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## Hazus-MH: Earthquake Global Risk Report

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**Region Name:** Eugene\_ACrustal2

**Earthquake Scenario:** Abitrary Eugene Fault

**Print Date:** May 02, 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 545.41 square miles and contains 65 census tracts. There are over 113 thousand households in the region which has a total population of 274,657 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 101 thousand buildings in the region with a total building replacement value (excluding contents) of 28,781 (millions of dollars). Approximately 91.00 % of the buildings (and 75.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 3,834 and 419 (millions of dollars) , respectively.



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## Building and Lifeline Inventory

### Building Inventory

Hazus estimates that there are 101 thousand buildings in the region which have an aggregate total replacement value of 28,781 (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 83% 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 3 hospitals in the region with a total bed capacity of 565 beds. There are 108 schools, 21 fire stations, 7 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 86 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 4,253.00 (millions of dollars). This inventory includes over 326 kilometers of highways, 72 bridges, 21,931 kilometers of pipes.



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**Table 1: Transportation System Lifeline Inventory**

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	72	1,926.00
	Segments	164	1,610.30
	Tunnels	0	0.00
	Subtotal		<b>3,536.30</b>
Railways	Bridges	0	0.00
	Facilities	6	16.00
	Segments	55	145.00
	Tunnels	0	0.00
	Subtotal		<b>161.00</b>
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		<b>0.00</b>
Bus	Facilities	2	2.50
	Subtotal		<b>2.50</b>
Ferry	Facilities	0	0.00
	Subtotal		<b>0.00</b>
Port	Facilities	0	0.00
	Subtotal		<b>0.00</b>
Airport	Facilities	2	21.30
	Runways	3	113.90
	Subtotal		<b>135.20</b>
		Total	<b>3,835.00</b>



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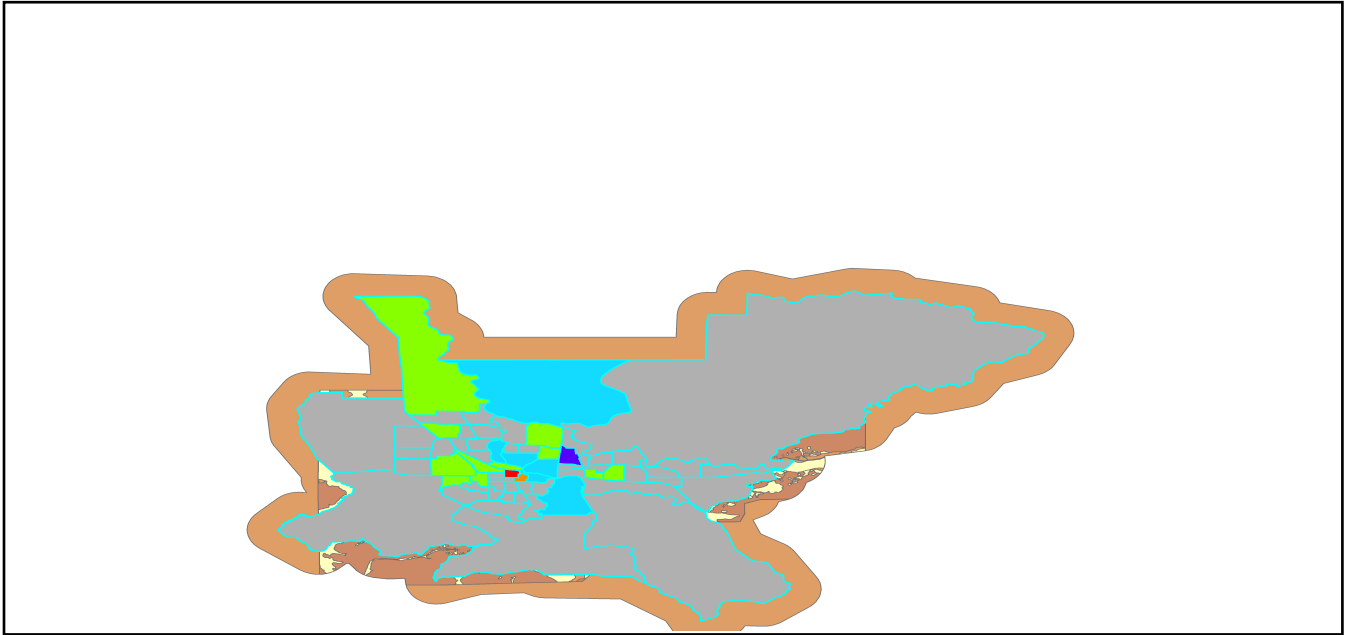
**Table 2: Utility System Lifeline Inventory**

System	Component	# Locations / Segments	Replacement value (millions of dollars)
<b>Potable Water</b>	Distribution Lines	NA	219.30
	Facilities	3	112.90
	Pipelines	0	0.00
	Subtotal		<b>332.20</b>
<b>Waste Water</b>	Distribution Lines	NA	131.60
	Facilities	4	301.00
	Pipelines	0	0.00
	Subtotal		<b>432.60</b>
<b>Natural Gas</b>	Distribution Lines	NA	87.70
	Facilities	2	2.50
	Pipelines	0	0.00
	Subtotal		<b>90.20</b>
<b>Oil Systems</b>	Facilities	1	0.10
	Pipelines	0	0.00
	Subtotal		<b>0.10</b>
<b>Electrical Power</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Communication</b>	Facilities	28	3.20
	Subtotal		<b>3.20</b>
	Total		<b>858.30</b>


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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.



<b>Scenario Name</b>	Arbitrary Eugene Fault
<b>Type of Earthquake</b>	Arbitrary
<b>Fault Name</b>	NA
<b>Historical Epicenter ID #</b>	NA
<b>Probabilistic Return Period</b>	NA
<b>Longitude of Epicenter</b>	-123.05
<b>Latitude of Epicenter</b>	44.08
<b>Earthquake Magnitude</b>	6.50
<b>Depth (km)</b>	10.00
<b>Rupture Length (Km)</b>	17.18
<b>Rupture Orientation (degrees)</b>	165.00
<b>Attenuation Function</b>	Pacific Northwest (PNW 2008) - Reverse



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## Building Damage

### Building Damage

Hazus estimates that about 44,747 buildings will be at least moderately damaged. This is over 44.00 % of the buildings in the region. There are an estimated 7,773 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

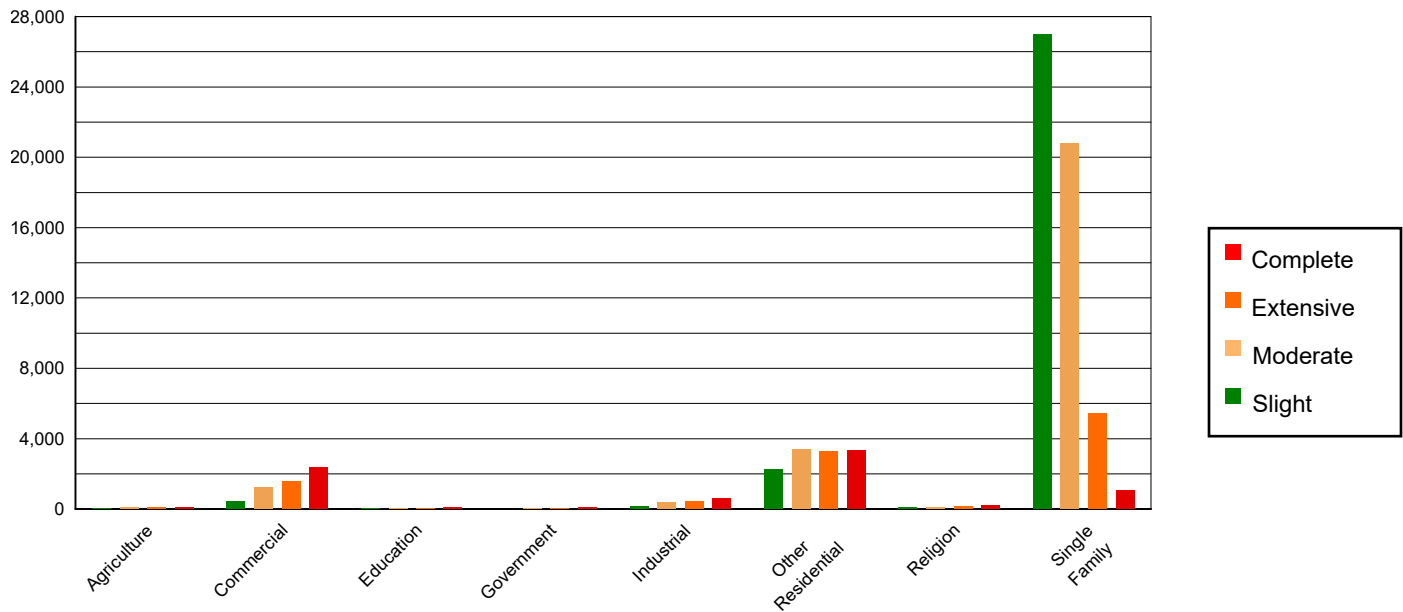


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Agriculture</b>	67	0.25	65	0.22	77	0.30	68	0.62	96	1.23
<b>Commercial</b>	367	1.35	459	1.53	1,222	4.70	1,537	14.01	2,342	30.13
<b>Education</b>	28	0.10	30	0.10	48	0.18	55	0.50	85	1.10
<b>Government</b>	6	0.02	6	0.02	19	0.07	37	0.34	87	1.12
<b>Industrial</b>	155	0.57	147	0.49	373	1.44	452	4.12	627	8.06
<b>Other Residential</b>	1,666	6.14	2,267	7.55	3,385	13.02	3,247	29.60	3,296	42.41
<b>Religion</b>	62	0.23	73	0.24	114	0.44	126	1.15	195	2.51
<b>Single Family</b>	24,768	91.33	26,993	89.86	20,766	79.86	5,449	49.67	1,045	13.45
<b>Total</b>	<b>27,118</b>		<b>30,040</b>		<b>26,004</b>		<b>10,970</b>		<b>7,773</b>	




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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	(%)
<b>Wood</b>	26,009	95.91	28646	95.36	22,360	85.99	6,009	54.77	1,157	14.89
<b>Steel</b>	118	0.43	89	0.29	306	1.18	564	5.15	1,007	12.95
<b>Concrete</b>	113	0.42	121	0.40	355	1.37	515	4.70	777	10.00
<b>Precast</b>	105	0.39	81	0.27	276	1.06	441	4.02	747	9.60
<b>RM</b>	15	0.06	10	0.03	35	0.13	56	0.51	84	1.08
<b>URM</b>	225	0.83	314	1.04	675	2.60	789	7.19	1,390	17.88
<b>MH</b>	533	1.97	780	2.60	1,996	7.68	2,595	23.66	2,611	33.59
<b>Total</b>	<b>27,118</b>		<b>30,040</b>		<b>26,004</b>		<b>10,970</b>		<b>7,773</b>	

\*Note:

RM      Reinforced Masonry  
 URM    Unreinforced Masonry  
 MH      Manufactured Housing


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### **Essential Facility Damage**

Before the earthquake, the region had 565 hospital beds available for use. On the day of the earthquake, the model estimates that only 4 hospital beds (1.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 4.00% of the beds will be back in service. By 30 days, 25.00% will be operational.

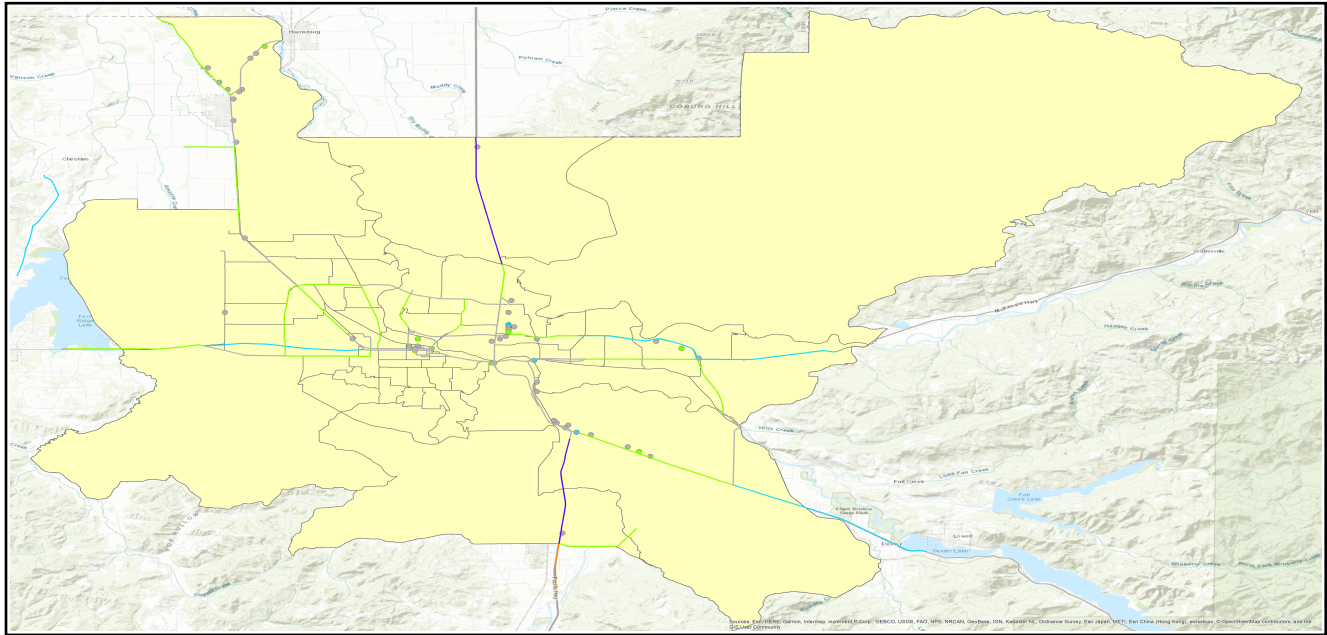
**Table 5: Expected Damage to Essential Facilities**

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	3	3	1	0
Schools	108	19	0	13
EOCs	2	0	0	0
PoliceStations	7	2	0	1
FireStations	21	4	0	6



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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	164	0	0	164	164
	Bridges	72	30	12	42	55
	Tunnels	0	0	0	0	0
Railways	Segments	55	0	0	55	55
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	6	1	0	5	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	2	1	0	1	2
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	2	1	0	2	2
	Runways	3	0	0	3	3

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	3	3	0	0	3
Waste Water	4	4	0	0	4
Natural Gas	2	2	0	0	2
Oil Systems	1	1	0	0	1
Electrical Power	0	0	0	0	0
Communication	28	27	0	19	28

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	10,966	4452	1113
Waste Water	6,580	3190	798
Natural Gas	4,386	915	229
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	113,685	56,418	53,910	48,550	10,995	0
Electric Power		58,225	35,898	14,757	2,885	81



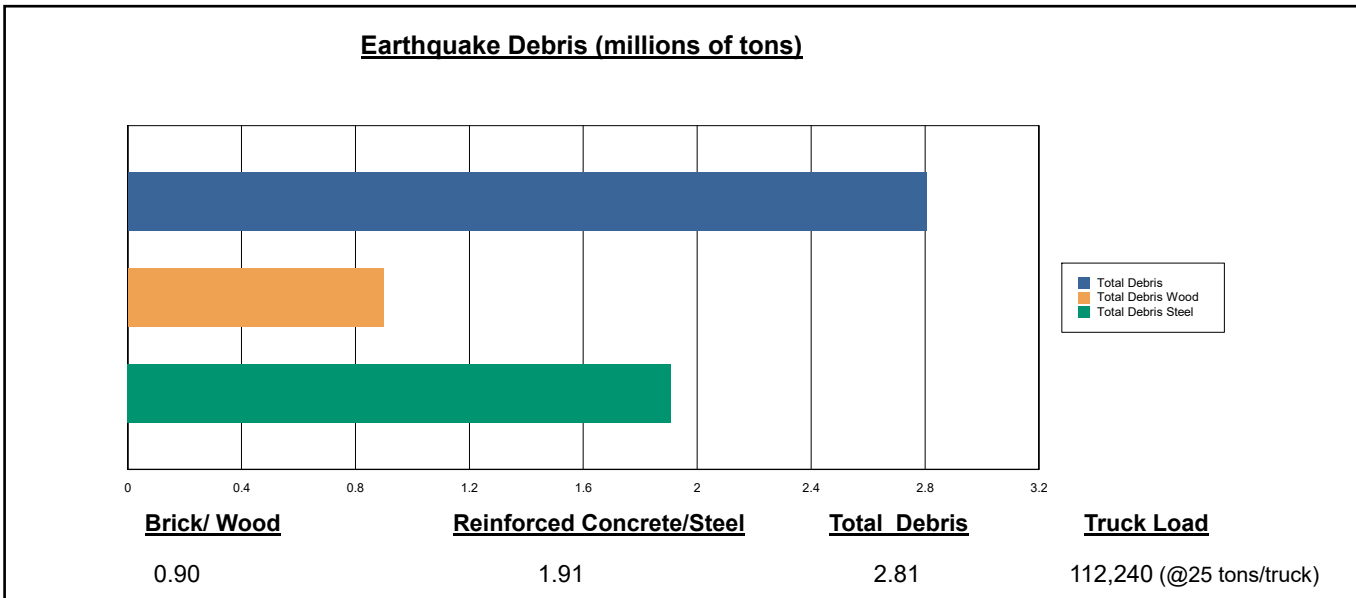
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## Induced Earthquake Damage

### 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 2.81 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 32.00% 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 112,240 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.





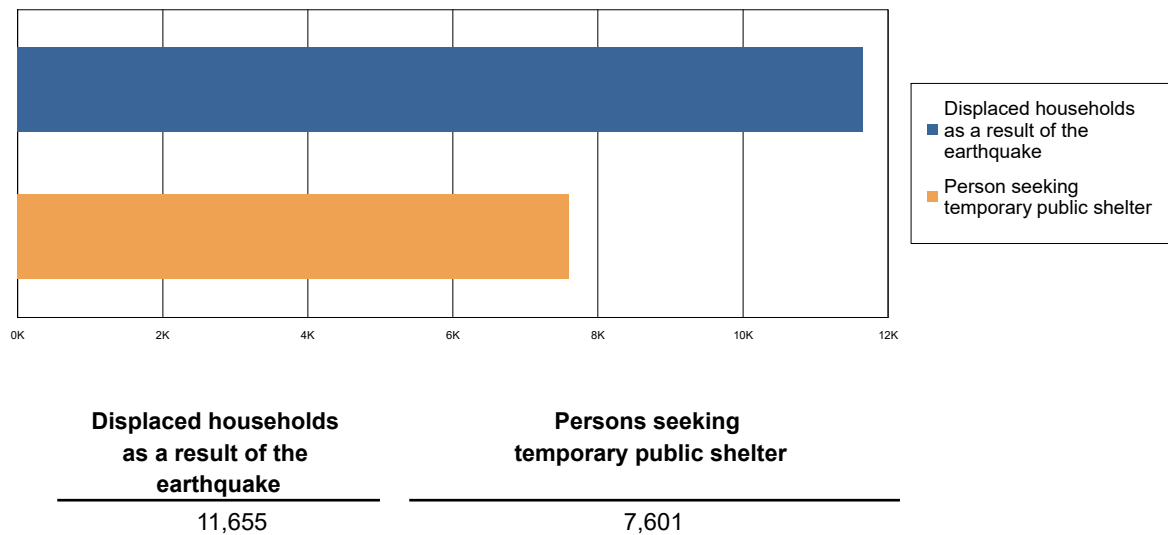
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## Social Impact

### 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 11,655 households to be displaced due to the earthquake. Of these, 7,601 people (out of a total population of 274,657) will seek temporary shelter in public shelters.

#### Displaced Households/ Persons Seeking Short Term Public Shelter



### 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
<b>2 AM</b>	Commercial	69	22	4	7
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	85	27	4	9
	Other-Residential	1,327	378	52	101
	Single Family	512	92	7	14
	<b>Total</b>	<b>1,993</b>	<b>518</b>	<b>68</b>	<b>131</b>
<b>2 PM</b>	Commercial	3,983	1,254	210	413
	Commuting	1	1	2	0
	Educational	1,881	603	103	201
	Hotels	0	0	0	0
	Industrial	628	197	33	64
	Other-Residential	275	79	11	21
	Single Family	108	20	2	3
	<b>Total</b>	<b>6,876</b>	<b>2,154</b>	<b>361</b>	<b>701</b>
<b>5 PM</b>	Commercial	2,840	894	150	292
	Commuting	17	21	38	7
	Educational	500	161	28	54
	Hotels	0	0	0	0
	Industrial	392	123	20	40
	Other-Residential	509	146	21	39
	Single Family	202	37	3	6
	<b>Total</b>	<b>4,461</b>	<b>1,382</b>	<b>260</b>	<b>437</b>





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## Economic Loss

The total economic loss estimated for the earthquake is 10,682.71 (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.

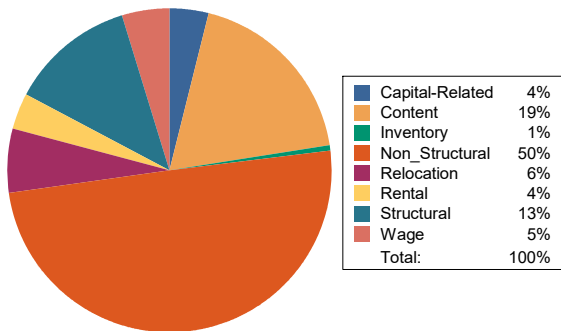


## Building-Related Losses

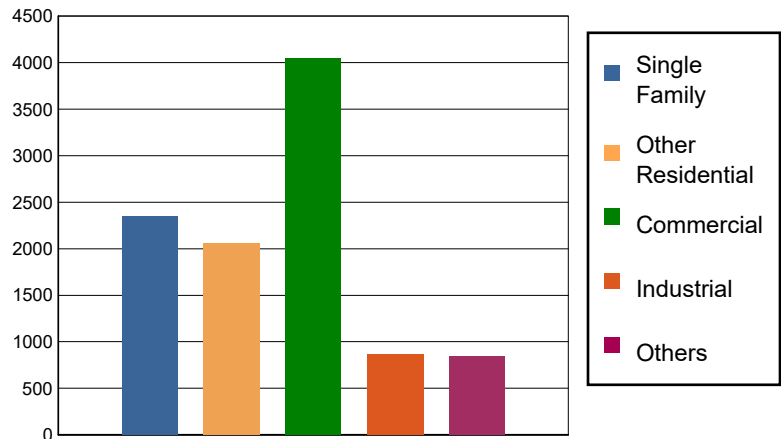
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 10,176.10 (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 43 % 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
<b>Income Losses</b>							
	Wage	0.00	41.15	397.10	15.81	24.12	478.19
	Capital-Related	0.00	17.56	348.14	9.42	6.89	382.01
	Rental	63.36	127.41	146.64	5.35	14.18	356.94
	Relocation	225.79	81.34	230.66	22.35	101.03	661.17
	<b>Subtotal</b>	<b>289.15</b>	<b>267.47</b>	<b>1,122.54</b>	<b>52.94</b>	<b>146.22</b>	<b>1,878.32</b>
<b>Capital Stock Losses</b>							
	Structural	302.28	256.91	499.44	107.72	115.74	1,282.08
	Non_Structural	1,352.61	1,257.32	1,642.37	403.28	393.32	5,048.90
	Content	407.82	278.82	766.41	258.25	189.48	1,900.79
	Inventory	0.00	0.00	16.84	46.97	2.20	66.01
	<b>Subtotal</b>	<b>2,062.71</b>	<b>1,793.04</b>	<b>2,925.07</b>	<b>816.22</b>	<b>700.74</b>	<b>8,297.78</b>
	<b>Total</b>	<b>2,351.86</b>	<b>2,060.51</b>	<b>4,047.61</b>	<b>869.16</b>	<b>846.96</b>	<b>10,176.10</b>


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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)

<b>System</b>	<b>Component</b>	<b>Inventory Value</b>	<b>Economic Loss</b>	<b>Loss Ratio (%)</b>
<b>Highway</b>	Segments	1,610.29	\$0.00	0.00
	Bridges	1,926.05	\$329.24	17.09
	Tunnels	0.00	\$0.00	0.00
	<b>Subtotal</b>	<b>3,536</b>	<b>329.20</b>	
<b>Railways</b>	Segments	145.03	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	15.98	\$4.90	30.66
	<b>Subtotal</b>	<b>161</b>	<b>4.90</b>	
<b>Light Rail</b>	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
	<b>Subtotal</b>	<b>0</b>	<b>0.00</b>	
<b>Bus</b>	Facilities	2.46	\$1.10	44.49
	<b>Subtotal</b>	<b>2</b>	<b>1.10</b>	
<b>Ferry</b>	Facilities	0.00	\$0.00	0.00
	<b>Subtotal</b>	<b>0</b>	<b>0.00</b>	
<b>Port</b>	Facilities	0.00	\$0.00	0.00
	<b>Subtotal</b>	<b>0</b>	<b>0.00</b>	
<b>Airport</b>	Facilities	21.30	\$6.53	30.66
	Runways	113.89	\$0.00	0.00
	<b>Subtotal</b>	<b>135</b>	<b>6.50</b>	
	<b>Total</b>	<b>3,835.00</b>	<b>341.80</b>	


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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	112.90	\$25.05	22.19
	Distribution Lines	219.30	\$20.03	9.13
	Subtotal	<b>332.21</b>	<b>\$45.08</b>	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	301.00	\$99.40	33.02
	Distribution Lines	131.60	\$14.36	10.91
	Subtotal	<b>432.62</b>	<b>\$113.76</b>	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	2.50	\$1.07	43.38
	Distribution Lines	87.70	\$4.12	4.69
	Subtotal	<b>90.19</b>	<b>\$5.19</b>	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.10	\$0.02	20.88
	Subtotal	<b>0.11</b>	<b>\$0.02</b>	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>\$0.00</b>	
Communication	Facilities	3.20	\$0.79	25.00
	Subtotal	<b>3.16</b>	<b>\$0.79</b>	
	Total	<b>858.30</b>	<b>\$164.84</b>	



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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	274,657	21,614	7,166	28,781
Total State		274,657	21,614	7,166	28,781
Total Region		274,657	21,614	7,166	28,781