

Hazus-MH: Earthquake Event Report

Region Name: summerville_6M

Earthquake Scenario: Summerville_6m

Print Date: May 25, 2016

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.

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General Description of the Region

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

The earthquake loss estimates provided in this report was based on a region that includes 8 county(ies) from the following state(s):

South Carolina

Note:

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

The geographical size of the region is 7,405.20 square miles and contains 221 census tracts. There are over 361 thousand households in the region which has a total population of 925,552 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 389 thousand buildings in the region with a total building replacement value (excluding contents) of 100,430 (millions of dollars). Approximately 93.00 % 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 19,198 and 7,911 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 389 thousand buildings in the region which have an aggregate total replacement value of 100,430 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 68% 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 21 hospitals in the region with a total bed capacity of 2,933 beds. There are 323 schools, 112 fire stations, 33 police stations and 8 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 3,804 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 27,109.00 (millions of dollars). This inventory includes over 3,063 kilometers of highways, 1,775 bridges, 8,974 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	1,775	2,496.40
	Segments	705	14,665.70
	Tunnels	0	0.00
	Subtotal		17,162.10
Railways	Bridges	2	3.20
	Facilities	12	32.00
	Segments	581	955.10
	Tunnels	0	0.00
	Subtotal		990.30
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	6	5.40
	Subtotal		5.40
Ferry	Facilities	7	9.30
	Subtotal		9.30
Port	Facilities	86	171.70
	Subtotal		171.70
Airport	Facilities	13	138.50
	Runways	19	721.30
	Subtotal		859.80
		Total	19,198.60

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	741.70
	Facilities	309	1,060.70
	Pipelines	13,155	1,243.20
		Subtotal	3,045.60
Waste Water	Distribution Lines	NA	445.00
	Facilities	809	114.80
	Pipelines	20,741	1,894.20
		Subtotal	2,454.10
Natural Gas	Distribution Lines	NA	296.70
	Facilities	0	0.00
	Pipelines	47	176.00
		Subtotal	472.70
Oil Systems	Facilities	8	14.30
	Pipelines	0	0.00
		Subtotal	14.30
Electrical Power	Facilities	66	3,370.20
		Subtotal	3,370.20
Communication	Facilities	35	38.00
		Subtotal	38.00
		Total	9,395.00

Earthquake Scenario

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

Scenario Name	Summerville_6m
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-80.18
Latitude of Epicenter	33.02
Earthquake Magnitude	6.00
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Building Damage

Building Damage

Hazus estimates that about 73,078 buildings will be at least moderately damaged. This is over 19.00 % of the buildings in the region. There are an estimated 11,530 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	813	0.32	151	0.26	125	0.29	65	0.35	50	0.43
Commercial	10,393	4.03	2,414	4.09	2,578	5.98	1,630	8.85	1,455	12.62
Education	434	0.17	94	0.16	103	0.24	68	0.37	63	0.54
Government	342	0.13	77	0.13	86	0.20	47	0.25	33	0.29
Industrial	2,543	0.99	595	1.01	732	1.70	526	2.86	509	4.42
Other Residential	53,156	20.63	12,009	20.35	12,237	28.37	7,669	41.63	6,016	52.17
Religion	1,571	0.61	297	0.50	239	0.56	126	0.68	103	0.89
Single Family	188,409	73.12	43,365	73.50	27,028	62.67	8,288	45.00	3,303	28.64
Total	257,661		59,002		43,129		18,419		11,531	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	187,006	72.58	42891	72.69	25,607	59.37	6,777	36.80	1,233	10.69
Steel	6,886	2.67	1506	2.55	1,914	4.44	1,323	7.18	1,242	10.77
Concrete	1,223	0.47	283	0.48	391	0.91	255	1.38	221	1.92
Precast	466	0.18	87	0.15	131	0.30	104	0.56	89	0.77
RM	2,205	0.86	318	0.54	465	1.08	376	2.04	250	2.17
URM	16,609	6.45	4315	7.31	4,121	9.56	2,707	14.70	2,996	25.98
MH	43,265	16.79	9602	16.27	10,499	24.34	6,877	37.34	5,500	47.70
Total	257,661		59,002		43,129		18,419		11,531	

*Note:

RM Reinforced Masonry
 URM Unreinforced Masonry
 MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 2,933 hospital beds available for use. On the day of the earthquake, the model estimates that only 1,453 hospital beds (50.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 65.00% of the beds will be back in service. By 30 days, 79.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	21	4	4	14
Schools	323	77	48	194
EOCs	8	1	1	5
PoliceStations	33	4	2	26
FireStations	112	22	8	77

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	Number of Locations_			
			With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	705	0	0	705	705
	Bridges	1,775	197	58	1,579	1,659
	Tunnels	0	0	0	0	0
Railways	Segments	581	0	0	581	581
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
	Facilities	12	1	0	11	12
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	6	0	0	6	6
Ferry	Facilities	7	0	0	7	7
Port	Facilities	86	0	0	86	86
Airport	Facilities	13	1	0	12	13
	Runways	19	0	0	19	19

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	309	41	0	264	277
Waste Water	809	223	0	452	689
Natural Gas	0	0	0	0	0
Oil Systems	8	0	0	4	8
Electrical Power	66	0	0	43	43
Communication	35	4	0	31	35

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	4,249	354	88
Waste Water	4,354	1267	317
Natural Gas	372	16	4
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	361,569	0	0	0	0	0
Electric Power		48,275	19,729	5,159	884	286

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 3.28 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 44.00% 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 131,160 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

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 12,963 households to be displaced due to the earthquake. Of these, 8,352 people (out of a total population of 925,552) will seek temporary shelter in public shelters.

Casualties

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

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

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

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

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	66	19	3	6
	Commuting	1	1	2	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	111	33	5	10
	Other-Residential	1,582	400	45	84
	Single Family	1,535	373	49	96
	Total	3,295	826	104	196
2 PM	Commercial	3,822	1,111	171	333
	Commuting	7	8	14	3
	Educational	1,663	499	81	158
	Hotels	0	0	0	0
	Industrial	822	244	38	75
	Other-Residential	308	78	9	16
	Single Family	305	76	11	19
	Total	6,928	2,017	324	605
5 PM	Commercial	2,780	811	126	242
	Commuting	123	144	267	51
	Educational	140	41	7	13
	Hotels	0	0	0	0
	Industrial	514	153	24	47
	Other-Residential	593	152	18	33
	Single Family	615	154	21	40
	Total	4,765	1,455	463	425

Economic Loss

The total economic loss estimated for the earthquake is 11,289.72 (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 10,919.45 (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 62 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	32.27	287.27	14.77	16.62	350.92
	Capital-Related	0.00	13.69	233.91	9.24	3.67	260.52
	Rental	76.17	108.30	135.78	4.95	7.30	332.49
	Relocation	277.55	121.43	217.01	22.49	55.37	693.84
	Subtotal	353.72	275.69	873.97	51.44	82.95	1,637.78
Capital Stock Losses							
	Structural	640.53	265.84	383.48	105.14	71.70	1,466.68
	Non_Structural	2,818.61	1,154.93	1,080.10	373.56	211.38	5,638.57
	Content	967.75	270.22	527.32	240.83	102.58	2,108.70
	Inventory	0.00	0.00	17.11	49.24	1.36	67.71
	Subtotal	4,426.89	1,690.99	2,008.01	768.77	387.02	9,281.67
	Total	4,780.61	1,966.68	2,881.98	820.21	469.97	10,919.45

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	14,665.74	\$0.00	0.00
	Bridges	2,496.41	\$93.35	3.74
	Tunnels	0.00	\$0.00	0.00
	Subtotal	17162.10	93.30	
Railways	Segments	955.14	\$0.00	0.00
	Bridges	3.20	\$0.01	0.16
	Tunnels	0.00	\$0.00	0.00
	Facilities	31.96	\$6.54	20.47
	Subtotal	990.30	6.50	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	5.36	\$0.43	8.00
	Subtotal	5.40	0.40	
Ferry	Facilities	9.32	\$0.68	7.32
	Subtotal	9.30	0.70	
Port	Facilities	171.74	\$21.67	12.62
	Subtotal	171.70	21.70	
Airport	Facilities	138.46	\$18.13	13.09
	Runways	721.32	\$0.00	0.00
	Subtotal	859.80	18.10	
	Total	19198.60	140.80	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	1,243.20	\$0.88	0.07
	Facilities	1,060.70	\$155.46	14.66
	Distribution Lines	741.70	\$21.58	2.91
	Subtotal	3,045.63	\$177.92	
Waste Water	Pipelines	1,894.20	\$3.42	0.18
	Facilities	114.80	\$12.95	11.28
	Distribution Lines	445.00	\$15.46	3.47
	Subtotal	2,454.11	\$31.84	
Natural Gas	Pipelines	176.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	296.70	\$4.44	1.49
	Subtotal	472.71	\$4.44	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	14.30	\$1.55	10.81
	Subtotal	14.30	\$1.55	
Electrical Power	Facilities	3,370.20	\$9.47	0.28
	Subtotal	3,370.24	\$9.47	
Communication	Facilities	38.00	\$4.27	11.24
	Subtotal	37.97	\$4.27	
Total		9,394.96	\$229.47	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of \$)

LOSS	Total	%

Appendix A: County Listing for the Region

Berkeley,SC

Charleston,SC

Clarendon,SC

Colleton,SC

Dorchester,SC

Georgetown,SC

Orangeburg,SC

Williamsburg,SC

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
South Carolina	Berkeley	177,843	13,958	2,387	16,346
	Charleston	350,209	36,073	10,497	46,571
	Clarendon	34,971	2,200	412	2,613
	Colleton	38,892	2,723	838	3,562
	Dorchester	136,555	11,641	1,870	13,511
	Georgetown	60,158	6,001	1,594	7,596
	Orangeburg	92,501	5,768	2,088	7,856
	Williamsburg	34,423	1,874	498	2,372
Total State		925,552	80,238	20,184	100,427
Total Region		925,552	80,238	20,184	100,427