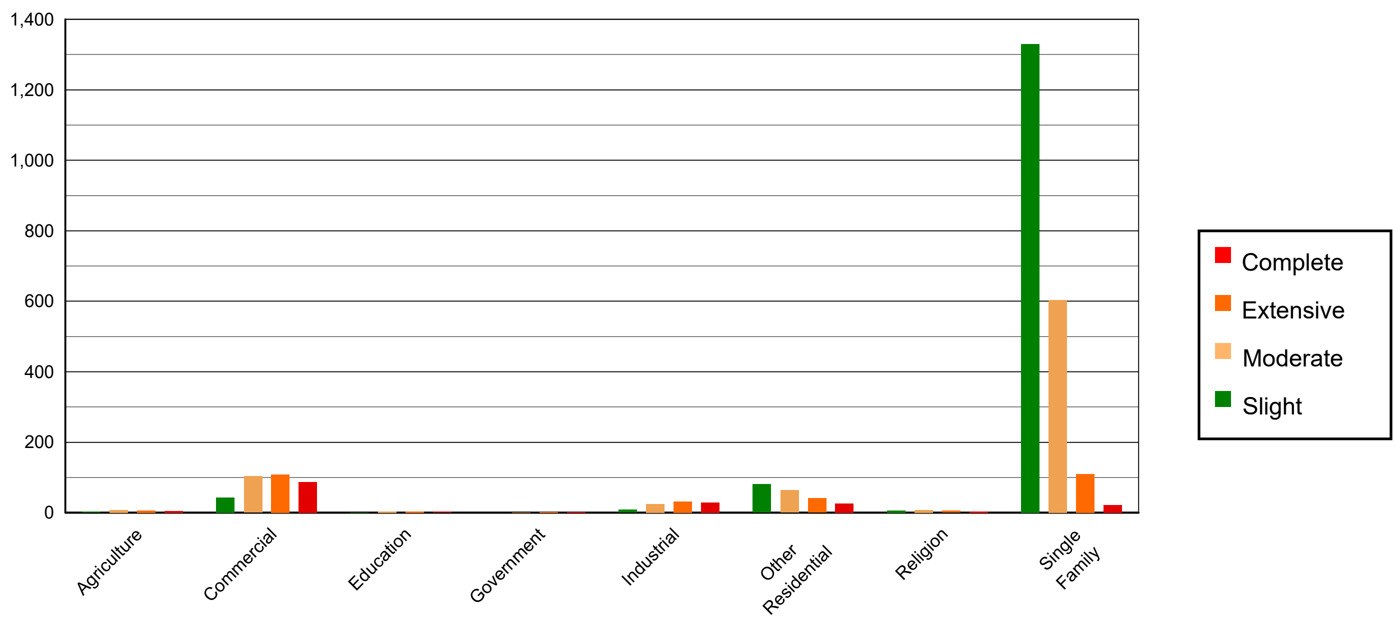


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	1.56	0.07	3.01	0.20	7.79	0.96	6.50	2.11	5.13	2.88
Commercial	30.60	1.28	42.33	2.87	103.10	12.67	107.87	35.02	87.11	48.93
Education	0.98	0.04	1.34	0.09	3.43	0.42	3.97	1.29	3.28	1.84
Government	0.29	0.01	0.41	0.03	1.18	0.15	1.61	0.52	1.51	0.85
Industrial	6.15	0.26	8.53	0.58	24.49	3.01	31.91	10.36	28.91	16.24
Other Residential	122.55	5.13	80.83	5.49	63.16	7.76	40.92	13.29	26.53	14.90
Religion	8.67	0.36	6.55	0.44	6.97	0.86	5.72	1.86	4.10	2.30
Single Family	2215.88	92.84	1330.28	90.29	603.90	74.19	109.48	35.55	21.46	12.05
Total	2,387		1,473		814		308		178	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2294.76	96.15	1374.13	93.27	622.58	76.48	102.46	33.27	14.31	8.04
Steel	8.41	0.35	13.26	0.90	56.51	6.94	92.19	29.93	89.86	50.47
Concrete	1.45	0.06	2.34	0.16	10.78	1.32	18.02	5.85	16.86	9.47
Precast	0.72	0.03	0.86	0.06	3.65	0.45	6.30	2.04	6.70	3.76
RM	6.83	0.29	5.33	0.36	18.00	2.21	25.07	8.14	16.82	9.45
URM	74.51	3.12	77.36	5.25	102.51	12.59	63.95	20.76	33.48	18.81
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**2,387**		**1,473**		**814**		**308**		**178**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had hospital beds available for use. On the day of the earthquake, the model estimates that only hospital beds (%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, % of the beds will be back in service. By 30 days, % 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	7	6	0	0
EOCs	1	1	0	0
PoliceStations	1	1	0	0
FireStations	3	2	0	0

Transportation Lifeline Damage

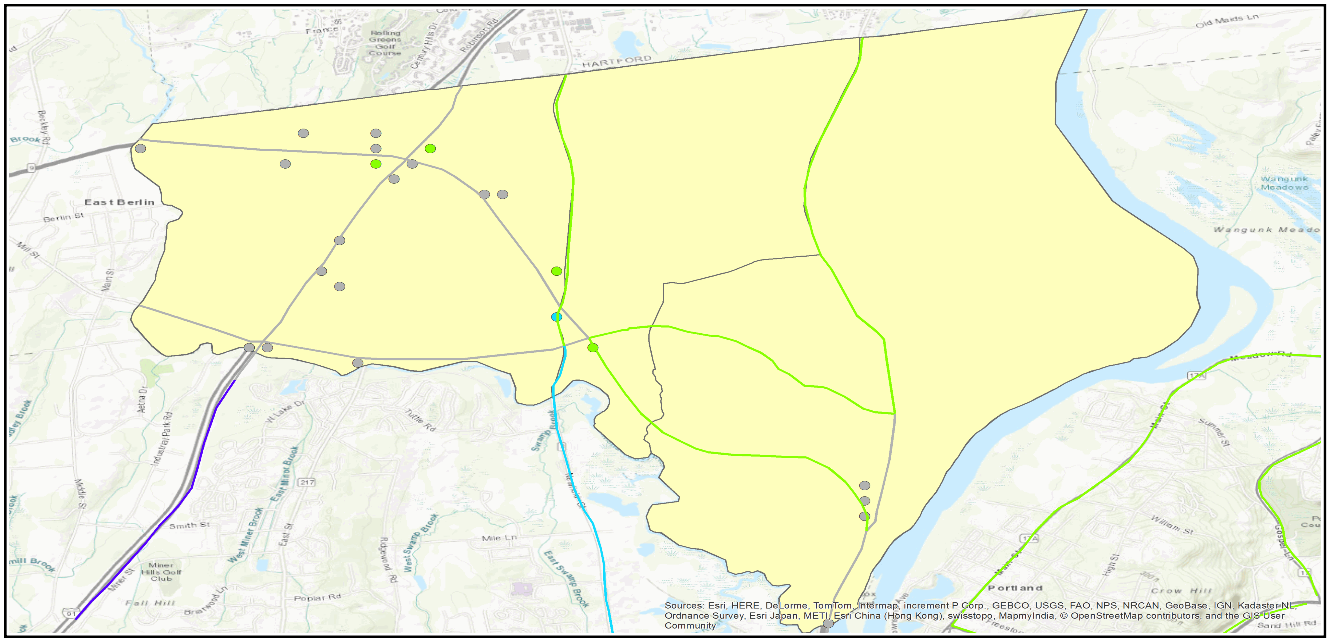


Table 6: Expected Damage to the Transportation Systems

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	63	0	0	63	63
	Bridges	32	15	2	17	24
	Tunnels	0	0	0	0	0
Railways	Segments	5	0	0	5	5
	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	0	0	0	0	0
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

Table 6 provides damage estimates for the transportation system.

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	0	0
Natural Gas	1	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	189	0	0
Waste Water	113	0	0
Natural Gas	76	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						
Electric Power						

Induced Earthquake Damage

Fire Following Earthquake

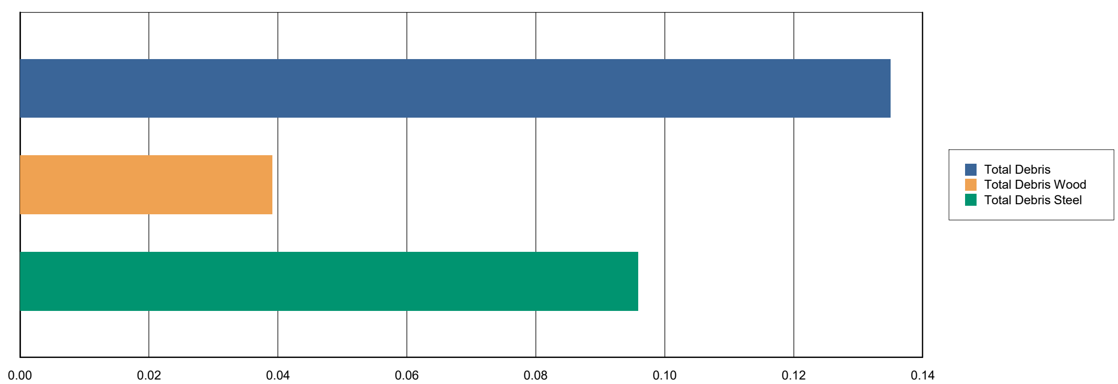
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there 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 135,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 29.00% 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 5,400 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



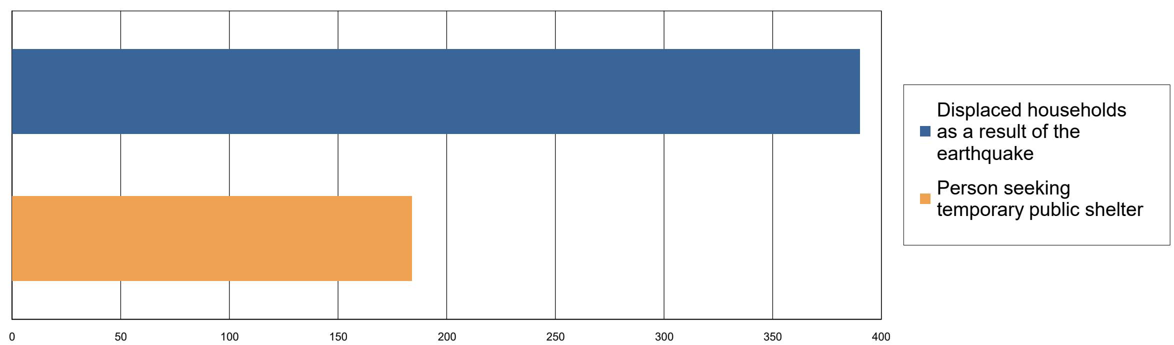
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.04	0.10	0.14	5,400 (@25 tons/truck)

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 390 households to be displaced due to the earthquake. Of these, 184 people (out of a total population of 14,005) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
390	184

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	2.95	0.84	0.13	0.25
	Commuting	0.03	0.03	0.06	0.01
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	3.60	1.05	0.16	0.32
	Other-Residential	38.65	11.50	1.93	3.82
	Single Family	15.09	2.81	0.32	0.62
	Total	**60**	**16**	**3**	**5**
2 PM	Commercial	163.96	46.90	7.07	13.82
	Commuting	0.26	0.31	0.57	0.11
	Educational	46.46	13.80	2.25	4.39
	Hotels	0.00	0.00	0.00	0.00
	Industrial	26.63	7.80	1.21	2.36
	Other-Residential	7.87	2.34	0.40	0.76
	Single Family	2.83	0.55	0.07	0.12
	Total	**248**	**72**	**12**	**22**
5 PM	Commercial	113.53	32.44	4.94	9.49
	Commuting	5.41	6.42	11.81	2.24
	Educational	4.15	1.24	0.20	0.40
	Hotels	0.00	0.00	0.00	0.00
	Industrial	16.64	4.87	0.76	1.48
	Other-Residential	15.18	4.50	0.76	1.46
	Single Family	5.95	1.15	0.14	0.26
	Total	**161**	**51**	**19**	**15**

Economic Loss

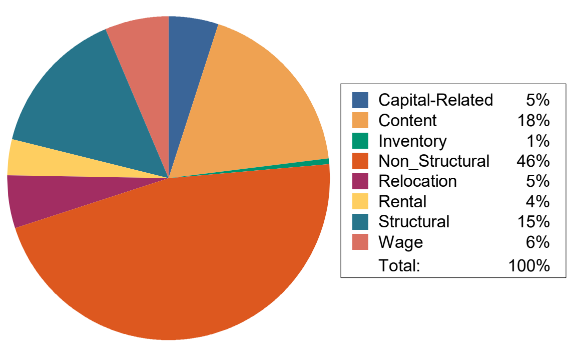
The total economic loss estimated for the earthquake is 637.23 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 531.21 (millions of dollars); 20 % 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 37 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

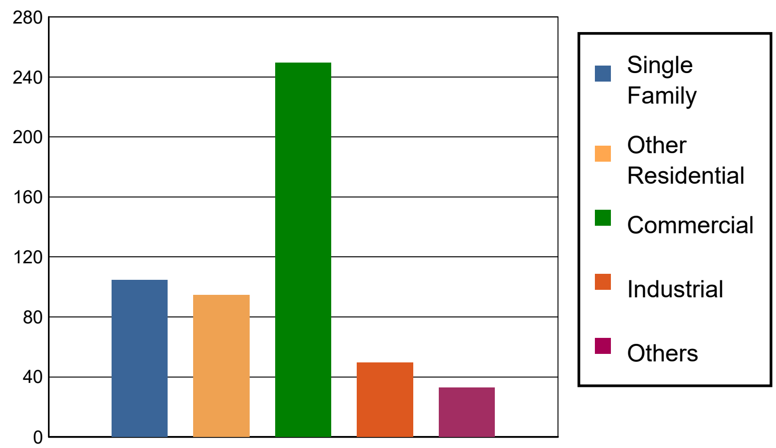


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	7.7809	24.1286	0.9155	0.9316	33.7566
	Capital-Related	0.0000	3.3034	21.7507	0.6311	0.2620	25.9472
	Rental	1.5874	7.0208	9.9380	0.3088	0.4686	19.3236
	Relocation	5.6751	2.4375	14.8058	1.4069	3.8414	28.1667
	Subtotal	**7.2625**	**20.5426**	**70.6231**	**3.2623**	**5.5036**	**107.1941**
Capital Stock Losses							
	Structural	13.1935	12.0441	40.7179	7.0107	5.6029	78.5691
	Non_Structural	61.8806	50.9308	94.6006	23.2300	14.9278	245.5698
	Content	22.1313	11.0196	41.8712	14.0816	6.7528	95.8565
	Inventory	0.0000	0.0000	1.7720	2.1459	0.0990	4.0169
	Subtotal	**97.2054**	**73.9945**	**178.9617**	**46.4682**	**27.3825**	**424.0123**
	Total	**104.47**	**94.54**	**249.58**	**49.73**	**32.89**	**531.21**

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.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	613.7627	0.0000	0.00
	Bridges	521.4156	106.0188	20.33
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**1135.1783**	**106.0188**	
Railways	Segments	16.4387	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**16.4387**	**0.0000**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**1,151.62**	**106.02**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	6.0858	0.0000	0.00
	Subtotal	**6.0858**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	76.5900	0.0000	0.00
	Distribution Lines	3.6515	0.0000	0.00
	Subtotal	**80.2415**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	1.2535	0.0000	0.00
	Distribution Lines	2.4343	0.0000	0.00
	Subtotal	**3.6878**	**0.0000**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**90.02**	**0.00**	

Appendix A: County Listing for the Region

Middlesex,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	Middlesex	14,005	1,856	586	2,442
Total Region		**14,005**	**1,856**	**586**	**2,442**

Hazus: Earthquake Global Risk Report

Region Name: Cromwell

Earthquake Scenario: Haddam

Print Date: October 16, 2019

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General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) 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 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 12.95 square miles and contains 3 census tracts. There are over 5 thousand households in the region which has a total population of 14,005 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,442 (millions of dollars). Approximately 89.00 % of the buildings (and 76.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,151 and 90 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 5 thousand buildings in the region which have an aggregate total replacement value of 2,442 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 85% 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 beds. There are 7 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 1 hazardous material sites, no military installations and no 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 1,241.00 (millions of dollars). This inventory includes over 54.68 miles of highways, 32 bridges, 377.79 miles of pipes.

Table 1: Transportation System Lifeline Inventory

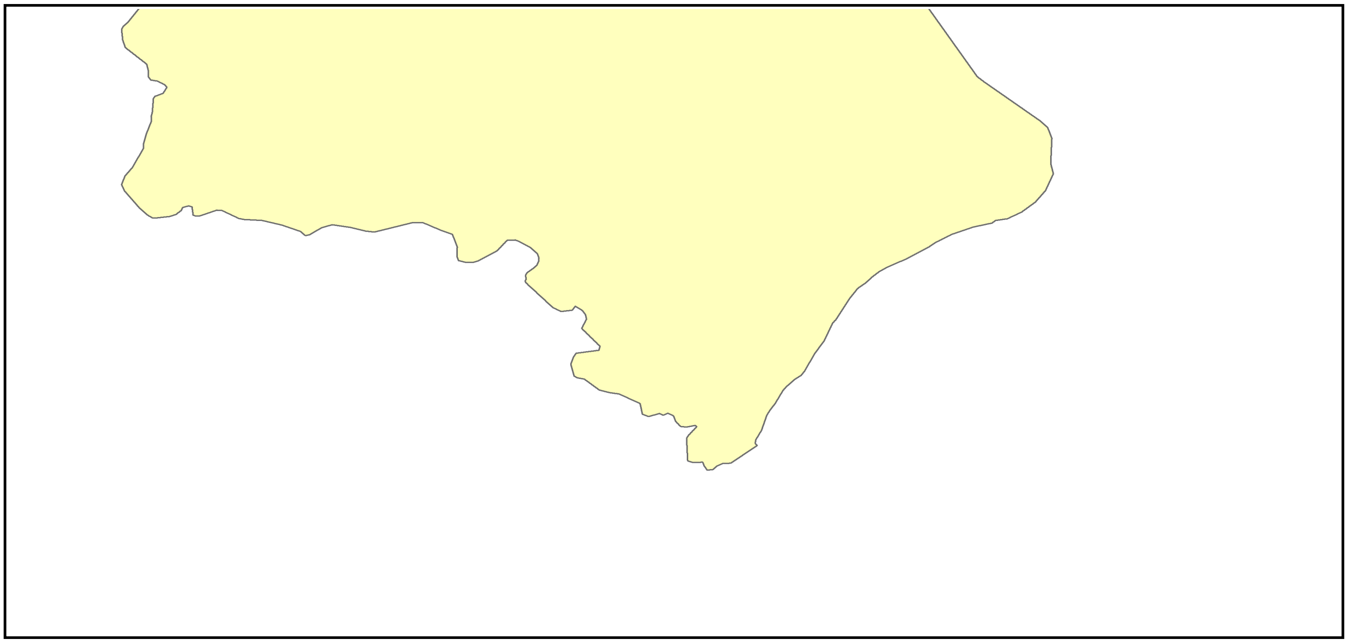
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	32	521.4156
	Segments	63	613.7627
	Tunnels	0	0.0000
		Subtotal	**1135.1783**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	5	16.4387
	Tunnels	0	0.0000
		Subtotal	**16.4387**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**1,151.60**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.0858
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.0858**
Waste Water	Distribution Lines	NA	3.6515
	Facilities	1	76.5900
	Pipelines	0	0.0000
		Subtotal	**80.2415**
Natural Gas	Distribution Lines	NA	2.4343
	Facilities	1	1.2535
	Pipelines	0	0.0000
		Subtotal	**3.6878**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**90.00**

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	-72.50
Latitude of Epicenter	41.50
Earthquake Magnitude	5.70
Depth (km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 969 buildings will be at least moderately damaged. This is over 19.00 % of the buildings in the region. There are an estimated 77 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.

Damage Categories by General Occupancy Type

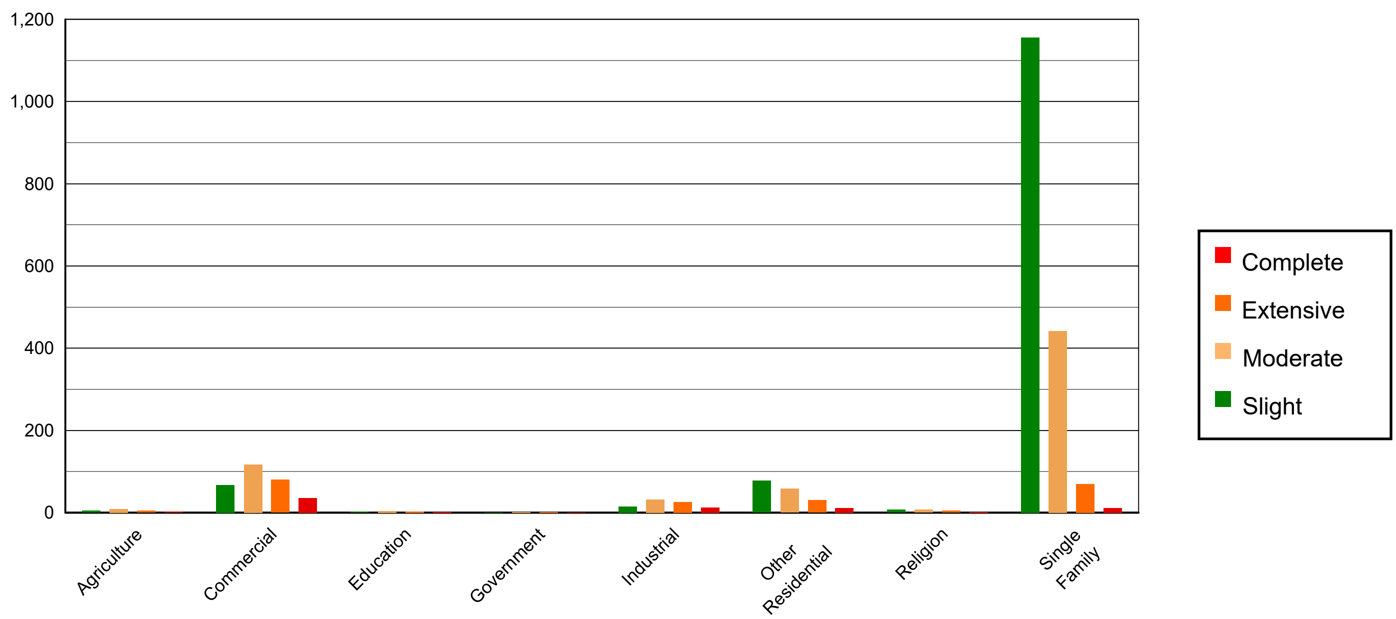


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	3.91	0.14	5.02	0.38	8.27	1.23	4.64	2.11	2.16	2.78
Commercial	69.95	2.45	67.50	5.07	117.70	17.52	80.06	36.34	35.79	46.12
Education	2.16	0.08	2.15	0.16	4.16	0.62	3.10	1.41	1.44	1.86
Government	0.68	0.02	0.71	0.05	1.57	0.23	1.35	0.61	0.68	0.88
Industrial	15.13	0.53	14.98	1.13	31.63	4.71	25.73	11.68	12.52	16.13
Other Residential	155.13	5.43	77.82	5.85	58.71	8.74	30.81	13.99	11.52	14.85
Religion	11.78	0.41	6.89	0.52	7.02	1.05	4.47	2.03	1.83	2.35
Single Family	2600.49	90.95	1156.18	86.85	442.54	65.89	70.13	31.83	11.65	15.02
Total	**2,859**		**1,331**		**672**		**220**		**78**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2691.36	94.13	1199.18	90.08	453.70	67.55	58.61	26.60	5.38	6.94
Steel	29.95	1.05	31.66	2.38	84.30	12.55	75.56	34.30	38.76	49.95
Concrete	5.11	0.18	5.56	0.42	16.45	2.45	15.22	6.91	7.10	9.16
Precast	2.55	0.09	1.88	0.14	5.16	0.77	5.89	2.67	2.74	3.54
RM	18.35	0.64	9.23	0.69	20.68	3.08	18.67	8.48	5.12	6.60
URM	111.93	3.91	83.73	6.29	91.31	13.60	46.35	21.04	18.49	23.83
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**2,859**		**1,331**		**672**		**220**		**78**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had hospital beds available for use. On the day of the earthquake, the model estimates that only hospital beds (%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, % of the beds will be back in service. By 30 days, % 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	7	2	0	0
EOCs	1	1	0	0
PoliceStations	1	1	0	0
FireStations	3	1	0	0

Transportation Lifeline Damage

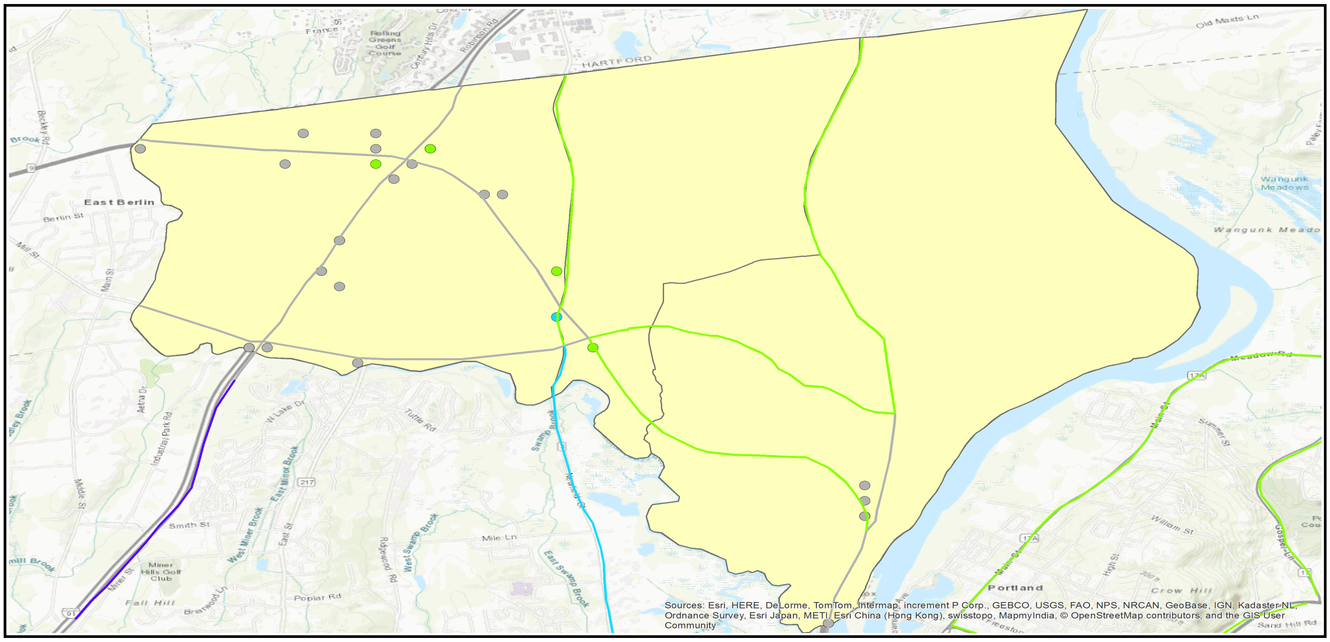


Table 6: Expected Damage to the Transportation Systems

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	63	0	0	63	63
	Bridges	32	7	0	26	30
	Tunnels	0	0	0	0	0
Railways	Segments	5	0	0	5	5
	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	0	0	0	0	0
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

Table 6 provides damage estimates for the transportation system.

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	0	0
Natural Gas	1	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	189	0	0
Waste Water	113	0	0
Natural Gas	76	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						
Electric Power						

Induced Earthquake Damage

Fire Following Earthquake

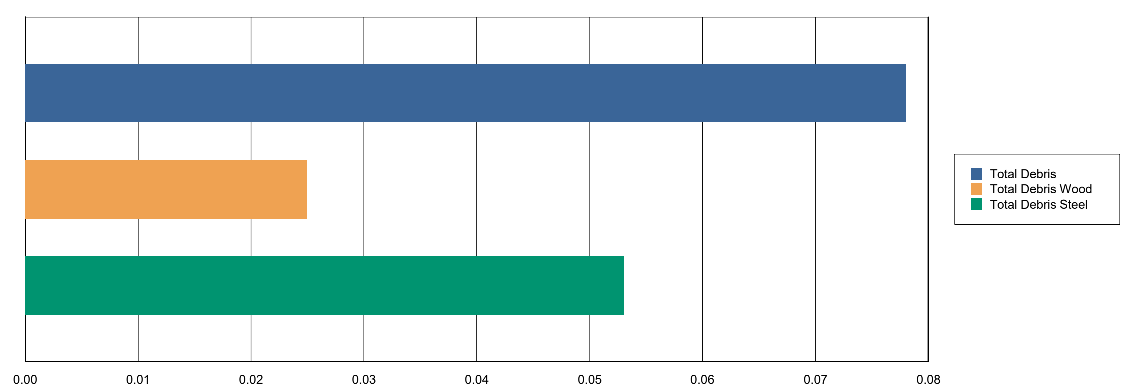
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there 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 78,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 32.00% 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 3,120 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



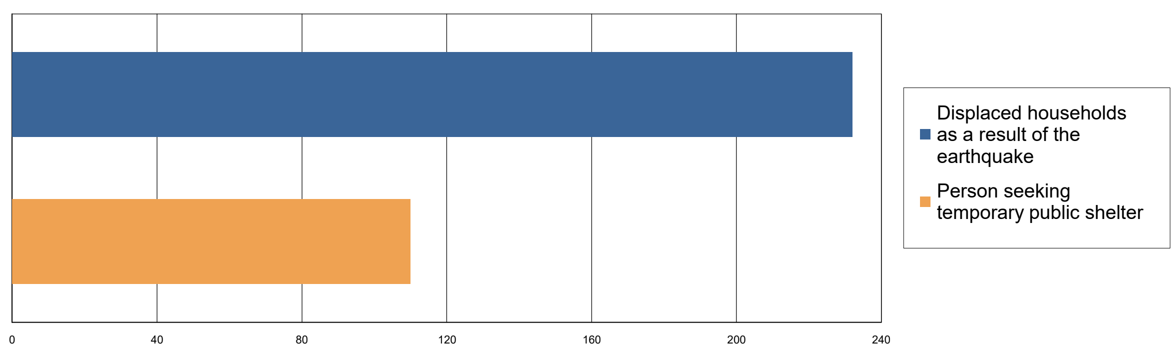
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.02	0.05	0.08	3,120 (@25 tons/truck)

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 232 households to be displaced due to the earthquake. Of these, 110 people (out of a total population of 14,005) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
232	110

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	1.44	0.37	0.05	0.10
	Commuting	0.02	0.02	0.04	0.01
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	1.73	0.46	0.07	0.13
	Other-Residential	19.79	5.30	0.84	1.65
	Single Family	9.85	1.66	0.17	0.34
	Total	**33**	**8**	**1**	**2**
2 PM	Commercial	80.27	20.90	2.97	5.79
	Commuting	0.16	0.18	0.34	0.06
	Educational	22.59	6.13	0.95	1.85
	Hotels	0.00	0.00	0.00	0.00
	Industrial	12.75	3.39	0.50	0.97
	Other-Residential	4.13	1.12	0.18	0.34
	Single Family	1.86	0.33	0.04	0.07
	Total	**122**	**32**	**5**	**9**
5 PM	Commercial	55.49	14.46	2.08	3.98
	Commuting	3.16	3.72	6.88	1.30
	Educational	2.08	0.57	0.09	0.17
	Hotels	0.00	0.00	0.00	0.00
	Industrial	7.97	2.12	0.31	0.60
	Other-Residential	7.78	2.09	0.33	0.64
	Single Family	3.86	0.68	0.08	0.14
	Total	**80**	**24**	**10**	**7**

Economic Loss

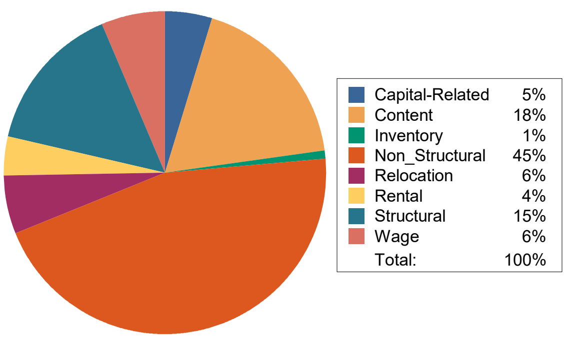
The total economic loss estimated for the earthquake is 382.85 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 321.36 (millions of dollars); 21 % 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 42 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

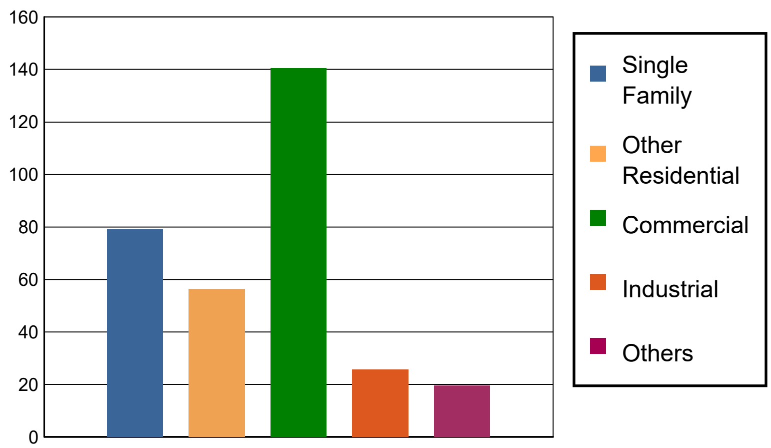


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	4.6510	14.6220	0.5589	0.6126	20.4445
	Capital-Related	0.0000	1.9740	13.0468	0.3806	0.1675	15.5689
	Rental	1.0969	4.3780	6.3941	0.1963	0.3144	12.3797
	Relocation	3.9059	1.6402	9.7734	0.9582	2.5625	18.8402
	Subtotal	**5.0028**	**12.6432**	**43.8363**	**2.0940**	**3.6570**	**67.2333**
Capital Stock Losses							
	Structural	9.2448	7.4195	24.3646	4.0633	3.4604	48.5526
	Non_Structural	46.6225	29.4792	49.4030	11.4819	8.5858	145.5724
	Content	18.2267	6.7886	21.9531	6.9929	3.9407	57.9020
	Inventory	0.0000	0.0000	0.9512	1.0929	0.0532	2.0973
	Subtotal	**74.0940**	**43.6873**	**96.6719**	**23.6310**	**16.0401**	**254.1243**
	Total	**79.10**	**56.33**	**140.51**	**25.73**	**19.70**	**321.36**

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.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	613.7627	0.0000	0.00
	Bridges	521.4156	61.4891	11.79
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**1135.1783**	**61.4891**	
Railways	Segments	16.4387	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**16.4387**	**0.0000**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**1,151.62**	**61.49**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	6.0858	0.0000	0.00
	Subtotal	**6.0858**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	76.5900	0.0000	0.00
	Distribution Lines	3.6515	0.0000	0.00
	Subtotal	**80.2415**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	1.2535	0.0000	0.00
	Distribution Lines	2.4343	0.0000	0.00
	Subtotal	**3.6878**	**0.0000**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**90.02**	**0.00**	

Appendix A: County Listing for the Region

Middlesex,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	Middlesex	14,005	1,856	586	2,442
Total Region		**14,005**	**1,856**	**586**	**2,442**

Hazus: Earthquake Global Risk Report

Region Name: Cromwell

Earthquake Scenario: Portland

Print Date: October 16, 2019

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
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 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-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) 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 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 12.95 square miles and contains 3 census tracts. There are over 5 thousand households in the region which has a total population of 14,005 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,442 (millions of dollars). Approximately 89.00 % of the buildings (and 76.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,151 and 90 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 5 thousand buildings in the region which have an aggregate total replacement value of 2,442 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 85% 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 beds. There are 7 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 1 hazardous material sites, no military installations and no 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 1,241.00 (millions of dollars). This inventory includes over 54.68 miles of highways, 32 bridges, 377.79 miles of pipes.

Table 1: Transportation System Lifeline Inventory

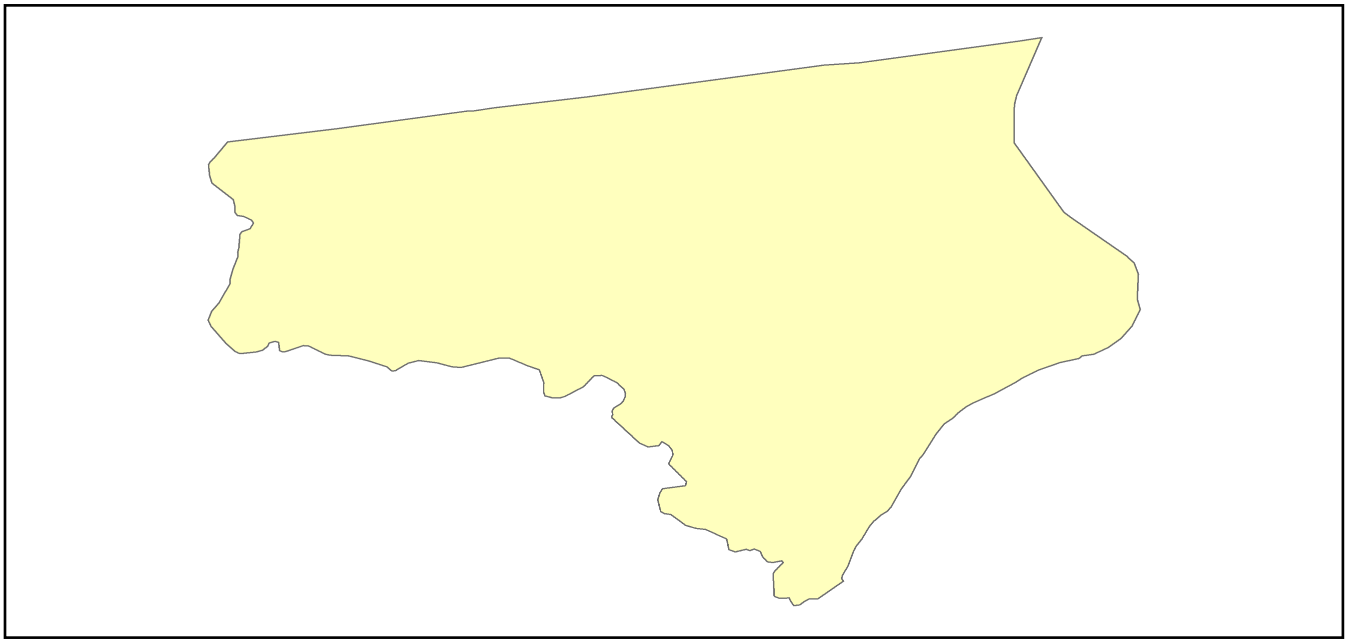
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	32	521.4156
	Segments	63	613.7627
	Tunnels	0	0.0000
		Subtotal	**1135.1783**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	5	16.4387
	Tunnels	0	0.0000
		Subtotal	**16.4387**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**1,151.60**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.0858
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.0858**
Waste Water	Distribution Lines	NA	3.6515
	Facilities	1	76.5900
	Pipelines	0	0.0000
		Subtotal	**80.2415**
Natural Gas	Distribution Lines	NA	2.4343
	Facilities	1	1.2535
	Pipelines	0	0.0000
		Subtotal	**3.6878**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**90.00**

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)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 2,380 buildings will be at least moderately damaged. This is over 46.00 % of the buildings in the region. There are an estimated 459 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.

Damage Categories by General Occupancy Type

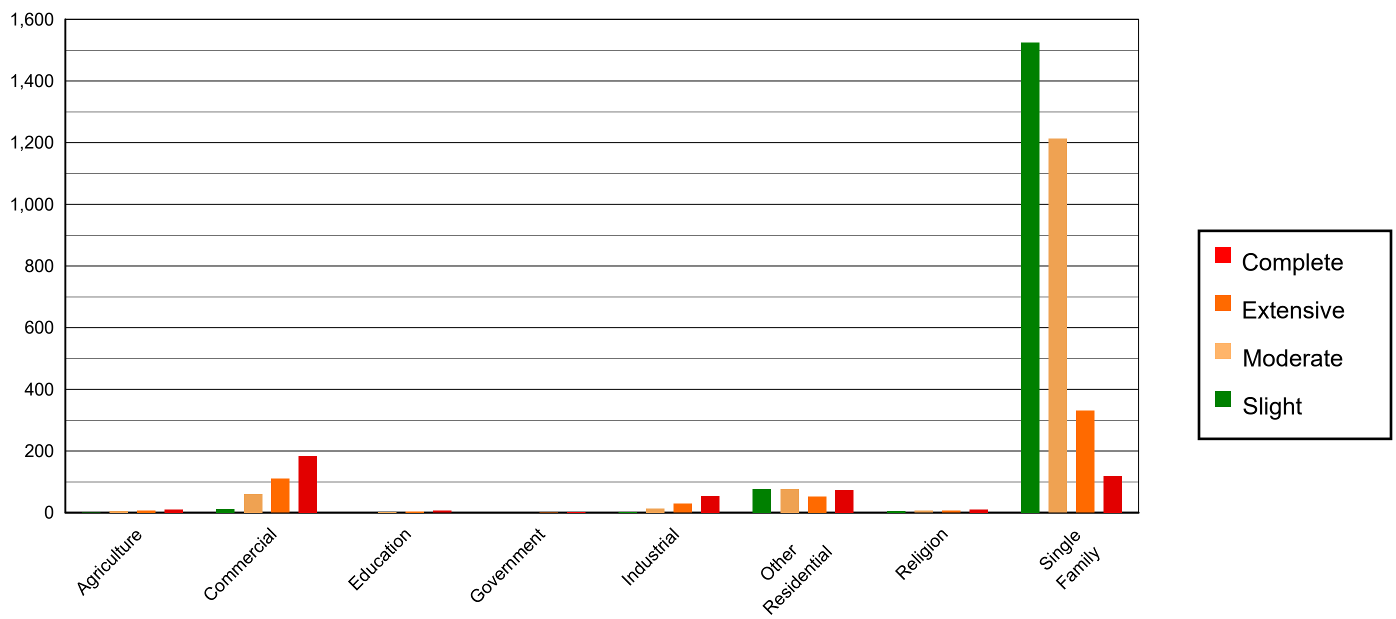


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0.29	0.02	1.07	0.07	5.18	0.38	7.24	1.34	10.22	2.22
Commercial	4.29	0.37	12.91	0.80	61.06	4.43	109.50	20.20	183.23	39.84
Education	0.15	0.01	0.41	0.03	1.99	0.14	3.92	0.72	6.53	1.42
Government	0.05	0.00	0.13	0.01	0.66	0.05	1.47	0.27	2.70	0.59
Industrial	0.97	0.08	2.59	0.16	13.35	0.97	29.36	5.42	53.73	11.68
Other Residential	53.42	4.62	76.65	4.72	77.22	5.60	53.40	9.85	73.31	15.94
Religion	3.30	0.29	5.00	0.31	6.39	0.46	6.51	1.20	10.81	2.35
Single Family	1093.20	94.60	1524.85	93.92	1213.04	87.97	330.56	60.99	119.36	25.95
Total	**1,156**		**1,624**		**1,379**		**542**		**460**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1146.18	99.18	1597.20	98.37	1272.30	92.27	332.00	61.26	60.56	13.17
Steel	1.87	0.16	3.87	0.24	25.90	1.88	77.51	14.30	151.08	32.85
Concrete	0.34	0.03	0.74	0.05	5.10	0.37	14.60	2.69	28.68	6.24
Precast	0.15	0.01	0.26	0.02	1.80	0.13	4.39	0.81	11.62	2.53
RM	1.49	0.13	1.92	0.12	10.79	0.78	22.23	4.10	35.62	7.75
URM	5.63	0.49	19.62	1.21	63.01	4.57	91.23	16.83	172.33	37.47
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**1,156**		**1,624**		**1,379**		**542**		**460**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had hospital beds available for use. On the day of the earthquake, the model estimates that only hospital beds (%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, % of the beds will be back in service. By 30 days, % 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	7	7	6	0
EOCs	1	1	1	0
PoliceStations	1	1	1	0
FireStations	3	3	2	0

Transportation Lifeline Damage

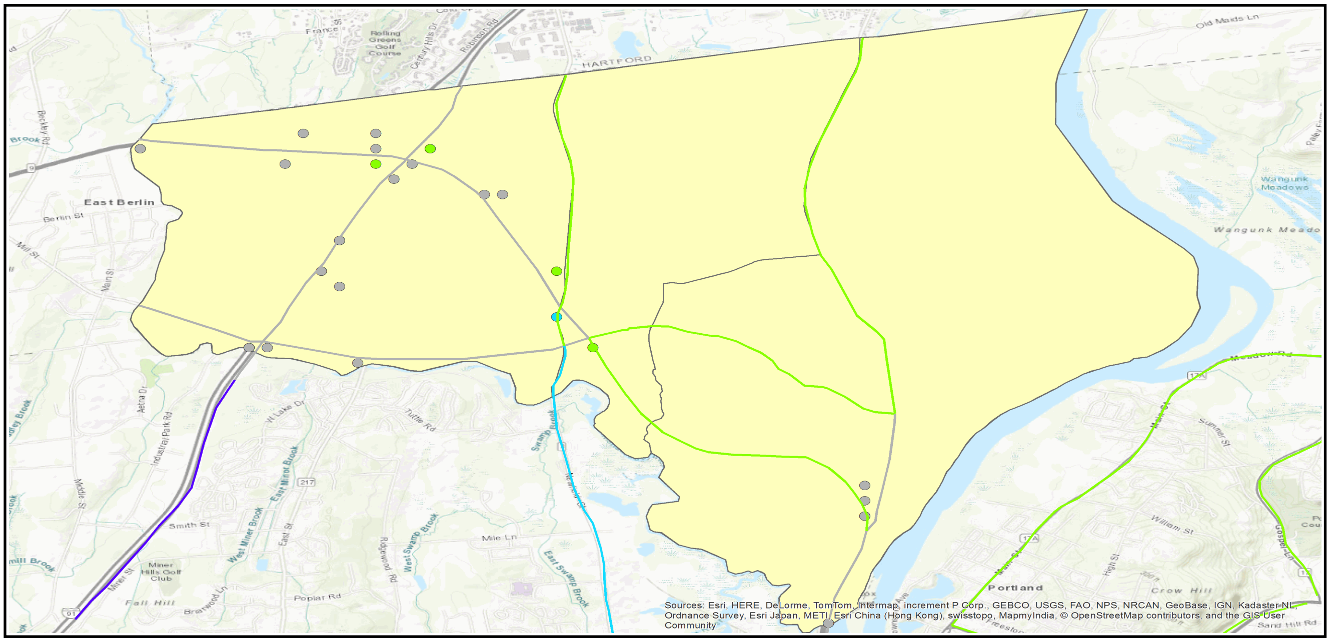


Table 6: Expected Damage to the Transportation Systems

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	63	0	0	63	63
	Bridges	32	18	6	14	14
	Tunnels	0	0	0	0	0
Railways	Segments	5	0	0	5	5
	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	0	0	0	0	0
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

Table 6 provides damage estimates for the transportation system.

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	0	0
Natural Gas	1	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	189	0	0
Waste Water	113	0	0
Natural Gas	76	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						
Electric Power						

Induced Earthquake Damage

Fire Following Earthquake

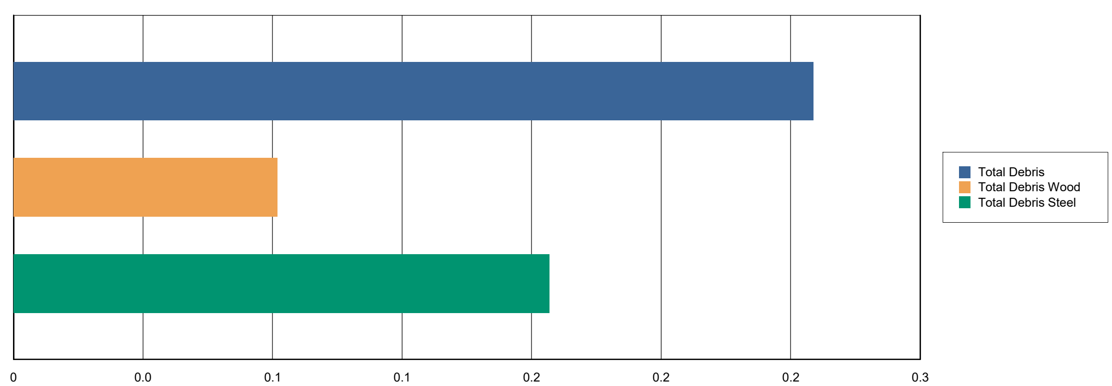
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there 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 247,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 33.00% 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 9,880 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



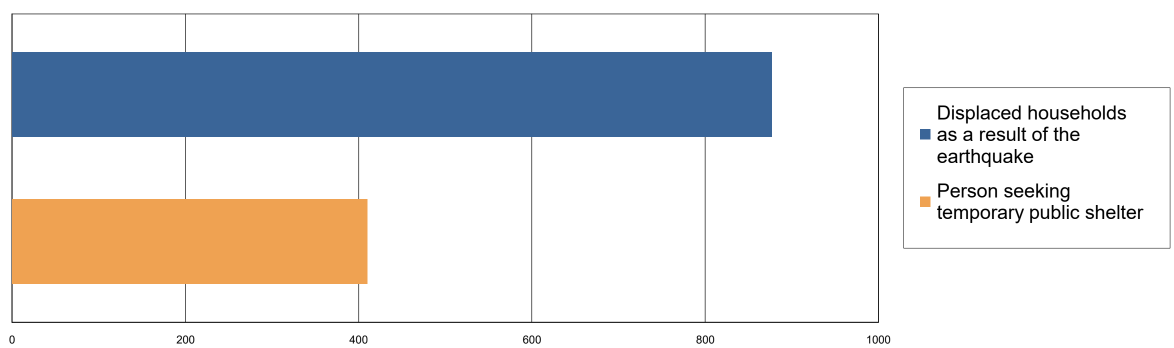
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.08	0.17	0.25	9,880 (@25 tons/truck)

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 877 households to be displaced due to the earthquake. Of these, 410 people (out of a total population of 14,005) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
877	410

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	6.07	1.85	0.29	0.57
	Commuting	0.05	0.05	0.10	0.02
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	6.81	2.12	0.34	0.67
	Other-Residential	99.34	31.33	5.26	10.41
	Single Family	52.30	12.53	1.63	3.19
	Total	**165**	**48**	**8**	**15**
2 PM	Commercial	336.18	102.79	16.14	31.60
	Commuting	0.41	0.49	0.89	0.17
	Educational	95.45	30.05	5.00	9.76
	Hotels	0.00	0.00	0.00	0.00
	Industrial	50.47	15.68	2.52	4.91
	Other-Residential	19.74	6.28	1.08	2.05
	Single Family	9.75	2.41	0.33	0.61
	Total	**512**	**158**	**26**	**49**
5 PM	Commercial	233.74	71.56	11.35	21.85
	Commuting	8.49	10.22	18.59	3.53
	Educational	8.34	2.63	0.44	0.86
	Hotels	0.00	0.00	0.00	0.00
	Industrial	31.54	9.80	1.58	3.07
	Other-Residential	39.49	12.53	2.14	4.08
	Single Family	20.92	5.17	0.71	1.32
	Total	**343**	**112**	**35**	**35**

Economic Loss

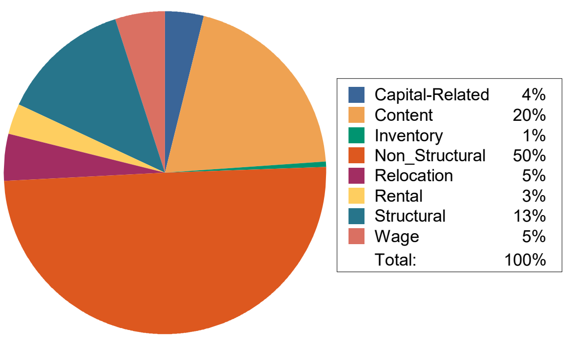
The total economic loss estimated for the earthquake is 1,229.98 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 1,062.41 (millions of dollars); 16 % 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 45 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

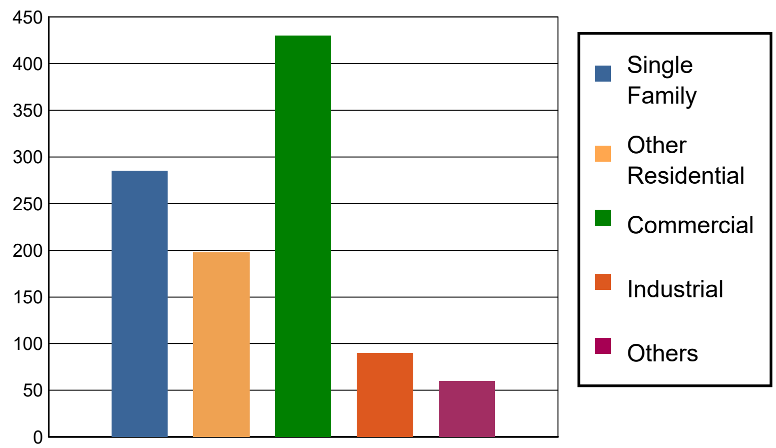


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	12.6820	37.2619	1.3462	1.3968	52.6869
	Capital-Related	0.0000	5.3853	33.7162	0.9352	0.4217	40.4584
	Rental	4.2386	12.6729	14.5989	0.4362	0.7236	32.6702
	Relocation	15.0430	4.6715	21.2246	1.8785	6.1067	48.9243
	Subtotal	**19.2816**	**35.4117**	**106.8016**	**4.5961**	**8.6488**	**174.7398**
Capital Stock Losses							
	Structural	35.1234	22.1444	63.0597	10.6825	9.2097	140.2197
	Non_Structural	167.9849	113.4594	173.8104	43.2903	28.2839	526.8289
	Content	62.4413	26.6518	82.9542	27.2039	13.8664	213.1176
	Inventory	0.0000	0.0000	3.2865	4.0268	0.1951	7.5084
	Subtotal	**265.5496**	**162.2556**	**323.1108**	**85.2035**	**51.5551**	**887.6746**
	Total	**284.83**	**197.67**	**429.91**	**89.80**	**60.20**	**1062.41**

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.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	613.7627	0.0000	0.00
	Bridges	521.4156	167.5618	32.14
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**1135.1783**	**167.5618**	
Railways	Segments	16.4387	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**16.4387**	**0.0000**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**1,151.62**	**167.56**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	6.0858	0.0000	0.00
	Subtotal	**6.0858**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	76.5900	0.0000	0.00
	Distribution Lines	3.6515	0.0000	0.00
	Subtotal	**80.2415**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	1.2535	0.0000	0.00
	Distribution Lines	2.4343	0.0000	0.00
	Subtotal	**3.6878**	**0.0000**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**90.02**	**0.00**	

Appendix A: County Listing for the Region

Middlesex,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	Middlesex	14,005	1,856	586	2,442
Total Region		**14,005**	**1,856**	**586**	**2,442**

Hazus: Earthquake Global Risk Report

Region Name: Cromwell

Earthquake Scenario: Stamford

Print Date: October 16, 2019

Disclaimer:

This version of Hazus utilizes 2010 Census Data.

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 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-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) 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 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 12.95 square miles and contains 3 census tracts. There are over 5 thousand households in the region which has a total population of 14,005 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,442 (millions of dollars). Approximately 89.00 % of the buildings (and 76.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,151 and 90 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 5 thousand buildings in the region which have an aggregate total replacement value of 2,442 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 85% 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 beds. There are 7 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 1 hazardous material sites, no military installations and no 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 1,241.00 (millions of dollars). This inventory includes over 54.68 miles of highways, 32 bridges, 377.79 miles of pipes.

Table 1: Transportation System Lifeline Inventory

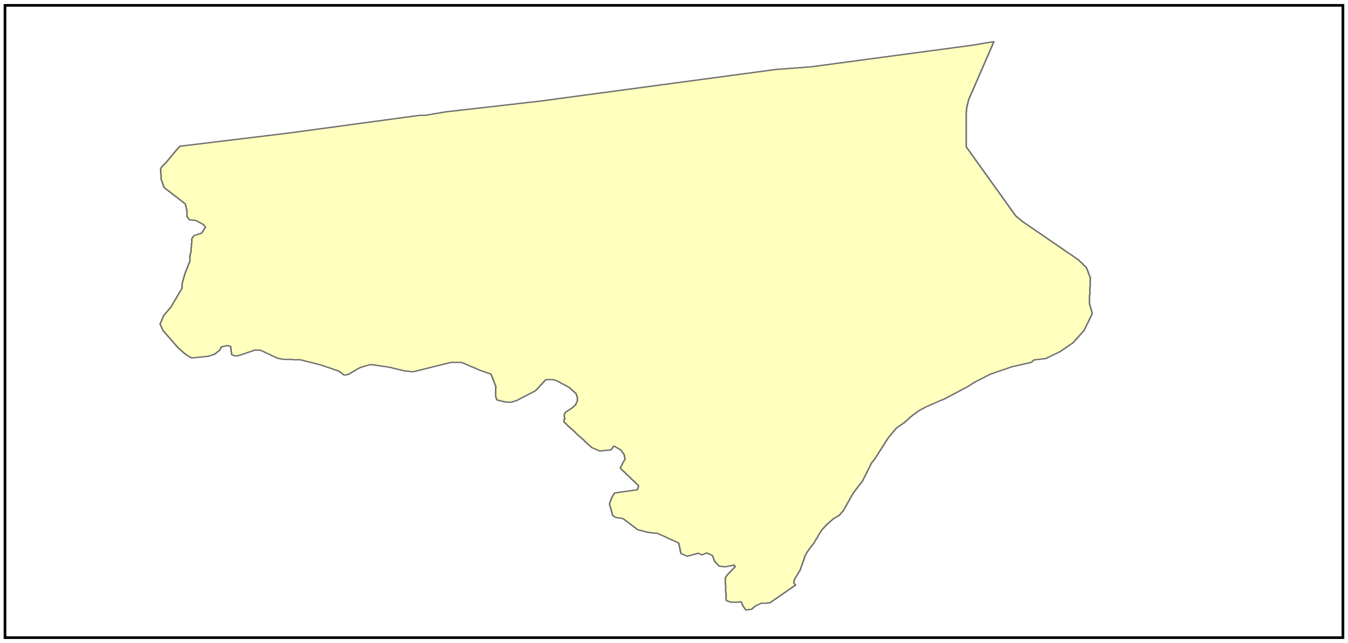
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	32	521.4156
	Segments	63	613.7627
	Tunnels	0	0.0000
		Subtotal	**1135.1783**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	5	16.4387
	Tunnels	0	0.0000
		Subtotal	**16.4387**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**1,151.60**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.0858
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.0858**
Waste Water	Distribution Lines	NA	3.6515
	Facilities	1	76.5900
	Pipelines	0	0.0000
		Subtotal	**80.2415**
Natural Gas	Distribution Lines	NA	2.4343
	Facilities	1	1.2535
	Pipelines	0	0.0000
		Subtotal	**3.6878**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**90.00**

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	-73.56
Latitude of Epicenter	41.11
Earthquake Magnitude	5.70
Depth (km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 24 buildings will be at least moderately damaged. This is over 0.00 % 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.

Damage Categories by General Occupancy Type

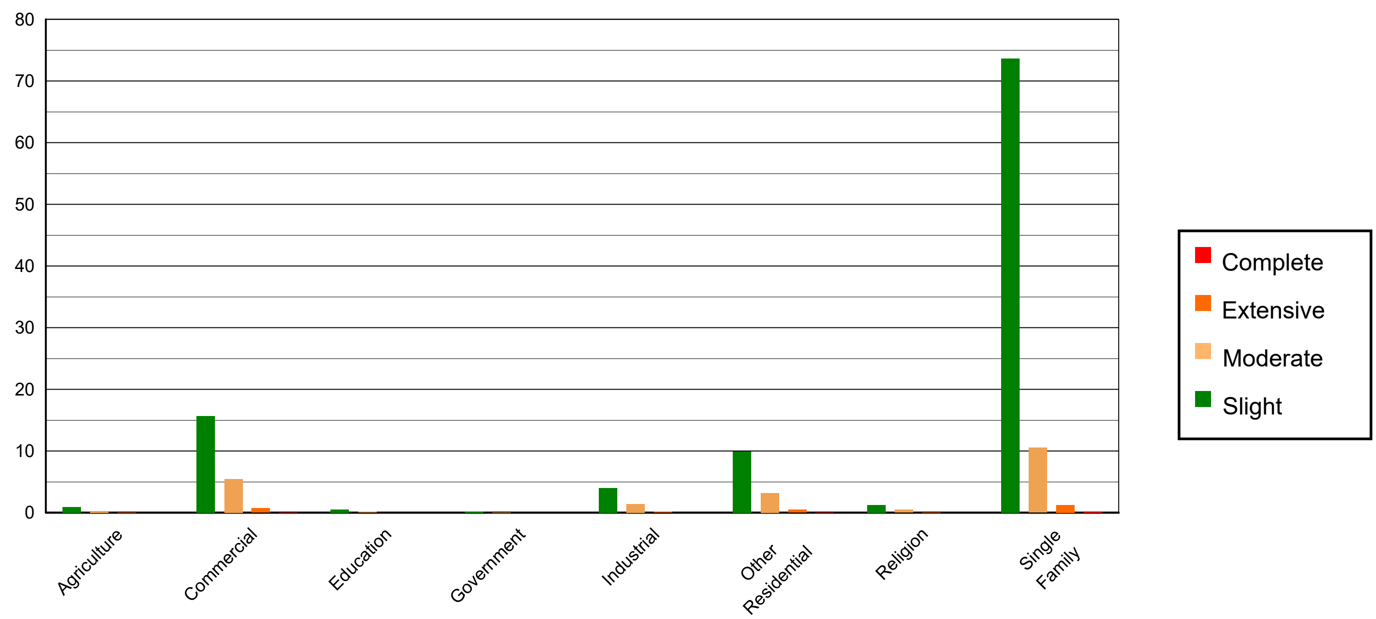


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	22.71	0.45	0.97	0.91	0.28	1.30	0.04	1.37	0.00	0.91
Commercial	349.11	6.94	15.69	14.77	5.44	25.26	0.72	26.58	0.05	24.20
Education	12.29	0.24	0.51	0.48	0.17	0.80	0.02	0.79	0.00	0.90
Government	4.73	0.09	0.20	0.19	0.07	0.32	0.01	0.30	0.00	0.26
Industrial	94.44	1.88	3.98	3.75	1.40	6.48	0.17	6.25	0.01	4.91
Other Residential	320.39	6.37	9.93	9.35	3.20	14.83	0.45	16.67	0.04	19.44
Religion	30.21	0.60	1.24	1.17	0.47	2.18	0.07	2.59	0.01	3.16
Single Family	4195.50	83.42	73.66	69.37	10.53	48.84	1.23	45.46	0.09	46.22
Total	**5,029**		**106**		**22**		**3**		**0**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	4333.67	86.17	68.12	64.15	6.02	27.91	0.43	15.96	0.00	0.00
Steel	247.39	4.92	9.44	8.89	3.10	14.41	0.30	10.92	0.01	3.25
Concrete	47.22	0.94	1.70	1.60	0.50	2.34	0.03	0.95	0.00	0.00
Precast	16.68	0.33	0.88	0.83	0.56	2.60	0.10	3.74	0.00	0.70
RM	68.59	1.36	2.19	2.07	1.12	5.20	0.15	5.63	0.00	0.00
URM	315.84	6.28	23.85	22.46	10.25	47.54	1.70	62.79	0.18	96.05
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**5,029**		**106**		**22**		**3**		**0**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had hospital beds available for use. On the day of the earthquake, the model estimates that only hospital beds (%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, % of the beds will be back in service. By 30 days, % 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	7	0	0	7
EOCs	1	0	0	1
PoliceStations	1	0	0	1
FireStations	3	0	0	3

Transportation Lifeline Damage

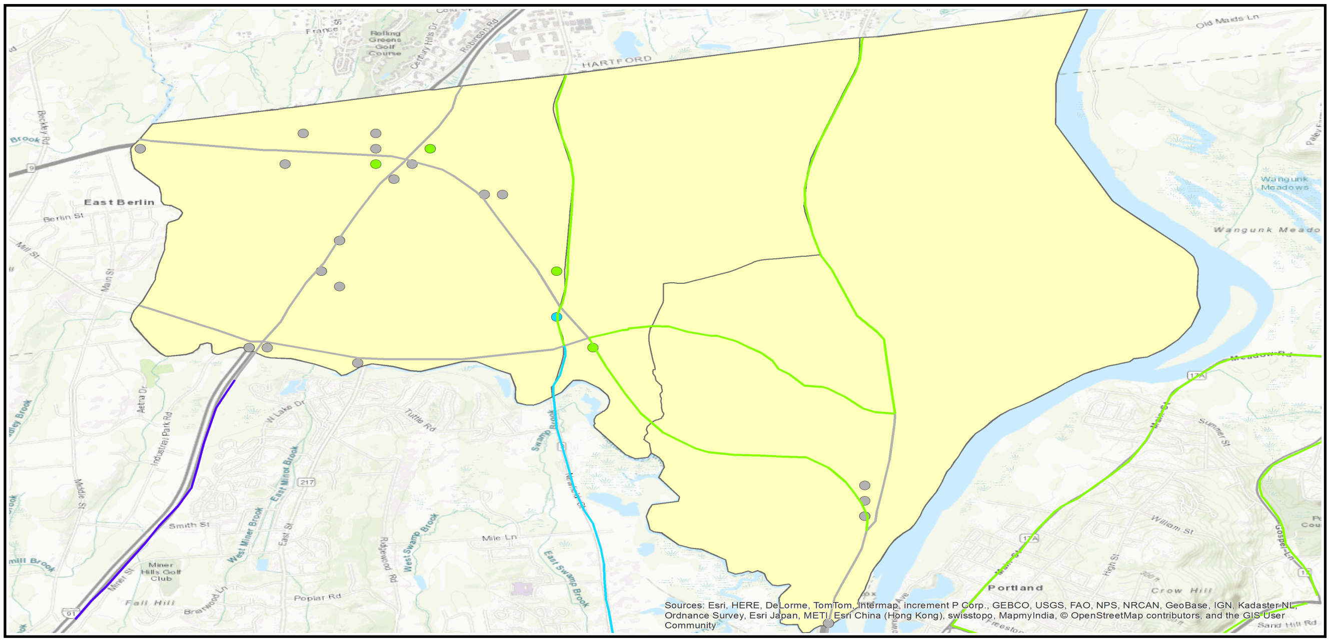


Table 6: Expected Damage to the Transportation Systems

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	63	0	0	63	63
	Bridges	32	0	0	32	32
	Tunnels	0	0	0	0	0
Railways	Segments	5	0	0	5	5
	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	0	0	0	0	0
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

Table 6 provides damage estimates for the transportation system.

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	0	0
Natural Gas	1	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	189	0	0
Waste Water	113	0	0
Natural Gas	76	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						
Electric Power						

Induced Earthquake Damage

Fire Following Earthquake

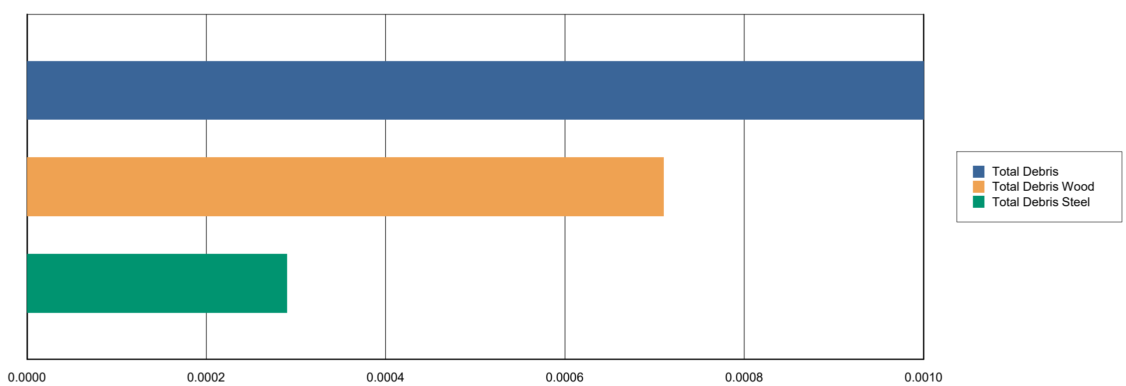
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there 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 1,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 71.00% 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 40 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



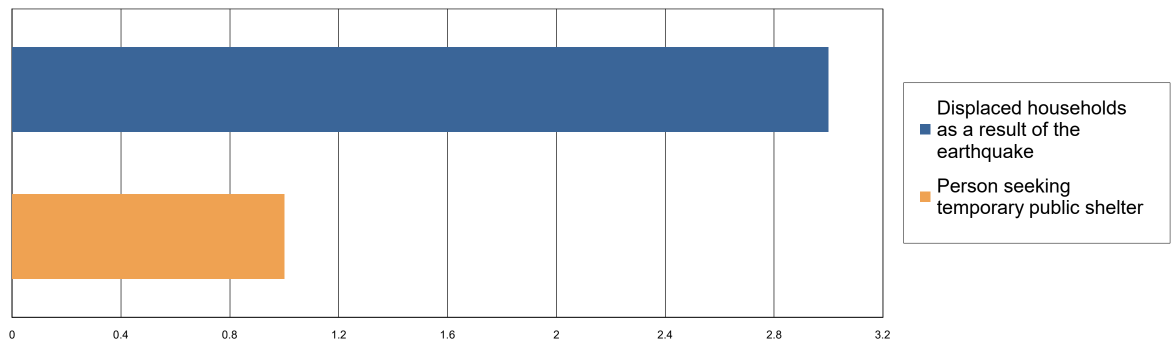
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.00	0.00	0.00	40 (@25 tons/truck)

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 3 households to be displaced due to the earthquake. Of these, 1 people (out of a total population of 14,005) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
3	1

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	0.01	0.00	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.01	0.00	0.00	0.00
	Other-Residential	0.29	0.04	0.00	0.01
	Single Family	0.24	0.02	0.00	0.00
	Total	**1**	**0**	**0**	**0**
2 PM	Commercial	0.71	0.09	0.01	0.01
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.19	0.02	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.09	0.01	0.00	0.00
	Other-Residential	0.06	0.01	0.00	0.00
	Single Family	0.04	0.00	0.00	0.00
	Total	**1**	**0**	**0**	**0**
5 PM	Commercial	0.49	0.06	0.00	0.01
	Commuting	0.01	0.01	0.01	0.00
	Educational	0.02	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.06	0.01	0.00	0.00
	Other-Residential	0.11	0.02	0.00	0.00
	Single Family	0.09	0.01	0.00	0.00
	Total	**1**	**0**	**0**	**0**

Economic Loss

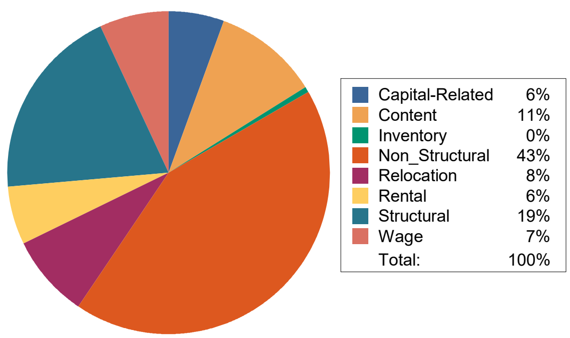
The total economic loss estimated for the earthquake is 4.78 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 4.28 (millions of dollars); 27 % 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 51 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

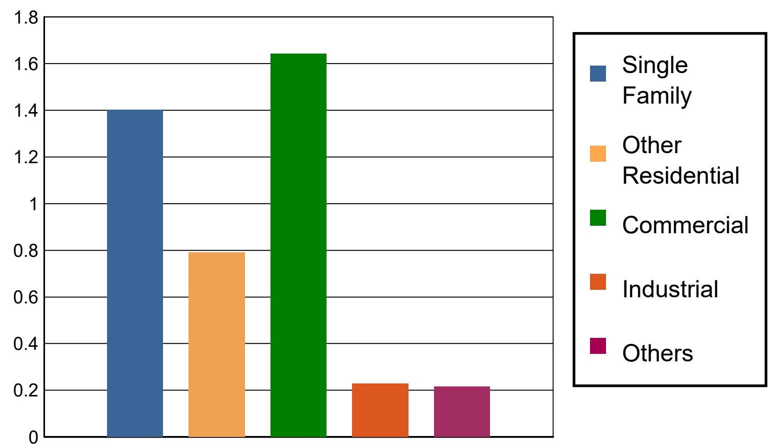


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.0478	0.2374	0.0066	0.0113	0.3031
	Capital-Related	0.0000	0.0203	0.2088	0.0045	0.0031	0.2367
	Rental	0.0252	0.0923	0.1267	0.0032	0.0044	0.2518
	Relocation	0.0812	0.0461	0.1703	0.0165	0.0397	0.3538
	Subtotal	**0.1064**	**0.2065**	**0.7432**	**0.0308**	**0.0585**	**1.1454**
Capital Stock Losses							
	Structural	0.2664	0.1484	0.3048	0.0507	0.0511	0.8214
	Non_Structural	0.8650	0.3781	0.4322	0.0888	0.0785	1.8426
	Content	0.1648	0.0580	0.1566	0.0510	0.0269	0.4573
	Inventory	0.0000	0.0000	0.0061	0.0074	0.0003	0.0138
	Subtotal	**1.2962**	**0.5845**	**0.8997**	**0.1979**	**0.1568**	**3.1351**
	Total	**1.40**	**0.79**	**1.64**	**0.23**	**0.22**	**4.28**

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.

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	613.7627	0.0000	0.00
	Bridges	521.4156	0.5017	0.10
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**1135.1783**	**0.5017**	
Railways	Segments	16.4387	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**16.4387**	**0.0000**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**1,151.62**	**0.50**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	6.0858	0.0000	0.00
	Subtotal	**6.0858**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	76.5900	0.0000	0.00
	Distribution Lines	3.6515	0.0000	0.00
	Subtotal	**80.2415**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	1.2535	0.0000	0.00
	Distribution Lines	2.4343	0.0000	0.00
	Subtotal	**3.6878**	**0.0000**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**90.02**	**0.00**	

Appendix A: County Listing for the Region

Middlesex,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	Middlesex	14,005	1,856	586	2,442
Total Region		**14,005**	**1,856**	**586**	**2,442**

Hazus: Earthquake Global Risk Report

Region Name: Cromwell

Earthquake Scenario: Annualized

Print Date: October 16, 2019

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
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 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-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) 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 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 12.95 square miles and contains 3 census tracts. There are over 5 thousand households in the region which has a total population of 14,005 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,442 (millions of dollars). Approximately 89.00 % of the buildings (and 76.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,151 and 90 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 5 thousand buildings in the region which have an aggregate total replacement value of 2,442 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 85% 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 beds. There are 7 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 1 hazardous material sites, no military installations and no 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 1,241.00 (millions of dollars). This inventory includes over 54.68 miles of highways, 32 bridges, 377.79 miles of pipes.

Table 1: Transportation System Lifeline Inventory

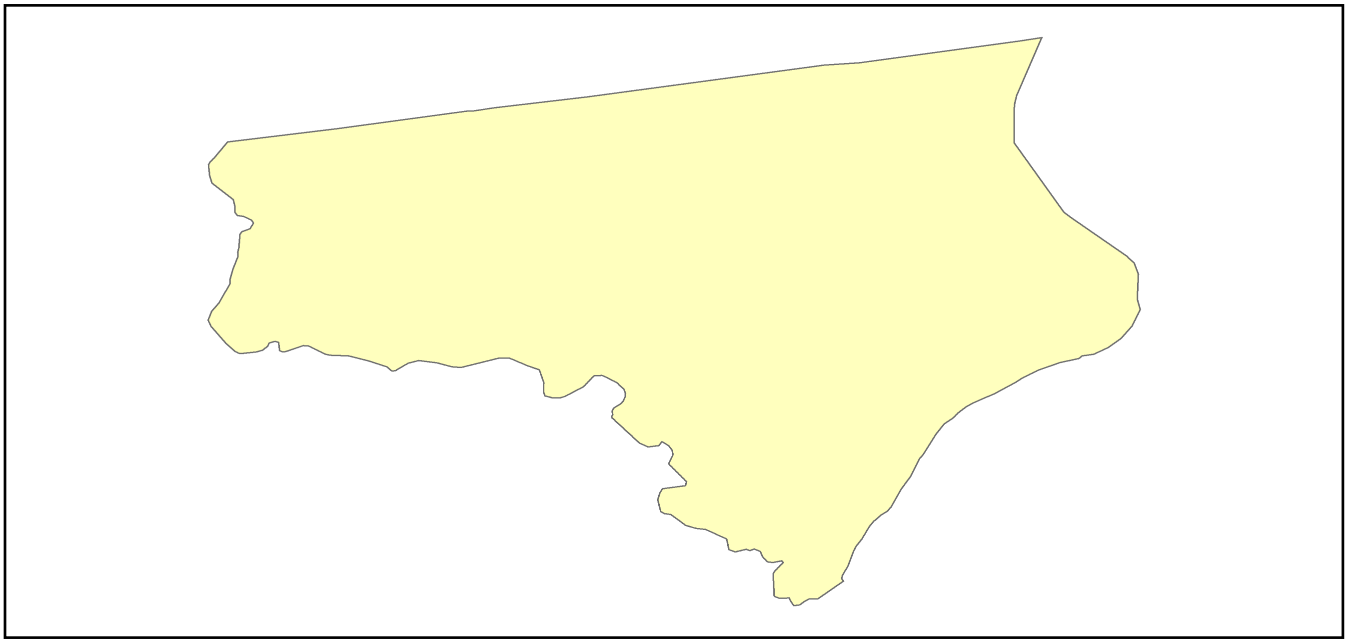
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	32	521.4156
	Segments	63	613.7627
	Tunnels	0	0.0000
		Subtotal	**1135.1783**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	5	16.4387
	Tunnels	0	0.0000
		Subtotal	**16.4387**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**1,151.60**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.0858
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.0858**
Waste Water	Distribution Lines	NA	3.6515
	Facilities	1	76.5900
	Pipelines	0	0.0000
		Subtotal	**80.2415**
Natural Gas	Distribution Lines	NA	2.4343
	Facilities	1	1.2535
	Pipelines	0	0.0000
		Subtotal	**3.6878**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**90.00**

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	Annualized
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	Annualized
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	NA
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Direct Earthquake Damage

Building Damage

Hazus estimates that about 7 buildings will be at least moderately damaged. This is over 0.00 % 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.

Damage Categories by General Occupancy Type

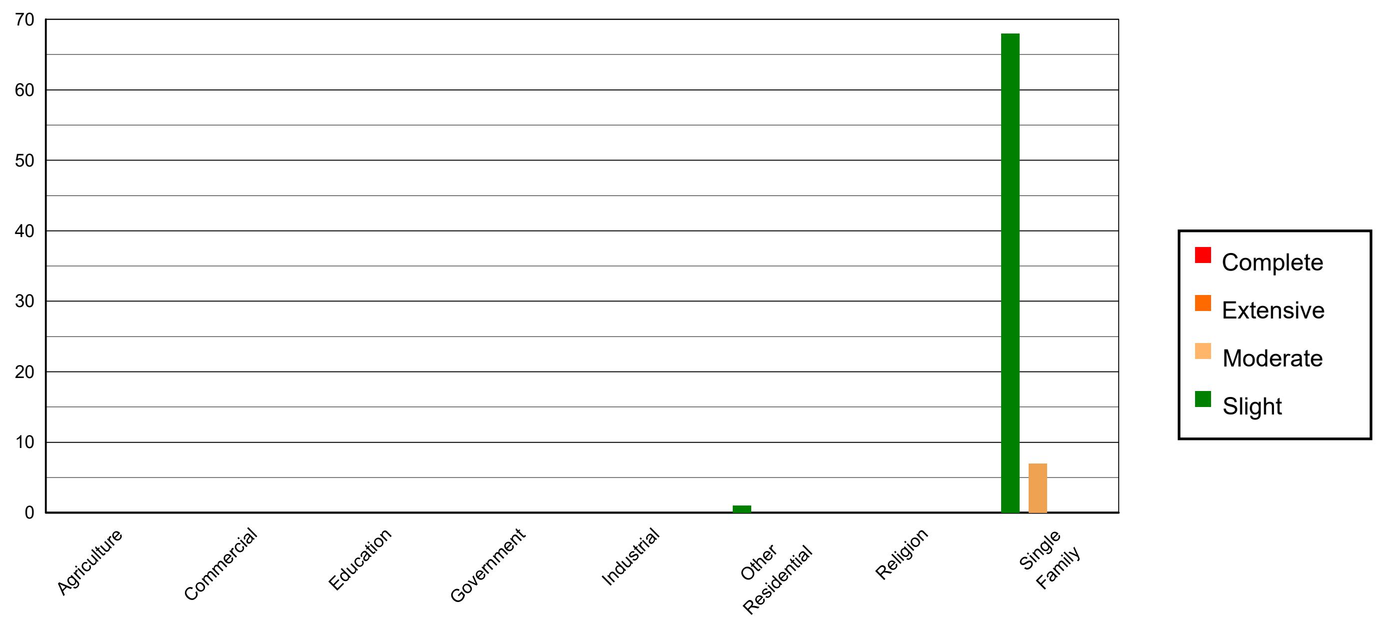


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	9.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	192.00	4.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Education	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Government	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	31.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Residential	254.00	5.41	1.00	1.45	0.00	0.00	0.00	0.00	0.00	0.00
Religion	17.00	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Single Family	4191.00	89.28	68.00	98.55	7.00	100.00	0.00	0.00	0.00	0.00
Total	**4,694**		**69**		**7**		**0**		**0**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	4292.00	91.44	61.00	88.41	4.00	57.14	0.00	0.00	0.00	0.00
Steel	110.00	2.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Concrete	10.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Precast	1.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RM	20.00	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
URM	261.00	5.56	8.00	11.59	3.00	42.86	0.00	0.00	0.00	0.00
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**4,694**		**69**		**7**		**0**		**0**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had hospital beds available for use. On the day of the earthquake, the model estimates that only hospital beds (%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, % of the beds will be back in service. By 30 days, % 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	7	0	0	7
EOCs	1	0	0	1
PoliceStations	1	0	0	1
FireStations	3	0	0	3

Transportation Lifeline Damage

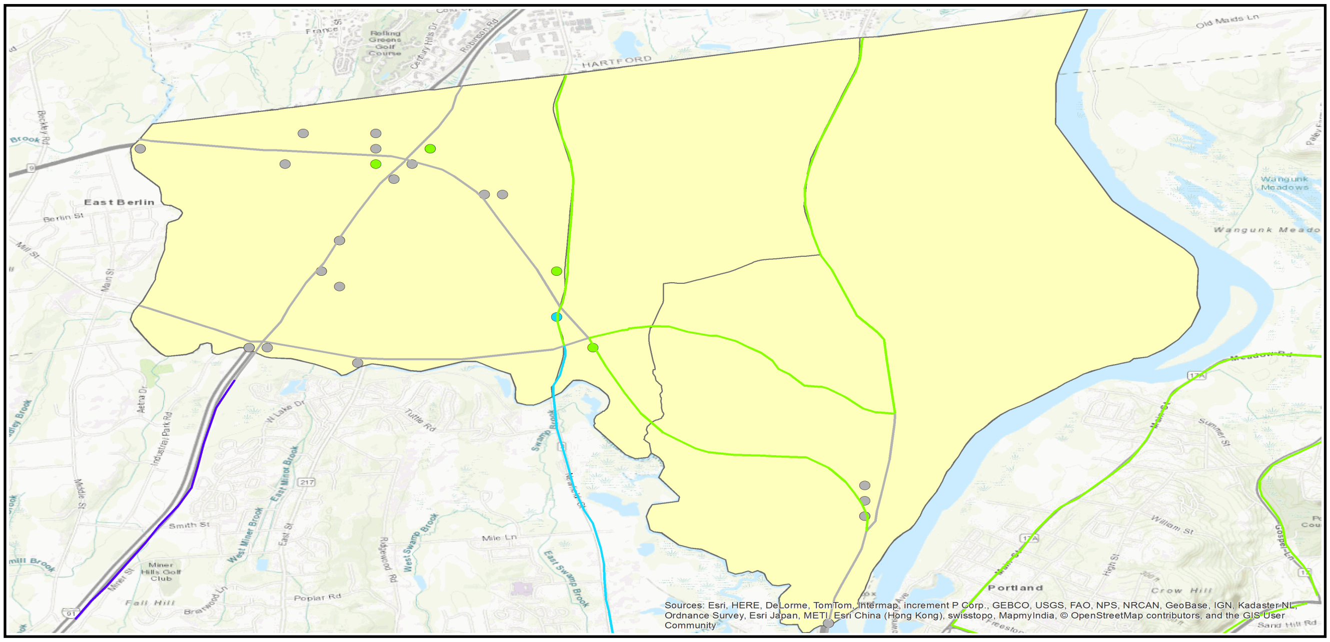


Table 6: Expected Damage to the Transportation Systems

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	63	0	0	63	63
	Bridges	32	0	0	32	32
	Tunnels	0	0	0	0	0
Railways	Segments	5	0	0	5	5
	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	0	0	0	0	0
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

Table 6 provides damage estimates for the transportation system.

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	0	0
Natural Gas	1	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	189	0	0
Waste Water	113	0	0
Natural Gas	76	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						
Electric Power						

Induced Earthquake Damage

Fire Following Earthquake

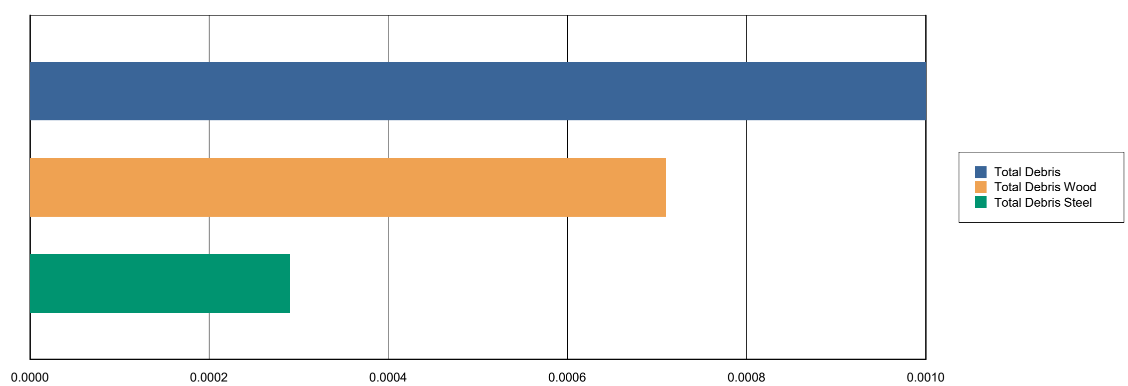
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there 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 1,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 71.00% 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 40 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



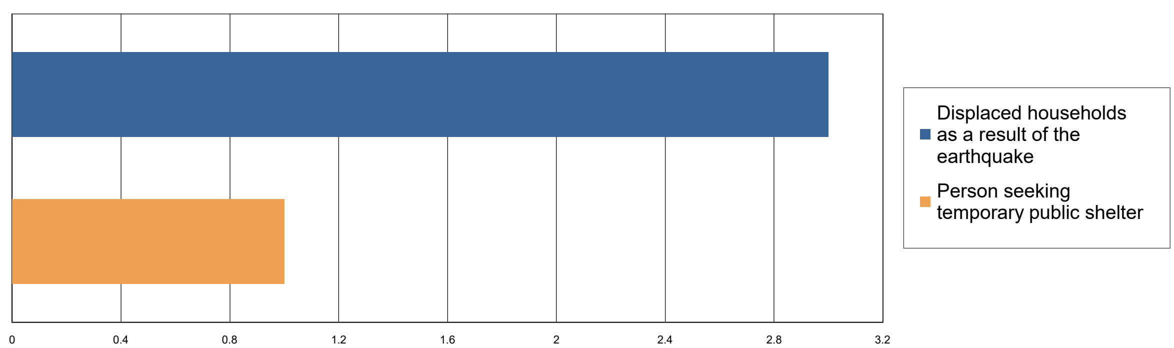
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.00	0.00	0.00	40 (@25 tons/truck)

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 3 households to be displaced due to the earthquake. Of these, 1 people (out of a total population of 14,005) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
3	1

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	0.00	0.00	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.00	0.00	0.00	0.00
	Other-Residential	0.00	0.00	0.00	0.00
	Single Family	0.00	0.00	0.00	0.00
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0.00	0.00	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.00	0.00	0.00	0.00
	Other-Residential	0.00	0.00	0.00	0.00
	Single Family	0.00	0.00	0.00	0.00
	Total	**0**	**0**	**0**	**0**
5 PM	Commercial	0.00	0.00	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.00	0.00	0.00	0.00
	Other-Residential	0.00	0.00	0.00	0.00
	Single Family	0.00	0.00	0.00	0.00
	Total	**0**	**0**	**0**	**0**

Economic Loss

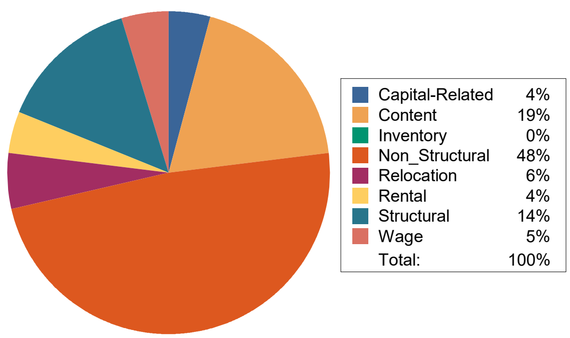
The total economic loss estimated for the earthquake is 0.53 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 0.03 (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 56 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

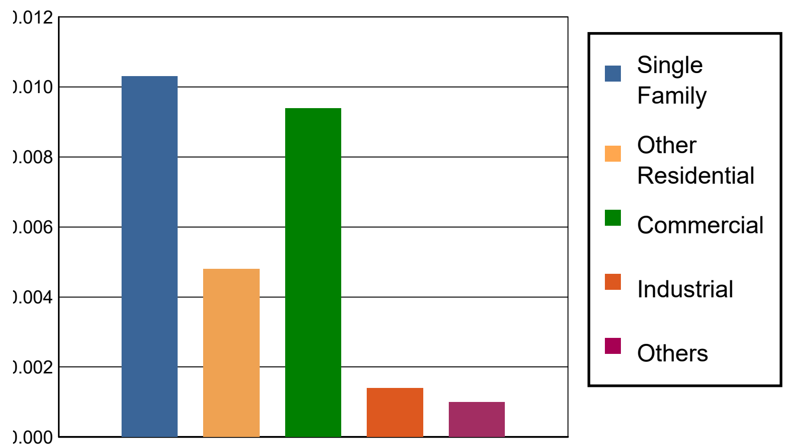


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.0002	0.0011	0.0000	0.0000	0.0013
	Capital-Related	0.0000	0.0001	0.0010	0.0000	0.0000	0.0011
	Rental	0.0001	0.0004	0.0006	0.0000	0.0000	0.0011
	Relocation	0.0004	0.0002	0.0008	0.0000	0.0001	0.0015
	Subtotal	**0.0005**	**0.0009**	**0.0035**	**0.0000**	**0.0001**	**0.0050**
Capital Stock Losses							
	Structural	0.0013	0.0007	0.0014	0.0002	0.0002	0.0038
	Non_Structural	0.0063	0.0026	0.0029	0.0007	0.0005	0.0130
	Content	0.0022	0.0006	0.0016	0.0005	0.0002	0.0051
	Inventory	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Subtotal	**0.0098**	**0.0039**	**0.0059**	**0.0014**	**0.0009**	**0.0219**
	Total	**0.01**	**0.00**	**0.01**	**0.00**	**0.00**	**0.03**

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.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	613.7627	0.0000	0.00
	Bridges	521.4156	0.5017	0.10
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**1135.1783**	**0.5017**	
Railways	Segments	16.4387	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**16.4387**	**0.0000**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**1,151.62**	**0.50**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	6.0858	0.0000	0.00
	Subtotal	**6.0858**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	76.5900	0.0000	0.00
	Distribution Lines	3.6515	0.0000	0.00
	Subtotal	**80.2415**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	1.2535	0.0000	0.00
	Distribution Lines	2.4343	0.0000	0.00
	Subtotal	**3.6878**	**0.0000**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**90.02**	**0.00**	

Appendix A: County Listing for the Region

Middlesex,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	Middlesex	14,005	1,856	586	2,442
Total Region		**14,005**	**1,856**	**586**	**2,442**