Hazus: Flood Global Risk Report

Region Name: Portland

Flood Scenario: PortlandAll

Print Date: Tuesday, December 31, 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 25 square miles and contains 251 census blocks. The region contains over 4 thousand households and has a total population of 9,508 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 3,970 buildings in the region with a total building replacement value (excluding contents) of 1,573 million dollars. Approximately 90.91% of the buildings (and 80.25% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,970 buildings in the region which have an aggregate total replacement value of 1,573 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,262,021	80.3%
Commercial	202,878	12.9%
Industrial	64,635	4.1%
Agricultural	7,848	0.5%
Religion	13,571	0.9%
Government	4,780	0.3%
Education	16,869	1.1%
Total	**1,572,602**	**100%**

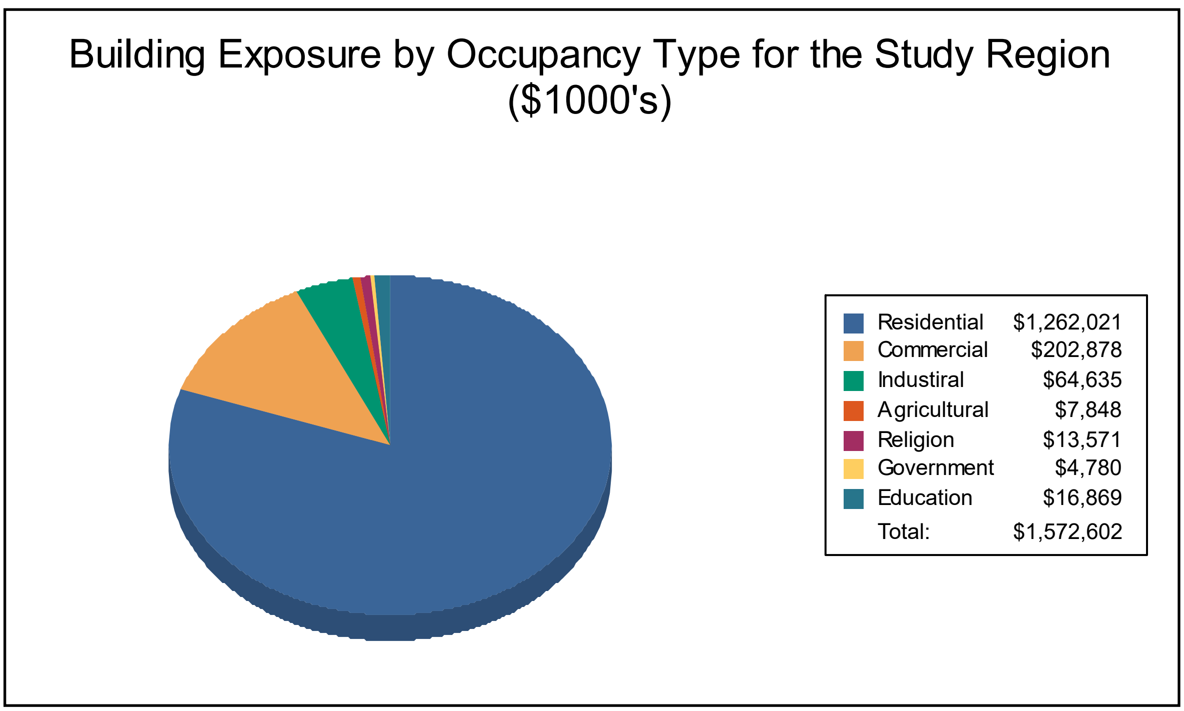
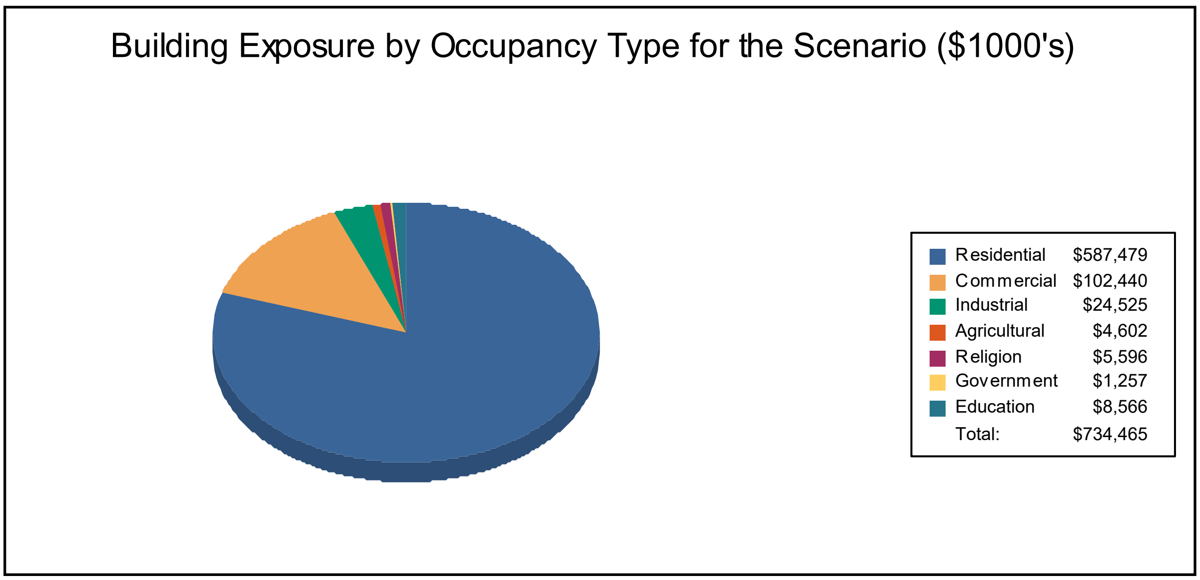


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	587,479	80.0%
Commercial	102,440	13.9%
Industrial	24,525	3.3%
Agricultural	4,602	0.6%
Religion	5,596	0.8%
Government	1,257	0.2%
Education	8,566	1.2%
Total	**734,465**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 6 schools, 3 fire stations, 1 police station and 1 emergency operation center.

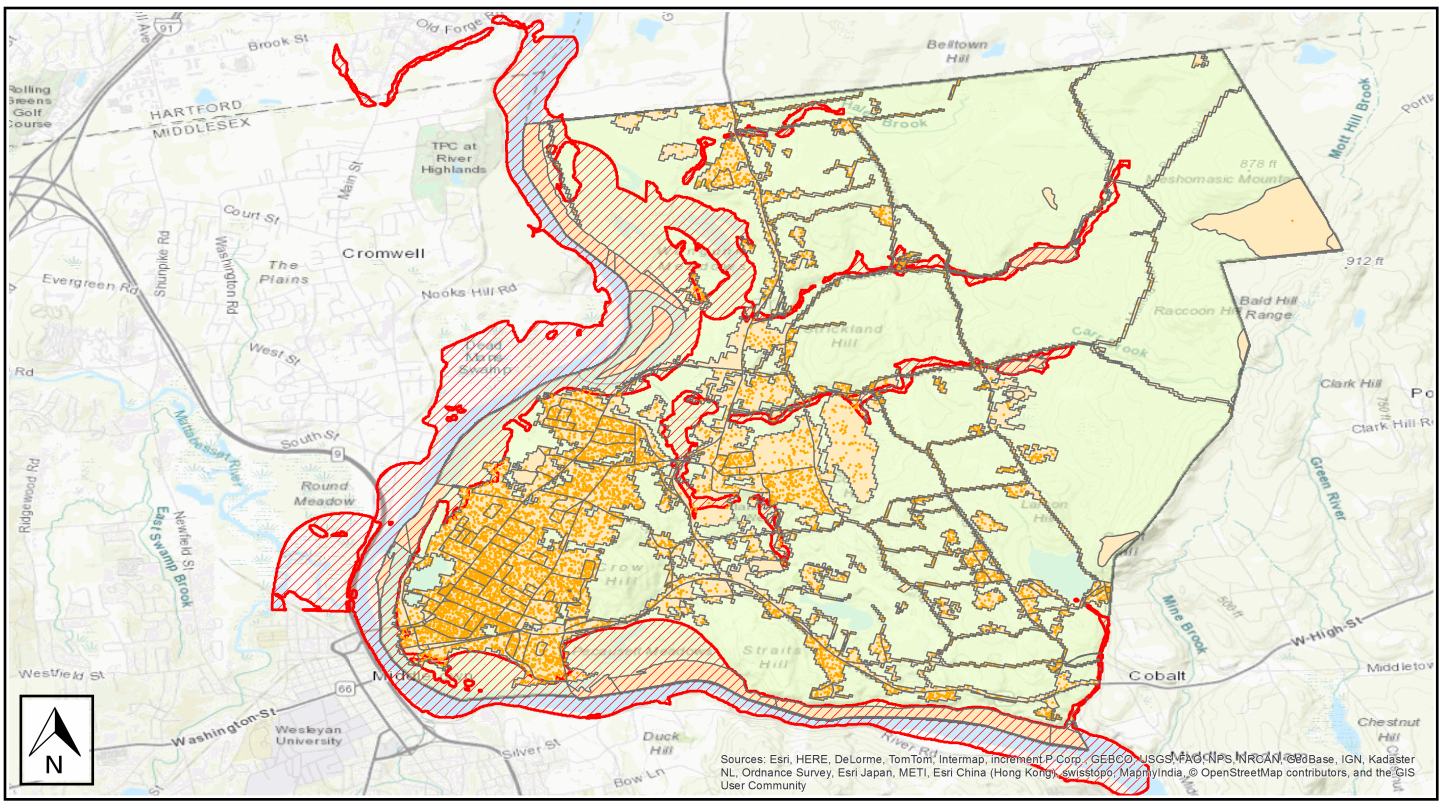
Flood Scenario Parameters

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

Study Region Name:	Portland
Scenario Name:	PortlandAll
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 15 buildings will be at least moderately damaged. This is over 96% 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

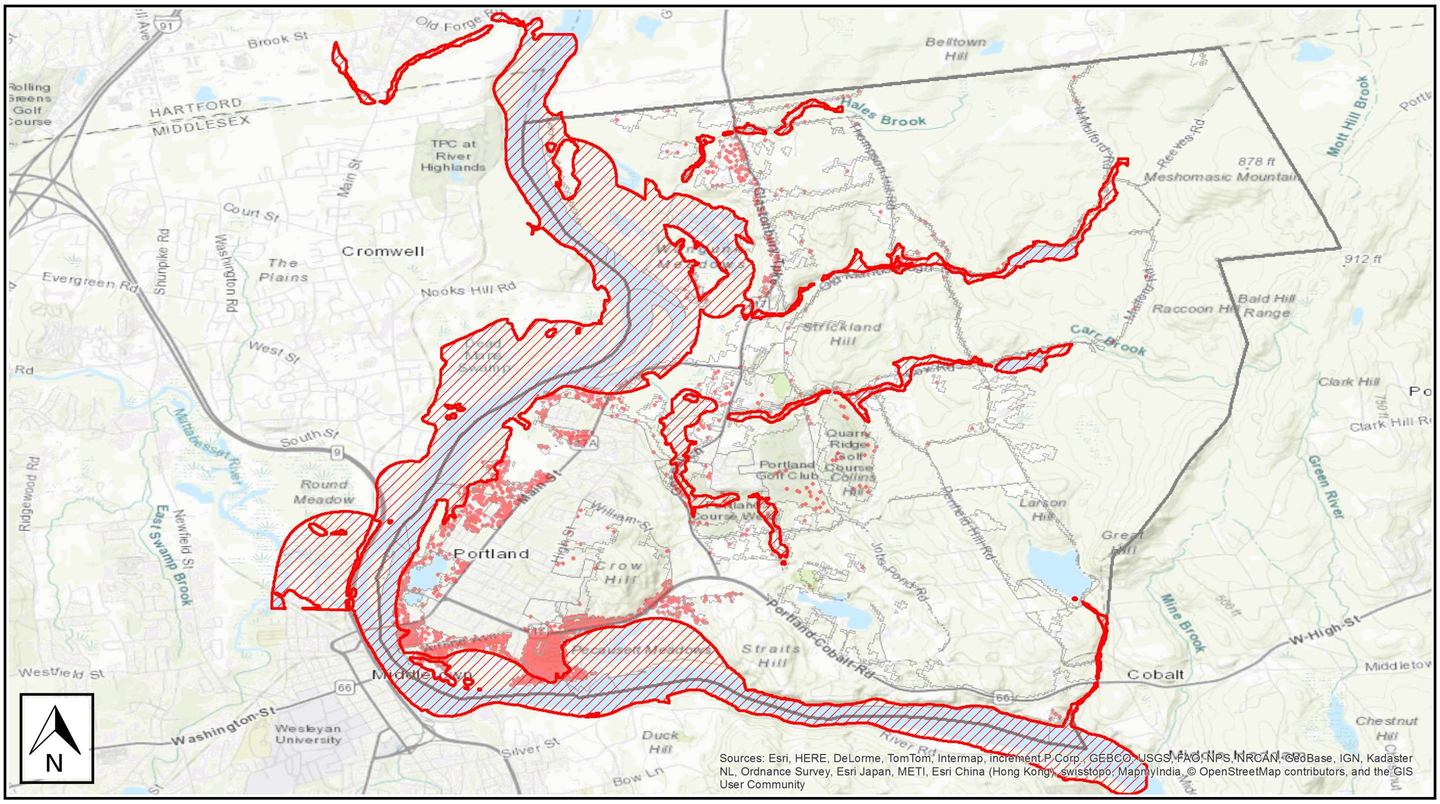


Table 3: Expected Building Damage by Occupancy

Occupancy	1-10 Count	1-10 (%)	11-20 Count	11-20 (%)	21-30 Count	21-30 (%)	31-40 Count	31-40 (%)	41-50 Count	41-50 (%)	>50 Count	>50 (%)
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	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	28	65	15	35	0	0	0	0	0	0	0	0
Total	**28**		**15**		**0**		**0**		**0**		**0**	

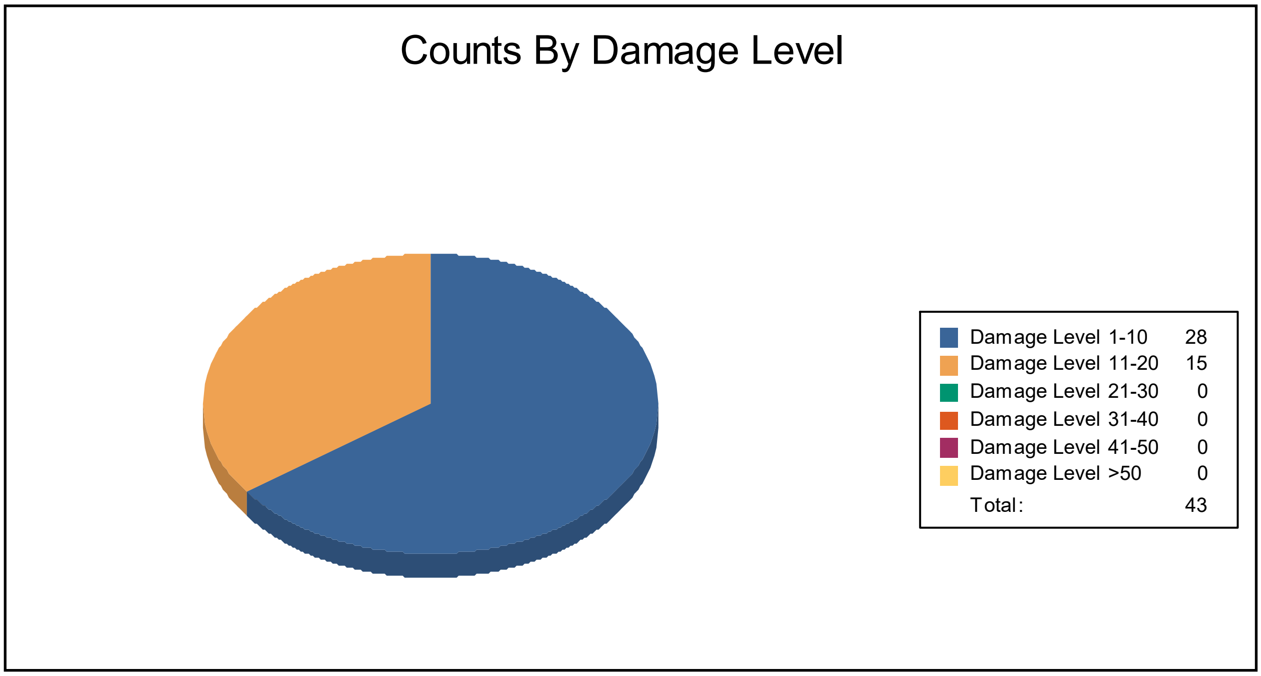


Table 4: Expected Building Damage by Building Type

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	28	65	15	35	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	3	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	6	0	0	0

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

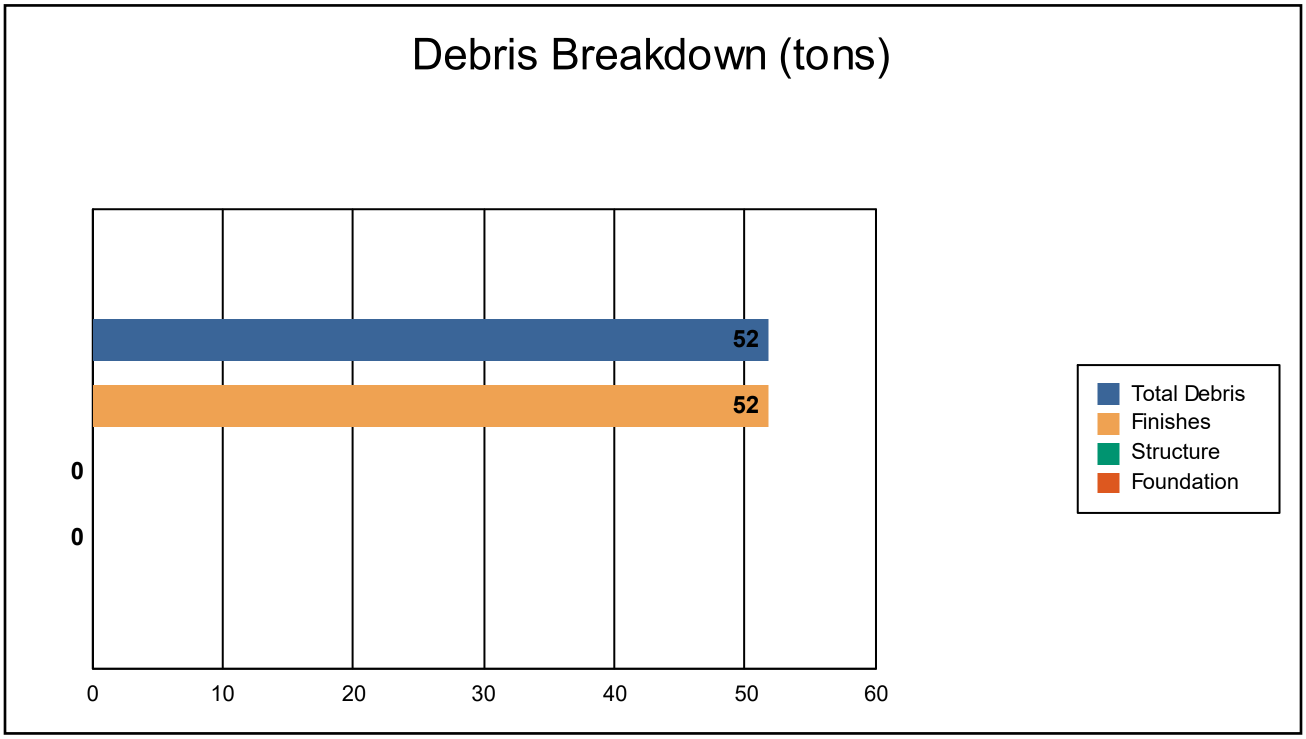
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(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.

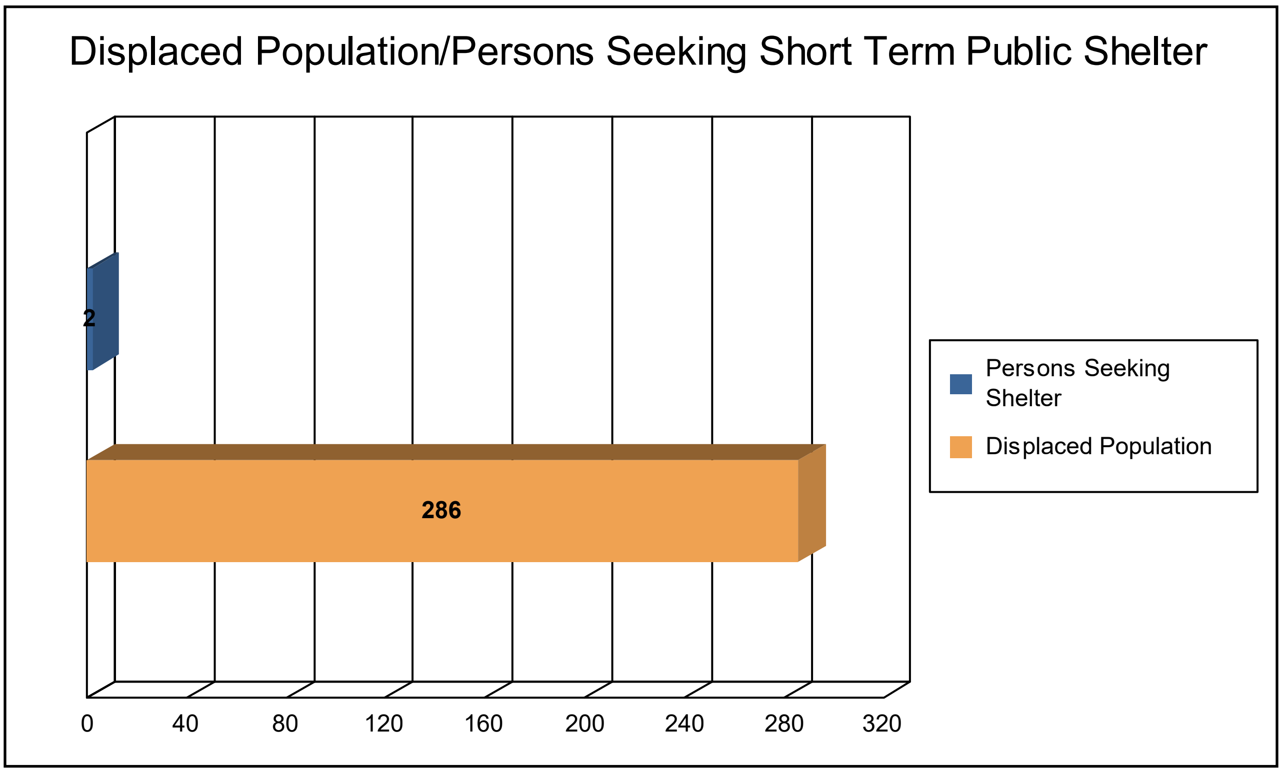


The model estimates that a total of 52 tons of debris will be generated. Of the total amount, Finishes comprises 100% of the total, Structure comprises 0% of the total, and Foundation comprises 0%. If the debris tonnage is converted into an estimated number of truckloads, it will require 3 truckloads (@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 95 households (or 286 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 2 people (out of a total population of 9,508) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 9.21 million dollars, which represents 1.25 % of the total replacement value of the scenario buildings.

Building-Related Losses

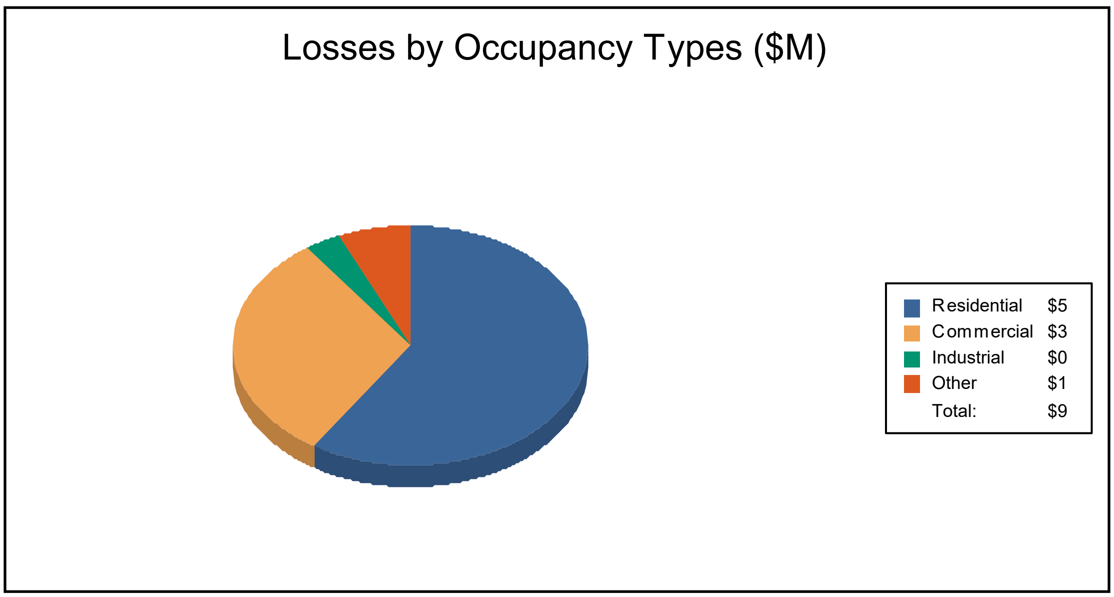
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 4.98 million dollars. 46% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 59.05% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	2.59	0.20	0.09	0.02	2.90
	Content	1.09	0.60	0.18	0.17	2.04
	Inventory	0.00	0.01	0.02	0.00	0.03
	Subtotal	**3.68**	**0.81**	**0.29**	**0.20**	**4.98**
Business Interruption						
	Income	0.00	0.93	0.00	0.09	1.02
	Relocation	1.34	0.17	0.00	0.01	1.52
	Rental Income	0.42	0.13	0.00	0.00	0.55
	Wage	0.00	0.81	0.01	0.33	1.15
	Subtotal	**1.75**	**2.03**	**0.02**	**0.43**	**4.23**
ALL	**Total**	**5.44**	**2.84**	**0.30**	**0.63**	**9.21**



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	9,508	1,262,021	310,581	1,572,602
Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**
Total Study Region	**9,508**	**1,262,021**	**310,581**	**1,572,602**

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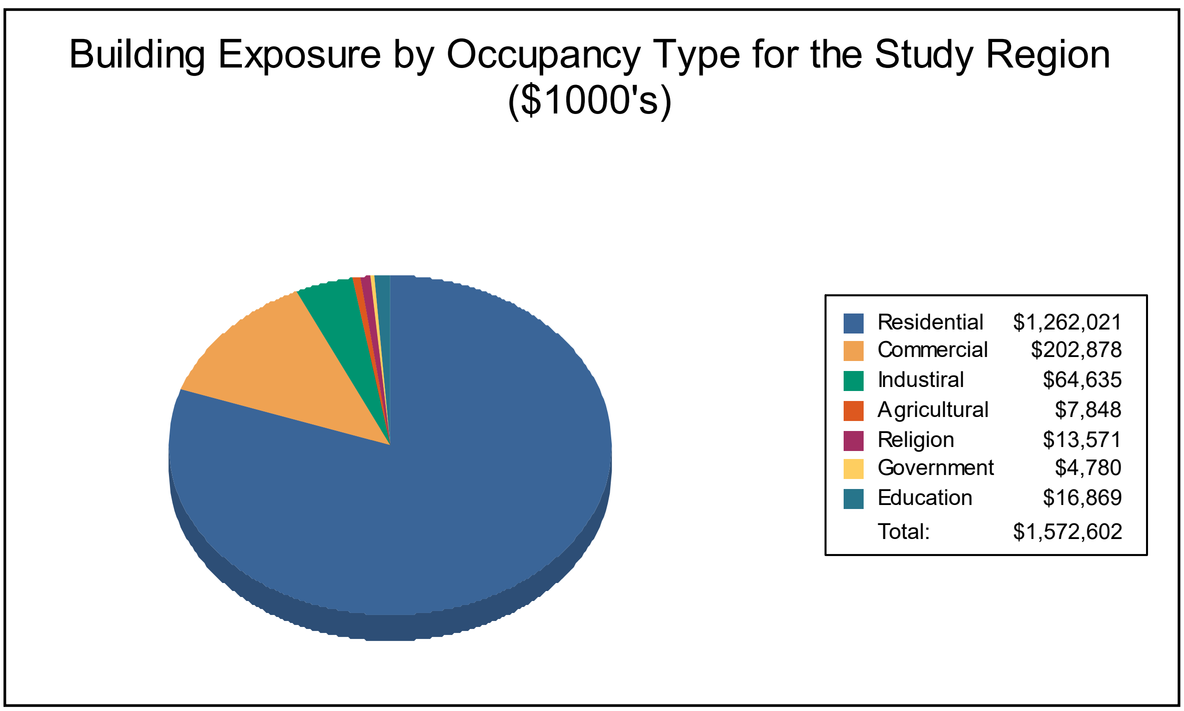

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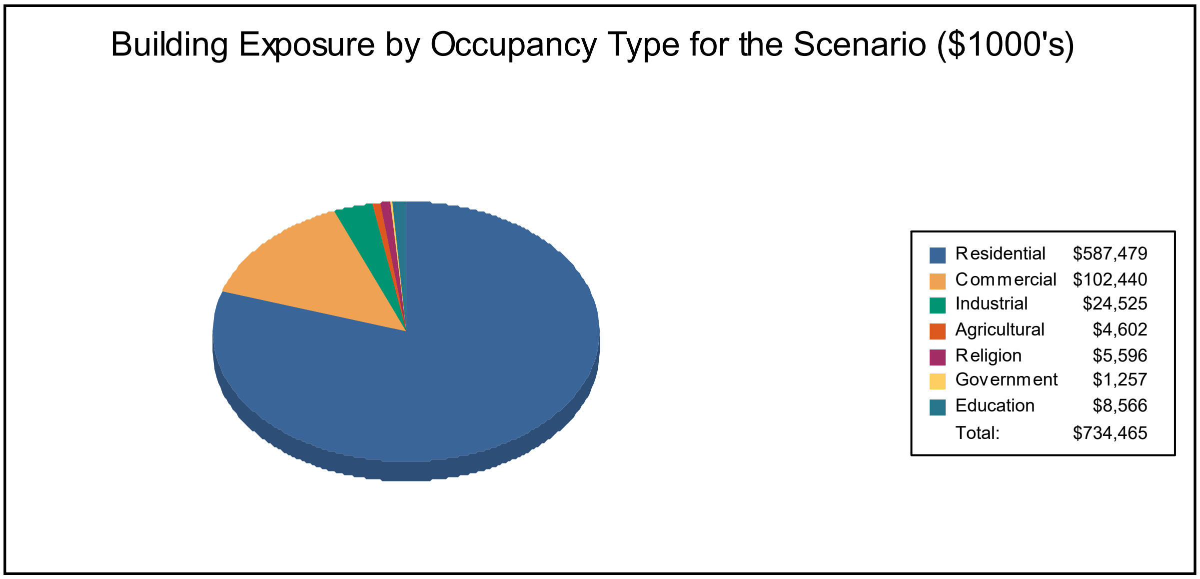

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 6 schools, 3 fire stations, 1 police station and 1 emergency operation center.

Flood Scenario Parameters

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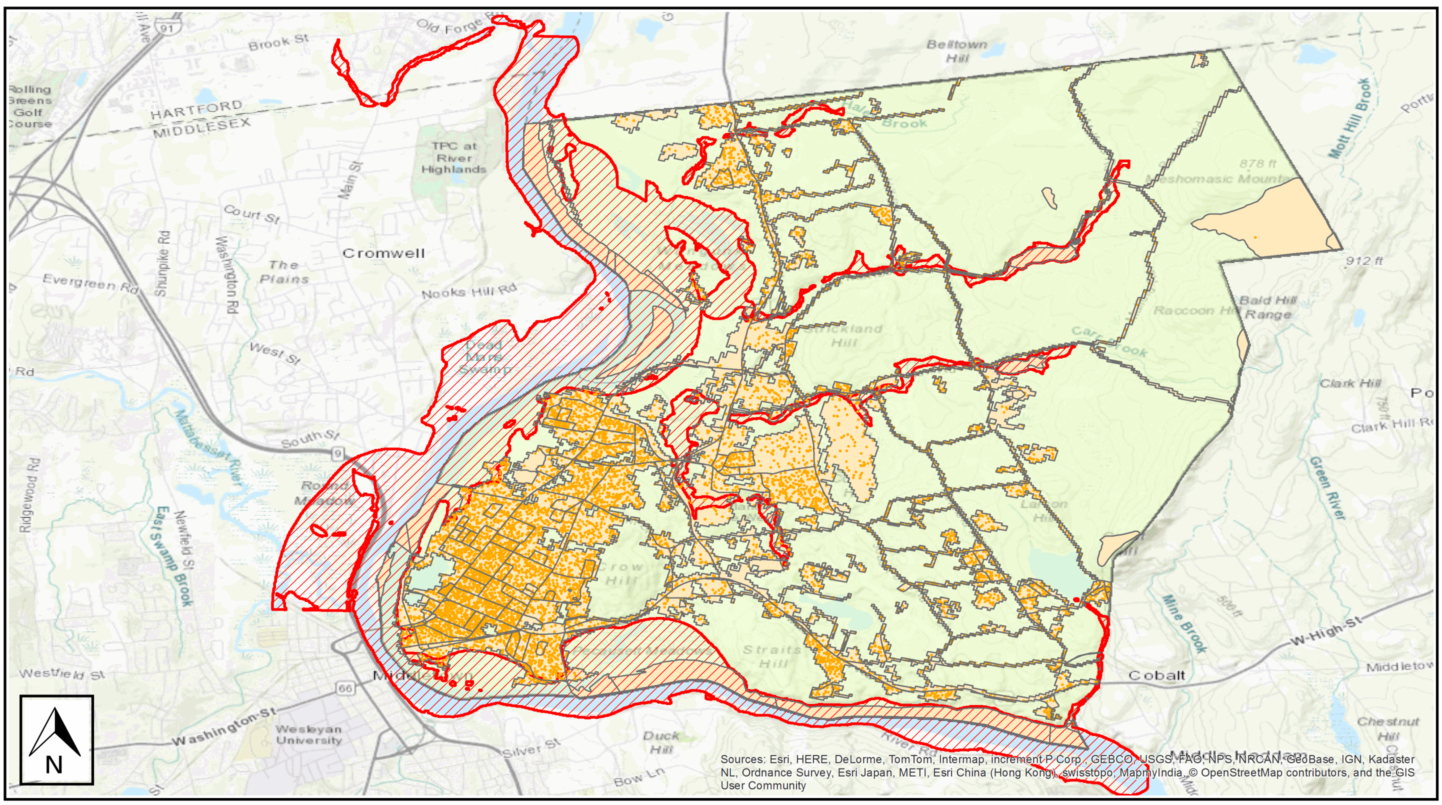
Study Region Name:	Portland
Scenario Name:	PortlandAll
Return Period Analyzed:	25
Analysis Options Analyzed:	No What-Ifs

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 25 buildings will be at least moderately damaged. This is over 98% 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

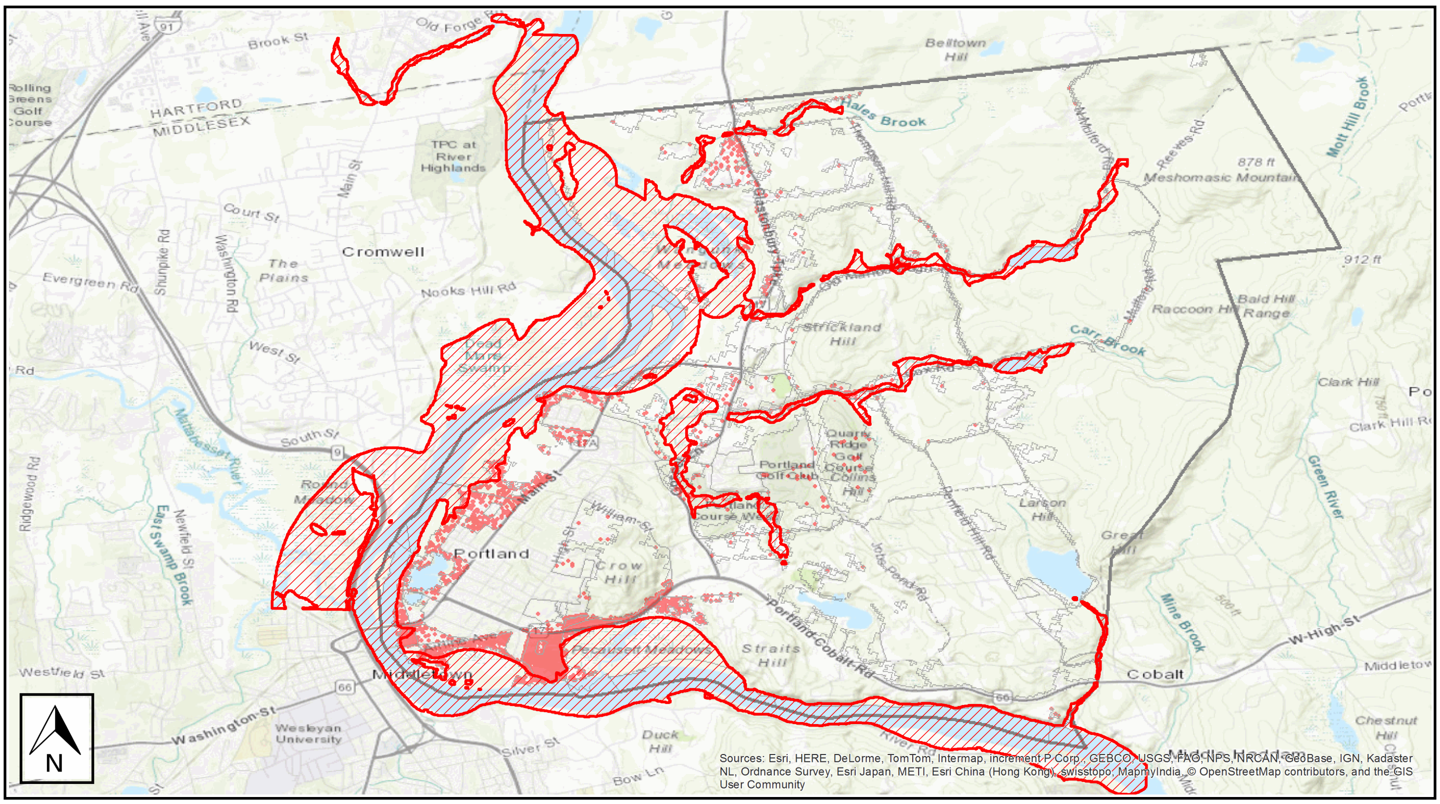


Table 3: Expected Building Damage by Occupancy

	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	26	51	25	49	0	0	0	0	0	0	0	0
Total	**26**		**25**		**0**		**0**		**0**		**0**	

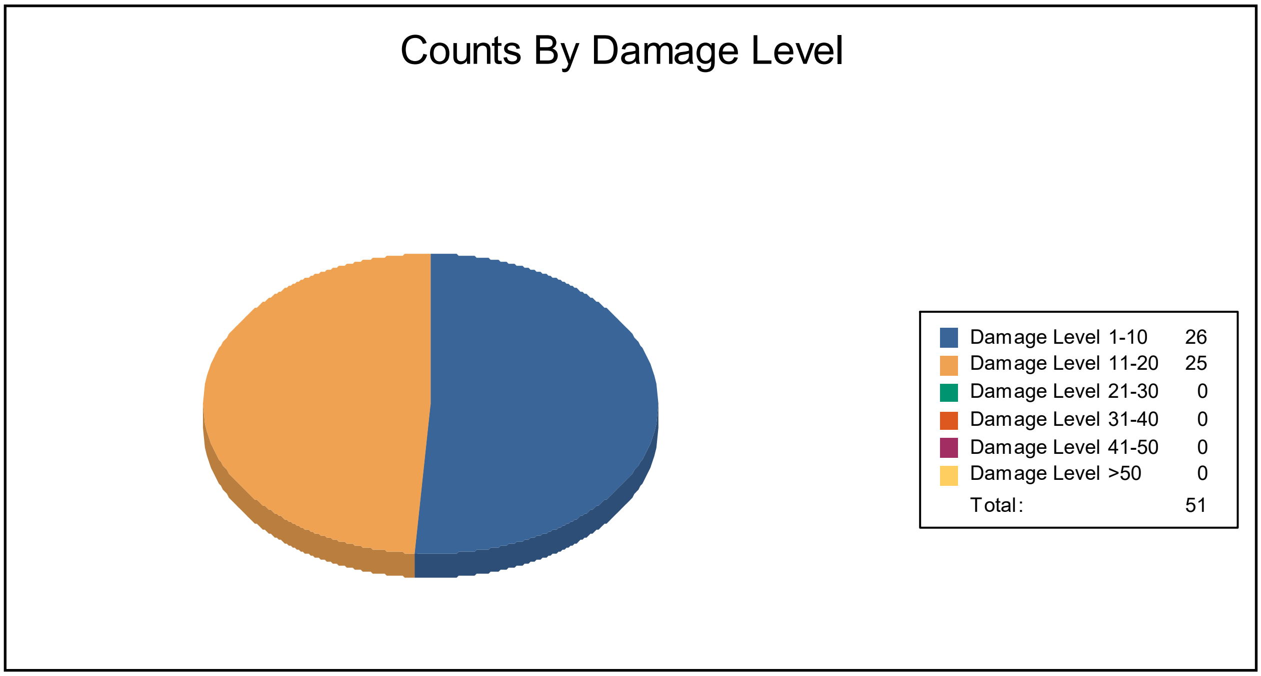


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Table 4: Expected Building Damage by Building Type

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	26	51	25	49	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	3	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	6	0	0	0

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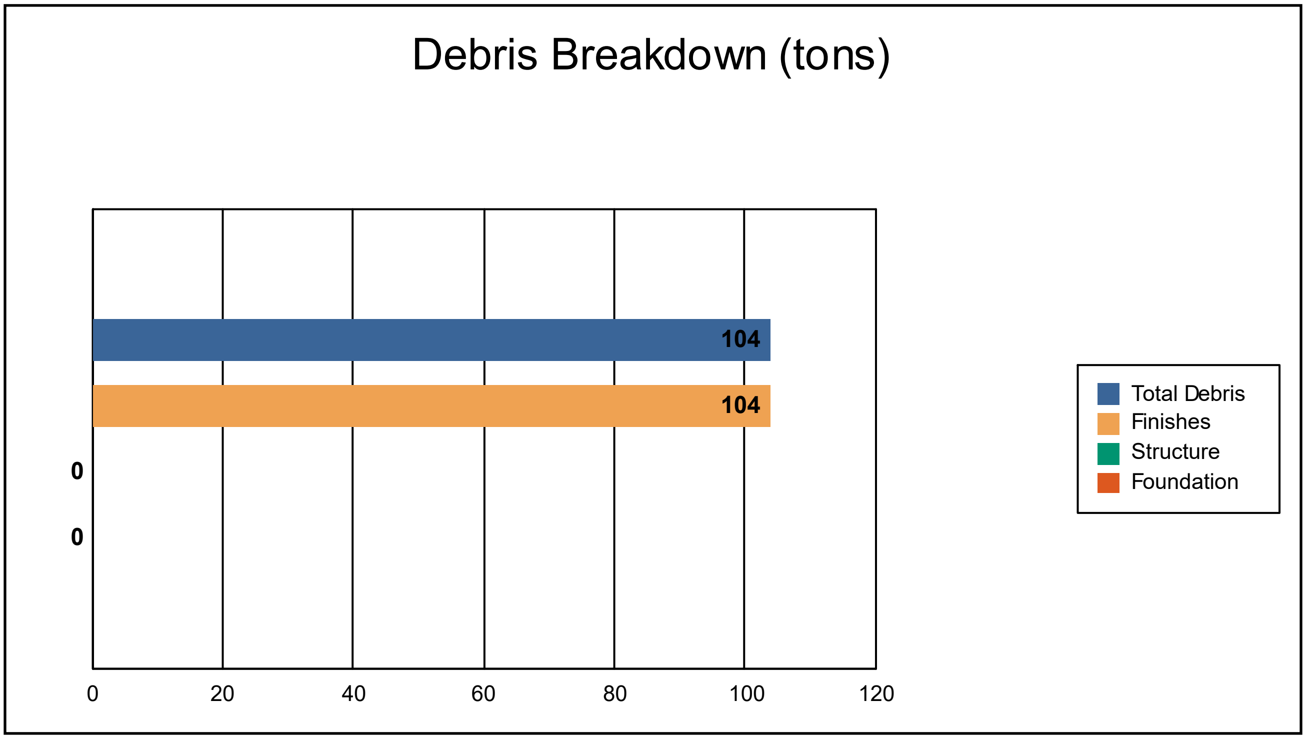
Induced Flood Damage

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.

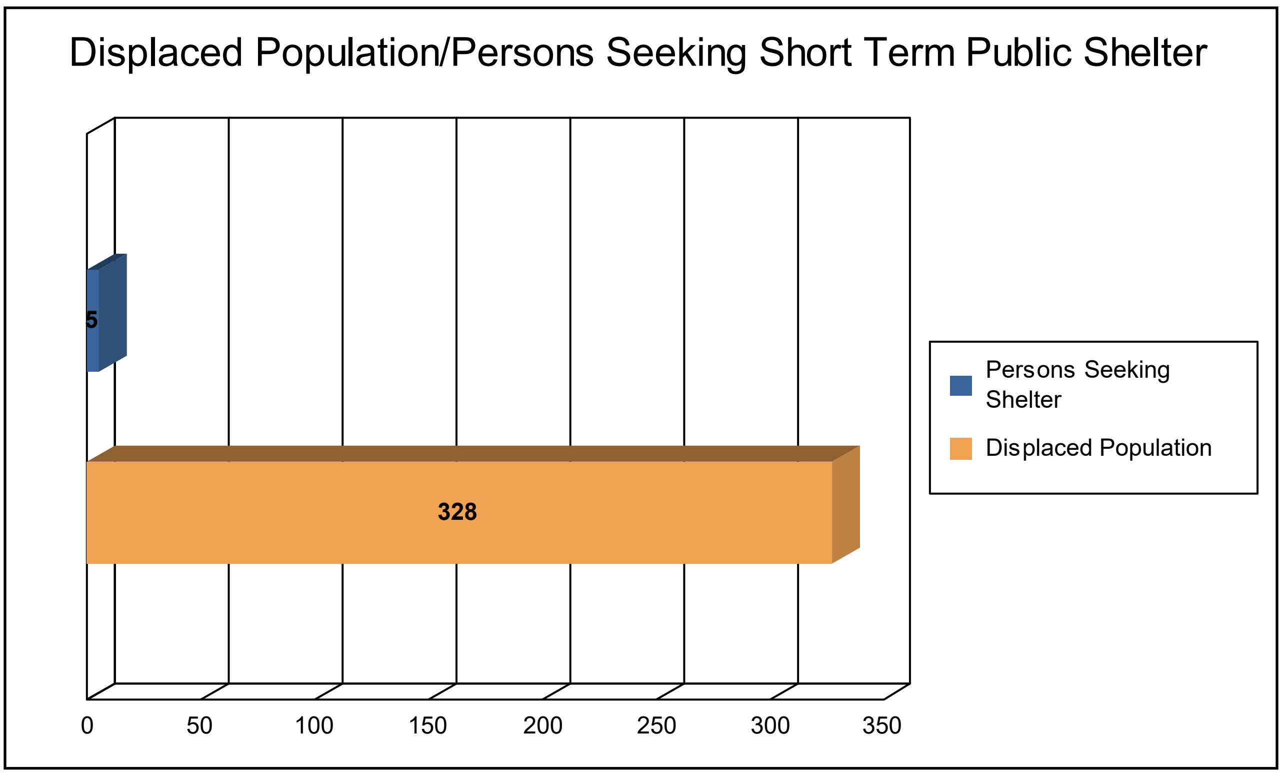


The model estimates that a total of 104 tons of debris will be generated. Of the total amount, Finishes comprises 100% of the total, Structure comprises 0% of the total, and Foundation comprises 0%. If the debris tonnage is converted into an estimated number of truckloads, it will require 5 truckloads (@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 109 households (or 328 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 5 people (out of a total population of 9,508) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 12.73 million dollars, which represents 1.73 % of the total replacement value of the scenario buildings.

Building-Related Losses

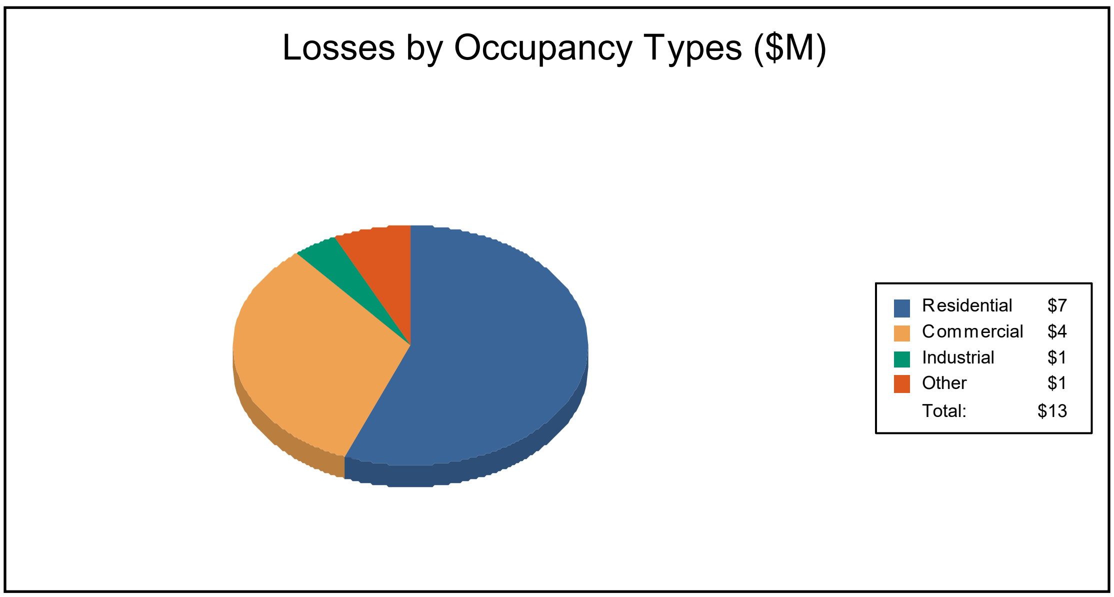
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 7.28 million dollars. 43% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 56.10% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	3.62	0.34	0.14	0.04	4.14
	Content	1.50	1.01	0.30	0.27	3.08
	Inventory	0.00	0.02	0.04	0.00	0.06
	Subtotal	**5.12**	**1.37**	**0.48**	**0.31**	**7.28**
Business Interruption						
	Income	0.00	1.25	0.01	0.12	1.38
	Relocation	1.53	0.28	0.01	0.02	1.84
	Rental Income	0.49	0.21	0.00	0.00	0.69
	Wage	0.00	1.09	0.02	0.43	1.54
	Subtotal	**2.02**	**2.82**	**0.03**	**0.57**	**5.45**
ALL	**Total**	**7.14**	**4.19**	**0.51**	**0.89**	**12.73**



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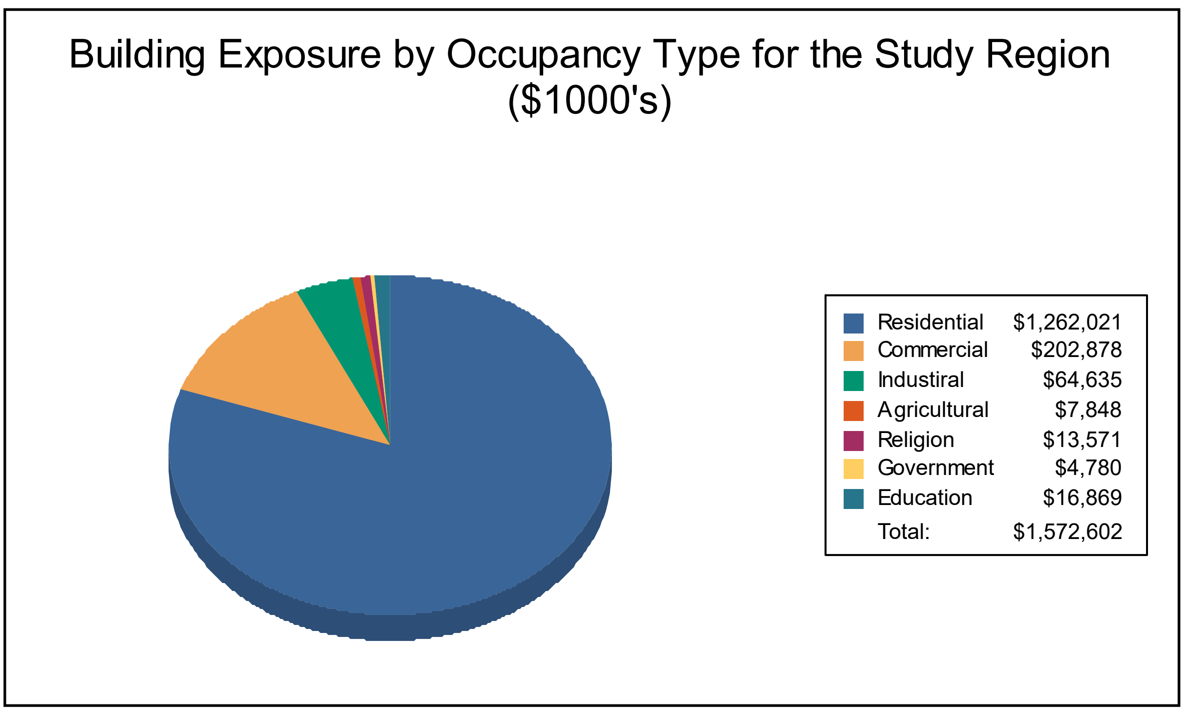

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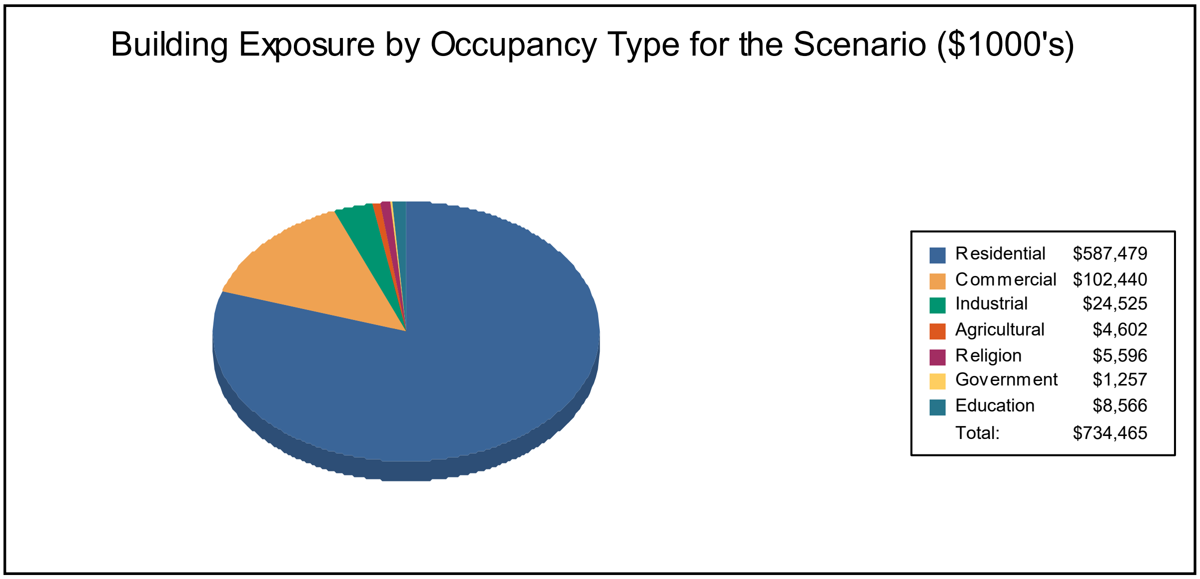
Total	**734,465**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 6 schools, 3 fire stations, 1 police station and 1 emergency operation center.

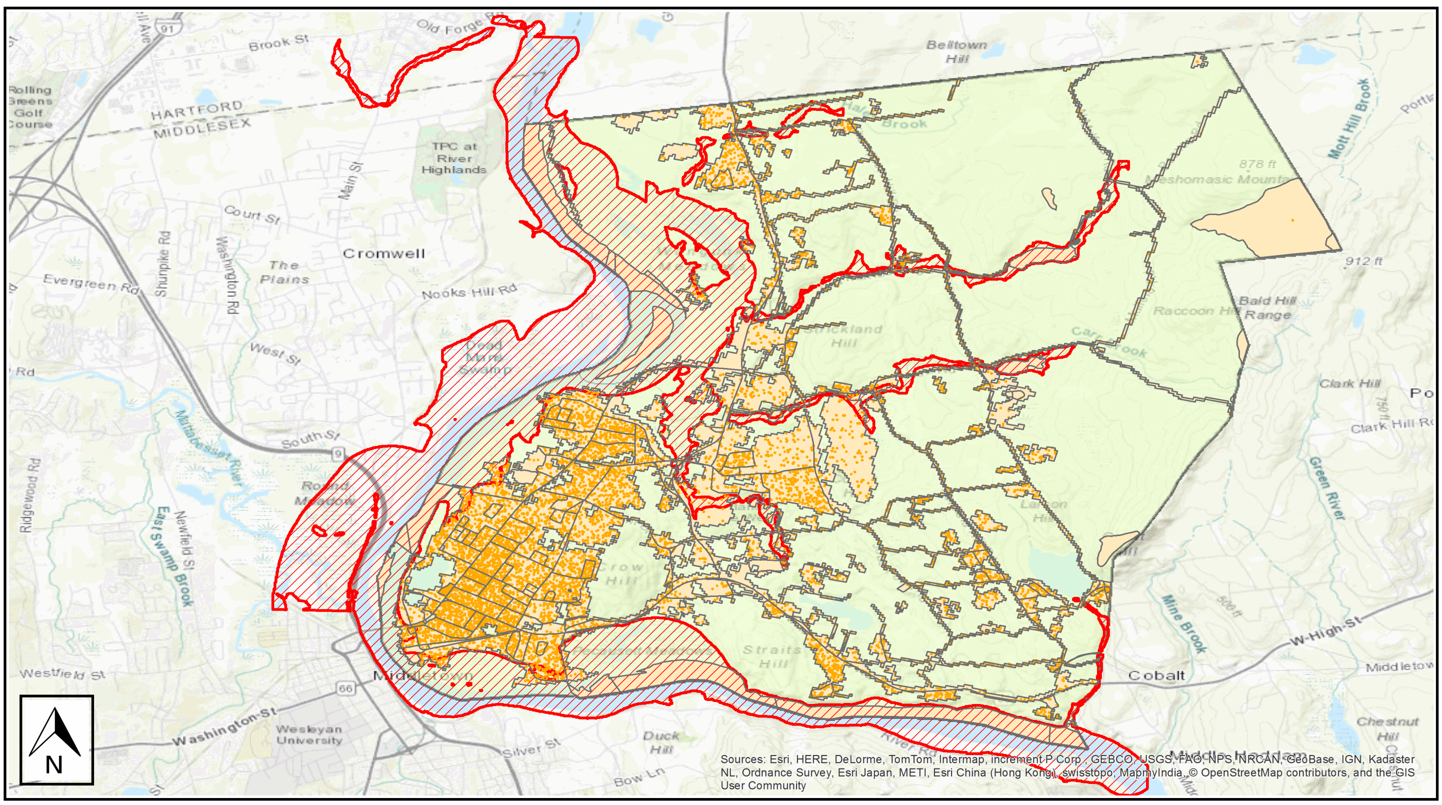
Flood Scenario Parameters

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

Study Region Name:	Portland
Scenario Name:	PortlandAll
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 39 buildings will be at least moderately damaged. This is over 96% 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

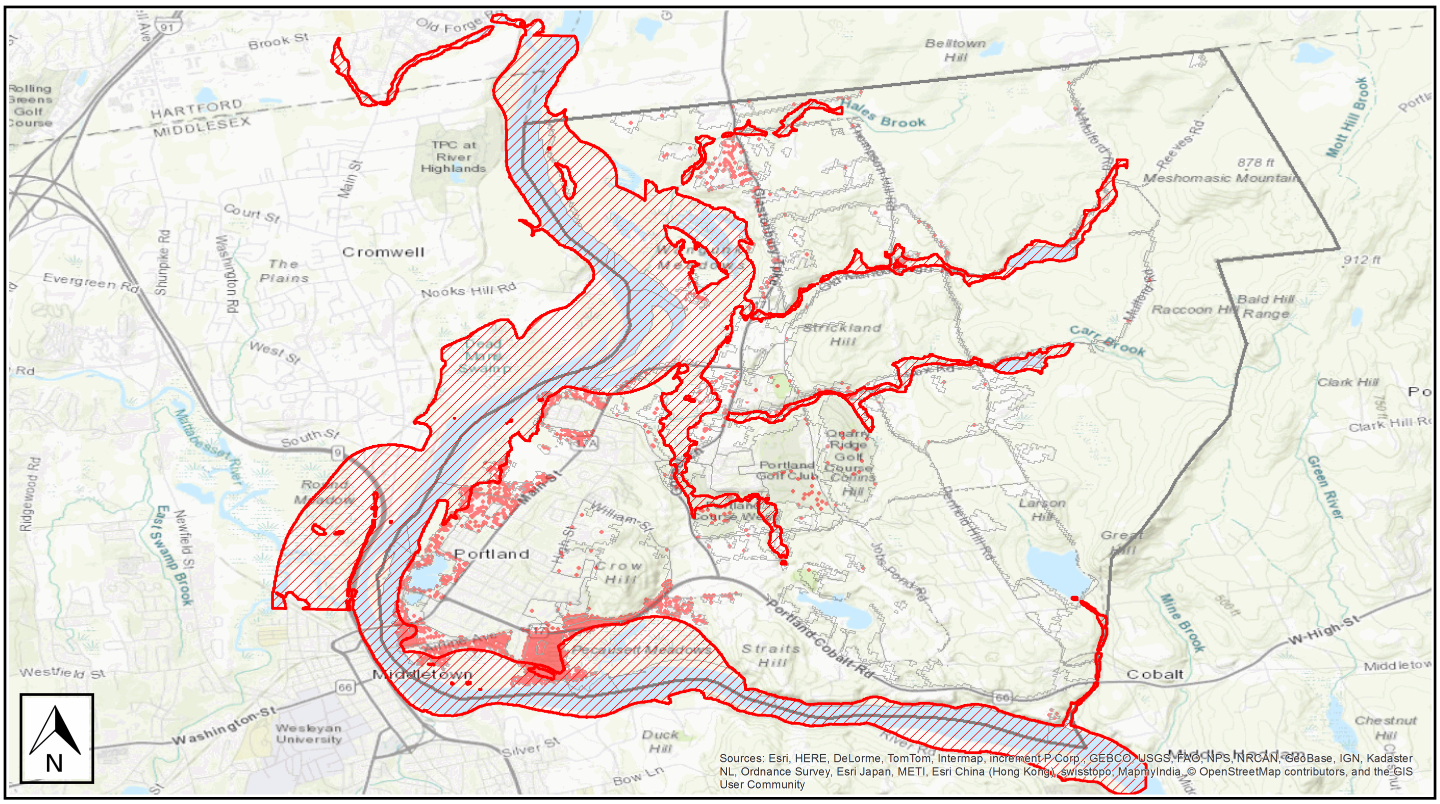


Table 3: Expected Building Damage by Occupancy

	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	32	45	34	48	5	7	0	0	0	0	0	0
Total	**32**		**34**		**5**		**0**		**0**		**0**	

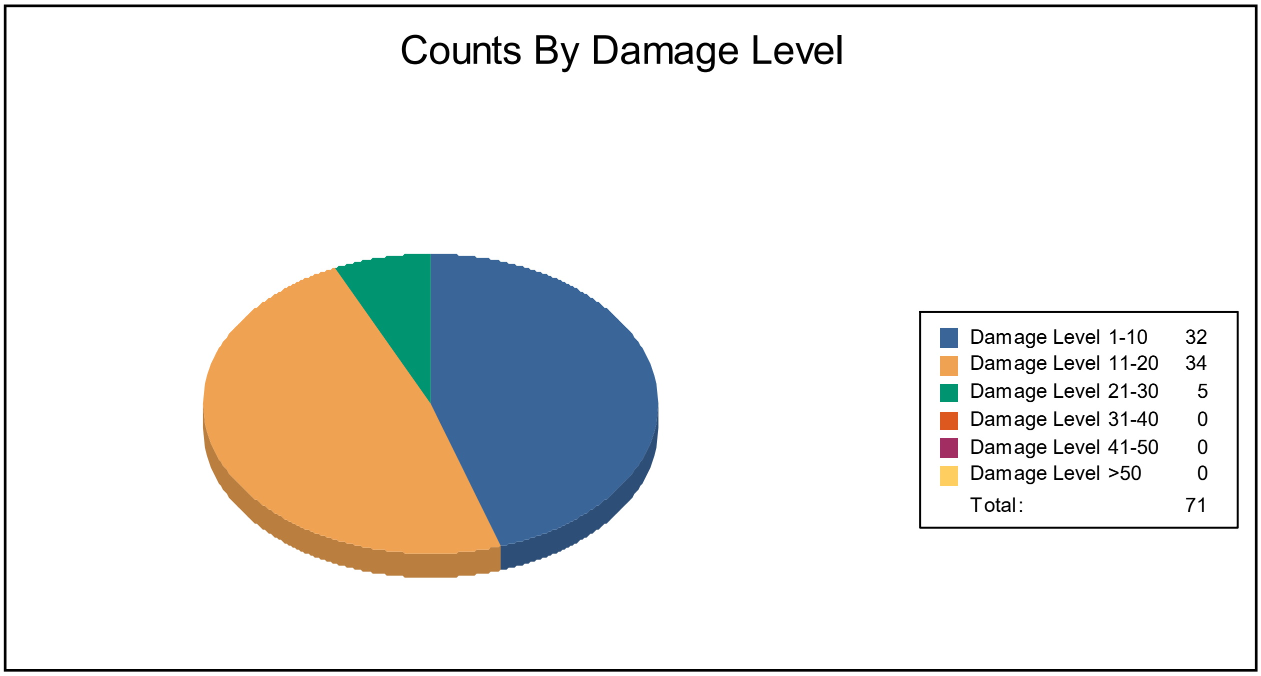


Table 4: Expected Building Damage by Building Type

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	32	45	34	48	5	7	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	3	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	6	0	0	0

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

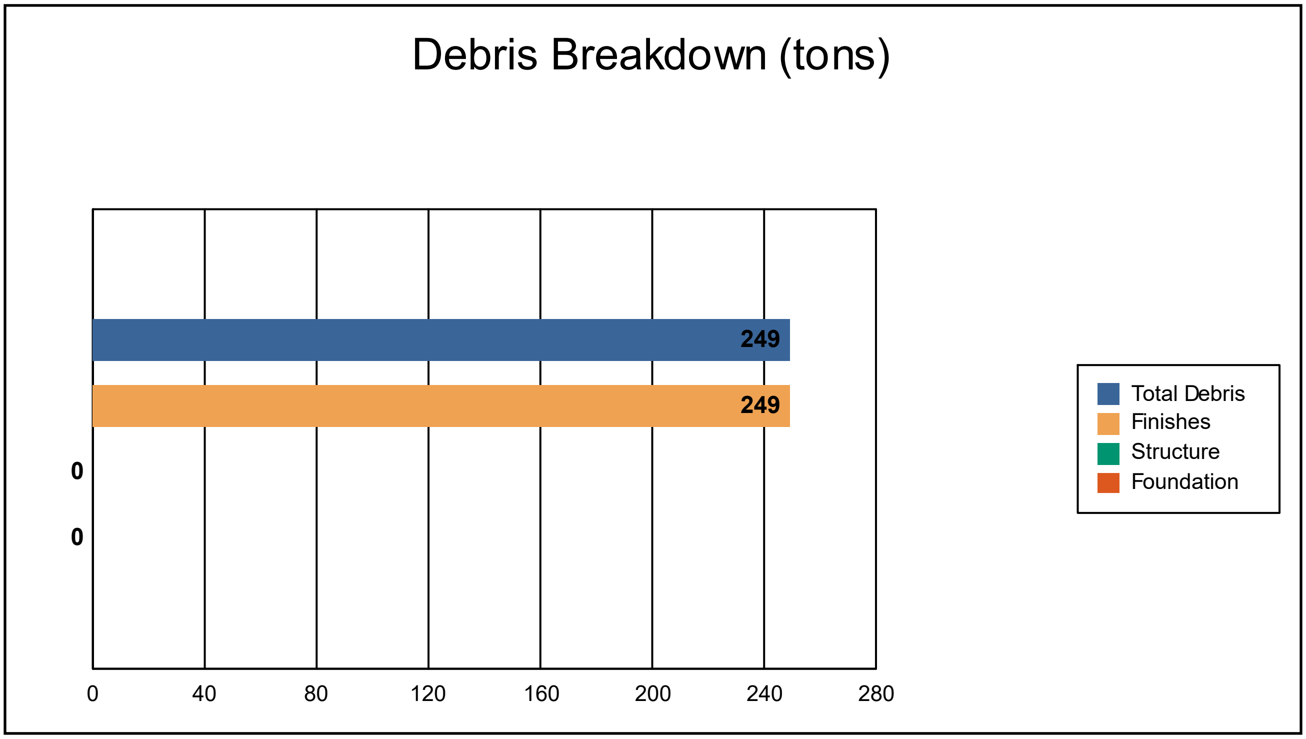
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(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.

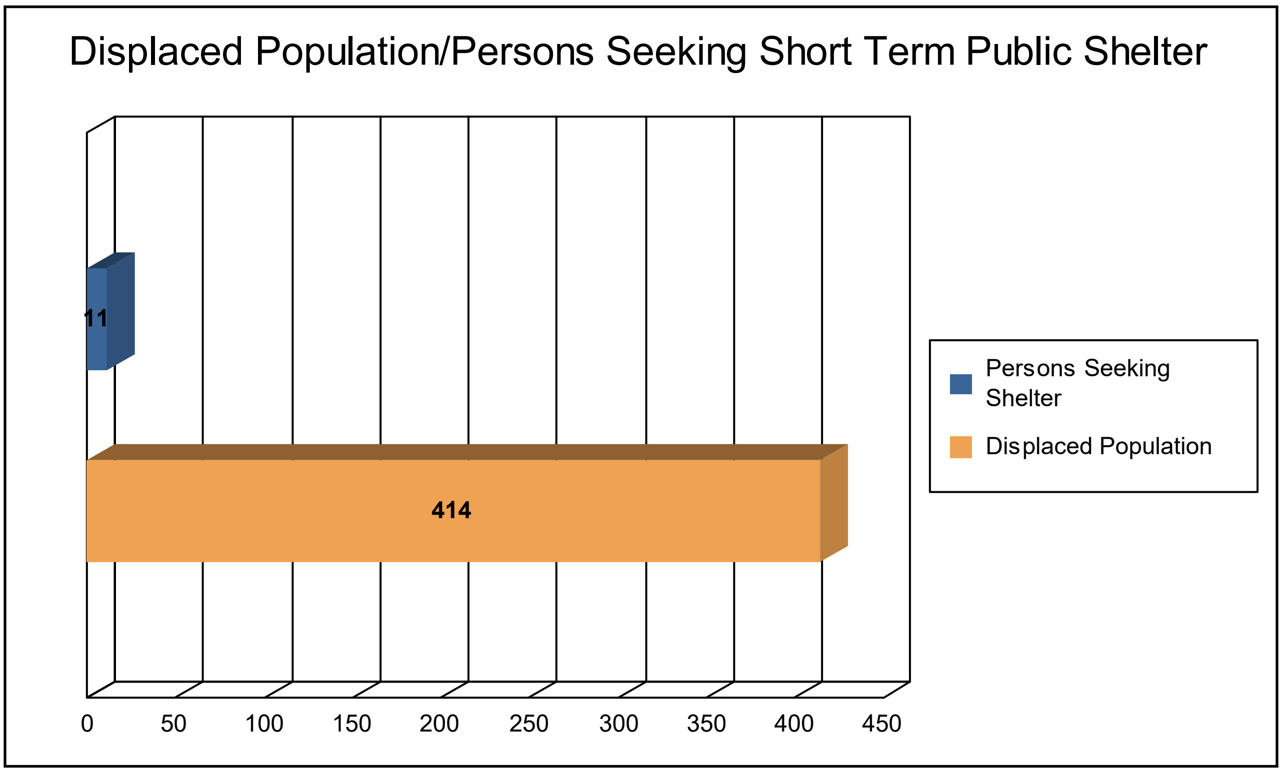


The model estimates that a total of 249 tons of debris will be generated. Of the total amount, Finishes comprises 100% of the total, Structure comprises 0% of the total, and Foundation comprises 0%. If the debris tonnage is converted into an estimated number of truckloads, it will require 10 truckloads (@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 414 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 11 people (out of a total population of 9,508) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 20.06 million dollars, which represents 2.73 % of the total replacement value of the scenario buildings.

Building-Related Losses

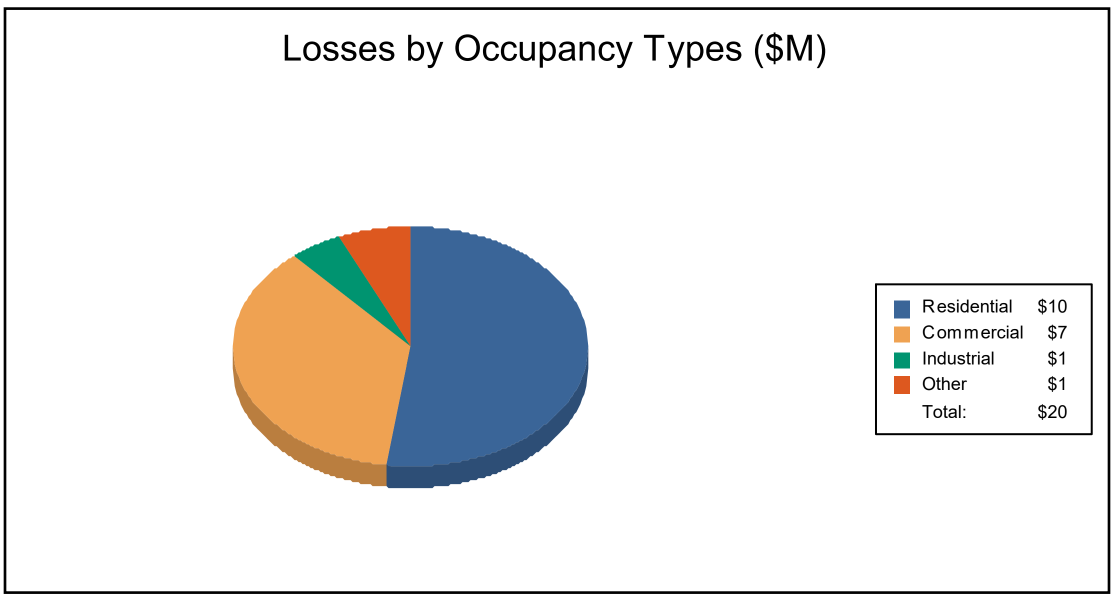
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 11.72 million dollars. 42% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 52.13% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	5.44	0.66	0.25	0.06	6.41
	Content	2.33	1.87	0.56	0.43	5.18
	Inventory	0.00	0.04	0.08	0.01	0.13
	Subtotal	**7.77**	**2.57**	**0.89**	**0.50**	**11.72**
Business Interruption						
	Income	0.00	2.03	0.02	0.18	2.23
	Relocation	2.03	0.53	0.02	0.04	2.61
	Rental Income	0.66	0.39	0.00	0.00	1.06
	Wage	0.00	1.79	0.04	0.62	2.45
	Subtotal	**2.69**	**4.74**	**0.08**	**0.83**	**8.34**
ALL	**Total**	**10.46**	**7.31**	**0.97**	**1.33**	**20.06**



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	9,508	1,262,021	310,581	1,572,602
Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**
Total Study Region	**9,508**	**1,262,021**	**310,581**	**1,572,602**

Hazus: Flood Global Risk Report

Region Name: Portland

Flood Scenario: PortlandAll

Print Date: Tuesday, December 31, 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.

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Connecticut

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

The geographical size of the region is approximately 25 square miles and contains 251 census blocks. The region contains over 4 thousand households and has a total population of 9,508 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 3,970 buildings in the region with a total building replacement value (excluding contents) of 1,573 million dollars. Approximately 90.91% of the buildings (and 80.25% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,970 buildings in the region which have an aggregate total replacement value of 1,573 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,262,021	80.3%
Commercial	202,878	12.9%
Industrial	64,635	4.1%
Agricultural	7,848	0.5%
Religion	13,571	0.9%
Government	4,780	0.3%
Education	16,869	1.1%
Total	**1,572,602**	**100%**

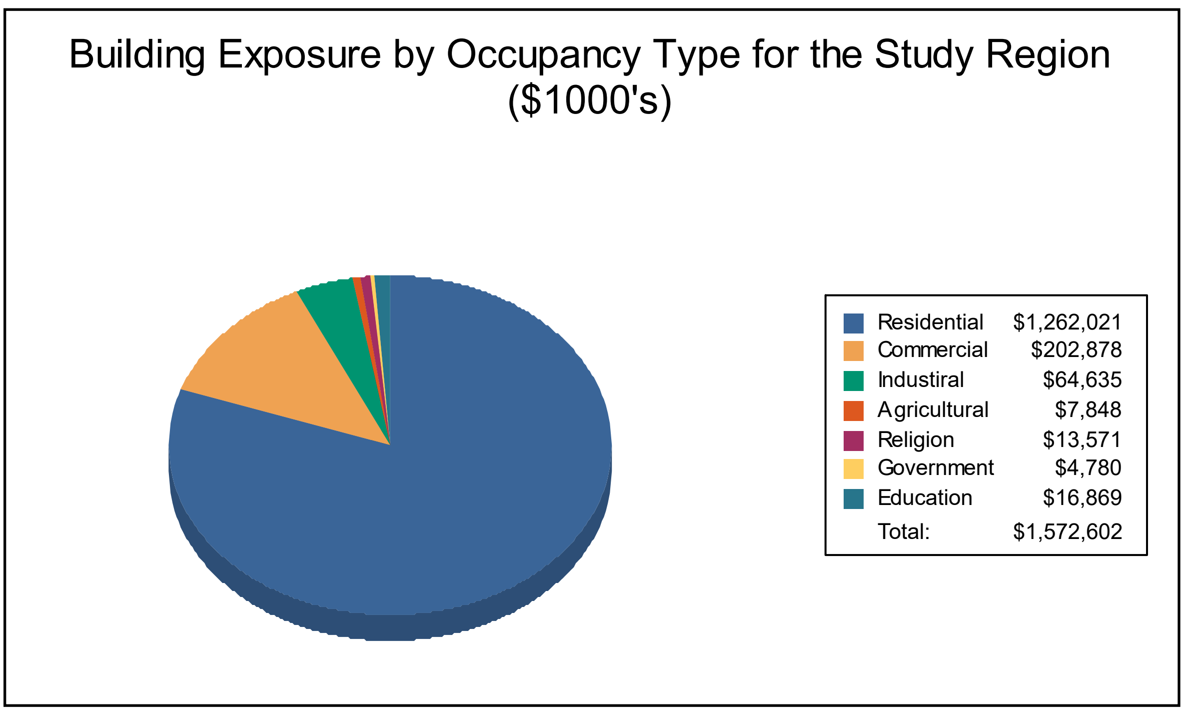
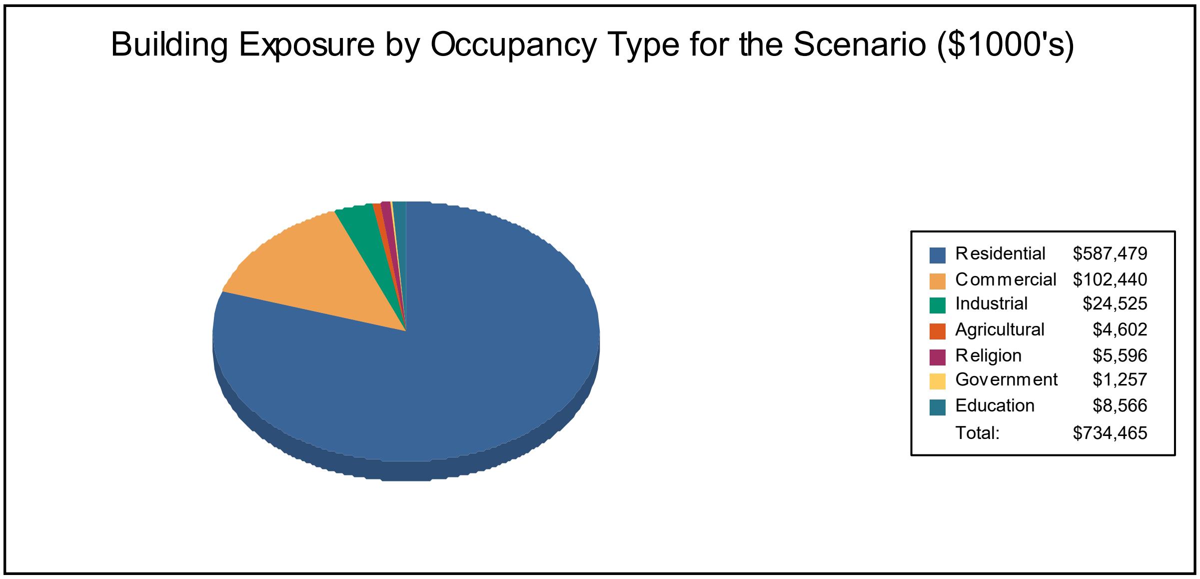


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	587,479	80.0%
Commercial	102,440	13.9%
Industrial	24,525	3.3%
Agricultural	4,602	0.6%
Religion	5,596	0.8%
Government	1,257	0.2%
Education	8,566	1.2%
Total	**734,465**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 6 schools, 3 fire stations, 1 police station and 1 emergency operation center.

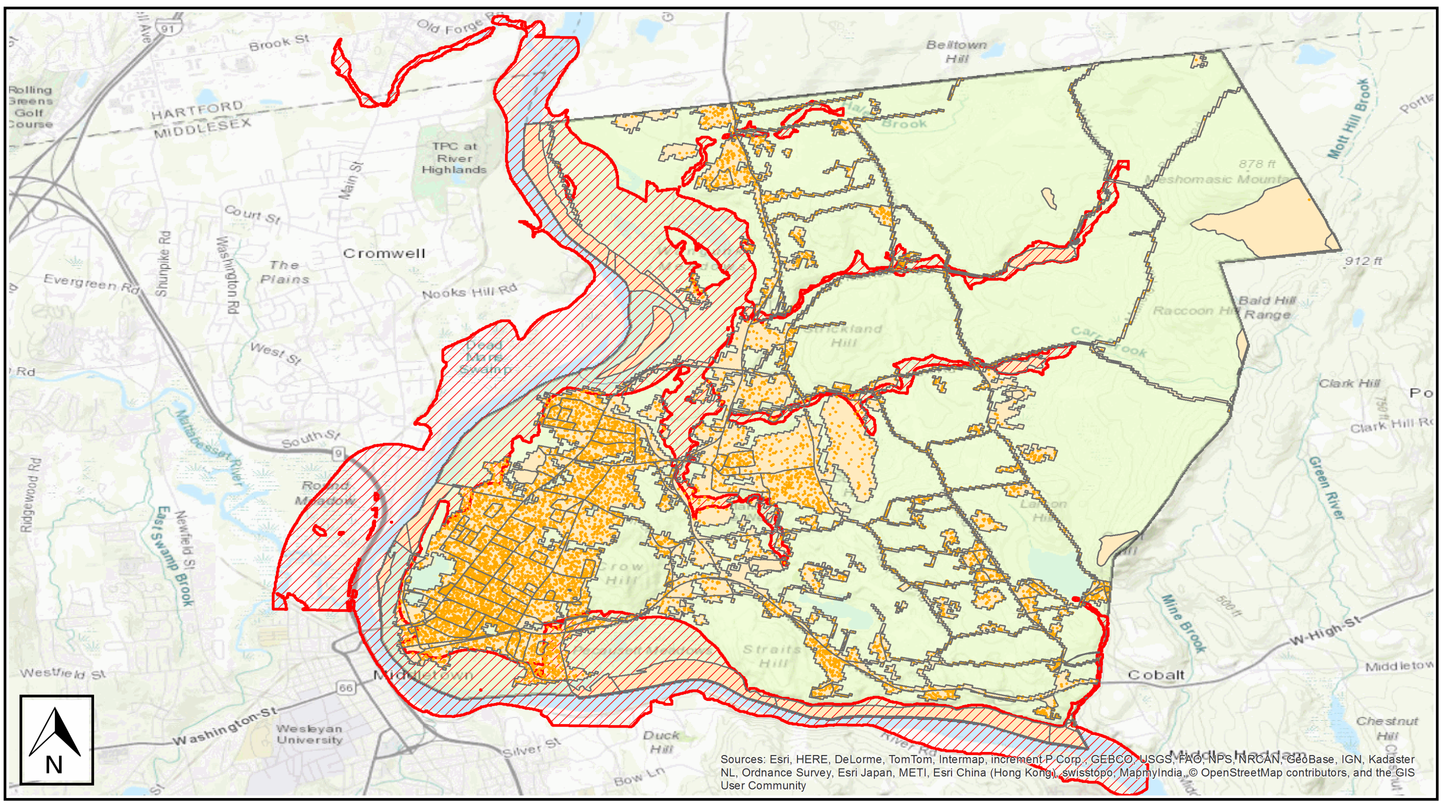
Flood Scenario Parameters

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

Study Region Name:	Portland
Scenario Name:	PortlandAll
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 91 buildings will be at least moderately damaged. This is over 67% of the total number of buildings in the scenario. There are an estimated 28 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

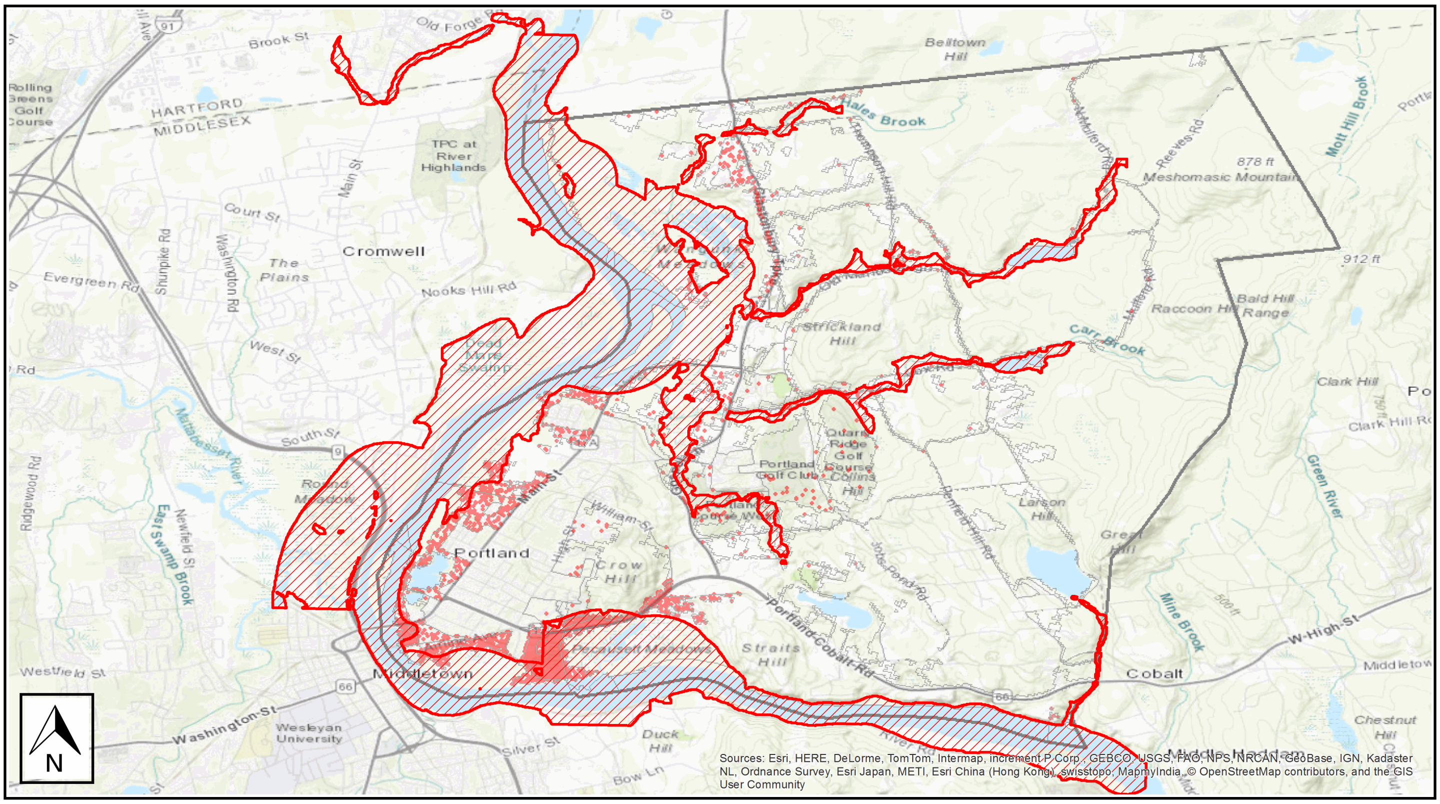


Table 3: Expected Building Damage by Occupancy

	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	34	27	39	31	13	10	6	5	5	4	28	22
Total	**34**		**39**		**13**		**6**		**5**		**28**	

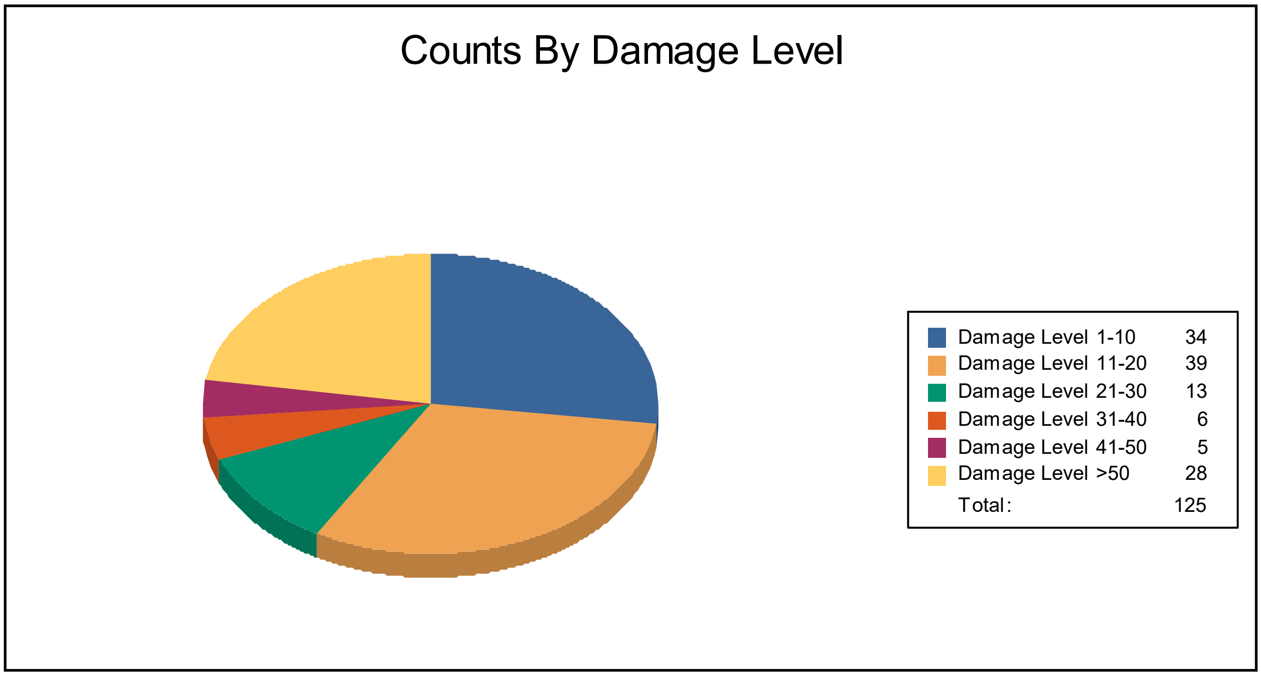


Table 4: Expected Building Damage by Building Type

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	34	27	39	31	13	10	6	5	5	4	28	22

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	1	0	0	0
Fire Stations	3	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	6	0	0	0

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

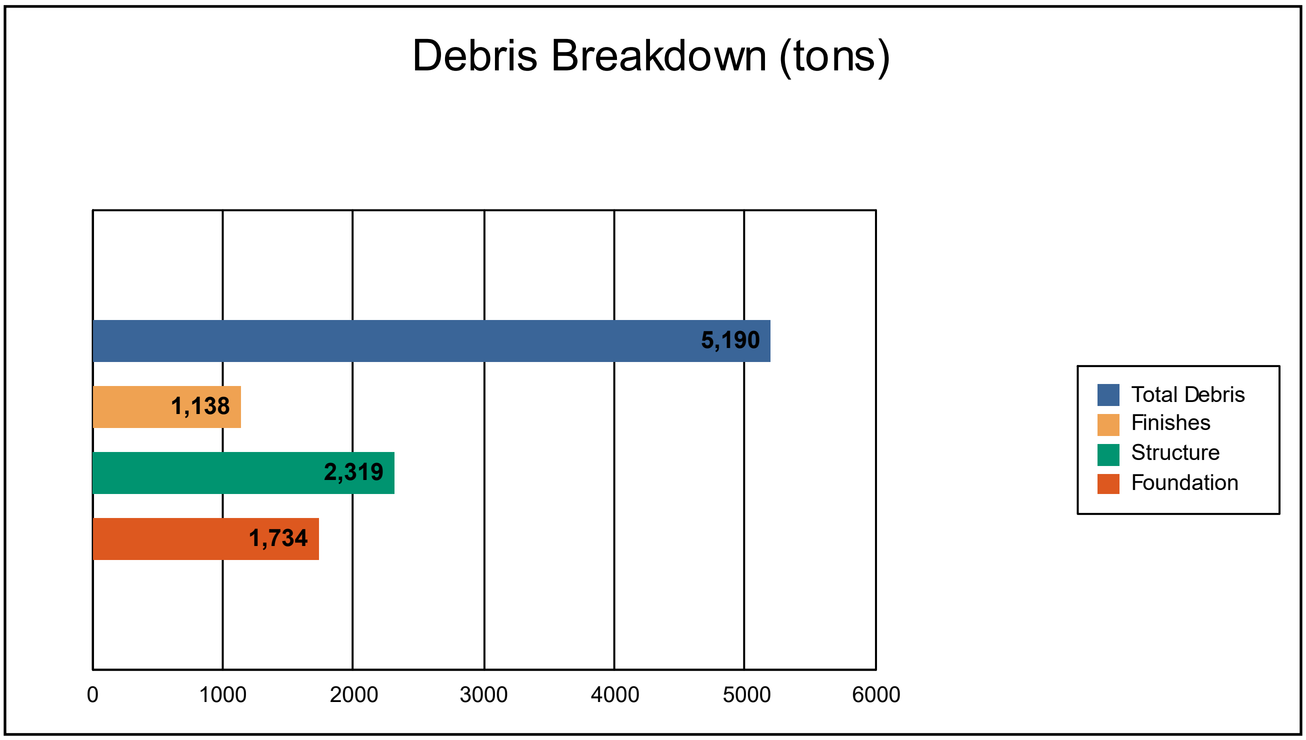
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(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.

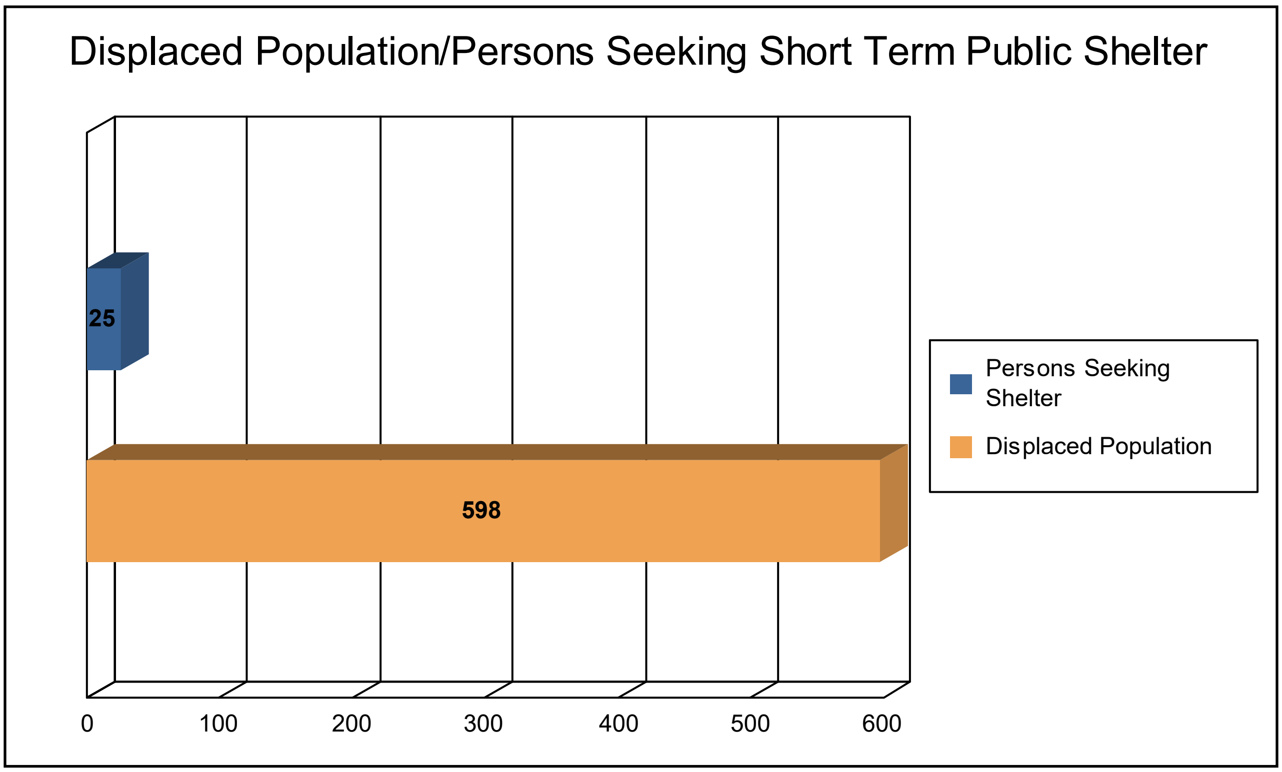


The model estimates that a total of 5,190 tons of debris will be generated. Of the total amount, Finishes comprises 22% of the total, Structure comprises 45% of the total, and Foundation comprises 33%. If the debris tonnage is converted into an estimated number of truckloads, it will require 208 truckloads (@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 199 households (or 598 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 25 people (out of a total population of 9,508) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 71.87 million dollars, which represents 9.78 % of the total replacement value of the scenario buildings.

Building-Related Losses

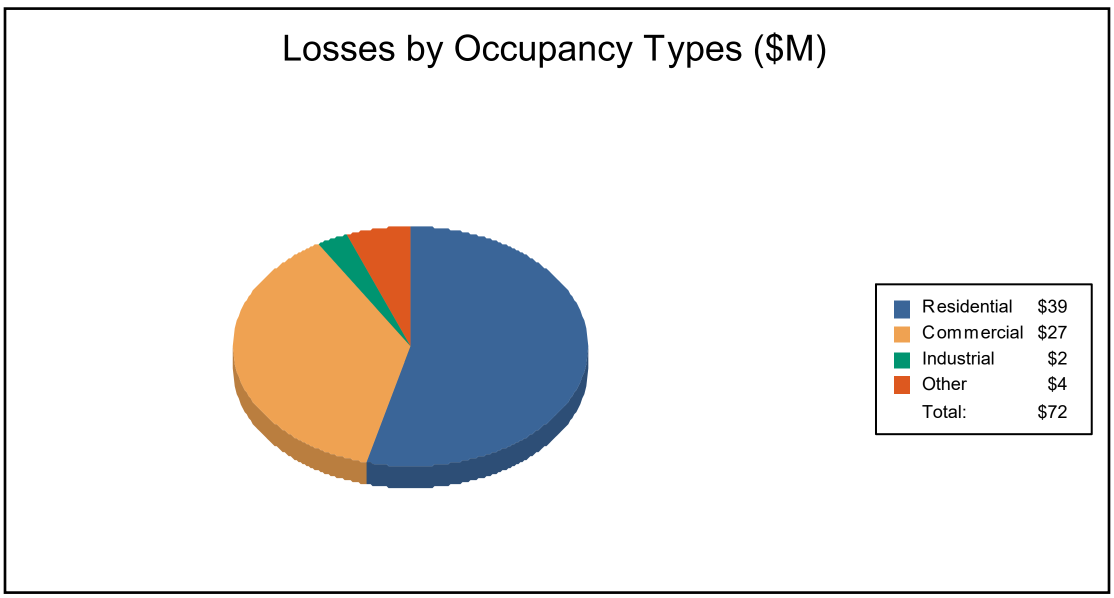
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 51.35 million dollars. 29% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 53.84% 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	23.25	5.41	0.61	0.95	30.21
	Content	9.83	8.24	1.15	1.56	20.77
	Inventory	0.00	0.11	0.15	0.10	0.36
	Subtotal	**33.08**	**13.75**	**1.91**	**2.61**	**51.35**
Business Interruption						
	Income	0.02	5.43	0.03	0.41	5.89
	Relocation	4.16	1.38	0.02	0.08	5.64
	Rental Income	1.38	1.05	0.00	0.00	2.44
	Wage	0.06	5.44	0.06	1.00	6.55
	Subtotal	**5.62**	**13.30**	**0.11**	**1.50**	**20.52**
ALL	**Total**	**38.69**	**27.05**	**2.03**	**4.10**	**71.87**



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	9,508	1,262,021	310,581	1,572,602
Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**
Total Study Region	**9,508**	**1,262,021**	**310,581**	**1,572,602**

Hazus: Flood Global Risk Report

Region Name: Portland

Flood Scenario: PortlandAll

Print Date: Tuesday, December 31, 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.

HAZUS
EARTHQUAKE • WIND • FLOOD • TSUNAMI

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- Connecticut

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

The geographical size of the region is approximately 25 square miles and contains 251 census blocks. The region contains over 4 thousand households and has a total population of 9,508 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 3,970 buildings in the region with a total building replacement value (excluding contents) of 1,573 million dollars. Approximately 90.91% of the buildings (and 80.25% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,970 buildings in the region which have an aggregate total replacement value of 1,573 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,262,021	80.3%
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Religion	13,571	0.9%
Government	4,780	0.3%
Education	16,869	1.1%
Total	**1,572,602**	**100%**

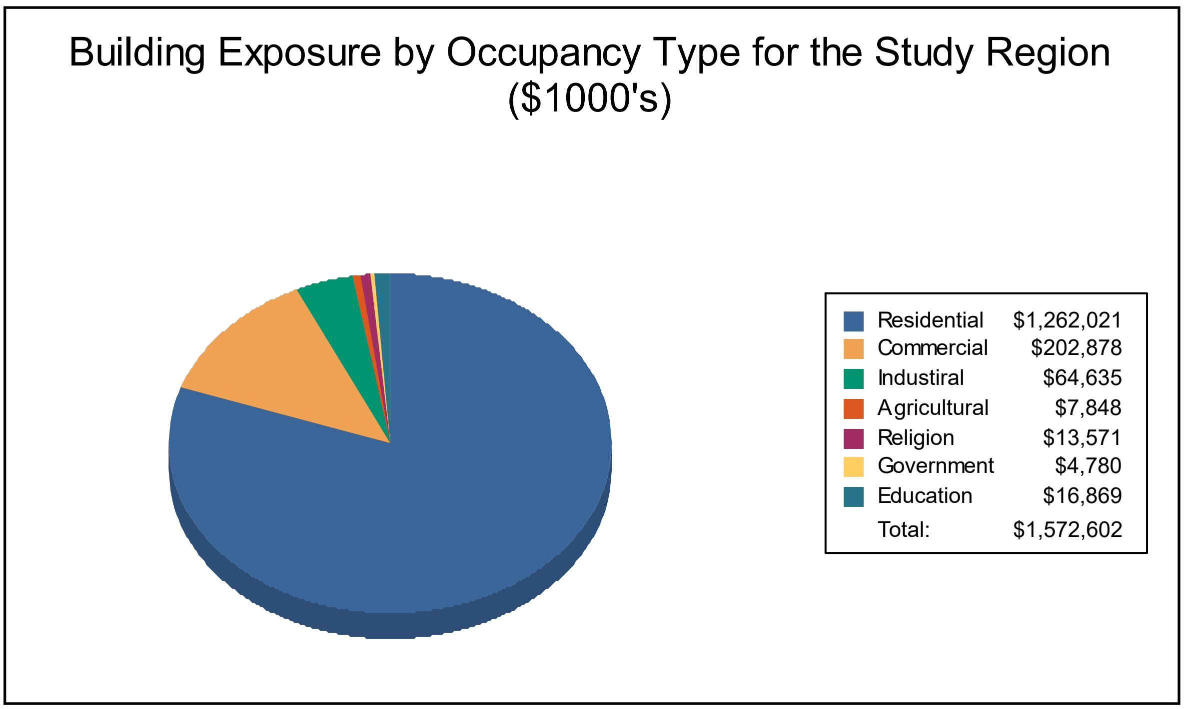

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	587,479	80.0%
Commercial	102,440	13.9%
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Agricultural	4,602	0.6%
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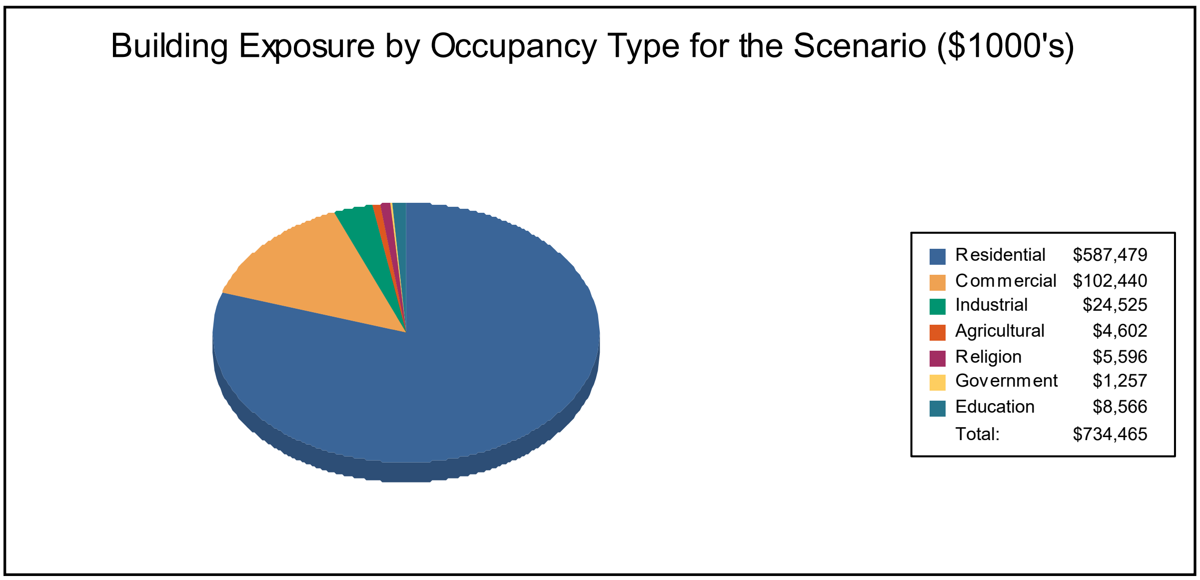
Education	8,566	1.2%
Total	**734,465**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 6 schools, 3 fire stations, 1 police station and 1 emergency operation center.

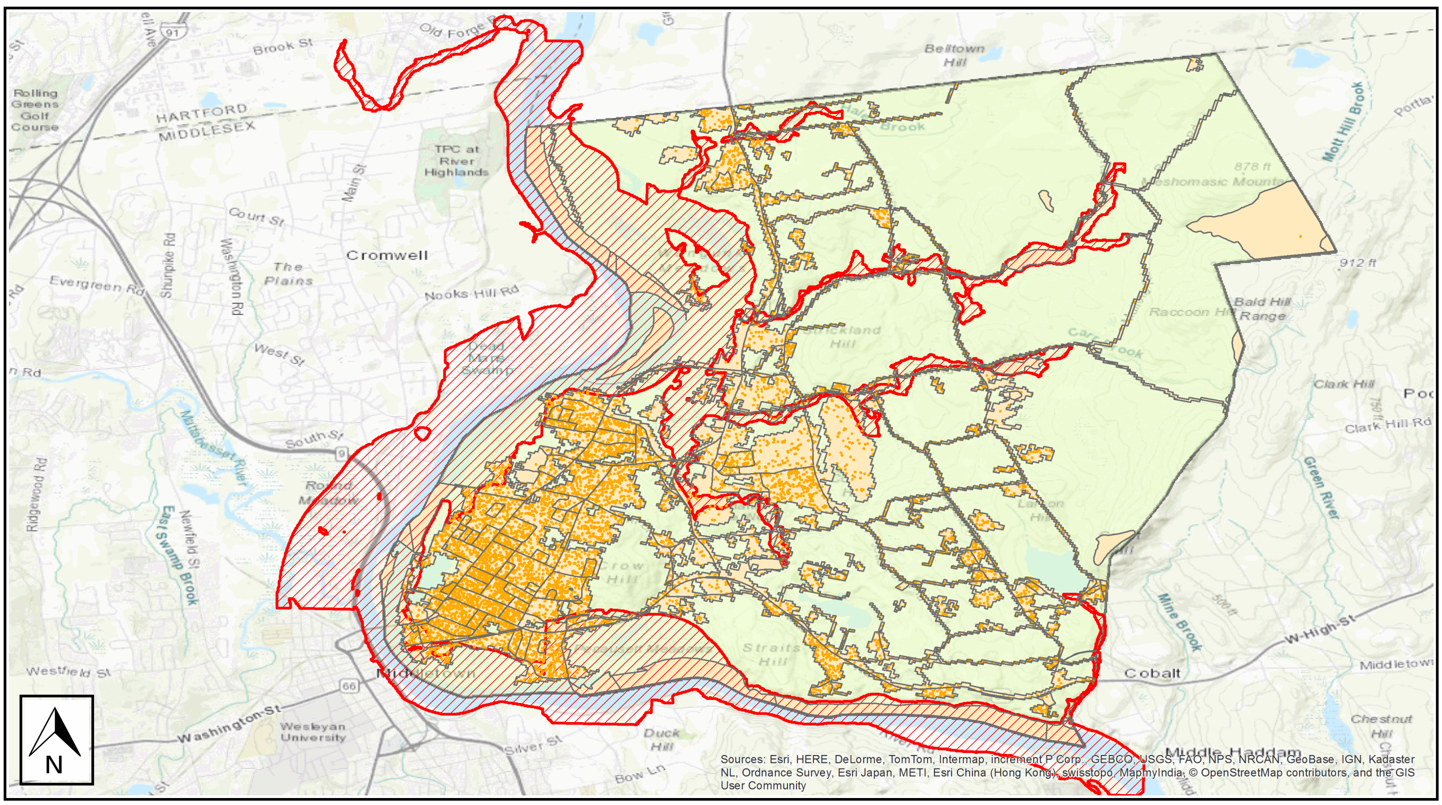
Flood Scenario Parameters

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

Study Region Name:	Portland
Scenario Name:	PortlandAll
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 126 buildings will be at least moderately damaged. This is over 61% of the total number of buildings in the scenario. There are an estimated 40 buildings that will be completely destroyed. The definition of the ‘damage states’ is provided in the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

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

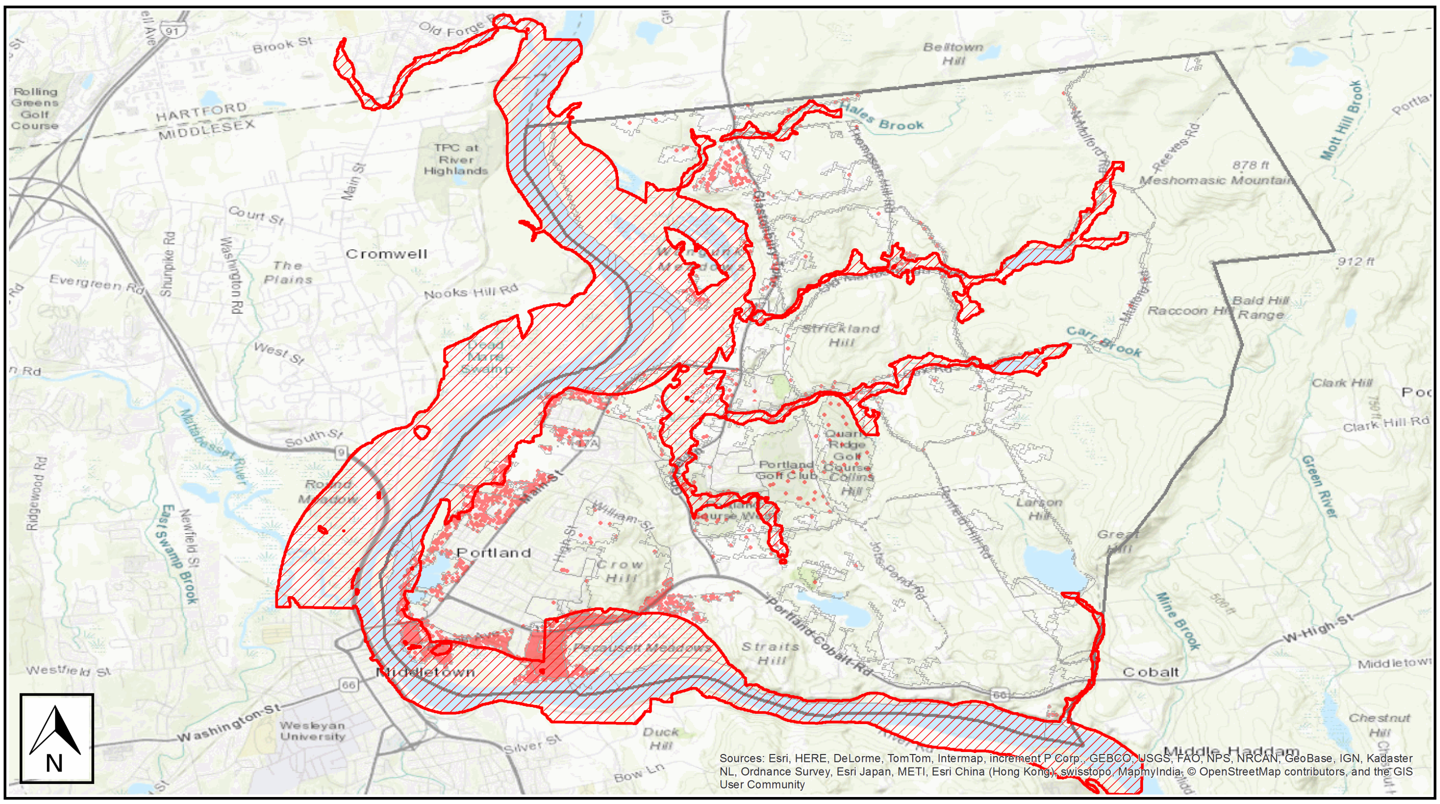


Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	1	100	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	30	19	36	23	28	18	14	9	7	5	40	26
Total	**30**		**37**		**28**		**14**		**7**		**40**	

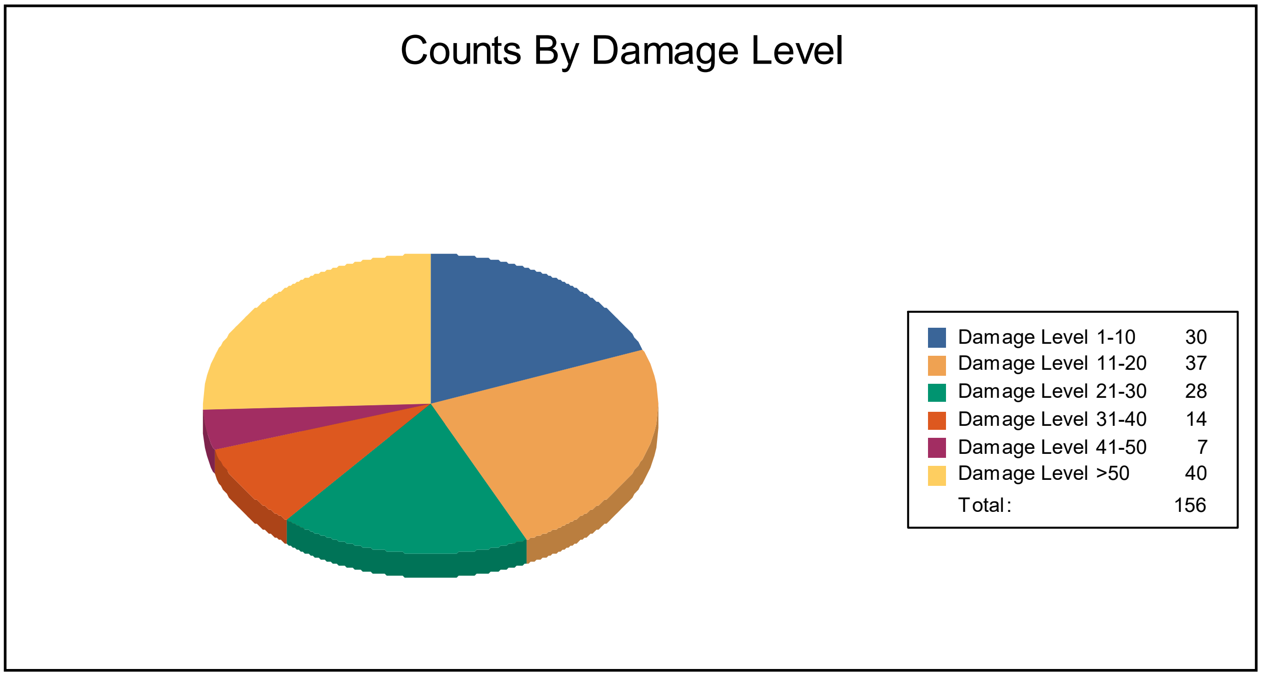


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	0	0	0	0	0	0	0	0	0	0	0	0
Steel	0	0	1	100	0	0	0	0	0	0	0	0
Wood	30	19	36	23	28	18	14	9	7	5	40	26

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	1	0	0	0
Fire Stations	3	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	6	0	0	0

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

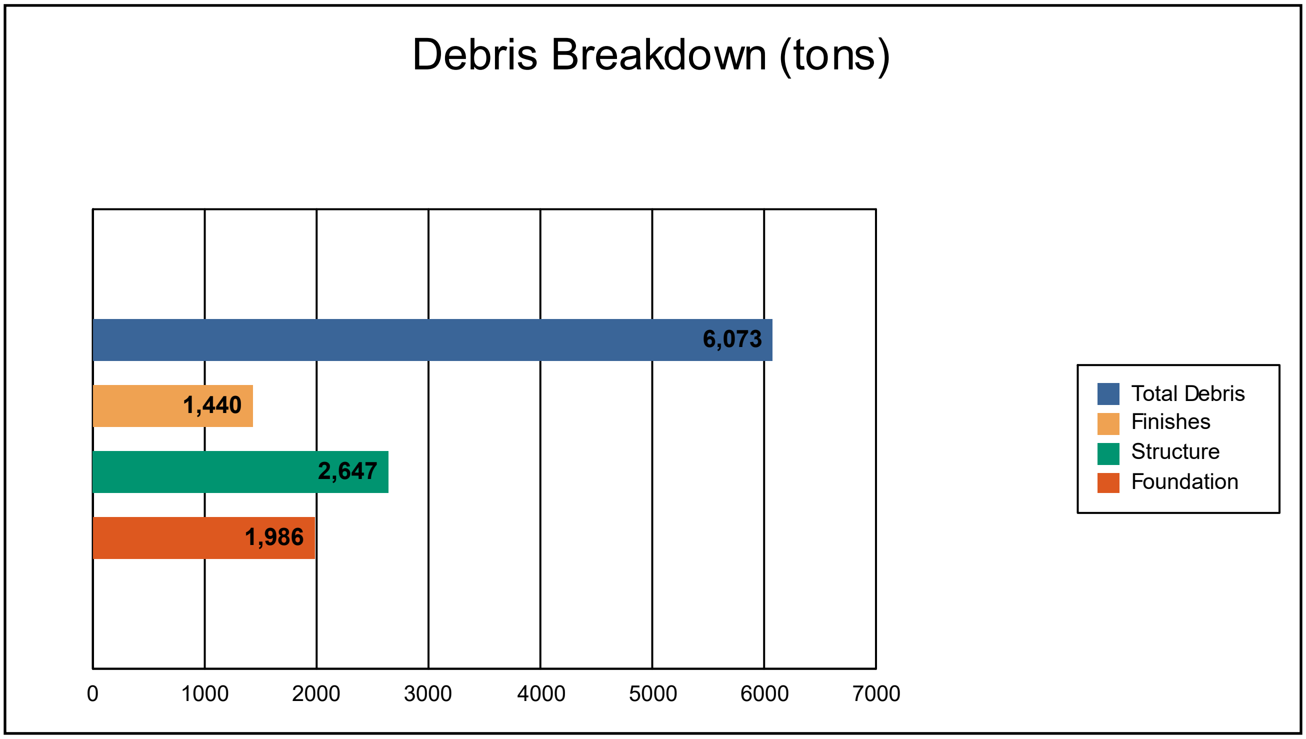
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

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

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

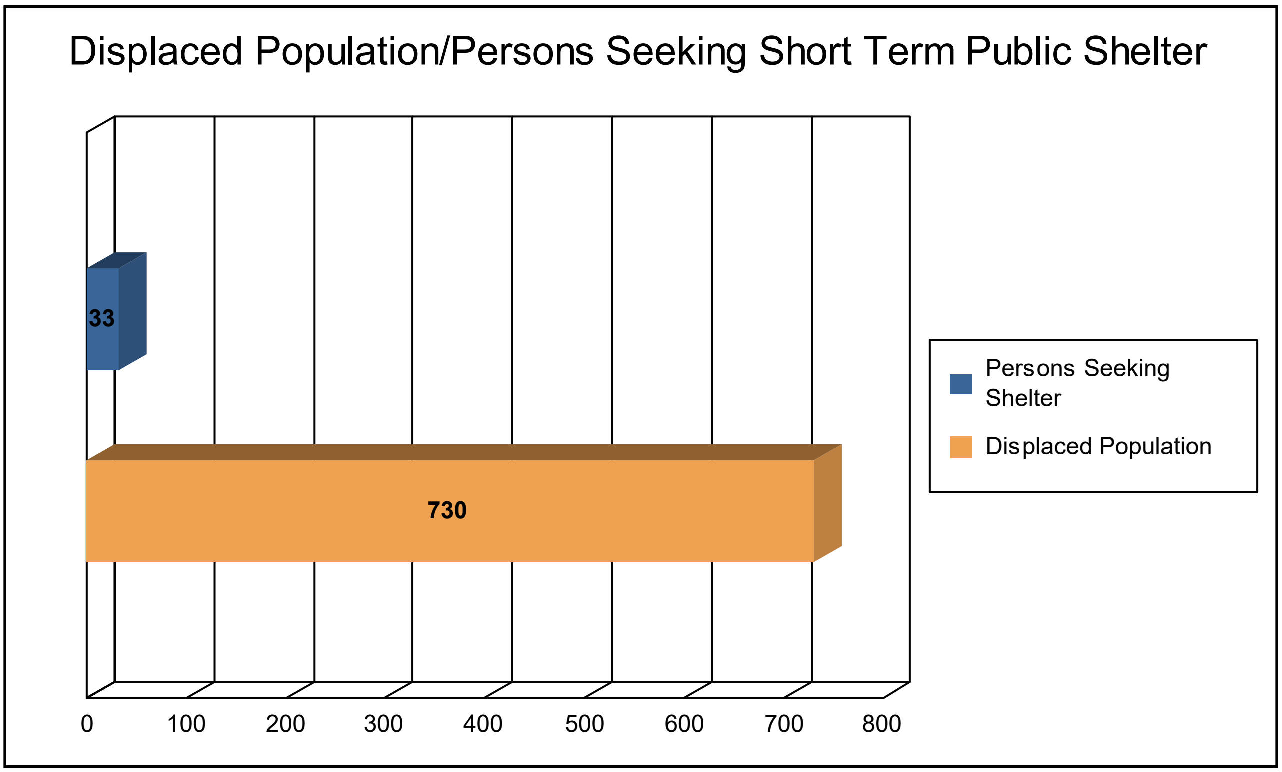


The model estimates that a total of 6,073 tons of debris will be generated. Of the total amount, Finishes comprises 24% of the total, Structure comprises 44% of the total, and Foundation comprises 33%. If the debris tonnage is converted into an estimated number of truckloads, it will require 243 truckloads (@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 243 households (or 730 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 33 people (out of a total population of 9,508) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 92.82 million dollars, which represents 12.64 % of the total replacement value of the scenario buildings.

Building-Related Losses

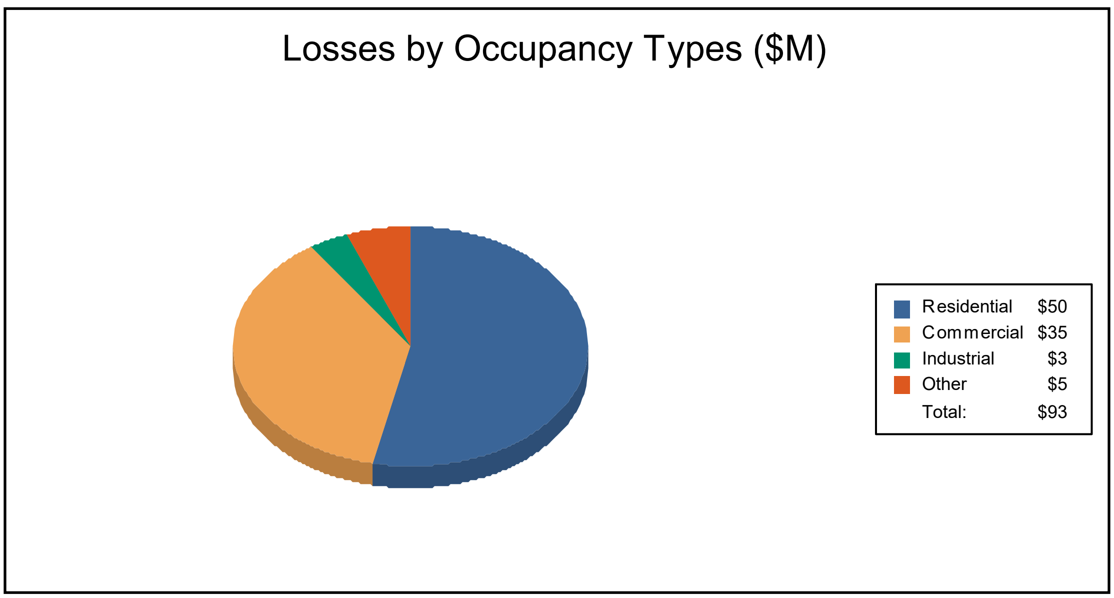
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability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

The total building-related losses were 66.54 million dollars. 28% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 53.41% 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	30.06	6.71	0.97	1.14	38.88
	Content	12.70	10.51	1.93	1.96	27.10
	Inventory	0.00	0.18	0.27	0.11	0.56
	Subtotal	**42.76**	**17.41**	**3.17**	**3.21**	**66.54**
Business Interruption						
	Income	0.03	6.81	0.05	0.53	7.42
	Relocation	5.04	1.97	0.05	0.13	7.19
	Rental Income	1.68	1.49	0.01	0.01	3.19
	Wage	0.06	6.86	0.10	1.46	8.49
	Subtotal	**6.82**	**17.13**	**0.20**	**2.13**	**26.28**
ALL	**Total**	**49.57**	**34.54**	**3.37**	**5.34**	**92.82**



Appendix A: County Listing for the Region

Connecticut

- Middlesex

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
Middlesex	9,508	1,262,021	310,581	1,572,602
Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**
Total Study Region	**9,508**	**1,262,021**	**310,581**	**1,572,602**

Hazus: Hurricane Global Risk Report

Region Name: Portland

Hurricane Scenario: UN-NAMED-1938-4

Print Date: Wednesday, October 9, 2019

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Connecticut

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

The geographical size of the region is 24.85 square miles and contains 2 census tracts. There are over 3 thousand households in the region and a total population of 9,508 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,573 million dollars (2014 dollars). Approximately 91% of the buildings (and 80% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,970 buildings in the region which have an aggregate total replacement value of 1,573 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

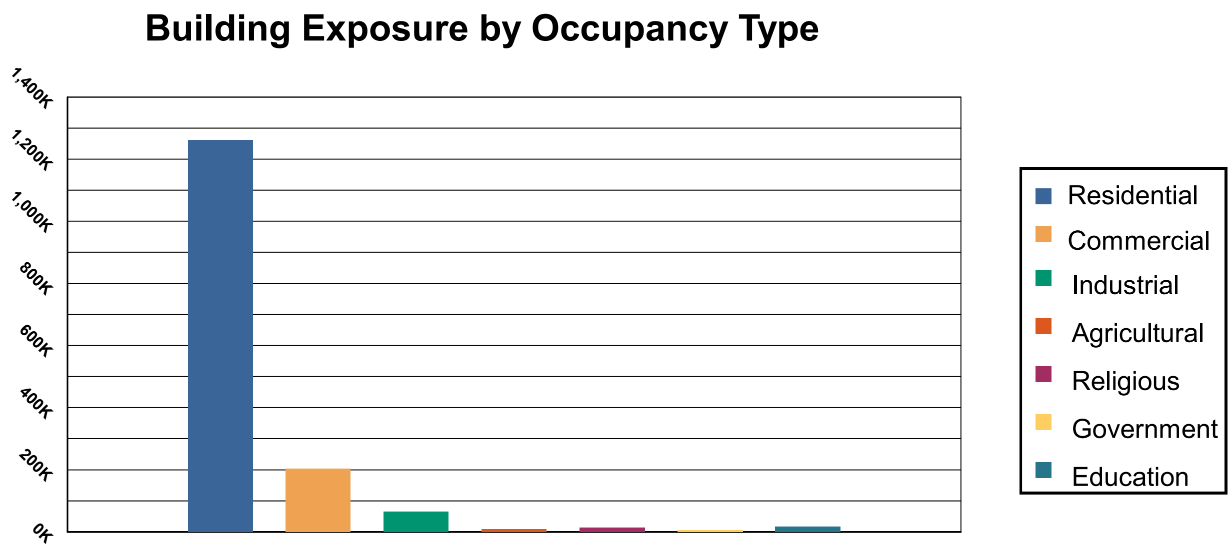


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,262,021	80.25 %
Commercial	202,878	12.90%
Industrial	64,635	4.11%
Agricultural	7,848	0.50%
Religious	13,571	0.86%
Government	4,780	0.30%
Education	16,869	1.07%
Total	**1,572,602**	**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 6 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities.

Hurricane Scenario

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

Scenario Name:	UN-NAMED-1938-4
Type:	Historic
Max Peak Gust in Study Region:	109 mph

Building Damage

General Building Stock Damage

Hazus estimates that about 232 buildings will be at least moderately damaged. This is over 6% of the total number of buildings in the region. There are an estimated 9 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.

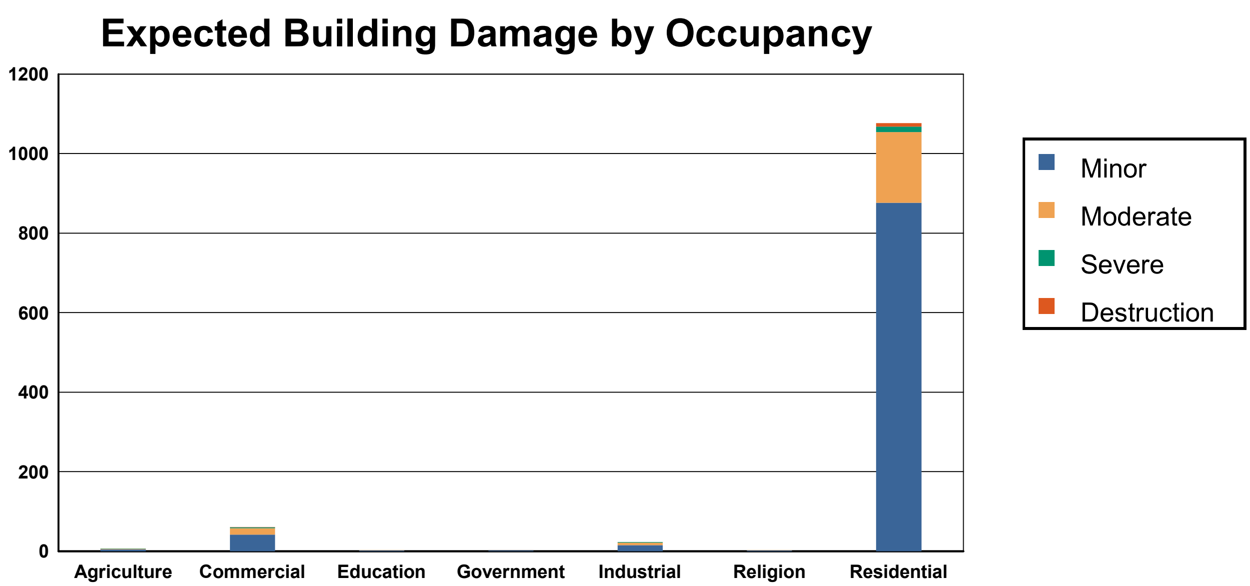


Table 2: Expected Building Damage by Occupancy

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	15.18	69.01	4.50	20.45	1.49	6.79	0.72	3.29	0.10	0.46
Commercial	165.51	73.24	41.38	18.31	16.36	7.24	2.72	1.20	0.02	0.01
Education	7.15	71.50	1.95	19.52	0.80	8.04	0.09	0.95	0.00	0.00
Government	3.57	71.30	0.96	19.20	0.42	8.48	0.05	1.02	0.00	0.00
Industrial	63.15	73.43	14.98	17.42	6.28	7.30	1.46	1.70	0.13	0.15
Religion	8.93	74.44	2.36	19.69	0.64	5.36	0.06	0.51	0.00	0.00
Residential	2,532.05	70.16	876.56	24.29	177.31	4.91	14.00	0.39	9.08	0.25
Total	**2,795.54**		**942.69**		**203.32**		**19.11**		**9.33**	

Table 3: Expected Building Damage by Building Type

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	16	68.70	5	19.97	2	10.44	0	0.89	0	0.00
Masonry	162	69.35	47	20.20	21	9.17	3	1.11	0	0.15
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	113	73.93	25	16.66	12	7.87	2	1.54	0	0.01
Wood	2,425	70.61	841	24.49	147	4.28	12	0.36	9	0.25

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

Thematic Map of Essential Facilities with greater than 50% moderate

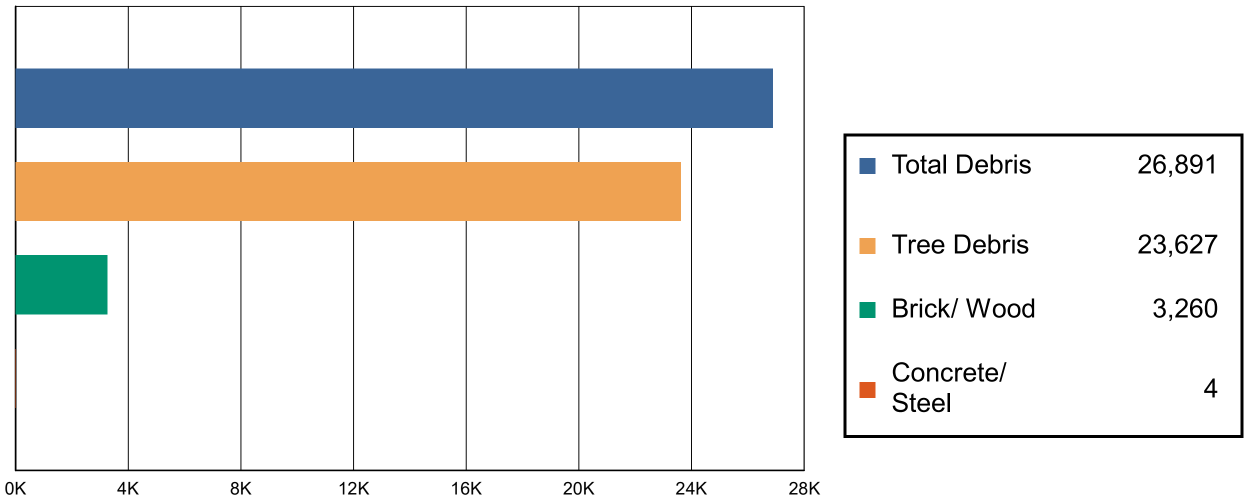
Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	6	0	0	0

Induced Hurricane Damage

Debris Generation

Estimated Debris (Tons)

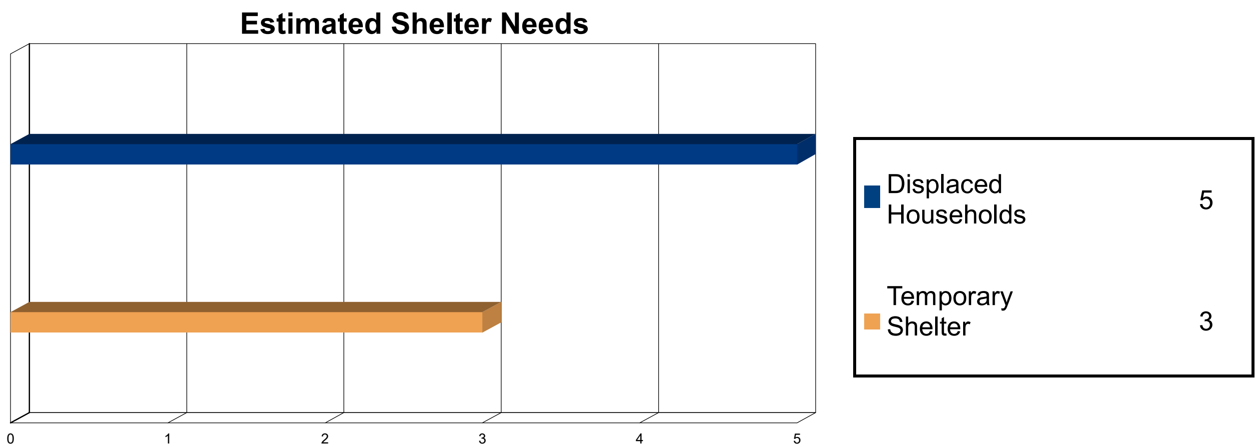


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 26,891 tons of debris will be generated. Of the total amount, 19,338 tons (72%) is Other Tree Debris. Of the remaining 7,553 tons, Brick/Wood comprises 43% 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 131 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 4,289 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 5 households to be displaced due to the hurricane. Of these, 3 people (out of a total population of 9,508) will seek temporary shelter in public shelters.

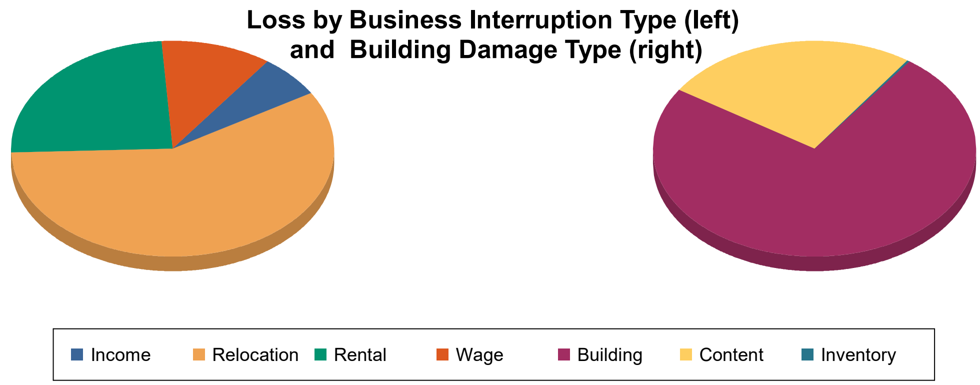
Economic Loss

The total economic loss estimated for the hurricane is 54.7 million dollars, which represents 3.48 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 55 million dollars. 8% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 87% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.



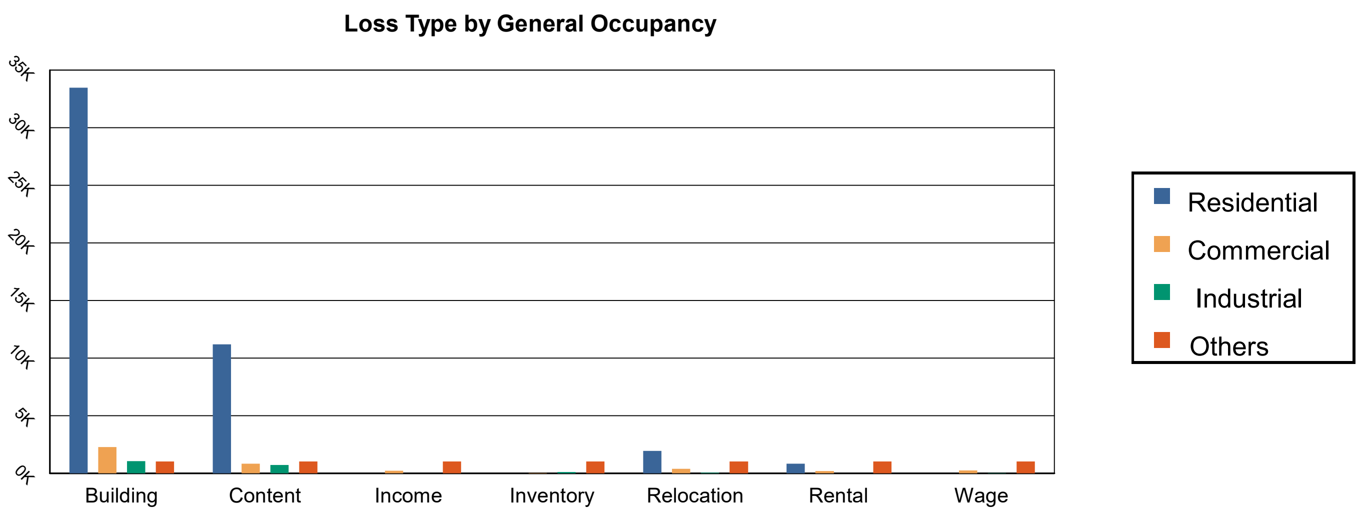


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	33,481.38	2,285.88	1,061.83	515.55	37,344.63
	Content	11,202.70	827.56	739.43	182.70	12,952.39
	Inventory	0.00	18.37	120.15	6.94	145.46
	Subtotal	**44,684.08**	**3,131.80**	**1,921.41**	**705.19**	**50,442.48**
Business Interruption Loss						
	Income	0.00	227.62	12.95	32.83	273.40
	Relocation	1,937.70	400.77	54.81	89.75	2,483.04
	Rental	834.29	196.45	10.59	6.55	1,047.89
	Wage	0.00	253.79	21.45	201.15	476.40
	Subtotal	**2,771.99**	**1,078.63**	**99.81**	**330.29**	**4,280.73**

Total

Total	**47,456.07**	**4,210.44**	**2,021.22**	**1,035.48**	**54,723.21**

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	9,508	1,262,021	310,581	1,572,602
Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**
Study Region Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**

Hazus: Hurricane Global Risk Report

Region Name: Portland

Hurricane Scenario: Probabilistic 10-year Return Period

Print Date: Thursday, September 26, 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 24.85 square miles and contains 2 census tracts. There are over 3 thousand households in the region and a total population of 9,508 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,573 million dollars (2014 dollars). Approximately 91% of the buildings (and 80% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,970 buildings in the region which have an aggregate total replacement value of 1,573 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

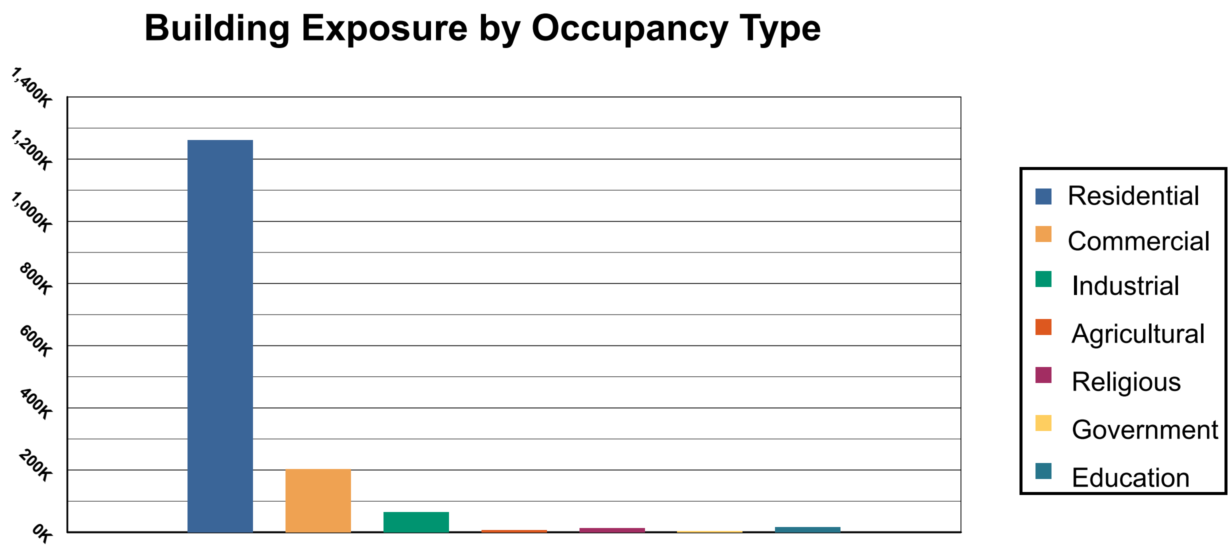


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,262,021	80.25 %
Commercial	202,878	12.90%
Industrial	64,635	4.11%
Agricultural	7,848	0.50%
Religious	13,571	0.86%
Government	4,780	0.30%
Education	16,869	1.07%
Total	**1,572,602**	**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 6 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities.

Hurricane Scenario

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

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

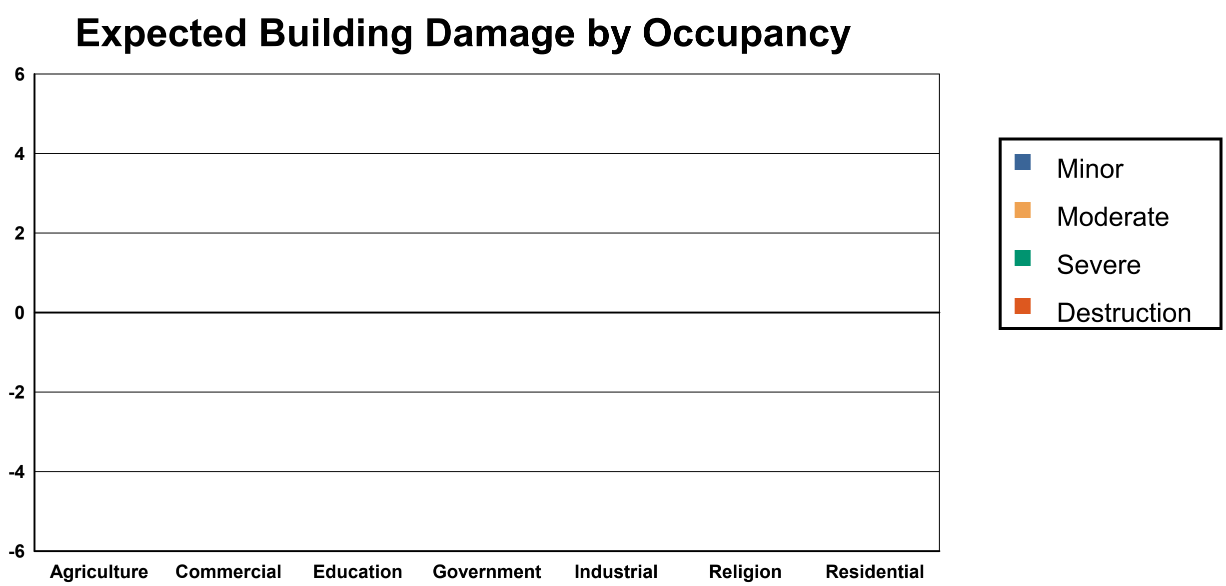


Table 2: Expected Building Damage by Occupancy : 10 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	22.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	226.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Education	10.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Government	5.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	86.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Religion	12.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential	3,609.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**3,970.00**		**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	23	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	234	100.00	0	0.00	0	0.00	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	153	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	3,435	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.

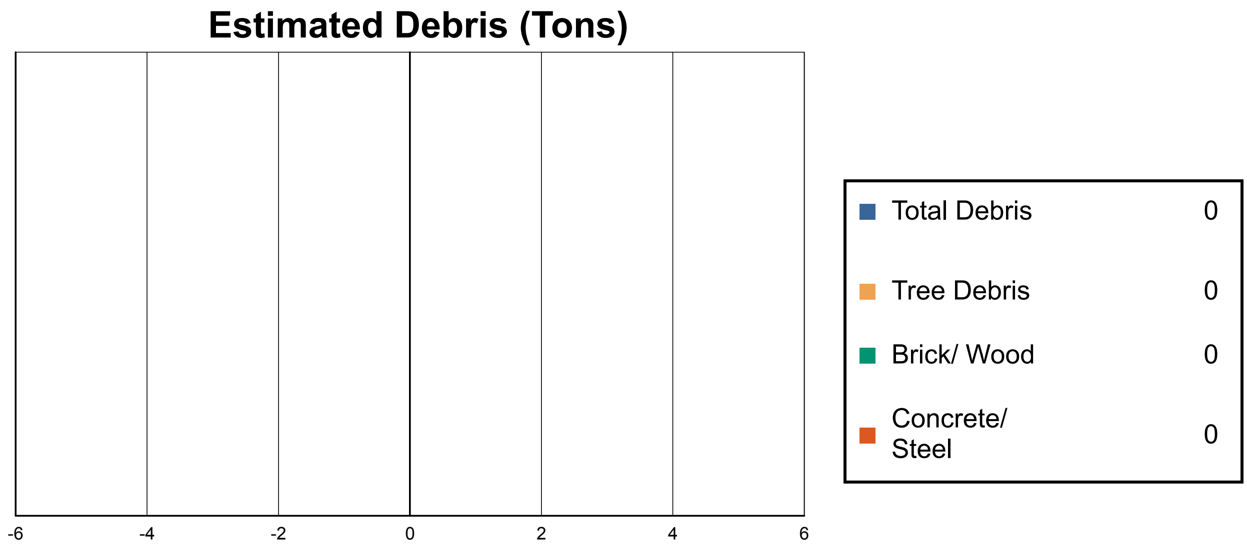
Thematic Map of Essential Facilities with greater than 50% moderate

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	3	0	0	3
Police Stations	1	0	0	1
Schools	6	0	0	6

Induced Hurricane Damage

Debris Generation

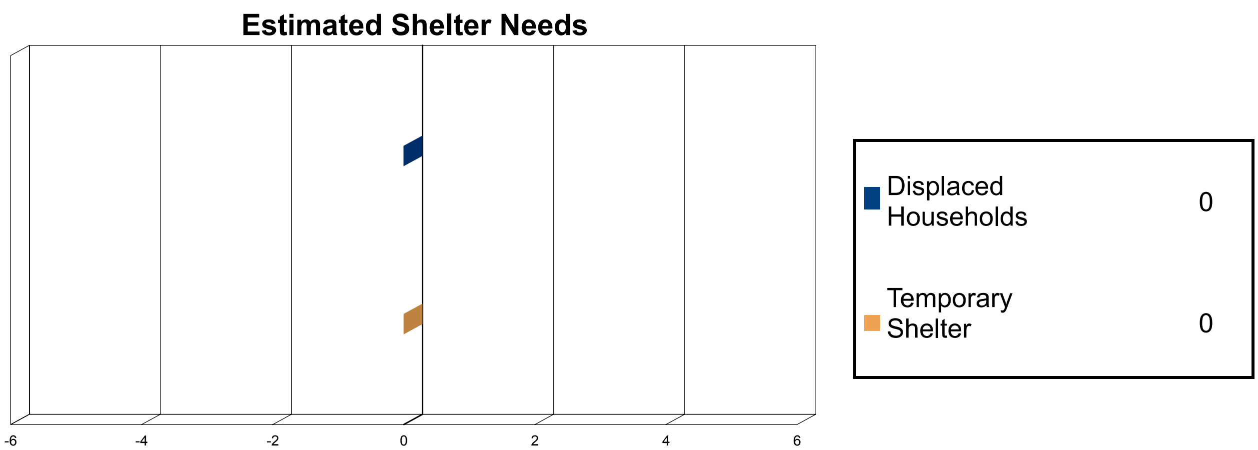


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling 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 9,508) will seek temporary shelter in public shelters.

Economic Loss

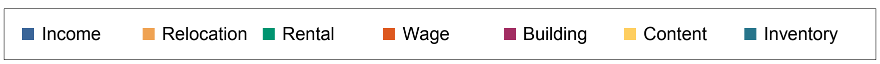
The total economic loss estimated for the hurricane is 0.0 million dollars, which represents 0.00 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 0 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 0% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

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



Loss Type by General Occupancy

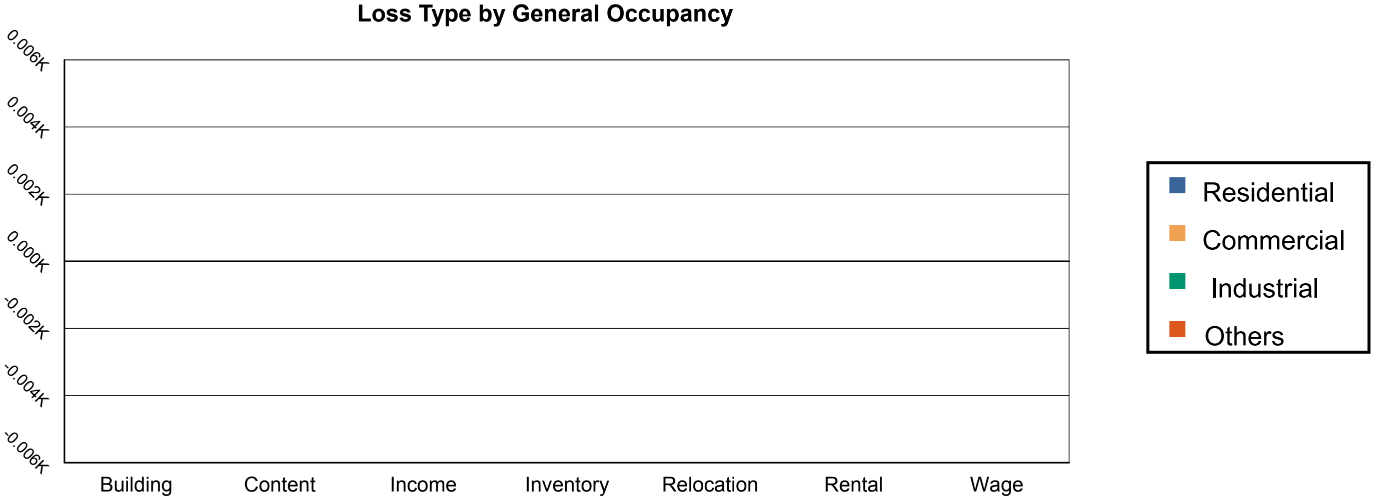


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

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

Total

Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Appendix A: County Listing for the Region

Connecticut

- Middlesex

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Middlesex	9,508	1,262,021	310,581	1,572,602
Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**
Study Region Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**

Hazus: Hurricane Global Risk Report

Region Name: Portland

Hurricane Scenario: Probabilistic 20-year Return Period

Print Date: Tuesday, October 1, 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 24.85 square miles and contains 2 census tracts. There are over 3 thousand households in the region and a total population of 9,508 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,573 million dollars (2014 dollars). Approximately 91% of the buildings (and 80% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,970 buildings in the region which have an aggregate total replacement value of 1,573 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Building Exposure by Occupancy Type

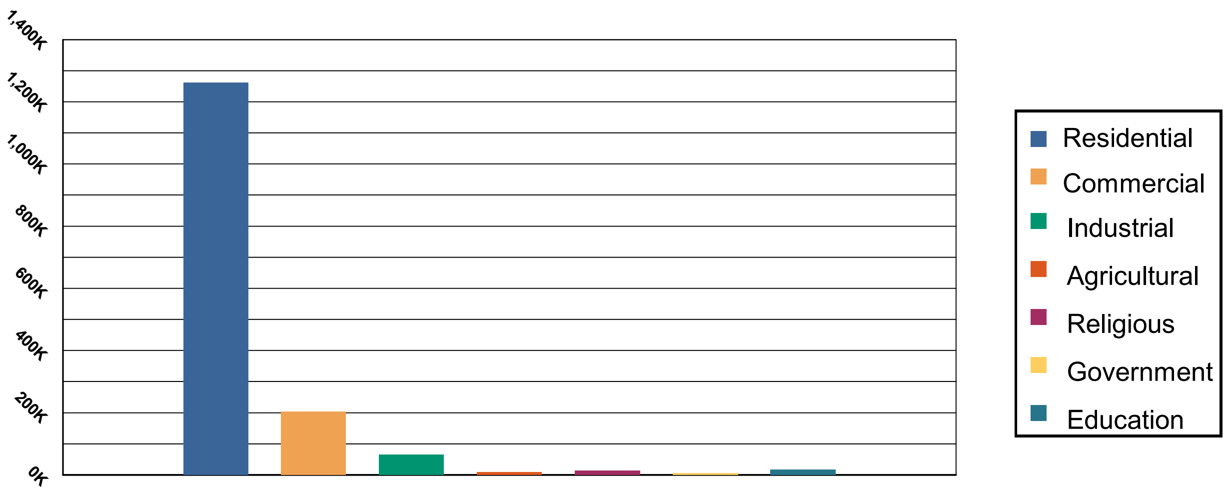


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,262,021	80.25 %
Commercial	202,878	12.90%
Industrial	64,635	4.11%
Agricultural	7,848	0.50%
Religious	13,571	0.86%
Government	4,780	0.30%
Education	16,869	1.07%
Total	**1,572,602**	**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 6 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities.

Hurricane Scenario

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

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

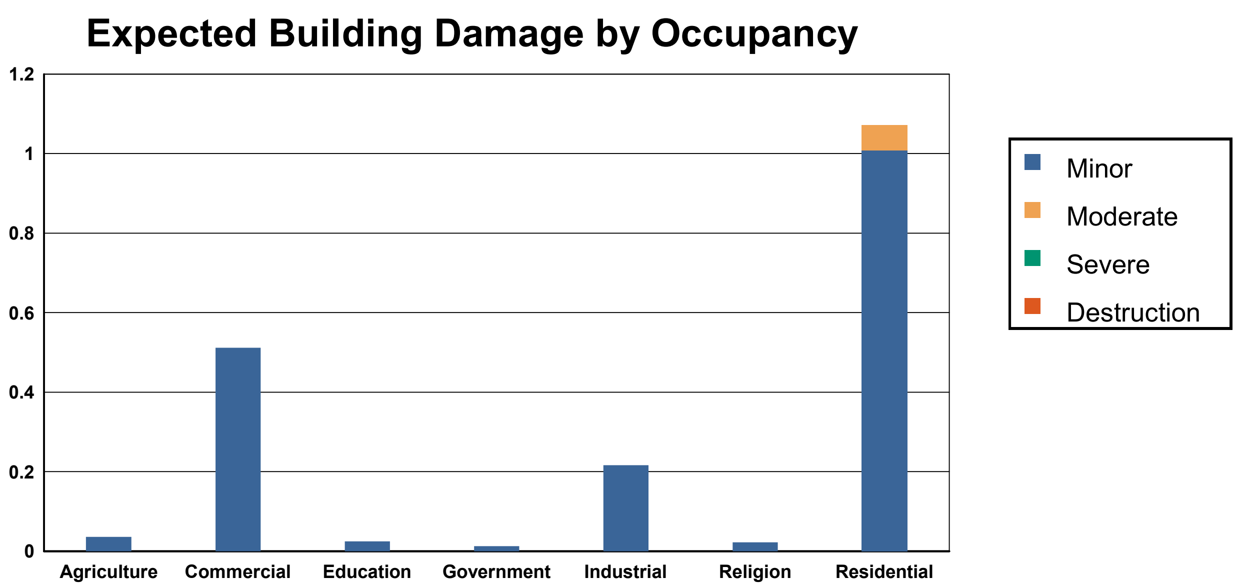


Table 2: Expected Building Damage by Occupancy : 20 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	21.96	99.84	0.04	0.16	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	225.49	99.77	0.51	0.23	0.00	0.00	0.00	0.00	0.00	0.00
Education	9.98	99.76	0.02	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Government	4.99	99.74	0.01	0.26	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	85.78	99.75	0.22	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Religion	11.98	99.81	0.02	0.19	0.00	0.00	0.00	0.00	0.00	0.00
Residential	3,607.93	99.97	1.01	0.03	0.06	0.00	0.00	0.00	0.00	0.00
Total	**3,968.10**		**1.83**		**0.06**		**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	23	99.69	0	0.31	0	0.00	0	0.00	0	0.00
Masonry	233	99.76	1	0.24	0	0.01	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	153	99.74	0	0.26	0	0.00	0	0.00	0	0.00
Wood	3,435	99.99	0	0.01	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

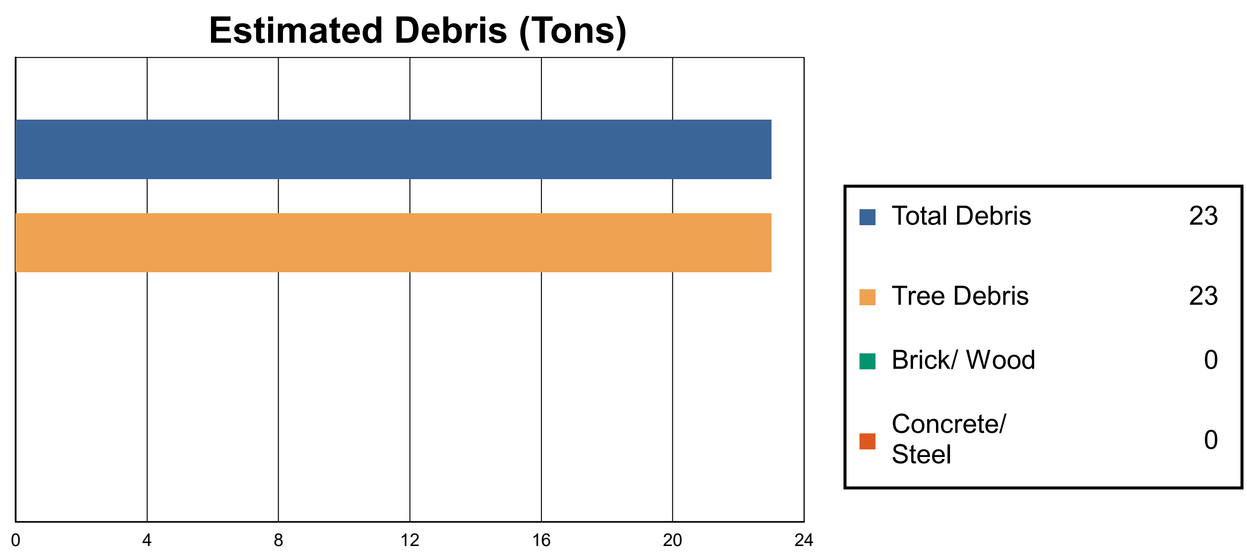
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	6	0	0	6

Induced Hurricane Damage

Debris Generation

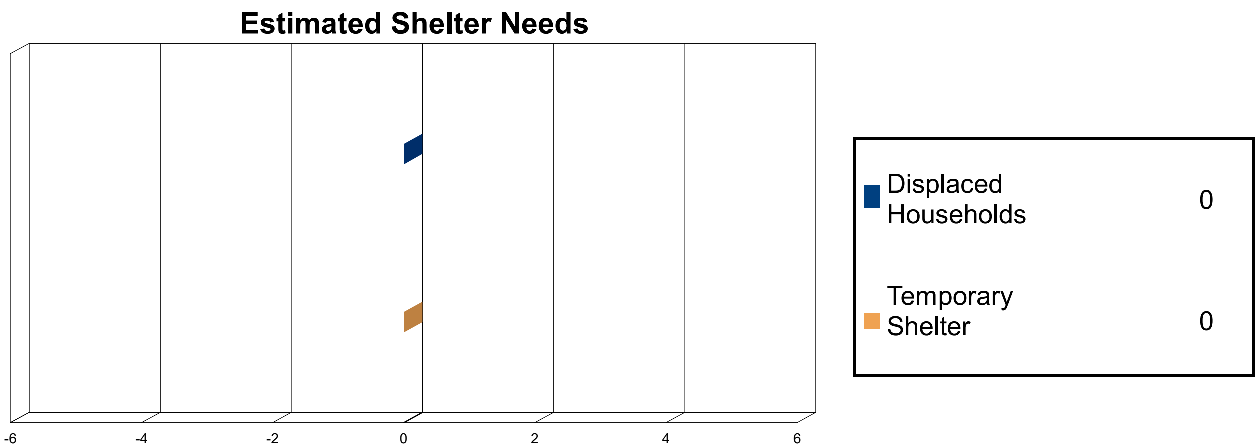


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 23 tons of debris will be generated. Of the total amount, 17 tons (74%) is Other Tree Debris. Of the remaining 6 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 6 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 9,508) will seek temporary shelter in public shelters.

Economic Loss

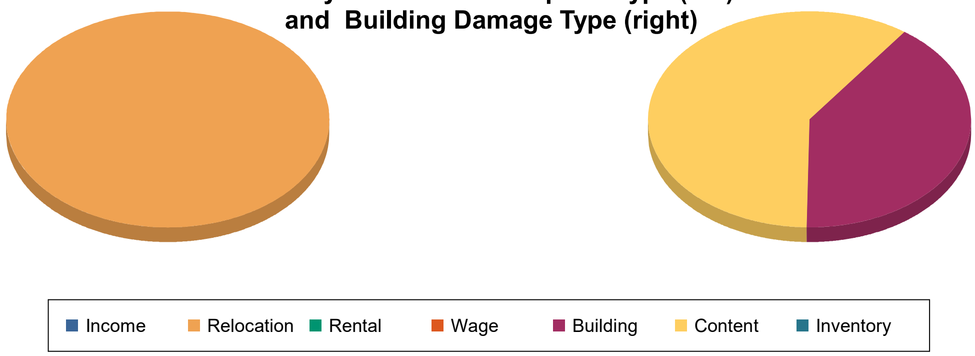
The total economic loss estimated for the hurricane is 0.1 million dollars, which represents 0.00 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 0 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 100% of the total loss. Table 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

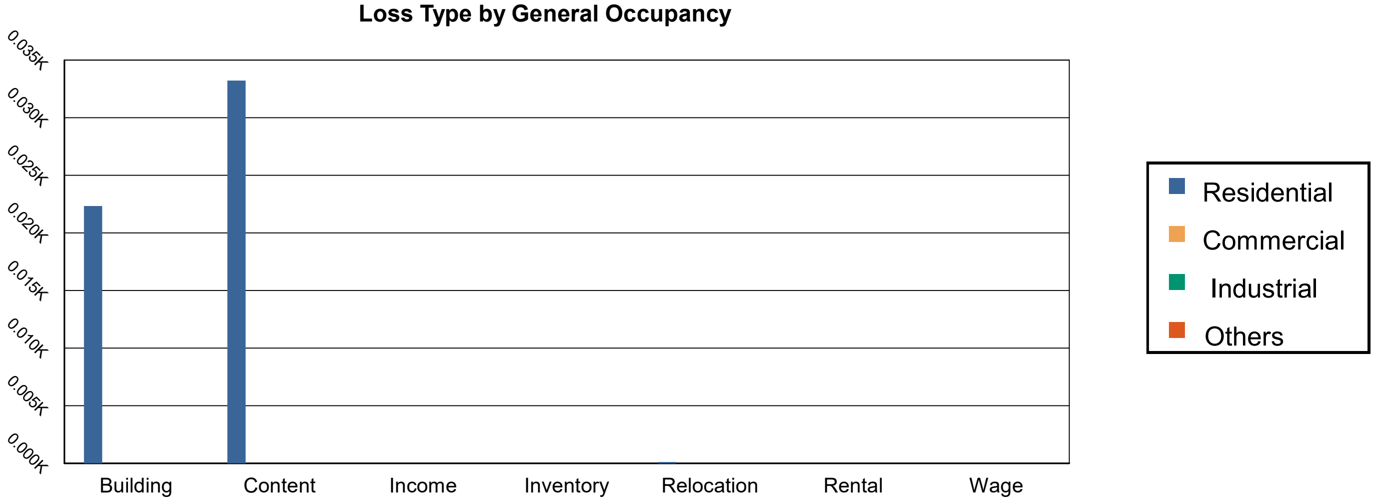


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	22.35	0.00	0.00	0.00	22.35
	Content	33.23	0.00	0.00	0.00	33.23
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**55.57**	**0.00**	**0.00**	**0.00**	**55.57**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.11	0.00	0.00	0.00	0.11
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.11**	**0.00**	**0.00**	**0.00**	**0.11**

Total

	Total	**55.69**	**0.00**	**0.00**	**0.00**	**55.69**

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	9,508	1,262,021	310,581	1,572,602
Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**
Study Region Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**

Hazus: Hurricane Global Risk Report

Region Name: Portland

Hurricane Scenario: Probabilistic 50-year Return Period

Print Date: Tuesday, October 1, 2019

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General Description of the Region

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The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Connecticut

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

The geographical size of the region is 24.85 square miles and contains 2 census tracts. There are over 3 thousand households in the region and a total population of 9,508 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,573 million dollars (2014 dollars). Approximately 91% of the buildings (and 80% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,970 buildings in the region which have an aggregate total replacement value of 1,573 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

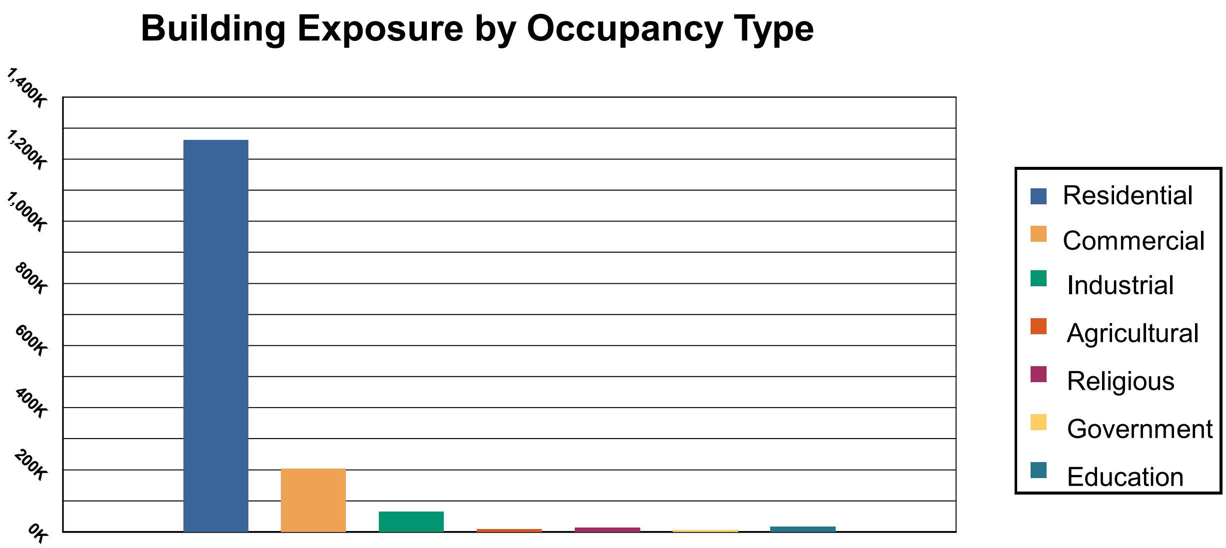


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,262,021	80.25 %
Commercial	202,878	12.90%
Industrial	64,635	4.11%
Agricultural	7,848	0.50%
Religious	13,571	0.86%
Government	4,780	0.30%
Education	16,869	1.07%
Total	**1,572,602**	**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 6 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities.

Hurricane Scenario

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

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 1 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

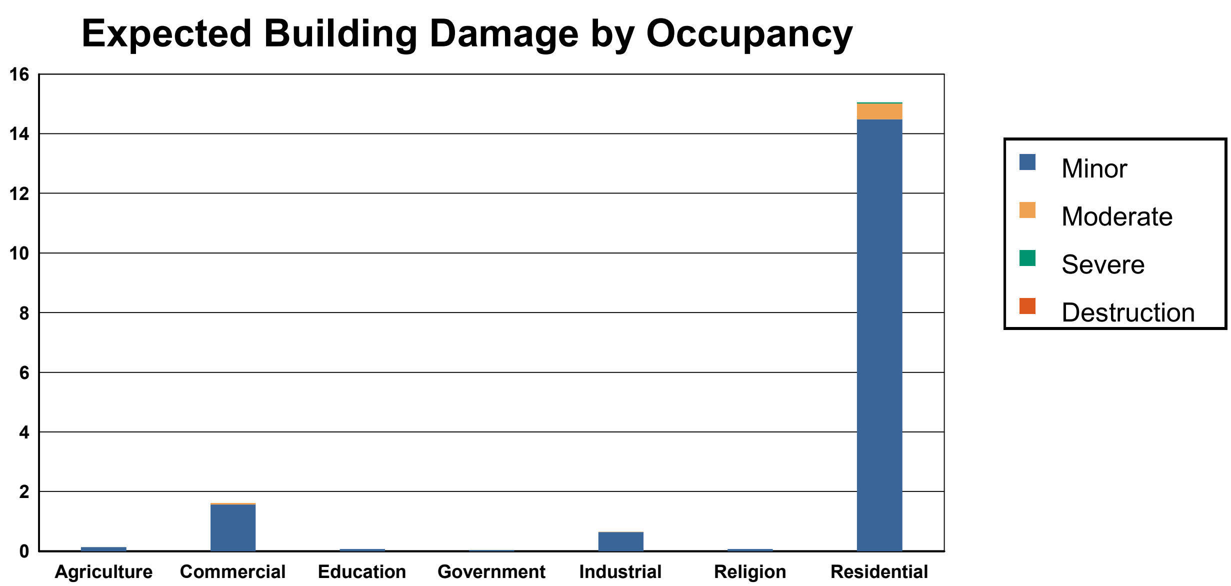


Table 2: Expected Building Damage by Occupancy : 50 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	21.86	99.38	0.13	0.59	0.01	0.03	0.00	0.00	0.00	0.00
Commercial	224.39	99.29	1.56	0.69	0.05	0.02	0.00	0.00	0.00	0.00
Education	9.93	99.26	0.07	0.75	0.00	0.00	0.00	0.00	0.00	0.00
Government	4.96	99.24	0.04	0.76	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	85.35	99.24	0.64	0.75	0.01	0.01	0.00	0.00	0.00	0.00
Religion	11.93	99.44	0.07	0.55	0.00	0.01	0.00	0.00	0.00	0.00
Residential	3,593.95	99.58	14.49	0.40	0.53	0.01	0.04	0.00	0.00	0.00
Total	**3,952.37**		**17.00**		**0.59**		**0.04**		**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	23	99.04	0	0.95	0	0.00	0	0.00	0	0.00
Masonry	232	98.99	2	0.92	0	0.08	0	0.01	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	152	99.23	1	0.76	0	0.01	0	0.00	0	0.00
Wood	3,423	99.66	11	0.33	0	0.01	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

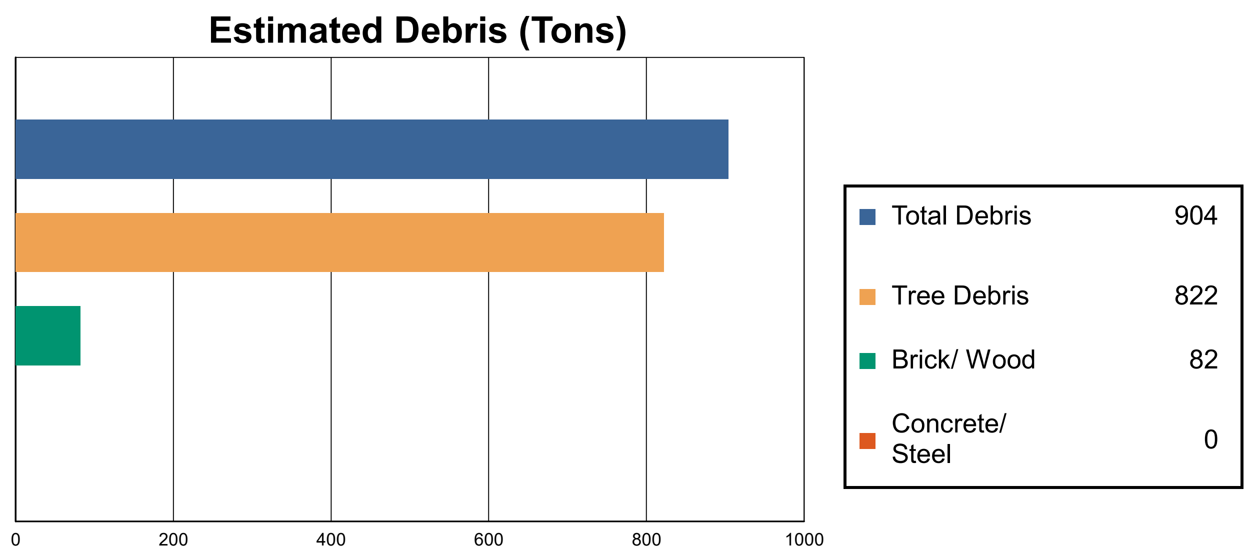
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	6	0	0	6

Induced Hurricane Damage

Debris Generation

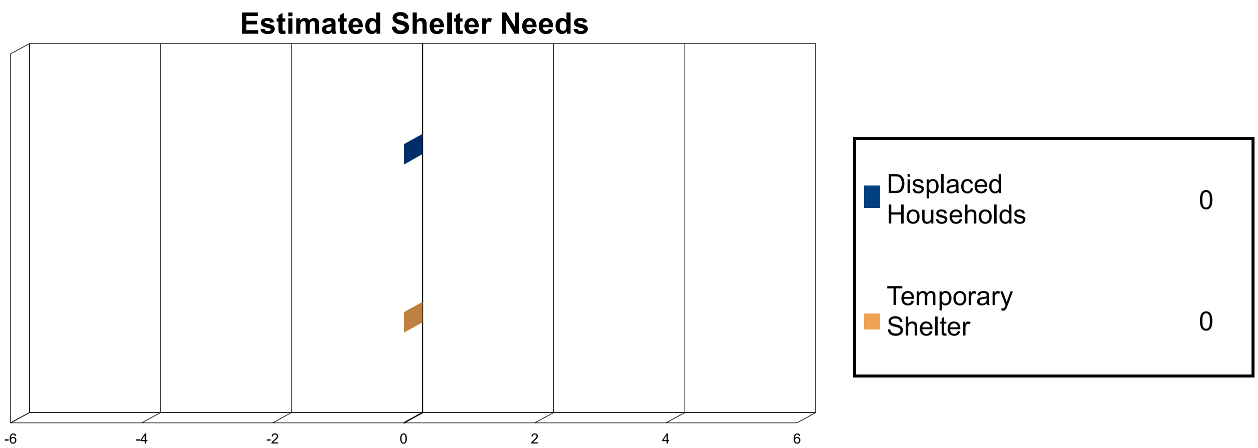


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 904 tons of debris will be generated. Of the total amount, 618 tons (68%) is Other Tree Debris. Of the remaining 286 tons, Brick/Wood comprises 29% 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 3 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 204 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 9,508) will seek temporary shelter in public shelters.

Economic Loss

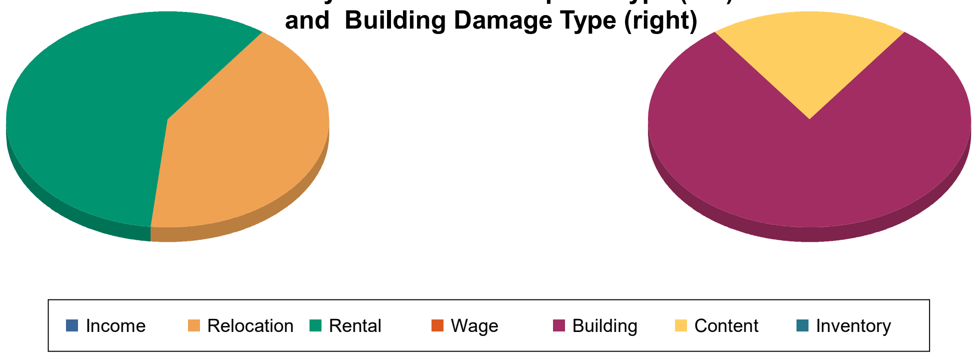
The total economic loss estimated for the hurricane is 2.4 million dollars, which represents 0.15 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 2 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 98% 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

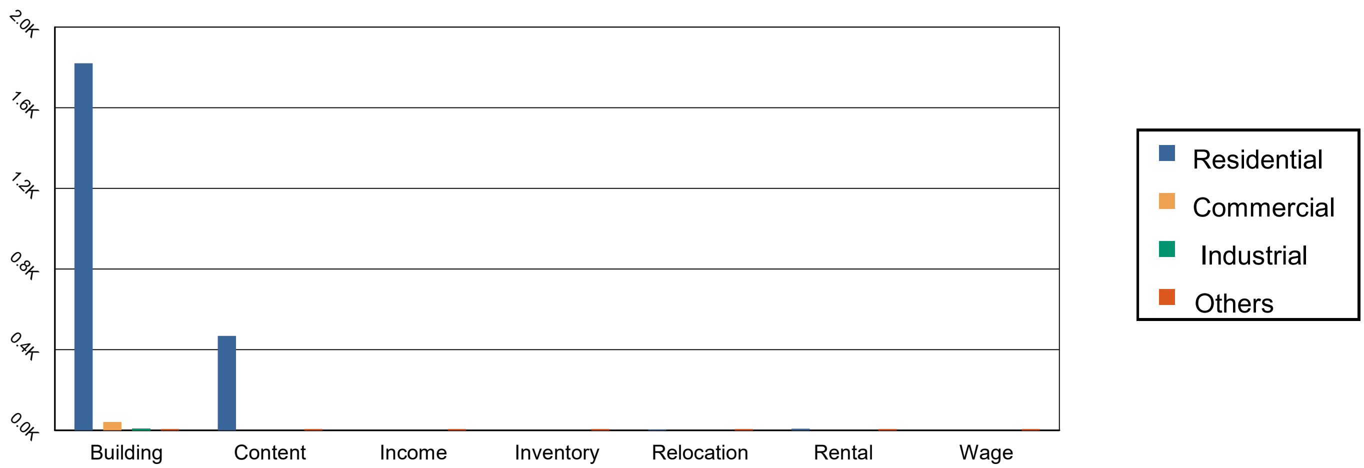


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	1,820.05	41.45	8.55	6.96	1,877.02
	Content	468.47	0.00	0.00	0.00	468.47
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**2,288.52**	**41.45**	**8.55**	**6.96**	**2,345.49**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	5.51	0.34	0.00	0.02	5.88
	Rental	8.19	0.00	0.00	0.00	8.19
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**13.70**	**0.34**	**0.00**	**0.02**	**14.06**

Total

Total	**2,302.22**	**41.80**	**8.55**	**6.99**	**2,359.55**

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
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Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**
Study Region Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**

Hazus: Hurricane Global Risk Report

Region Name: Portland

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Tuesday, October 1, 2019

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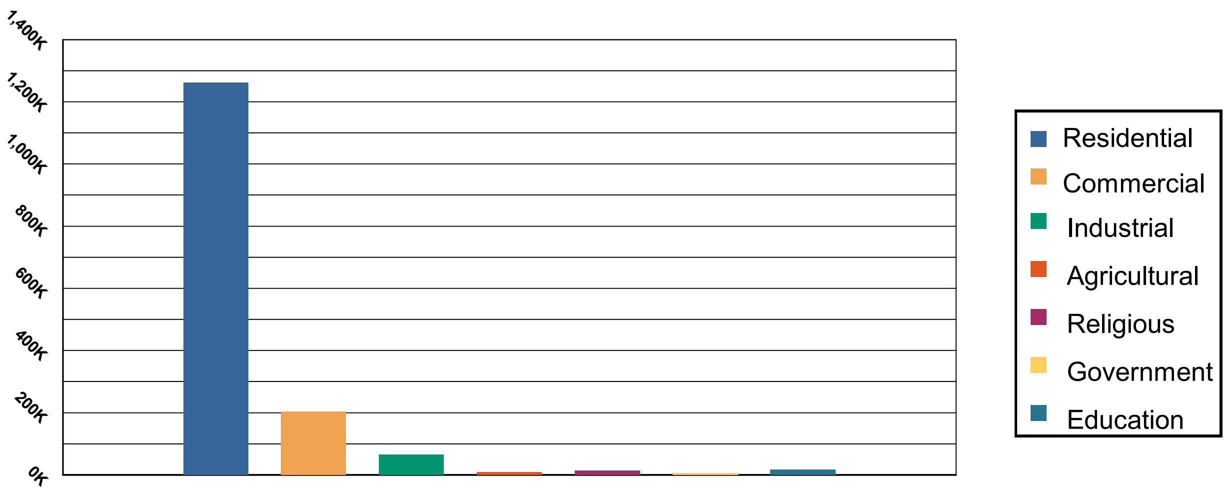

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Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 6 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities.

Hurricane Scenario

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

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 6 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in 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.

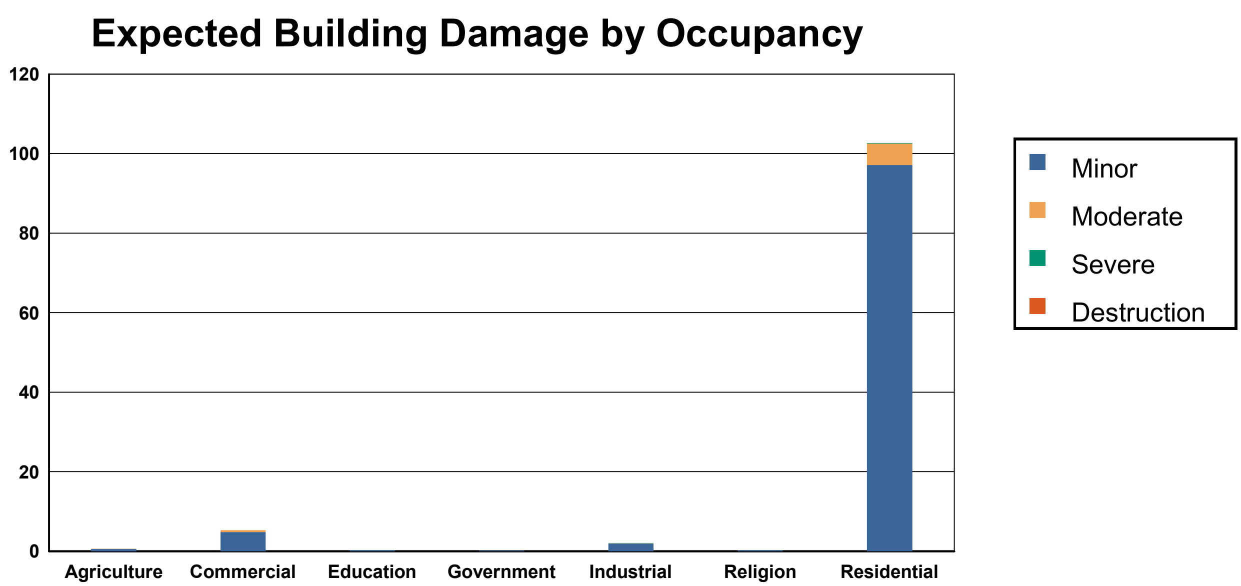


Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	21.39	97.25	0.52	2.36	0.06	0.29	0.02	0.10	0.00	0.00
Commercial	220.72	97.66	4.81	2.13	0.45	0.20	0.03	0.01	0.00	0.00
Education	9.76	97.63	0.23	2.30	0.01	0.08	0.00	0.00	0.00	0.00
Government	4.88	97.65	0.11	2.29	0.00	0.06	0.00	0.00	0.00	0.00
Industrial	83.97	97.64	1.89	2.20	0.11	0.13	0.03	0.03	0.00	0.00
Religion	11.76	97.99	0.23	1.94	0.01	0.06	0.00	0.00	0.00	0.00
Residential	3,506.35	97.16	97.14	2.69	5.37	0.15	0.14	0.00	0.00	0.00
Total	**3,858.83**		**104.93**		**6.02**		**0.21**		**0.00**	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	22	97.11	1	2.79	0	0.10	0	0.00	0	0.00
Masonry	226	96.40	7	3.05	1	0.52	0	0.03	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	149	97.71	3	2.10	0	0.18	0	0.01	0	0.00
Wood	3,344	97.35	88	2.56	3	0.09	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

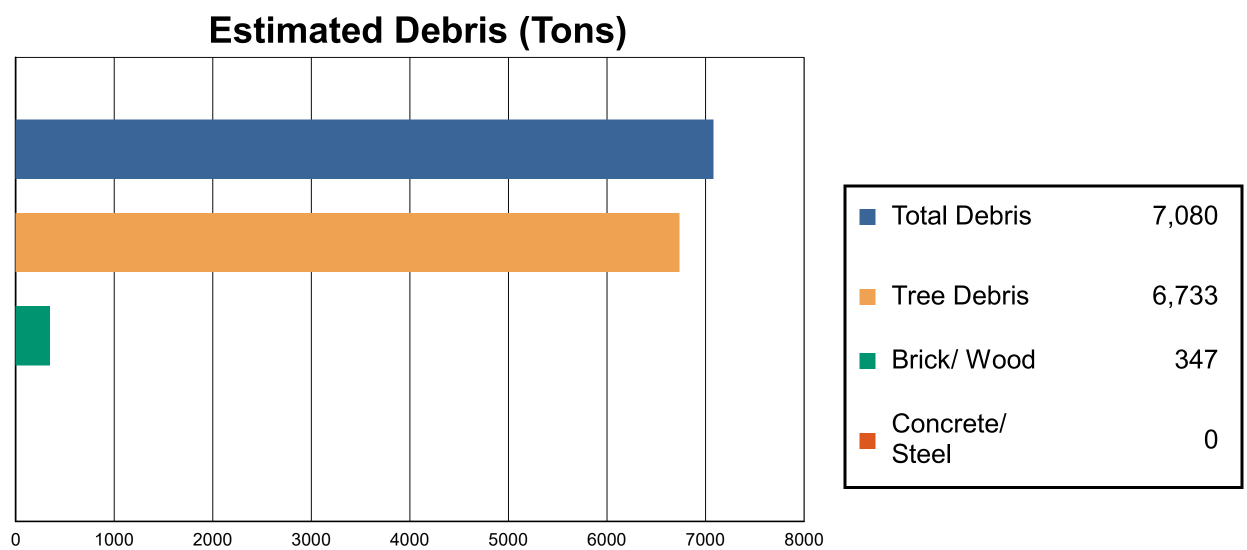
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	6	0	0	6

Induced Hurricane Damage

Debris Generation

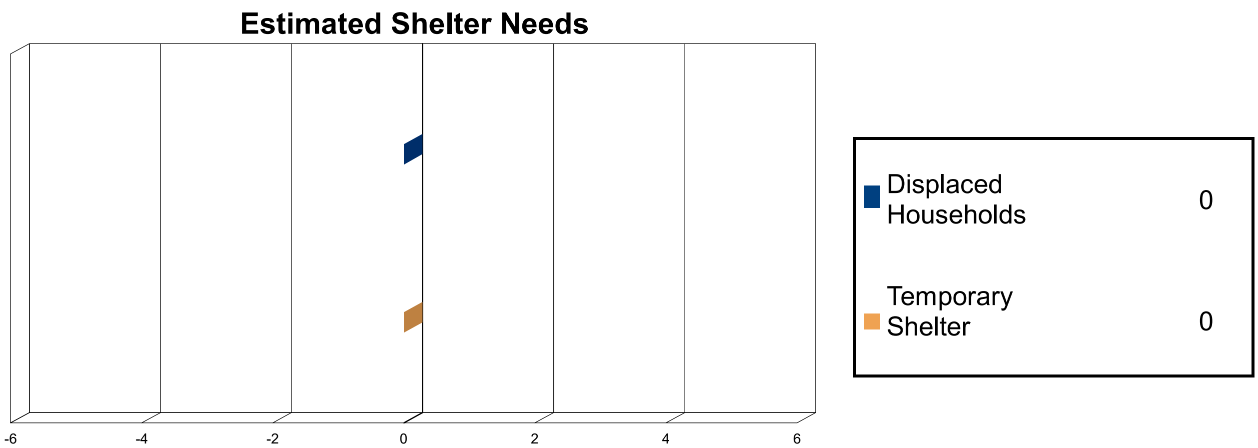


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 7,080 tons of debris will be generated. Of the total amount, 5,531 tons (78%) is Other Tree Debris. Of the remaining 1,549 tons, Brick/Wood comprises 22% 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 14 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 1,202 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 9,508) will seek temporary shelter in public shelters.

Economic Loss

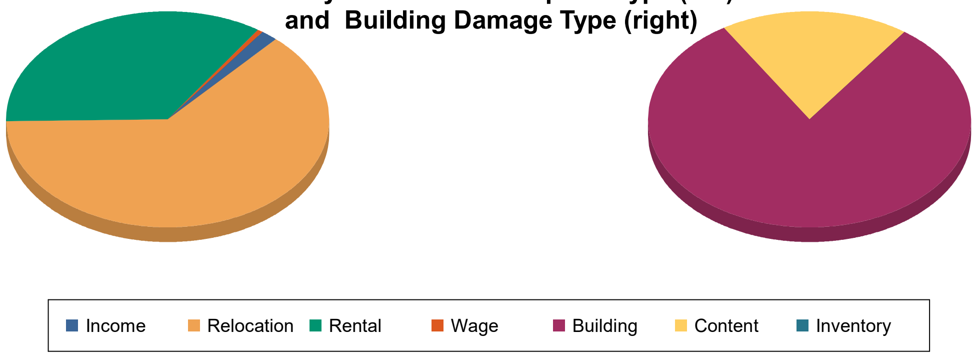
The total economic loss estimated for the hurricane is 7.0 million dollars, which represents 0.45 % of the total replacement value of the region's buildings.

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 7 million dollars. 4% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 96% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

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



Loss Type by General Occupancy

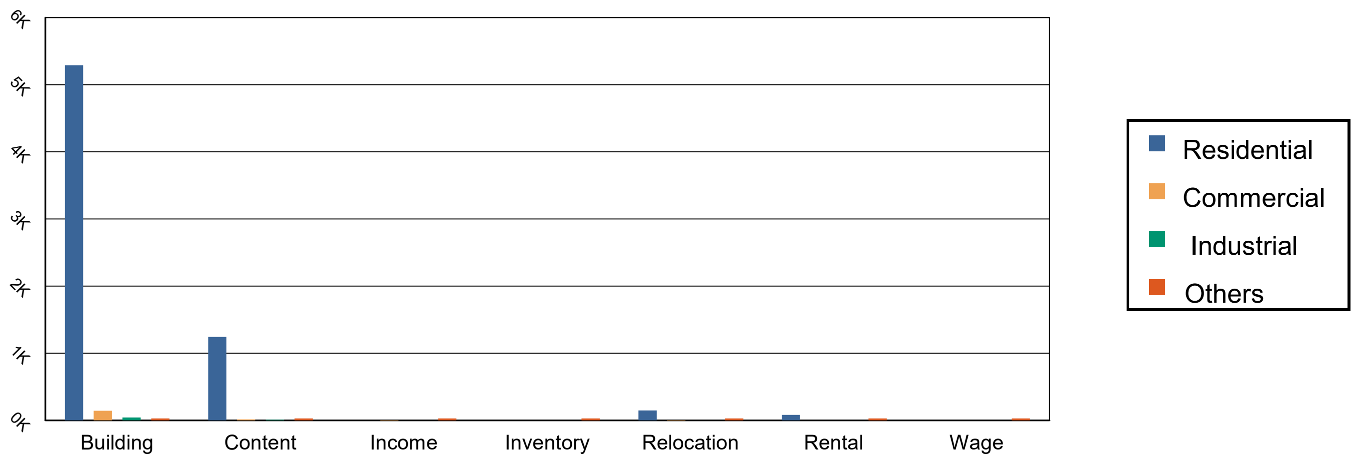


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	5,287.65	142.70	42.68	26.30	5,499.32
	Content	1,242.18	14.71	10.05	1.77	1,268.72
	Inventory	0.00	0.30	1.76	0.12	2.19
	Subtotal	**6,529.83**	**157.72**	**54.48**	**28.19**	**6,770.23**
Business Interruption Loss						
	Income	0.00	4.05	0.00	0.00	4.05
	Relocation	148.98	5.56	0.17	0.33	155.04
	Rental	83.35	1.82	0.00	0.00	85.17
	Wage	0.00	1.44	0.00	0.00	1.44
	Subtotal	**232.33**	**12.87**	**0.17**	**0.33**	**245.70**

Total

Total	**6,762.16**	**170.59**	**54.66**	**28.52**	**7,015.93**

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	9,508	1,262,021	310,581	1,572,602
Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**
Study Region Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**

Hazus: Hurricane Global Risk Report

Region Name: Portland

Hurricane Scenario: Probabilistic 200-year Return Period

Print Date: Tuesday, October 1, 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 24.85 square miles and contains 2 census tracts. There are over 3 thousand households in the region and a total population of 9,508 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,573 million dollars (2014 dollars). Approximately 91% of the buildings (and 80% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,970 buildings in the region which have an aggregate total replacement value of 1,573 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

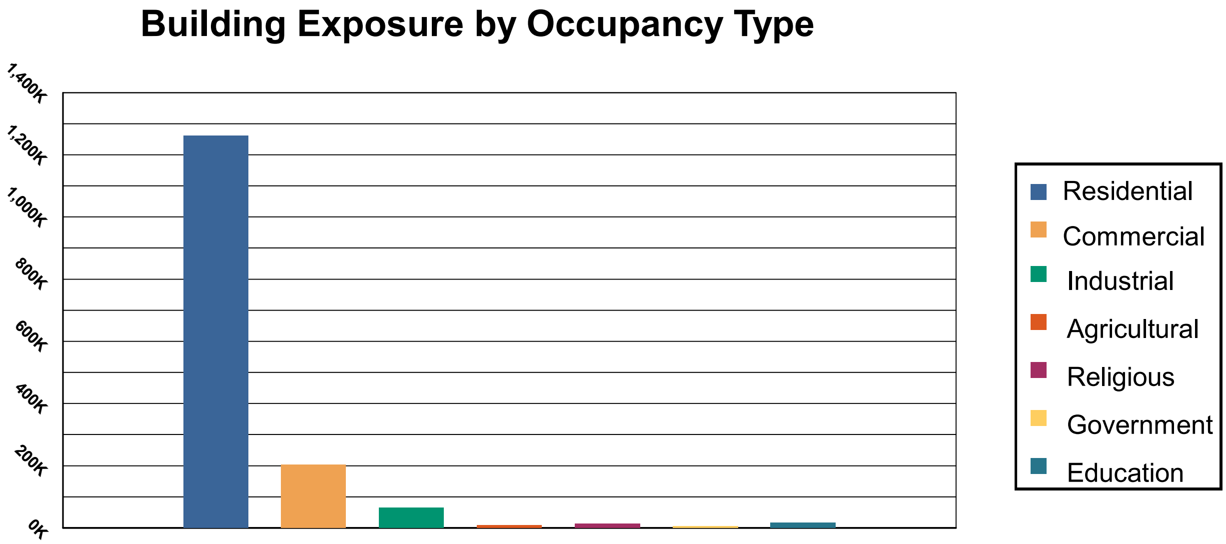


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,262,021	80.25 %
Commercial	202,878	12.90%
Industrial	64,635	4.11%
Agricultural	7,848	0.50%
Religious	13,571	0.86%
Government	4,780	0.30%
Education	16,869	1.07%
Total	**1,572,602**	**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 6 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities.

Hurricane Scenario

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

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 31 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.

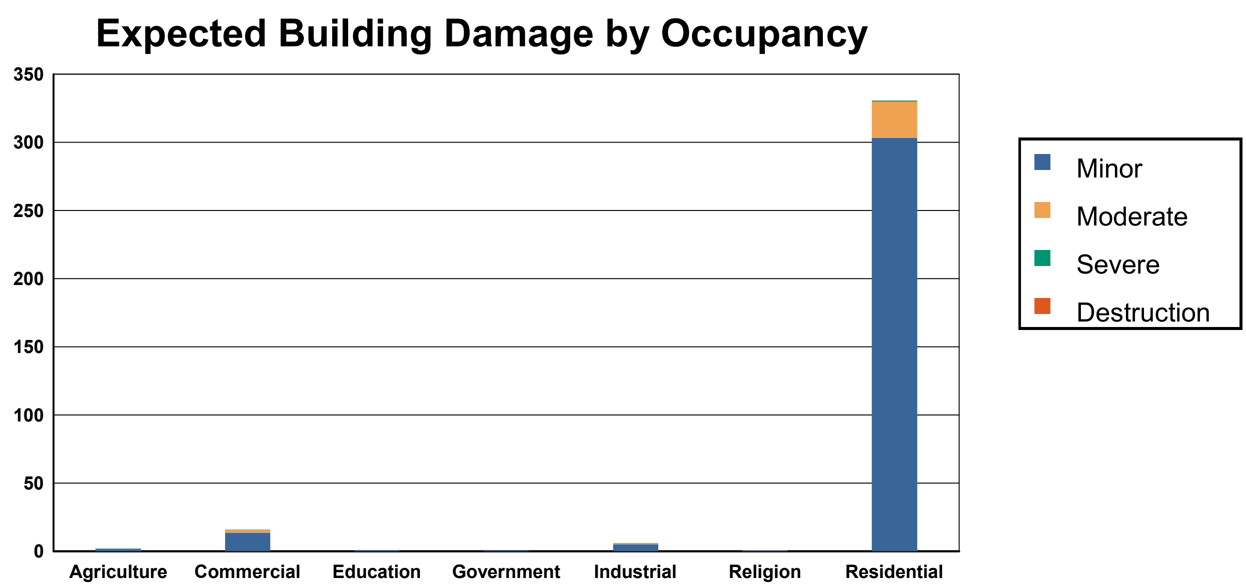


Table 2: Expected Building Damage by Occupancy : 200 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	20.03	91.04	1.54	7.00	0.30	1.35	0.13	0.58	0.01	0.03
Commercial	210.10	92.96	13.53	5.99	2.14	0.95	0.23	0.10	0.00	0.00
Education	9.27	92.72	0.66	6.57	0.07	0.70	0.00	0.02	0.00	0.00
Government	4.64	92.74	0.33	6.52	0.04	0.72	0.00	0.02	0.00	0.00
Industrial	80.00	93.03	5.08	5.91	0.74	0.86	0.17	0.19	0.01	0.01
Religion	11.22	93.54	0.72	6.00	0.05	0.45	0.00	0.02	0.00	0.00
Residential	3,278.31	90.84	303.16	8.40	26.65	0.74	0.64	0.02	0.23	0.01
Total	**3,613.58**		**325.02**		**29.98**		**1.17**		**0.25**	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	21	91.54	2	7.45	0	1.00	0	0.01	0	0.00
Masonry	211	90.20	18	7.72	4	1.92	0	0.15	0	0.01
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	143	93.35	9	5.57	1	0.95	0	0.12	0	0.00
Wood	3,131	91.15	285	8.28	19	0.55	1	0.02	0	0.01

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

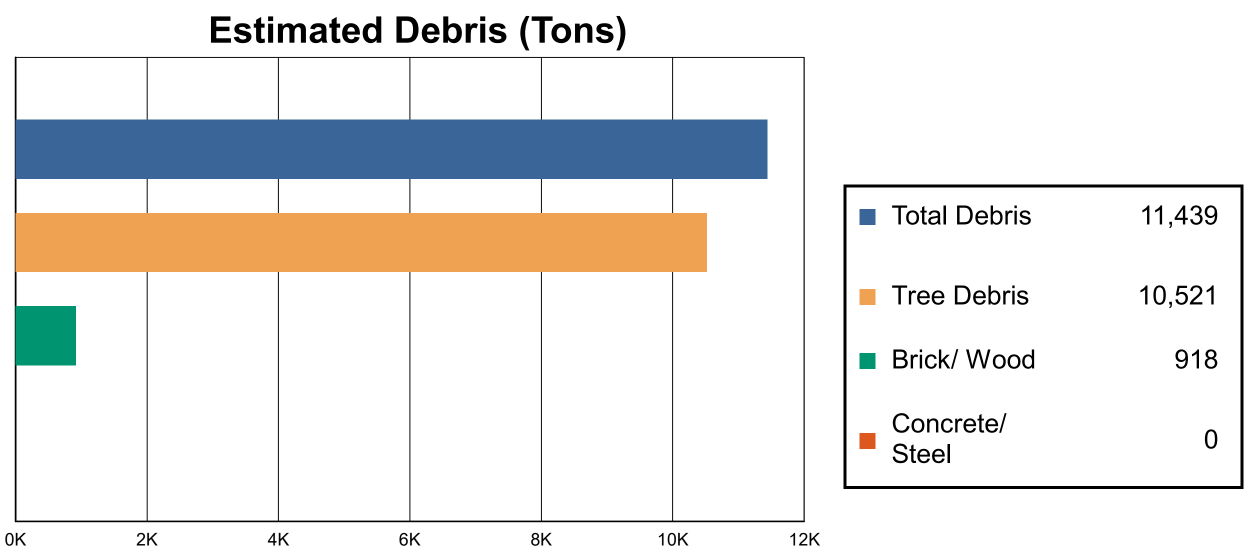
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

Classification	Total	# Facilities: Probability of at Least Moderate Damage > 50%	# Facilities: Probability of Complete Damage > 50%	# Facilities: Expected Loss of Use < 1 day
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	6	0	0	6

Induced Hurricane Damage

Debris Generation

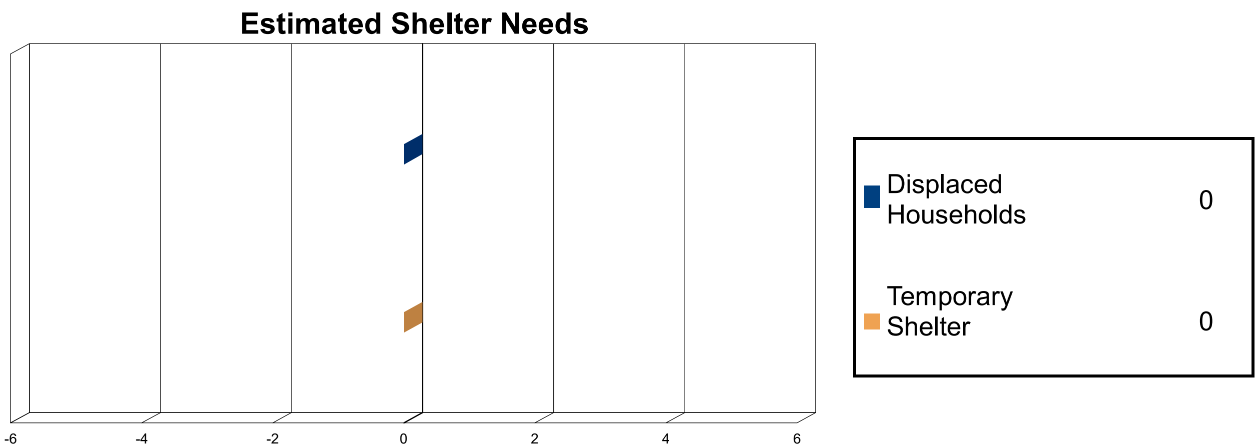


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 11,439 tons of debris will be generated. Of the total amount, 8,565 tons (75%) is Other Tree Debris. Of the remaining 2,874 tons, Brick/Wood comprises 32% 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 37 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 1,956 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 9,508) will seek temporary shelter in public shelters.

Economic Loss

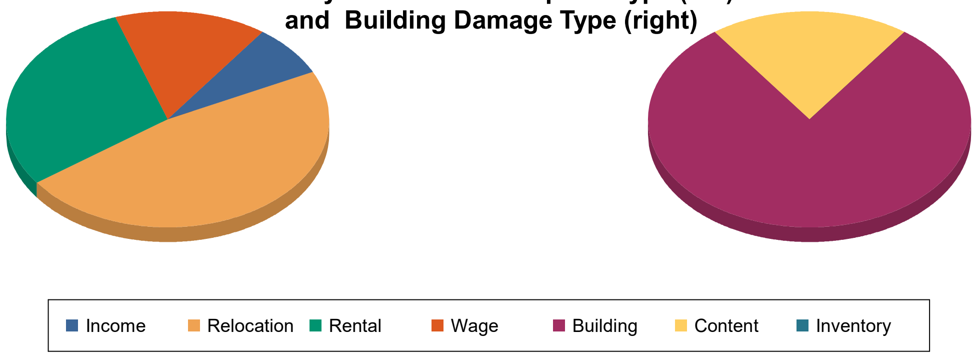
The total economic loss estimated for the hurricane is 14.8 million dollars, which represents 0.94 % of the total replacement value of the region's buildings.

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 15 million dollars. 5% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 92% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

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



Loss Type by General Occupancy

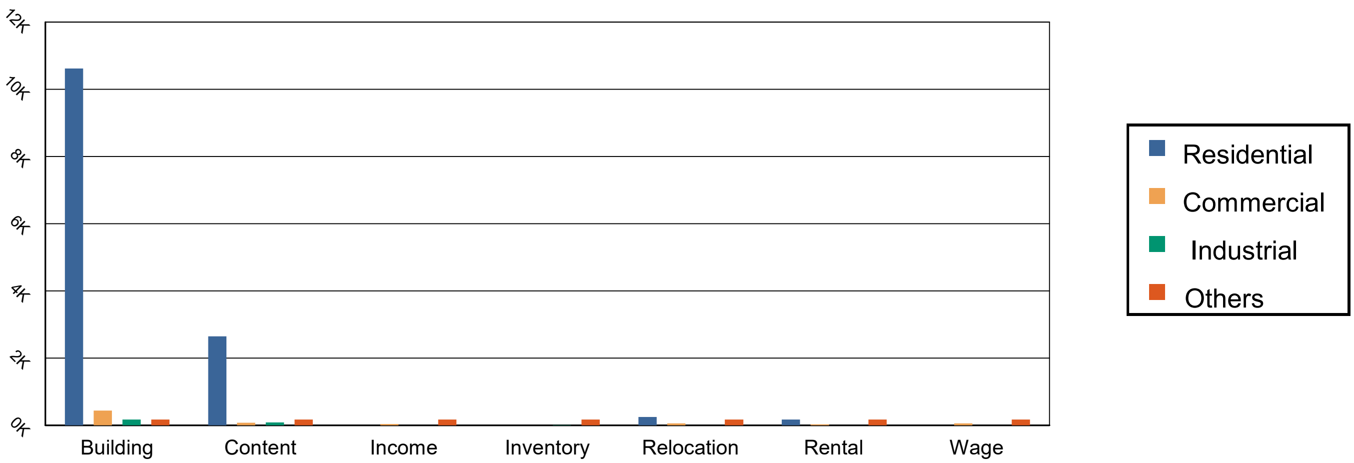


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	10,614.29	435.43	173.42	92.52	11,315.67
	Content	2,648.39	75.24	88.23	17.98	2,829.84
	Inventory	0.00	1.78	14.97	0.89	17.64
	Subtotal	**13,262.68**	**512.45**	**276.63**	**111.39**	**14,163.16**
Business Interruption Loss						
	Income	0.00	42.44	1.49	8.46	52.39
	Relocation	247.51	58.62	5.36	11.14	322.63
	Rental	171.90	28.09	1.18	0.86	202.04
	Wage	0.00	56.22	2.45	44.57	103.24
	Subtotal	**419.41**	**185.37**	**10.49**	**65.03**	**680.30**

Total

Total	13,682.09	697.82	287.12	176.42	14,843.45

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	9,508	1,262,021	310,581	1,572,602
Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**
Study Region Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**

Hazus: Hurricane Global Risk Report

Region Name: Portland

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Tuesday, October 1, 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):

- Connecticut

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

The geographical size of the region is 24.85 square miles and contains 2 census tracts. There are over 3 thousand households in the region and a total population of 9,508 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,573 million dollars (2014 dollars). Approximately 91% of the buildings (and 80% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,970 buildings in the region which have an aggregate total replacement value of 1,573 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

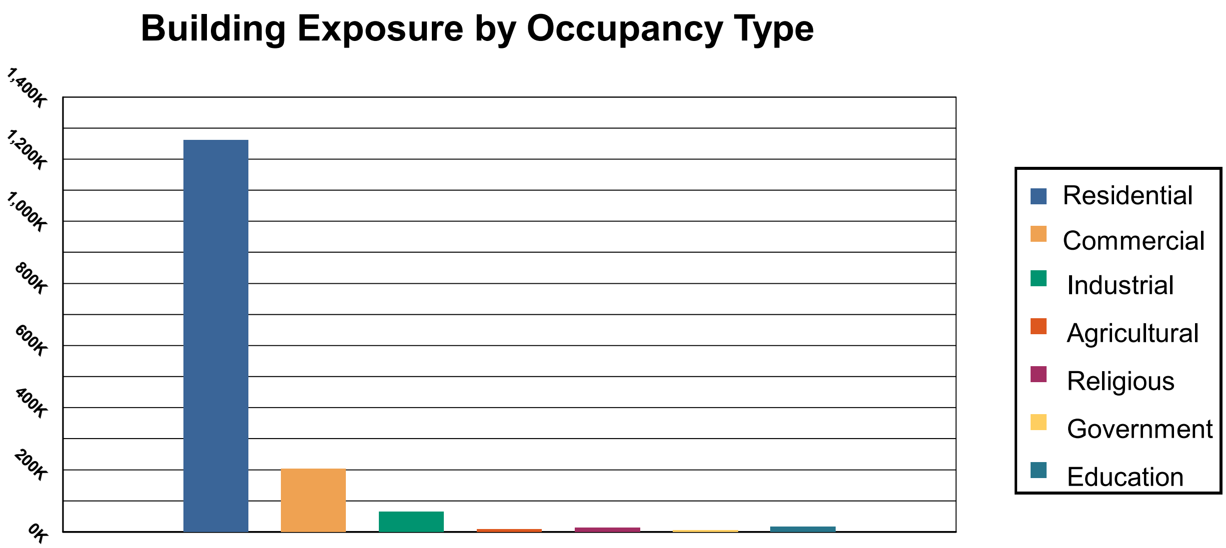


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,262,021	80.25 %
Commercial	202,878	12.90%
Industrial	64,635	4.11%
Agricultural	7,848	0.50%
Religious	13,571	0.86%
Government	4,780	0.30%
Education	16,869	1.07%
Total	**1,572,602**	**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 6 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities.

Hurricane Scenario

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

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 141 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.

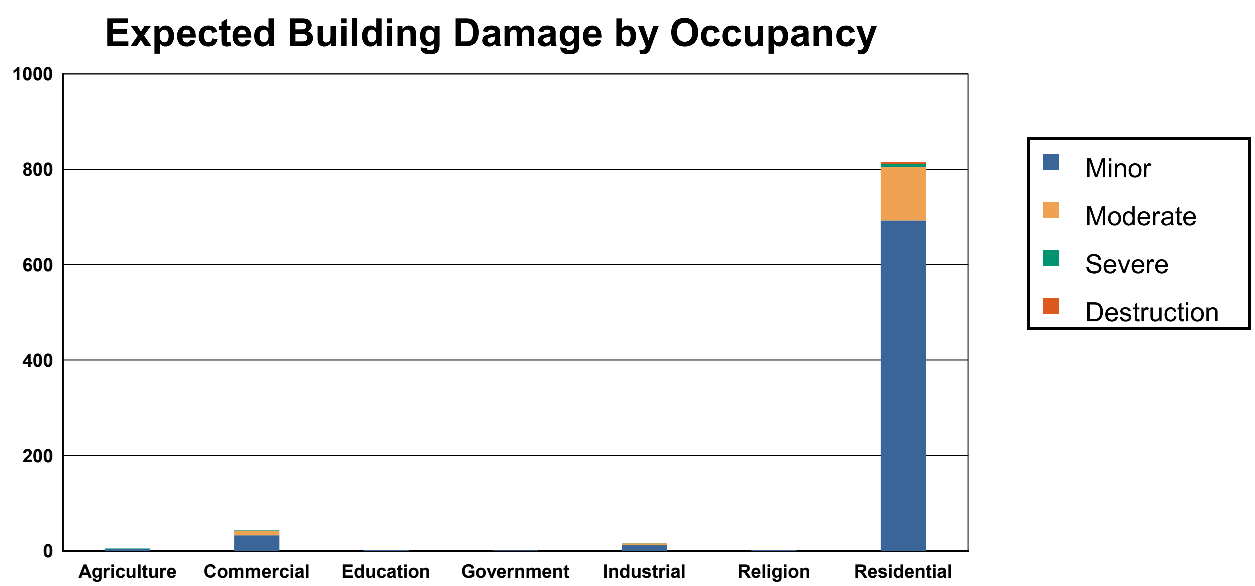


Table 2: Expected Building Damage by Occupancy : 500 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	16.89	76.76	3.56	16.19	1.01	4.58	0.49	2.21	0.06	0.25
Commercial	181.92	80.50	32.57	14.41	10.05	4.45	1.46	0.65	0.01	0.00
Education	7.92	79.22	1.57	15.67	0.47	4.73	0.04	0.38	0.00	0.00
Government	3.94	78.80	0.78	15.64	0.26	5.13	0.02	0.43	0.00	0.00
Industrial	69.36	80.65	11.88	13.82	3.84	4.46	0.85	0.99	0.07	0.08
Religion	9.79	81.57	1.82	15.19	0.36	3.03	0.03	0.22	0.00	0.00
Residential	2,793.86	77.41	692.91	19.20	111.83	3.10	6.31	0.17	4.10	0.11
Total	**3,083.67**		**745.09**		**127.81**		**9.19**		**4.23**	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	18	76.55	4	16.66	1	6.42	0	0.37	0	0.00
Masonry	179	76.56	38	16.43	15	6.27	2	0.66	0	0.08
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	124	81.16	20	13.21	7	4.80	1	0.82	0	0.01
Wood	2,674	77.86	661	19.25	90	2.62	5	0.16	4	0.11

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

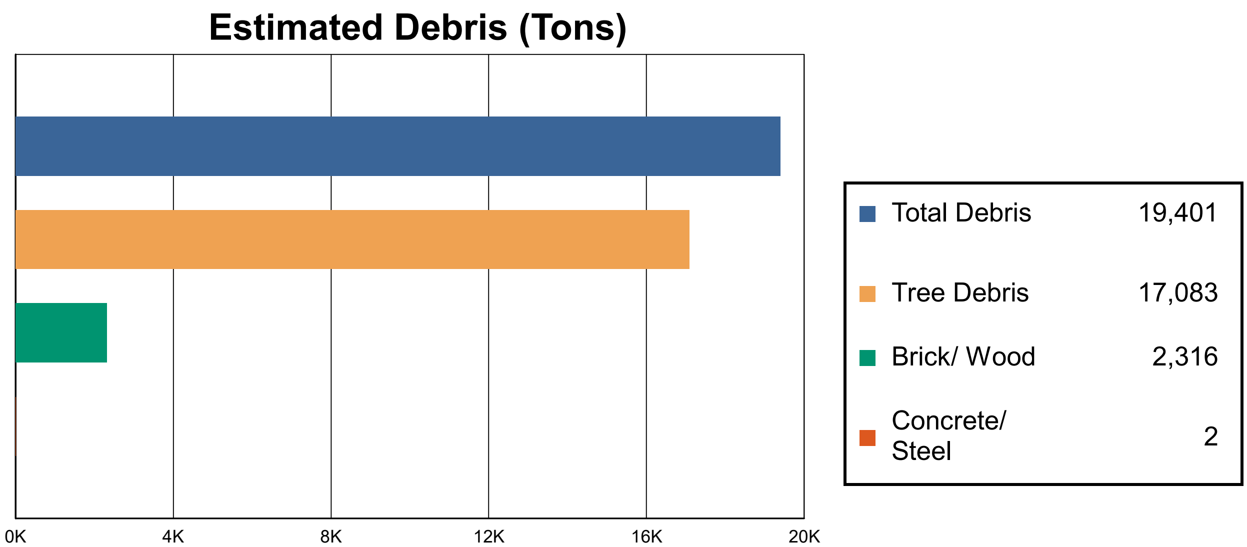
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

Classification	Total	# Facilities: Probability of at Least Moderate Damage > 50%	# Facilities: Probability of Complete Damage > 50%	# Facilities: Expected Loss of Use < 1 day
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	6	0	0	3

Induced Hurricane Damage

Debris Generation

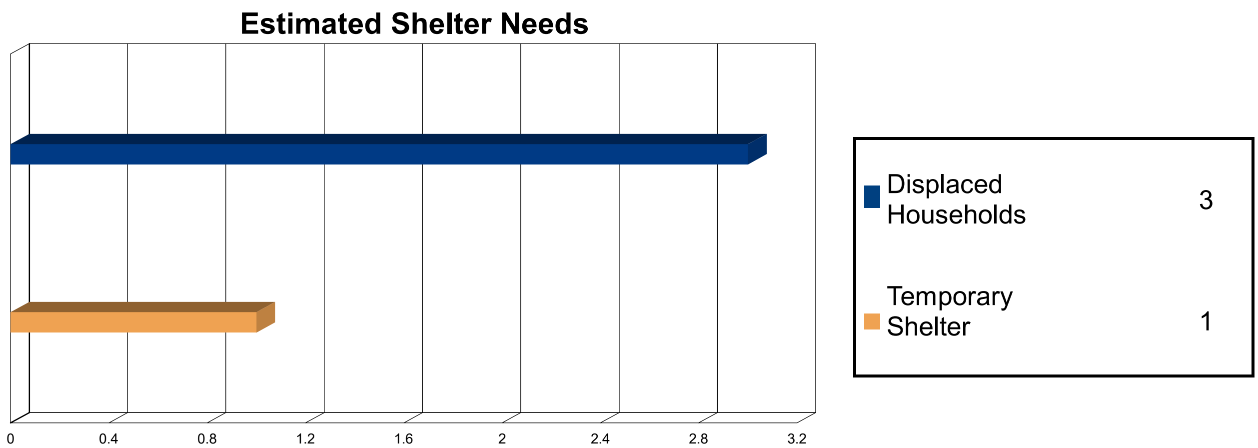


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 19,401 tons of debris will be generated. Of the total amount, 13,869 tons (71%) is Other Tree Debris. Of the remaining 5,532 tons, Brick/Wood comprises 42% 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 93 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 3,214 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 3 households to be displaced due to the hurricane. Of these, 1 people (out of a total population of 9,508) will seek temporary shelter in public shelters.

Economic Loss

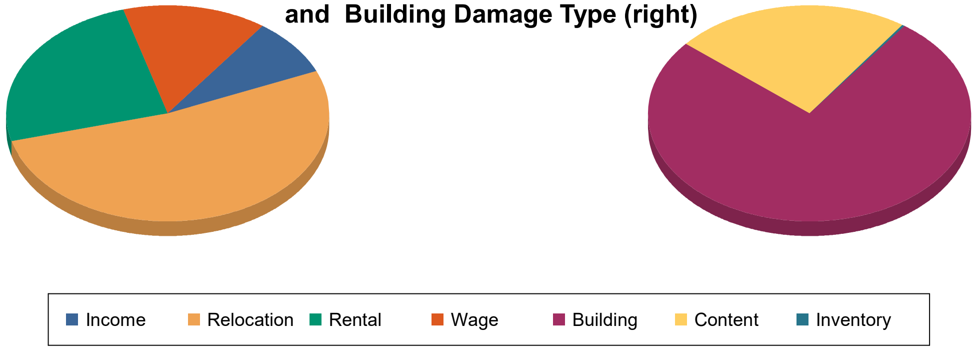
The total economic loss estimated for the hurricane is 36.7 million dollars, which represents 2.34 % of the total replacement value of the region’s buildings.

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 37 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 87% 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

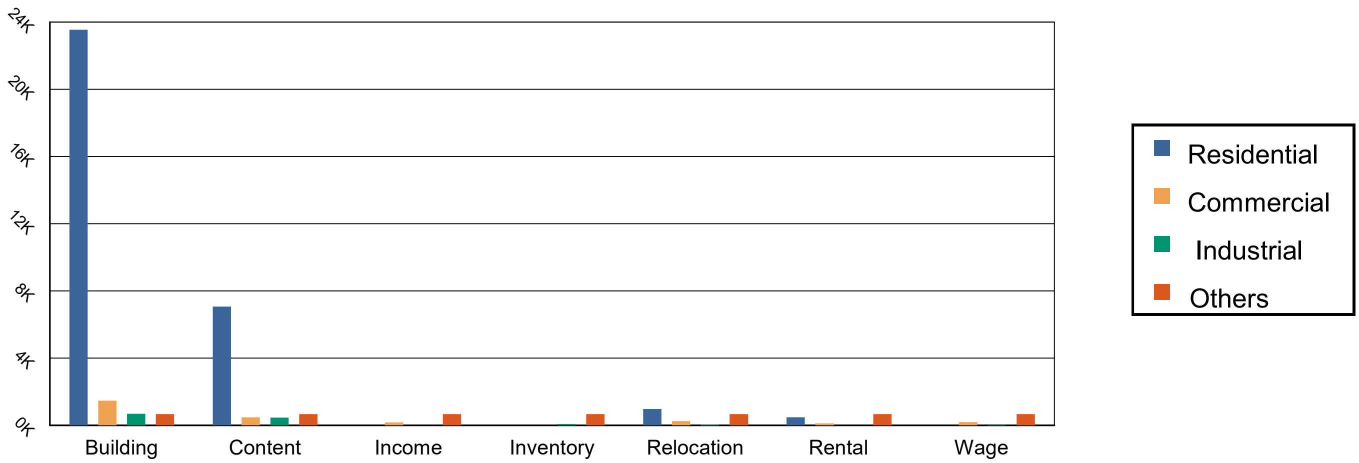


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	23,540.42	1,468.80	680.02	330.67	26,019.91
	Content	7,061.05	473.72	453.43	104.38	8,092.59
	Inventory	0.00	10.70	74.30	4.26	89.26
	Subtotal	**30,601.47**	**1,953.22**	**1,207.75**	**439.31**	**34,201.75**
Business Interruption Loss						
	Income	0.00	181.98	8.44	25.46	215.88
	Relocation	977.34	252.76	33.67	54.57	1,318.34
	Rental	486.85	125.83	6.86	4.07	623.62
	Wage	0.00	196.85	13.95	154.51	365.31
	Subtotal	**1,464.19**	**757.42**	**62.93**	**238.61**	**2,523.16**

Total

Total	**32,065.66**	**2,710.64**	**1,270.67**	**677.92**	**36,724.90**

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	9,508	1,262,021	310,581	1,572,602
Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**
Study Region Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**

Hazus: Hurricane Global Risk Report

Region Name: Portland

Hurricane Scenario: Probabilistic 1000-year Return Period

Print Date: Tuesday, October 1, 2019

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Connecticut

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

The geographical size of the region is 24.85 square miles and contains 2 census tracts. There are over 3 thousand households in the region and a total population of 9,508 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,573 million dollars (2014 dollars). Approximately 91% of the buildings (and 80% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 3,970 buildings in the region which have an aggregate total replacement value of 1,573 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

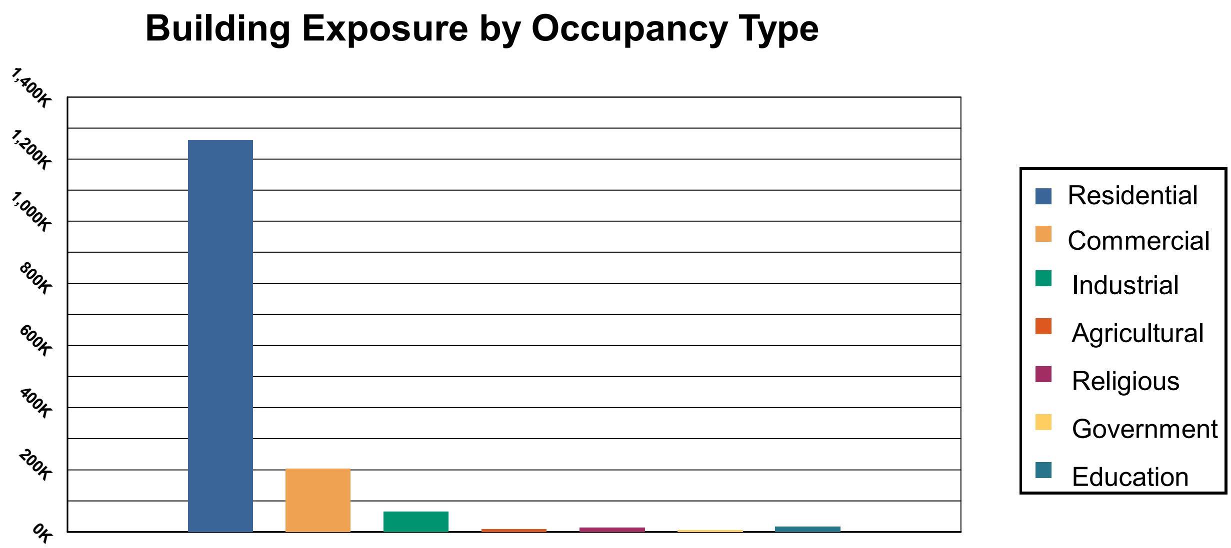


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,262,021	80.25 %
Commercial	202,878	12.90%
Industrial	64,635	4.11%
Agricultural	7,848	0.50%
Religious	13,571	0.86%
Government	4,780	0.30%
Education	16,869	1.07%
Total	**1,572,602**	**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 6 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities.

Hurricane Scenario

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

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 286 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.

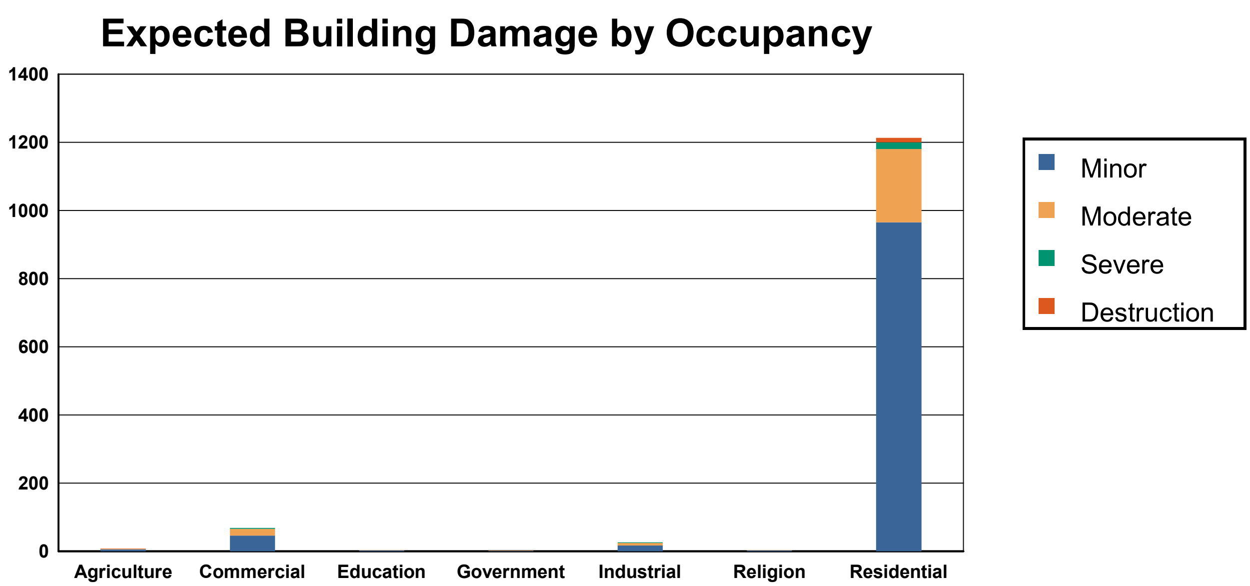


Table 2: Expected Building Damage by Occupancy : 1000 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	14.31	65.03	4.94	22.47	1.76	8.01	0.86	3.91	0.13	0.58
Commercial	157.36	69.63	45.47	20.12	19.70	8.71	3.45	1.53	0.03	0.01
Education	6.78	67.84	2.11	21.14	0.97	9.69	0.13	1.34	0.00	0.00
Government	3.45	69.06	1.01	20.28	0.47	9.47	0.06	1.19	0.00	0.00
Industrial	60.09	69.88	16.43	19.10	7.55	8.78	1.78	2.07	0.15	0.17
Religion	8.48	70.68	2.63	21.88	0.81	6.73	0.09	0.71	0.00	0.00
Residential	2,396.11	66.39	965.00	26.74	214.95	5.96	19.91	0.55	13.03	0.36
Total	**2,646.60**		**1,037.59**		**246.21**		**26.28**		**13.33**	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	15	66.09	5	21.04	3	11.79	0	1.08	0	0.00
Masonry	155	66.10	51	21.81	25	10.52	3	1.36	0	0.21
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	108	70.35	28	18.23	14	9.47	3	1.95	0	0.02
Wood	2,295	66.80	929	27.03	181	5.28	18	0.52	13	0.37

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

Thematic Map of Essential Facilities with greater than 50% moderate

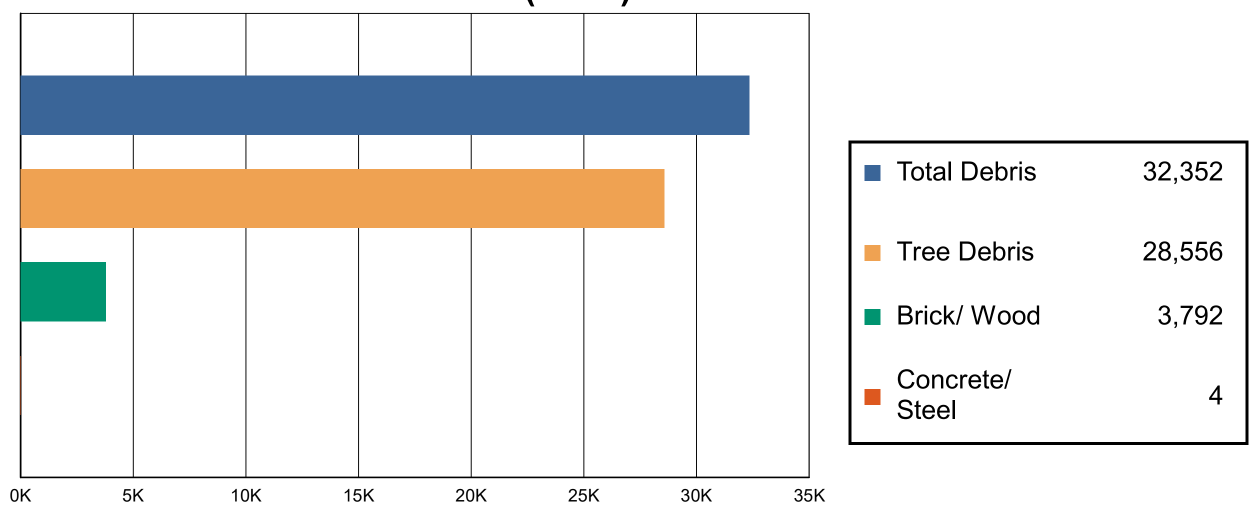
Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
EOCs	1	0	0	1
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	6	0	0	0

Induced Hurricane Damage

Debris Generation

Estimated Debris (Tons)

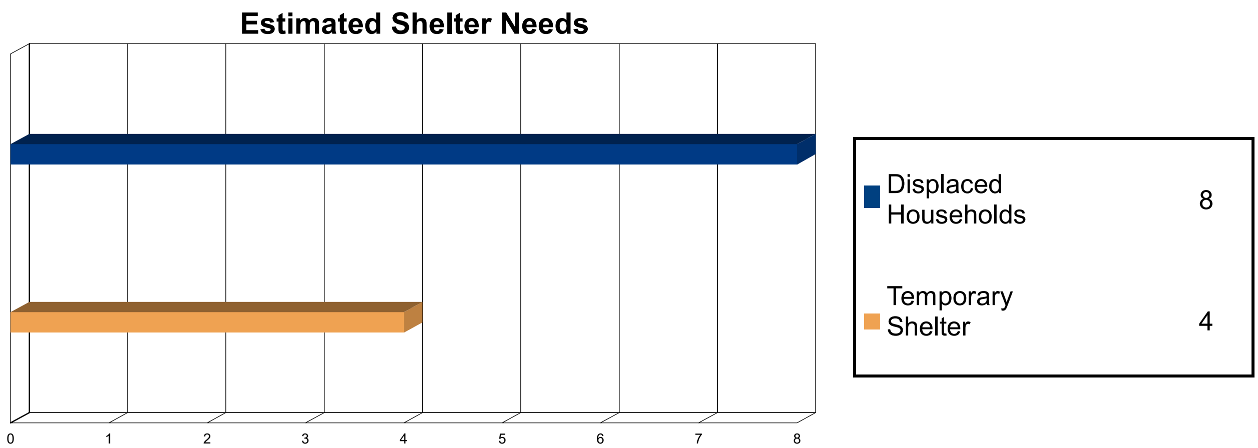


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 32,352 tons of debris will be generated. Of the total amount, 23,542 tons (73%) is Other Tree Debris. Of the remaining 8,810 tons, Brick/Wood comprises 43% 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 152 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 5,014 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 8 households to be displaced due to the hurricane. Of these, 4 people (out of a total population of 9,508) will seek temporary shelter in public shelters.

Economic Loss

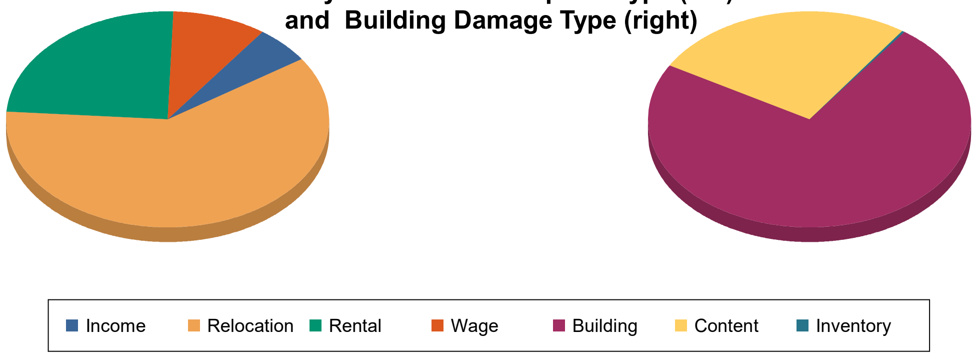
The total economic loss estimated for the hurricane is 65.1 million dollars, which represents 4.14 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 65 million dollars. 8% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 87% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

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



Loss Type by General Occupancy

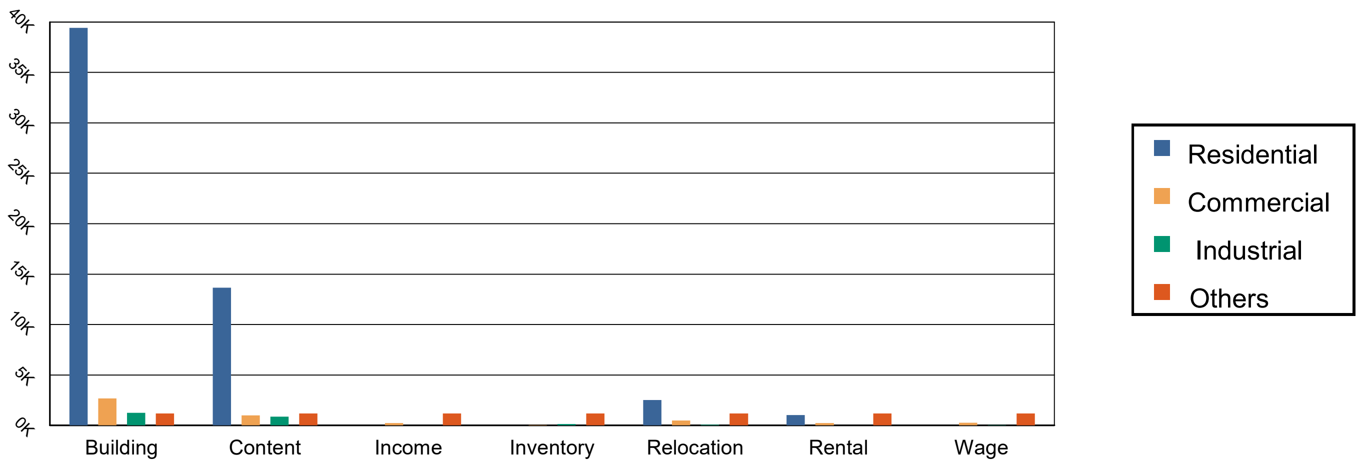


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	39,420.31	2,685.59	1,238.63	608.80	43,953.32
	Content	13,641.88	1,000.40	870.59	223.60	15,736.46
	Inventory	0.00	21.91	140.71	8.41	171.03
	Subtotal	**53,062.18**	**3,707.90**	**2,249.92**	**840.81**	**59,860.81**
Business Interruption Loss						
	Income	0.02	236.85	15.16	33.69	285.72
	Relocation	2,510.24	471.86	65.39	104.77	3,152.27
	Rental	1,023.78	234.70	12.45	7.47	1,278.39
	Wage	0.04	261.68	25.10	205.63	492.45
	Subtotal	**3,534.08**	**1,205.08**	**118.11**	**351.56**	**5,208.83**

Total

Total	**56,596.26**	**4,912.98**	**2,368.03**	**1,192.37**	**65,069.64**

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	9,508	1,262,021	310,581	1,572,602
Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**
Study Region Total	**9,508**	**1,262,021**	**310,581**	**1,572,602**

Hazus: Earthquake Global Risk Report

Region Name: Portland

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 24.85 square miles and contains 2 census tracts. There are over 3 thousand households in the region which has a total population of 9,508 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,572 (millions of dollars). Approximately 91.00 % of the buildings (and 80.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 561 and 90 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 3 thousand buildings in the region which have an aggregate total replacement value of 1,572 (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 87% 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 6 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 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 651.00 (millions of dollars). This inventory includes over 54.06 miles of highways, 3 bridges, 431.23 miles of pipes.

Table 1: Transportation System Lifeline Inventory

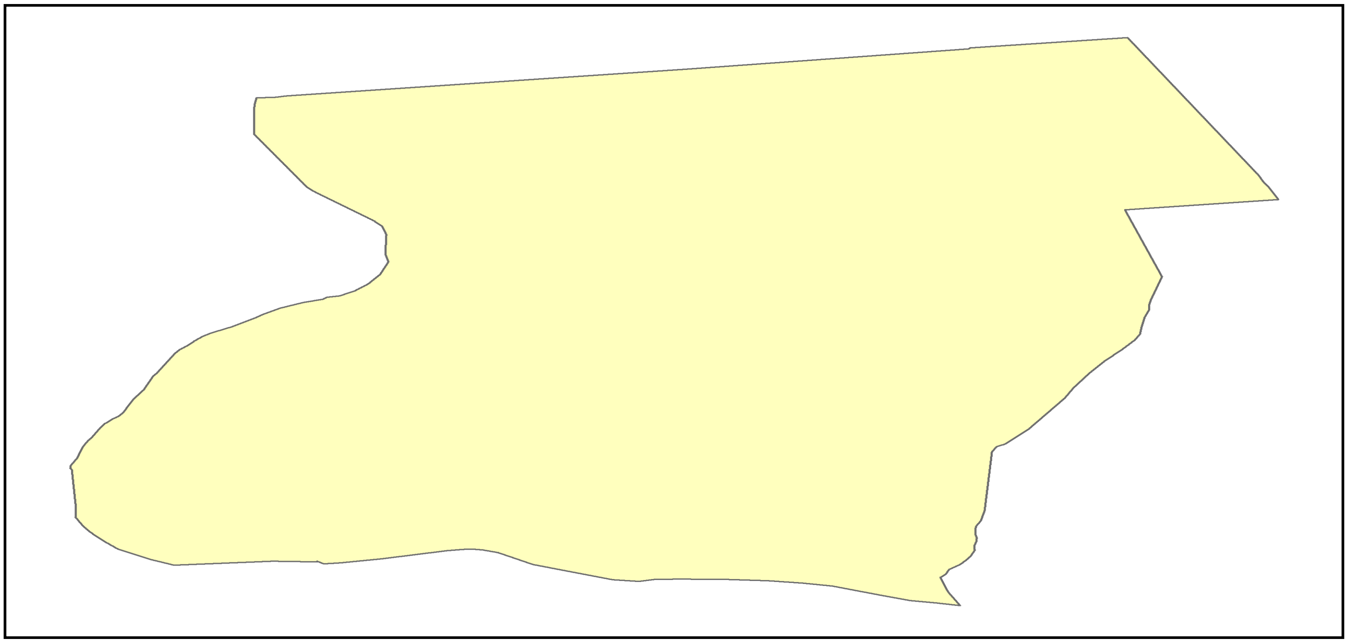
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	3	6.7951
	Segments	48	528.4404
	Tunnels	0	0.0000
		Subtotal	**535.2355**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	5	16.4387
	Tunnels	0	0.0000
		Subtotal	**16.4387**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	5	9.9850
		Subtotal	**9.9850**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**561.70**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.9488
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.9488**
Waste Water	Distribution Lines	NA	4.1693
	Facilities	1	76.5900
	Pipelines	0	0.0000
		Subtotal	**80.7593**
Natural Gas	Distribution Lines	NA	2.7795
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**2.7795**
Oil Systems	Facilities	1	0.1150
	Pipelines	0	0.0000
		Subtotal	**0.1150**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**90.60**

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 6 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

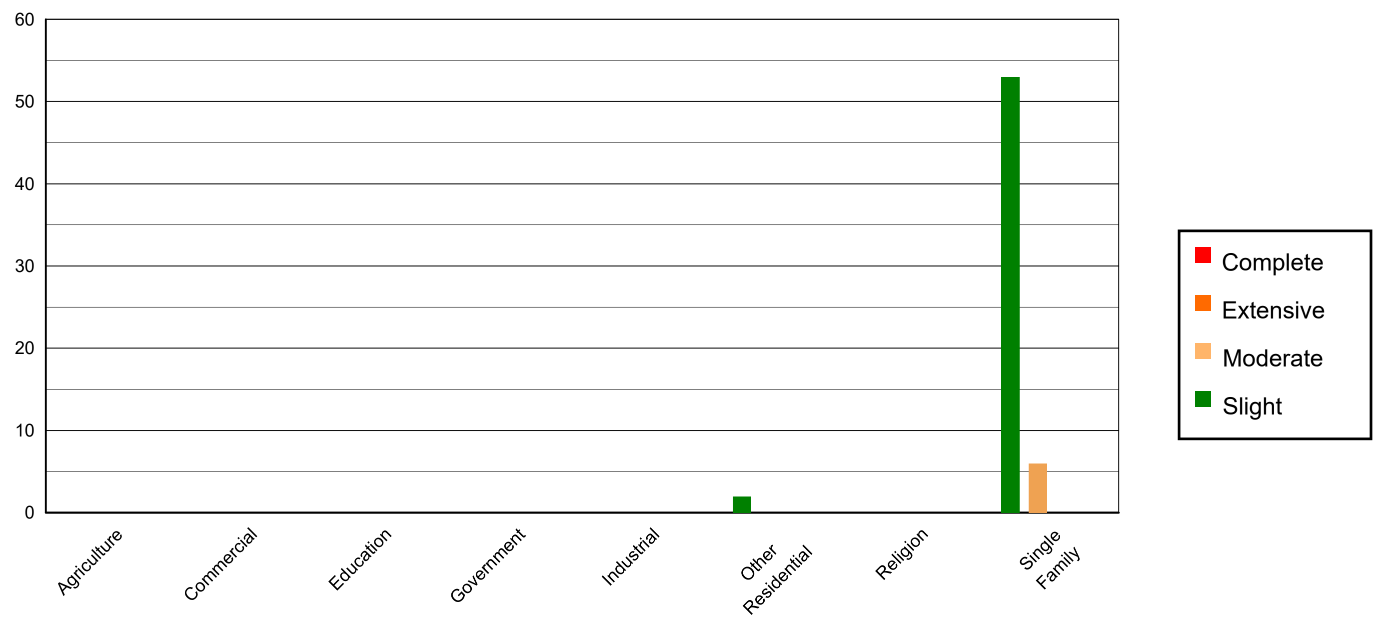


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	11.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	107.00	2.93	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	32.00	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Residential	176.00	4.82	2.00	3.64	0.00	0.00	0.00	0.00	0.00	0.00
Religion	5.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Single Family	3320.00	90.93	53.00	96.36	6.00	100.00	0.00	0.00	0.00	0.00
Total	**3,651**		**55**		**6**		**0**		**0**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	3367.00	92.22	47.00	85.45	3.00	50.00	0.00	0.00	0.00	0.00
Steel	75.00	2.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Concrete	5.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Precast	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RM	12.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
URM	192.00	5.26	8.00	14.55	3.00	50.00	0.00	0.00	0.00	0.00
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**3,651**		**55**		**6**		**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	6	0	0	6
EOCs	1	0	0	1
PoliceStations	1	0	0	1
FireStations	3	0	0	3

Transportation Lifeline Damage

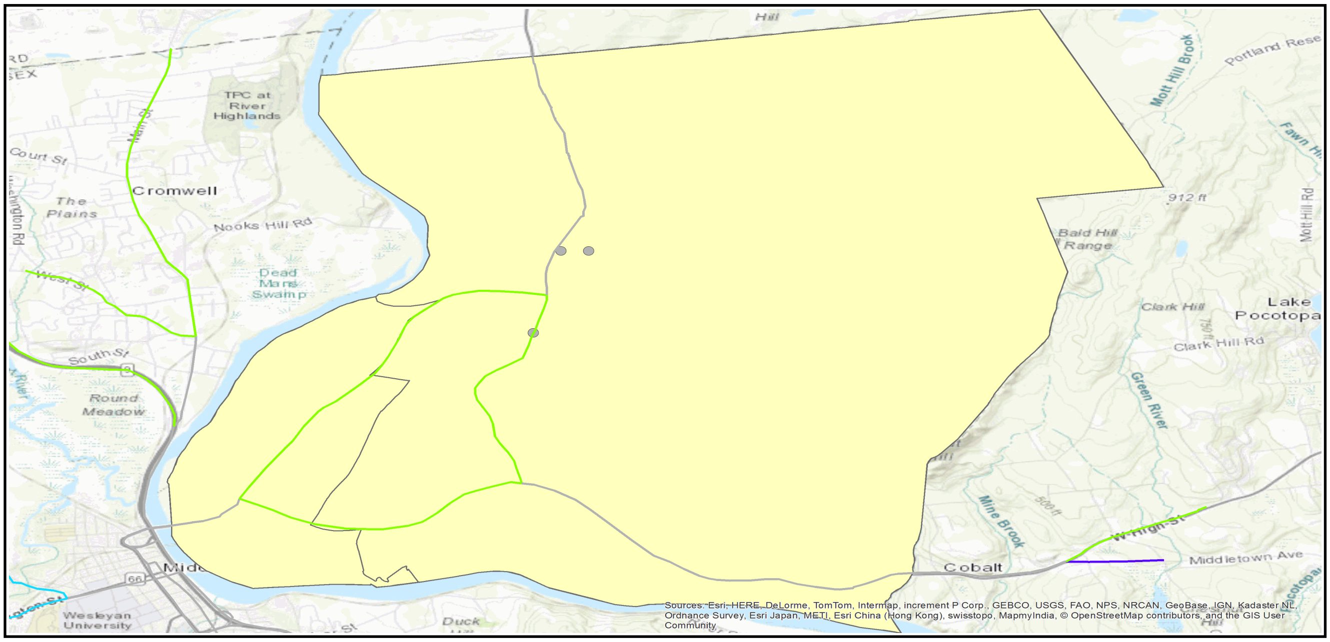


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	With Functionality > 50 % After Day 7
Highway	Segments	48	0	0	48	48
	Bridges	3	0	0	3	3
	Tunnels	0	0	0	0	0
Railways	Segments	5	0	0	2	2
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	5	0	0	5	5
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	1	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	216	0	0
Waste Water	130	0	0
Natural Gas	86	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 72.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)

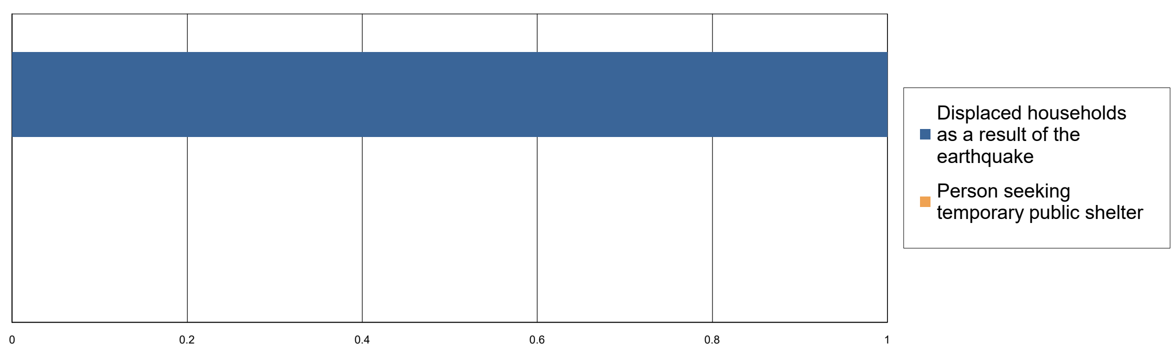
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.00	0.00	0.00	0 (@25 tons/truck)

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 1 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 9,508) 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
1	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

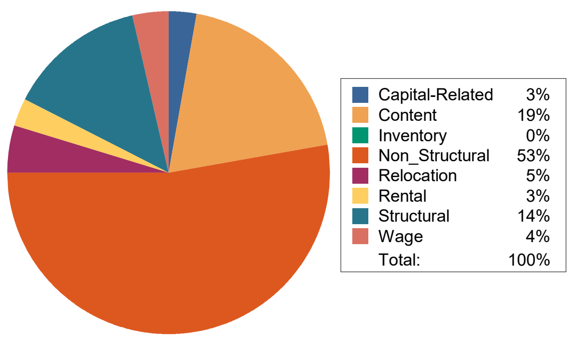
The total economic loss estimated for the earthquake is 0.12 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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); 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 60 % 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)

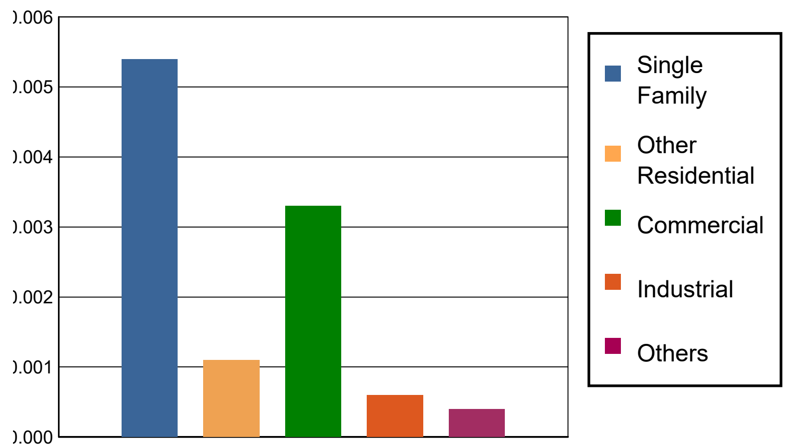


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.0000	0.0004	0.0000	0.0000	0.0004
	Capital-Related	0.0000	0.0000	0.0003	0.0000	0.0000	0.0003
	Rental	0.0000	0.0001	0.0002	0.0000	0.0000	0.0003
	Relocation	0.0002	0.0000	0.0003	0.0000	0.0000	0.0005
	Subtotal	**0.0002**	**0.0001**	**0.0012**	**0.0000**	**0.0000**	**0.0015**
Capital Stock Losses							
	Structural	0.0007	0.0002	0.0004	0.0001	0.0001	0.0015
	Non_Structural	0.0034	0.0007	0.0011	0.0003	0.0002	0.0057
	Content	0.0011	0.0001	0.0006	0.0002	0.0001	0.0021
	Inventory	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Subtotal	**0.0052**	**0.0010**	**0.0021**	**0.0006**	**0.0004**	**0.0093**
	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	528.4404	0.0000	0.00
	Bridges	6.7951	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**535.2355**	**0.0000**	
Railways	Segments	16.4387	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**16.4387**	**0.0000**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	9.9850	0.1043	1.04
	Subtotal	**9.9850**	**0.1043**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**561.66**	**0.10**	

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	6.9488	0.0000	0.00
	Subtotal	**6.9488**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	76.5900	0.0000	0.00
	Distribution Lines	4.1693	0.0000	0.00
	Subtotal	**80.7593**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	2.7795	0.0000	0.00
	Subtotal	**2.7795**	**0.0000**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.1150	0.0000	0.00
	Subtotal	**0.1150**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**90.60**	**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	9,508	1,262	310	1,572
Total Region		**9,508**	**1,262**	**310**	**1,572**

Hazus: Earthquake Global Risk Report

Region Name: Portland

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 24.85 square miles and contains 2 census tracts. There are over 3 thousand households in the region which has a total population of 9,508 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,572 (millions of dollars). Approximately 91.00 % of the buildings (and 80.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 561 and 90 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 3 thousand buildings in the region which have an aggregate total replacement value of 1,572 (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 87% 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 6 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 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 651.00 (millions of dollars). This inventory includes over 54.06 miles of highways, 3 bridges, 431.23 miles of pipes.

Table 1: Transportation System Lifeline Inventory

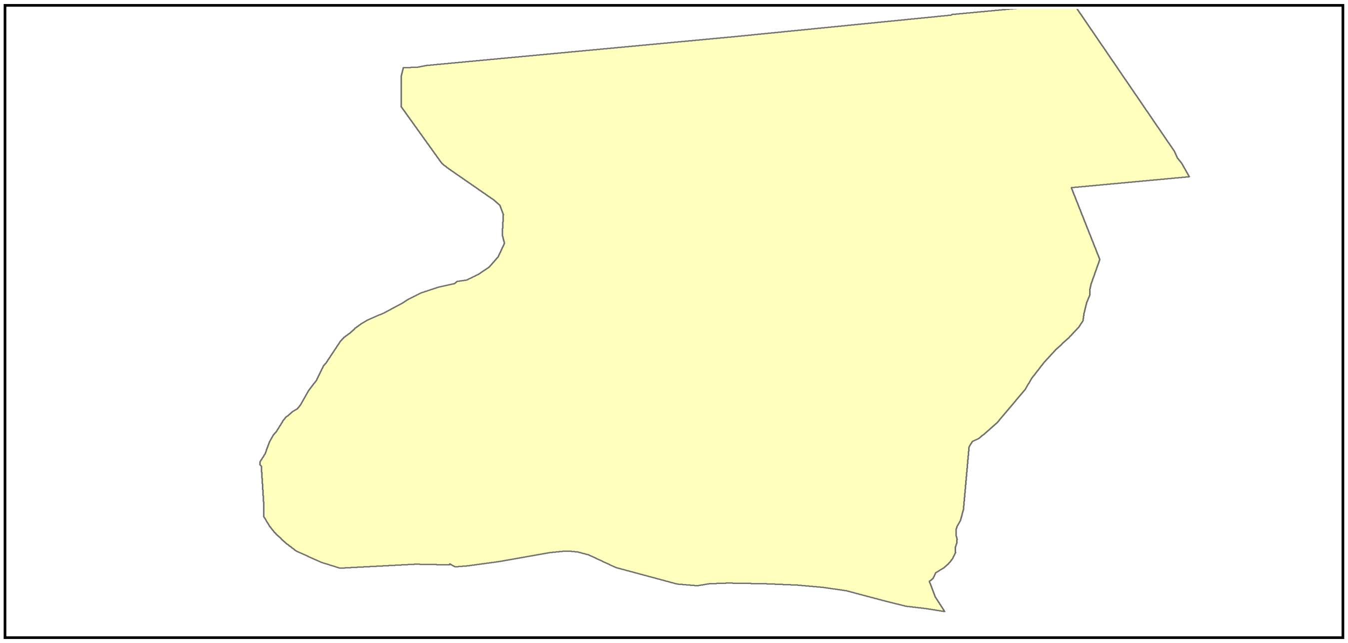
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	3	6.7951
	Segments	48	528.4404
	Tunnels	0	0.0000
		Subtotal	**535.2355**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	5	16.4387
	Tunnels	0	0.0000
		Subtotal	**16.4387**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	5	9.9850
		Subtotal	**9.9850**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**561.70**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.9488
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.9488**
Waste Water	Distribution Lines	NA	4.1693
	Facilities	1	76.5900
	Pipelines	0	0.0000
		Subtotal	**80.7593**
Natural Gas	Distribution Lines	NA	2.7795
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**2.7795**
Oil Systems	Facilities	1	0.1150
	Pipelines	0	0.0000
		Subtotal	**0.1150**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**90.60**

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 1,283 buildings will be at least moderately damaged. This is over 32.00 % of the buildings in the region. There are an estimated 199 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

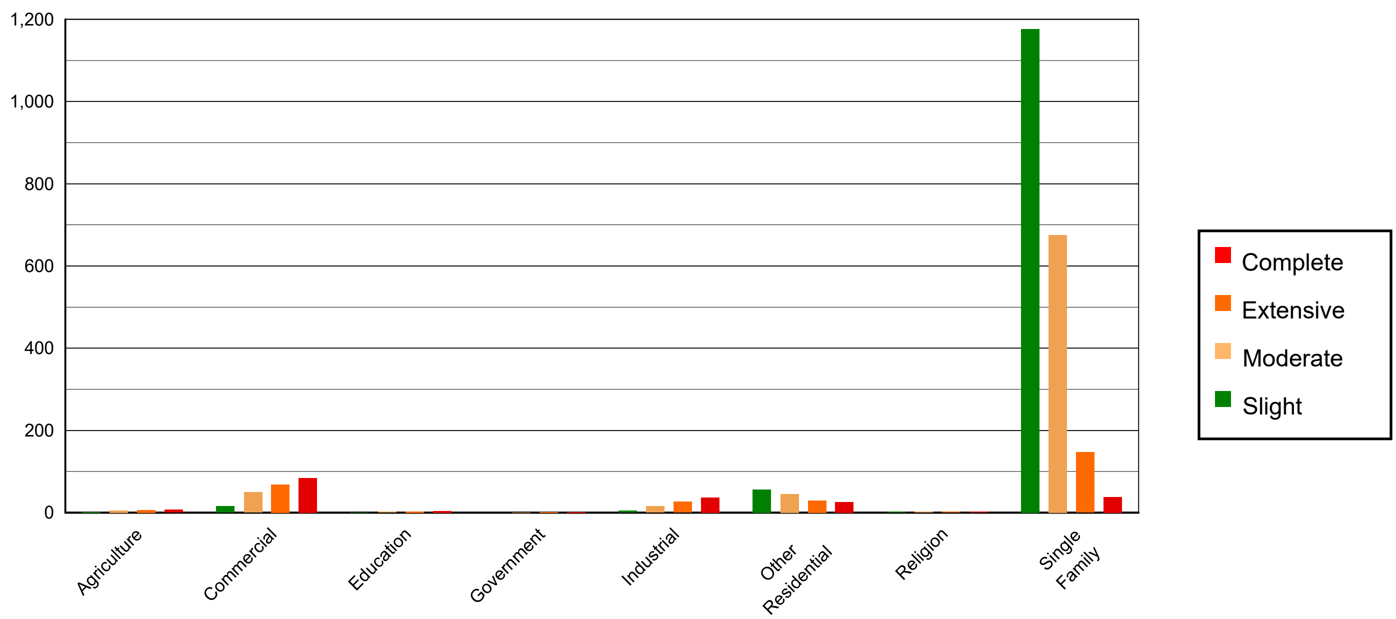


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0.64	0.04	1.66	0.13	5.91	0.74	6.57	2.30	7.22	3.61
Commercial	7.89	0.55	15.55	1.24	49.66	6.23	68.81	24.06	84.10	42.07
Education	0.37	0.03	0.69	0.05	2.15	0.27	3.14	1.10	3.66	1.83
Government	0.17	0.01	0.29	0.02	0.97	0.12	1.59	0.56	1.99	1.00
Industrial	2.37	0.17	4.42	0.35	15.69	1.97	26.86	9.39	36.66	18.34
Other Residential	65.02	4.55	55.95	4.45	45.35	5.69	29.83	10.43	25.85	12.93
Religion	2.26	0.16	2.28	0.18	2.57	0.32	2.37	0.83	2.52	1.26
Single Family	1350.53	94.49	1176.48	93.57	675.29	84.67	146.78	51.33	37.93	18.97
Total	**1,429**		**1,257**		**798**		**286**		**200**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1399.02	97.89	1208.98	96.16	685.73	85.98	136.85	47.86	21.65	10.83
Steel	2.18	0.15	4.12	0.33	23.51	2.95	56.91	19.90	87.47	43.75
Concrete	0.41	0.03	0.79	0.06	4.62	0.58	10.77	3.77	15.76	7.89
Precast	0.17	0.01	0.26	0.02	1.54	0.19	3.38	1.18	6.46	3.23
RM	1.65	0.12	1.88	0.15	8.93	1.12	16.20	5.66	18.08	9.04
URM	25.82	1.81	41.27	3.28	73.26	9.19	61.83	21.62	50.49	25.25
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**1,429**		**1,257**		**798**		**286**		**200**	

*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	6	6	0	0
EOCs	1	1	0	0
PoliceStations	1	1	0	0
FireStations	3	3	0	0

Transportation Lifeline Damage

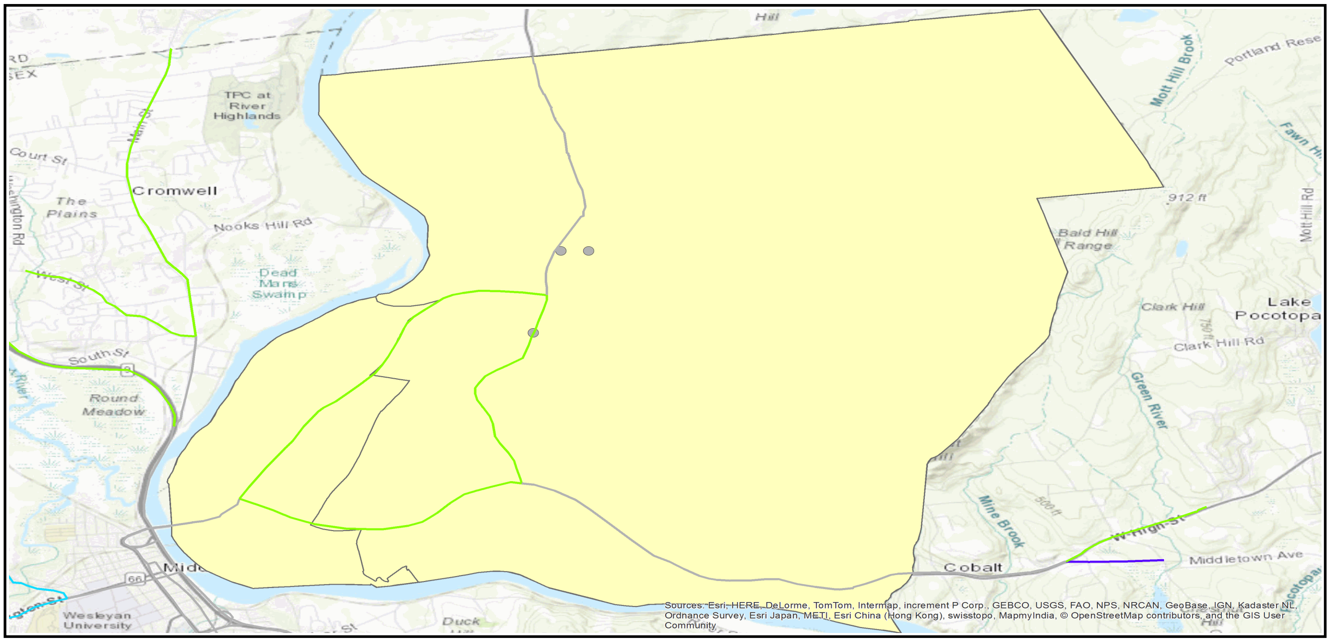


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	48	0	0	48	48
	Bridges	3	0	0	3	3
	Tunnels	0	0	0	0	0
Railways	Segments	5	0	0	2	2
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	5	1	0	5	5
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	1	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	216	0	0
Waste Water	130	0	0
Natural Gas	86	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

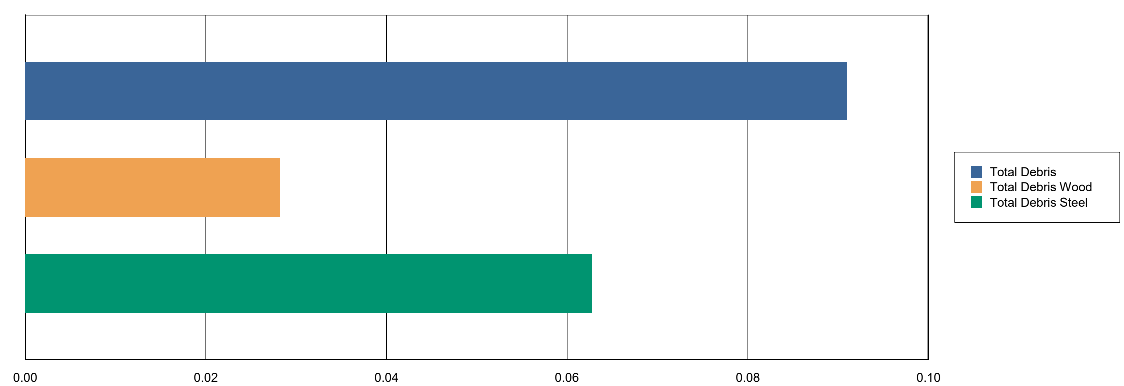
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there 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 91,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 31.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 3,640 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



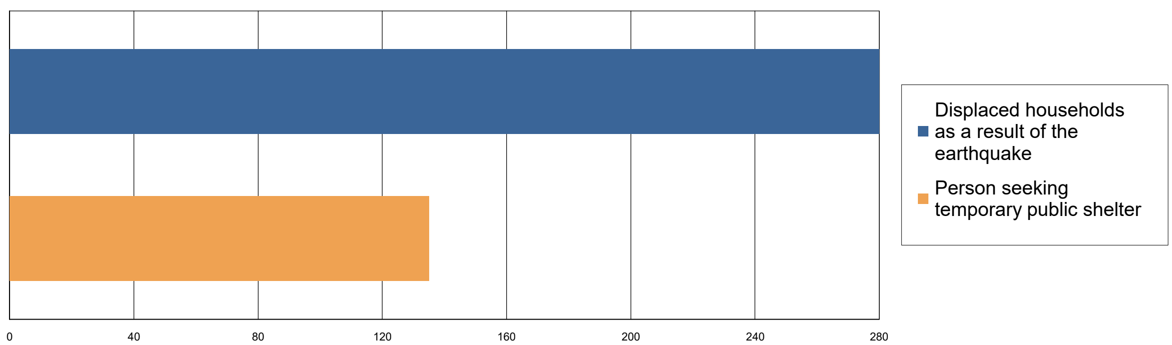
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.03	0.06	0.09	3,640 (@25 tons/truck)

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 280 households to be displaced due to the earthquake. Of these, 135 people (out of a total population of 9,508) 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
280	135

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

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

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	2.76	0.82	0.13	0.25
	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	4.06	1.25	0.20	0.39
	Other-Residential	21.98	6.72	1.13	2.24
	Single Family	20.92	4.45	0.55	1.07
	Total	**50**	**13**	**2**	**4**
2 PM	Commercial	154.26	45.97	7.12	13.92
	Commuting	0.01	0.03	0.02	0.01
	Educational	54.77	16.86	2.79	5.43
	Hotels	0.00	0.00	0.00	0.00
	Industrial	30.07	9.22	1.48	2.89
	Other-Residential	4.05	1.24	0.21	0.40
	Single Family	3.70	0.81	0.11	0.20
	Total	**247**	**74**	**12**	**23**
5 PM	Commercial	110.29	32.84	5.13	9.87
	Commuting	0.11	0.54	0.43	0.11
	Educational	4.32	1.33	0.22	0.43
	Hotels	0.00	0.00	0.00	0.00
	Industrial	18.80	5.77	0.93	1.81
	Other-Residential	8.67	2.64	0.45	0.86
	Single Family	8.31	1.83	0.24	0.44
	Total	**150**	**45**	**7**	**14**

Economic Loss

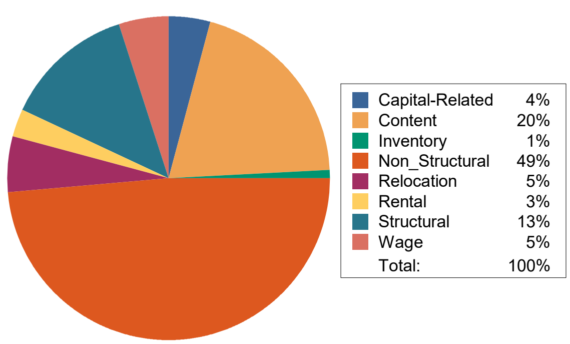
The total economic loss estimated for the earthquake is 416.56 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 412.68 (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 39 % 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)

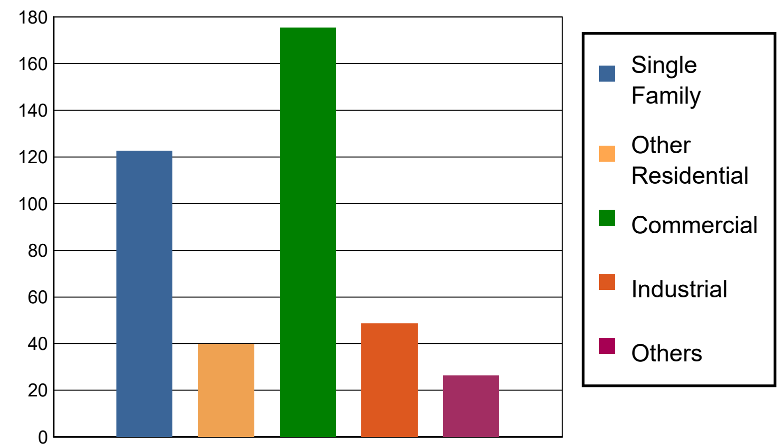


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.9004	18.3947	0.9866	0.7759	21.0576
	Capital-Related	0.0000	0.3840	16.5388	0.5846	0.1837	17.6911
	Rental	1.9398	2.9312	6.5476	0.2652	0.2342	11.9180
	Relocation	6.9326	1.3632	10.8905	1.0750	2.3171	22.5784
	Subtotal	**8.8724**	**5.5788**	**52.3716**	**2.9114**	**3.5109**	**73.2451**
Capital Stock Losses							
	Structural	15.9118	5.0657	21.5404	6.1312	4.8965	53.5456
	Non_Structural	72.6510	23.8959	69.3370	22.9227	12.1313	200.9379
	Content	25.2250	5.2960	31.4135	13.9835	5.5884	81.5064
	Inventory	0.0000	0.0000	0.6526	2.6613	0.1331	3.4470
	Subtotal	**113.7878**	**34.2576**	**122.9435**	**45.6987**	**22.7493**	**339.4369**
	Total	**122.66**	**39.84**	**175.32**	**48.61**	**26.26**	**412.68**

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	528.4404	0.0000	0.00
	Bridges	6.7951	0.5040	7.42
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**535.2355**	**0.5040**	
Railways	Segments	16.4387	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**16.4387**	**0.0000**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	9.9850	3.3685	33.74
	Subtotal	**9.9850**	**3.3685**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**561.66**	**3.87**	

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	6.9488	0.0000	0.00
	Subtotal	**6.9488**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	76.5900	0.0000	0.00
	Distribution Lines	4.1693	0.0000	0.00
	Subtotal	**80.7593**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	2.7795	0.0000	0.00
	Subtotal	**2.7795**	**0.0000**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.1150	0.0000	0.00
	Subtotal	**0.1150**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**90.60**	**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	9,508	1,262	310	1,572
Total Region		**9,508**	**1,262**	**310**	**1,572**

Hazus: Earthquake Global Risk Report

Region Name: Portland

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 24.85 square miles and contains 2 census tracts. There are over 3 thousand households in the region which has a total population of 9,508 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,572 (millions of dollars). Approximately 91.00 % of the buildings (and 80.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 561 and 90 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 3 thousand buildings in the region which have an aggregate total replacement value of 1,572 (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 87% 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 6 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 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 651.00 (millions of dollars). This inventory includes over 54.06 miles of highways, 3 bridges, 431.23 miles of pipes.

Table 1: Transportation System Lifeline Inventory

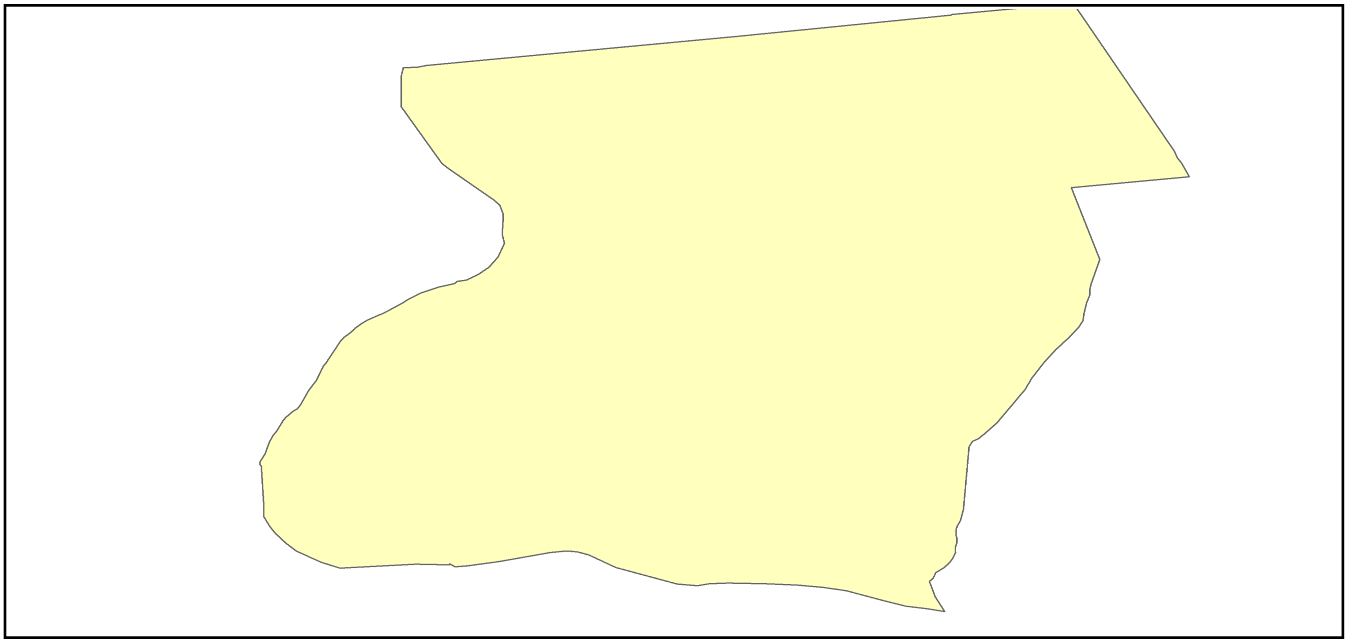
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	3	6.7951
	Segments	48	528.4404
	Tunnels	0	0.0000
		Subtotal	**535.2355**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	5	16.4387
	Tunnels	0	0.0000
		Subtotal	**16.4387**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	5	9.9850
		Subtotal	**9.9850**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**561.70**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.9488
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.9488**
Waste Water	Distribution Lines	NA	4.1693
	Facilities	1	76.5900
	Pipelines	0	0.0000
		Subtotal	**80.7593**
Natural Gas	Distribution Lines	NA	2.7795
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**2.7795**
Oil Systems	Facilities	1	0.1150
	Pipelines	0	0.0000
		Subtotal	**0.1150**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**90.60**

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 1,222 buildings will be at least moderately damaged. This is over 31.00 % of the buildings in the region. There are an estimated 149 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

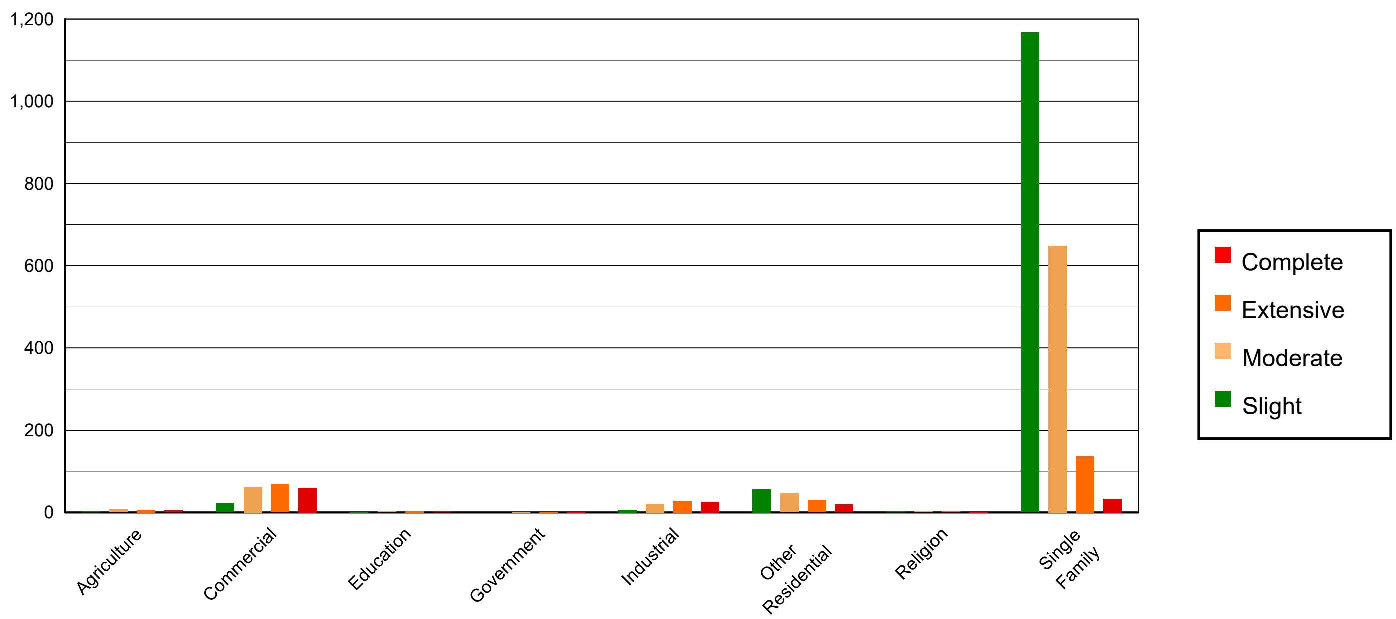


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	1.12	0.08	2.57	0.20	7.18	0.90	6.16	2.21	4.96	3.32
Commercial	12.29	0.83	22.19	1.76	62.31	7.85	69.53	24.93	59.68	39.86
Education	0.58	0.04	0.96	0.08	2.72	0.34	3.17	1.14	2.58	1.72
Government	0.26	0.02	0.41	0.03	1.26	0.16	1.65	0.59	1.42	0.95
Industrial	3.95	0.27	6.64	0.53	21.11	2.66	28.27	10.14	26.03	17.38
Other Residential	67.03	4.51	57.02	4.53	47.79	6.02	30.39	10.90	19.77	13.21
Religion	2.46	0.17	2.40	0.19	2.81	0.35	2.44	0.87	1.89	1.26
Single Family	1400.09	94.11	1167.23	92.68	649.03	81.72	137.25	49.22	33.39	22.30
Total	**1,488**		**1,259**		**794**		**279**		**150**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1449.31	97.41	1202.16	95.45	661.80	83.33	123.49	44.28	15.47	10.33
Steel	5.21	0.35	8.39	0.67	36.91	4.65	61.98	22.23	61.71	41.21
Concrete	0.92	0.06	1.51	0.12	7.05	0.89	11.87	4.25	11.01	7.35
Precast	0.36	0.02	0.47	0.04	2.21	0.28	4.07	1.46	4.70	3.14
RM	3.11	0.21	2.99	0.24	11.52	1.45	17.33	6.21	11.79	7.87
URM	28.87	1.94	43.90	3.49	74.73	9.41	60.12	21.56	45.06	30.09
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**1,488**		**1,259**		**794**		**279**		**150**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

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

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	0	0	0	0
Schools	6	6	0	0
EOCs	1	1	0	0
PoliceStations	1	1	0	0
FireStations	3	3	0	0

Transportation Lifeline Damage

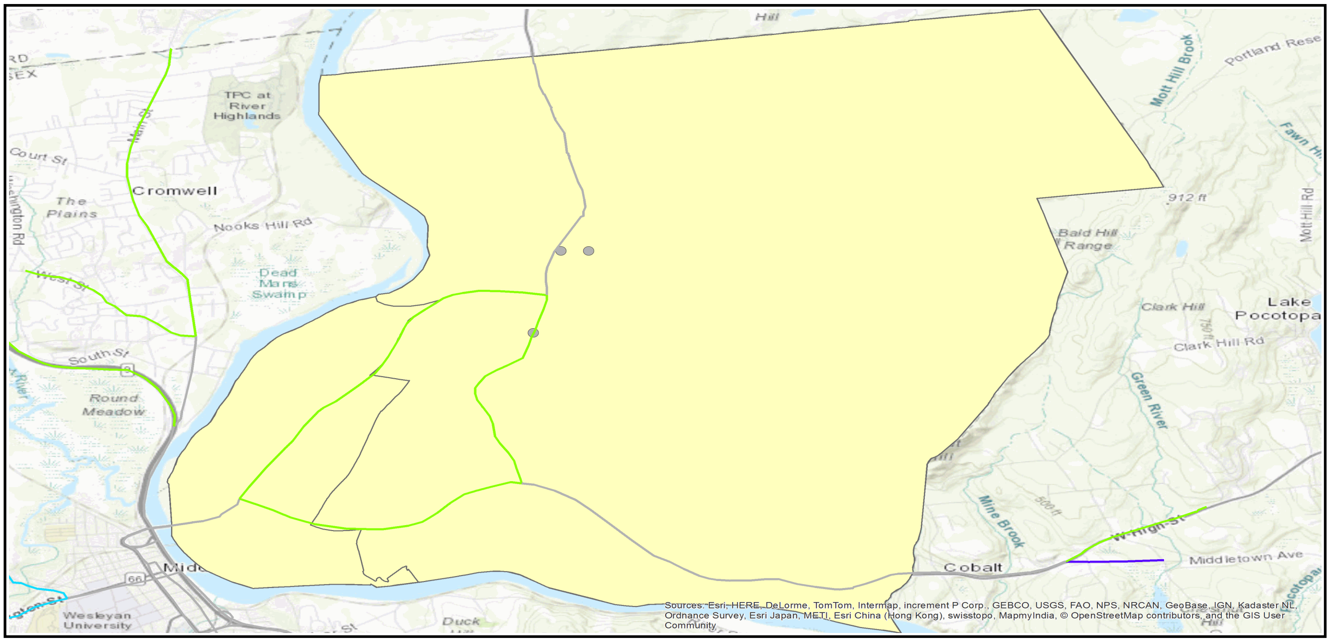


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	48	0	0	48	48
	Bridges	3	0	0	3	3
	Tunnels	0	0	0	0	0
Railways	Segments	5	0	0	2	2
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	5	5	0	4	5
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	1	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	216	0	0
Waste Water	130	0	0
Natural Gas	86	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

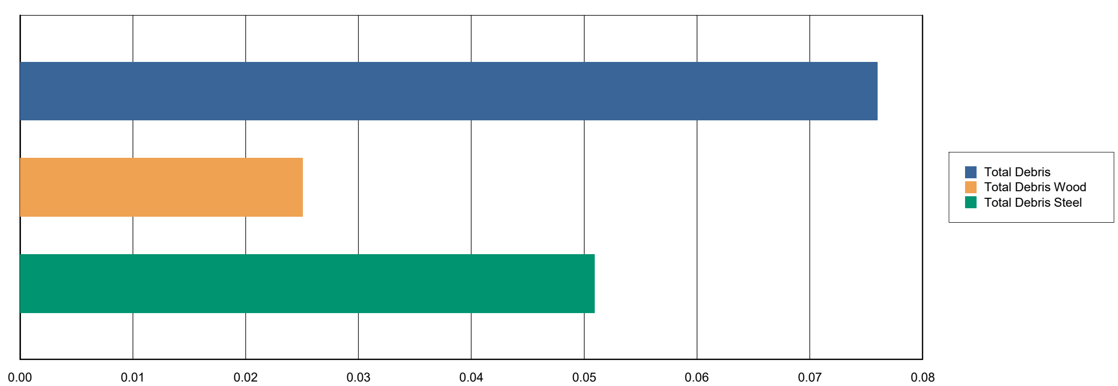
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there 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 76,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 33.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 3,040 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



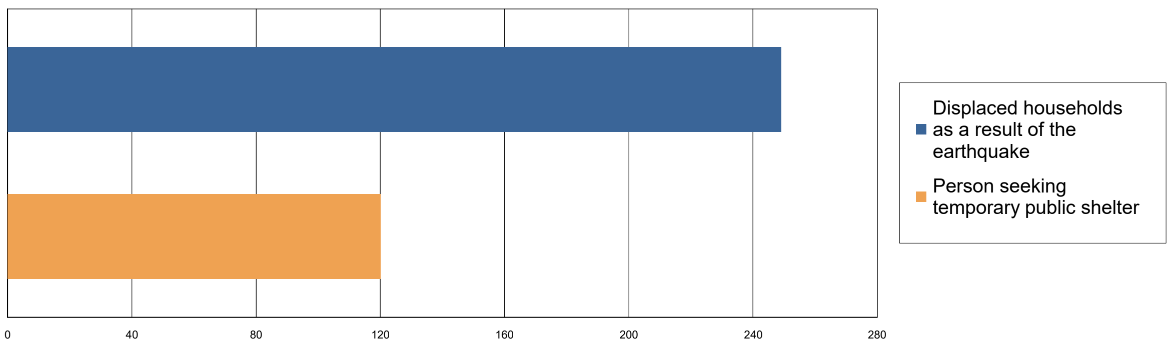
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.03	0.05	0.08	3,040 (@25 tons/truck)

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 249 households to be displaced due to the earthquake. Of these, 120 people (out of a total population of 9,508) 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
249	120

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

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

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	2.10	0.61	0.09	0.18
	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	3.06	0.91	0.14	0.28
	Other-Residential	18.02	5.30	0.87	1.72
	Single Family	19.12	3.97	0.48	0.94
	Total	**42**	**11**	**2**	**3**
2 PM	Commercial	117.24	33.90	5.17	10.11
	Commuting	0.00	0.01	0.01	0.00
	Educational	41.36	12.35	2.01	3.92
	Hotels	0.00	0.00	0.00	0.00
	Industrial	22.62	6.72	1.06	2.07
	Other-Residential	3.33	0.98	0.16	0.31
	Single Family	3.39	0.73	0.09	0.17
	Total	**188**	**55**	**9**	**17**
5 PM	Commercial	83.80	24.24	3.73	7.18
	Commuting	0.05	0.23	0.18	0.05
	Educational	3.26	0.97	0.16	0.31
	Hotels	0.00	0.00	0.00	0.00
	Industrial	14.14	4.20	0.66	1.30
	Other-Residential	7.12	2.10	0.35	0.67
	Single Family	7.59	1.63	0.21	0.39
	Total	**116**	**33**	**5**	**10**

Economic Loss

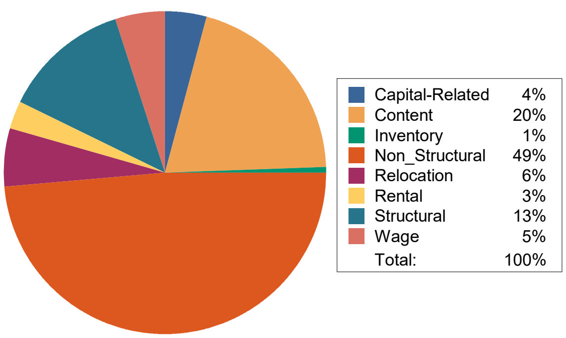
The total economic loss estimated for the earthquake is 362.79 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 358.57 (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 44 % 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)

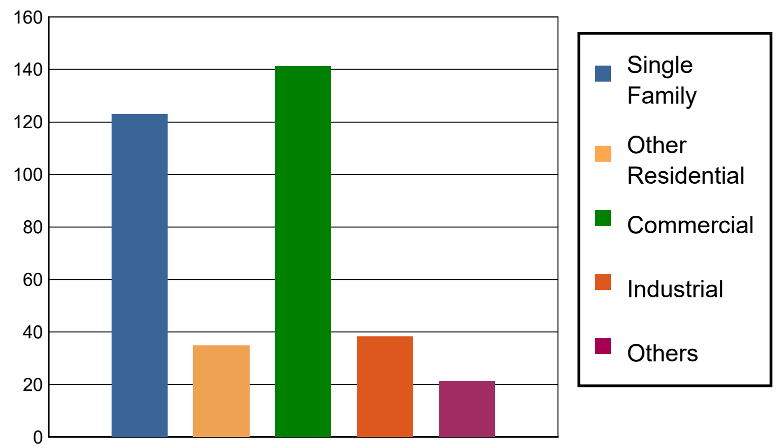


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.7738	15.4095	0.8269	0.6616	17.6718
	Capital-Related	0.0000	0.3301	13.7544	0.4905	0.1520	14.7270
	Rental	1.8243	2.5892	5.5921	0.2269	0.2012	10.4337
	Relocation	6.5255	1.2408	9.3916	0.9392	2.0007	20.0978
	Subtotal	**8.3498**	**4.9339**	**44.1476**	**2.4835**	**3.0155**	**62.9303**
Capital Stock Losses							
	Structural	14.9406	4.3814	17.6109	5.0303	3.9986	45.9618
	Non_Structural	72.2310	20.7227	54.2325	17.6832	9.6757	174.5451
	Content	27.3654	4.8386	24.8095	10.8956	4.5303	72.4394
	Inventory	0.0000	0.0000	0.5118	2.0726	0.1043	2.6887
	Subtotal	**114.5370**	**29.9427**	**97.1647**	**35.6817**	**18.3089**	**295.6350**
	Total	**122.89**	**34.88**	**141.31**	**38.17**	**21.32**	**358.57**

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	528.4404	0.0000	0.00
	Bridges	6.7951	0.2430	3.58
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**535.2355**	**0.2430**	
Railways	Segments	16.4387	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**16.4387**	**0.0000**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	9.9850	3.9799	39.86
	Subtotal	**9.9850**	**3.9799**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**561.66**	**4.22**	

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	6.9488	0.0000	0.00
	Subtotal	**6.9488**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	76.5900	0.0000	0.00
	Distribution Lines	4.1693	0.0000	0.00
	Subtotal	**80.7593**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	2.7795	0.0000	0.00
	Subtotal	**2.7795**	**0.0000**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.1150	0.0000	0.00
	Subtotal	**0.1150**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**90.60**	**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	9,508	1,262	310	1,572
Total Region		**9,508**	**1,262**	**310**	**1,572**

Hazus: Earthquake Global Risk Report

Region Name: Portland

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 24.85 square miles and contains 2 census tracts. There are over 3 thousand households in the region which has a total population of 9,508 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,572 (millions of dollars). Approximately 91.00 % of the buildings (and 80.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 561 and 90 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 3 thousand buildings in the region which have an aggregate total replacement value of 1,572 (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 87% 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 6 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 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 651.00 (millions of dollars). This inventory includes over 54.06 miles of highways, 3 bridges, 431.23 miles of pipes.

Table 1: Transportation System Lifeline Inventory

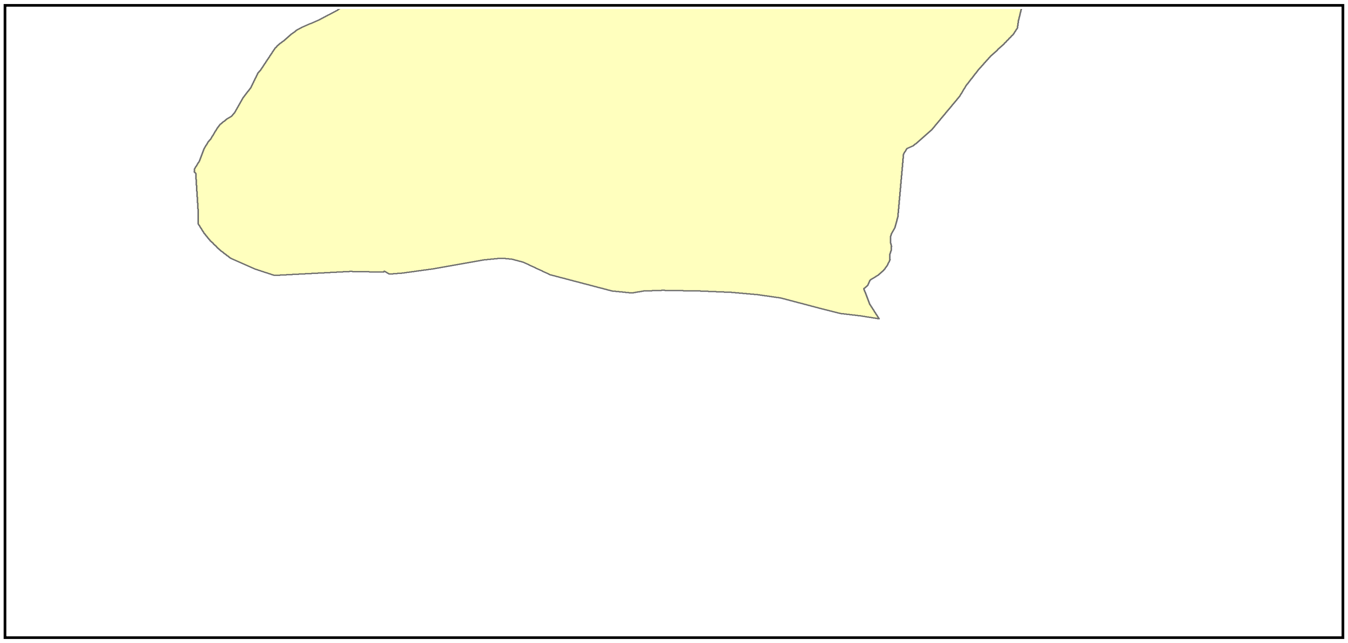
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	3	6.7951
	Segments	48	528.4404
	Tunnels	0	0.0000
		Subtotal	**535.2355**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	5	16.4387
	Tunnels	0	0.0000
		Subtotal	**16.4387**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	5	9.9850
		Subtotal	**9.9850**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**561.70**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.9488
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.9488**
Waste Water	Distribution Lines	NA	4.1693
	Facilities	1	76.5900
	Pipelines	0	0.0000
		Subtotal	**80.7593**
Natural Gas	Distribution Lines	NA	2.7795
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**2.7795**
Oil Systems	Facilities	1	0.1150
	Pipelines	0	0.0000
		Subtotal	**0.1150**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**90.60**

Earthquake Scenario

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



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

Building Damage

Hazus estimates that about 1,895 buildings will be at least moderately damaged. This is over 48.00 % of the buildings in the region. There are an estimated 341 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

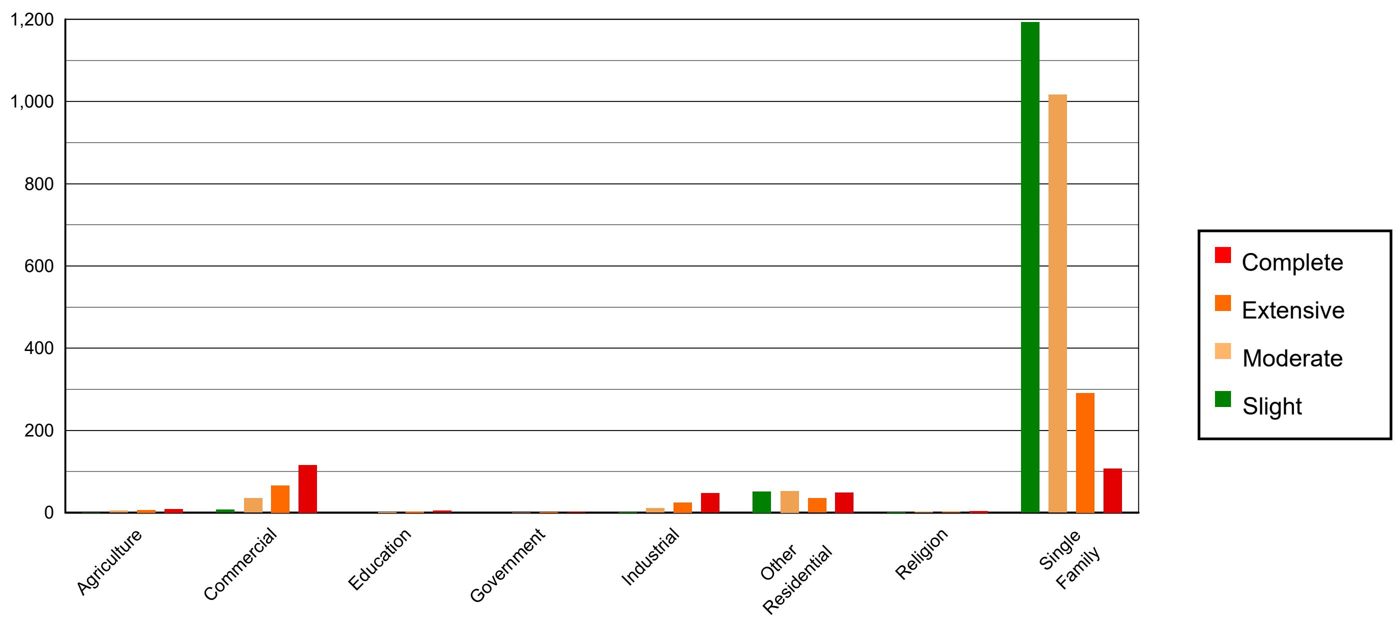


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0.23	0.03	0.89	0.07	4.55	0.40	6.62	1.54	9.71	2.85
Commercial	2.18	0.27	6.91	0.55	35.08	3.12	65.84	15.30	115.99	33.99
Education	0.10	0.01	0.29	0.02	1.48	0.13	2.99	0.69	5.14	1.51
Government	0.04	0.01	0.12	0.01	0.63	0.06	1.46	0.34	2.75	0.81
Industrial	0.72	0.09	1.97	0.16	10.85	0.97	24.85	5.78	47.61	13.95
Other Residential	33.84	4.14	51.48	4.10	52.74	4.69	35.13	8.17	48.81	14.30
Religion	1.12	0.14	1.82	0.14	2.37	0.21	2.43	0.57	4.25	1.25
Single Family	779.69	95.32	1192.85	94.95	1016.54	90.42	290.91	67.62	107.01	31.36
Total	**818**		**1,256**		**1,124**		**430**		**341**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	812.92	99.39	1241.14	98.79	1056.62	93.98	288.74	67.11	52.81	15.48
Steel	1.13	0.14	2.37	0.19	16.33	1.45	50.84	11.82	103.53	30.34
Concrete	0.20	0.02	0.45	0.04	3.18	0.28	9.39	2.18	19.14	5.61
Precast	0.09	0.01	0.15	0.01	1.09	0.10	2.73	0.63	7.75	2.27
RM	0.89	0.11	1.16	0.09	6.69	0.60	14.05	3.27	23.94	7.02
URM	2.70	0.33	11.06	0.88	40.34	3.59	64.49	14.99	134.08	39.29
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**818**		**1,256**		**1,124**		**430**		**341**	

*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	6	6	2	0
EOCs	1	1	1	0
PoliceStations	1	1	1	0
FireStations	3	3	2	0

Transportation Lifeline Damage

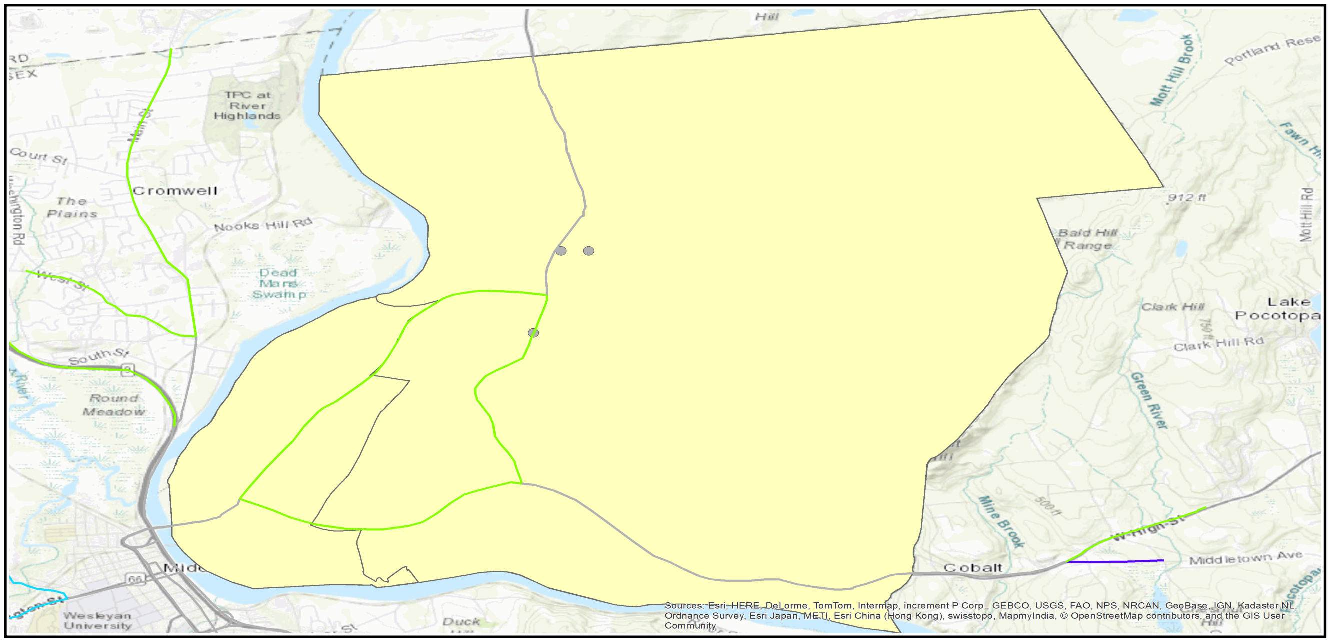


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	48	0	0	48	48
	Bridges	3	0	0	3	3
	Tunnels	0	0	0	0	0
Railways	Segments	5	0	0	2	2
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	5	5	0	0	5
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	1	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	216	0	0
Waste Water	130	0	0
Natural Gas	86	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

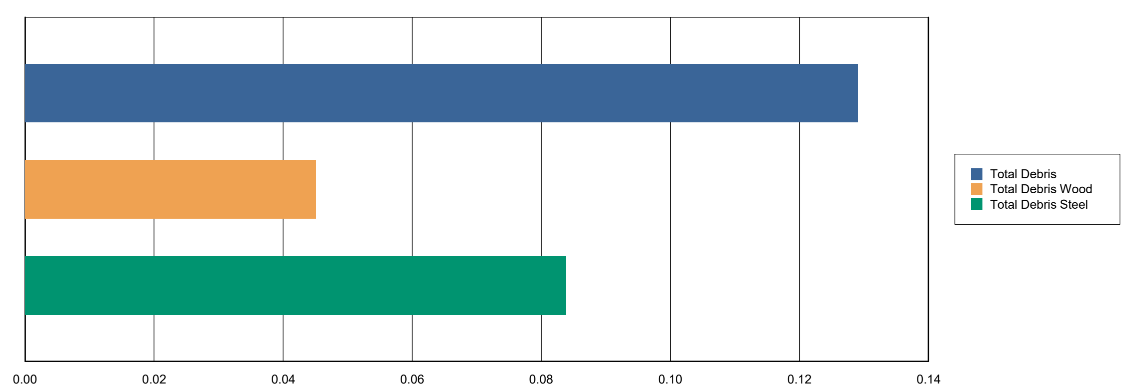
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there 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 129,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 35.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 5,160 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



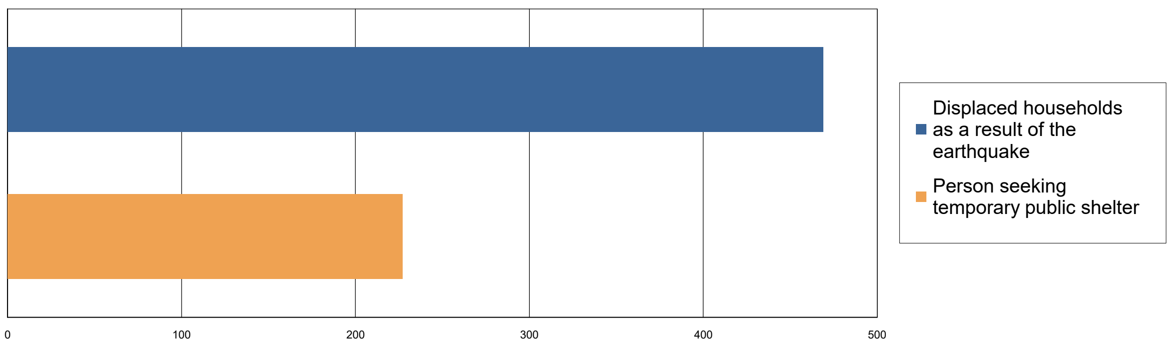
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.05	0.08	0.13	5,160 (@25 tons/truck)

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 469 households to be displaced due to the earthquake. Of these, 227 people (out of a total population of 9,508) 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
469	227

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	3.91	1.20	0.19	0.37
	Commuting	0.00	0.01	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	5.29	1.66	0.27	0.53
	Other-Residential	40.20	12.64	2.11	4.18
	Single Family	44.84	10.81	1.40	2.73
	Total	**94**	**26**	**4**	**8**
2 PM	Commercial	218.40	67.01	10.55	20.66
	Commuting	0.01	0.05	0.04	0.01
	Educational	76.34	24.05	3.99	7.79
	Hotels	0.00	0.00	0.00	0.00
	Industrial	39.24	12.29	2.00	3.89
	Other-Residential	7.51	2.38	0.41	0.77
	Single Family	8.04	2.00	0.27	0.51
	Total	**350**	**108**	**17**	**34**
5 PM	Commercial	156.48	48.08	7.65	14.72
	Commuting	0.19	0.96	0.77	0.19
	Educational	6.01	1.89	0.31	0.61
	Hotels	0.00	0.00	0.00	0.00
	Industrial	24.52	7.68	1.25	2.43
	Other-Residential	16.00	5.07	0.86	1.64
	Single Family	17.95	4.46	0.61	1.13
	Total	**221**	**68**	**11**	**21**

Economic Loss

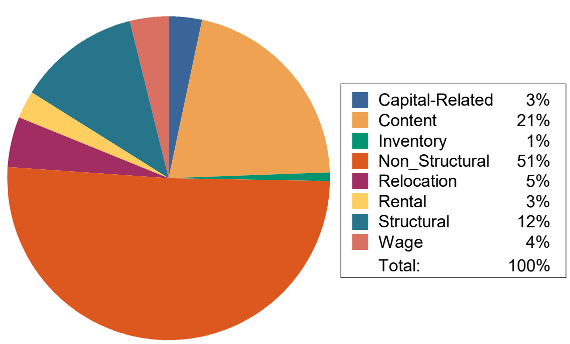
The total economic loss estimated for the earthquake is 638.27 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 631.54 (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 49 % 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)

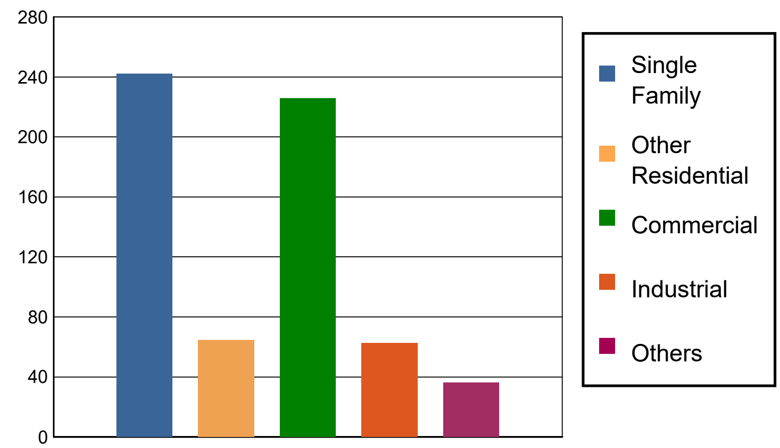


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	1.1329	21.9337	1.1459	0.9622	25.1747
	Capital-Related	0.0000	0.4832	19.5802	0.6786	0.2340	20.9760
	Rental	3.5935	4.2787	7.7742	0.3029	0.3004	16.2497
	Relocation	12.7394	2.0674	12.8270	1.2148	2.9523	31.8009
	Subtotal	**16.3329**	**7.9622**	**62.1151**	**3.3422**	**4.4489**	**94.2013**
Capital Stock Losses							
	Structural	29.5453	7.4139	26.5616	7.2505	6.2298	77.0011
	Non_Structural	142.7061	39.8488	92.1000	29.8490	17.0220	321.5259
	Content	53.4996	9.5311	44.1371	18.6577	8.3435	134.1690
	Inventory	0.0000	0.0000	0.8960	3.5560	0.1862	4.6382
	Subtotal	**225.7510**	**56.7938**	**163.6947**	**59.3132**	**31.7815**	**537.3342**
	Total	**242.08**	**64.76**	**225.81**	**62.66**	**36.23**	**631.54**

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	528.4404	0.0000	0.00
	Bridges	6.7951	0.8035	11.82
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**535.2355**	**0.8035**	
Railways	Segments	16.4387	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**16.4387**	**0.0000**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	9.9850	5.9272	59.36
	Subtotal	**9.9850**	**5.9272**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**561.66**	**6.73**	

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	6.9488	0.0000	0.00
	Subtotal	**6.9488**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	76.5900	0.0000	0.00
	Distribution Lines	4.1693	0.0000	0.00
	Subtotal	**80.7593**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	2.7795	0.0000	0.00
	Subtotal	**2.7795**	**0.0000**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.1150	0.0000	0.00
	Subtotal	**0.1150**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**90.60**	**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	9,508	1,262	310	1,572
Total Region		**9,508**	**1,262**	**310**	**1,572**

Hazus: Earthquake Global Risk Report

Region Name: Portland

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 24.85 square miles and contains 2 census tracts. There are over 3 thousand households in the region which has a total population of 9,508 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 3 thousand buildings in the region with a total building replacement value (excluding contents) of 1,572 (millions of dollars). Approximately 91.00 % of the buildings (and 80.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 561 and 90 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 3 thousand buildings in the region which have an aggregate total replacement value of 1,572 (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 87% 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 6 schools, 3 fire stations, 1 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 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 651.00 (millions of dollars). This inventory includes over 54.06 miles of highways, 3 bridges, 431.23 miles of pipes.

Table 1: Transportation System Lifeline Inventory

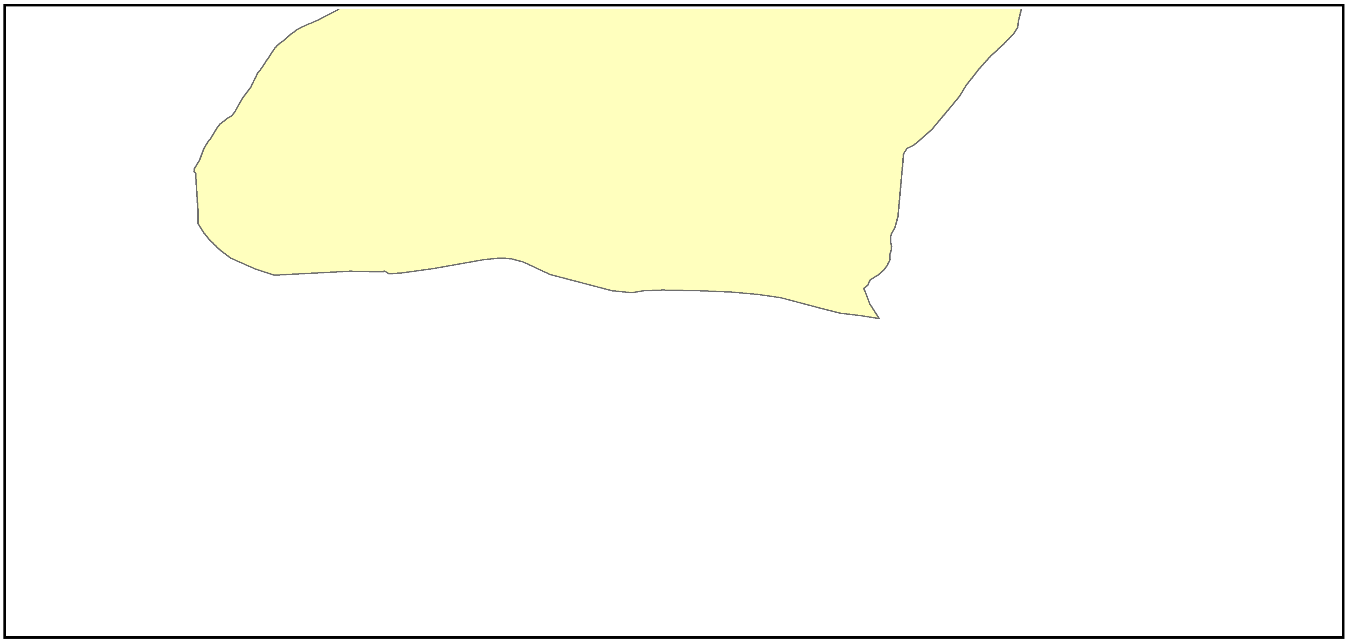
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	3	6.7951
	Segments	48	528.4404
	Tunnels	0	0.0000
		Subtotal	**535.2355**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	5	16.4387
	Tunnels	0	0.0000
		Subtotal	**16.4387**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	5	9.9850
		Subtotal	**9.9850**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**561.70**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.9488
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.9488**
Waste Water	Distribution Lines	NA	4.1693
	Facilities	1	76.5900
	Pipelines	0	0.0000
		Subtotal	**80.7593**
Natural Gas	Distribution Lines	NA	2.7795
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**2.7795**
Oil Systems	Facilities	1	0.1150
	Pipelines	0	0.0000
		Subtotal	**0.1150**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**90.60**

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 17 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

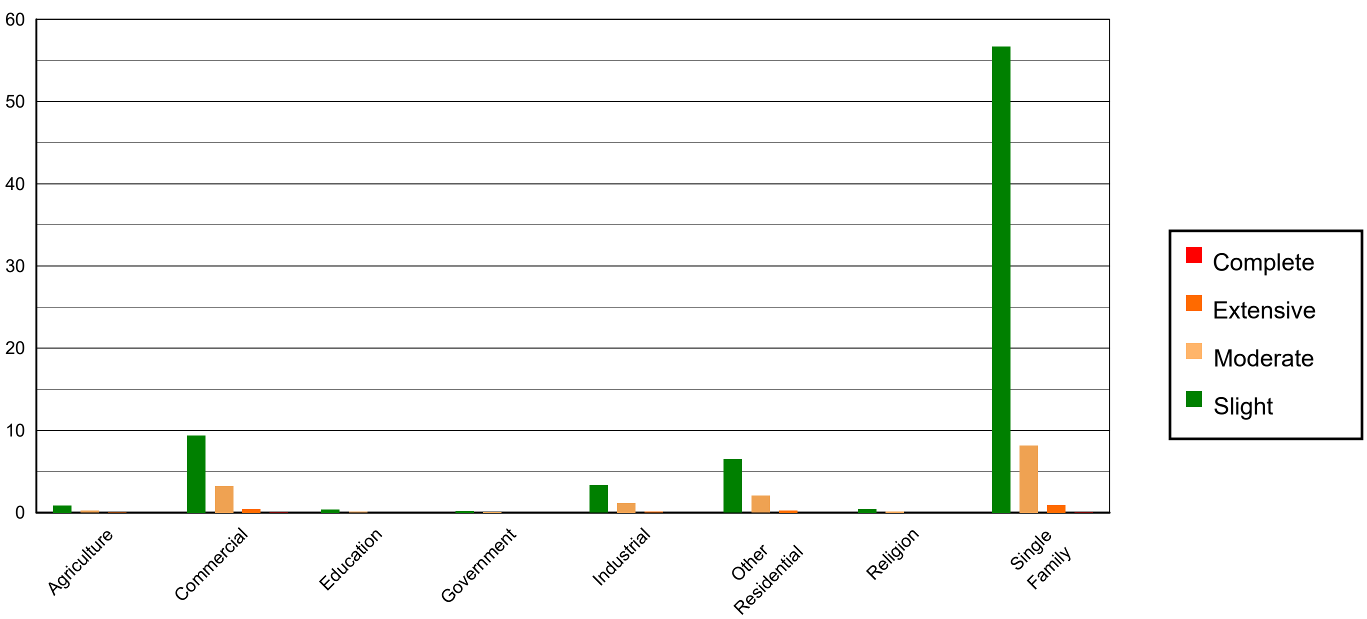


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	20.84	0.54	0.87	1.12	0.25	1.65	0.03	1.74	0.00	1.16
Commercial	212.95	5.50	9.37	12.03	3.23	21.15	0.42	22.39	0.03	20.96
Education	9.46	0.24	0.39	0.50	0.13	0.85	0.02	0.84	0.00	0.98
Government	4.73	0.12	0.20	0.25	0.07	0.45	0.01	0.43	0.00	0.38
Industrial	81.32	2.10	3.36	4.32	1.17	7.68	0.14	7.45	0.01	5.96
Other Residential	213.13	5.50	6.49	8.34	2.07	13.56	0.29	15.44	0.02	18.80
Religion	11.34	0.29	0.46	0.59	0.17	1.13	0.03	1.36	0.00	1.65
Single Family	3321.12	85.71	56.69	72.85	8.17	53.54	0.95	50.36	0.06	50.11
Total	**3,875**		**78**		**15**		**2**		**0**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	3395.55	87.63	51.70	66.44	4.63	30.37	0.34	17.87	0.00	0.00
Steel	165.81	4.28	6.18	7.94	2.01	13.20	0.19	10.00	0.00	3.27
Concrete	30.93	0.80	1.09	1.39	0.32	2.10	0.02	0.86	0.00	0.00
Precast	10.83	0.28	0.56	0.72	0.35	2.32	0.06	3.30	0.00	0.67
RM	44.52	1.15	1.41	1.81	0.72	4.69	0.10	5.16	0.00	0.00
URM	227.25	5.86	16.88	21.69	7.23	47.33	1.19	62.81	0.12	96.06
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**3,875**		**78**		**15**		**2**		**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	6	0	0	6
EOCs	1	0	0	1
PoliceStations	1	0	0	1
FireStations	3	0	0	3

Transportation Lifeline Damage

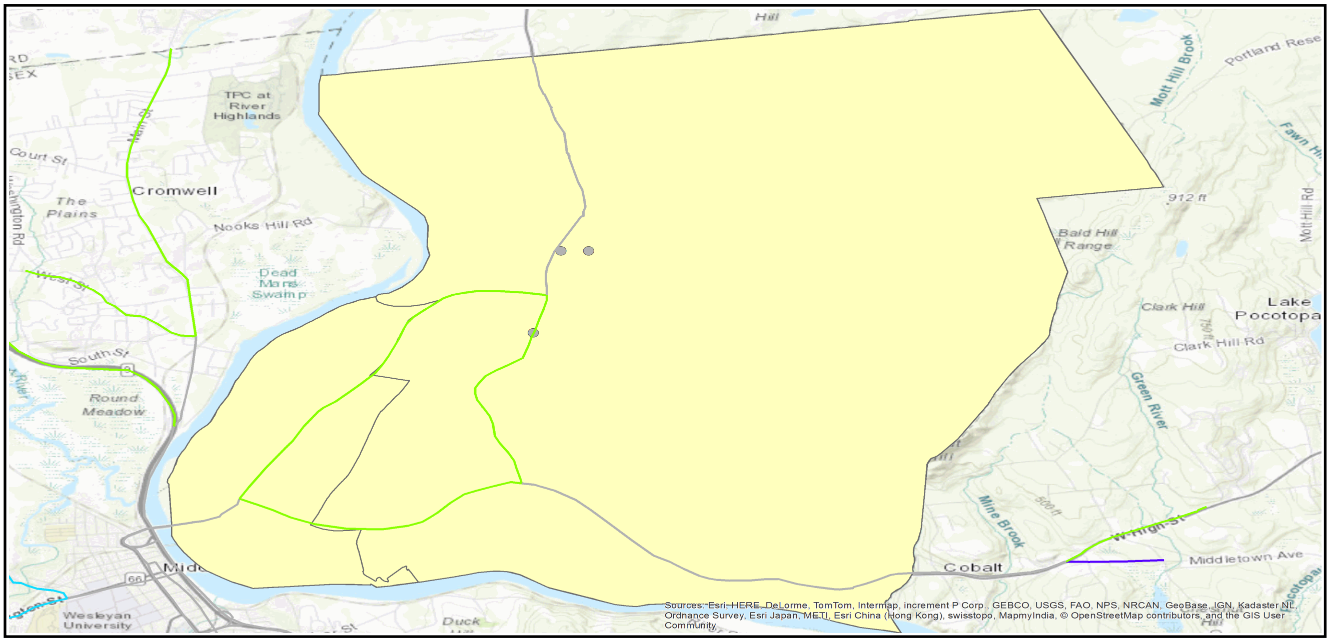


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	48	0	0	48	48
	Bridges	3	0	0	3	3
	Tunnels	0	0	0	0	0
Railways	Segments	5	0	0	2	2
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	5	0	0	5	5
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	1	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	216	0	0
Waste Water	130	0	0
Natural Gas	86	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 72.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)

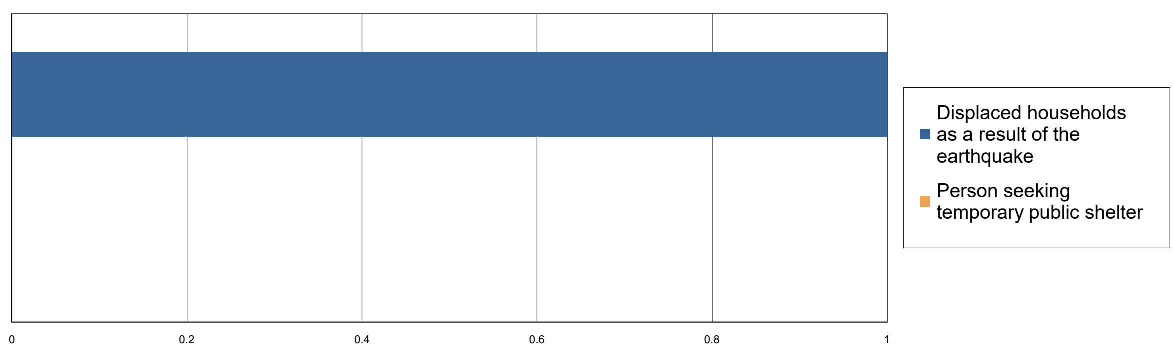
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.00	0.00	0.00	0 (@25 tons/truck)

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 1 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 9,508) 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
1	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	0.11	0.01	0.00	0.00
	Single Family	0.18	0.02	0.00	0.00
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0.43	0.05	0.00	0.01
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.14	0.02	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.06	0.01	0.00	0.00
	Other-Residential	0.02	0.00	0.00	0.00
	Single Family	0.03	0.00	0.00	0.00
	Total	**1**	**0**	**0**	**0**
5 PM	Commercial	0.31	0.04	0.00	0.01
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.01	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.04	0.00	0.00	0.00
	Other-Residential	0.04	0.01	0.00	0.00
	Single Family	0.07	0.01	0.00	0.00
	Total	**0**	**0**	**0**	**0**

Economic Loss

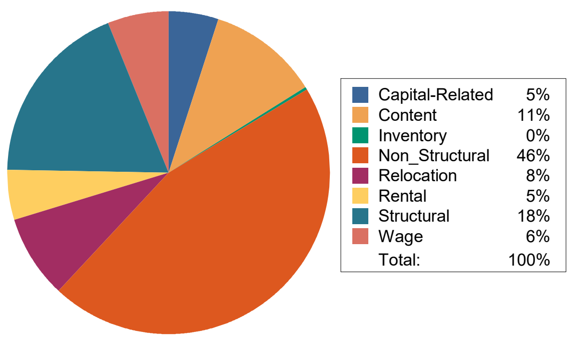
The total economic loss estimated for the earthquake is 2.47 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

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

The total building-related losses were 2.37 (millions of dollars); 24 % 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 55 % 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)

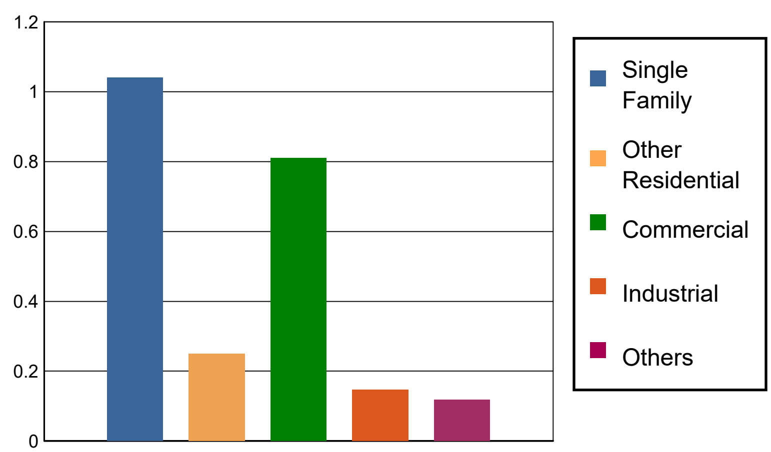


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.0046	0.1277	0.0058	0.0076	0.1457
	Capital-Related	0.0000	0.0019	0.1102	0.0035	0.0014	0.1170
	Rental	0.0191	0.0301	0.0651	0.0021	0.0018	0.1182
	Relocation	0.0617	0.0187	0.0901	0.0092	0.0186	0.1983
	Subtotal	**0.0808**	**0.0553**	**0.3931**	**0.0206**	**0.0294**	**0.5792**
Capital Stock Losses							
	Structural	0.1993	0.0489	0.1251	0.0324	0.0305	0.4362
	Non_Structural	0.6401	0.1263	0.2139	0.0564	0.0425	1.0792
	Content	0.1199	0.0192	0.0768	0.0320	0.0151	0.2630
	Inventory	0.0000	0.0000	0.0015	0.0061	0.0003	0.0079
	Subtotal	**0.9593**	**0.1944**	**0.4173**	**0.1269**	**0.0884**	**1.7863**
	Total	**1.04**	**0.25**	**0.81**	**0.15**	**0.12**	**2.37**

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	528.4404	0.0000	0.00
	Bridges	6.7951	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**535.2355**	**0.0000**	
Railways	Segments	16.4387	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**16.4387**	**0.0000**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	9.9850	0.1043	1.04
	Subtotal	**9.9850**	**0.1043**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**561.66**	**0.10**	

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	6.9488	0.0000	0.00
	Subtotal	**6.9488**	**0.0000**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	76.5900	0.0000	0.00
	Distribution Lines	4.1693	0.0000	0.00
	Subtotal	**80.7593**	**0.0000**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	2.7795	0.0000	0.00
	Subtotal	**2.7795**	**0.0000**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.1150	0.0000	0.00
	Subtotal	**0.1150**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**90.60**	**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	9,508	1,262	310	1,572
Total Region		**9,508**	**1,262**	**310**	**1,572**