Hazus: Earthquake Global Risk Report

Region Name: BigLagoonBaldMtn

Earthquake Scenario: biglagoonbaldmtn2011_m7p87_se

Print Date: May 01, 2024

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social 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 18 county(ies) from the following state(s):

California

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

The geographical size of the region is 45,556.28 square miles and contains 473 census tracts. There are over 701 thousand households in the region which has a total population of 1,842,224 peopleF. The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 725 thousand buildings in the region with a total building replacement value (excluding contents) of 384,954 (millions of dollars). Approximately 89.00 % of the buildings (and 63.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 56,969 and 77,134 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 725 thousand buildings in the region which have an aggregate total replacement value of 384,954 (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 82% 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 61 hospitals in the region with a total bed capacity of 3,638 beds. There are 1,082 schools, 575 fire stations, 136 police stations and 21 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 134,103.00 (millions of dollars). This inventory includes over 4,443.42 miles of highways, 4,883 bridges, 141,901.87 miles of pipes.

Table 1: Transportation System Lifeline Inventory

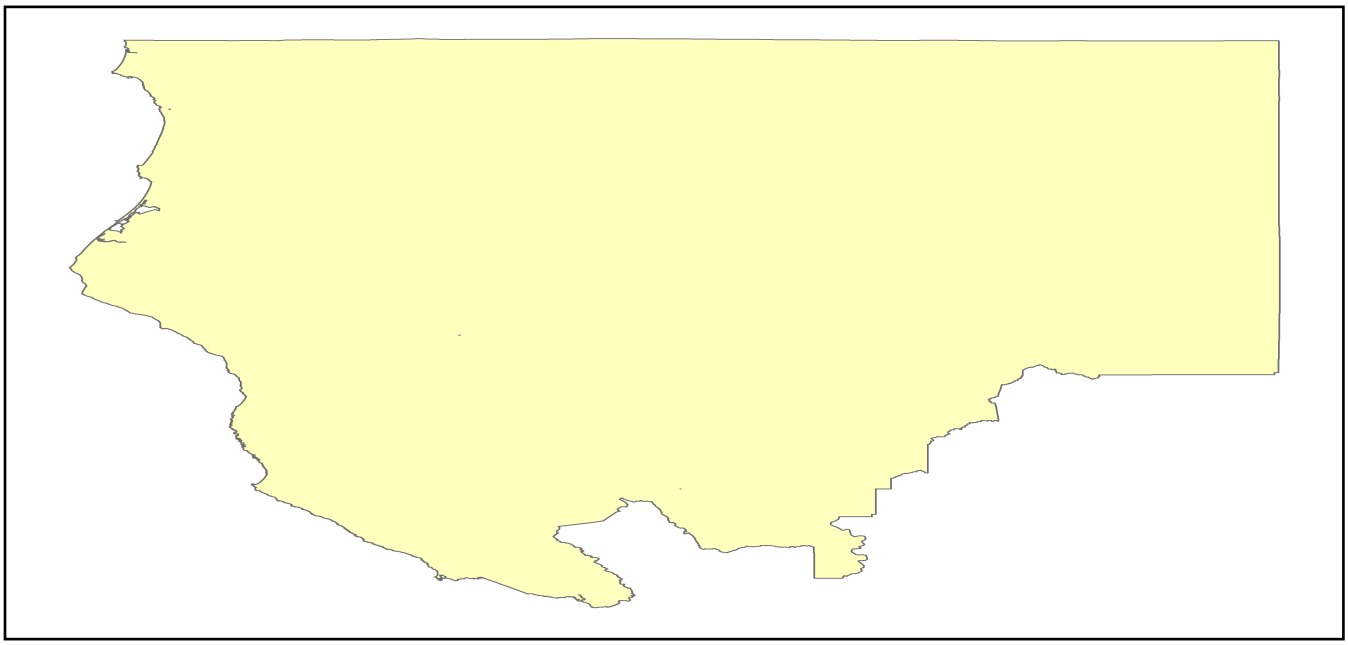
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	4,883	13166.9442
	Segments	1,334	30817.7337
	Tunnels	4	44.1578
		Subtotal	**44028.8357**
Railways	Bridges	800	4552.0000
	Facilities	8	21.3040
	Segments	849	7205.9253
	Tunnels	0	0.0000
		Subtotal	**11779.2293**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	10	22.9955
		Subtotal	**22.9955**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	58	221.0869
		Subtotal	**221.0869**
Airport	Facilities	71	425.1064
	Runways	84	492.0949
		Subtotal	**917.2013**
		Total	**56,969.30**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	2824.9758
	Facilities	6	235.7640
	Pipelines	0	0.0000
		Subtotal	**3060.7398**
Waste Water	Distribution Lines	NA	1694.9855
	Facilities	66	11348.8188
	Pipelines	0	0.0000
		Subtotal	**13043.8043**
Natural Gas	Distribution Lines	NA	1129.9903
	Facilities	4	164.9741
	Pipelines	449	8353.1619
		Subtotal	**9648.1263**
Oil Systems	Facilities	1	0.1180
	Pipelines	0	0.0000
		Subtotal	**0.1180**
Electrical Power	Facilities	108	51363.7665
		Subtotal	**51363.7665**
Communication	Facilities	151	17.8180
		Subtotal	**17.8180**
		Total	**77,134.40**

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	biglagoonbaldmtn2011_m7p87_se
Type of Earthquake	User-defined
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	7.87
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Direct Earthquake Damage

Building Damage

Hazus estimates that about 12,421 buildings will be at least moderately damaged. This is over 2.00 % of the buildings in the region. There are an estimated 675 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

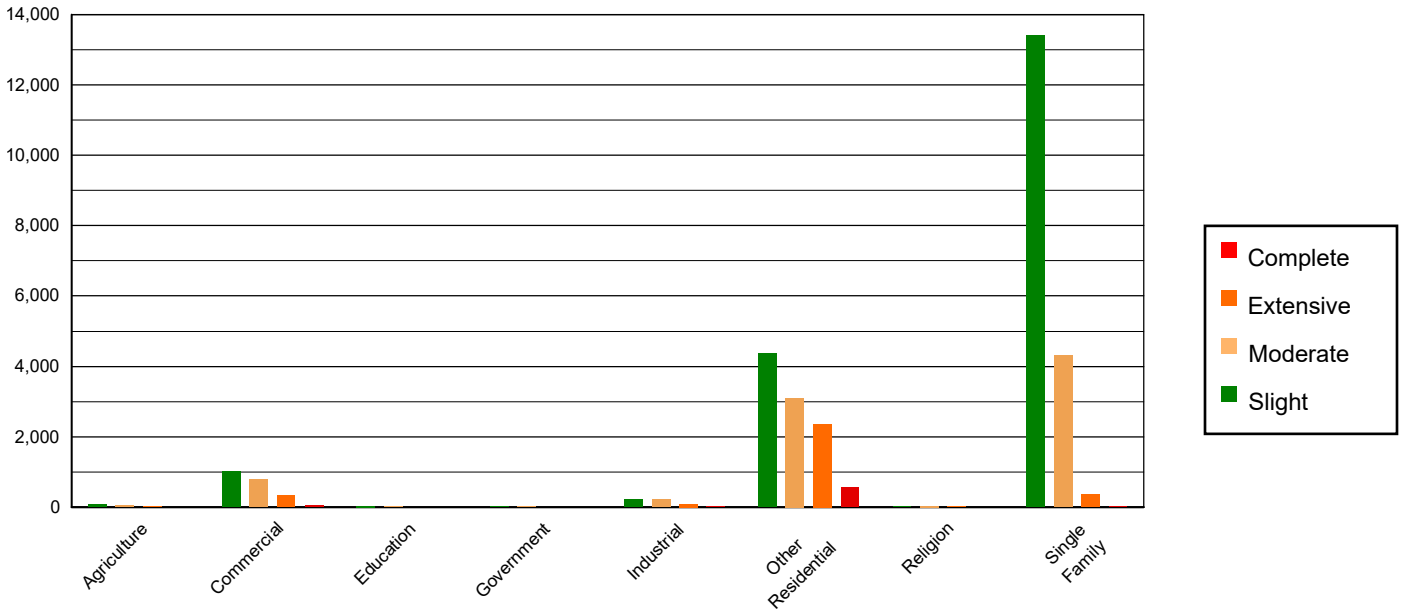


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	9614.14	1.39	82.12	0.43	47.13	0.55	12.48	0.39	1.12	0.17
Commercial	46606.06	6.72	1024.44	5.34	785.04	9.18	327.70	10.26	60.76	8.99
Education	1502.10	0.22	34.54	0.18	21.27	0.25	3.92	0.12	0.17	0.03
Government	2059.47	0.30	24.30	0.13	19.15	0.22	9.38	0.29	1.71	0.25
Industrial	11860.24	1.71	221.97	1.16	226.63	2.65	91.76	2.87	22.39	3.31
Other Residential	133820.61	19.28	4383.55	22.83	3112.81	36.40	2365.51	74.07	571.52	84.60
Religion	2623.78	0.38	27.97	0.15	32.73	0.38	16.79	0.53	1.74	0.26
Single Family	485941.36	70.02	13400.61	69.80	4307.60	50.37	366.26	11.47	16.17	2.39
Total	**694,028**		**19,200**		**8,552**		**3,194**		**676**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	571050.50	82.28	16597.35	86.45	5228.30	61.13	448.37	14.04	19.46	2.88
Steel	16957.72	2.44	329.27	1.71	402.77	4.71	185.81	5.82	45.74	6.77
Concrete	17741.92	2.56	493.47	2.57	376.84	4.41	195.65	6.13	43.43	6.43
Precast	11040.13	1.59	208.01	1.08	192.99	2.26	82.36	2.58	10.63	1.57
RM	22133.39	3.19	381.73	1.99	306.13	3.58	113.36	3.55	7.37	1.09
URM	2204.91	0.32	39.08	0.20	63.40	0.74	66.69	2.09	24.91	3.69
MH	52899.18	7.62	1150.60	5.99	1981.93	23.17	2101.57	65.80	524.04	77.57
Total	**694,028**		**19,200**		**8,552**		**3,194**		**676**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 3,638 hospital beds available for use. On the day of the earthquake, the model estimates that only 3,195 hospital beds (88.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 93.00% of the beds will be back in service. By 30 days, 99.00% 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	61	7	0	54
Schools	1,082	63	1	981
EOCs	21	1	0	20
PoliceStations	136	9	0	121
FireStations	575	16	0	546

Transportation Lifeline Damage

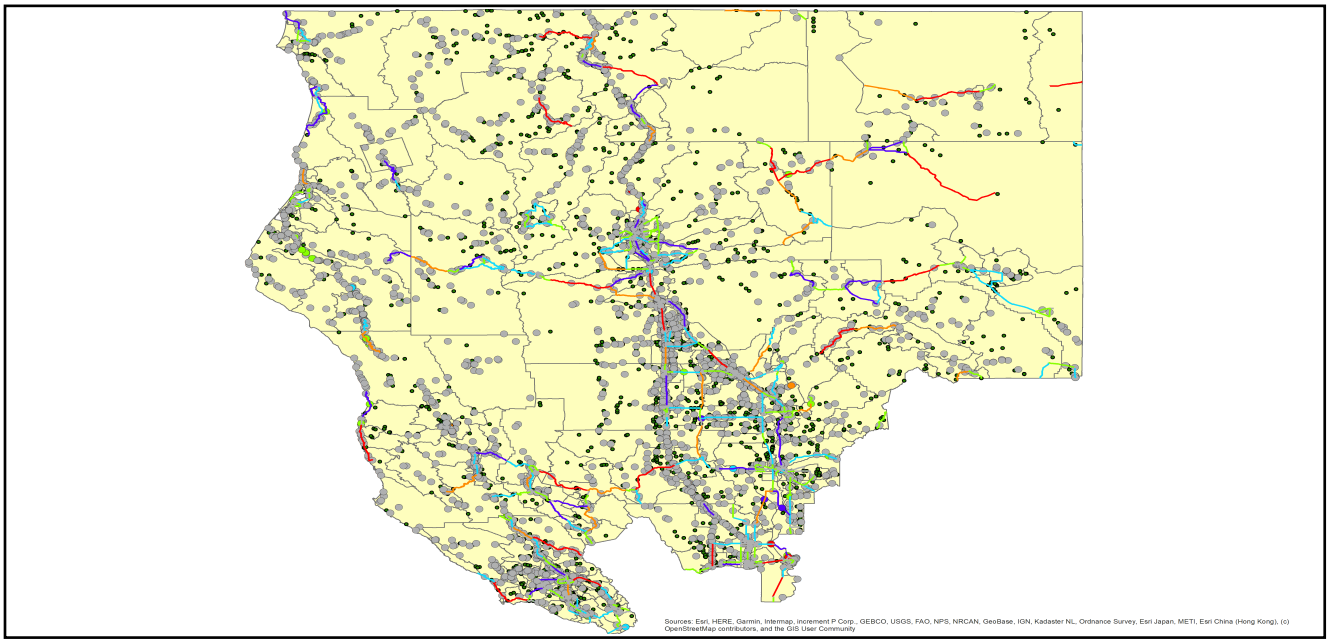


Table 6: Expected Damage to the Transportation Systems

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	1,334	0	0	1,334	1,334
	Bridges	4,883	9	0	4,875	4,877
	Tunnels	4	0	0	4	4
Railways	Segments	849	0	0	849	849
	Bridges	800	0	0	800	800
	Tunnels	0	0	0	0	0
	Facilities	8	0	0	8	8
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	10	0	0	10	10
Ferry	Facilities	0	0	0	0	0
Port	Facilities	58	1	0	57	58
Airport	Facilities	71	3	0	68	71
	Runways	84	0	0	84	84

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	6	0	0	6	6
Waste Water	66	1	0	58	65
Natural Gas	4	0	0	4	4
Oil Systems	1	0	0	1	1
Electrical Power	108	4	0	107	108
Communication	151	16	0	145	151

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

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	87,768	4076	1019
Waste Water	52,661	2048	512
Natural Gas	1,474	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	701,259	16,057	13,637	10,133	0	0
Electric Power		15,919	11,696	6,161	1,081	19

Induced Earthquake Damage

Fire Following Earthquake

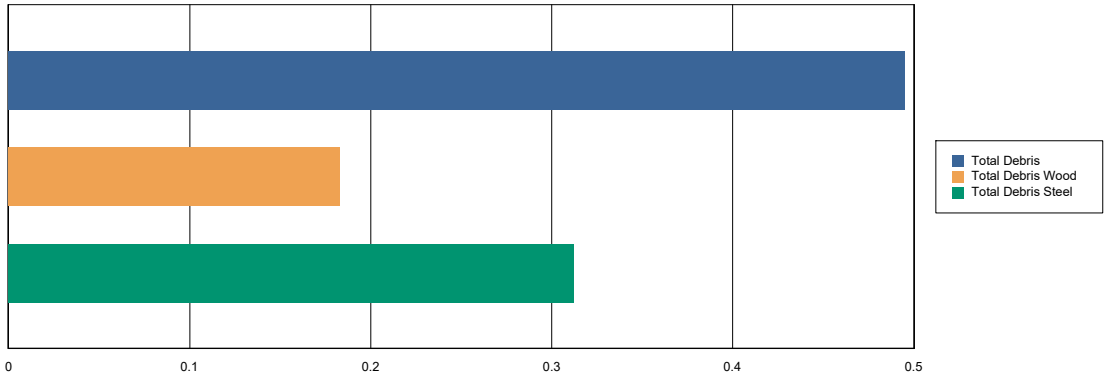
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there 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 495,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 37.00% 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 19,800 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



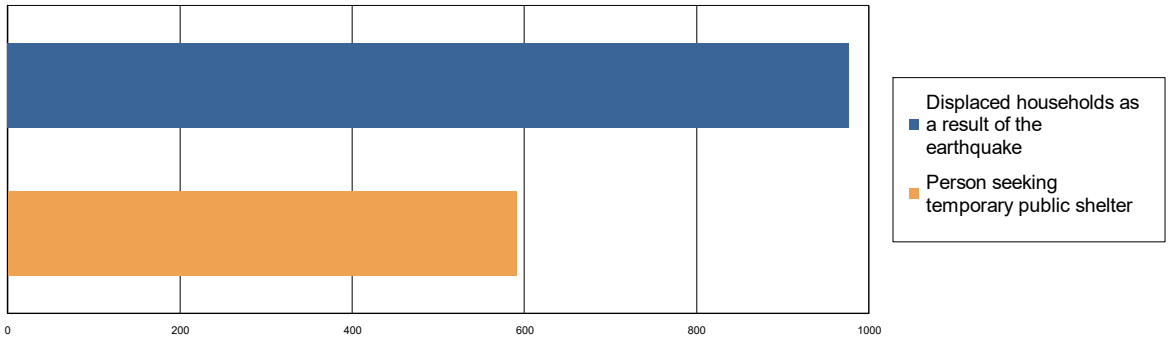
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.18	0.31	0.50	19,800 (@25 tons/truck)

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 977 households to be displaced due to the earthquake. Of these, 591 people (out of a total population of 1,842,224) 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
977	591

Casualties

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

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

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

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

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	1.62	0.34	0.04	0.08
	Commuting	0.02	0.03	0.04	0.01
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.06	0.01	0.00	0.00
	Industrial	1.35	0.29	0.04	0.07
	Other-Residential	141.41	25.75	1.89	3.39
	Single Family	55.05	4.79	0.06	0.10
	Total	**200**	**31**	**2**	**4**
2 PM	Commercial	133.94	26.57	3.22	6.23
	Commuting	0.17	0.25	0.39	0.08
	Educational	46.32	7.44	0.66	1.27
	Hotels	0.01	0.00	0.00	0.00
	Industrial	9.94	2.15	0.28	0.55
	Other-Residential	50.23	9.13	0.69	1.22
	Single Family	18.95	1.67	0.03	0.04
	Total	**260**	**47**	**5**	**9**
5 PM	Commercial	91.10	17.97	2.19	4.20
	Commuting	2.53	3.73	5.87	1.16
	Educational	8.00	1.00	0.05	0.10
	Hotels	0.02	0.00	0.00	0.00
	Industrial	6.22	1.35	0.18	0.34
	Other-Residential	51.62	9.44	0.72	1.28
	Single Family	20.85	1.85	0.03	0.04
	Total	**180**	**35**	**9**	**7**

Economic Loss

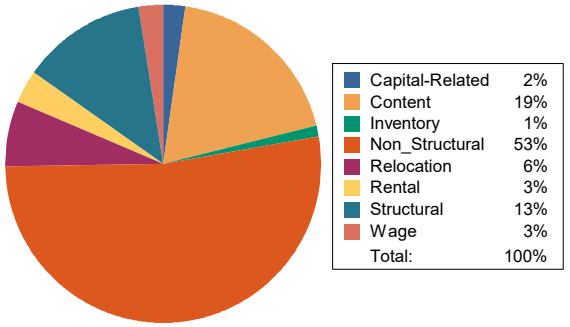
The total economic loss estimated for the earthquake is 3,482.37 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 2,755.02 (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 54 % 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)

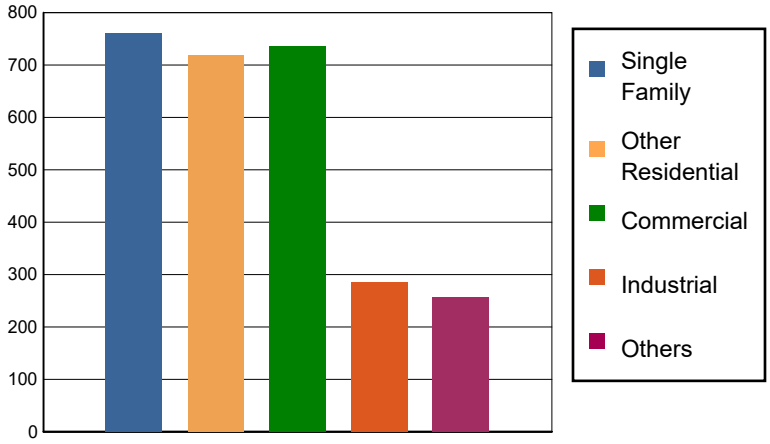


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	11.0457	43.3392	5.4325	9.1693	68.9867
	Capital-Related	0.0000	4.6931	50.3499	3.3492	1.8543	60.2465
	Rental	13.2381	34.0714	37.2105	2.2738	5.3114	92.1052
	Relocation	48.8773	34.9194	52.5694	10.4699	32.1900	179.0260
	Subtotal	**62.1154**	**84.7296**	**183.4690**	**21.5254**	**48.5250**	**400.3644**
Capital Stock Losses							
	Structural	85.0507	98.7223	95.6121	42.0265	32.2340	353.6456
	Non_Structural	459.2282	441.7411	297.6699	124.9551	126.3691	1,449.9634
	Content	153.8991	92.5504	141.5021	84.2804	46.2807	518.5127
	Inventory	0.0000	0.0000	16.3884	11.9401	4.2030	32.5315
	Subtotal	**698.1780**	**633.0138**	**551.1725**	**263.2021**	**209.0868**	**2354.6532**
	Total	**760.29**	**717.74**	**734.64**	**284.73**	**257.61**	**2755.02**

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	30817.7337	0.0000	0.00
	Bridges	13166.9442	44.2771	0.34
	Tunnels	44.1578	0.0564	0.13
	Subtotal	**44028.8357**	**44.3335**	
Railways	Segments	7205.9253	0.0000	0.00
	Bridges	4552.0000	0.1508	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	21.3040	0.1748	0.82
	Subtotal	**11779.2293**	**0.3256**	
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	22.9955	1.7296	7.52
	Subtotal	**22.9955**	**1.7296**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	221.0869	14.5249	6.57
	Subtotal	**221.0869**	**14.5249**	
Airport	Facilities	425.1064	21.8024	5.13
	Runways	492.0949	0.0000	0.00
	Subtotal	**917.2013**	**21.8024**	
	Total	**56,969.35**	**82.72**	

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	235.7640	0.4063	0.17
	Distribution Lines	2824.9758	18.3427	0.65
	Subtotal	**3060.7398**	**18.7490**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	11348.8188	228.2454	2.01
	Distribution Lines	1694.9855	9.2140	0.54
	Subtotal	**13043.8043**	**237.4594**	
Natural Gas	Pipelines	8353.1619	0.0000	0.00
	Facilities	164.9741	0.2273	0.14
	Distribution Lines	1129.9903	3.1566	0.28
	Subtotal	**9648.1263**	**3.3839**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.1180	0.0001	0.08
	Subtotal	**0.1180**	**0.0001**	
Electrical Power	Facilities	51363.7665	383.9503	0.75
	Subtotal	**51363.7665**	**383.9503**	
Communication	Facilities	17.8180	1.0954	6.15
	Subtotal	**17.8180**	**1.0954**	
	Total	**77,134.37**	**644.64**	

Appendix A: County Listing for the Region

Butte,CA

Colusa,CA

Del Norte,CA

Glenn,CA

Humboldt,CA

Lake,CA

Lassen,CA

Mendocino,CA

Modoc,CA

Plumas,CA

Shasta,CA

Siskiyou,CA

Sonoma,CA

Sutter,CA

Tehama,CA

Trinity,CA

Yolo,CA

Yuba,CA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
California					
	Butte	211,632	25,875	16,639	42,514
	Colusa	21,839	2,244	2,024	4,268
	Del Norte	27,743	5,004	1,876	6,881
	Glenn	28,917	2,791	3,717	6,508
	Humboldt	136,463	19,361	8,683	28,044
	Lake	68,163	9,699	4,530	14,229
	Lassen	32,730	4,033	2,008	6,042
	Mendocino	91,601	14,237	8,510	22,748
	Modoc	8,700	1,435	1,468	2,904
	Plumas	19,790	6,128	2,276	8,405
	Shasta	182,155	21,572	15,715	37,288
	Siskiyou	44,076	6,856	4,758	11,615
	Sonoma	488,863	68,827	35,781	104,609
	Sutter	99,633	10,618	6,448	17,066
	Tehama	65,829	7,705	5,113	12,818
	Trinity	16,112	2,209	1,485	3,694
	Yolo	216,403	24,130	18,343	42,473
	Yuba	81,575	8,161	4,677	12,839
Total Region		**1,842,224**	**240,885**	**144,051**	**384,945**