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Hazus-MH: Earthquake Global Risk Report

Region Name: Lane_CSZ

Earthquake Scenario: Lane_EugeneRegion_CSZ_M9

Print Date: May 08, 2018

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 1 county(ies) from the following state(s):

Oregon

Note:

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

The geographical size of the region is 4,618.08 square miles and contains 86 census tracts. There are over 145 thousand households in the region which has a total population of 351,715 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 138 thousand buildings in the region with a total building replacement value (excluding contents) of 35,999 (millions of dollars). Approximately 92.00 % of the buildings (and 76.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 6,841 and 1,941 (millions of dollars) , respectively.



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Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 138 thousand buildings in the region which have an aggregate total replacement value of 35,999 (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 81% 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 4 hospitals in the region with a total bed capacity of 586 beds. There are 157 schools, 50 fire stations, 11 police stations and 2 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the inventory. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 91 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 8,782.00 (millions of dollars). This inventory includes over 644 kilometers of highways, 199 bridges, 28,459 kilometers of pipes.



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Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	199	3,407.20
	Segments	198	2,776.60
	Tunnels	2	10.40
	Subtotal		6,194.20
Railways	Bridges	0	0.00
	Facilities	6	16.00
	Segments	143	384.70
	Tunnels	0	0.00
	Subtotal		400.70
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	3	3.70
	Subtotal		3.70
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	5	10.00
	Subtotal		10.00
Airport	Facilities	4	42.60
	Runways	5	189.80
	Subtotal		232.40
		Total	6,841.00

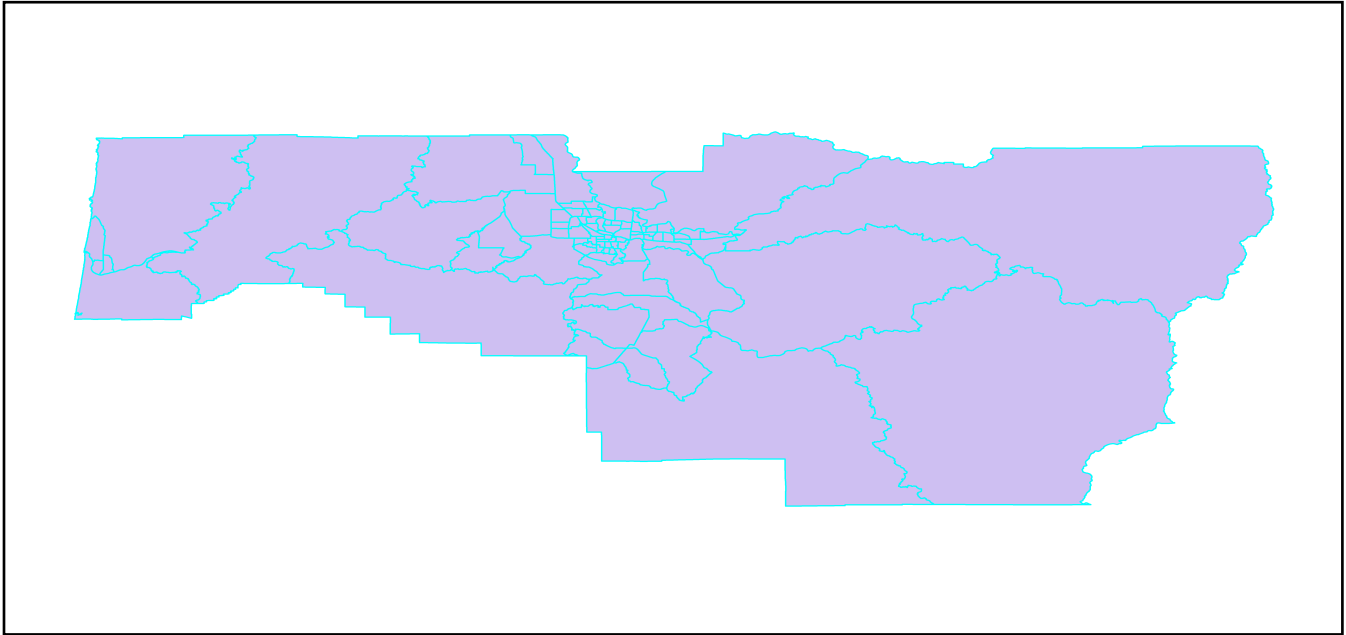

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Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	284.60
	Facilities	7	263.40
	Pipelines	0	0.00
	Subtotal		548.00
Waste Water	Distribution Lines	NA	170.80
	Facilities	13	978.40
	Pipelines	0	0.00
	Subtotal		1,149.10
Natural Gas	Distribution Lines	NA	113.80
	Facilities	2	2.50
	Pipelines	0	0.00
	Subtotal		116.30
Oil Systems	Facilities	1	0.10
	Pipelines	0	0.00
	Subtotal		0.10
Electrical Power	Facilities	1	124.30
	Subtotal		124.30
Communication	Facilities	37	4.20
	Subtotal		4.20
		Total	1,942.00


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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	Lane_EugeneRegion_CSZ_M9
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	9.00
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA


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Building Damage

Building Damage

Hazus estimates that about 23,757 buildings will be at least moderately damaged. This is over 17.00 % of the buildings in the region. There are an estimated 4,949 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

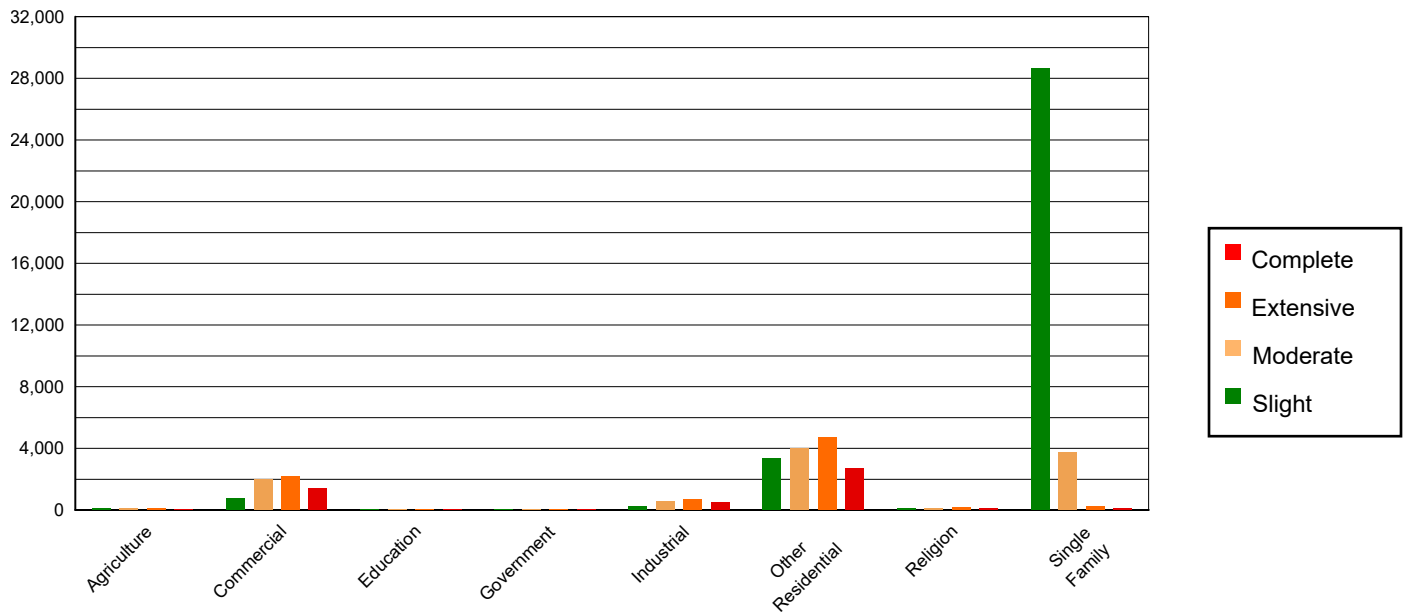


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	237	0.29	89	0.27	80	0.76	103	1.26	69	1.40
Commercial	1,166	1.43	759	2.29	2,002	18.93	2,165	26.29	1,411	28.51
Education	90	0.11	40	0.12	56	0.53	76	0.92	55	1.11
Government	47	0.06	14	0.04	34	0.32	58	0.71	60	1.21
Industrial	428	0.52	202	0.61	563	5.33	712	8.65	456	9.21
Other Residential	6,338	7.76	3,338	10.05	3,967	37.52	4,737	57.53	2,685	54.24
Religion	211	0.26	99	0.30	131	1.24	180	2.19	124	2.50
Single Family	73,172	89.57	28,675	86.33	3,740	35.37	202	2.46	90	1.82
Total	81,688		33,218		10,574		8,234		4,949	


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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	76,341	93.45	30417	91.57	4,592	43.43	450	5.47	72	1.46
Steel	351	0.43	97	0.29	399	3.78	947	11.50	875	17.68
Concrete	314	0.38	127	0.38	557	5.27	857	10.41	496	10.02
Precast	315	0.39	75	0.22	362	3.42	793	9.63	596	12.05
RM	39	0.05	9	0.03	55	0.52	101	1.23	48	0.98
URM	934	1.14	801	2.41	1,224	11.57	830	10.08	539	10.89
MH	3,393	4.15	1692	5.09	3,385	32.02	4,255	51.67	2,322	46.92
Total	81,688		33,218		10,574		8,234		4,949	

*Note:

RM Reinforced Masonry
 URM Unreinforced Masonry
 MH Manufactured Housing


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Essential Facility Damage

Before the earthquake, the region had 586 hospital beds available for use. On the day of the earthquake, the model estimates that only 138 hospital beds (24.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 30.00% of the beds will be back in service. By 30 days, 62.00% will be operational.

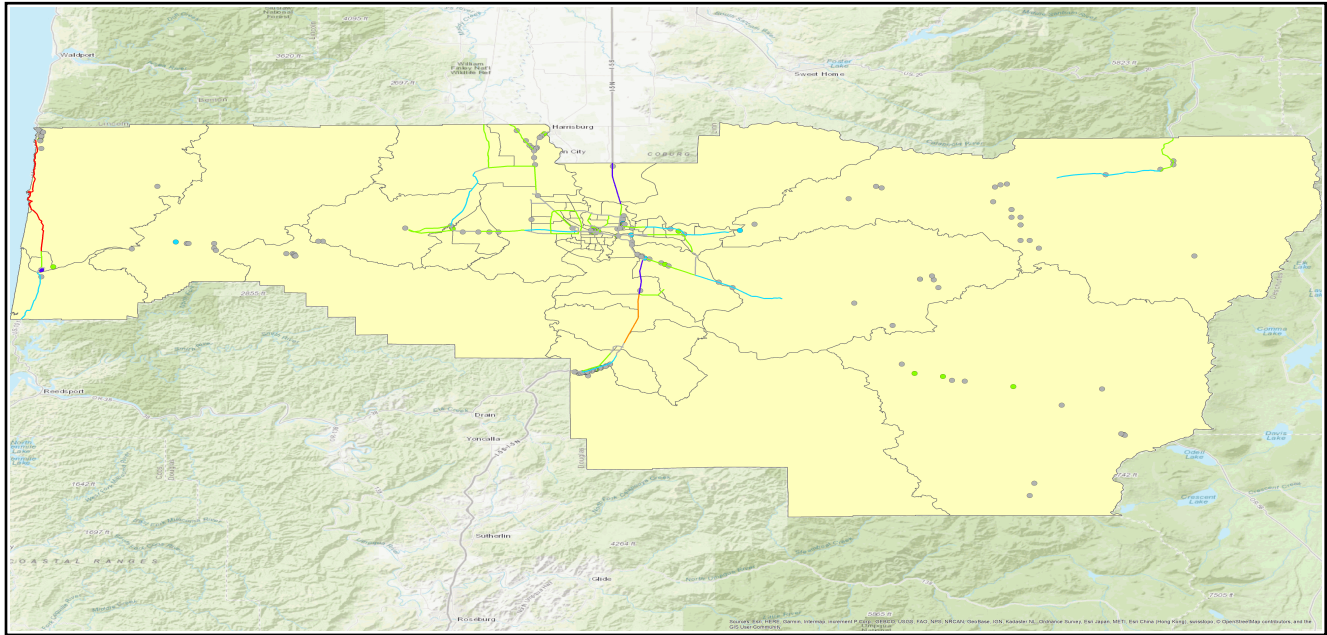
Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	4	3	0	1
Schools	157	0	0	111
EOCs	2	0	0	1
PoliceStations	11	0	0	6
FireStations	50	0	0	40



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Transportation Lifeline Damage




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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	198	0	0	198	198
	Bridges	199	18	0	181	189
	Tunnels	2	0	0	2	2
Railways	Segments	143	0	0	143	143
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	6	0	0	6	6
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	3	0	0	3	3
Ferry	Facilities	0	0	0	0	0
Port	Facilities	5	0	0	5	5
Airport	Facilities	4	0	0	4	4
	Runways	5	0	0	5	5

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.



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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	7	0	0	7	7
Waste Water	13	3	0	6	13
Natural Gas	2	0	0	2	2
Oil Systems	1	0	0	1	1
Electrical Power	1	0	0	0	1
Communication	37	6	0	37	37

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	14,230	1957	489
Waste Water	8,538	1403	351
Natural Gas	5,692	402	101
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	145,966	13,704	10,710	5,532	0	0
Electric Power		0	0	0	0	0

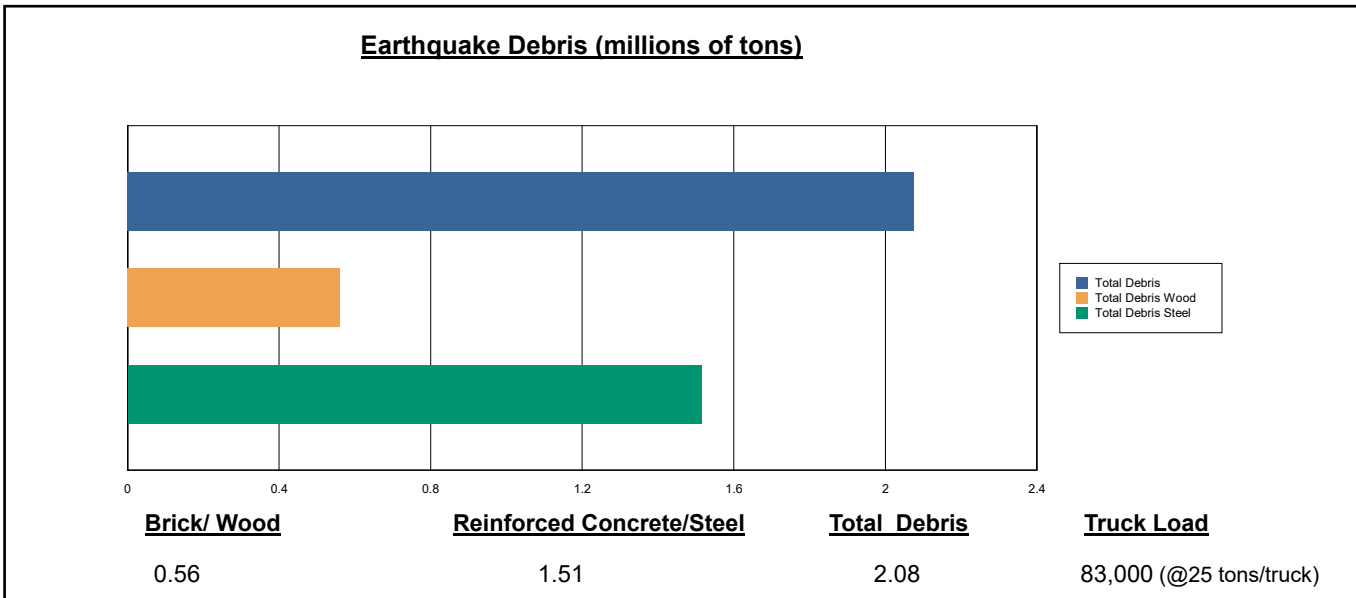


Induced Earthquake Damage

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 2.08 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 27.00% 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 83,000 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.



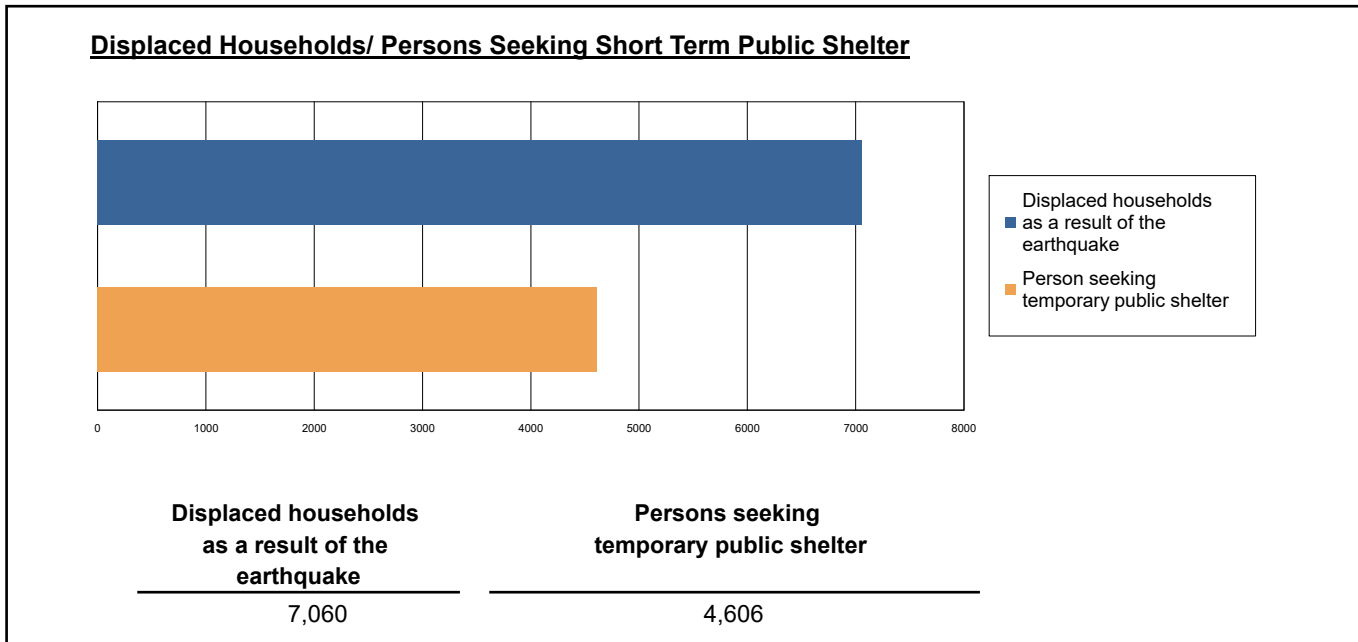


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Social Impact

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 7,060 households to be displaced due to the earthquake. Of these, 4,606 people (out of a total population of 351,715) 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



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Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	44	13	2	4
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	69	20	3	6
	Other-Residential	866	226	28	54
	Single Family	106	16	2	4
	Total	1,085	276	36	68
2 PM	Commercial	2,544	754	125	245
	Commuting	0	0	1	0
	Educational	1,226	369	62	120
	Hotels	0	0	0	0
	Industrial	506	150	24	47
	Other-Residential	172	45	6	10
	Single Family	21	3	0	1
	Total	4,471	1,321	217	424
5 PM	Commercial	1,813	536	89	173
	Commuting	6	7	14	3
	Educational	307	93	16	31
	Hotels	0	0	0	0
	Industrial	317	94	15	29
	Other-Residential	325	86	11	20
	Single Family	41	7	1	2
	Total	2,809	823	145	257



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Economic Loss

The total economic loss estimated for the earthquake is 6,421.04 (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.



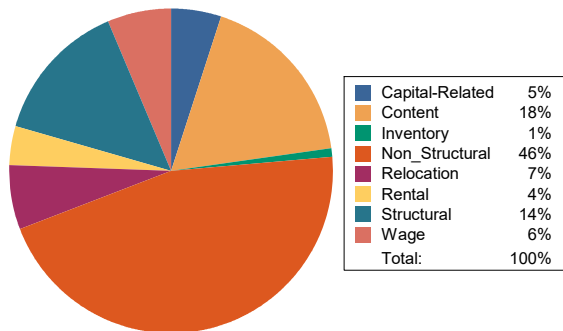
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Building-Related Losses

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 6,124.66 (millions of dollars); 22 % 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 30 % 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)

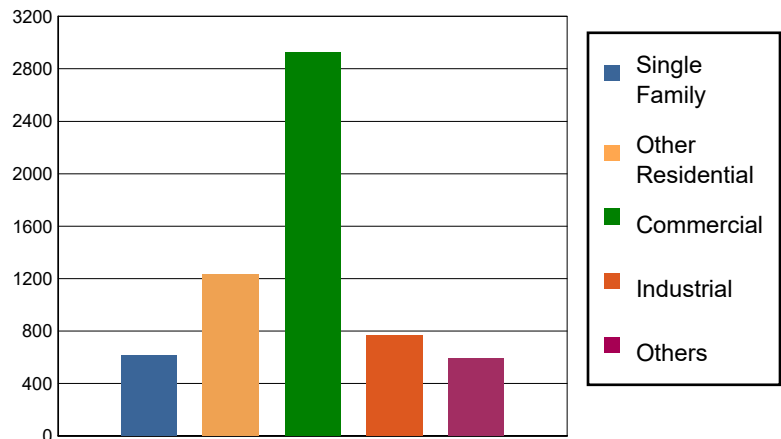


Table 11: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	23.29	325.66	17.18	20.01	386.14
	Capital-Related	0.00	9.94	283.85	10.27	5.33	309.39
	Rental	8.68	81.40	129.84	6.41	11.79	238.12
	Relocation	26.93	62.61	205.26	25.41	82.81	403.02
	Subtotal	35.61	177.24	944.62	59.26	119.95	1,336.68
Capital Stock Losses							
	Structural	55.51	183.50	414.06	116.22	96.85	866.14
	Non_Structural	360.87	726.52	1,098.04	342.61	260.43	2,788.47
	Content	165.74	145.52	453.67	209.81	109.66	1,084.41
	Inventory	0.00	0.00	11.36	36.13	1.48	48.96
	Subtotal	582.12	1,055.54	1,977.13	704.77	468.42	4,787.98
	Total	617.73	1,232.78	2,921.75	764.02	588.37	6,124.66


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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	2,776.60	\$0.00	0.00
	Bridges	3,407.19	\$153.80	4.51
	Tunnels	10.38	\$0.00	0.03
	Subtotal	6,194	153.80	
Railways	Segments	384.74	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	15.98	\$3.13	19.61
	Subtotal	401	3.10	
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	0.00	
Bus	Facilities	3.70	\$0.81	21.89
	Subtotal	4	0.80	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0	0.00	
Port	Facilities	9.99	\$0.65	6.51
	Subtotal	10	0.70	
Airport	Facilities	42.60	\$6.75	15.83
	Runways	189.82	\$0.00	0.00
	Subtotal	232	6.70	
	Total	6,841.00	165.10	


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Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	263.40	\$11.26	4.28
	Distribution Lines	284.60	\$8.81	3.09
	Subtotal	547.99	\$20.07	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	978.40	\$83.62	8.55
	Distribution Lines	170.80	\$6.31	3.70
	Subtotal	1,149.11	\$89.93	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	2.50	\$0.21	8.57
	Distribution Lines	113.80	\$1.81	1.59
	Subtotal	116.30	\$2.02	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.10	\$0.01	9.91
	Subtotal	0.11	\$0.01	
Electrical Power	Facilities	124.30	\$18.87	15.18
	Subtotal	124.30	\$18.87	
Communication	Facilities	4.20	\$0.33	7.83
	Subtotal	4.18	\$0.33	
	Total	1,942.00	\$131.23	



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Appendix A: County Listing for the Region

Lane,OR



Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Oregon	Lane	351,715	27,437	8,561	35,999
Total State		351,715	27,437	8,561	35,999
Total Region		351,715	27,437	8,561	35,999