Hazus: Flood Global Risk Report

Region Name: Killingworth

Flood Scenario: KillingworthAll

Print Date: Monday, December 23, 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 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 36 square miles and contains 166 census blocks. The region contains over 2 thousand households and has a total population of 6,525 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 2,824 buildings in the region with a total building replacement value (excluding contents) of 985 million dollars. Approximately 91.78% of the buildings (and 89.03% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 2,824 buildings in the region which have an aggregate total replacement value of 985 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	876,705	89.0%
Commercial	68,668	7.0%
Industrial	18,389	1.9%
Agricultural	5,075	0.5%
Religion	6,751	0.7%
Government	1,220	0.1%
Education	7,910	0.8%
Total	**984,718**	**100%**

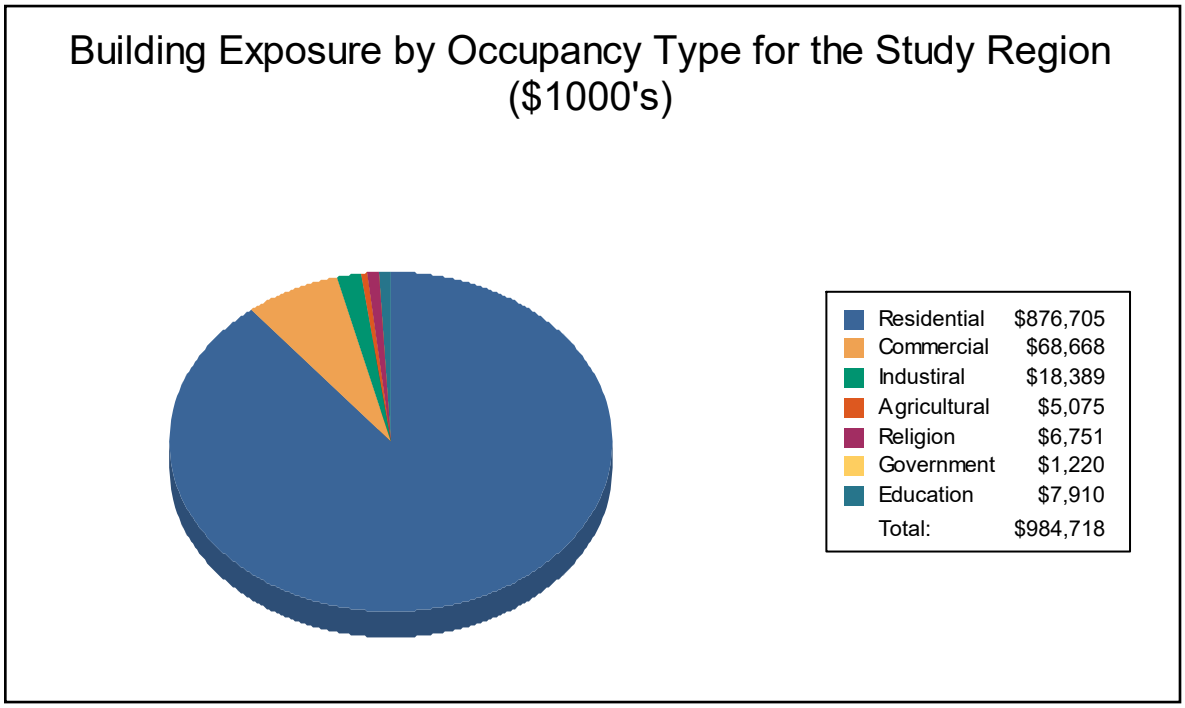
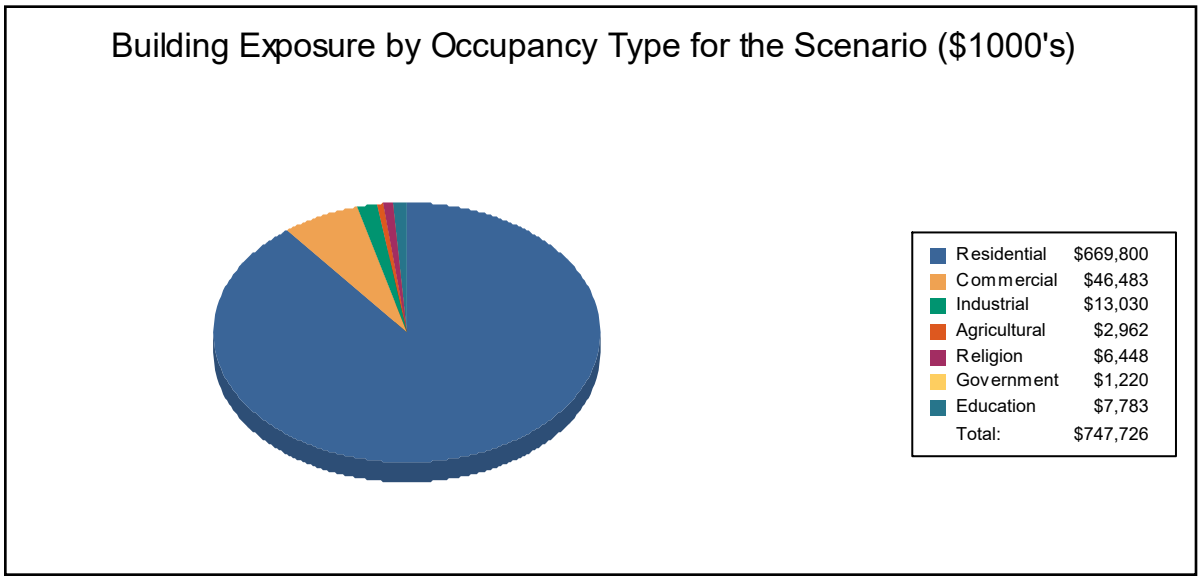


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	669,800	89.6%
Commercial	46,483	6.2%
Industrial	13,030	1.7%
Agricultural	2,962	0.4%
Religion	6,448	0.9%
Government	1,220	0.2%
Education	7,783	1.0%
Total	**747,726**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 2 schools, 2 fire stations, 1 police station and 1 emergency operation center.

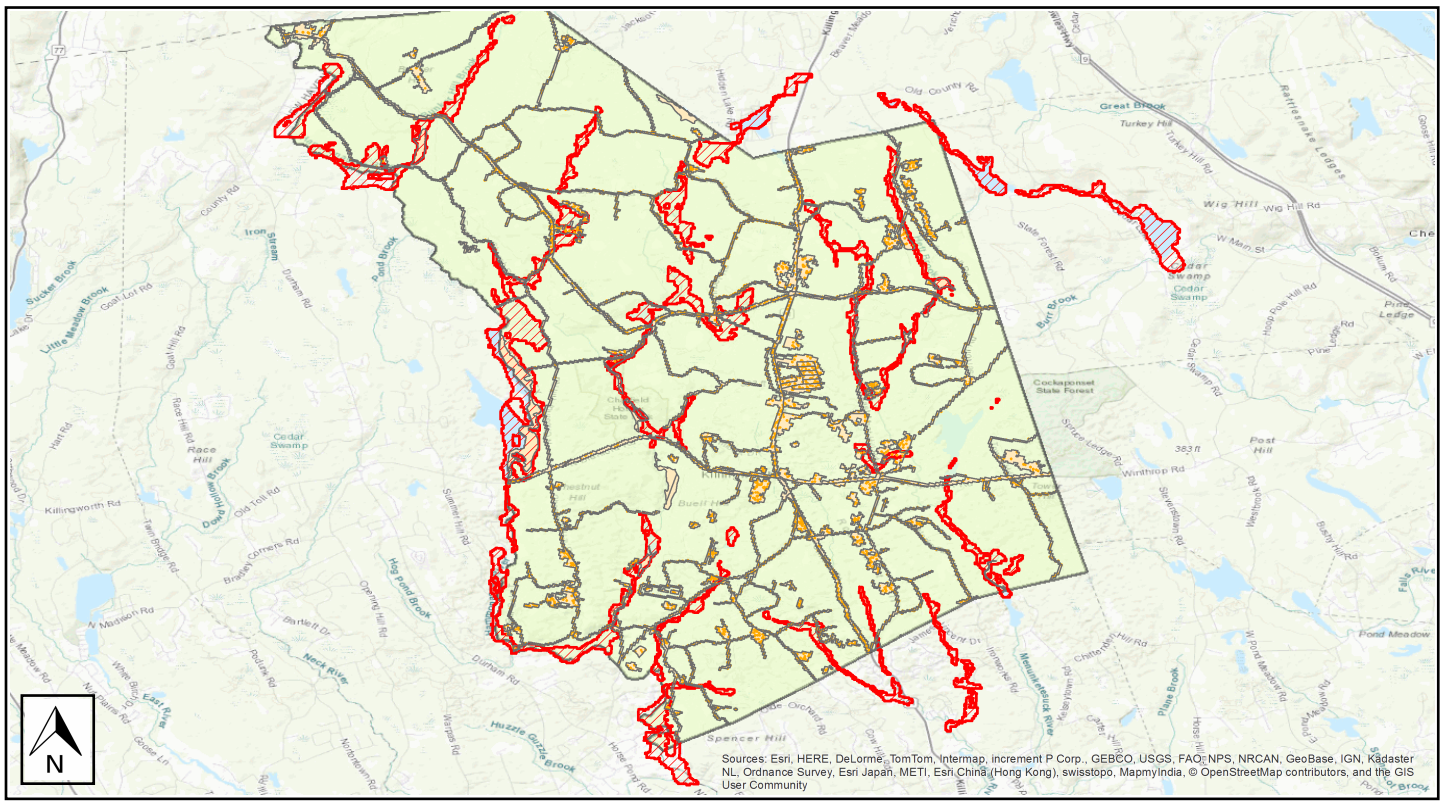
Flood Scenario Parameters

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

Study Region Name:	Killingworth
Scenario Name:	KillingworthAll
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 2 buildings will be at least moderately damaged. This is over 77% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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

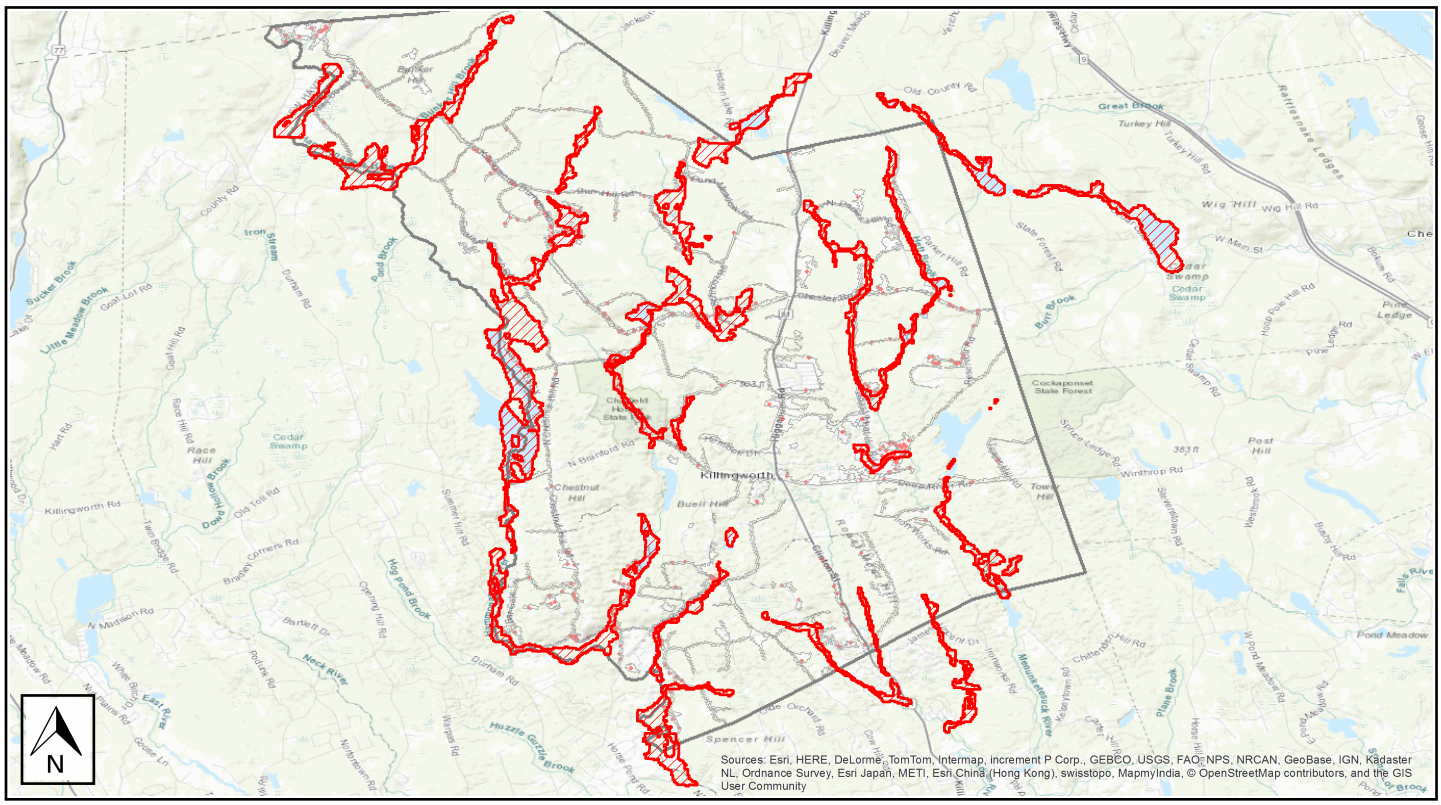


Table 3: Expected Building Damage by Occupancy

	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	0	0	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	15	88	2	12	0	0	0	0	0	0	0	0
Total	**15**		**2**		**0**		**0**		**0**		**0**	

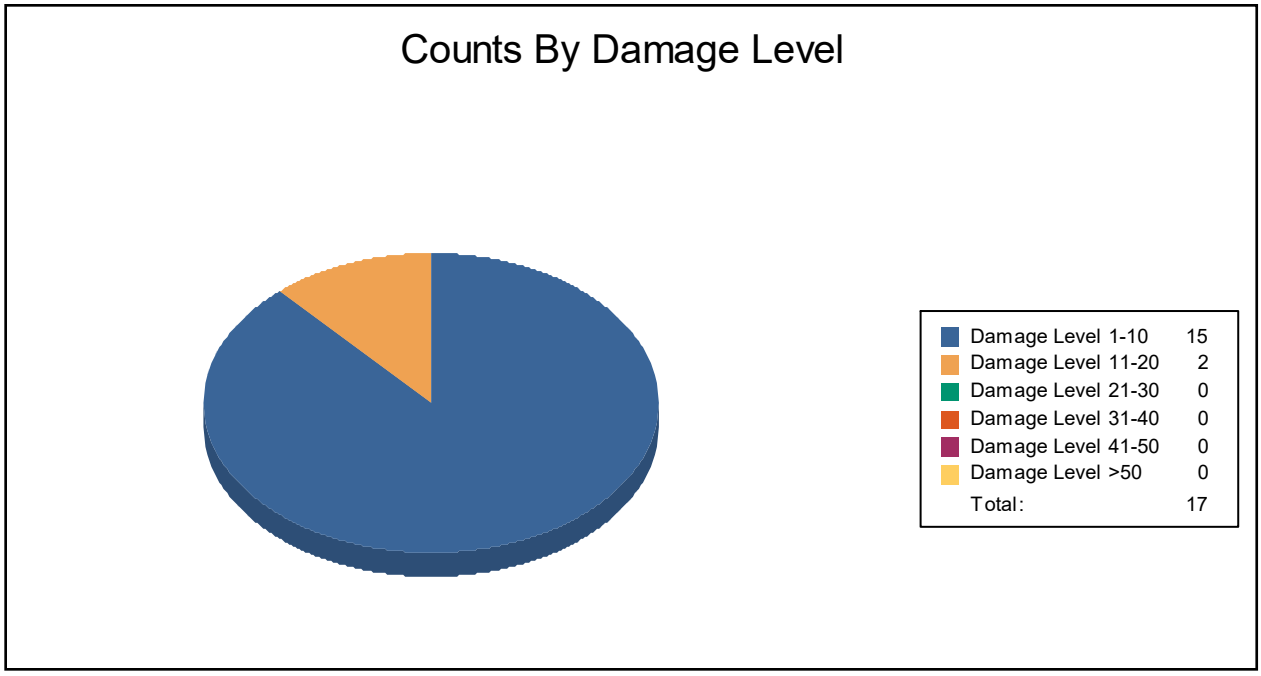


Table 4: Expected Building Damage by Building Type

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	0	0	0	0	0	0	0	0	0	0	0	0
Wood	15	88	2	12	0	0	0	0	0	0	0	0

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	2	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	2	0	0	0

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

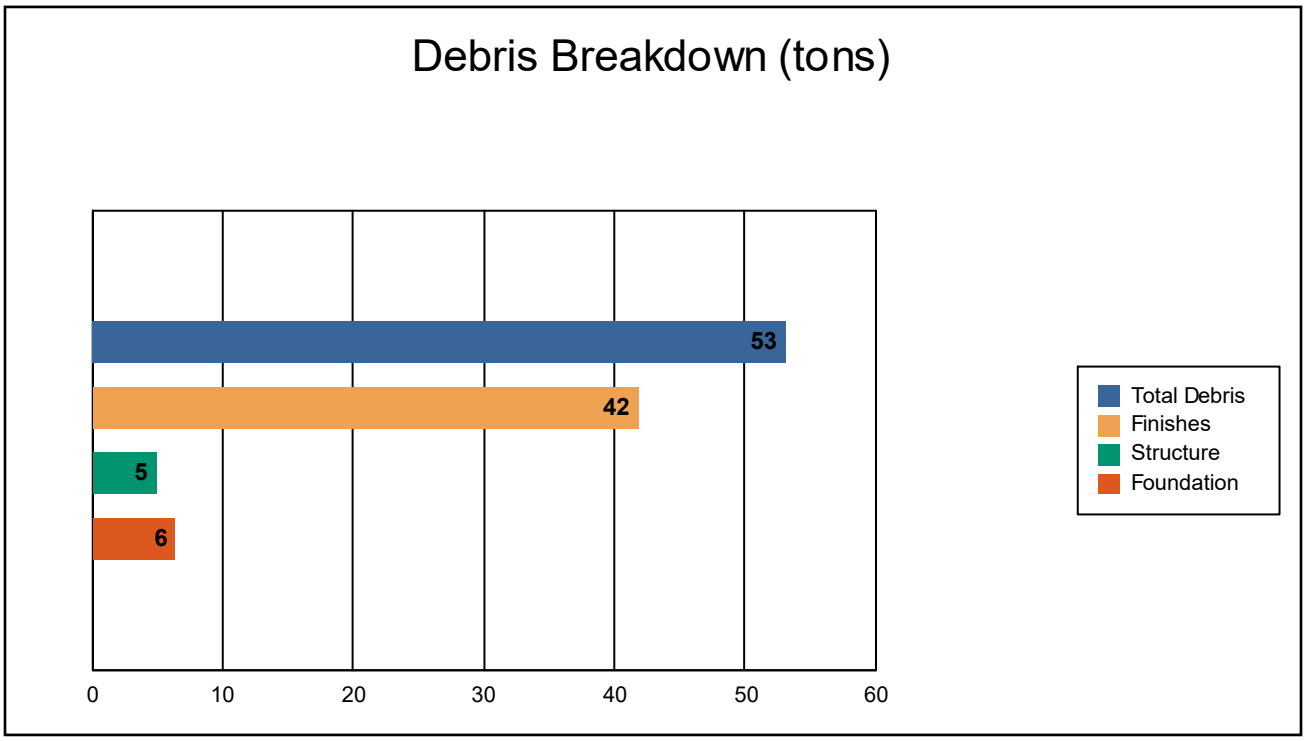
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(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.

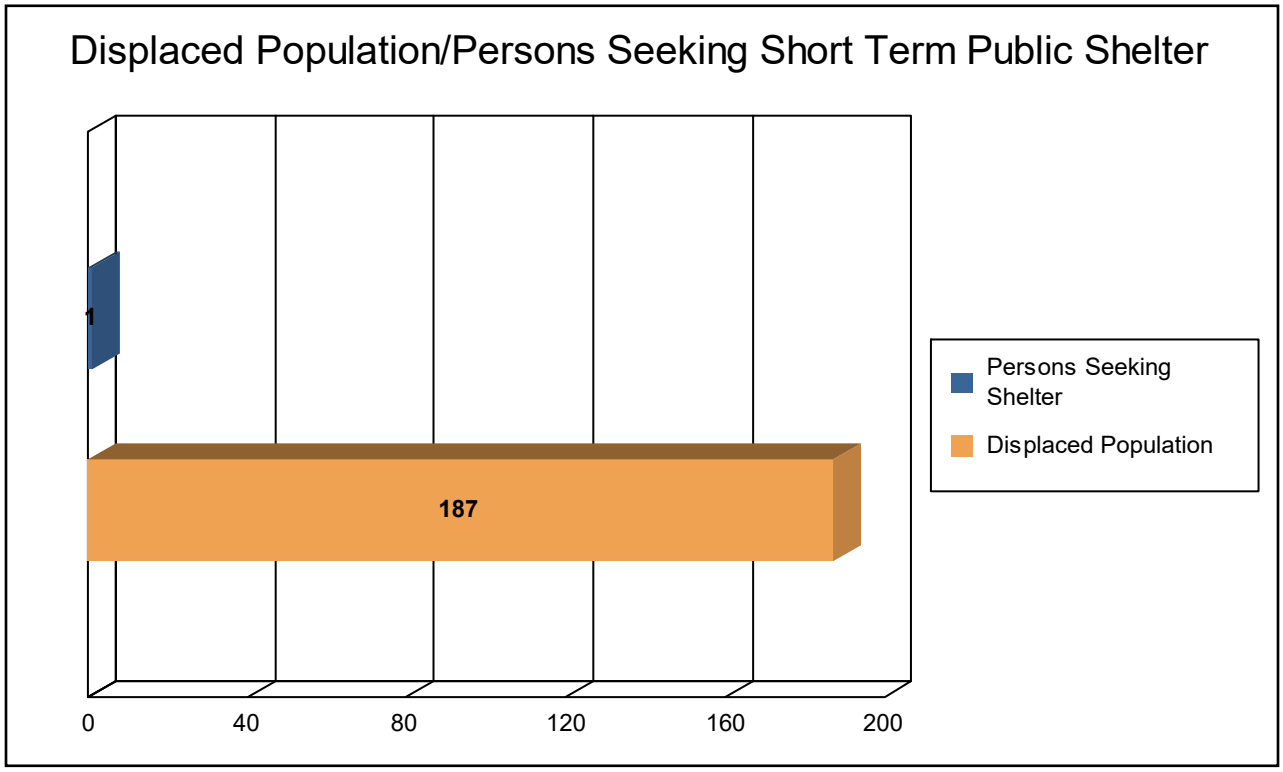


The model estimates that a total of 53 tons of debris will be generated. Of the total amount, Finishes comprises 79% of the total, Structure comprises 9% of the total, and Foundation comprises 12%. If the debris tonnage is converted into an estimated number of truckloads, it will require 3 truckloads (@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 62 households (or 187 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 1 people (out of a total population of 6,525) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 5.42 million dollars, which represents 0.72 % of the total replacement value of the scenario buildings.

Building-Related Losses

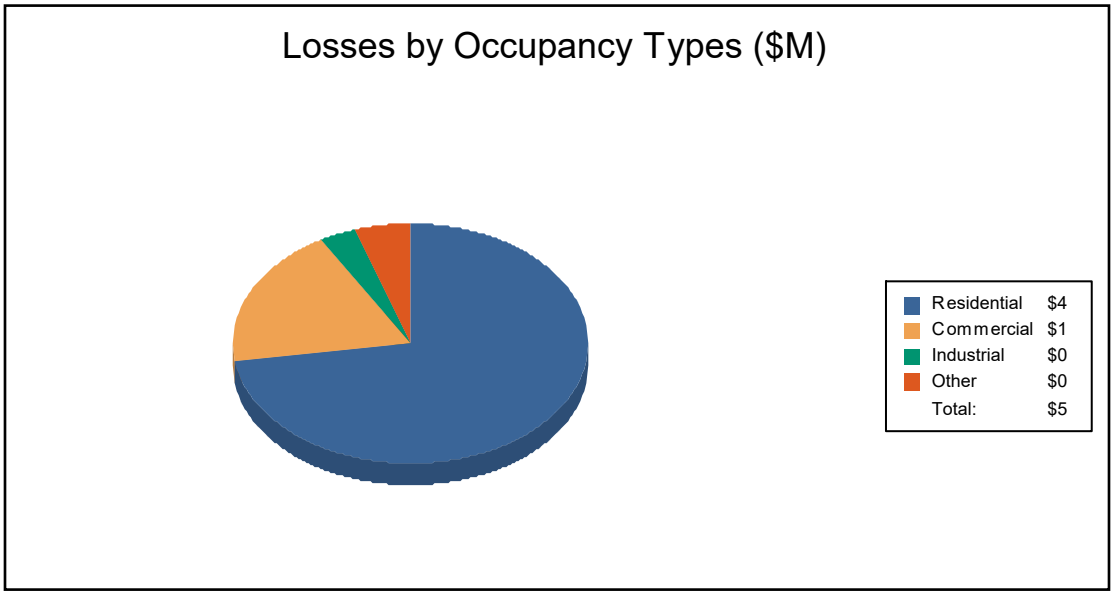
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 3.06 million dollars. 43% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 72.43% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	1.83	0.07	0.07	0.00	1.98
	Content	0.75	0.21	0.09	0.03	1.08
	Inventory	0.00	0.00	0.01	0.00	0.01
	Subtotal	**2.58**	**0.28**	**0.17**	**0.03**	**3.06**
Business Interruption						
	Income	0.01	0.40	0.00	0.05	0.46
	Relocation	1.04	0.06	0.00	0.01	1.10
	Rental Income	0.27	0.05	0.00	0.00	0.32
	Wage	0.02	0.26	0.00	0.19	0.47
	Subtotal	**1.34**	**0.76**	**0.01**	**0.25**	**2.35**
ALL	**Total**	**3.92**	**1.04**	**0.18**	**0.28**	**5.42**



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	6,525	876,705	108,013	984,718
Total	**6,525**	**876,705**	**108,013**	**984,718**
Total Study Region	**6,525**	**876,705**	**108,013**	**984,718**

Hazus: Flood Global Risk Report

Region Name: Killingworth

Flood Scenario: KillingworthAll

Print Date: Thursday, December 26, 2019

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Note:
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Building Inventory

General Building Stock

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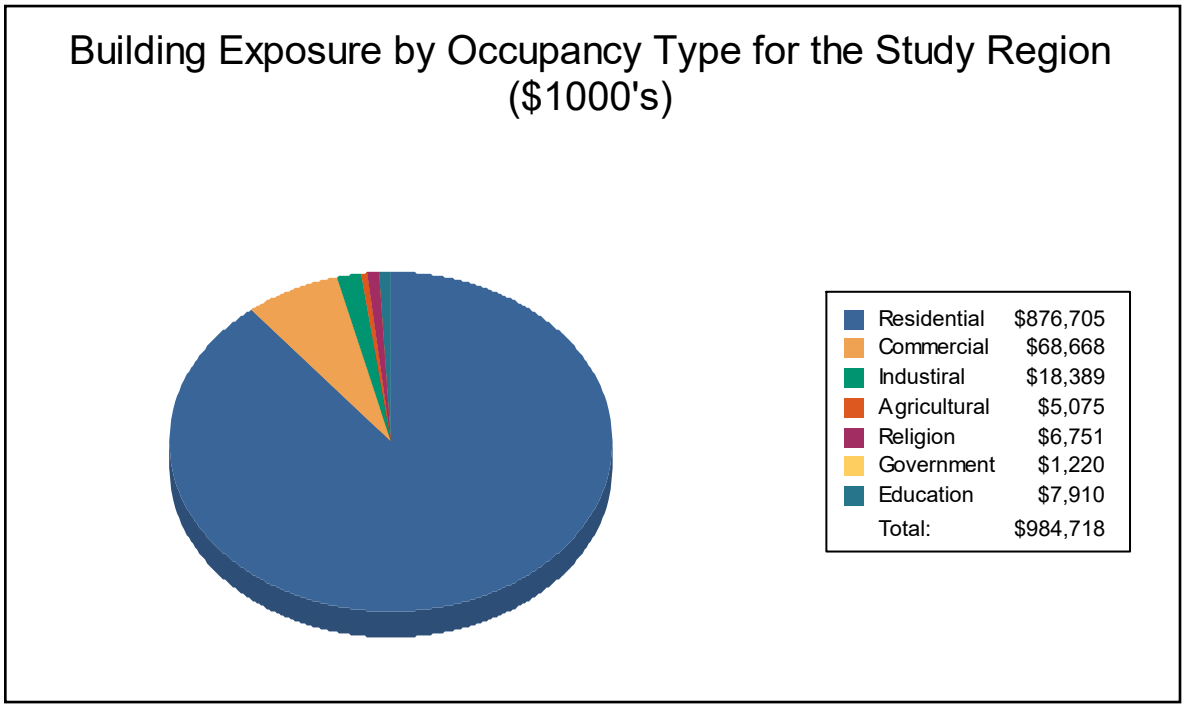

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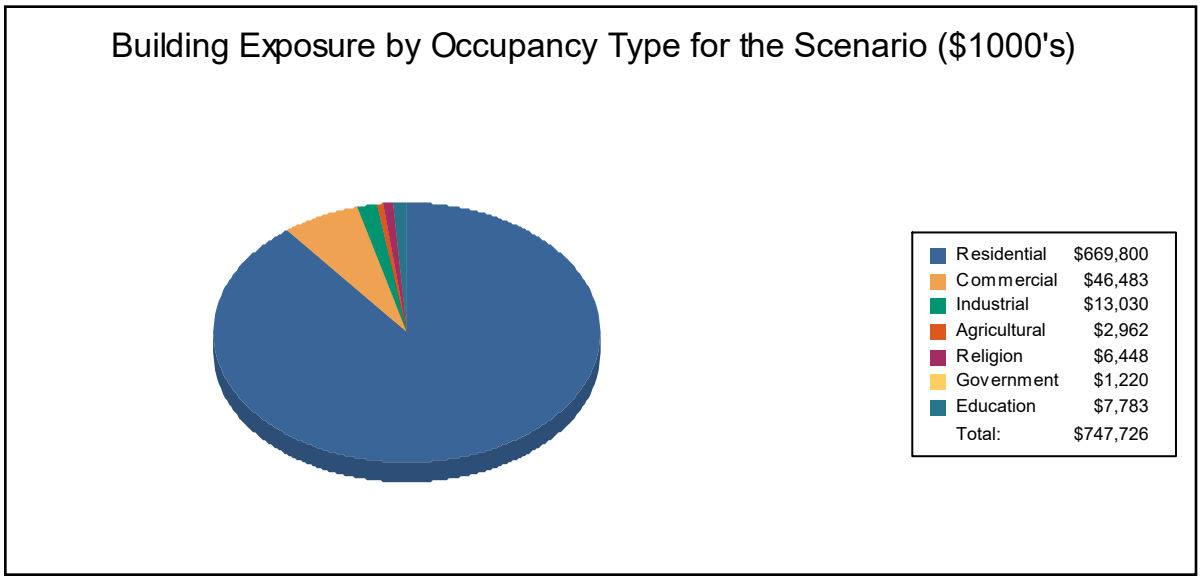


Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 2 schools, 2 fire stations, 1 police station and 1 emergency operation center.

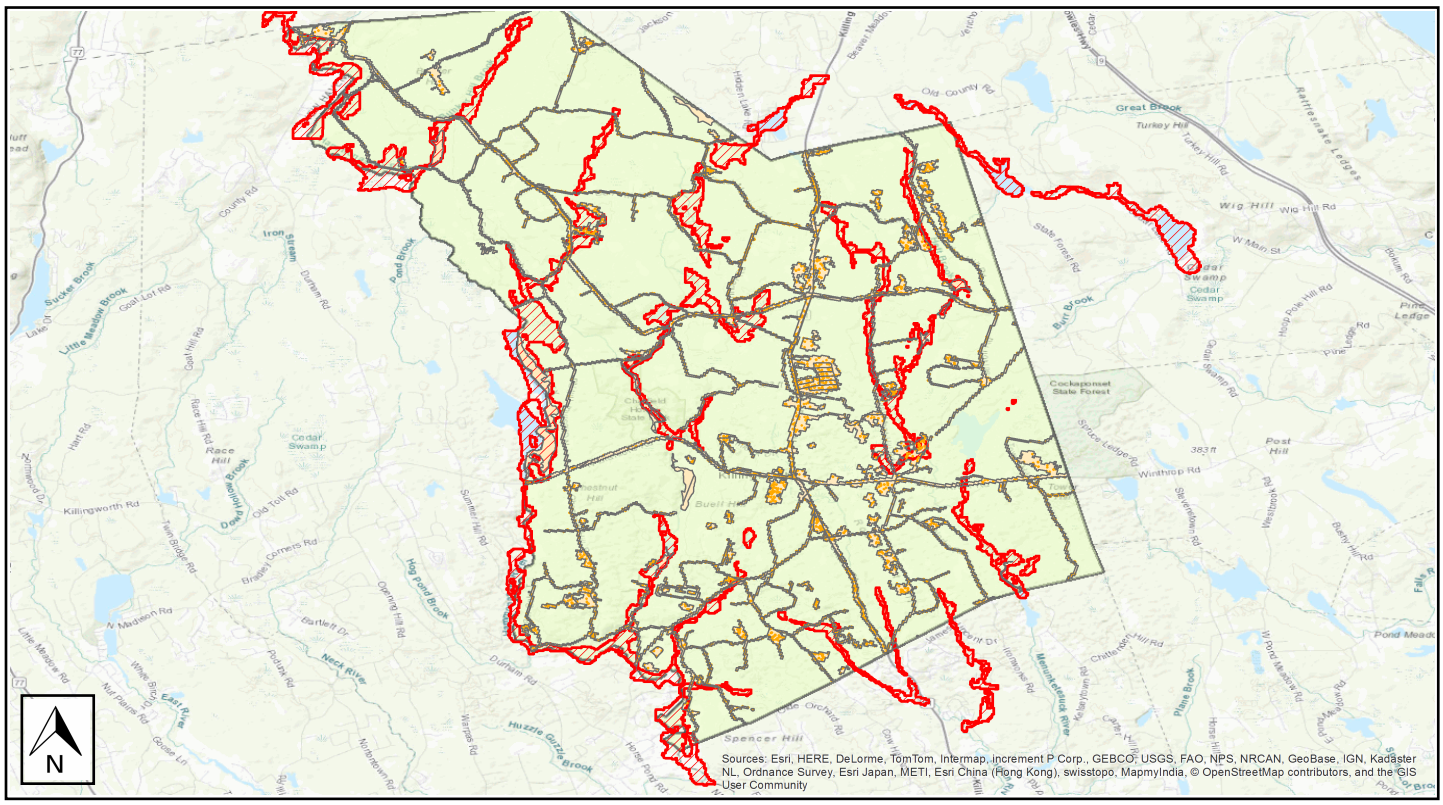
Flood Scenario Parameters

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

Study Region Name:	Killingworth
Scenario Name:	KillingworthAll
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 4 buildings will be at least moderately damaged. This is over 83% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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

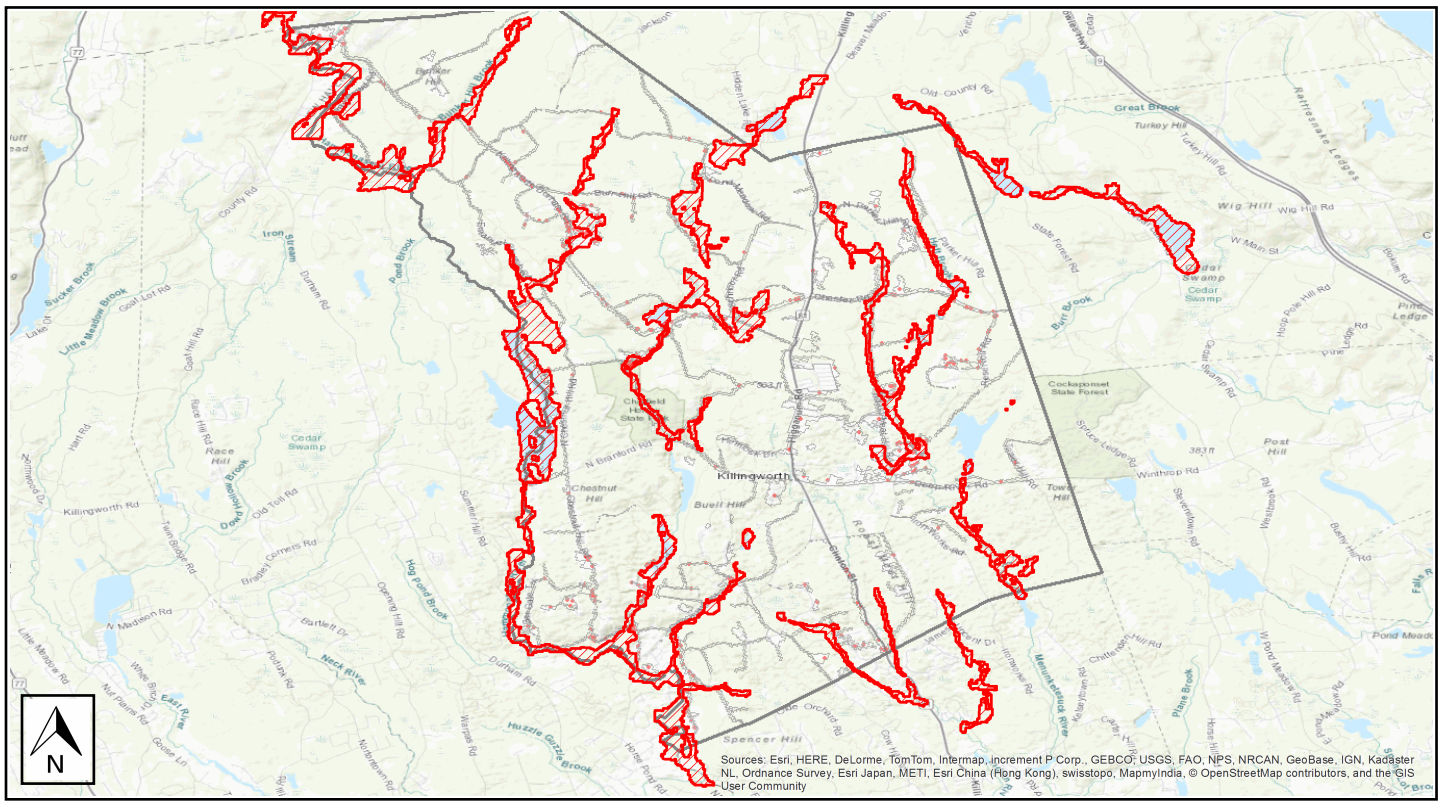


Table 3: Expected Building Damage by Occupancy

	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	0	0	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	20	83	4	17	0	0	0	0	0	0	0	0
Total	**20**		**4**		**0**		**0**		**0**		**0**	

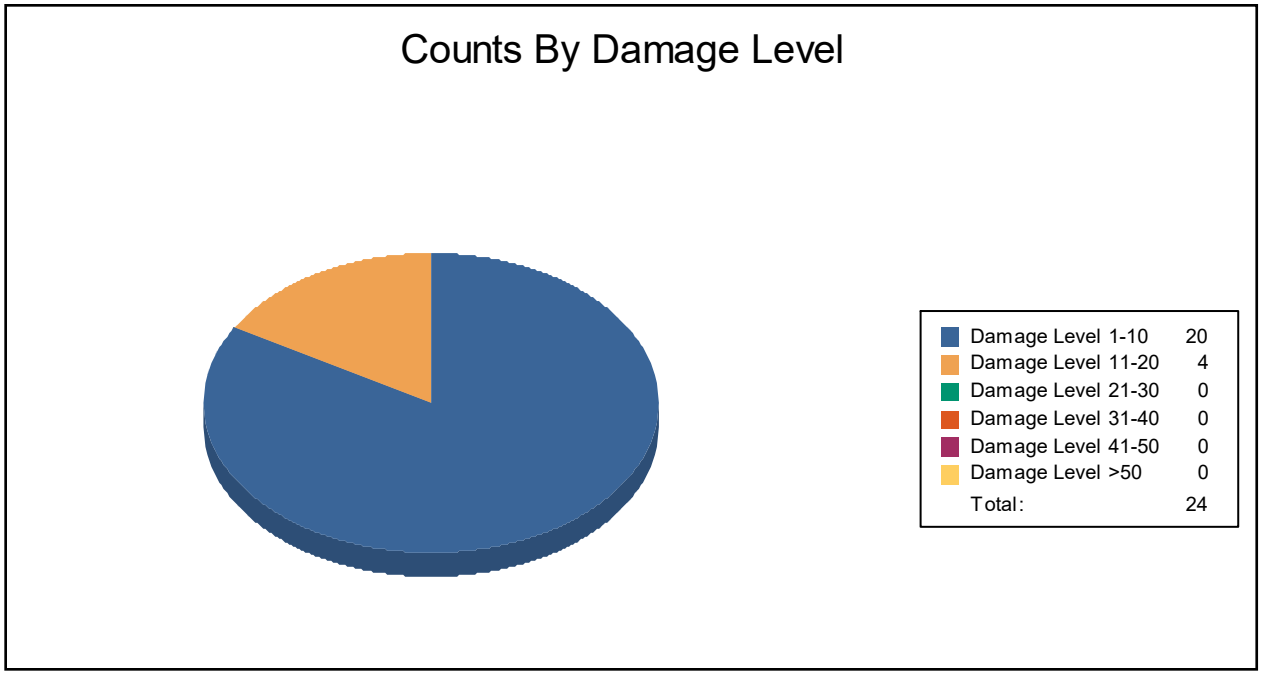


Table 4: Expected Building Damage by Building Type

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	0	0	0	0	0	0	0	0	0	0	0	0
Wood	20	83	4	17	0	0	0	0	0	0	0	0

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	2	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	2	0	0	0

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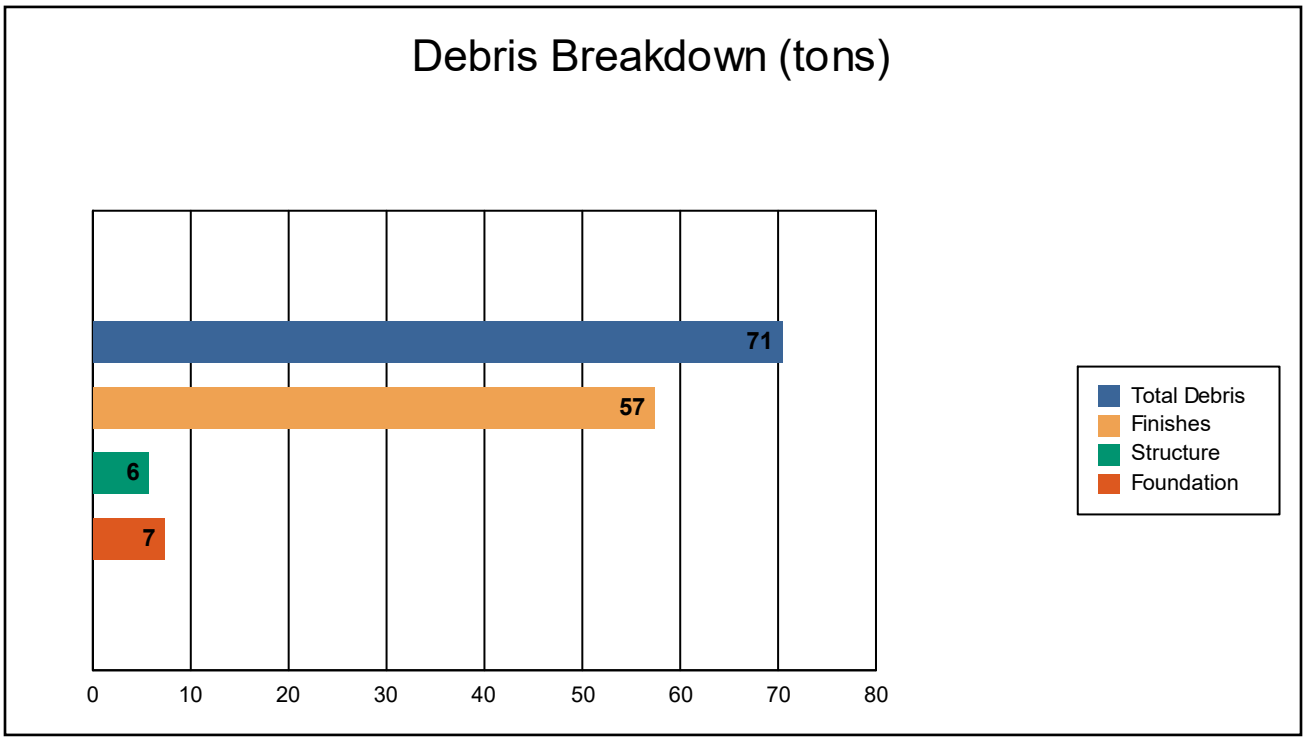
Induced Flood Damage

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.

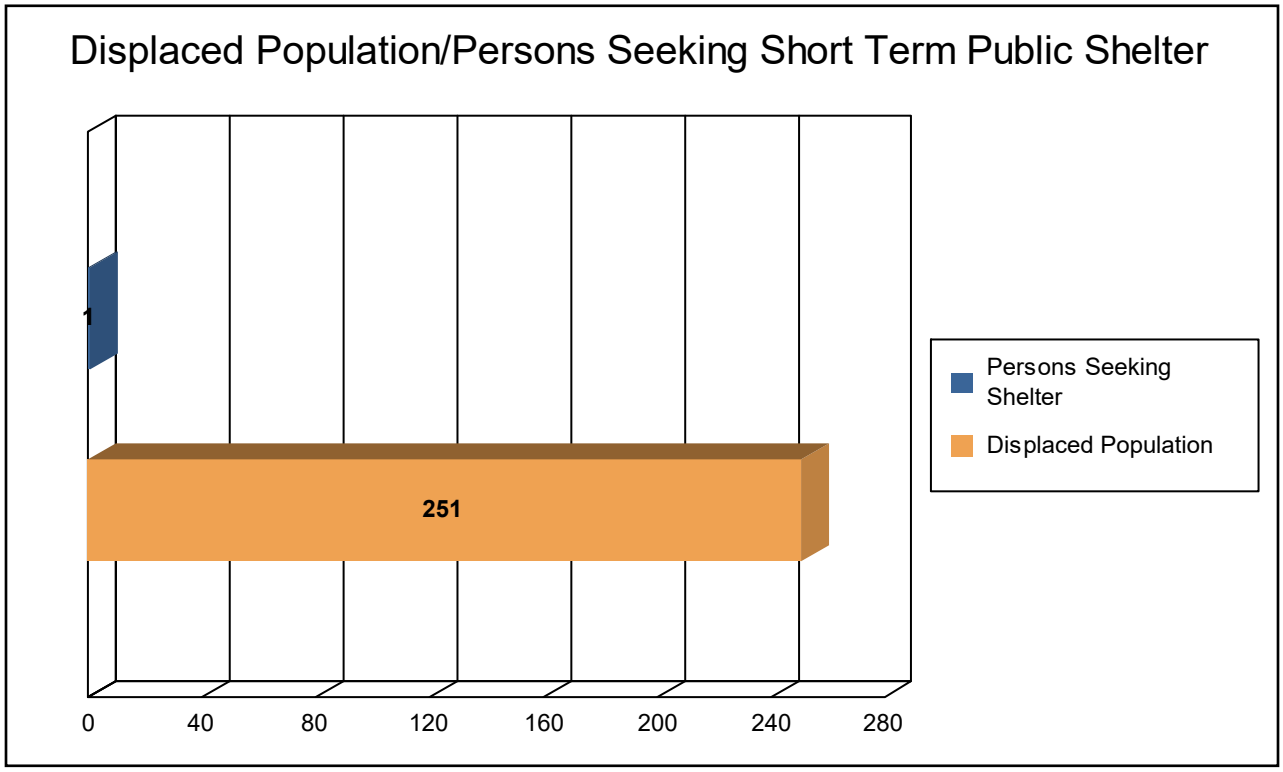


The model estimates that a total of 71 tons of debris will be generated. Of the total amount, Finishes comprises 81% of the total, Structure comprises 8% of the total, and Foundation comprises 11%. If the debris tonnage is converted into an estimated number of truckloads, it will require 3 truckloads (@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 84 households (or 251 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 1 people (out of a total population of 6,525) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 7.62 million dollars, which represents 1.02 % of the total replacement value of the scenario buildings.

Building-Related Losses

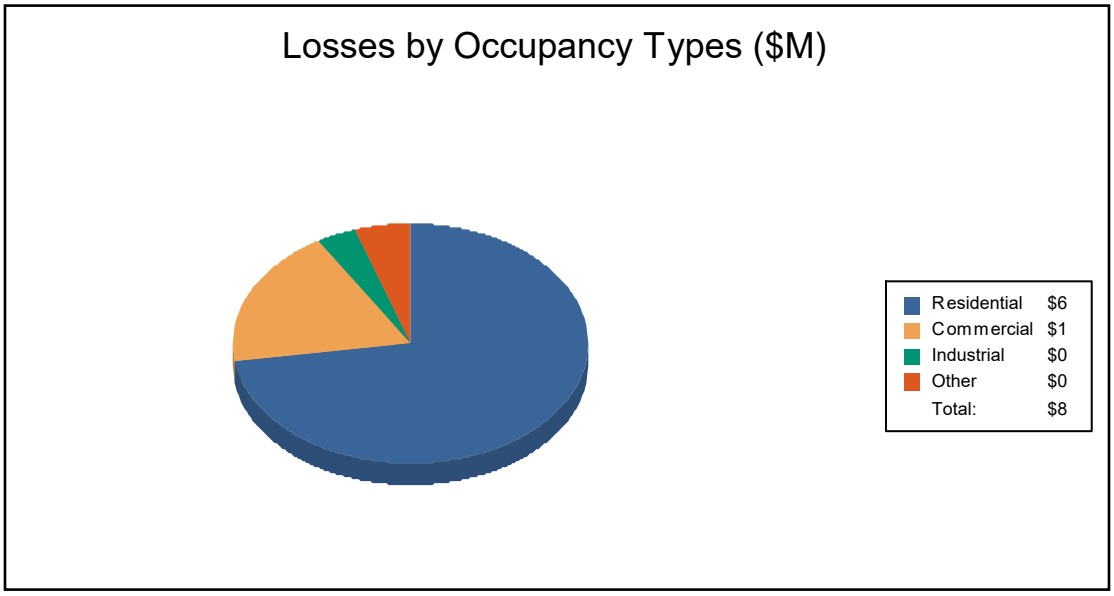
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 4.44 million dollars. 42% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 72.60% 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	2.63	0.10	0.10	0.00	2.84
	Content	1.10	0.29	0.15	0.05	1.59
	Inventory	0.00	0.00	0.02	0.00	0.02
	Subtotal	**3.73**	**0.40**	**0.27**	**0.05**	**4.44**
Business Interruption						
	Income	0.01	0.51	0.00	0.08	0.60
	Relocation	1.39	0.08	0.00	0.01	1.48
	Rental Income	0.38	0.06	0.00	0.00	0.44
	Wage	0.03	0.39	0.01	0.24	0.66
	Subtotal	**1.80**	**1.04**	**0.01**	**0.32**	**3.17**
ALL	**Total**	**5.53**	**1.43**	**0.28**	**0.38**	**7.62**



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
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Middlesex	6,525	876,705	108,013	984,718
Total	**6,525**	**876,705**	**108,013**	**984,718**
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There are an estimated 2,824 buildings in the region with a total building replacement value (excluding contents) of 985 million dollars. Approximately 91.78% of the buildings (and 89.03% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 2,824 buildings in the region which have an aggregate total replacement value of 985 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	876,705	89.0%
Commercial	68,668	7.0%
Industrial	18,389	1.9%
Agricultural	5,075	0.5%
Religion	6,751	0.7%
Government	1,220	0.1%
Education	7,910	0.8%
Total	**984,718**	**100%**

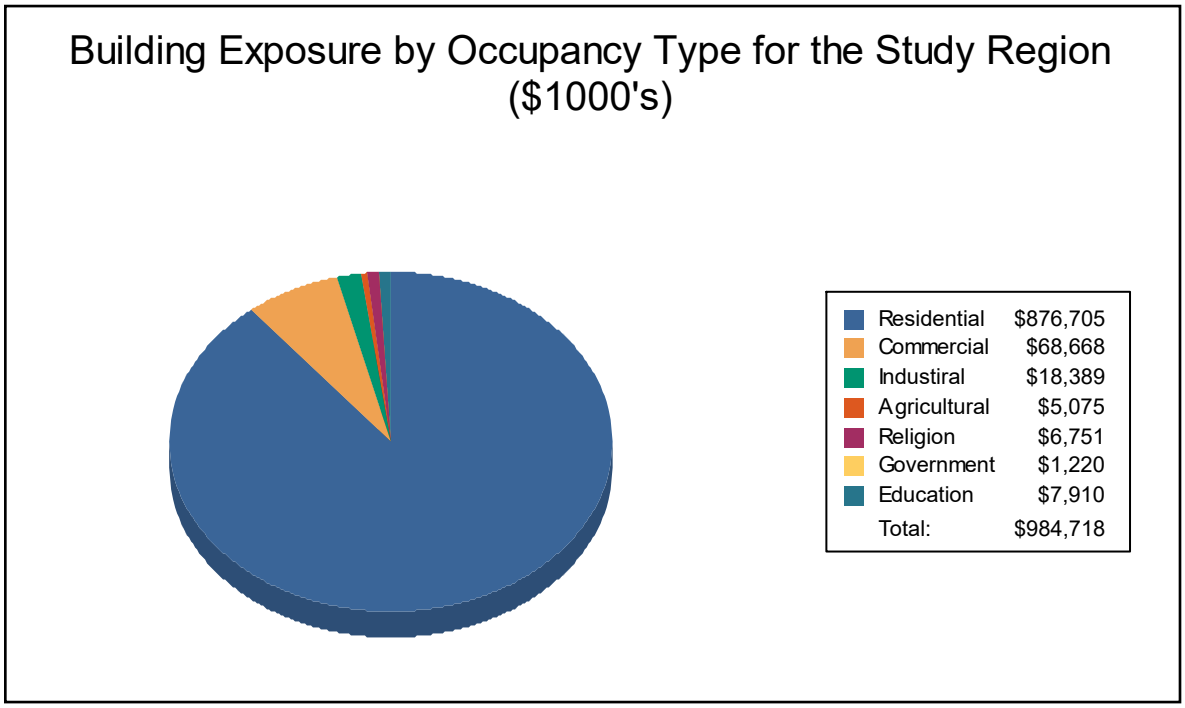
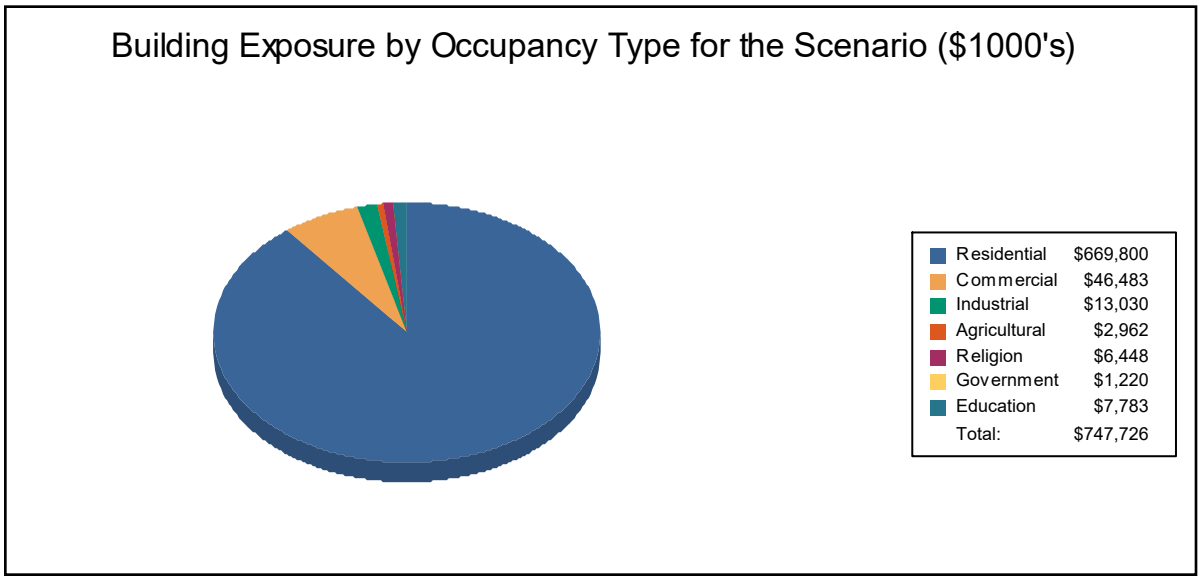


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	669,800	89.6%
Commercial	46,483	6.2%
Industrial	13,030	1.7%
Agricultural	2,962	0.4%
Religion	6,448	0.9%
Government	1,220	0.2%
Education	7,783	1.0%
Total	**747,726**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 2 schools, 2 fire stations, 1 police station and 1 emergency operation center.

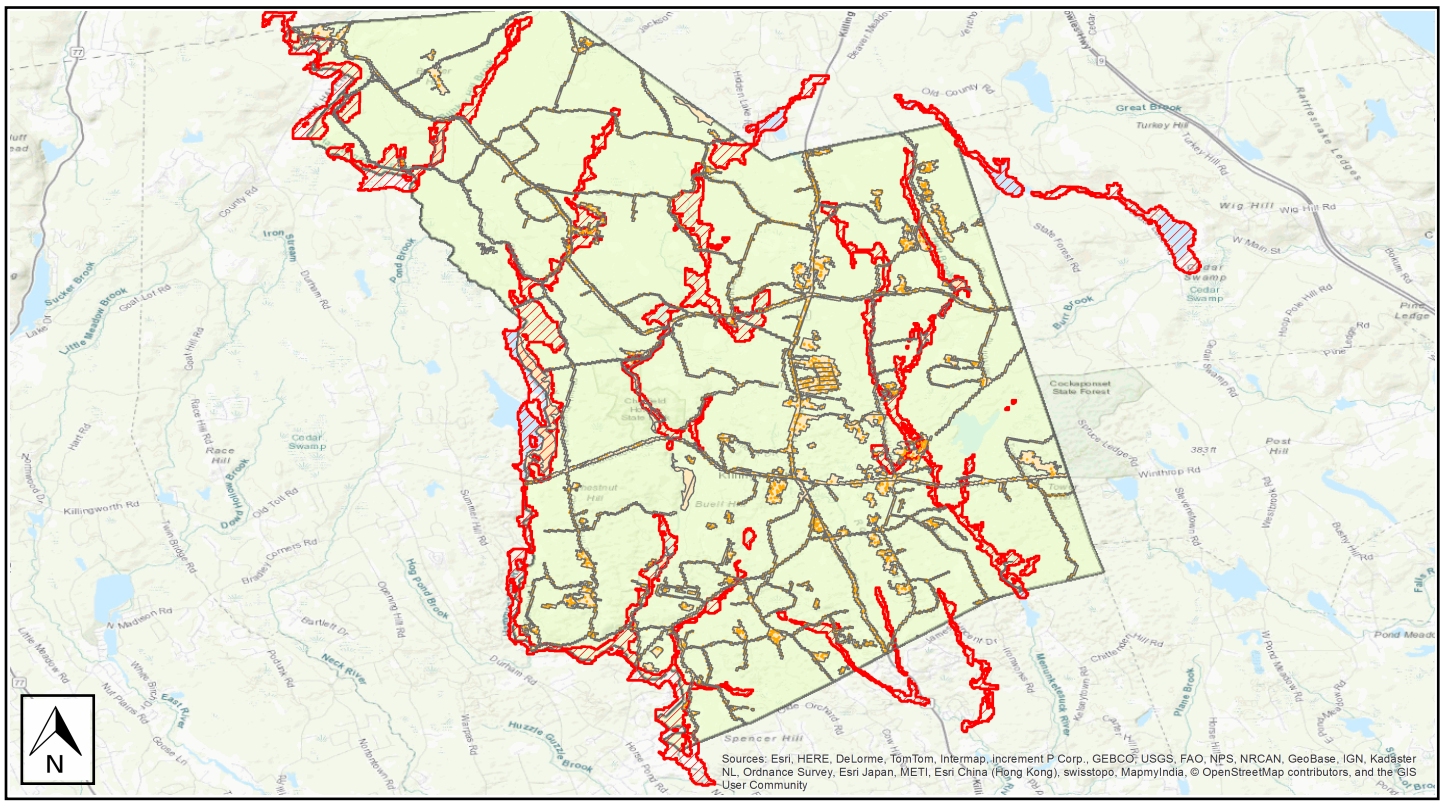
Flood Scenario Parameters

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

Study Region Name:	Killingworth
Scenario Name:	KillingworthAll
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 7 buildings will be at least moderately damaged. This is over 86% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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

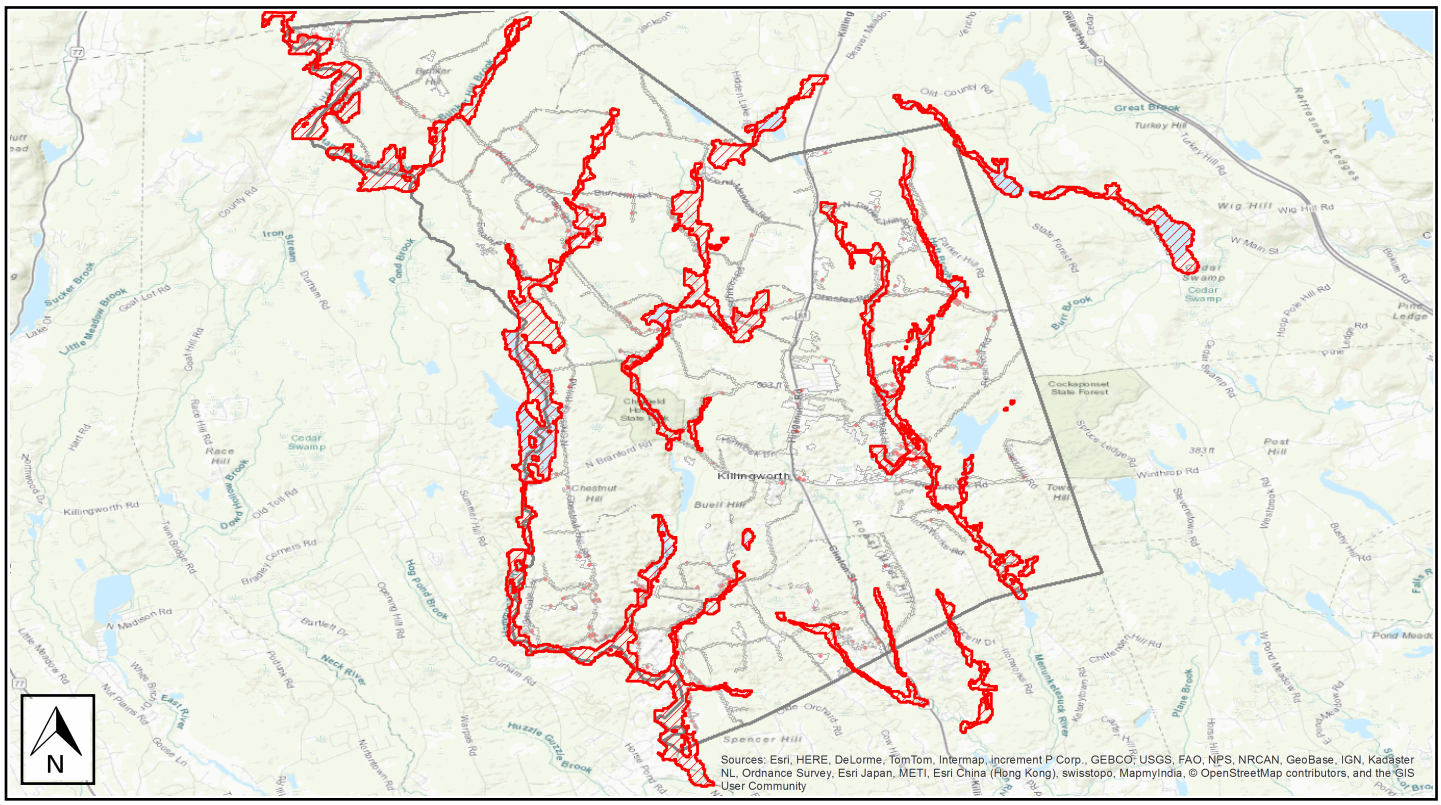


Table 3: Expected Building Damage by Occupancy

	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	0	0	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	23	77	6	20	1	3	0	0	0	0	0	0
Total	**23**		**6**		**1**		**0**		**0**		**0**	

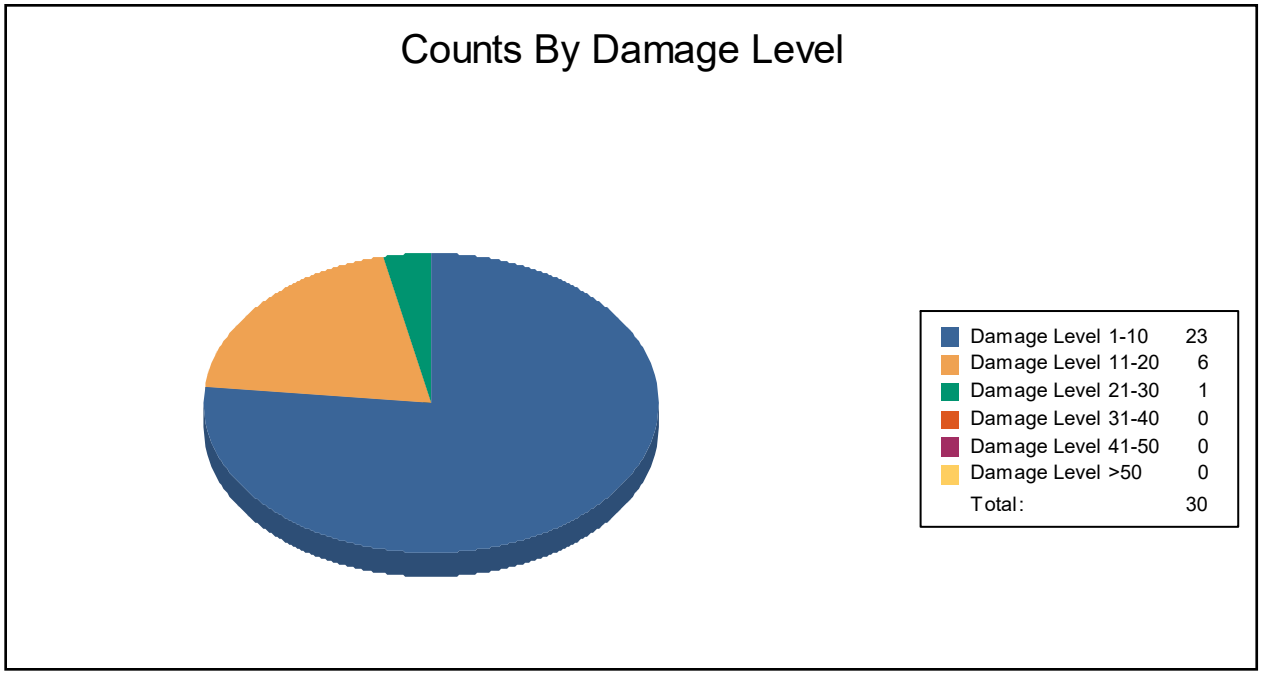


Table 4: Expected Building Damage by Building Type

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	0	0	0	0	0	0	0	0	0	0	0	0
Wood	23	77	6	20	1	3	0	0	0	0	0	0

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	2	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	2	0	0	0

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

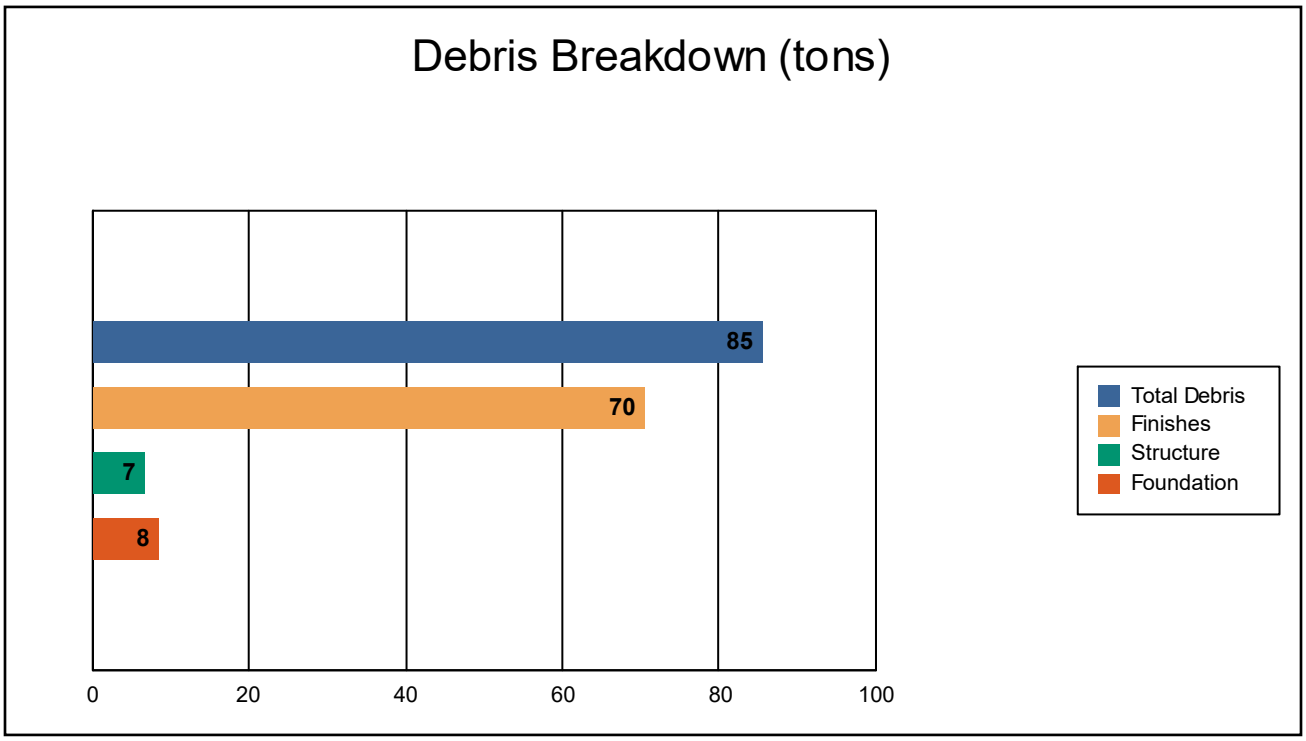
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(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.

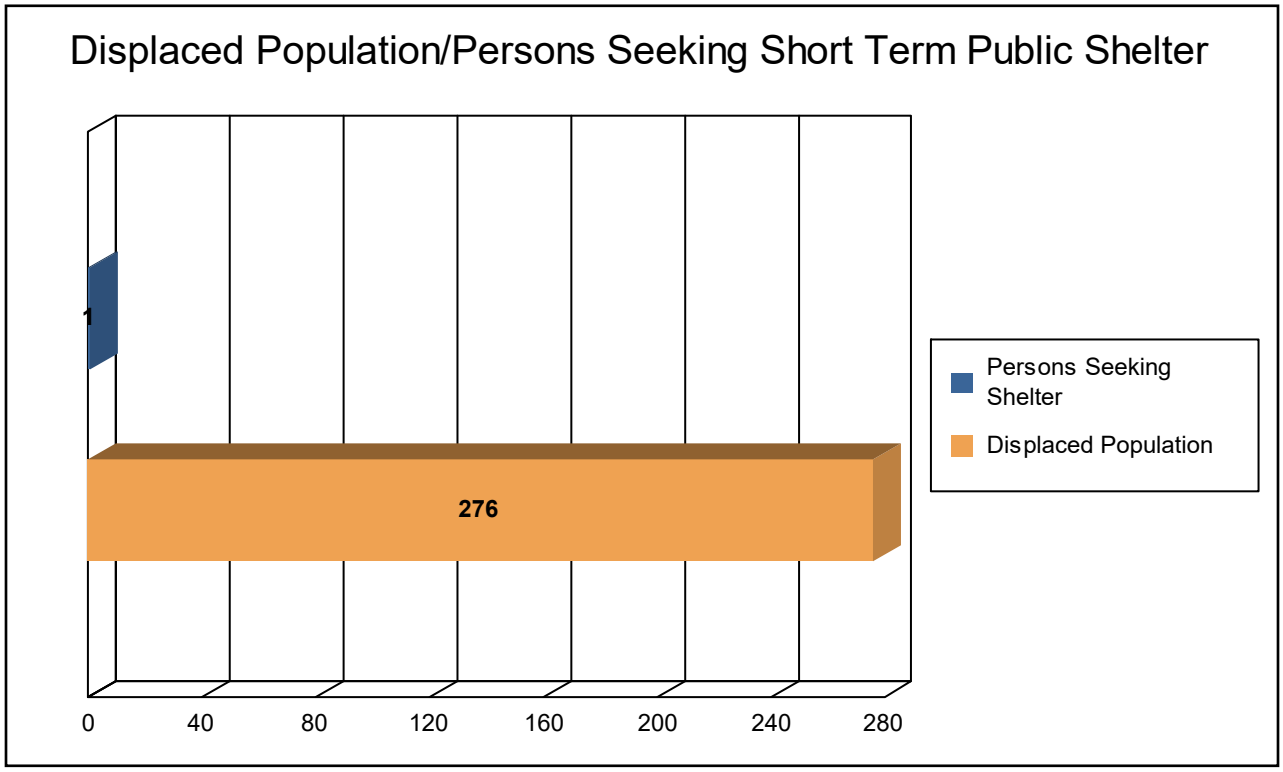


The model estimates that a total of 85 tons of debris will be generated. Of the total amount, Finishes comprises 82% of the total, Structure comprises 8% of the total, and Foundation comprises 10%. If the debris tonnage is converted into an estimated number of truckloads, it will require 4 truckloads (@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 92 households (or 276 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 1 people (out of a total population of 6,525) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 8.94 million dollars, which represents 1.20 % of the total replacement value of the scenario buildings.

Building-Related Losses

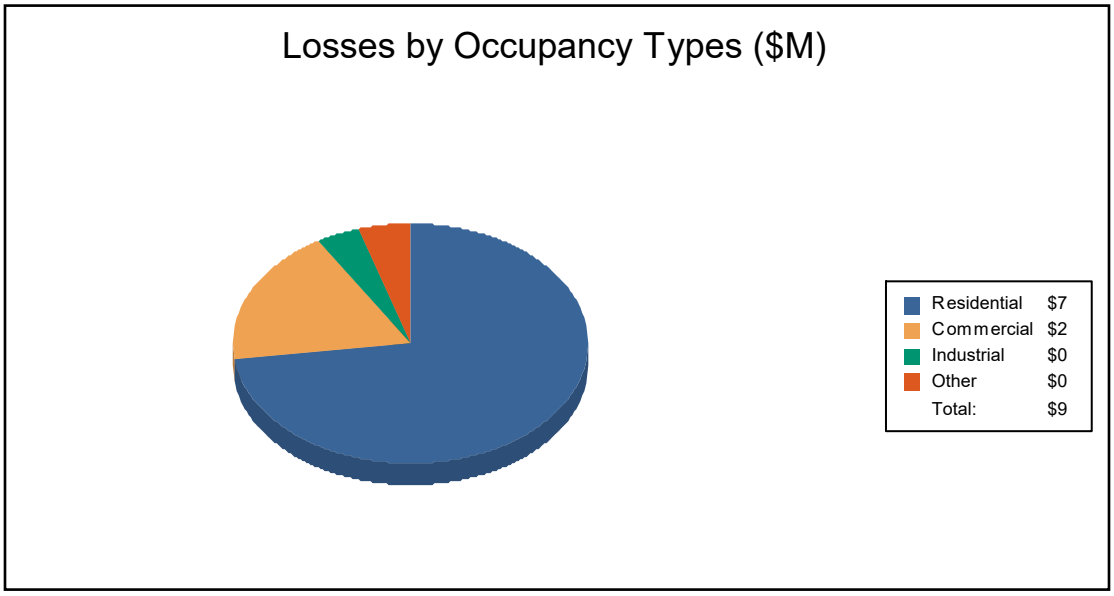
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 5.40 million dollars. 40% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 72.89% 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	3.18	0.13	0.12	0.00	3.43
	Content	1.33	0.37	0.18	0.06	1.94
	Inventory	0.00	0.00	0.02	0.00	0.02
	Subtotal	**4.51**	**0.50**	**0.33**	**0.06**	**5.40**
Business Interruption						
	Income	0.01	0.59	0.00	0.09	0.69
	Relocation	1.54	0.08	0.00	0.02	1.65
	Rental Income	0.42	0.07	0.00	0.00	0.49
	Wage	0.03	0.43	0.01	0.26	0.72
	Subtotal	**2.01**	**1.17**	**0.01**	**0.36**	**3.55**
ALL	**Total**	**6.52**	**1.67**	**0.34**	**0.42**	**8.94**



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	6,525	876,705	108,013	984,718
Total	**6,525**	**876,705**	**108,013**	**984,718**
Total Study Region	**6,525**	**876,705**	**108,013**	**984,718**

Hazus: Flood Global Risk Report

Region Name: Killingworth

Flood Scenario: KillingworthAll

Print Date: Thursday, December 26, 2019

Disclaimer:
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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

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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.

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General Building Stock

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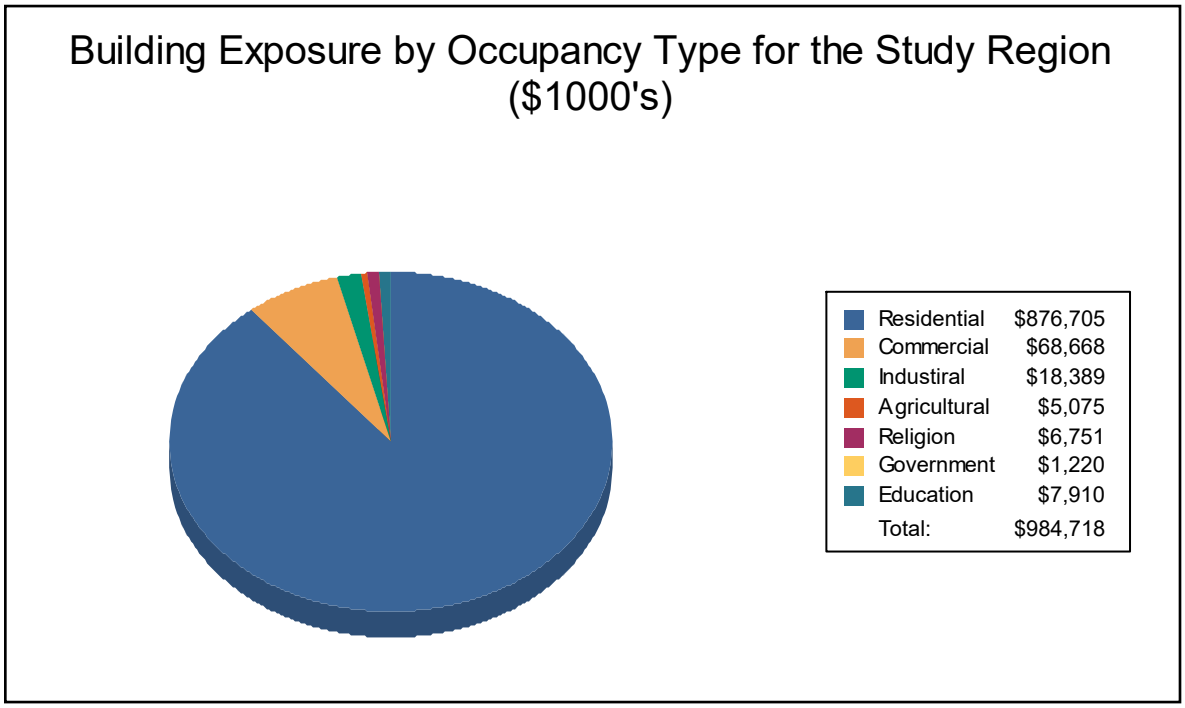

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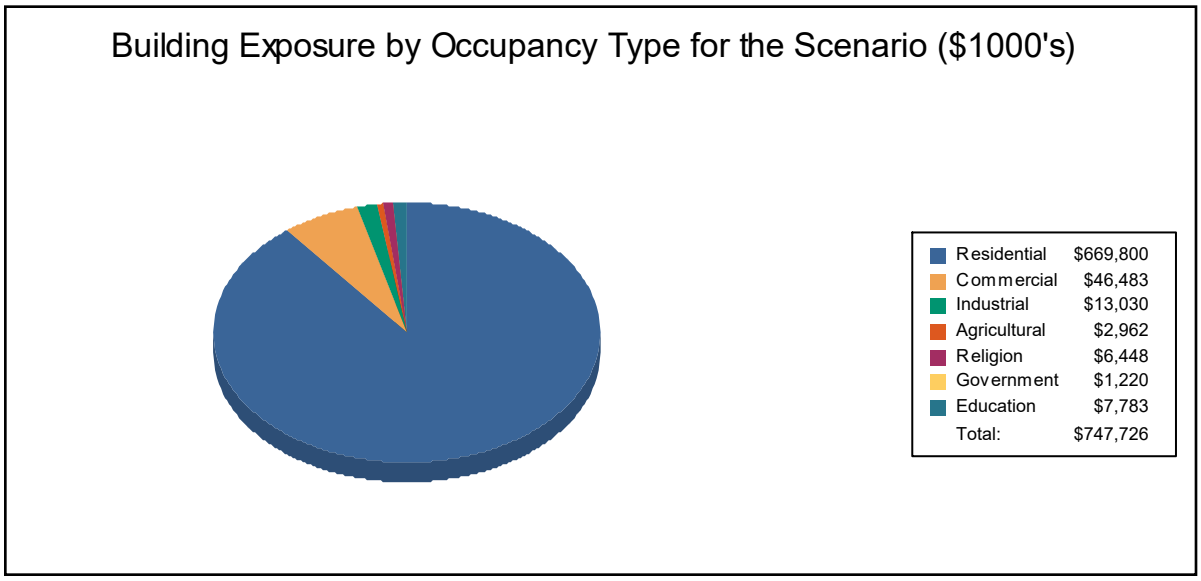


Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 2 schools, 2 fire stations, 1 police station and 1 emergency operation center.

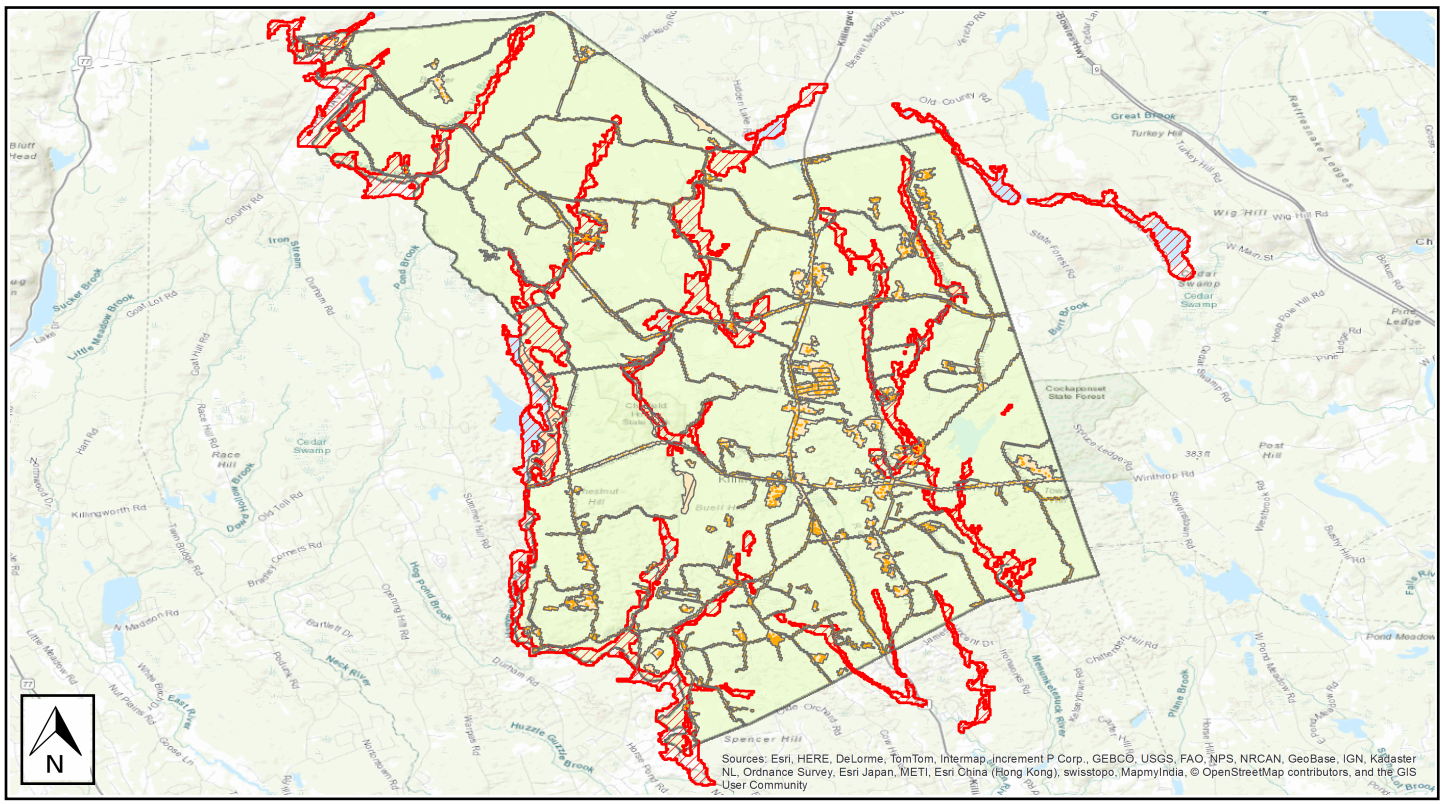
Flood Scenario Parameters

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

Study Region Name:	Killingworth
Scenario Name:	KillingworthAll
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 12 buildings will be at least moderately damaged. This is over 89% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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

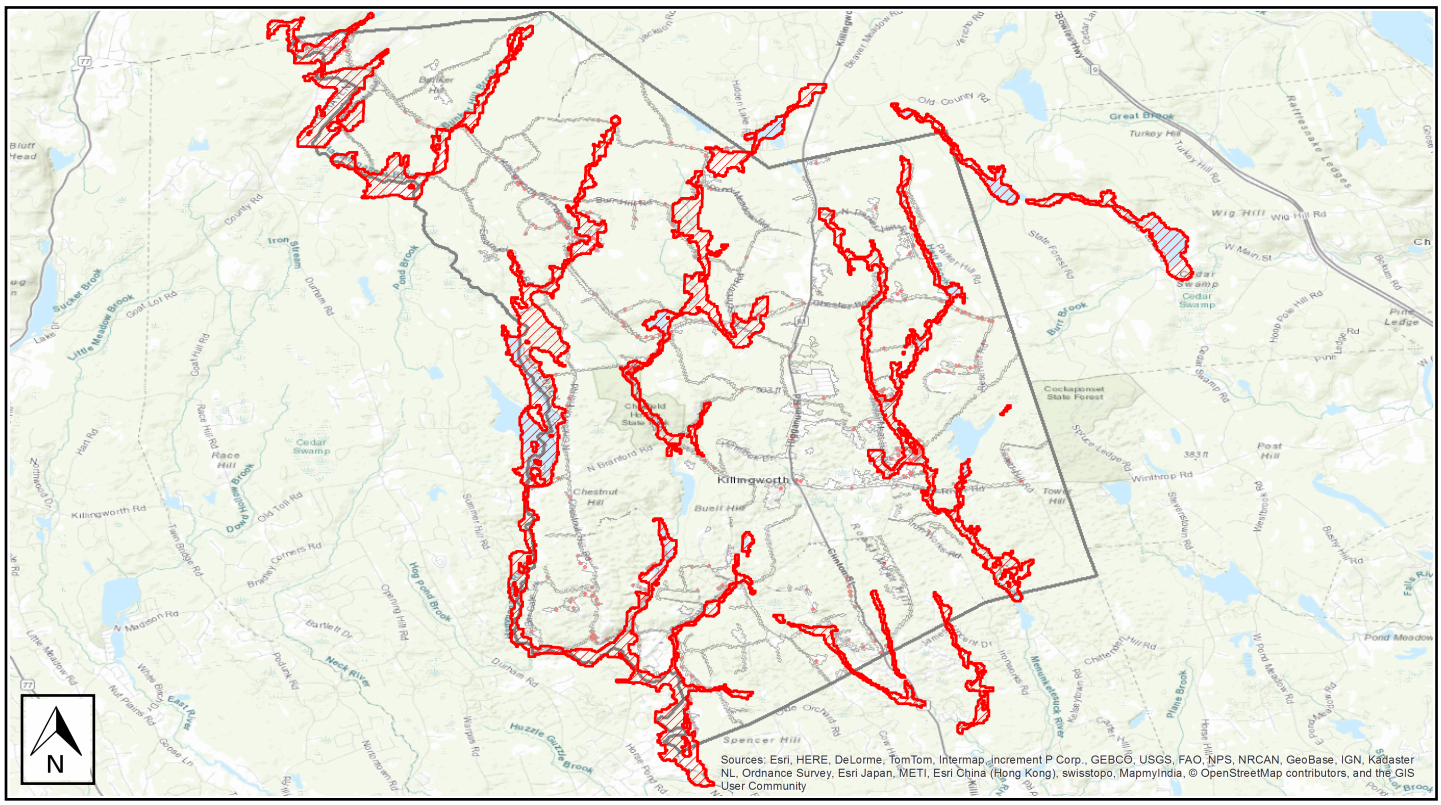


Table 3: Expected Building Damage by Occupancy

	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	0	0	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	27	69	11	28	1	3	0	0	0	0	0	0
Total	**27**		**11**		**1**		**0**		**0**		**0**	

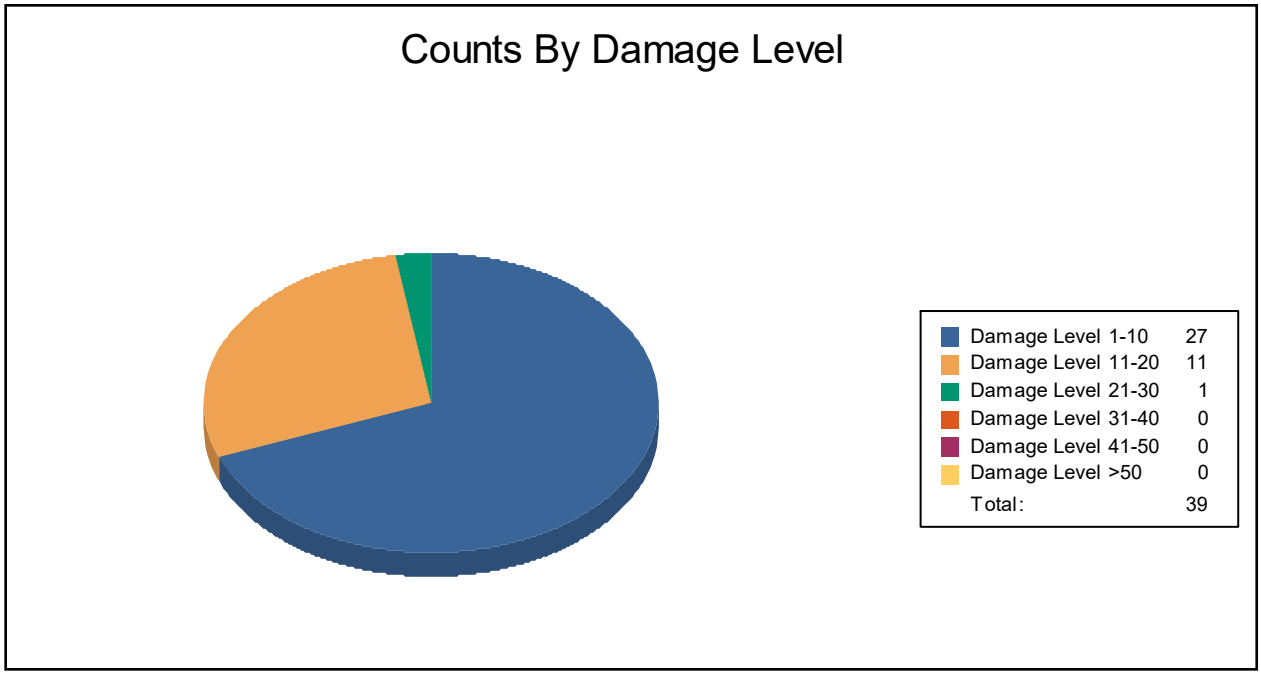


Table 4: Expected Building Damage by Building Type

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	0	0	0	0	0	0	0	0	0	0	0	0
Wood	27	69	11	28	1	3	0	0	0	0	0	0

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	2	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	2	0	0	0

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

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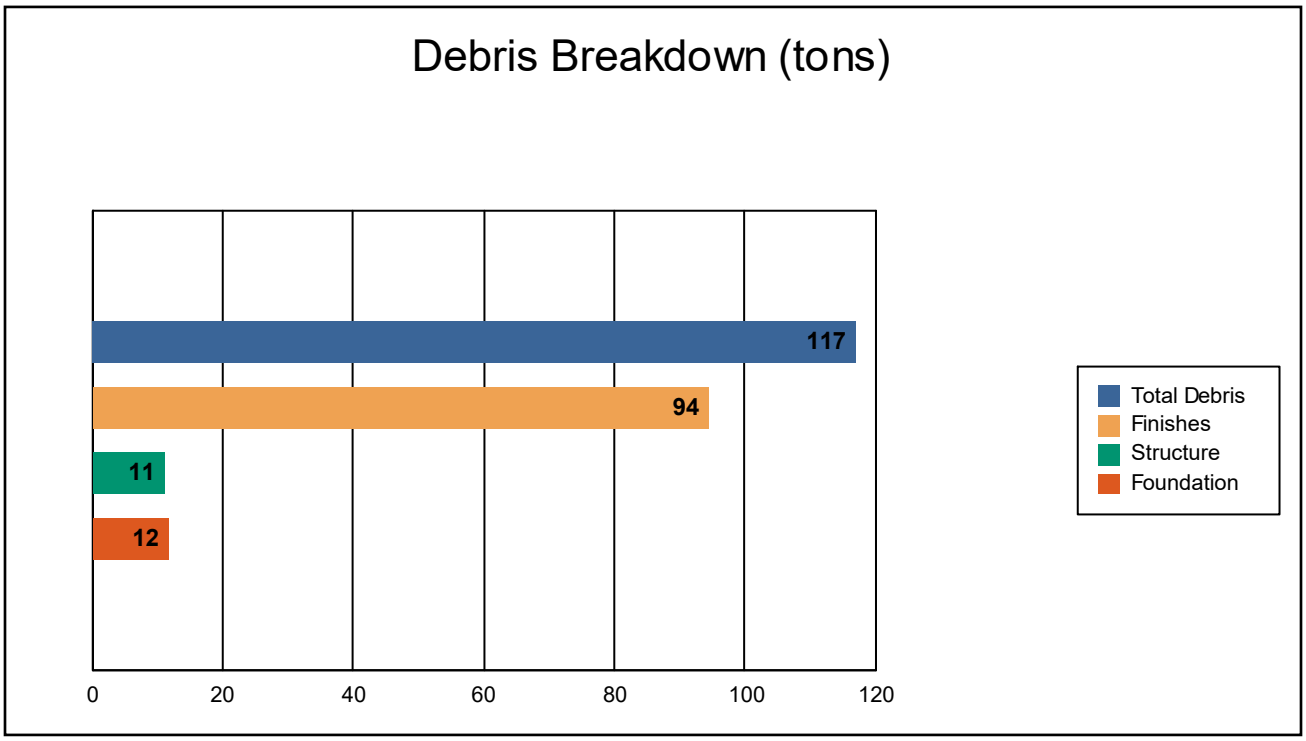
(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

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.

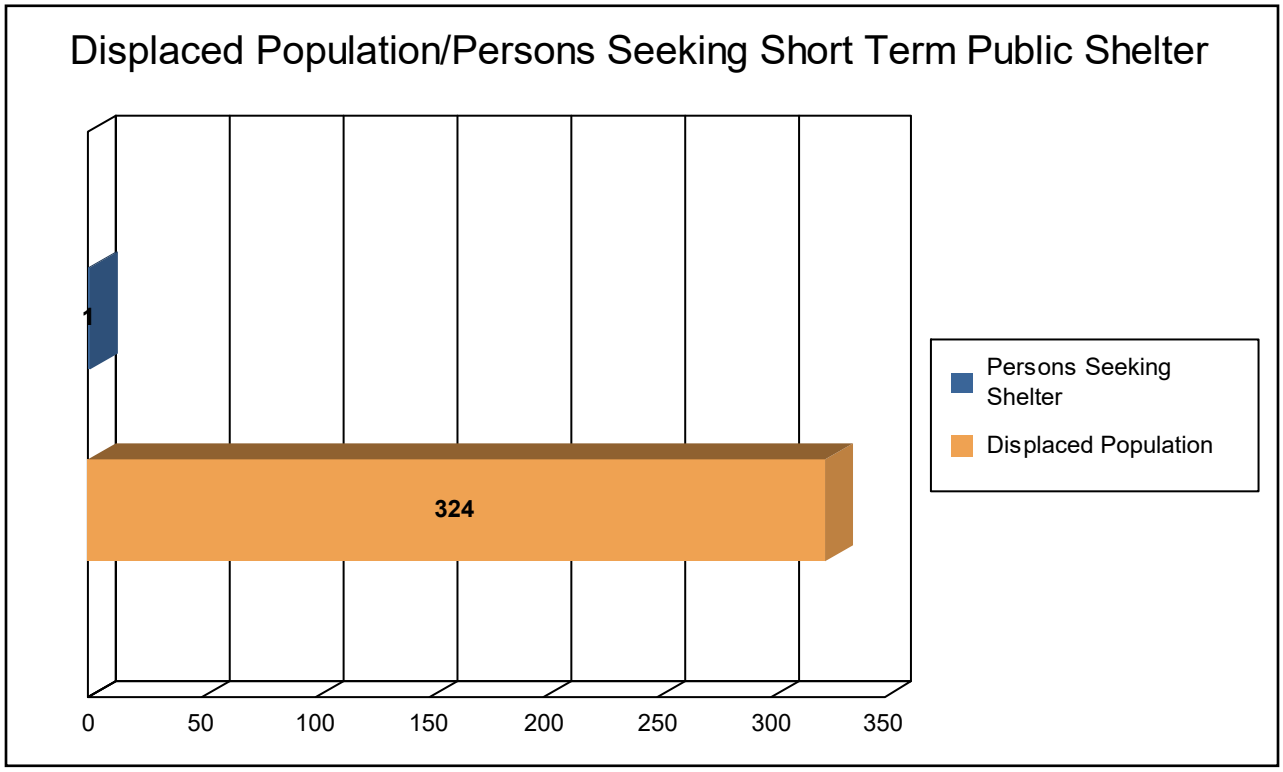


The model estimates that a total of 117 tons of debris will be generated. Of the total amount, Finishes comprises 81% of the total, Structure comprises 9% of the total, and Foundation comprises 10%. If the debris tonnage is converted into an estimated number of truckloads, it will require 5 truckloads (@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 108 households (or 324 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 1 people (out of a total population of 6,525) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 11.53 million dollars, which represents 1.54 % of the total replacement value of the scenario buildings.

Building-Related Losses

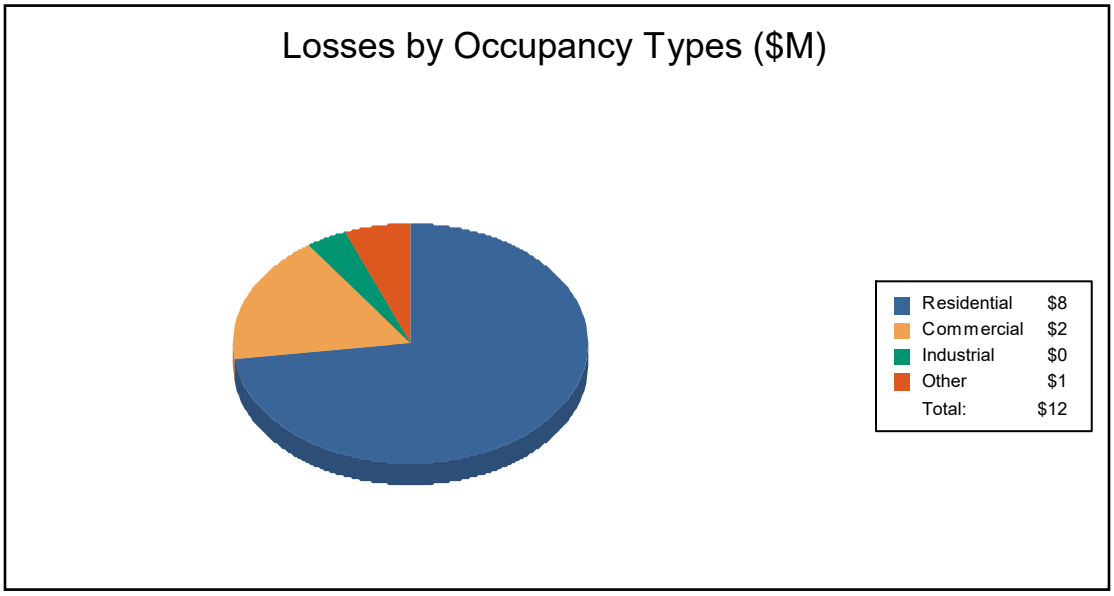
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 7.16 million dollars. 38% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 72.84% 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	4.21	0.17	0.16	0.00	4.53
	Content	1.80	0.47	0.23	0.10	2.60
	Inventory	0.00	0.00	0.03	0.00	0.03
	Subtotal	**6.00**	**0.64**	**0.41**	**0.11**	**7.16**
Business Interruption						
	Income	0.02	0.68	0.00	0.15	0.85
	Relocation	1.84	0.09	0.00	0.05	1.98
	Rental Income	0.51	0.07	0.00	0.00	0.58
	Wage	0.04	0.53	0.01	0.40	0.97
	Subtotal	**2.40**	**1.37**	**0.01**	**0.60**	**4.38**
ALL	**Total**	**8.40**	**2.01**	**0.42**	**0.71**	**11.53**



Appendix A: County Listing for the Region

Connecticut

- Middlesex

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
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Middlesex	6,525	876,705	108,013	984,718
Total	**6,525**	**876,705**	**108,013**	**984,718**
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Hazus: Flood Global Risk Report

Region Name: Killingworth

Flood Scenario: KillingworthAll

Print Date: Thursday, December 26, 2019

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Education	7,910	0.8%
Total	**984,718**	**100%**

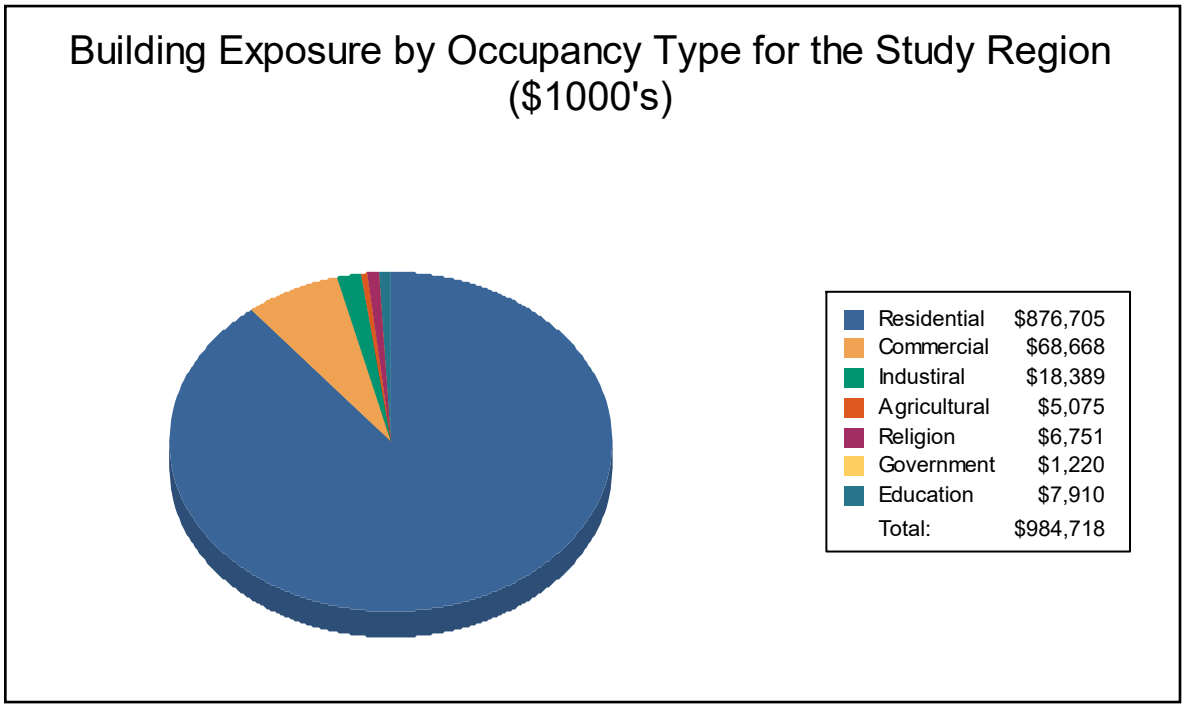
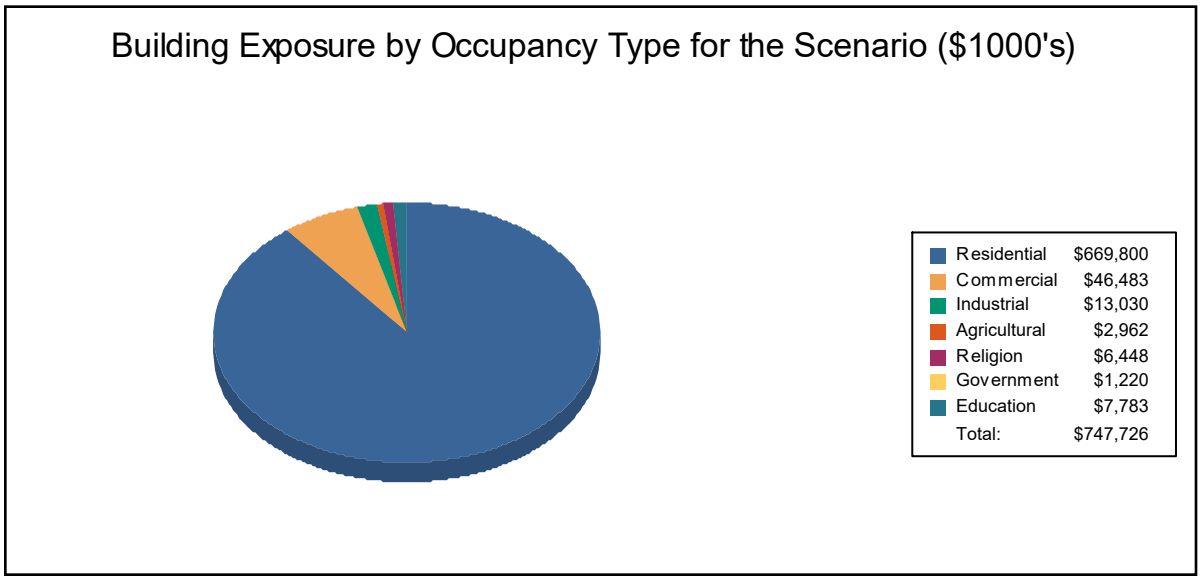


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	669,800	89.6%
Commercial	46,483	6.2%
Industrial	13,030	1.7%
Agricultural	2,962	0.4%
Religion	6,448	0.9%
Government	1,220	0.2%
Education	7,783	1.0%
Total	**747,726**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 2 schools, 2 fire stations, 1 police station and 1 emergency operation center.

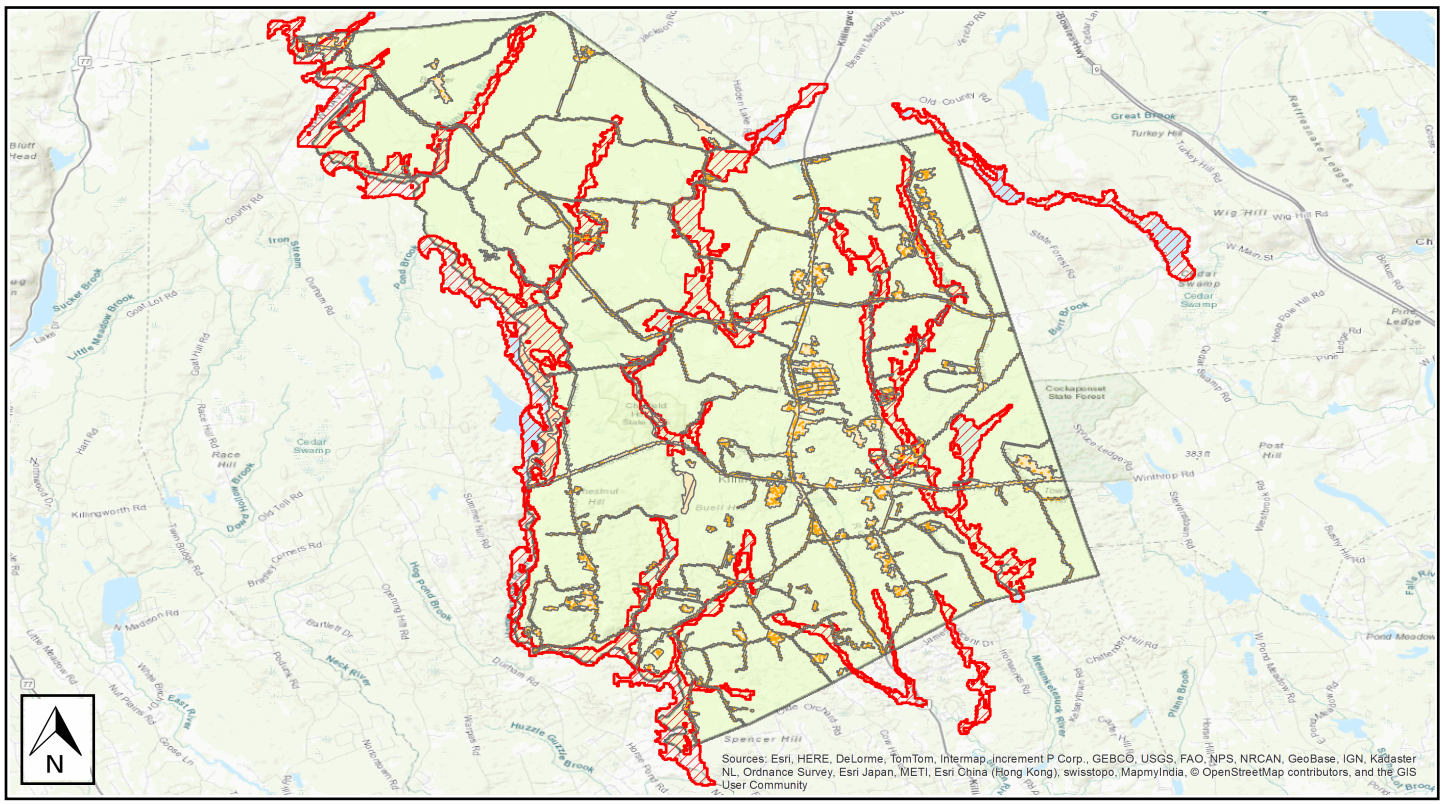
Flood Scenario Parameters

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

Study Region Name:	Killingworth
Scenario Name:	KillingworthAll
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 24 buildings will be at least moderately damaged. This is over 94% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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

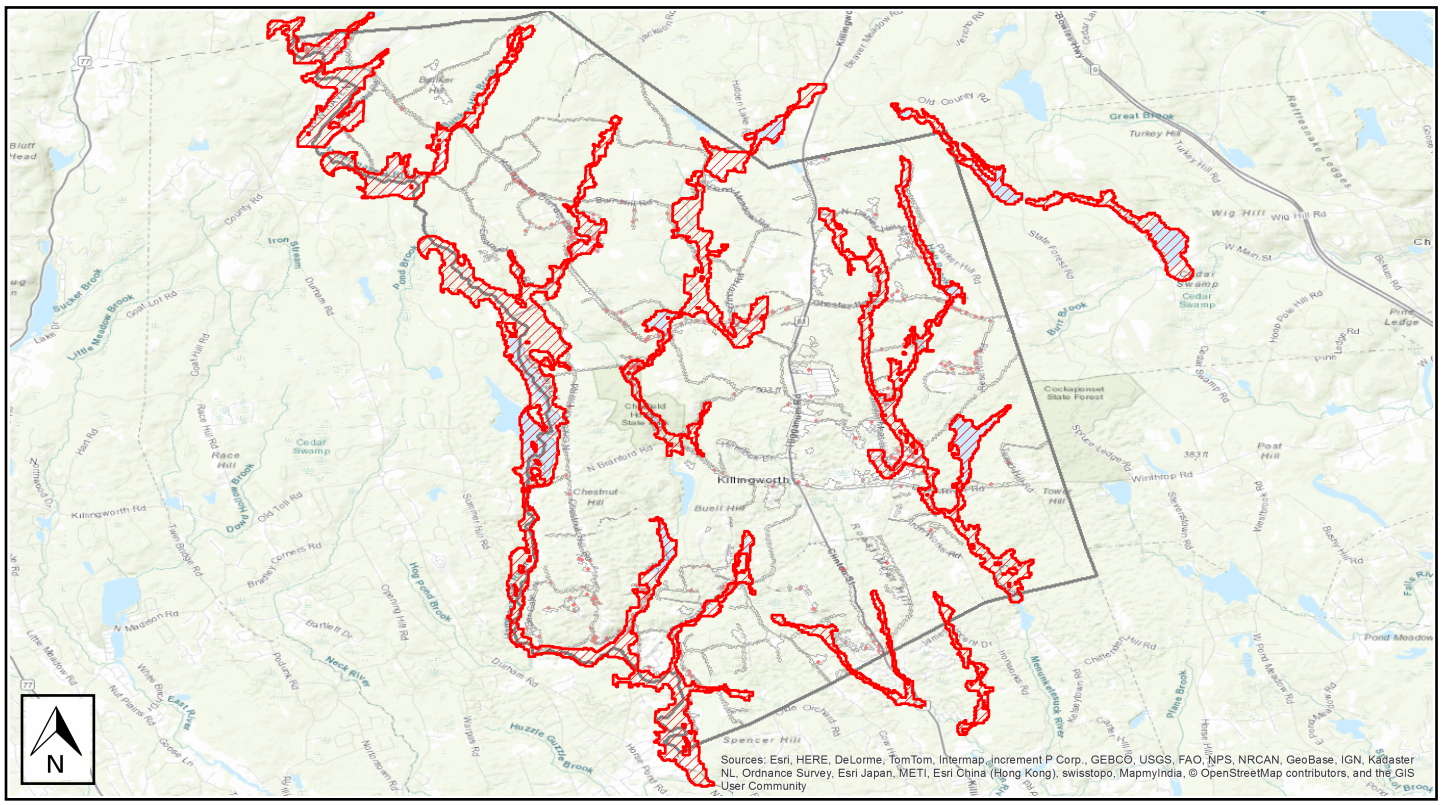


Table 3: Expected Building Damage by Occupancy

	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	0	0	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	22	48	22	48	2	4	0	0	0	0	0	0
Total	**22**		**22**		**2**		**0**		**0**		**0**	

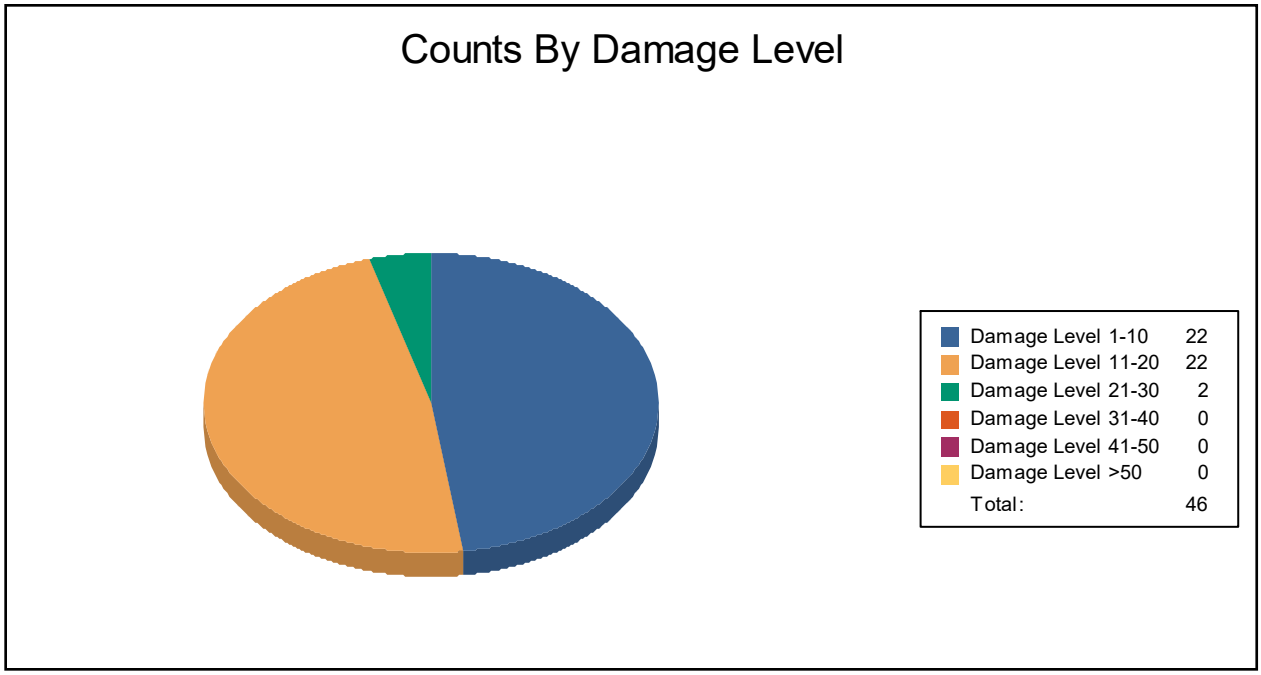


Table 4: Expected Building Damage by Building Type

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	0	0	0	0	0	0	0	0	0	0	0	0
Wood	22	48	22	48	2	4	0	0	0	0	0	0

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	2	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	2	0	0	0

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

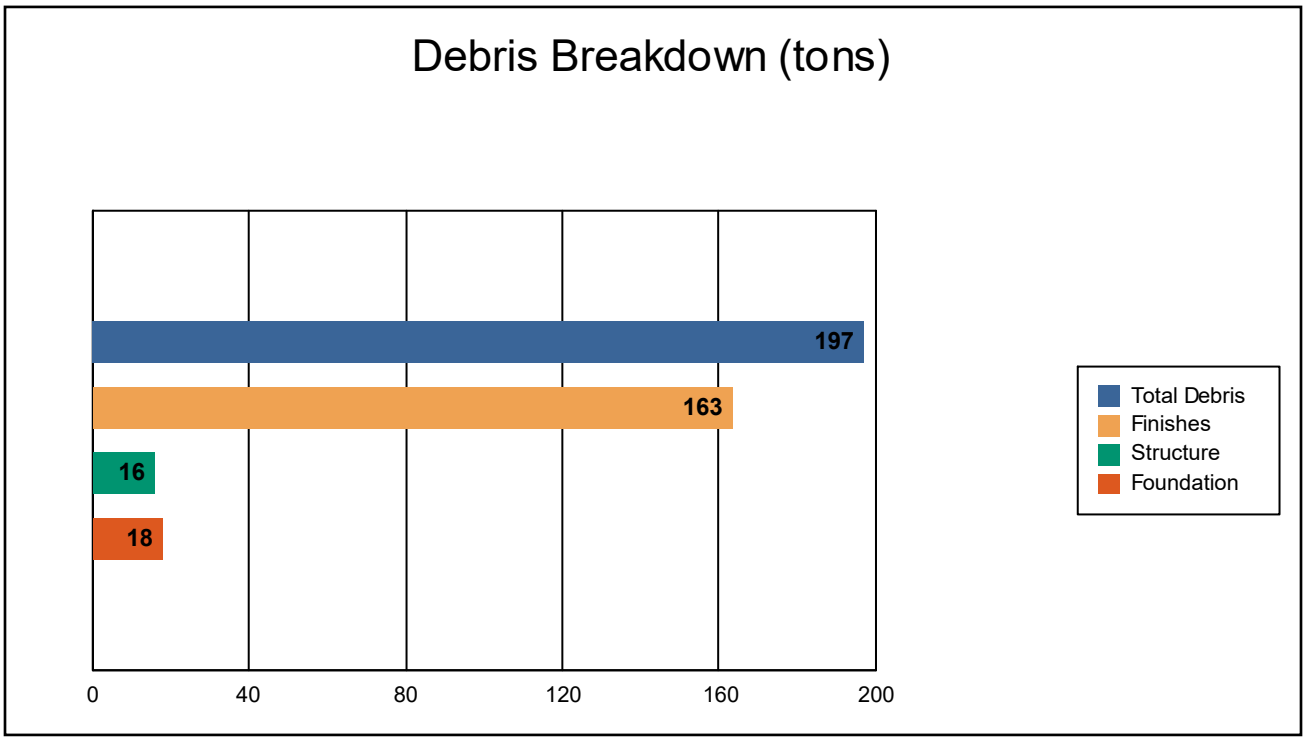
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(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.

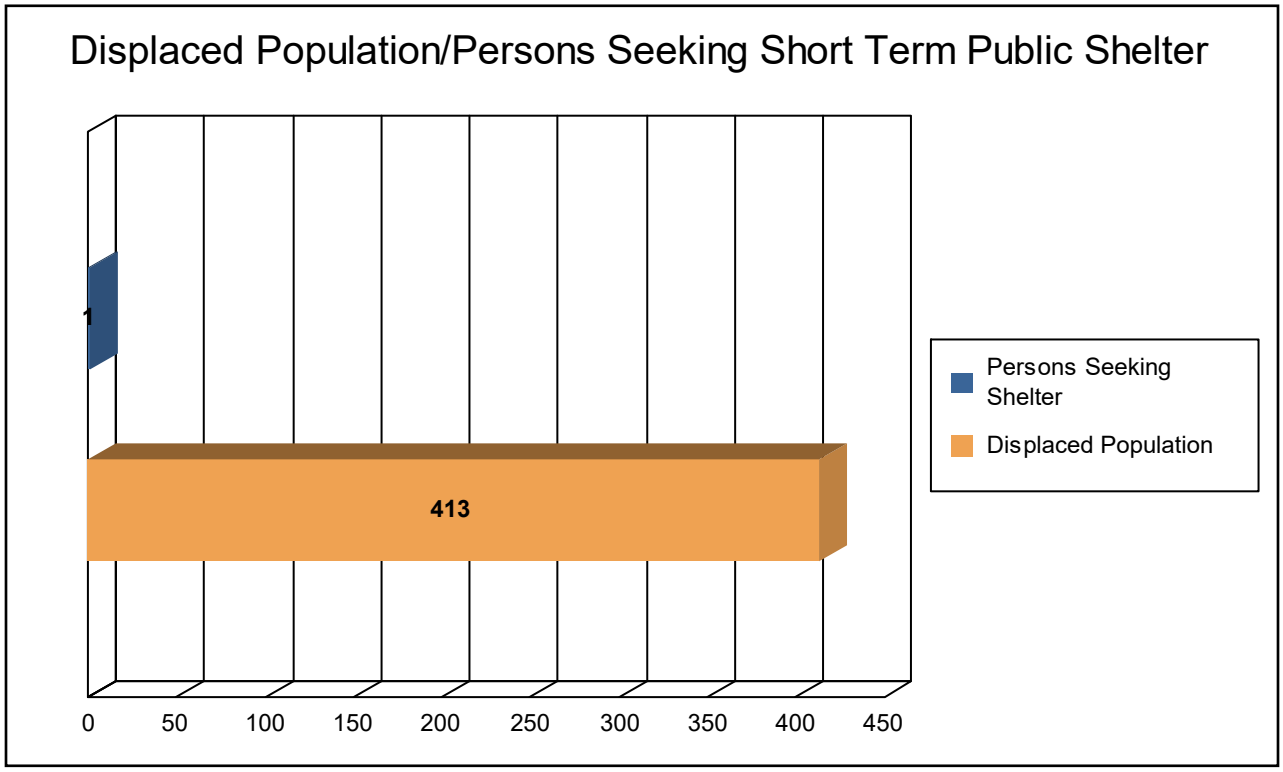


The model estimates that a total of 197 tons of debris will be generated. Of the total amount, Finishes comprises 83% of the total, Structure comprises 8% of the total, and Foundation comprises 9%. If the debris tonnage is converted into an estimated number of truckloads, it will require 8 truckloads (@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 138 households (or 413 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 1 people (out of a total population of 6,525) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 16.82 million dollars, which represents 2.25 % of the total replacement value of the scenario buildings.

Building-Related Losses

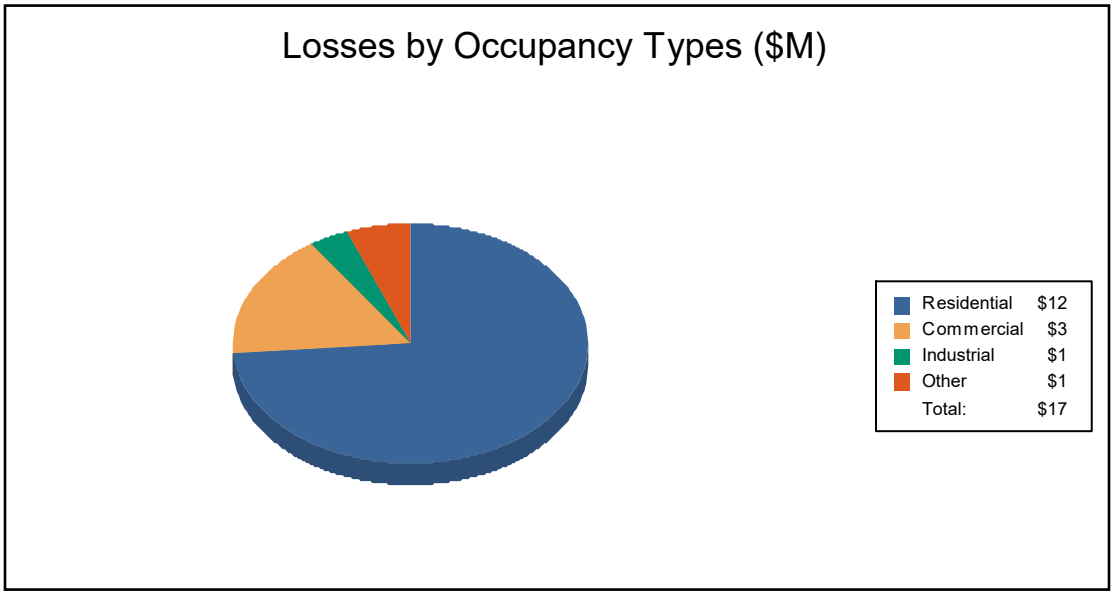
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 11.03 million dollars. 34% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 73.55% 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	6.48	0.27	0.22	0.02	6.99
	Content	2.74	0.72	0.32	0.21	3.99
	Inventory	0.00	0.01	0.04	0.00	0.05
	Subtotal	**9.22**	**0.99**	**0.58**	**0.24**	**11.03**
Business Interruption						
	Income	0.02	0.93	0.00	0.19	1.13
	Relocation	2.42	0.13	0.00	0.06	2.60
	Rental Income	0.67	0.10	0.00	0.00	0.77
	Wage	0.05	0.71	0.02	0.51	1.28
	Subtotal	**3.15**	**1.86**	**0.02**	**0.76**	**5.79**
ALL	**Total**	**12.37**	**2.85**	**0.60**	**1.00**	**16.82**



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	6,525	876,705	108,013	984,718
Total	**6,525**	**876,705**	**108,013**	**984,718**
Total Study Region	**6,525**	**876,705**	**108,013**	**984,718**

Hazus: Hurricane Global Risk Report

Region Name: Killingworth

Hurricane Scenario: UN-NAMED-1938-4

Print Date: Friday, October 11, 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 35.78 square miles and contains 1 census tracts. There are over 2 thousand households in the region and a total population of 6,525 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 2 thousand buildings in the region with a total building replacement value (excluding contents) of 985 million dollars (2014 dollars). Approximately 92% of the buildings (and 89% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 2,824 buildings in the region which have an aggregate total replacement value of 985 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.

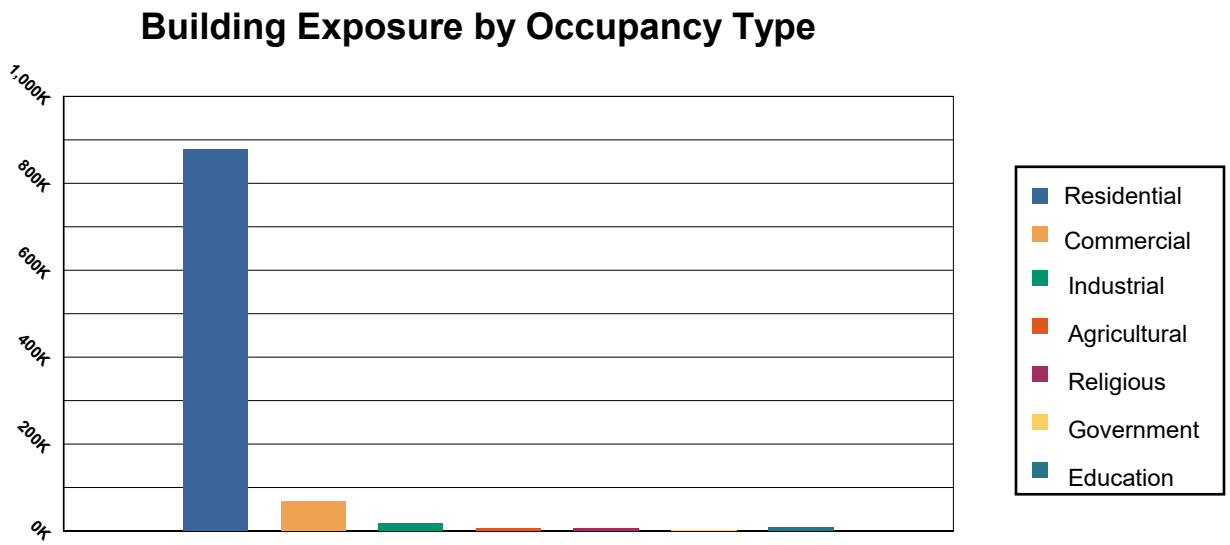


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	876,705	89.03%
Commercial	68,668	6.97%
Industrial	18,389	1.87%
Agricultural	5,075	0.52%
Religious	6,751	0.69%
Government	1,220	0.12%
Education	7,910	0.80%
Total	**984,718**	**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 2 schools, 2 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:	111 mph

Building Damage

General Building Stock Damage

Hazus estimates that about 133 buildings will be at least moderately damaged. This is over 5% of the total number of buildings in the region. There are an estimated 7 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.

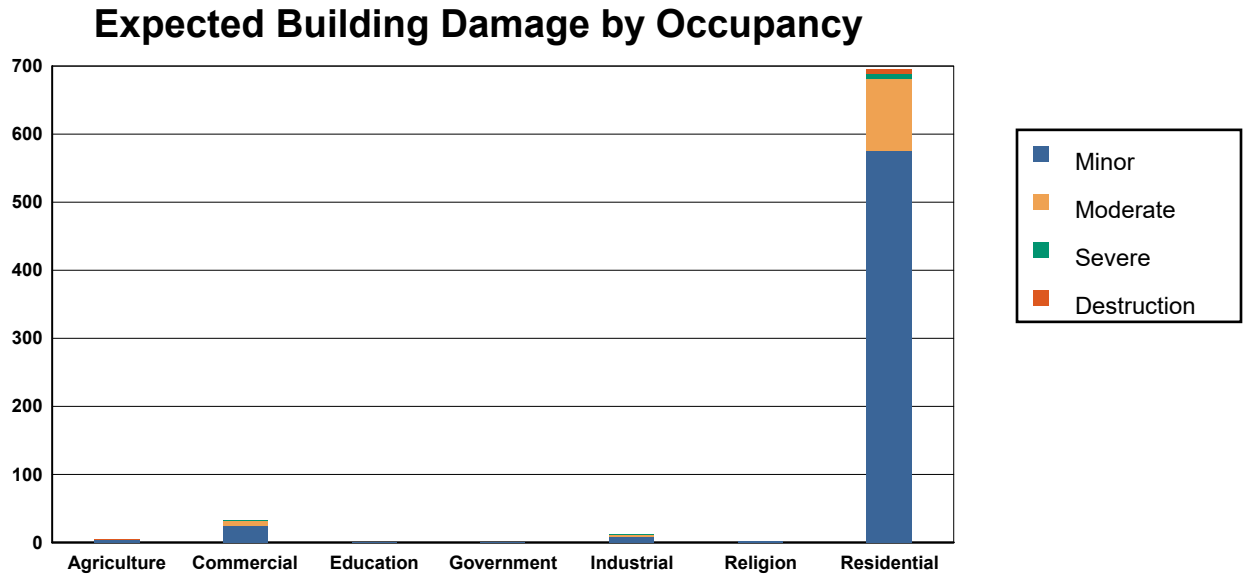


Table 2: Expected Building Damage by Occupancy

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	12.19	71.69	3.29	19.37	0.98	5.79	0.47	2.79	0.06	0.37
Commercial	113.69	77.87	24.26	16.62	7.06	4.84	0.98	0.67	0.01	0.00
Education	3.15	78.84	0.67	16.70	0.17	4.21	0.01	0.25	0.00	0.00
Government	1.58	78.82	0.33	16.48	0.09	4.44	0.01	0.26	0.00	0.00
Industrial	43.45	79.00	8.71	15.83	2.42	4.39	0.39	0.71	0.04	0.07
Religion	6.18	77.31	1.49	18.60	0.31	3.86	0.02	0.23	0.00	0.00
Residential	1,896.80	73.18	575.42	22.20	105.84	4.08	7.41	0.29	6.53	0.25
Total	**2,077.05**		**614.16**		**116.87**		**9.29**		**6.63**	

Table 3: Expected Building Damage by Building Type

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	6	80.20	1	15.35	0	4.20	0	0.25	0	0.00
Masonry	79	73.95	21	19.73	6	5.37	1	0.81	0	0.15
MH	237	88.09	18	6.71	11	3.95	0	0.19	3	1.07
Steel	82	79.95	15	14.70	5	4.59	1	0.75	0	0.01
Wood	1,613	71.64	538	23.88	91	4.03	7	0.30	3	0.15

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.

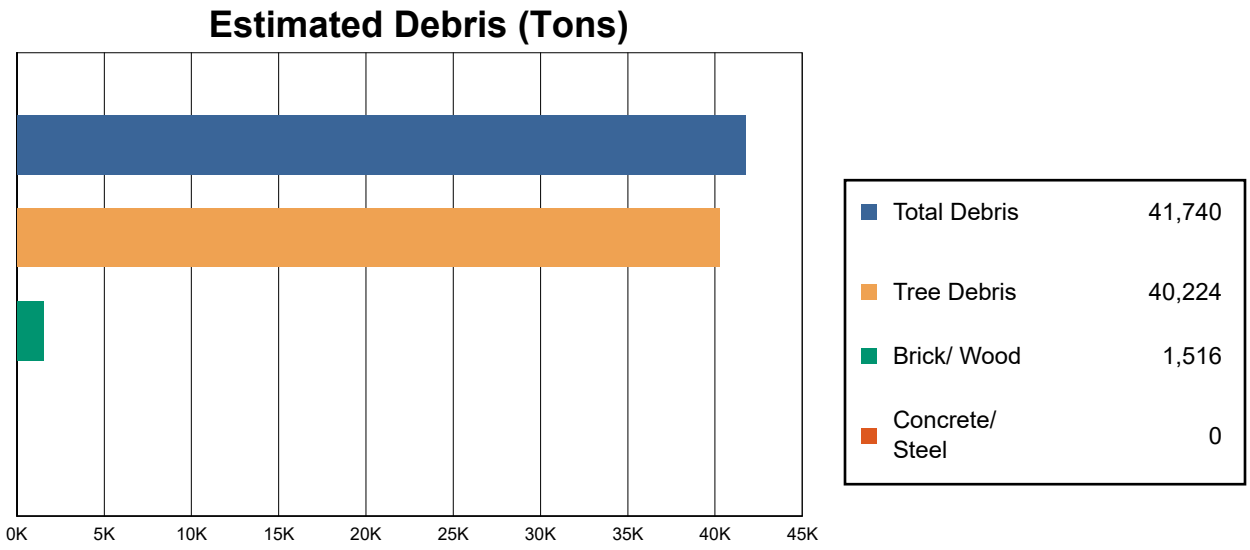
Thematic Map of Essential Facilities with greater than 50% moderate

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	2	0	0	2
Police Stations	1	0	0	1
Schools	2	0	0	2

Induced Hurricane Damage

Debris Generation

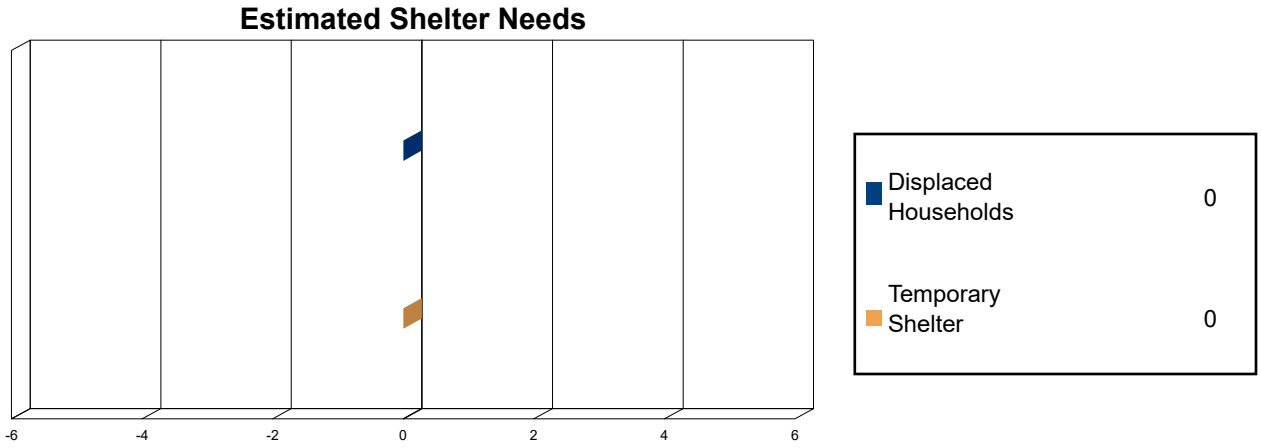


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 41,740 tons of debris will be generated. Of the total amount, 36,764 tons (88%) is Other Tree Debris. Of the remaining 4,976 tons, Brick/Wood comprises 30% 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 3,460 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 6,525) will seek temporary shelter in public shelters.

Economic Loss

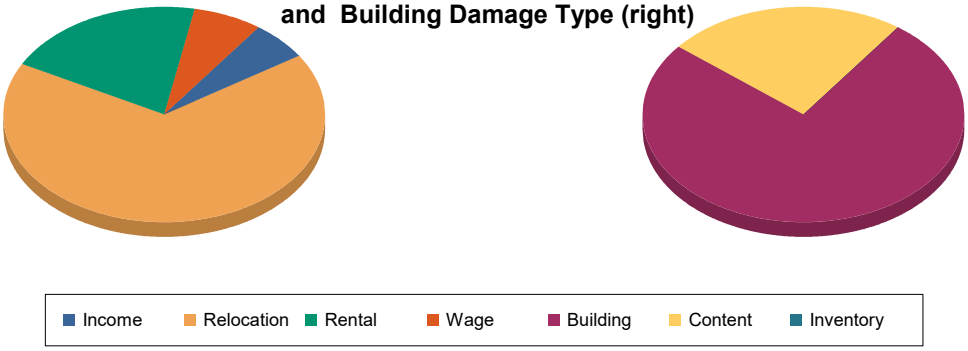
The total economic loss estimated for the hurricane is 28.8 million dollars, which represents 2.92 % of the total replacement value of the region's buildings.

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 29 million dollars. 6% 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 94% 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

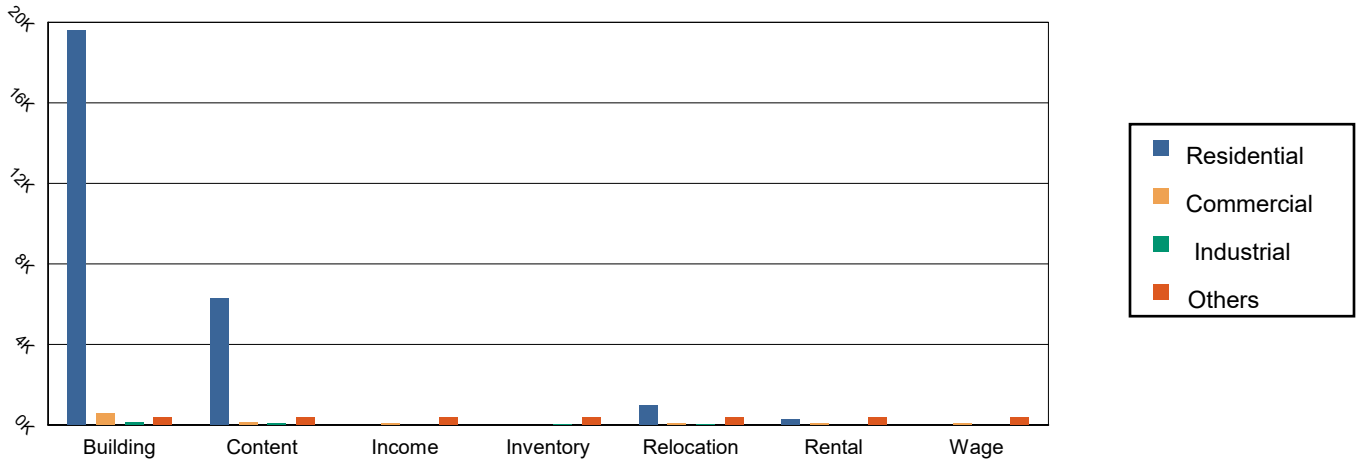


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	19,587.02	595.52	150.03	208.79	20,541.36
	Content	6,282.11	141.61	66.75	61.18	6,551.65
	Inventory	0.00	3.15	10.39	3.67	17.21
	Subtotal	**25,869.12**	**740.28**	**227.18**	**273.64**	**27,110.22**
Business Interruption Loss						
	Income	0.00	83.17	1.81	15.64	100.62
	Relocation	982.53	100.28	11.33	35.12	1,129.26
	Rental	278.39	60.96	1.38	2.48	343.20
	Wage	0.00	68.43	3.16	48.00	119.59
	Subtotal	**1,260.92**	**312.85**	**17.68**	**101.24**	**1,692.68**

Total

Total	**27,130.04**	**1,053.13**	**244.86**	**374.87**	**28,802.90**

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	6,525	876,705	108,013	984,718
Total	**6,525**	**876,705**	**108,013**	**984,718**
Study Region Total	**6,525**	**876,705**	**108,013**	**984,718**

Hazus: Hurricane Global Risk Report

Region Name: Killingworth

Hurricane Scenario: Probabilistic 10-year Return Period

Print Date: Thursday, October 3, 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.

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- Connecticut

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

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There are an estimated 2 thousand buildings in the region with a total building replacement value (excluding contents) of 985 million dollars (2014 dollars). Approximately 92% of the buildings (and 89% of the building value) are associated with residential housing.

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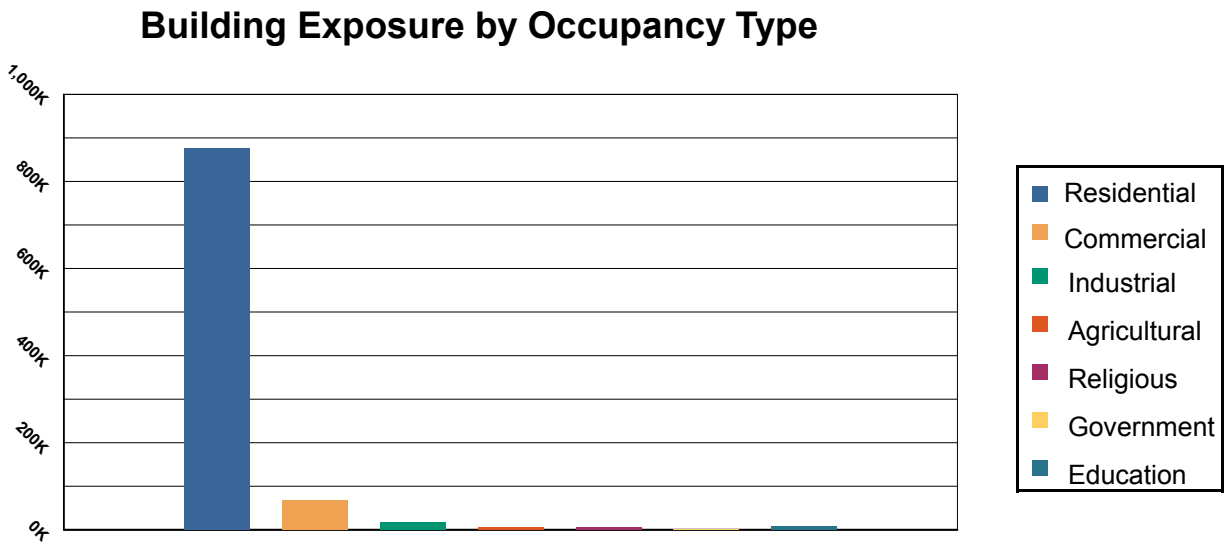
General Building Stock

Hazus estimates that there are 2,824 buildings in the region which have an aggregate total replacement value of 985 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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Residential	876,705	89.03 %
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Industrial	18,389	1.87%
Agricultural	5,075	0.52%
Religious	6,751	0.69%
Government	1,220	0.12%
Education	7,910	0.80%
Total	**984,718**	**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 2 schools, 2 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.

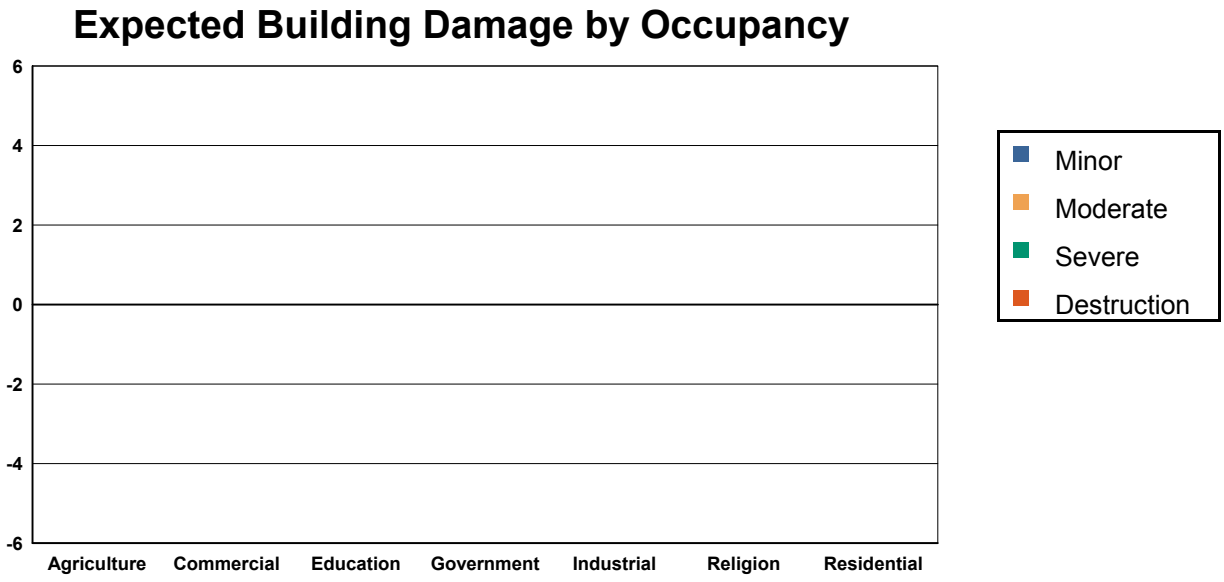


Table 2: Expected Building Damage by Occupancy : 10 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	17.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	146.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Education	4.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Government	2.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	55.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Religion	8.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential	2,592.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**2,824.00**		**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	7	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	107	100.00	0	0.00	0	0.00	0	0.00	0	0.00
MH	269	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	102	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	2,251	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.

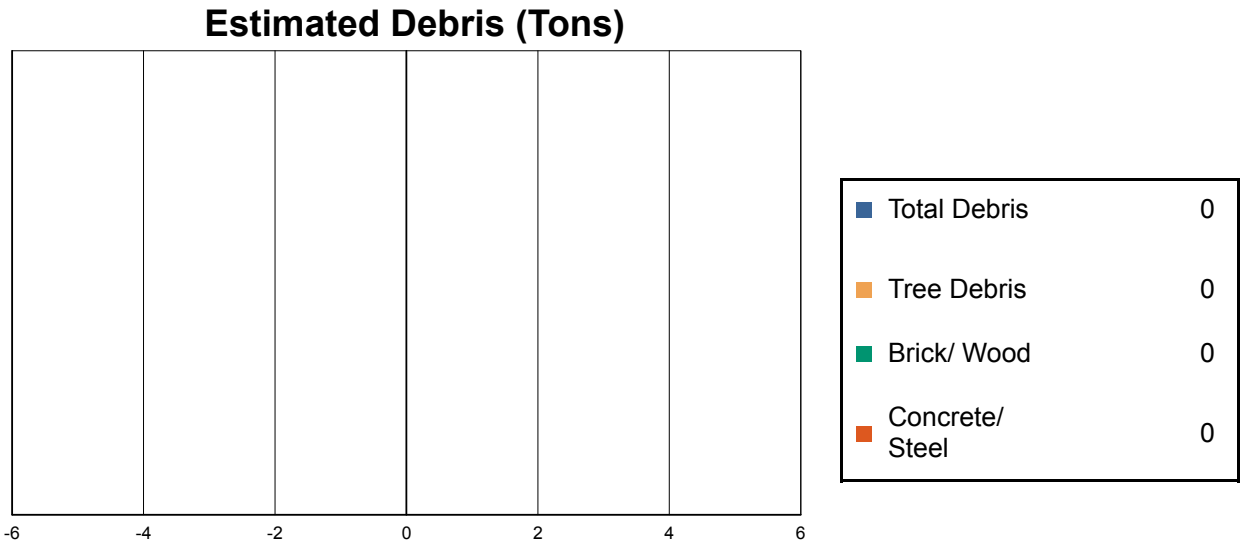
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# 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	2	0	0	2
Police Stations	1	0	0	1
Schools	2	0	0	2

Induced Hurricane Damage

Debris Generation

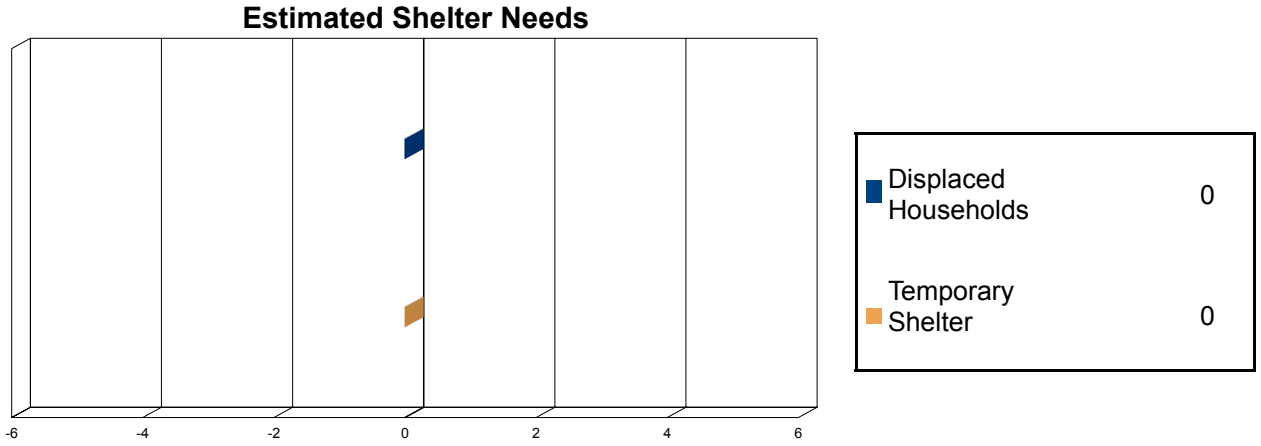


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling 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 6,525) 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)

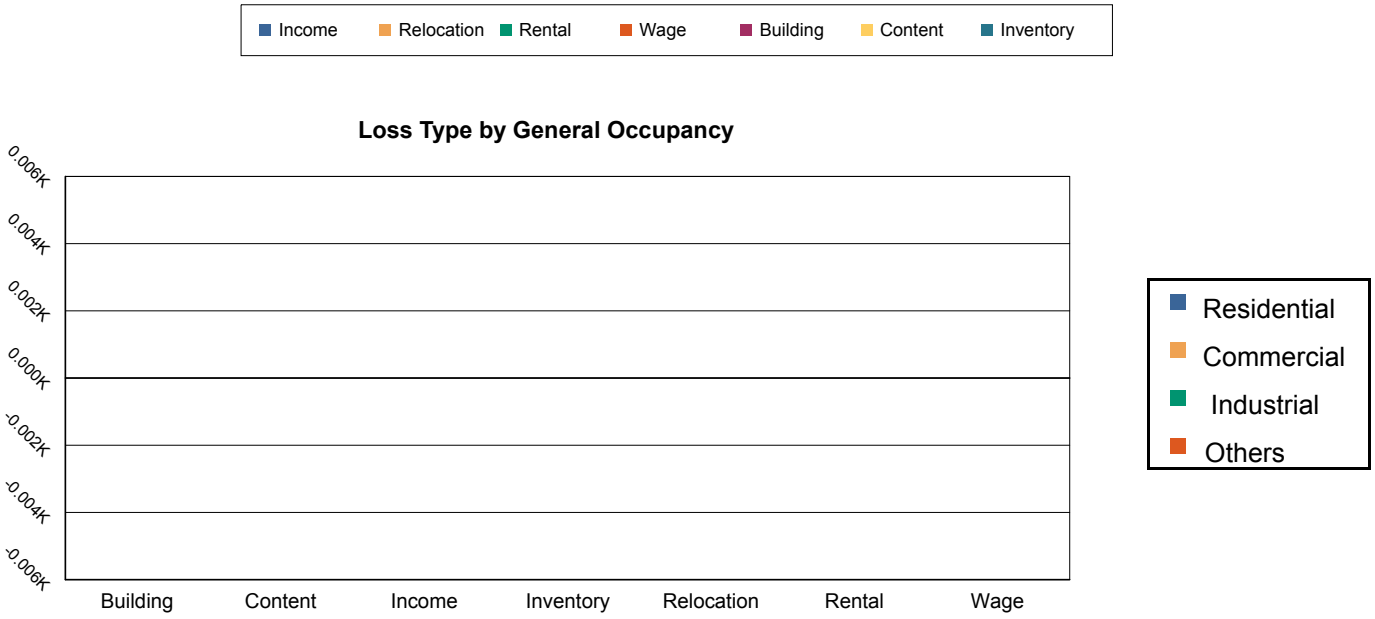


Table 5: Building-Related Economic Loss Estimates

(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	6,525	876,705	108,013	984,718
Total	**6,525**	**876,705**	**108,013**	**984,718**
Study Region Total	**6,525**	**876,705**	**108,013**	**984,718**

Hazus: Hurricane Global Risk Report

Region Name: Killingworth

Hurricane Scenario: Probabilistic 20-year Return Period

Print Date: Thursday, October 3, 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 35.78 square miles and contains 1 census tracts. There are over 2 thousand households in the region and a total population of 6,525 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 2 thousand buildings in the region with a total building replacement value (excluding contents) of 985 million dollars (2014 dollars). Approximately 92% of the buildings (and 89% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 2,824 buildings in the region which have an aggregate total replacement value of 985 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.

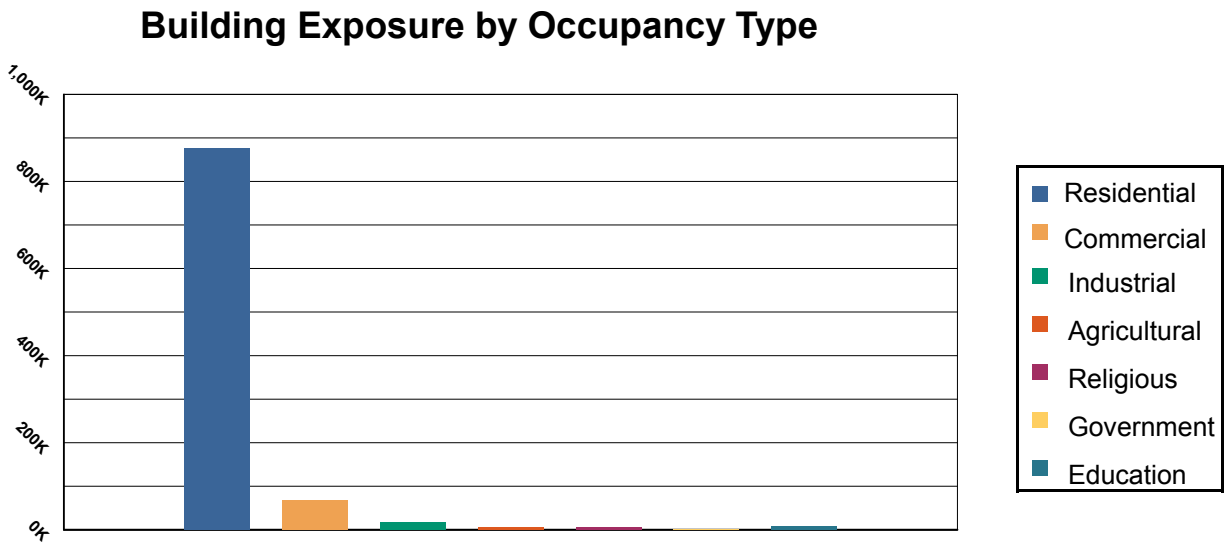


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	876,705	89.03 %
Commercial	68,668	6.97%
Industrial	18,389	1.87%
Agricultural	5,075	0.52%
Religious	6,751	0.69%
Government	1,220	0.12%
Education	7,910	0.80%
Total	**984,718**	**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 2 schools, 2 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.

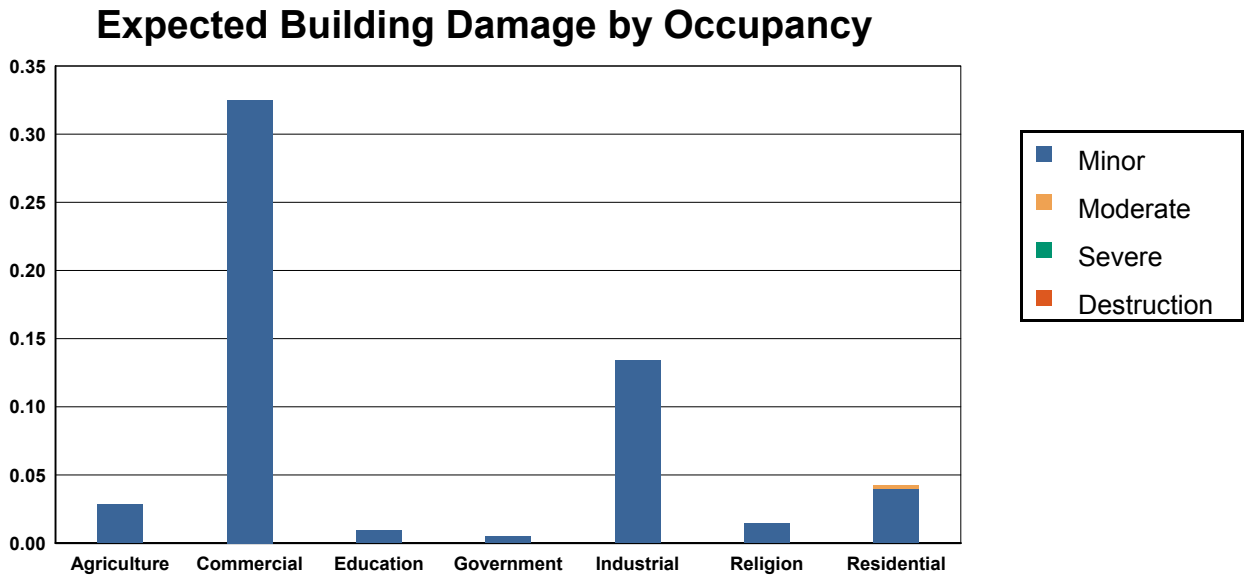


Table 2: Expected Building Damage by Occupancy : 20 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	16.97	99.83	0.03	0.17	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	145.67	99.78	0.33	0.22	0.00	0.00	0.00	0.00	0.00	0.00
Education	3.99	99.77	0.01	0.23	0.00	0.00	0.00	0.00	0.00	0.00
Government	2.00	99.76	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	54.87	99.76	0.13	0.24	0.00	0.00	0.00	0.00	0.00	0.00
Religion	7.99	99.82	0.01	0.18	0.00	0.00	0.00	0.00	0.00	0.00
Residential	2,591.96	100.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**2,823.44**		**0.56**		**0.00**		**0.00**		**0.00**	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	7	99.74	0	0.26	0	0.00	0	0.00	0	0.00
Masonry	107	99.85	0	0.15	0	0.00	0	0.00	0	0.00
MH	269	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	102	99.75	0	0.25	0	0.00	0	0.00	0	0.00
Wood	2,251	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.

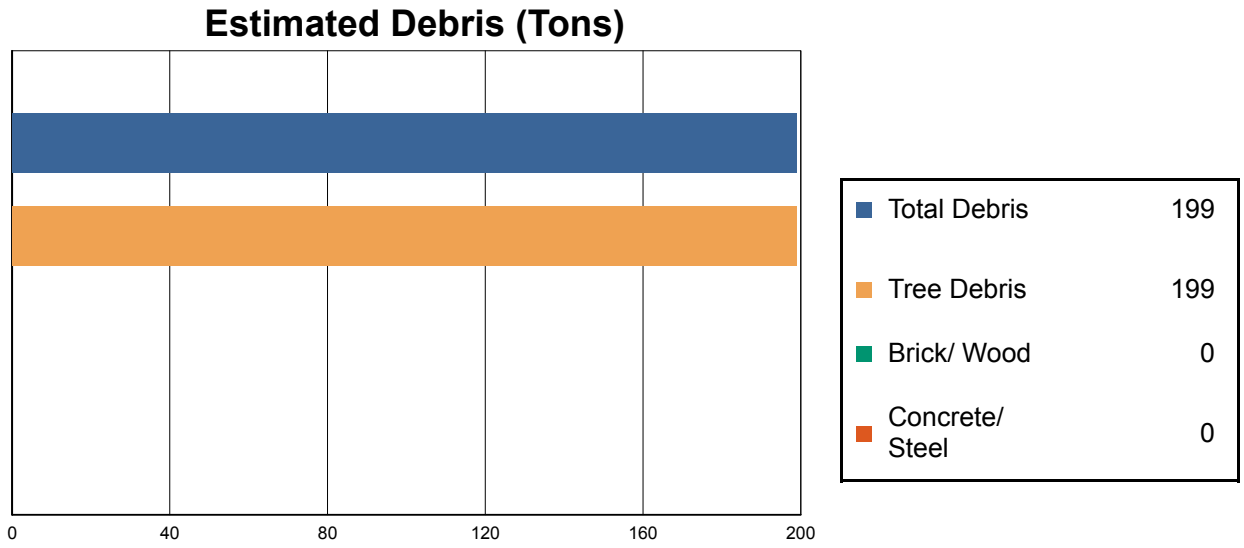
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# 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	2	0	0	2
Police Stations	1	0	0	1
Schools	2	0	0	2

Induced Hurricane Damage

Debris Generation

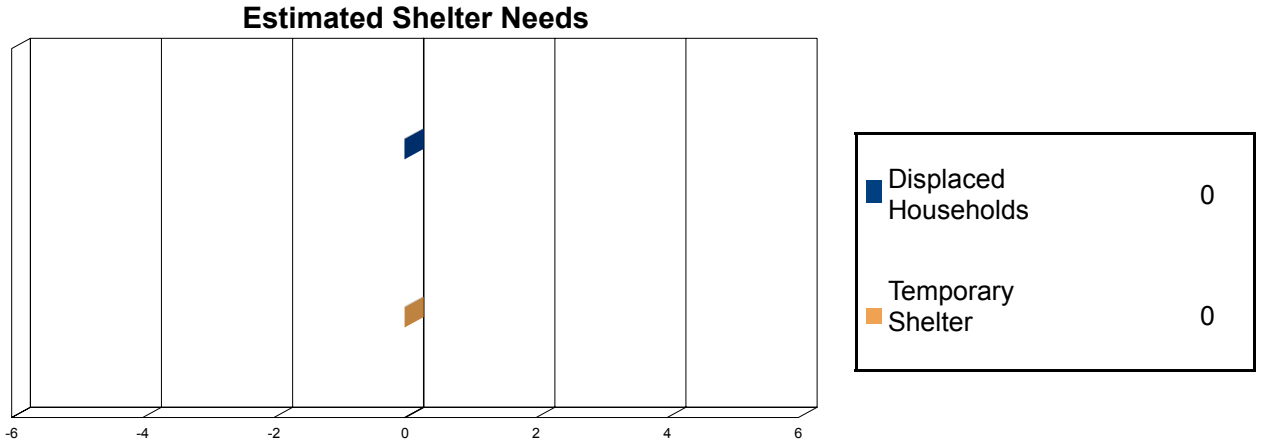


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 199 tons of debris will be generated. Of the total amount, 182 tons (91%) is Other Tree Debris. Of the remaining 17 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 17 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 6,525) will seek temporary shelter in public shelters.

Economic Loss

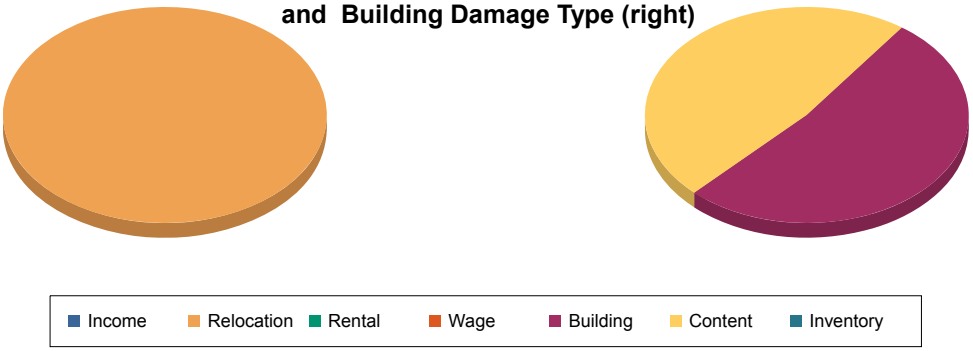
The total economic loss estimated for the hurricane is 0.0 million dollars, which represents 0.00 % of the total replacement value of the region's buildings.

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 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

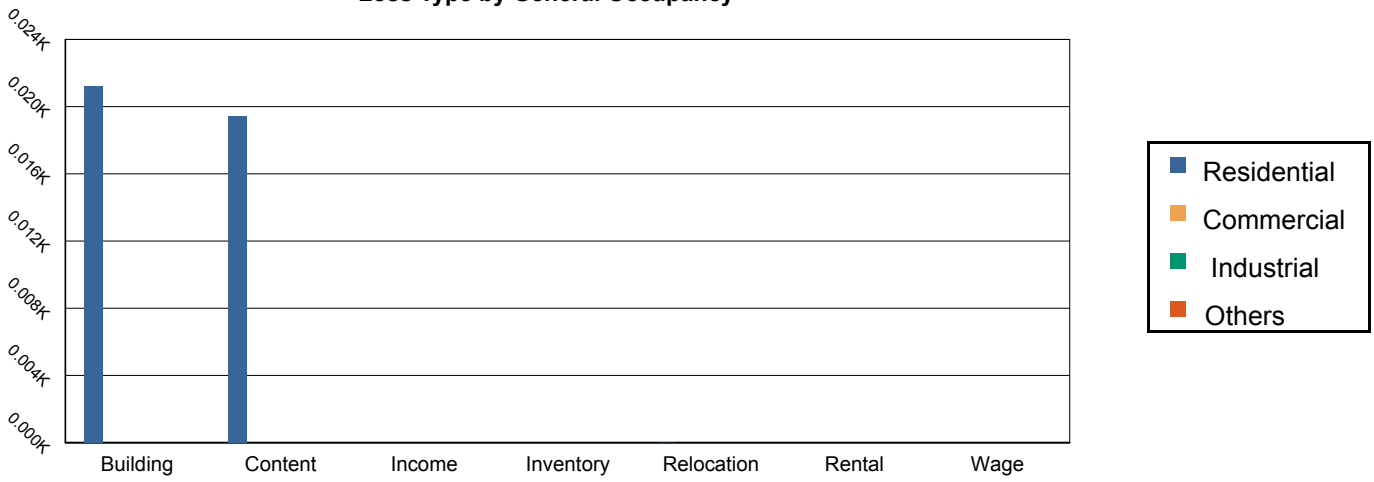


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	21.21	0.00	0.00	0.00	21.21
	Content	19.45	0.00	0.00	0.00	19.45
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**40.67**	**0.00**	**0.00**	**0.00**	**40.67**
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	**40.67**	**0.00**	**0.00**	**0.00**	**40.67**

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	6,525	876,705	108,013	984,718
Total	**6,525**	**876,705**	**108,013**	**984,718**
Study Region Total	**6,525**	**876,705**	**108,013**	**984,718**

Hazus: Hurricane Global Risk Report

Region Name: Killingworth

Hurricane Scenario: Probabilistic 50-year Return Period

Print Date: Thursday, October 3, 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.

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- Connecticut

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

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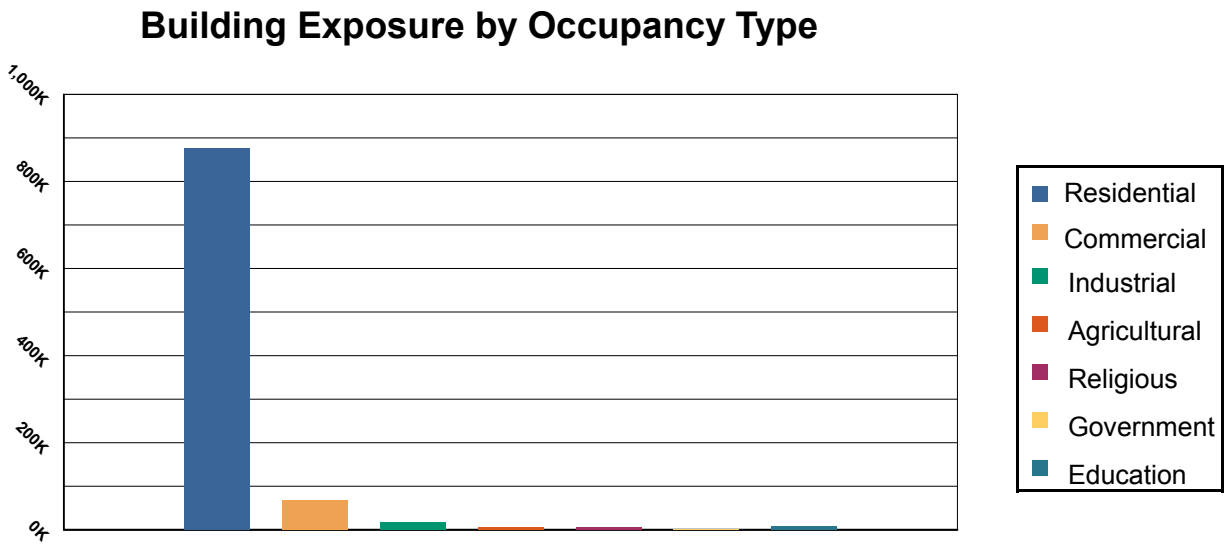
There are an estimated 2 thousand buildings in the region with a total building replacement value (excluding contents) of 985 million dollars (2014 dollars). Approximately 92% of the buildings (and 89% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 2,824 buildings in the region which have an aggregate total replacement value of 985 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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Industrial	18,389	1.87%
Agricultural	5,075	0.52%
Religious	6,751	0.69%
Government	1,220	0.12%
Education	7,910	0.80%
Total	**984,718**	**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 2 schools, 2 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.

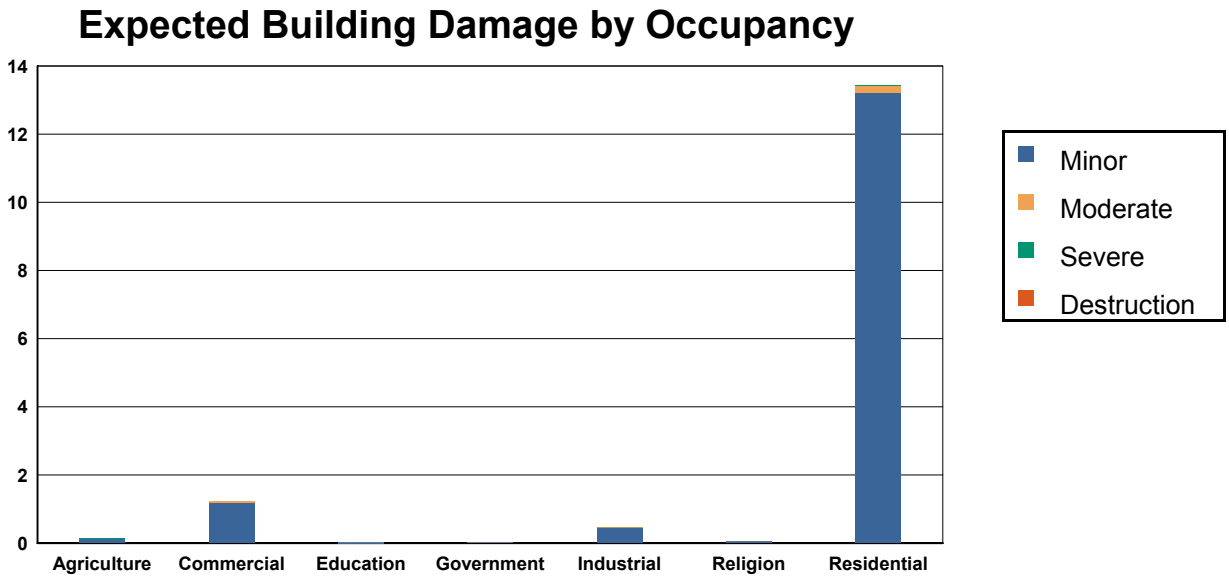


Table 2: Expected Building Damage by Occupancy : 50 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	16.86	99.21	0.13	0.75	0.01	0.04	0.00	0.01	0.00	0.00
Commercial	144.78	99.16	1.16	0.80	0.06	0.04	0.00	0.00	0.00	0.00
Education	3.97	99.19	0.03	0.80	0.00	0.01	0.00	0.00	0.00	0.00
Government	1.98	99.15	0.02	0.84	0.00	0.01	0.00	0.00	0.00	0.00
Industrial	54.53	99.15	0.46	0.84	0.01	0.01	0.00	0.00	0.00	0.00
Religion	7.95	99.32	0.05	0.66	0.00	0.02	0.00	0.00	0.00	0.00
Residential	2,578.58	99.48	13.21	0.51	0.20	0.01	0.00	0.00	0.00	0.00
Total	**2,808.65**		**15.07**		**0.28**		**0.00**		**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	7	99.13	0	0.87	0	0.00	0	0.00	0	0.00
Masonry	106	99.12	1	0.84	0	0.04	0	0.00	0	0.00
MH	269	99.98	0	0.01	0	0.01	0	0.00	0	0.00
Steel	101	99.15	1	0.83	0	0.02	0	0.00	0	0.00
Wood	2,238	99.44	12	0.55	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.

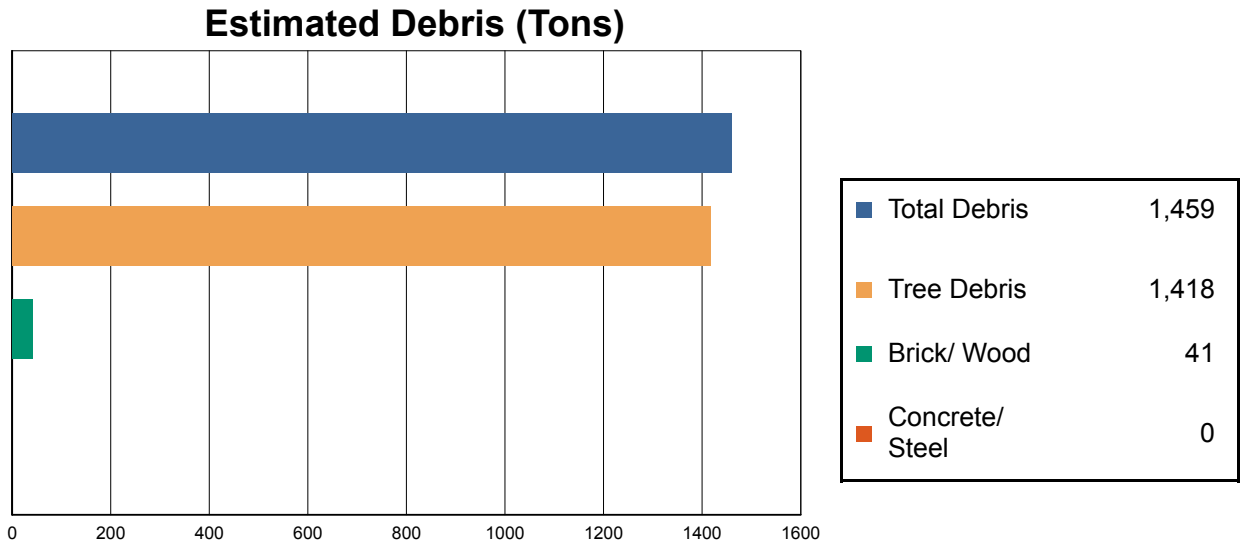
Thematic Map of Essential Facilities with greater than 50% moderate

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	2	0	0	2
Police Stations	1	0	0	1
Schools	2	0	0	2

Induced Hurricane Damage

Debris Generation

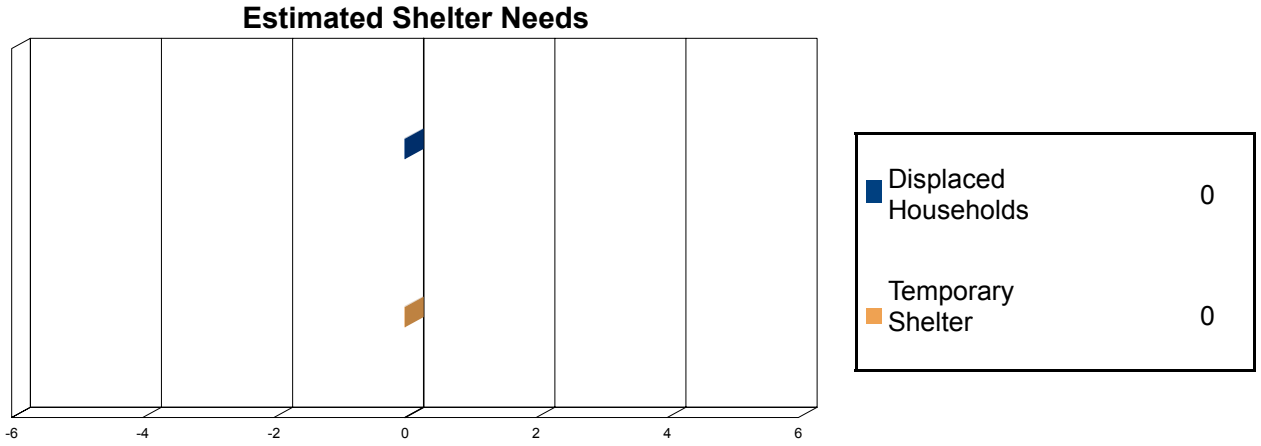


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 1,459 tons of debris will be generated. Of the total amount, 1,296 tons (89%) is Other Tree Debris. Of the remaining 163 tons, Brick/Wood comprises 25% 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 2 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 122 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 6,525) will seek temporary shelter in public shelters.

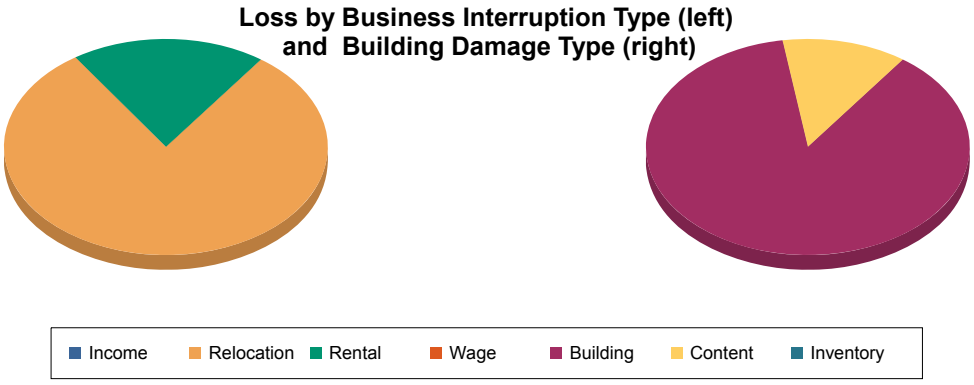
Economic Loss

The total economic loss estimated for the hurricane is 1.6 million dollars, which represents 0.16 % 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 2 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 98% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.



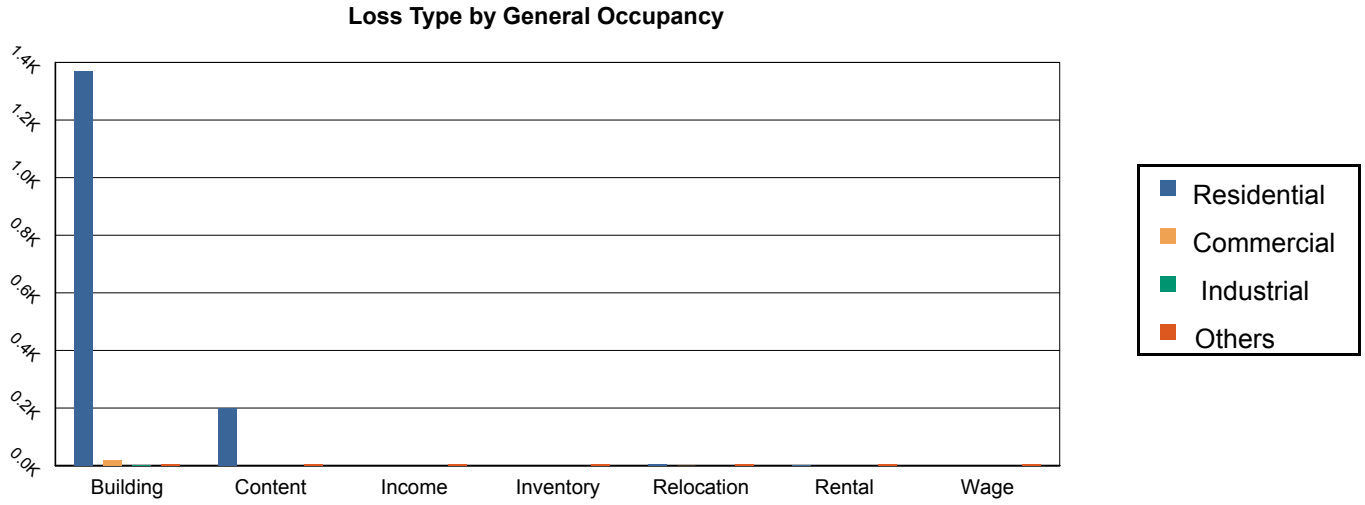


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	1,368.55	18.32	3.68	4.87	1,395.42
	Content	198.56	0.00	0.00	0.00	198.56
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**1,567.11**	**18.32**	**3.68**	**4.87**	**1,593.97**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	5.30	0.21	0.01	0.03	5.55
	Rental	1.33	0.00	0.00	0.00	1.33
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**6.63**	**0.21**	**0.01**	**0.03**	**6.88**

Total

Total	**1,573.74**	**18.53**	**3.69**	**4.90**	**1,600.85**

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	6,525	876,705	108,013	984,718
Total	**6,525**	**876,705**	**108,013**	**984,718**
Study Region Total	**6,525**	**876,705**	**108,013**	**984,718**

Hazus: Hurricane Global Risk Report

Region Name: Killingworth

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Thursday, October 3, 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 35.78 square miles and contains 1 census tracts. There are over 2 thousand households in the region and a total population of 6,525 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 2 thousand buildings in the region with a total building replacement value (excluding contents) of 985 million dollars (2014 dollars). Approximately 92% of the buildings (and 89% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 2,824 buildings in the region which have an aggregate total replacement value of 985 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.

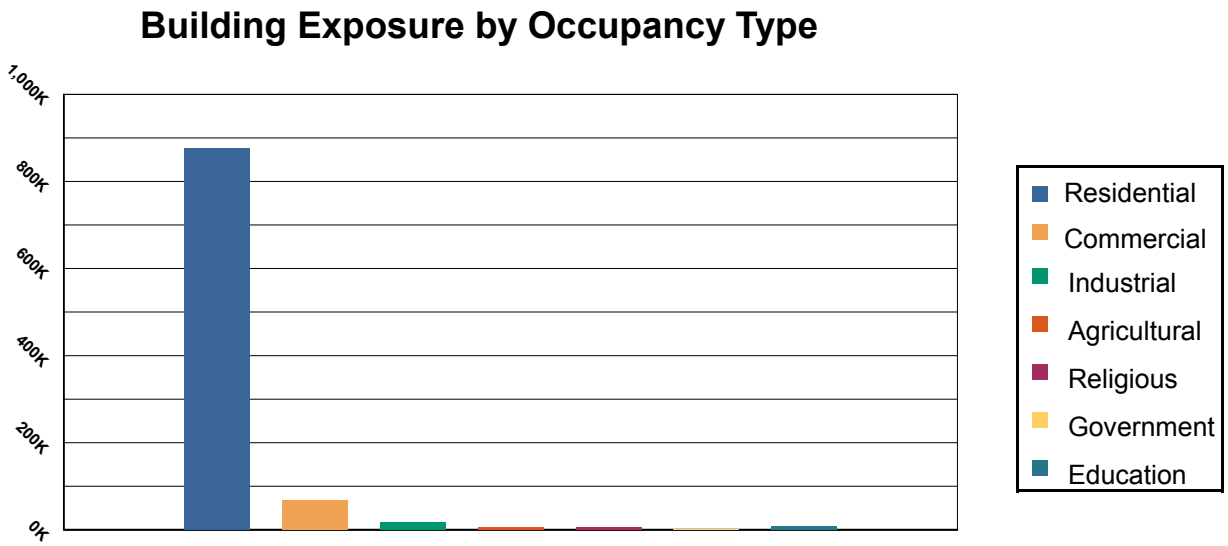


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	876,705	89.03 %
Commercial	68,668	6.97%
Industrial	18,389	1.87%
Agricultural	5,075	0.52%
Religious	6,751	0.69%
Government	1,220	0.12%
Education	7,910	0.80%
Total	**984,718**	**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 2 schools, 2 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 4 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.

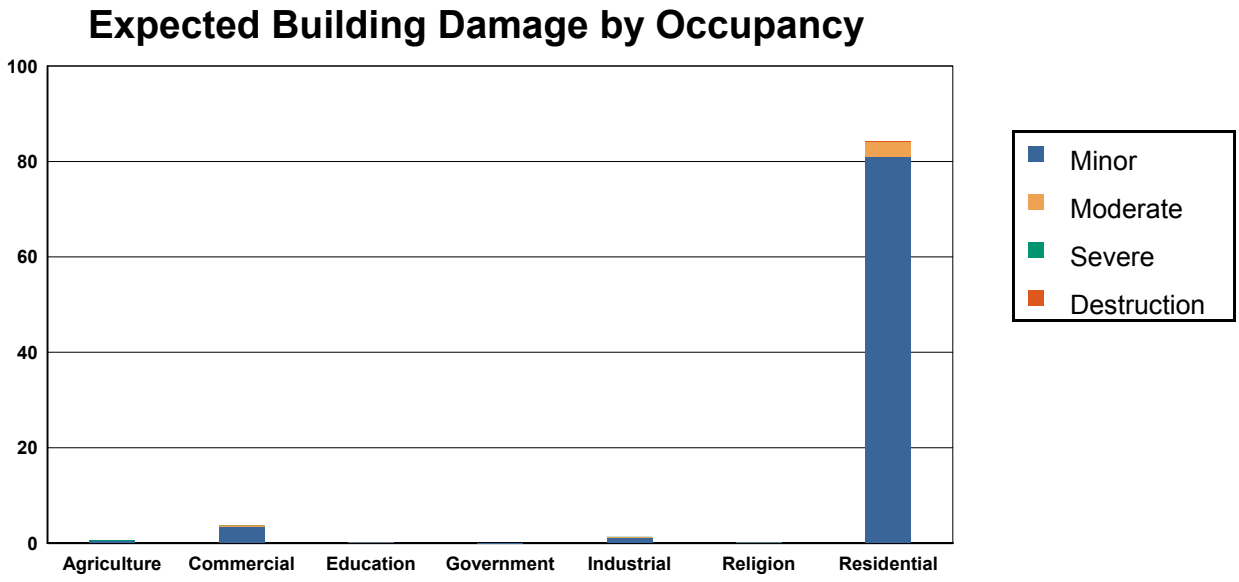


Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	16.44	96.68	0.48	2.81	0.06	0.38	0.02	0.13	0.00	0.00
Commercial	142.26	97.44	3.36	2.30	0.35	0.24	0.02	0.01	0.00	0.00
Education	3.91	97.71	0.09	2.24	0.00	0.06	0.00	0.00	0.00	0.00
Government	1.95	97.69	0.05	2.27	0.00	0.05	0.00	0.00	0.00	0.00
Industrial	53.68	97.60	1.25	2.27	0.06	0.10	0.01	0.02	0.00	0.00
Religion	7.82	97.71	0.18	2.22	0.01	0.06	0.00	0.01	0.00	0.00
Residential	2,507.86	96.75	81.08	3.13	3.03	0.12	0.01	0.00	0.03	0.00
Total	**2,733.92**		**86.48**		**3.51**		**0.07**		**0.03**	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	7	97.77	0	2.19	0	0.04	0	0.00	0	0.00
Masonry	103	96.57	3	3.14	0	0.26	0	0.03	0	0.00
MH	268	99.66	1	0.27	0	0.06	0	0.00	0	0.01
Steel	100	97.71	2	2.12	0	0.16	0	0.01	0	0.00
Wood	2,172	96.49	76	3.40	3	0.12	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.

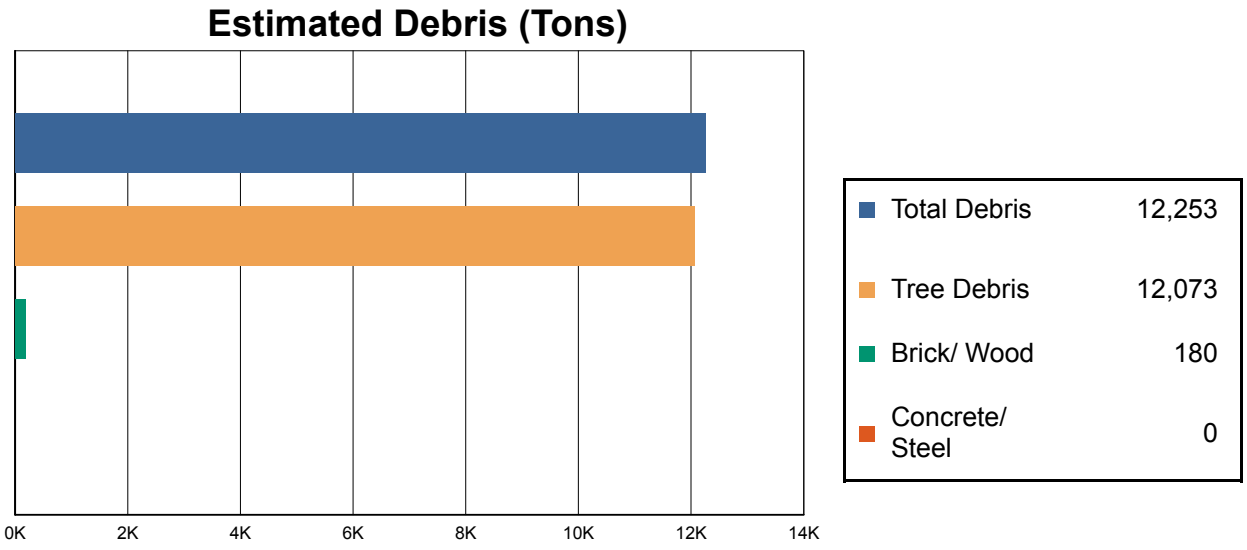
Thematic Map of Essential Facilities with greater than 50% moderate

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	2	0	0	2
Police Stations	1	0	0	1
Schools	2	0	0	2

Induced Hurricane Damage

Debris Generation

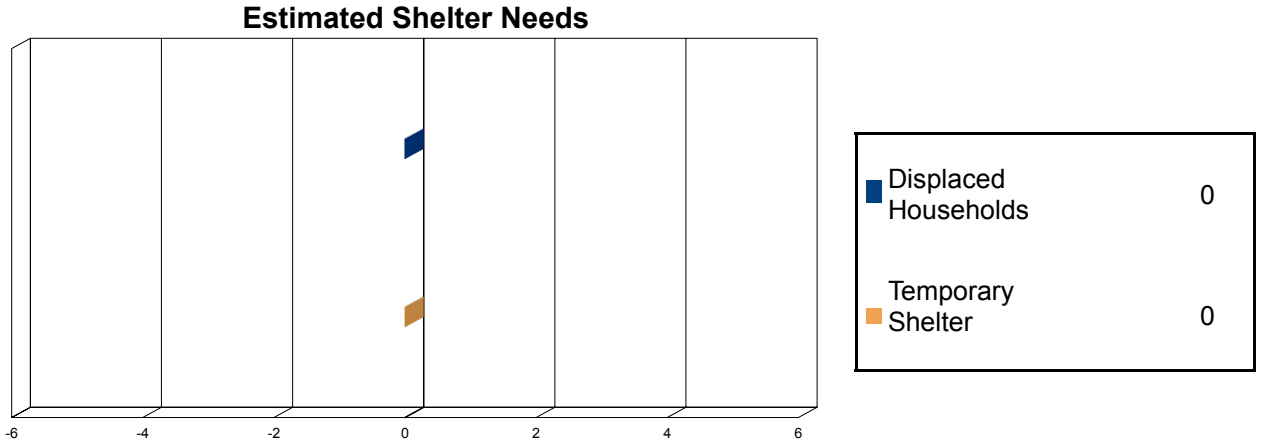


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 12,253 tons of debris will be generated. Of the total amount, 11,034 tons (90%) is Other Tree Debris. Of the remaining 1,219 tons, Brick/Wood comprises 15% 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 7 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 1,039 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 6,525) will seek temporary shelter in public shelters.

Economic Loss

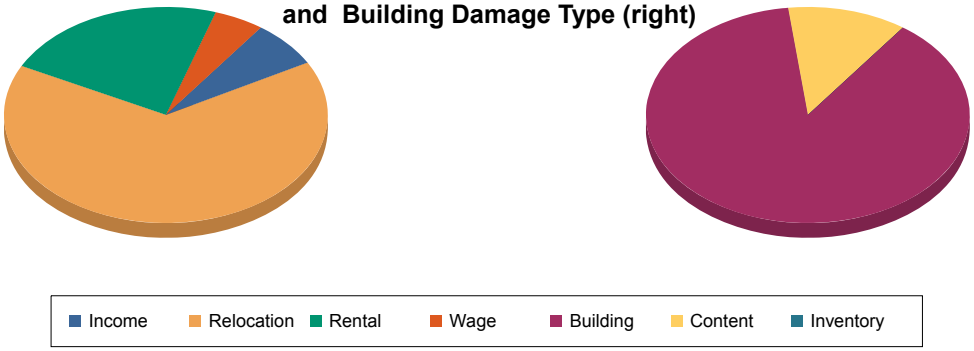
The total economic loss estimated for the hurricane is 4.5 million dollars, which represents 0.46 % of the total replacement value of the region's buildings.

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 5 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 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

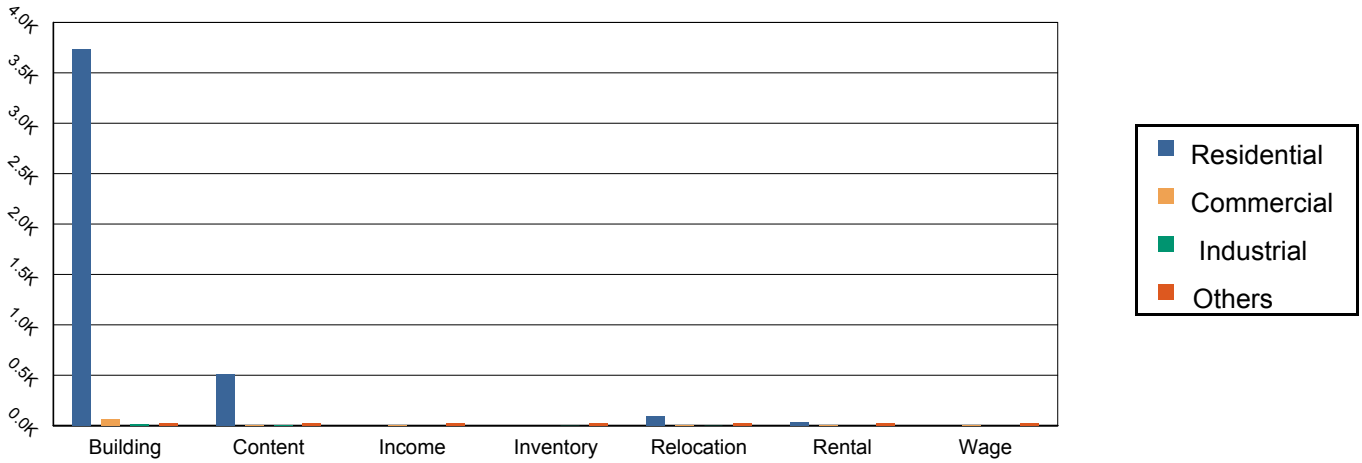


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	3,734.30	64.06	10.99	17.46	3,826.80
	Content	509.03	7.96	1.66	2.04	520.69
	Inventory	0.00	0.15	0.28	0.13	0.56
	Subtotal	**4,243.33**	**72.16**	**12.93**	**19.63**	**4,348.05**
Business Interruption Loss						
	Income	0.00	9.14	0.06	2.05	11.26
	Relocation	99.01	6.29	0.21	1.43	106.93
	Rental	32.37	4.12	0.05	0.13	36.68
	Wage	0.00	3.25	0.09	4.81	8.16
	Subtotal	**131.38**	**22.81**	**0.41**	**8.43**	**163.02**

Total

Total	**4,374.70**	**94.97**	**13.34**	**28.06**	**4,511.08**

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	6,525	876,705	108,013	984,718
Total	**6,525**	**876,705**	**108,013**	**984,718**
Study Region Total	**6,525**	**876,705**	**108,013**	**984,718**

Hazus: Hurricane Global Risk Report

Region Name: Killingworth

Hurricane Scenario: Probabilistic 200-year Return Period

Print Date: Thursday, October 3, 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.

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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):

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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 2 thousand buildings in the region with a total building replacement value (excluding contents) of 985 million dollars (2014 dollars). Approximately 92% of the buildings (and 89% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 2,824 buildings in the region which have an aggregate total replacement value of 985 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.

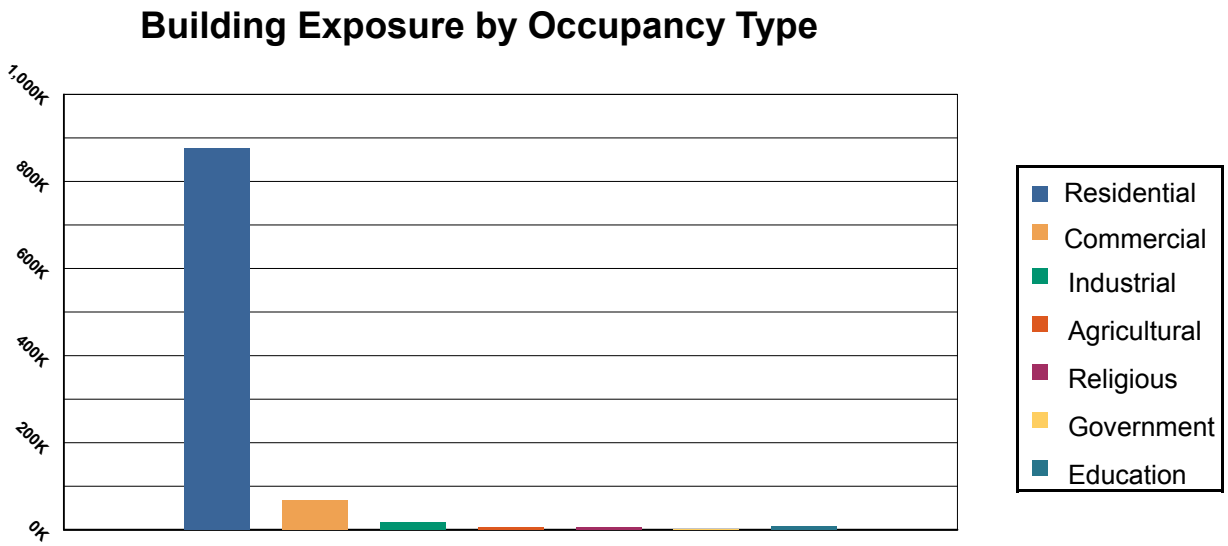


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	876,705	89.03 %
Commercial	68,668	6.97%
Industrial	18,389	1.87%
Agricultural	5,075	0.52%
Religious	6,751	0.69%
Government	1,220	0.12%
Education	7,910	0.80%
Total	**984,718**	**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 2 schools, 2 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 22 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.

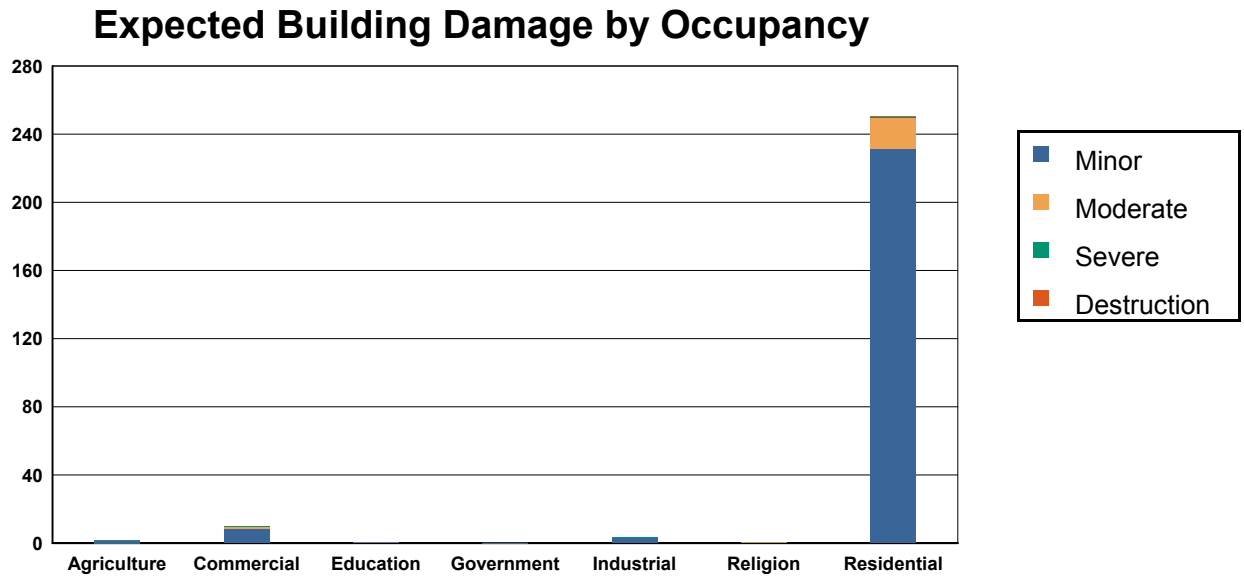


Table 2: Expected Building Damage by Occupancy : 200 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	15.34	90.23	1.28	7.55	0.25	1.49	0.12	0.68	0.01	0.05
Commercial	135.93	93.10	8.67	5.94	1.25	0.86	0.15	0.11	0.00	0.00
Education	3.75	93.77	0.23	5.82	0.02	0.40	0.00	0.01	0.00	0.00
Government	1.88	93.82	0.12	5.78	0.01	0.39	0.00	0.01	0.00	0.00
Industrial	51.51	93.65	3.11	5.65	0.31	0.56	0.07	0.13	0.00	0.01
Religion	7.46	93.19	0.51	6.40	0.03	0.39	0.00	0.02	0.00	0.00
Residential	2,341.60	90.34	231.11	8.92	18.73	0.72	0.12	0.00	0.44	0.02
Total	**2,557.46**		**245.04**		**20.60**		**0.46**		**0.45**	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	7	94.27	0	5.36	0	0.36	0	0.01	0	0.00
Masonry	97	90.74	9	8.00	1	1.10	0	0.15	0	0.01
MH	263	97.81	4	1.59	1	0.47	0	0.01	0	0.11
Steel	96	94.09	5	5.16	1	0.64	0	0.11	0	0.00
Wood	2,017	89.61	217	9.65	16	0.73	0	0.01	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use 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.

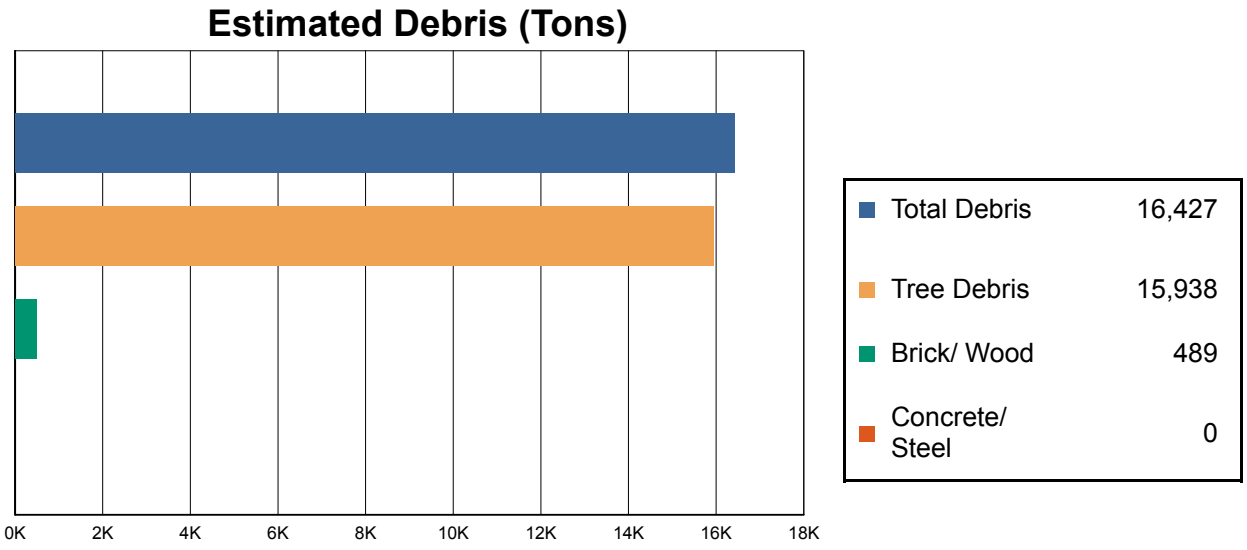
Thematic Map of Essential Facilities with greater than 50% moderate

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	2	0	0	2
Police Stations	1	0	0	1
Schools	2	0	0	2

Induced Hurricane Damage

Debris Generation

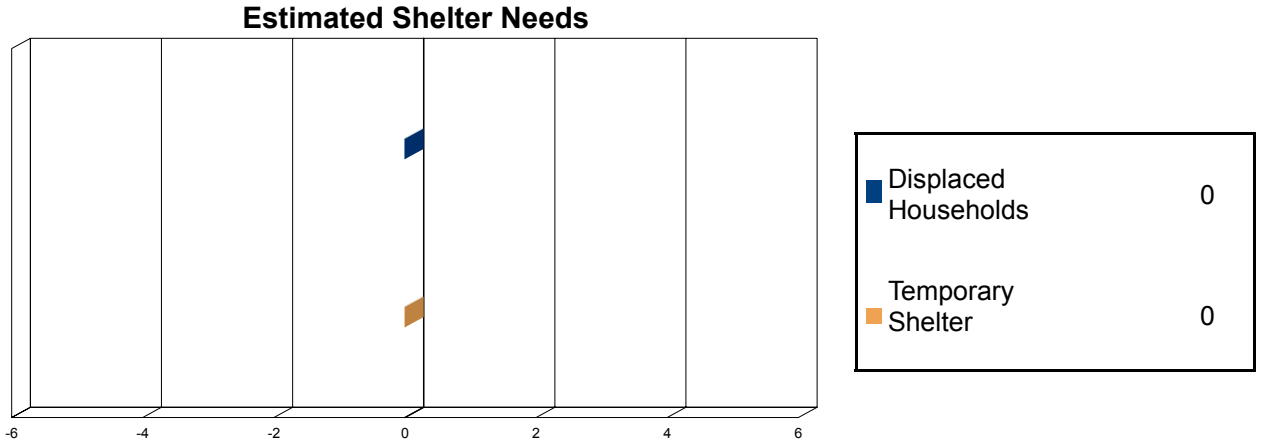


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 16,427 tons of debris will be generated. Of the total amount, 14,567 tons (89%) is Other Tree Debris. Of the remaining 1,860 tons, Brick/Wood comprises 26% 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 20 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 1,371 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 6,525) will seek temporary shelter in public shelters.

Economic Loss

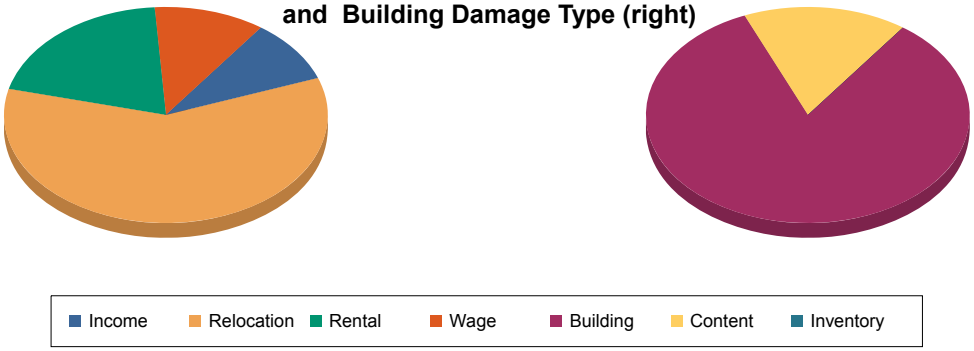
The total economic loss estimated for the hurricane is 9.2 million dollars, which represents 0.94 % of the total replacement value of the region's buildings.

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 9 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 95% 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

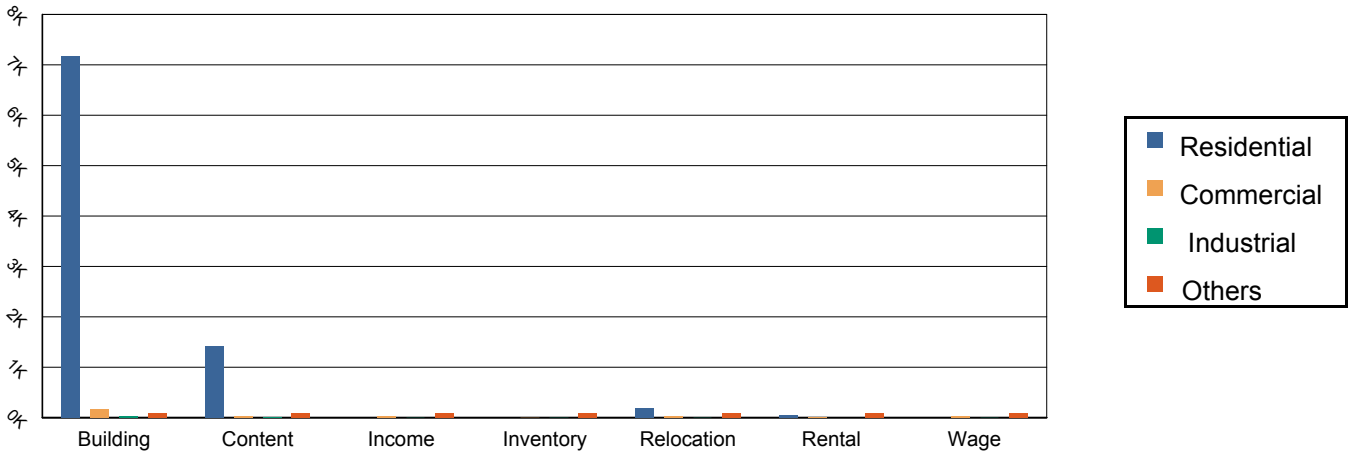


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	7,166.01	164.79	33.03	52.13	7,415.96
	Content	1,412.85	22.36	10.34	10.77	1,456.31
	Inventory	0.00	0.45	1.70	0.69	2.85
	Subtotal	**8,578.86**	**187.61**	**45.07**	**63.58**	**8,875.12**
Business Interruption Loss						
	Income	0.00	29.58	0.48	5.28	35.34
	Relocation	186.72	26.13	1.86	7.50	222.21
	Rental	56.12	17.37	0.31	0.59	74.38
	Wage	0.00	24.65	0.85	15.68	41.18
	Subtotal	**242.84**	**97.72**	**3.50**	**29.06**	**373.11**

Total

Total	**8,821.69**	**285.33**	**48.57**	**92.64**	**9,248.23**

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	6,525	876,705	108,013	984,718
Total	**6,525**	**876,705**	**108,013**	**984,718**
Study Region Total	**6,525**	**876,705**	**108,013**	**984,718**

Hazus: Hurricane Global Risk Report

Region Name: Killingworth

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Thursday, October 3, 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.

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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 35.78 square miles and contains 1 census tracts. There are over 2 thousand households in the region and a total population of 6,525 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 2 thousand buildings in the region with a total building replacement value (excluding contents) of 985 million dollars (2014 dollars). Approximately 92% of the buildings (and 89% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 2,824 buildings in the region which have an aggregate total replacement value of 985 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.

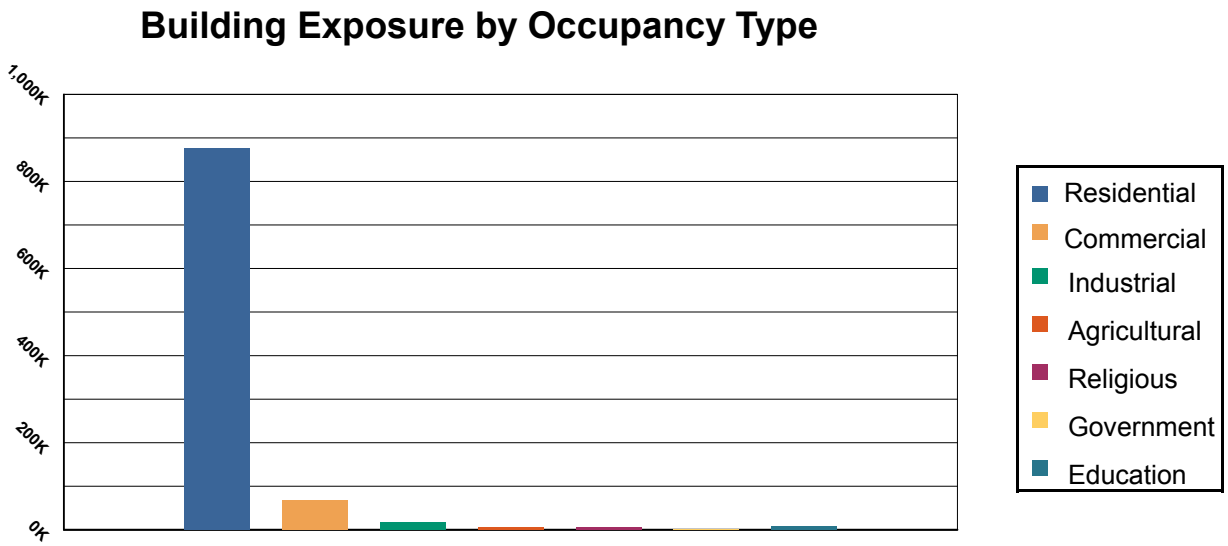


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	876,705	89.03 %
Commercial	68,668	6.97%
Industrial	18,389	1.87%
Agricultural	5,075	0.52%
Religious	6,751	0.69%
Government	1,220	0.12%
Education	7,910	0.80%
Total	**984,718**	**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 2 schools, 2 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 100 buildings will be at least moderately damaged. This is over 4% of the total number of buildings in the region. There are an estimated 4 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.

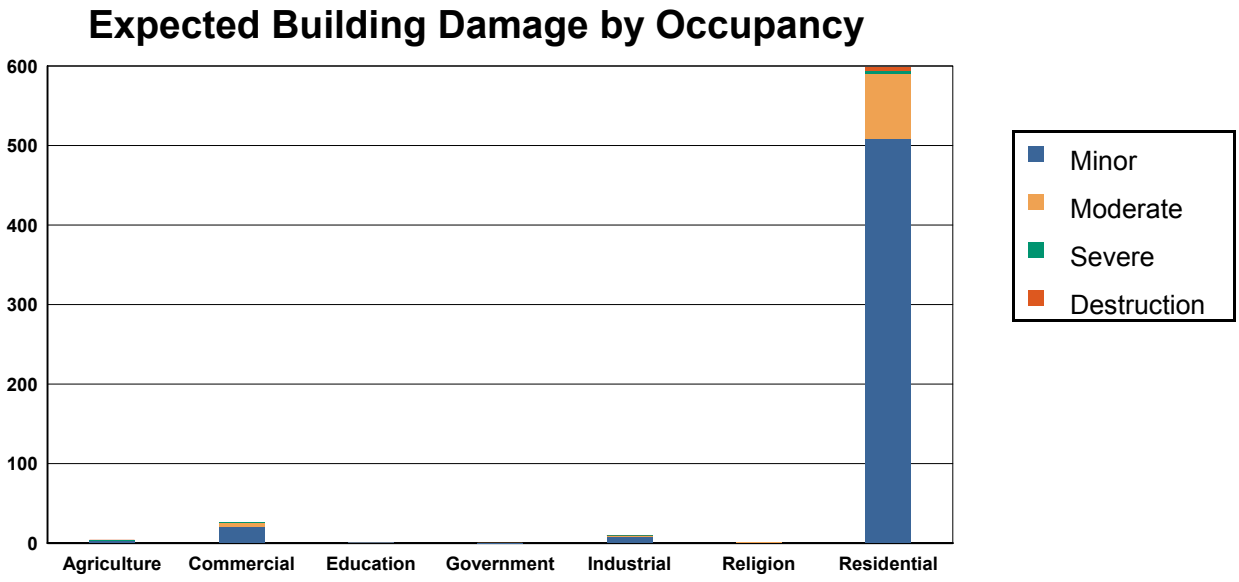


Table 2: Expected Building Damage by Occupancy : 500 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	12.89	75.81	2.89	16.98	0.79	4.67	0.38	2.26	0.05	0.28
Commercial	119.13	81.60	20.94	14.34	5.23	3.58	0.70	0.48	0.00	0.00
Education	3.30	82.60	0.57	14.36	0.12	2.91	0.01	0.13	0.00	0.00
Government	1.65	82.62	0.28	14.18	0.06	3.06	0.00	0.14	0.00	0.00
Industrial	45.47	82.66	7.50	13.64	1.72	3.14	0.28	0.52	0.03	0.05
Religion	6.49	81.15	1.28	16.02	0.22	2.70	0.01	0.13	0.00	0.00
Residential	1,993.76	76.92	507.87	19.59	81.76	3.15	4.53	0.17	4.08	0.16
Total	**2,182.70**		**541.33**		**89.89**		**5.92**		**4.16**	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	6	83.83	1	13.17	0	2.87	0	0.13	0	0.00
Masonry	83	77.75	19	17.40	4	4.15	1	0.60	0	0.10
MH	244	90.71	15	5.53	8	2.91	0	0.11	2	0.74
Steel	85	83.56	13	12.62	3	3.28	1	0.53	0	0.00
Wood	1,700	75.51	475	21.09	70	3.13	4	0.18	2	0.09

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.

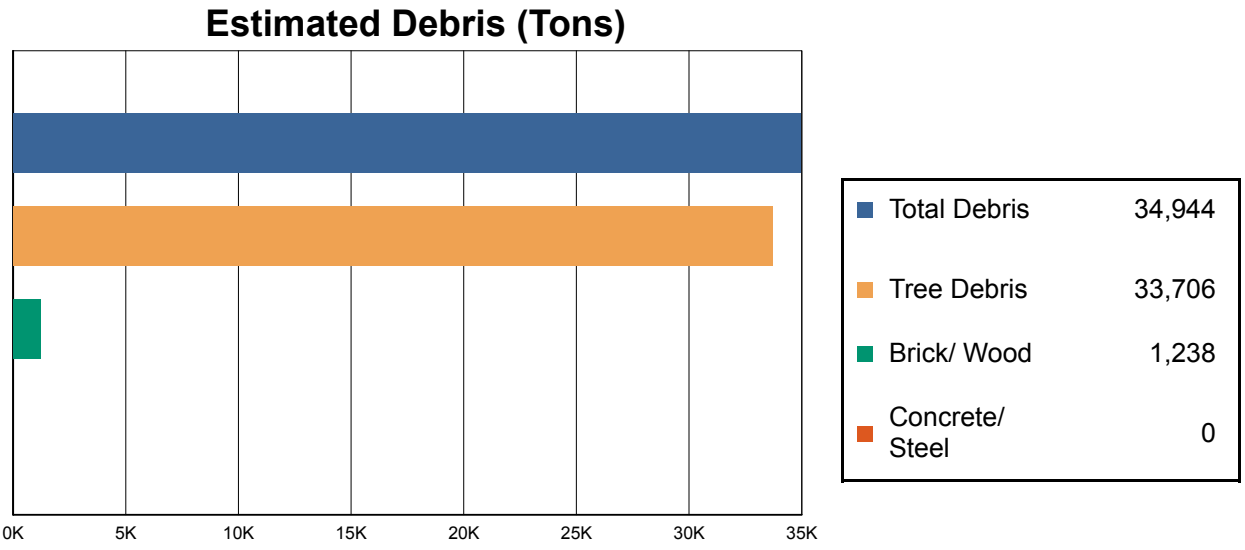
Thematic Map of Essential Facilities with greater than 50% moderate

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	2	0	0	2
Police Stations	1	0	0	1
Schools	2	0	0	2

Induced Hurricane Damage

Debris Generation

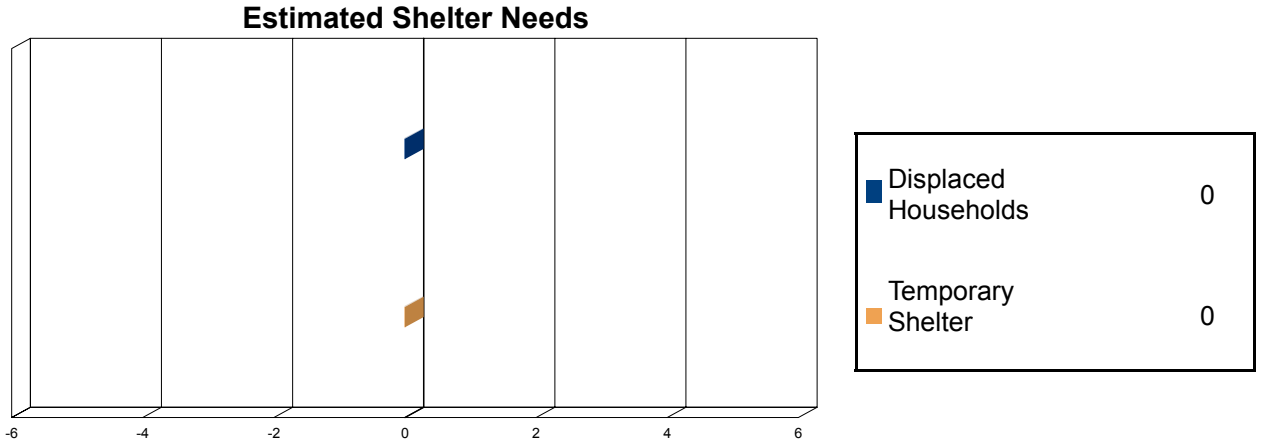


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 34,944 tons of debris will be generated. Of the total amount, 30,806 tons (88%) is Other Tree Debris. Of the remaining 4,138 tons, Brick/Wood comprises 30% 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 50 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 2,900 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 6,525) will seek temporary shelter in public shelters.

Economic Loss

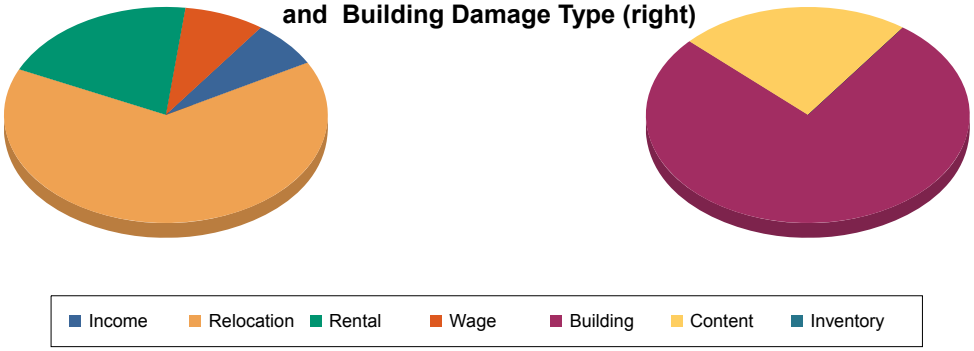
The total economic loss estimated for the hurricane is 23.2 million dollars, which represents 2.36 % of the total replacement value of the region's buildings.

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 23 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 94% 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

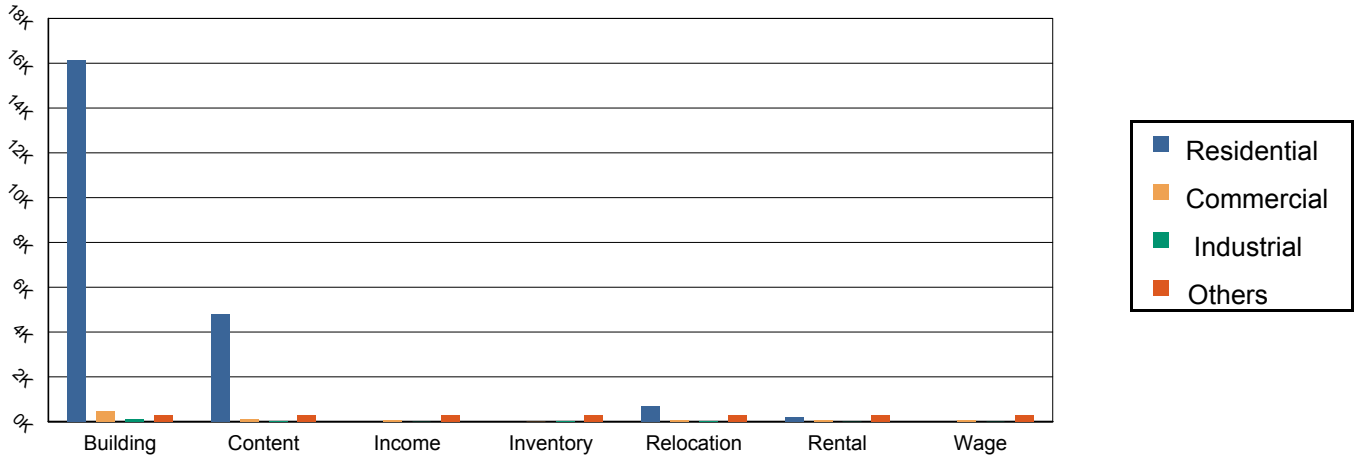


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	16,155.39	473.16	114.62	165.00	16,908.16
	Content	4,819.63	101.21	48.63	45.48	5,014.96
	Inventory	0.00	2.26	7.67	2.85	12.78
	Subtotal	**20,975.02**	**576.63**	**170.92**	**213.33**	**21,935.89**
Business Interruption Loss						
	Income	0.00	74.52	1.55	13.02	89.09
	Relocation	707.14	79.06	8.52	27.31	822.03
	Rental	199.44	48.95	1.13	1.91	251.43
	Wage	0.00	60.89	2.71	39.88	103.48
	Subtotal	**906.58**	**263.43**	**13.90**	**82.12**	**1,266.03**

Total

Total	**21,881.60**	**840.06**	**184.82**	**295.44**	**23,201.92**

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	6,525	876,705	108,013	984,718
Total	**6,525**	**876,705**	**108,013**	**984,718**
Study Region Total	**6,525**	**876,705**	**108,013**	**984,718**

Hazus: Hurricane Global Risk Report

Region Name: Killingworth

Hurricane Scenario: Probabilistic 1000-year Return Period

Print Date: Thursday, October 3, 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.

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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 35.78 square miles and contains 1 census tracts. There are over 2 thousand households in the region and a total population of 6,525 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

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Building Inventory

General Building Stock

Hazus estimates that there are 2,824 buildings in the region which have an aggregate total replacement value of 985 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.

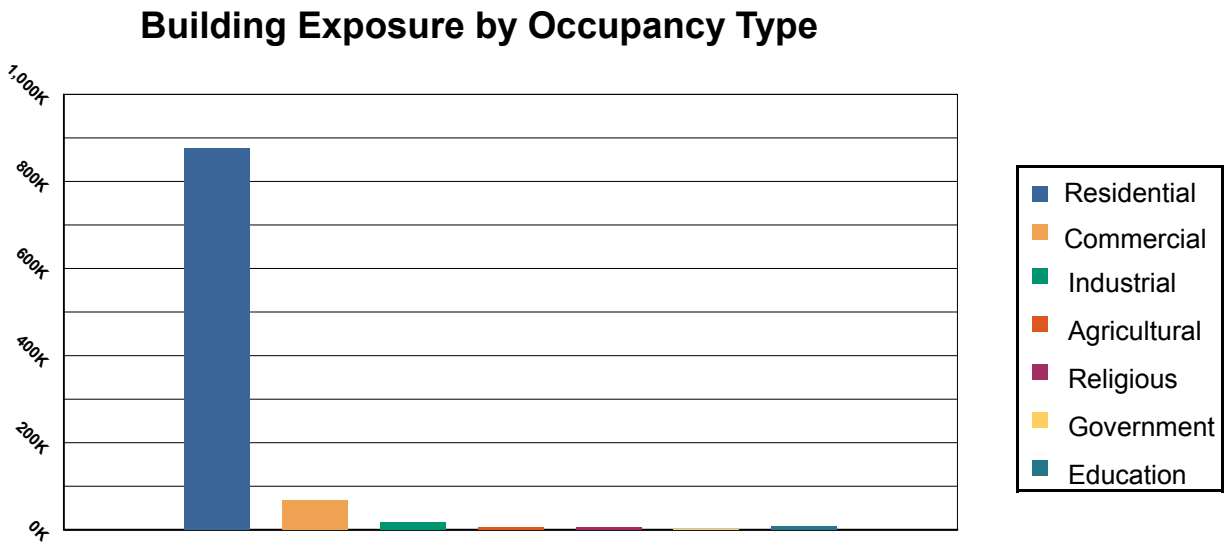

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	876,705	89.03 %
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Industrial	18,389	1.87%
Agricultural	5,075	0.52%
Religious	6,751	0.69%
Government	1,220	0.12%
Education	7,910	0.80%
Total	**984,718**	**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 2 schools, 2 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 201 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.

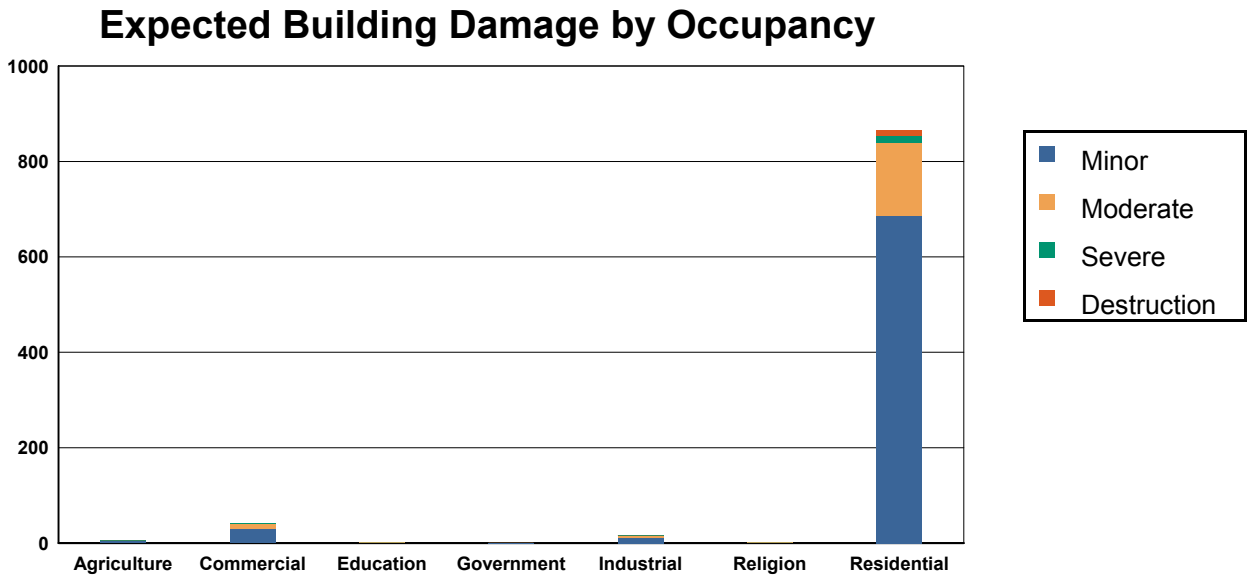


Table 2: Expected Building Damage by Occupancy : 1000 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	10.93	64.31	3.97	23.35	1.36	7.97	0.65	3.82	0.09	0.56
Commercial	103.47	70.87	29.87	20.46	11.03	7.56	1.61	1.10	0.01	0.01
Education	2.87	71.69	0.83	20.63	0.28	7.10	0.02	0.59	0.00	0.00
Government	1.43	71.57	0.41	20.29	0.15	7.51	0.01	0.63	0.00	0.00
Industrial	39.61	72.02	10.75	19.54	3.94	7.17	0.65	1.18	0.05	0.10
Religion	5.61	70.11	1.84	22.98	0.51	6.42	0.04	0.50	0.00	0.00
Residential	1,725.77	66.58	685.82	26.46	153.19	5.91	14.79	0.57	12.42	0.48
Total	**1,889.69**		**733.48**		**170.47**		**17.78**		**12.58**	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	5	73.20	1	19.03	1	7.18	0	0.60	0	0.00
Masonry	72	67.09	25	23.53	8	7.84	1	1.28	0	0.27
MH	223	82.88	24	8.83	16	6.12	1	0.35	5	1.82
Steel	74	72.99	19	18.23	8	7.49	1	1.27	0	0.01
Wood	1,460	64.88	640	28.42	131	5.80	13	0.58	7	0.32

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.

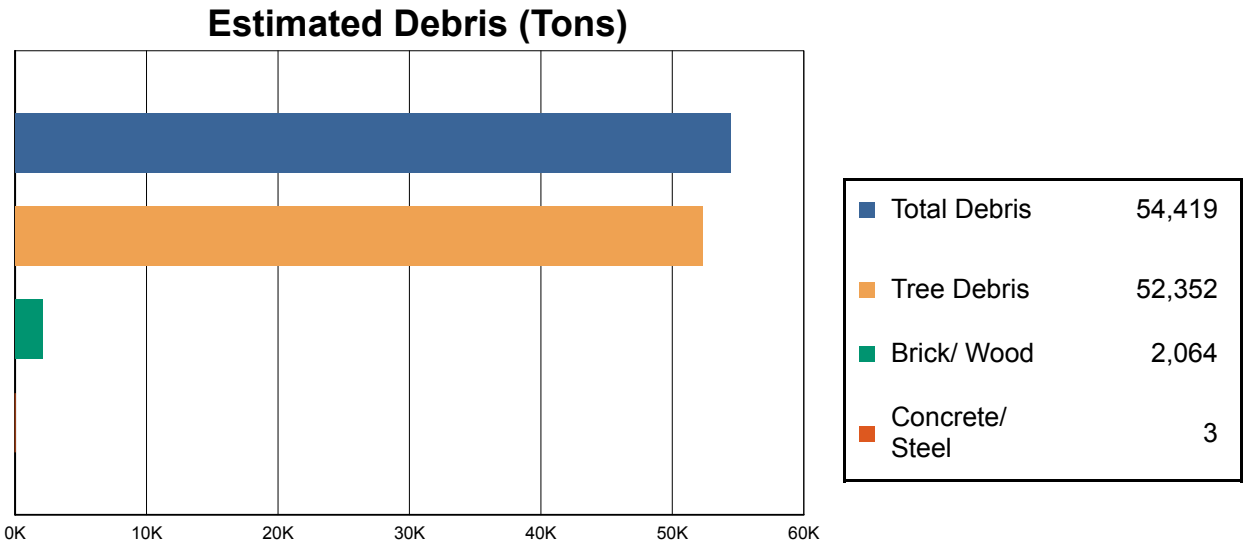
Thematic Map of Essential Facilities with greater than 50% moderate

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	2	0	0	2
Police Stations	1	0	0	1
Schools	2	0	0	0

Induced Hurricane Damage

Debris Generation

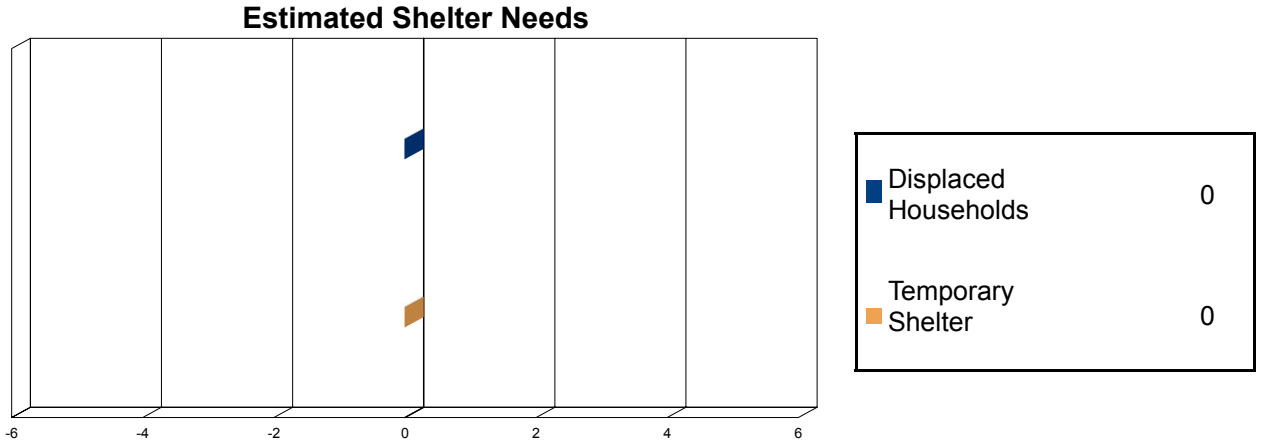


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 54,419 tons of debris will be generated. Of the total amount, 47,848 tons (88%) is Other Tree Debris. Of the remaining 6,571 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 83 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 4,504 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 6,525) will seek temporary shelter in public shelters.

Economic Loss

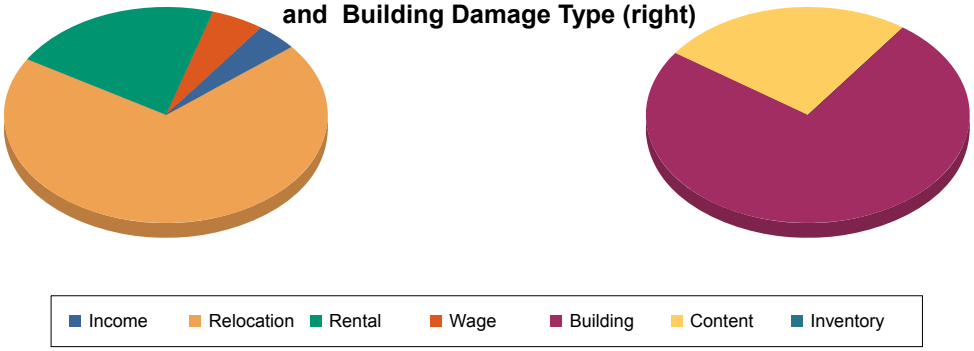
The total economic loss estimated for the hurricane is 40.2 million dollars, which represents 4.09 % of the total replacement value of the region's buildings.

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 40 million dollars. 7% 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 94% 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

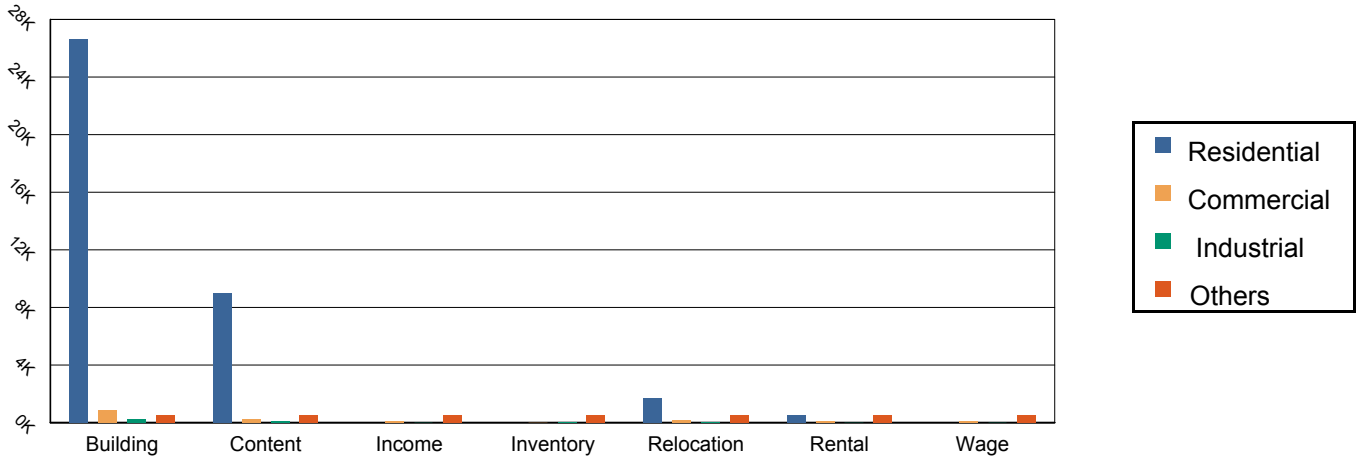


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	26,652.91	854.00	222.72	299.16	28,028.79
	Content	8,978.07	233.64	106.15	95.55	9,413.41
	Inventory	0.00	5.14	16.24	5.34	26.71
	Subtotal	**35,630.98**	**1,092.78**	**345.10**	**400.04**	**37,468.91**
Business Interruption Loss						
	Income	0.00	97.31	2.67	17.80	117.77
	Relocation	1,699.24	150.51	18.88	51.49	1,920.12
	Rental	490.20	90.43	2.16	3.60	586.39
	Wage	0.00	82.34	4.65	56.01	142.99
	Subtotal	**2,189.44**	**420.59**	**28.35**	**128.89**	**2,767.28**

Total

Total	**37,820.42**	**1,513.38**	**373.46**	**528.93**	**40,236.19**

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	6,525	876,705	108,013	984,718
Total	**6,525**	**876,705**	**108,013**	**984,718**
Study Region Total	**6,525**	**876,705**	**108,013**	**984,718**

Hazus: Earthquake Global Risk Report

Region Name: Killingworth

Earthquake Scenario: Annualized

Print Date: October 17, 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 35.77 square miles and contains 1 census tracts. There are over 2 thousand households in the region which has a total population of 6,525 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 2 thousand buildings in the region with a total building replacement value (excluding contents) of 984 (millions of dollars). Approximately 92.00 % of the buildings (and 89.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 274 and 12 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 2 thousand buildings in the region which have an aggregate total replacement value of 984 (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 80% 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 2 schools, 2 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 no 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 286.00 (millions of dollars). This inventory includes over 31.69 miles of highways, 2 bridges, 392.71 miles of pipes.

Table 1: Transportation System Lifeline Inventory

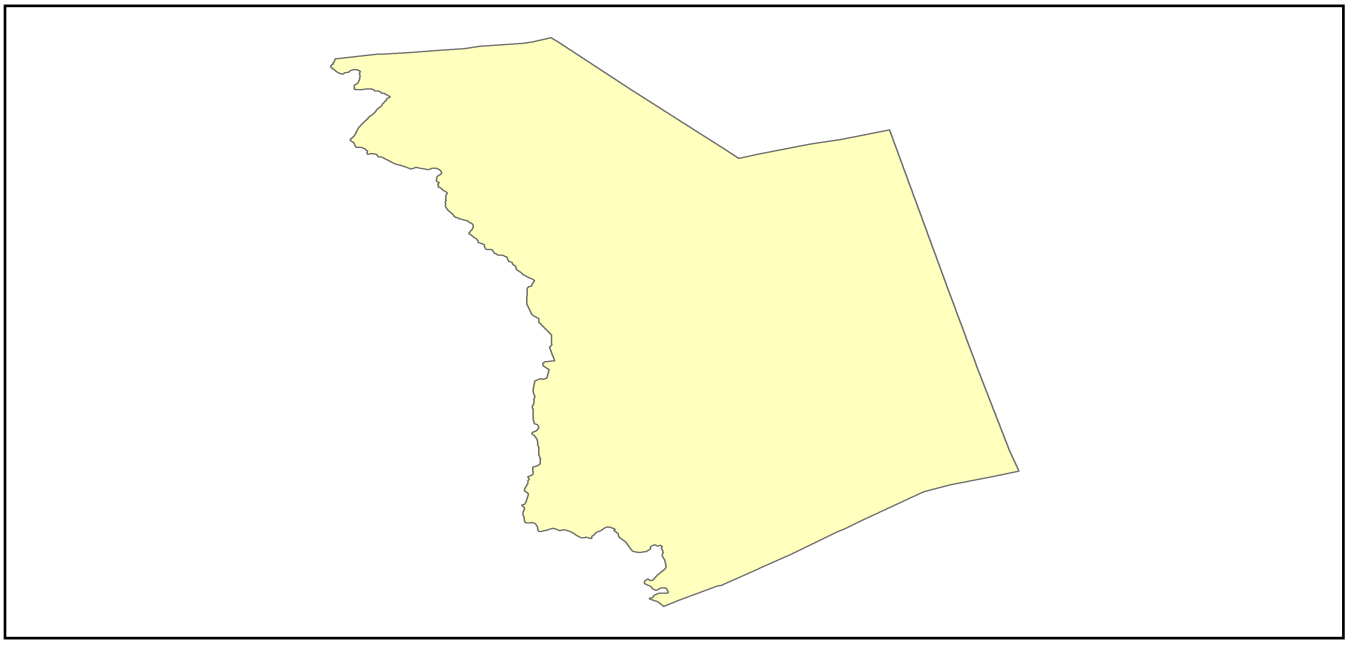
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	2	4.7756
	Segments	10	260.7516
	Tunnels	0	0.0000
		Subtotal	**265.5272**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	1	5.9036
	Tunnels	0	0.0000
		Subtotal	**5.9036**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	1	2.8177
	Tunnels	0	0.0000
		Subtotal	**2.8177**
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	**274.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.3251
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.3251**
Waste Water	Distribution Lines	NA	3.7951
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**3.7951**
Natural Gas	Distribution Lines	NA	2.5300
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**2.5300**
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	**12.70**

Earthquake Scenario

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



Scenario Name	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 13 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

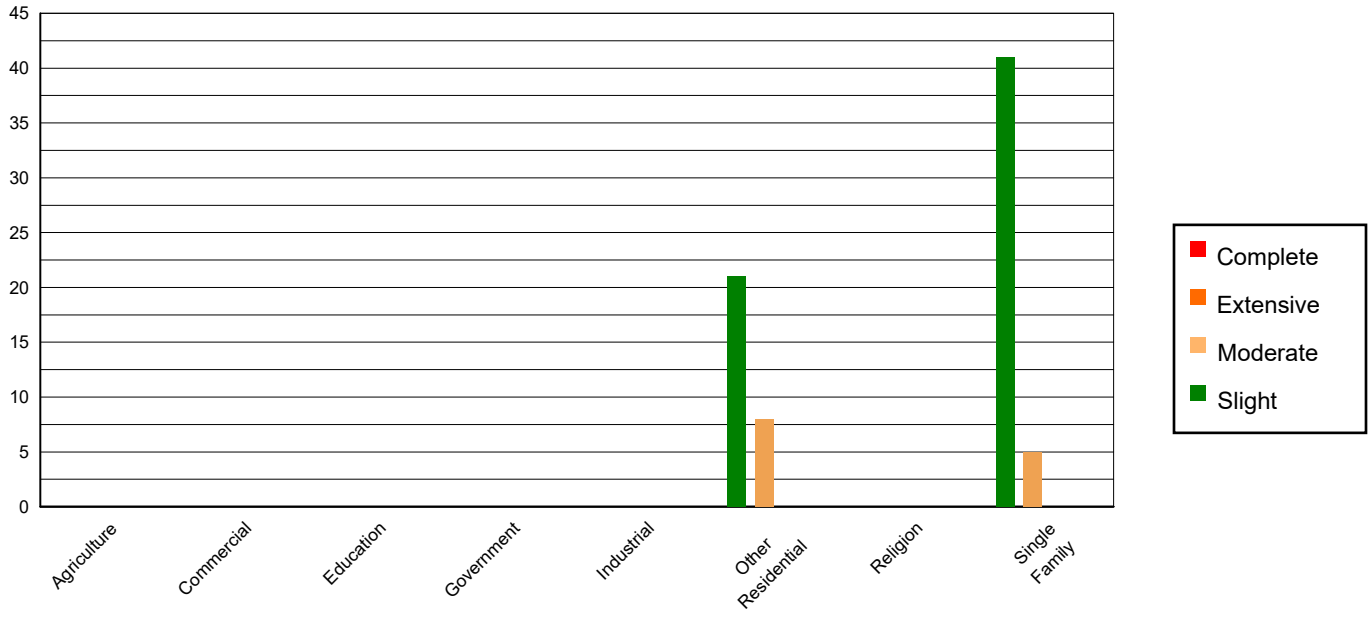


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	9.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	83.00	3.16	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	30.00	1.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Residential	242.00	9.21	21.00	33.87	8.00	61.54	0.00	0.00	0.00	0.00
Religion	3.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Single Family	2262.00	86.04	41.00	66.13	5.00	38.46	0.00	0.00	0.00	0.00
Total	**2,629**		**62**		**13**		**0**		**0**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2219.00	84.40	35.00	56.45	3.00	23.08	0.00	0.00	0.00	0.00
Steel	57.00	2.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Concrete	3.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Precast	1.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RM	3.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
URM	107.00	4.07	6.00	9.68	2.00	15.38	0.00	0.00	0.00	0.00
MH	239.00	9.09	21.00	33.87	8.00	61.54	0.00	0.00	0.00	0.00
Total	**2,629**		**62**		**13**		**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	2	0	0	2
EOCs	1	0	0	1
PoliceStations	1	0	0	1
FireStations	2	0	0	2

Transportation Lifeline Damage

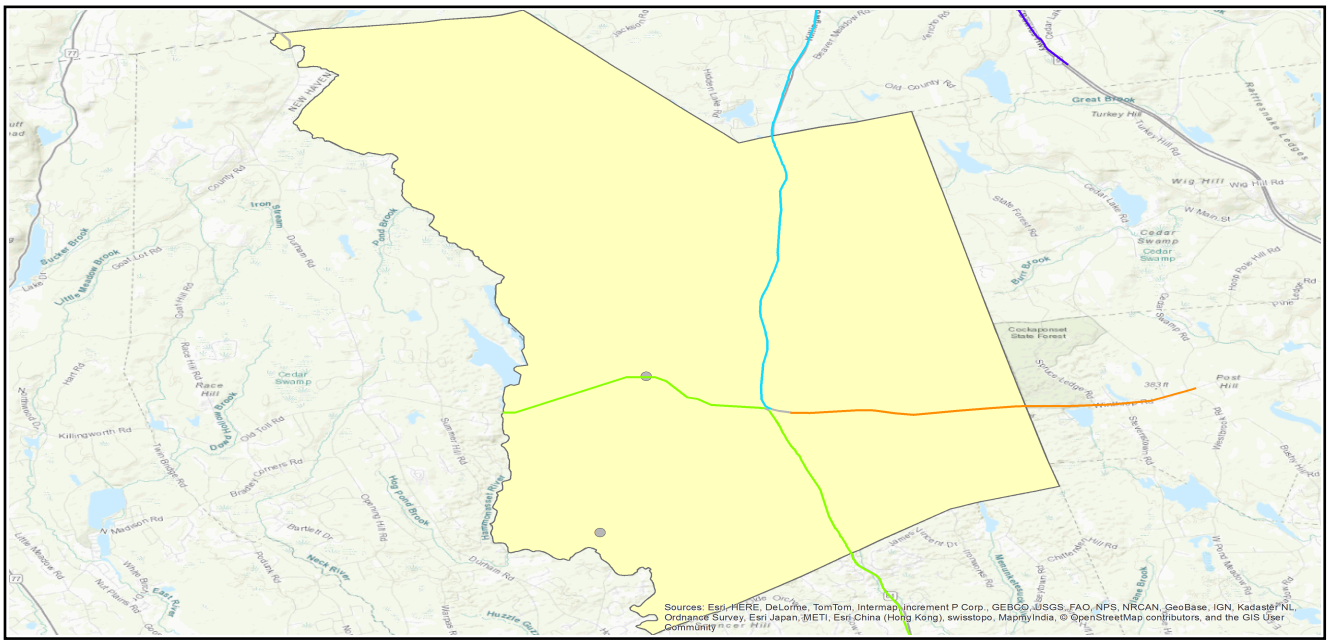


Table 6: Expected Damage to the Transportation Systems

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	10	0	0	10	10
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	1	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	0	0	0	0	0
Natural Gas	0	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	197	0	0
Waste Water	118	0	0
Natural Gas	79	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 0 tons of debris will be generated. Of the total amount, Brick/Wood comprises 75.00% 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 0 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	0 (@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 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 6,525) 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
0	0

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

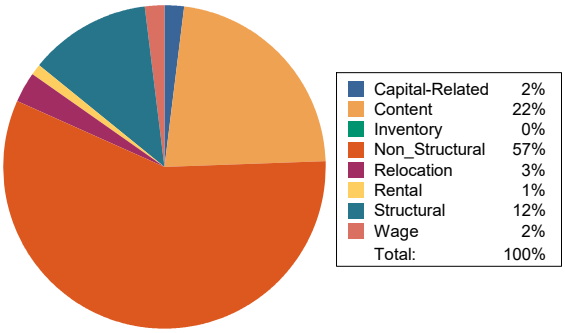
The total economic loss estimated for the earthquake is 0.01 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 0.01 (millions of 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 79 % 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)

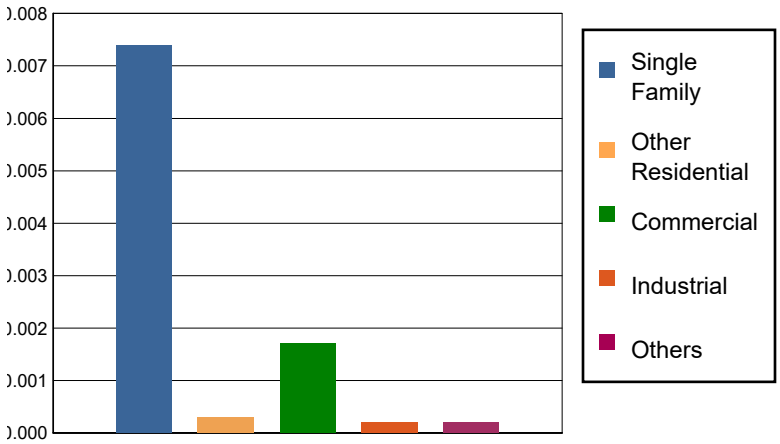


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.0000	0.0002	0.0000	0.0000	0.0002
	Capital-Related	0.0000	0.0000	0.0002	0.0000	0.0000	0.0002
	Rental	0.0000	0.0000	0.0001	0.0000	0.0000	0.0001
	Relocation	0.0002	0.0000	0.0001	0.0000	0.0000	0.0003
	Subtotal	**0.0002**	**0.0000**	**0.0006**	**0.0000**	**0.0000**	**0.0008**
Capital Stock Losses							
	Structural	0.0009	0.0001	0.0002	0.0000	0.0000	0.0012
	Non_Structural	0.0046	0.0002	0.0006	0.0001	0.0001	0.0056
	Content	0.0017	0.0000	0.0003	0.0001	0.0001	0.0022
	Inventory	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Subtotal	**0.0072**	**0.0003**	**0.0011**	**0.0002**	**0.0002**	**0.0090**
	Total	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**

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	260.7516	0.0000	0.00
	Bridges	4.7756	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**265.5272**	**0.0000**	
Railways	Segments	5.9036	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	**5.9036**	**0.0000**	
Light Rail	Segments	2.8177	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	**2.8177**	**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	**274.25**	**0.00**	

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	6.3251	0.0000	0.00
	Subtotal	**6.3251**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	3.7951	0.0000	0.00
	Subtotal	**3.7951**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	2.5300	0.0000	0.00
	Subtotal	**2.5300**	**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	**12.65**	**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	6,525	876	108	984
Total Region		**6,525**	**876**	**108**	**984**

Hazus: Earthquake Global Risk Report

Region Name: Killingworth

Earthquake Scenario: EastHaddam

Print Date: October 17, 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 35.77 square miles and contains 1 census tracts. There are over 2 thousand households in the region which has a total population of 6,525 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 2 thousand buildings in the region with a total building replacement value (excluding contents) of 984 (millions of dollars). Approximately 92.00 % of the buildings (and 89.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 274 and 12 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 2 thousand buildings in the region which have an aggregate total replacement value of 984 (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 80% 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 2 schools, 2 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 no 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 286.00 (millions of dollars). This inventory includes over 31.69 miles of highways, 2 bridges, 392.71 miles of pipes.

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System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
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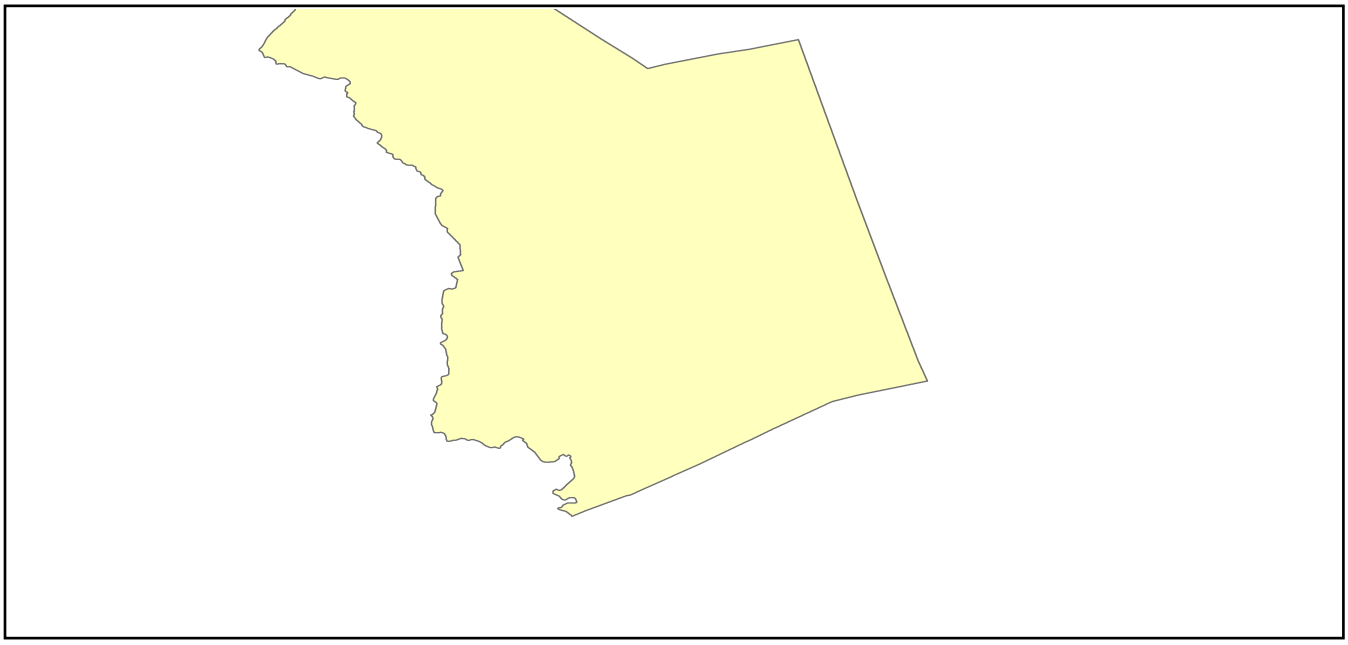
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	1	2.8177
	Tunnels	0	0.0000
		Subtotal	**2.8177**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**274.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.3251
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.3251**
Waste Water	Distribution Lines	NA	3.7951
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**3.7951**
Natural Gas	Distribution Lines	NA	2.5300
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**2.5300**
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	**12.70**

Earthquake Scenario

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



Scenario Name	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 1,052 buildings will be at least moderately damaged. This is over 37.00 % of the buildings in the region. There are an estimated 239 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

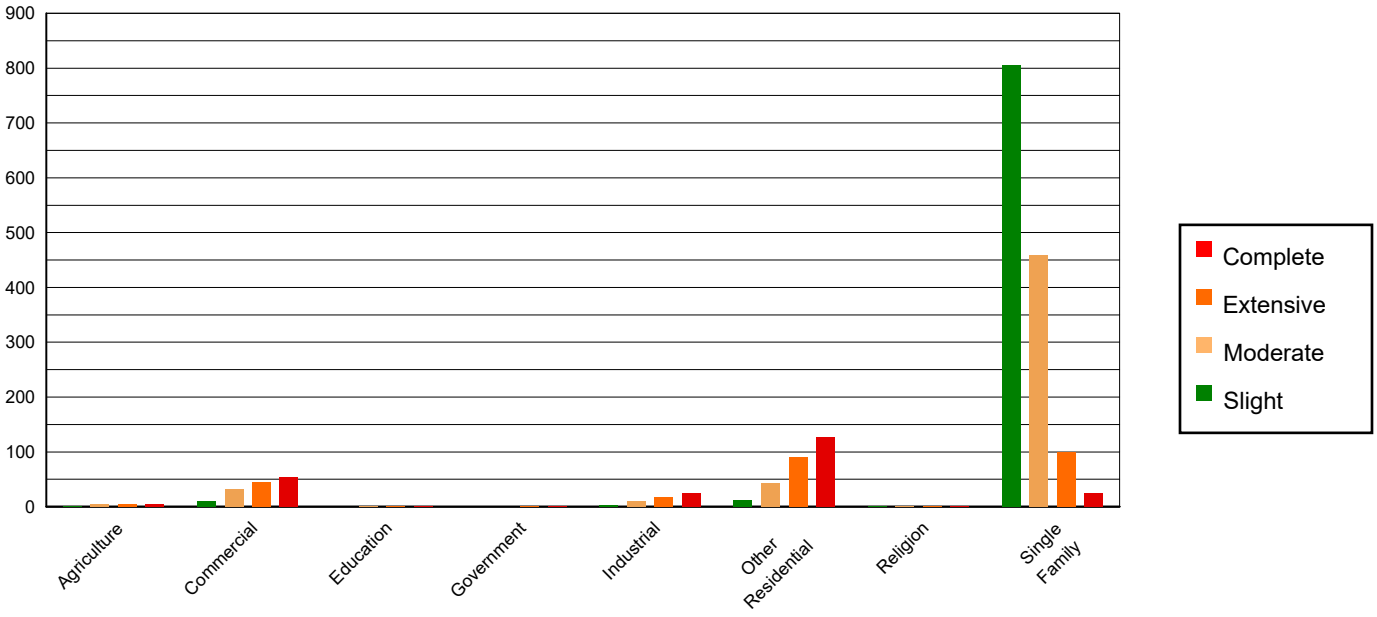


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0.48	0.05	1.27	0.15	4.56	0.83	5.10	1.96	5.59	2.33
Commercial	4.93	0.53	9.98	1.20	32.11	5.81	44.55	17.12	54.44	22.70
Education	0.14	0.02	0.27	0.03	0.84	0.15	1.26	0.48	1.49	0.62
Government	0.05	0.01	0.09	0.01	0.35	0.06	0.63	0.24	0.87	0.36
Industrial	1.43	0.15	2.74	0.33	9.89	1.79	17.19	6.61	23.74	9.90
Other Residential	4.19	0.45	12.48	1.50	43.22	7.83	90.82	34.91	127.29	53.07
Religion	1.50	0.16	1.53	0.18	1.72	0.31	1.58	0.61	1.67	0.70
Single Family	925.55	98.64	805.07	96.60	459.60	83.22	99.03	38.07	24.74	10.31
Total	**938**		**833**		**552**		**260**		**240**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	920.35	98.09	796.80	95.60	450.62	81.59	89.74	34.49	14.39	6.00
Steel	1.23	0.13	2.39	0.29	13.88	2.51	34.42	13.23	54.10	22.56
Concrete	0.15	0.02	0.29	0.04	1.84	0.33	4.52	1.74	6.88	2.87
Precast	0.08	0.01	0.14	0.02	0.81	0.15	1.82	0.70	3.65	1.52
RM	0.52	0.06	0.60	0.07	3.06	0.55	5.82	2.24	7.28	3.04
URM	13.65	1.46	22.51	2.70	40.46	7.33	34.31	13.19	27.66	11.53
MH	2.29	0.24	10.69	1.28	41.62	7.54	89.53	34.41	125.87	52.48
Total	**938**		**833**		**552**		**260**		**240**	

*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	2	2	0	0
EOCs	1	1	0	0
PoliceStations	1	1	0	0
FireStations	2	2	0	0

Transportation Lifeline Damage

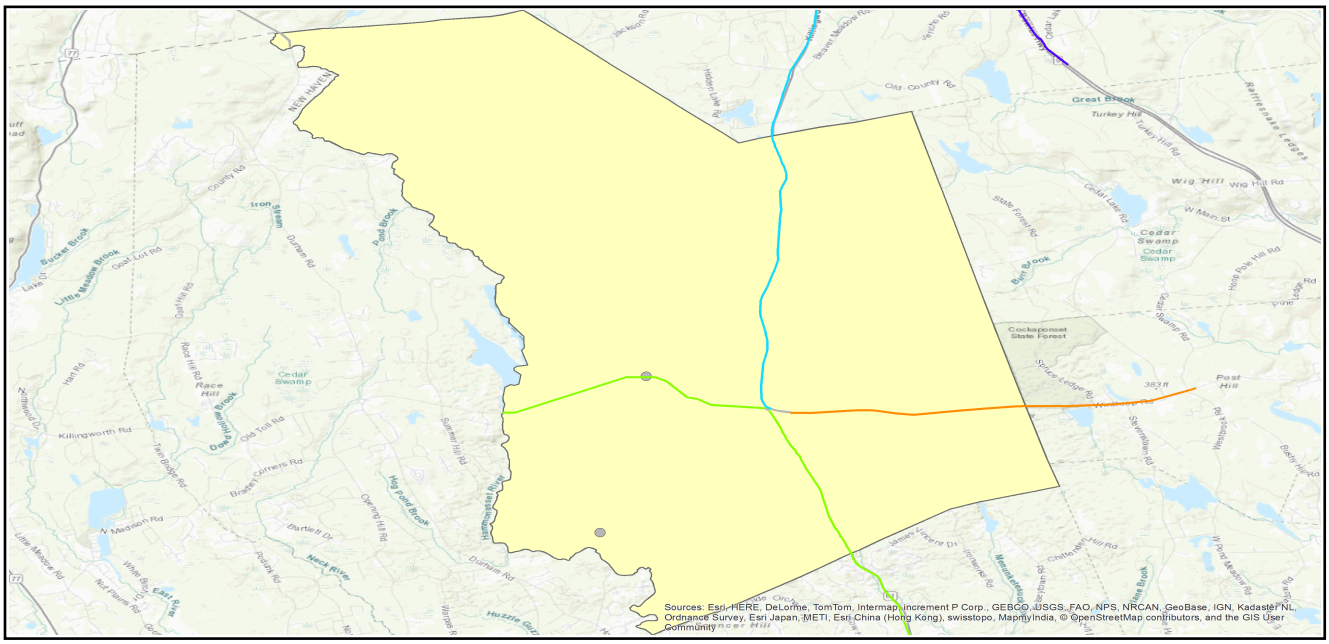


Table 6: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	With Functionality > 50 % After Day 7
Highway	Segments	10	0	0	10	10
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	1	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	0	0	0	0	0
Natural Gas	0	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	197	0	0
Waste Water	118	0	0
Natural Gas	79	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

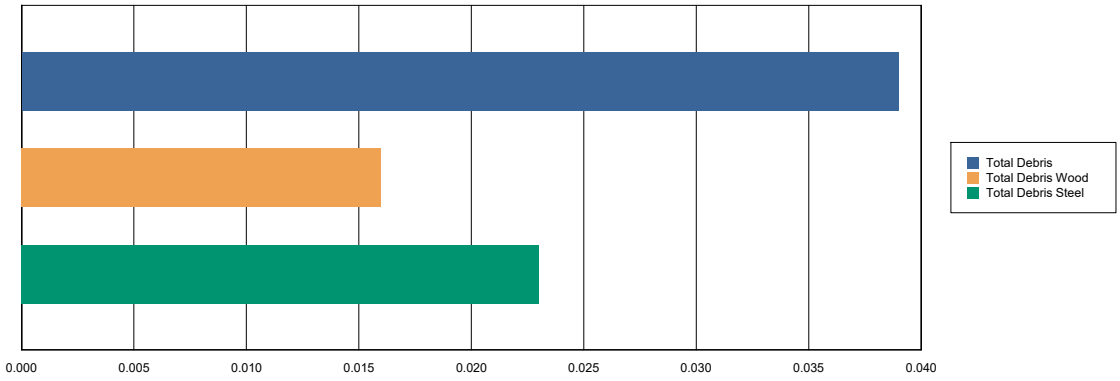
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there 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 39,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 41.00% 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 1,560 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



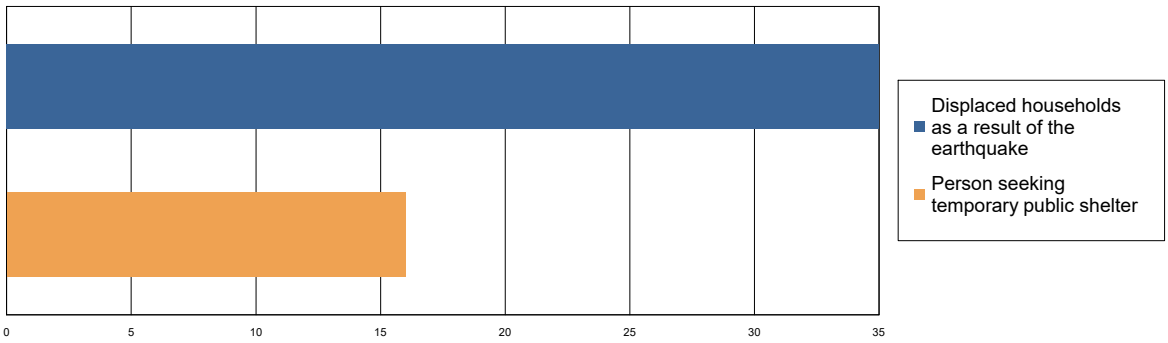
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.02	0.02	0.04	1,560 (@25 tons/truck)

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 35 households to be displaced due to the earthquake. Of these, 16 people (out of a total population of 6,525) 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
35	16

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	1.90	0.56	0.09	0.17
	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	2.95	0.90	0.14	0.28
	Other-Residential	15.17	3.70	0.25	0.41
	Single Family	14.88	3.13	0.38	0.74
	Total	**35**	**8**	**1**	**2**
2 PM	Commercial	106.57	31.64	4.88	9.55
	Commuting	0.00	0.02	0.02	0.00
	Educational	42.49	13.07	2.16	4.21
	Hotels	0.00	0.00	0.00	0.00
	Industrial	21.88	6.66	1.06	2.06
	Other-Residential	2.45	0.60	0.04	0.07
	Single Family	2.68	0.58	0.08	0.14
	Total	**176**	**53**	**8**	**16**
5 PM	Commercial	76.82	22.79	3.55	6.82
	Commuting	0.10	0.51	0.40	0.10
	Educational	1.67	0.51	0.08	0.17
	Hotels	0.00	0.00	0.00	0.00
	Industrial	13.67	4.16	0.66	1.29
	Other-Residential	5.40	1.32	0.09	0.15
	Single Family	5.91	1.28	0.17	0.31
	Total	**104**	**31**	**5**	**9**

Economic Loss

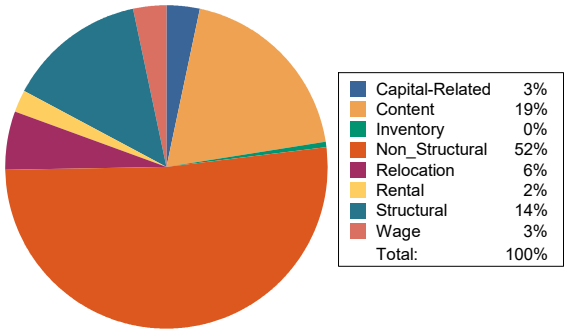
The total economic loss estimated for the earthquake is 189.52 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 189.24 (millions of dollars); 15 % 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)

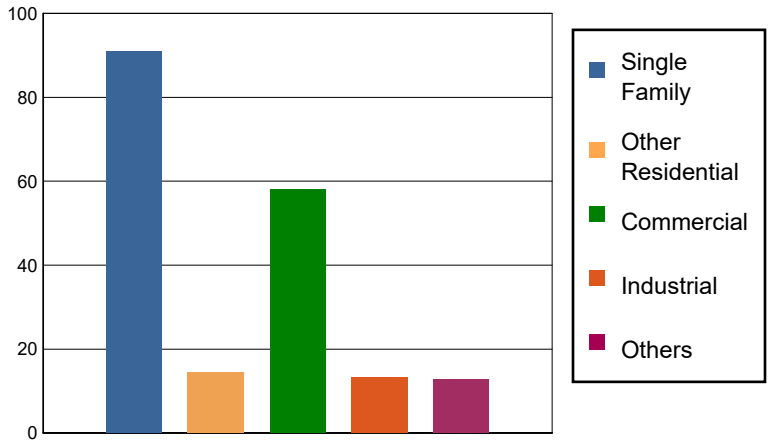


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.5498	5.0976	0.2770	0.2350	6.1594
	Capital-Related	0.0000	0.2335	5.7370	0.1553	0.0961	6.2219
	Rental	1.3582	0.3875	2.5704	0.0537	0.1128	4.4826
	Relocation	4.8576	1.0378	3.5603	0.3652	1.1013	10.9222
	Subtotal	**6.2158**	**2.2086**	**16.9653**	**0.8512**	**1.5452**	**27.7861**
Capital Stock Losses							
	Structural	11.8082	2.6292	7.5093	1.7527	2.5921	26.2915
	Non_Structural	54.0349	8.0057	23.2098	6.5894	5.7949	97.6347
	Content	18.8010	1.6388	10.0860	3.3935	2.6843	36.6036
	Inventory	0.0000	0.0000	0.2265	0.6103	0.0865	0.9233
	Subtotal	**84.6441**	**12.2737**	**41.0316**	**12.3459**	**11.1578**	**161.4531**
	Total	**90.86**	**14.48**	**58.00**	**13.20**	**12.70**	**189.24**

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	260.7516	0.0000	0.00
	Bridges	4.7756	0.2788	5.84
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**265.5272**	**0.2788**	
Railways	Segments	5.9036	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	**5.9036**	**0.0000**	
Light Rail	Segments	2.8177	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	**2.8177**	**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	**274.25**	**0.28**	

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	6.3251	0.0000	0.00
	Subtotal	**6.3251**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	3.7951	0.0000	0.00
	Subtotal	**3.7951**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	2.5300	0.0000	0.00
	Subtotal	**2.5300**	**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	**12.65**	**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	6,525	876	108	984
Total Region		**6,525**	**876**	**108**	**984**

Hazus: Earthquake Global Risk Report

Region Name: Killingworth

Earthquake Scenario: Haddam

Print Date: October 17, 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 35.77 square miles and contains 1 census tracts. There are over 2 thousand households in the region which has a total population of 6,525 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 2 thousand buildings in the region with a total building replacement value (excluding contents) of 984 (millions of dollars). Approximately 92.00 % of the buildings (and 89.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 274 and 12 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 2 thousand buildings in the region which have an aggregate total replacement value of 984 (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 80% 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 2 schools, 2 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 no 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 286.00 (millions of dollars). This inventory includes over 31.69 miles of highways, 2 bridges, 392.71 miles of pipes.

Table 1: Transportation System Lifeline Inventory

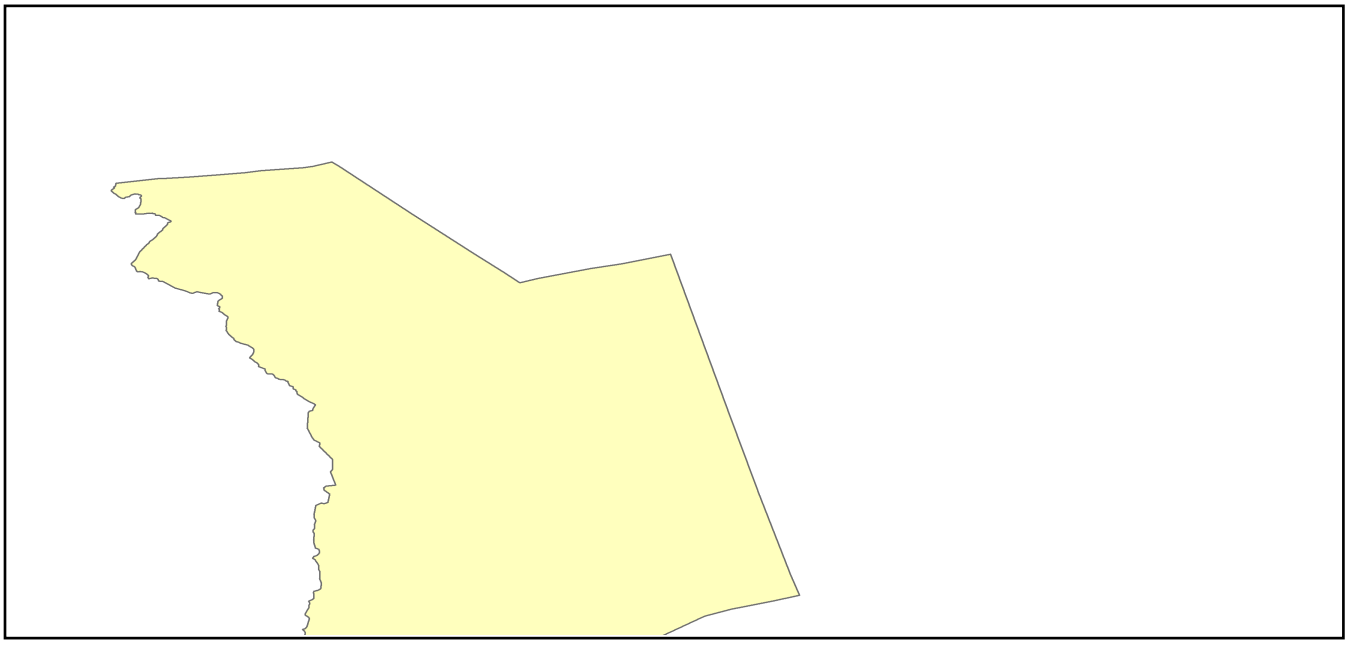
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	2	4.7756
	Segments	10	260.7516
	Tunnels	0	0.0000
		Subtotal	**265.5272**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	1	5.9036
	Tunnels	0	0.0000
		Subtotal	**5.9036**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	1	2.8177
	Tunnels	0	0.0000
		Subtotal	**2.8177**
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	**274.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.3251
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.3251**
Waste Water	Distribution Lines	NA	3.7951
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**3.7951**
Natural Gas	Distribution Lines	NA	2.5300
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**2.5300**
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	**12.70**

Earthquake Scenario

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



Scenario Name	Haddam
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-72.50
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 914 buildings will be at least moderately damaged. This is over 32.00 % of the buildings in the region. There are an estimated 146 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

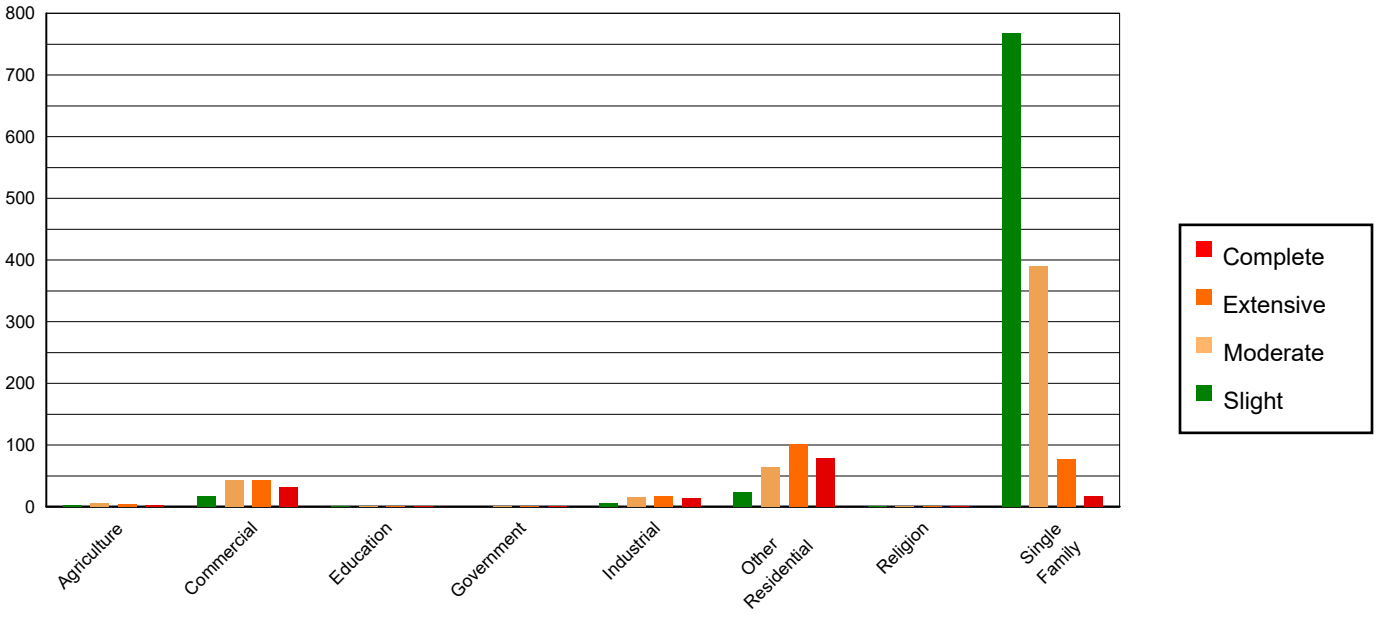


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	1.17	0.11	2.38	0.29	5.85	1.12	4.47	1.82	3.12	2.13
Commercial	10.69	0.98	17.27	2.11	43.56	8.34	43.14	17.51	31.34	21.46
Education	0.30	0.03	0.46	0.06	1.17	0.22	1.22	0.50	0.85	0.58
Government	0.12	0.01	0.18	0.02	0.54	0.10	0.66	0.27	0.51	0.35
Industrial	3.38	0.31	5.14	0.63	14.93	2.86	17.74	7.20	13.81	9.46
Other Residential	10.02	0.92	23.42	2.86	64.74	12.40	101.07	41.02	78.75	53.93
Religion	1.90	0.17	1.66	0.20	1.89	0.36	1.54	0.63	1.00	0.69
Single Family	1062.58	97.47	768.72	93.83	389.51	74.59	76.54	31.07	16.65	11.40
Total	**1,090**		**819**		**522**		**246**		**146**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1055.10	96.78	761.48	92.95	382.45	73.24	65.31	26.51	7.56	5.18
Steel	4.34	0.40	6.57	0.80	25.81	4.94	37.58	15.25	31.73	21.73
Concrete	0.52	0.05	0.77	0.09	3.40	0.65	5.04	2.05	3.95	2.71
Precast	0.26	0.02	0.31	0.04	1.36	0.26	2.33	0.94	2.25	1.54
RM	1.34	0.12	1.21	0.15	4.48	0.86	6.44	2.61	3.82	2.62
URM	20.89	1.92	27.31	3.33	41.69	7.98	29.91	12.14	18.80	12.87
MH	7.71	0.71	21.57	2.63	63.02	12.07	99.79	40.50	77.91	53.35
Total	**1,090**		**819**		**522**		**246**		**146**	

*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	2	1	0	0
EOCs	1	0	0	0
PoliceStations	1	0	0	0
FireStations	2	1	0	0

Transportation Lifeline Damage

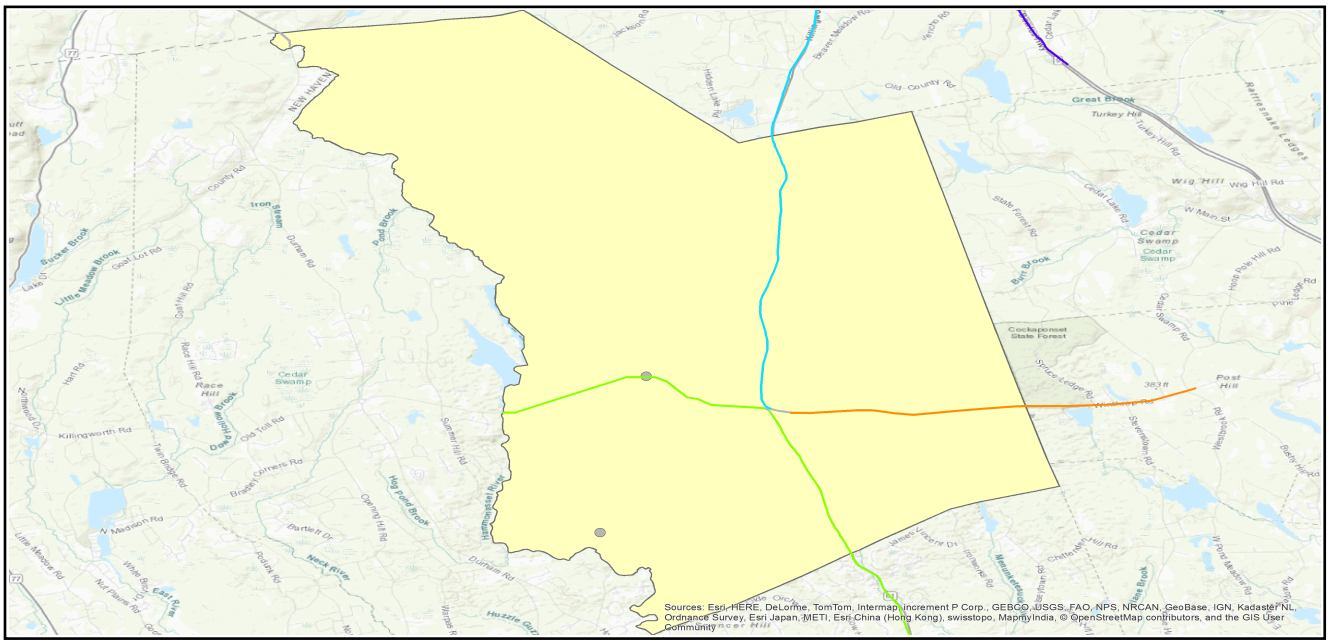


Table 6: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	With Functionality > 50 % After Day 7
Highway	Segments	10	0	0	10	10
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	1	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	0	0	0	0	0
Natural Gas	0	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	197	0	0
Waste Water	118	0	0
Natural Gas	79	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

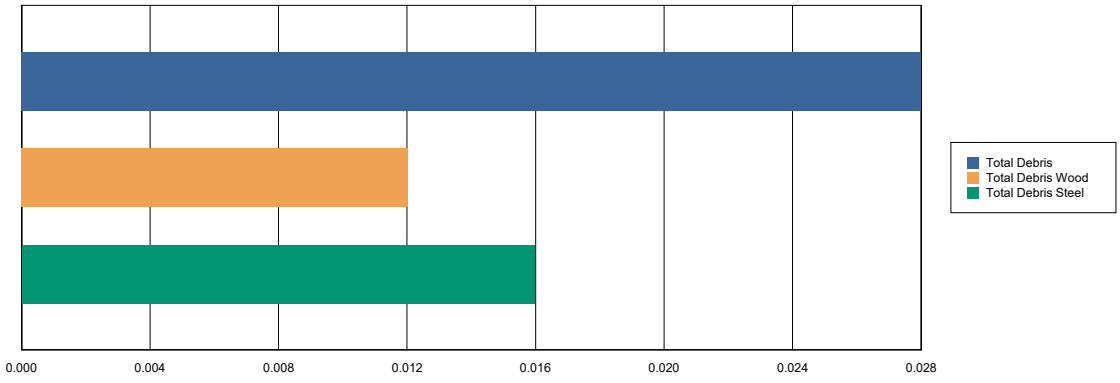
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there 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 28,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 43.00% 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 1,120 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



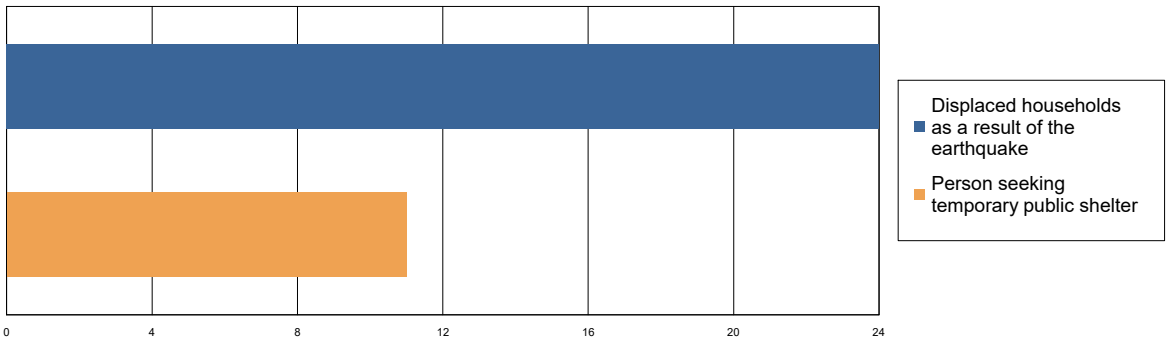
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.01	0.02	0.03	1,120 (@25 tons/truck)

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 24 households to be displaced due to the earthquake. Of these, 11 people (out of a total population of 6,525) 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
24	11

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	1.20	0.34	0.05	0.10
	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	1.87	0.54	0.08	0.16
	Other-Residential	10.33	2.39	0.15	0.25
	Single Family	11.23	2.21	0.26	0.50
	Total	**25**	**5**	**1**	**1**
2 PM	Commercial	67.48	19.06	2.87	5.60
	Commuting	0.00	0.00	0.00	0.00
	Educational	26.78	7.83	1.26	2.47
	Hotels	0.00	0.00	0.00	0.00
	Industrial	13.86	4.01	0.62	1.21
	Other-Residential	1.66	0.39	0.03	0.04
	Single Family	2.01	0.41	0.05	0.09
	Total	**112**	**32**	**5**	**9**
5 PM	Commercial	48.60	13.73	2.09	4.01
	Commuting	0.02	0.09	0.07	0.02
	Educational	1.05	0.31	0.05	0.10
	Hotels	0.00	0.00	0.00	0.00
	Industrial	8.66	2.51	0.39	0.76
	Other-Residential	3.68	0.85	0.06	0.09
	Single Family	4.44	0.91	0.11	0.21
	Total	**66**	**18**	**3**	**5**

Economic Loss

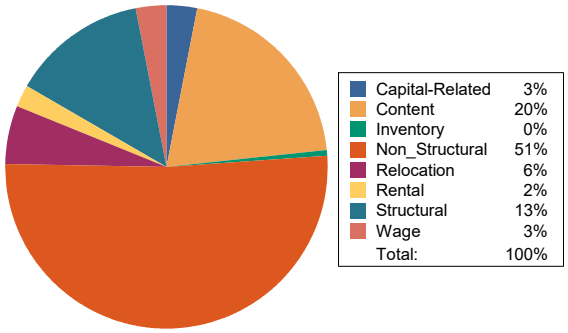
The total economic loss estimated for the earthquake is 147.75 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 147.69 (millions of dollars); 14 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 61 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

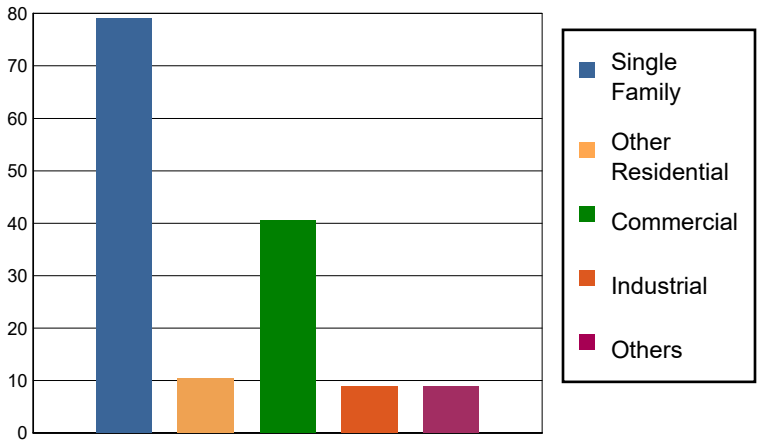


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.4087	3.7939	0.2002	0.1771	4.5799
	Capital-Related	0.0000	0.1736	4.2384	0.1125	0.0692	4.5937
	Rental	1.0867	0.2989	1.9764	0.0410	0.0861	3.4891
	Relocation	3.8896	0.8402	2.7738	0.2953	0.8471	8.6460
	Subtotal	**4.9763**	**1.7214**	**12.7825**	**0.6490**	**1.1795**	**21.3087**
Capital Stock Losses							
	Structural	9.4751	1.9190	5.3944	1.2757	1.8469	19.9111
	Non_Structural	46.5581	5.7209	15.4451	4.3139	3.9180	75.9560
	Content	17.9993	1.1019	6.7305	2.2386	1.8318	29.9021
	Inventory	0.0000	0.0000	0.1499	0.4022	0.0574	0.6095
	Subtotal	**74.0325**	**8.7418**	**27.7199**	**8.2304**	**7.6541**	**126.3787**
	Total	**79.01**	**10.46**	**40.50**	**8.88**	**8.83**	**147.69**

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	260.7516	0.0000	0.00
	Bridges	4.7756	0.0616	1.29
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**265.5272**	**0.0616**	
Railways	Segments	5.9036	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	**5.9036**	**0.0000**	
Light Rail	Segments	2.8177	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	**2.8177**	**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	**274.25**	**0.06**	

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	6.3251	0.0000	0.00
	Subtotal	**6.3251**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	3.7951	0.0000	0.00
	Subtotal	**3.7951**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	2.5300	0.0000	0.00
	Subtotal	**2.5300**	**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	**12.65**	**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	6,525	876	108	984
Total Region		**6,525**	**876**	**108**	**984**

Hazus: Earthquake Global Risk Report

Region Name: Killingworth

Earthquake Scenario: Portland

Print Date: October 17, 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 35.77 square miles and contains 1 census tracts. There are over 2 thousand households in the region which has a total population of 6,525 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 2 thousand buildings in the region with a total building replacement value (excluding contents) of 984 (millions of dollars). Approximately 92.00 % of the buildings (and 89.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 274 and 12 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 2 thousand buildings in the region which have an aggregate total replacement value of 984 (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 80% 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 2 schools, 2 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 no 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 286.00 (millions of dollars). This inventory includes over 31.69 miles of highways, 2 bridges, 392.71 miles of pipes.

Table 1: Transportation System Lifeline Inventory

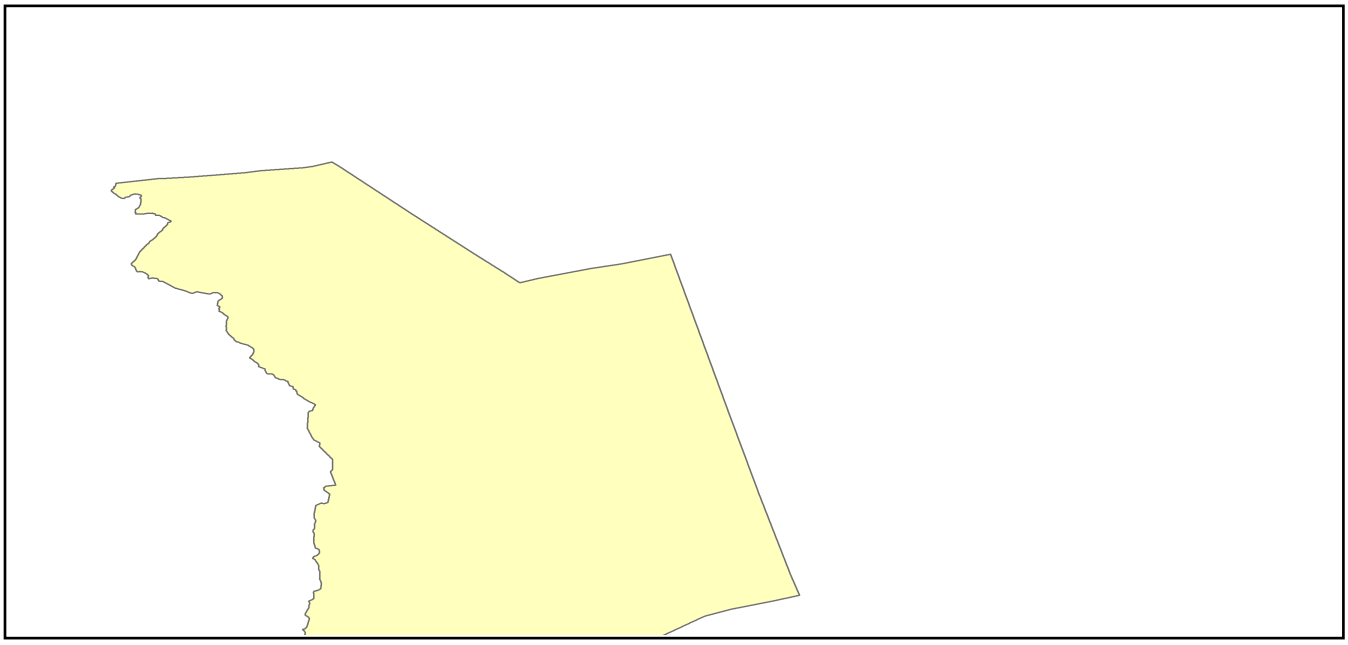
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	2	4.7756
	Segments	10	260.7516
	Tunnels	0	0.0000
		Subtotal	**265.5272**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	1	5.9036
	Tunnels	0	0.0000
		Subtotal	**5.9036**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	1	2.8177
	Tunnels	0	0.0000
		Subtotal	**2.8177**
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	**274.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.3251
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.3251**
Waste Water	Distribution Lines	NA	3.7951
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**3.7951**
Natural Gas	Distribution Lines	NA	2.5300
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**2.5300**
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	**12.70**

Earthquake Scenario

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



Scenario Name	Portland
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-72.60
Latitude of Epicenter	41.60
Earthquake Magnitude	5.70
Depth (km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 406 buildings will be at least moderately damaged. This is over 14.00 % of the buildings in the region. There are an estimated 23 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

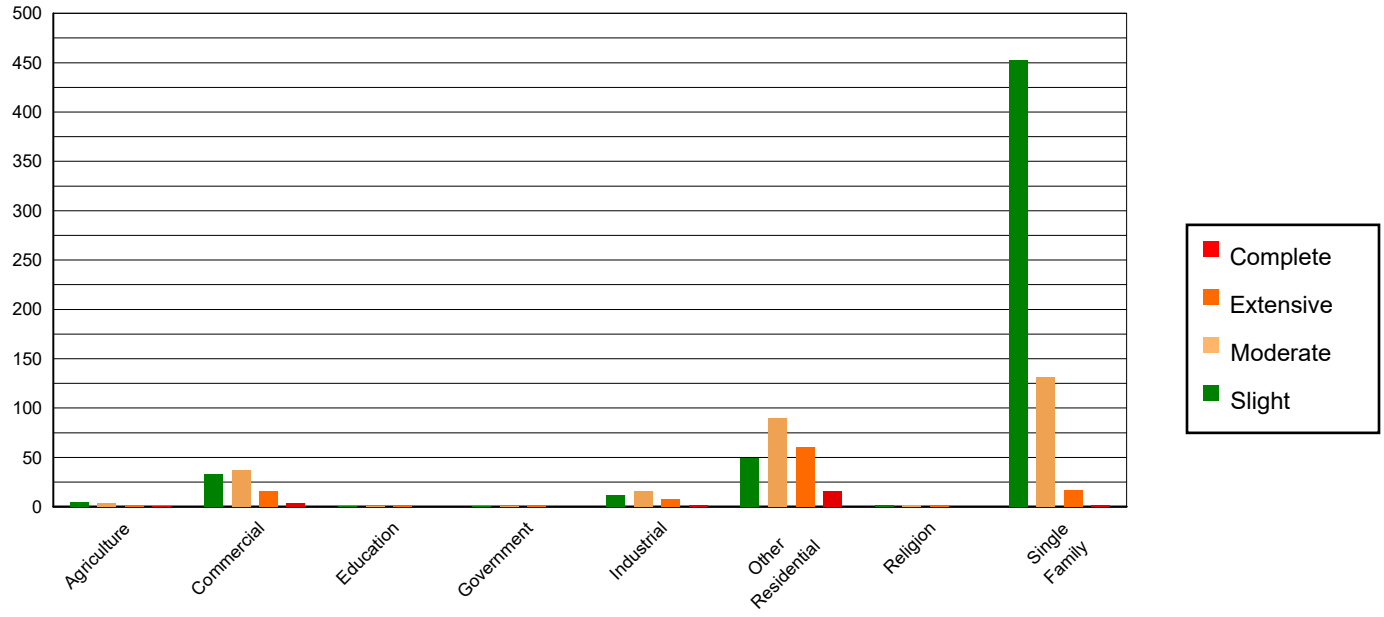


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	6.66	0.36	4.36	0.79	4.03	1.44	1.56	1.52	0.40	1.66
Commercial	56.49	3.03	32.66	5.90	37.27	13.30	15.71	15.36	3.88	16.24
Education	1.58	0.08	0.87	0.16	1.03	0.37	0.41	0.40	0.10	0.42
Government	0.69	0.04	0.41	0.07	0.57	0.20	0.26	0.25	0.07	0.28
Industrial	19.00	1.02	11.31	2.04	15.56	5.55	7.28	7.12	1.85	7.75
Other Residential	63.85	3.42	49.20	8.89	89.64	31.98	59.94	58.62	15.37	64.42
Religion	4.48	0.24	1.60	0.29	1.31	0.47	0.51	0.49	0.11	0.44
Single Family	1711.56	91.81	452.90	81.85	130.85	46.69	16.59	16.22	2.10	8.80
Total	**1,864**		**553**		**280**		**102**		**24**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1690.82	90.69	447.72	80.92	121.91	43.50	10.89	10.65	0.57	2.37
Steel	30.20	1.62	20.24	3.66	33.74	12.04	17.14	16.76	4.71	19.72
Concrete	3.84	0.21	2.50	0.45	4.62	1.65	2.18	2.13	0.55	2.31
Precast	2.33	0.13	1.01	0.18	1.79	0.64	1.20	1.17	0.18	0.73
RM	9.10	0.49	2.65	0.48	3.70	1.32	1.75	1.71	0.08	0.35
URM	68.89	3.70	31.54	5.70	26.04	9.29	9.60	9.39	2.51	10.50
MH	59.13	3.17	47.64	8.61	88.46	31.57	59.49	58.18	15.28	64.01
Total	**1,864**		**553**		**280**		**102**		**24**	

*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	2	0	0	2
EOCs	1	0	0	1
PoliceStations	1	0	0	1
FireStations	2	0	0	1

Transportation Lifeline Damage

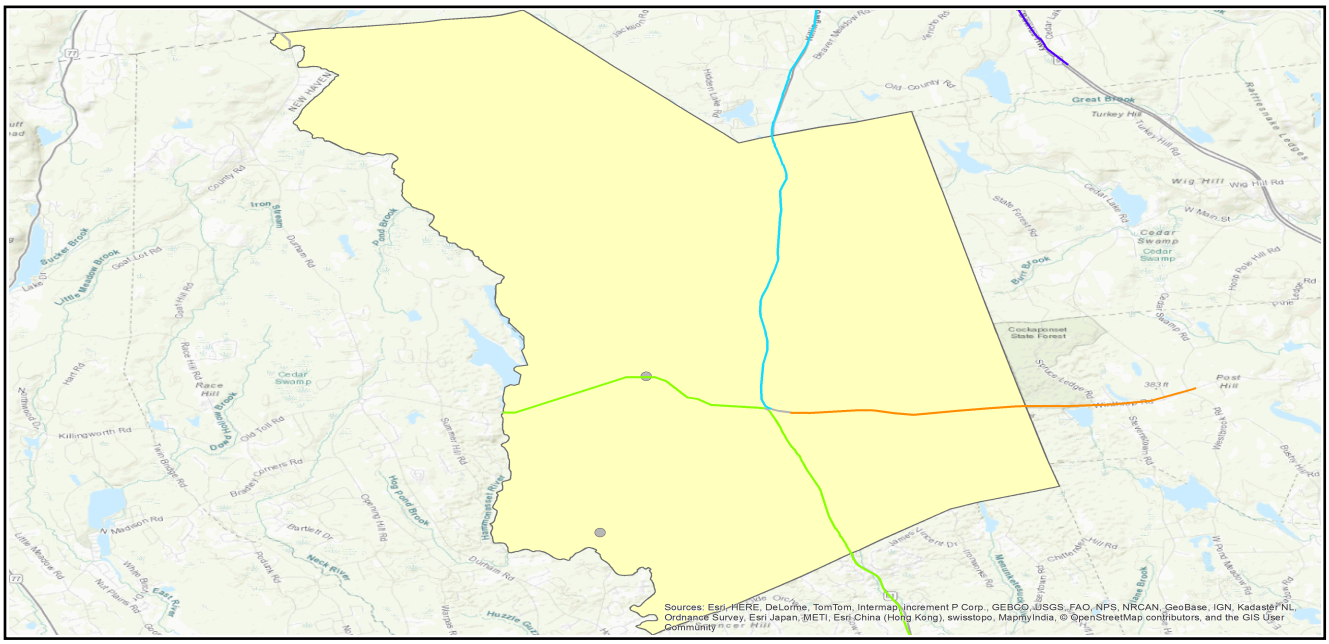


Table 6: Expected Damage to the Transportation Systems

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	10	0	0	10	10
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	1	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	0	0	0	0	0
Natural Gas	0	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	197	0	0
Waste Water	118	0	0
Natural Gas	79	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

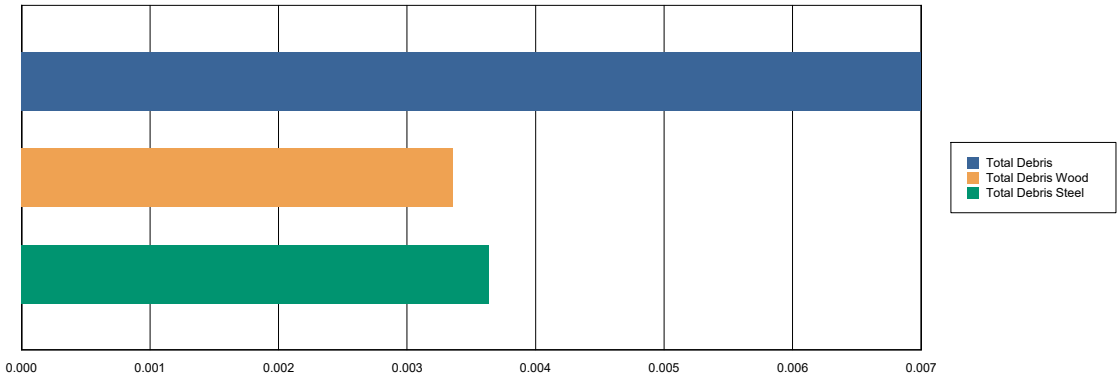
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there 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 7,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 48.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 280 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



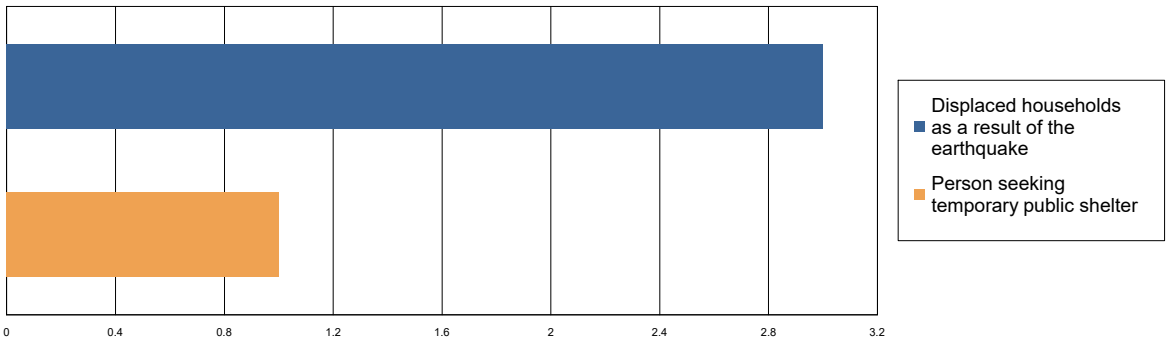
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.00	0.00	0.01	280 (@25 tons/truck)

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 6,525) 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	0.22	0.05	0.01	0.01
	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	0.37	0.08	0.01	0.02
	Other-Residential	3.04	0.56	0.03	0.05
	Single Family	2.71	0.38	0.03	0.07
	Total	**6**	**1**	**0**	**0**
2 PM	Commercial	12.29	2.68	0.33	0.64
	Commuting	0.00	0.00	0.00	0.00
	Educational	4.76	1.09	0.15	0.29
	Hotels	0.00	0.00	0.00	0.00
	Industrial	2.70	0.61	0.08	0.16
	Other-Residential	0.49	0.09	0.00	0.01
	Single Family	0.48	0.07	0.01	0.01
	Total	**21**	**5**	**1**	**1**
5 PM	Commercial	8.80	1.93	0.24	0.46
	Commuting	0.00	0.01	0.01	0.00
	Educational	0.19	0.04	0.01	0.01
	Hotels	0.00	0.00	0.00	0.00
	Industrial	1.69	0.38	0.05	0.10
	Other-Residential	1.08	0.20	0.01	0.02
	Single Family	1.05	0.15	0.02	0.03
	Total	**13**	**3**	**0**	**1**

Economic Loss

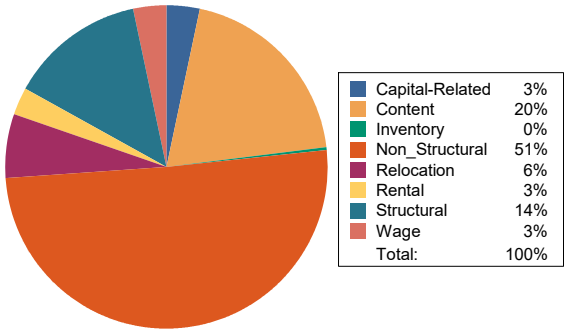
The total economic loss estimated for the earthquake is 43.18 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 43.17 (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 66 % 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)

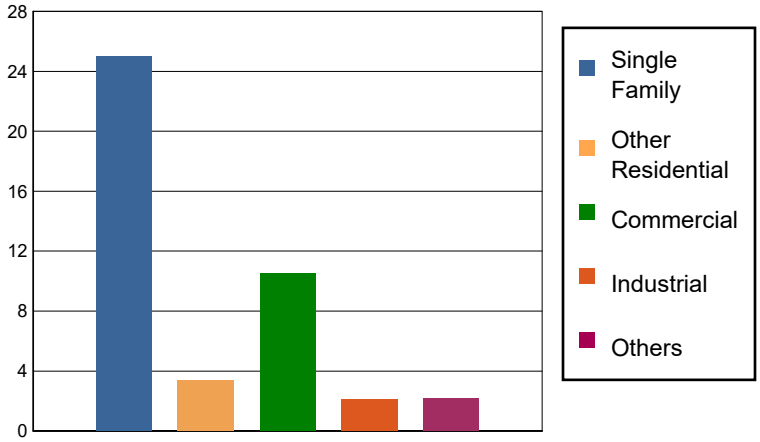


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.1103	1.2173	0.0605	0.0530	1.4411
	Capital-Related	0.0000	0.0468	1.3283	0.0342	0.0187	1.4280
	Rental	0.3068	0.1017	0.6621	0.0145	0.0262	1.1113
	Relocation	1.0767	0.3987	0.9430	0.1214	0.2609	2.8007
	Subtotal	**1.3835**	**0.6575**	**4.1507**	**0.2306**	**0.3588**	**6.7811**
Capital Stock Losses							
	Structural	2.8461	0.6983	1.4998	0.3854	0.5027	5.9323
	Non_Structural	14.9033	1.7359	3.3940	0.9461	0.8675	21.8468
	Content	5.8628	0.2509	1.4671	0.4853	0.4111	8.4772
	Inventory	0.0000	0.0000	0.0323	0.0870	0.0130	0.1323
	Subtotal	**23.6122**	**2.6851**	**6.3932**	**1.9038**	**1.7943**	**36.3886**
	Total	**25.00**	**3.34**	**10.54**	**2.13**	**2.15**	**43.17**

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	260.7516	0.0000	0.00
	Bridges	4.7756	0.0086	0.18
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**265.5272**	**0.0086**	
Railways	Segments	5.9036	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	**5.9036**	**0.0000**	
Light Rail	Segments	2.8177	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	**2.8177**	**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	**274.25**	**0.01**	

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	6.3251	0.0000	0.00
	Subtotal	**6.3251**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	3.7951	0.0000	0.00
	Subtotal	**3.7951**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	2.5300	0.0000	0.00
	Subtotal	**2.5300**	**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	**12.65**	**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	6,525	876	108	984
Total Region		**6,525**	**876**	**108**	**984**

Hazus: Earthquake Global Risk Report

Region Name: Killingworth

Earthquake Scenario: Stamford

Print Date: October 17, 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 35.77 square miles and contains 1 census tracts. There are over 2 thousand households in the region which has a total population of 6,525 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 2 thousand buildings in the region with a total building replacement value (excluding contents) of 984 (millions of dollars). Approximately 92.00 % of the buildings (and 89.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 274 and 12 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 2 thousand buildings in the region which have an aggregate total replacement value of 984 (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 80% 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 2 schools, 2 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 no 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 286.00 (millions of dollars). This inventory includes over 31.69 miles of highways, 2 bridges, 392.71 miles of pipes.

Table 1: Transportation System Lifeline Inventory

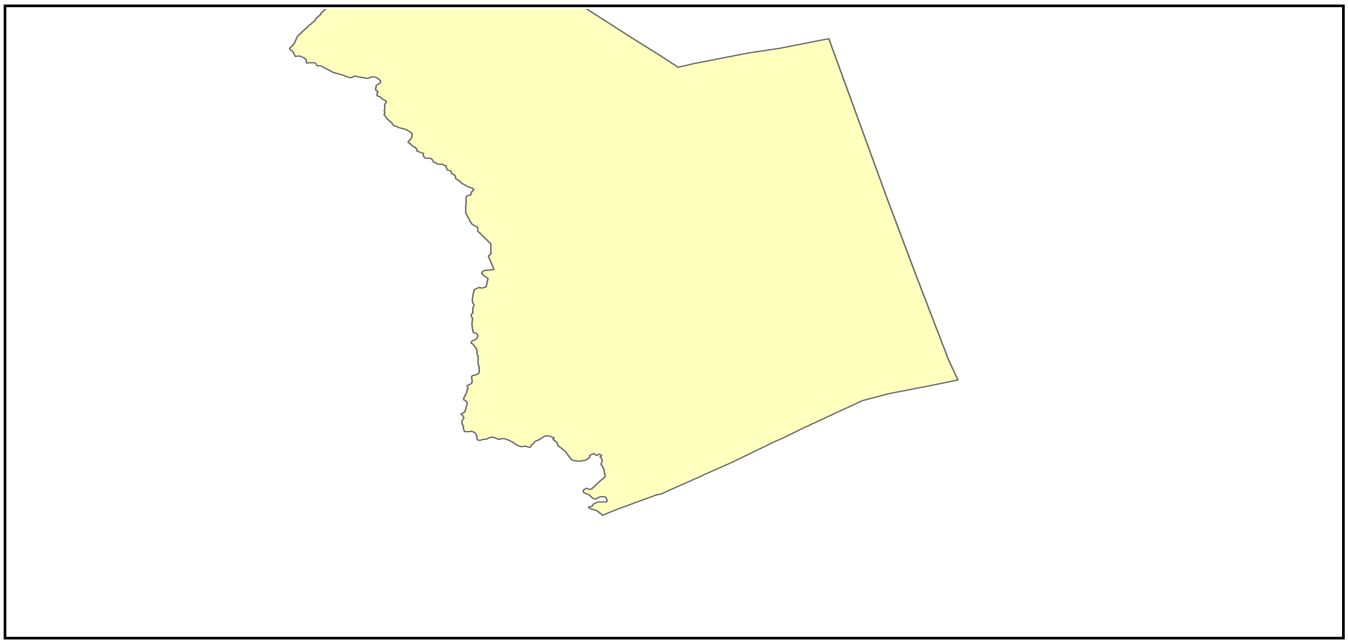
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	2	4.7756
	Segments	10	260.7516
	Tunnels	0	0.0000
		Subtotal	**265.5272**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	1	5.9036
	Tunnels	0	0.0000
		Subtotal	**5.9036**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	1	2.8177
	Tunnels	0	0.0000
		Subtotal	**2.8177**
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	**274.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.3251
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.3251**
Waste Water	Distribution Lines	NA	3.7951
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**3.7951**
Natural Gas	Distribution Lines	NA	2.5300
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**2.5300**
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	**12.70**

Earthquake Scenario

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



Scenario Name	Stamford
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-73.56
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 19 buildings will be at least moderately damaged. This is over 1.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

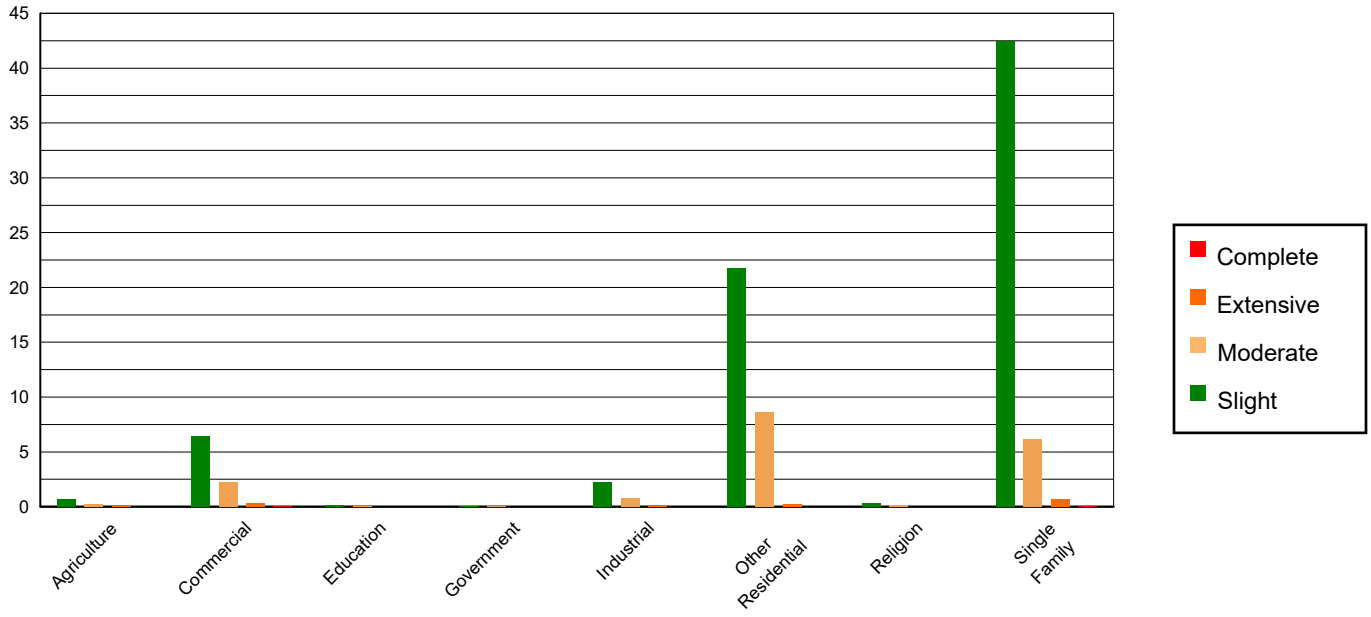


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	16.04	0.59	0.72	0.97	0.21	1.15	0.03	2.03	0.00	1.63
Commercial	137.03	5.02	6.42	8.65	2.24	12.27	0.30	21.57	0.02	24.75
Education	3.77	0.14	0.16	0.22	0.06	0.31	0.01	0.51	0.00	0.71
Government	1.89	0.07	0.08	0.11	0.03	0.15	0.00	0.22	0.00	0.24
Industrial	51.83	1.90	2.27	3.06	0.80	4.37	0.10	6.94	0.01	6.95
Other Residential	247.34	9.06	21.78	29.35	8.64	47.43	0.24	17.12	0.00	1.09
Religion	7.53	0.28	0.32	0.44	0.12	0.68	0.02	1.36	0.00	1.97
Single Family	2264.68	82.95	42.44	57.21	6.13	33.64	0.69	50.26	0.05	62.65
Total	**2,730**		**74**		**18**		**1**		**0**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2230.74	81.71	37.51	50.56	3.42	18.79	0.22	16.18	0.00	0.00
Steel	100.51	3.68	4.04	5.44	1.35	7.40	0.13	9.29	0.00	4.45
Concrete	13.05	0.48	0.48	0.65	0.15	0.80	0.01	0.49	0.00	0.00
Precast	5.91	0.22	0.33	0.45	0.22	1.19	0.04	2.91	0.00	0.63
RM	16.37	0.60	0.57	0.77	0.30	1.64	0.04	3.09	0.00	0.00
URM	123.84	4.54	9.74	13.12	4.23	23.22	0.71	51.75	0.08	94.92
MH	239.70	8.78	21.52	29.01	8.56	46.97	0.22	16.29	0.00	0.00
Total	**2,730**		**74**		**18**		**1**		**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	2	0	0	2
EOCs	1	0	0	1
PoliceStations	1	0	0	1
FireStations	2	0	0	2

Transportation Lifeline Damage

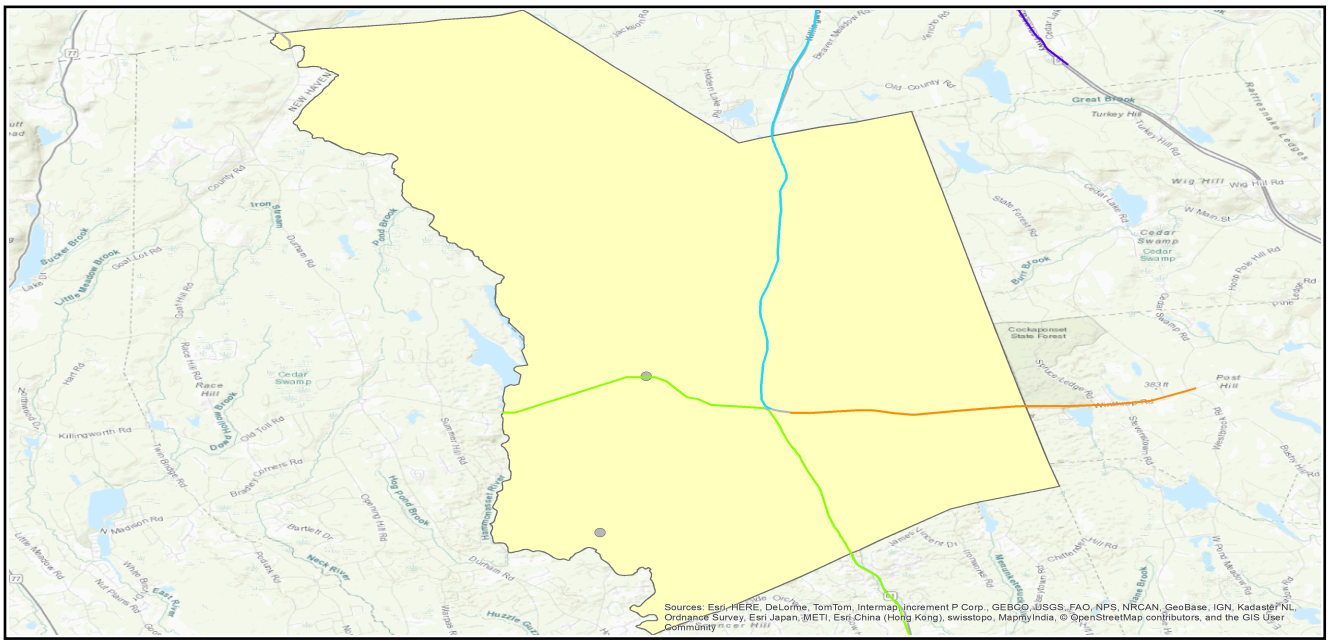


Table 6: Expected Damage to the Transportation Systems

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	10	0	0	10	10
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	1	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	0	0	0	0	0
Natural Gas	0	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	197	0	0
Waste Water	118	0	0
Natural Gas	79	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 0 tons of debris will be generated. Of the total amount, Brick/Wood comprises 75.00% 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 0 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	0 (@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 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 6,525) 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
0	0

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	0.06	0.01	0.00	0.00
	Single Family	0.15	0.01	0.00	0.00
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0.33	0.04	0.00	0.01
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.12	0.02	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.05	0.01	0.00	0.00
	Other-Residential	0.01	0.00	0.00	0.00
	Single Family	0.03	0.00	0.00	0.00
	Total	**1**	**0**	**0**	**0**
5 PM	Commercial	0.24	0.03	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	0.03	0.00	0.00	0.00
	Other-Residential	0.02	0.00	0.00	0.00
	Single Family	0.06	0.01	0.00	0.00
	Total	**0**	**0**	**0**	**0**

Economic Loss

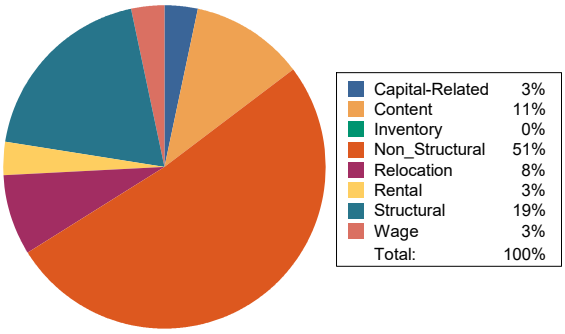
The total economic loss estimated for the earthquake is 1.35 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 1.35 (millions of dollars); 18 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 71 % 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)

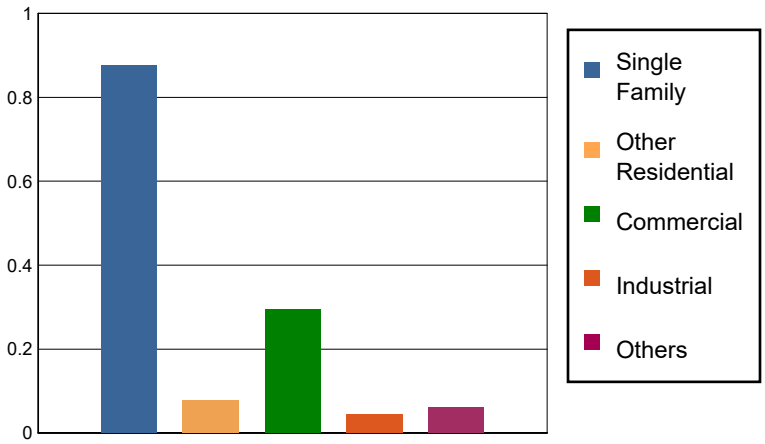


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.0027	0.0388	0.0014	0.0021	0.0450
	Capital-Related	0.0000	0.0011	0.0413	0.0008	0.0007	0.0439
	Rental	0.0148	0.0033	0.0267	0.0004	0.0009	0.0461
	Relocation	0.0478	0.0130	0.0321	0.0037	0.0095	0.1061
	Subtotal	**0.0626**	**0.0201**	**0.1389**	**0.0063**	**0.0132**	**0.2411**
Capital Stock Losses							
	Structural	0.1647	0.0212	0.0473	0.0100	0.0170	0.2602
	Non_Structural	0.5419	0.0346	0.0789	0.0181	0.0218	0.6953
	Content	0.1069	0.0025	0.0281	0.0087	0.0081	0.1543
	Inventory	0.0000	0.0000	0.0006	0.0015	0.0002	0.0023
	Subtotal	**0.8135**	**0.0583**	**0.1549**	**0.0383**	**0.0471**	**1.1121**
	Total	**0.88**	**0.08**	**0.29**	**0.04**	**0.06**	**1.35**

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	260.7516	0.0000	0.00
	Bridges	4.7756	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**265.5272**	**0.0000**	
Railways	Segments	5.9036	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	**5.9036**	**0.0000**	
Light Rail	Segments	2.8177	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	**2.8177**	**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	**274.25**	**0.00**	

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	6.3251	0.0000	0.00
	Subtotal	**6.3251**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	3.7951	0.0000	0.00
	Subtotal	**3.7951**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	2.5300	0.0000	0.00
	Subtotal	**2.5300**	**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	**12.65**	**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	6,525	876	108	984
Total Region		**6,525**	**876**	**108**	**984**