



FEMA

Note to Readers:

While performing the Hazus analysis the authors of DOGAMI publication IMS-60 discovered some software bugs associated with the Lane County data when using the CSZ ground motion input data. Hazus would not accept the tract (building) values the authors entered, so the authors were forced to analyze the tract data separately from the rest of the assets in Hazus. The Hazus global reports provided in Appendix B of IMS-60 include both sets of results, but the sections in each report that should not be used have been obscured via redaction.



Hazus-MH: Earthquake Global Risk Report

Region Name: CSZ_Detailed_LSDry

Earthquake Scenario: Lane_CSZ_m9y

Print Date: May 09, 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.


FEMA

Table of Contents

Section	Page #
General Description of the Region	3
Building and Lifeline Inventory	4
Building Inventory	
Critical Facility Inventory	
Transportation and Utility Lifeline Inventory	
Earthquake Scenario Parameters	6
Direct Earthquake Damage	7
Buildings Damage	
Critical Facilities Damage	
Transportation and Utility Lifeline Damage	
Induced Earthquake Damage	11
Debris Generation	
Social Impact	12
Shelter Requirements	
Casualties	
Economic Loss	13
Building Losses	
Transportation and Utility Lifeline Losses	
 Appendix A: County Listing for the Region	
Appendix B: Regional Population and Building Value Data	

**FEMA**

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.



FEMA

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.


FEMA
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

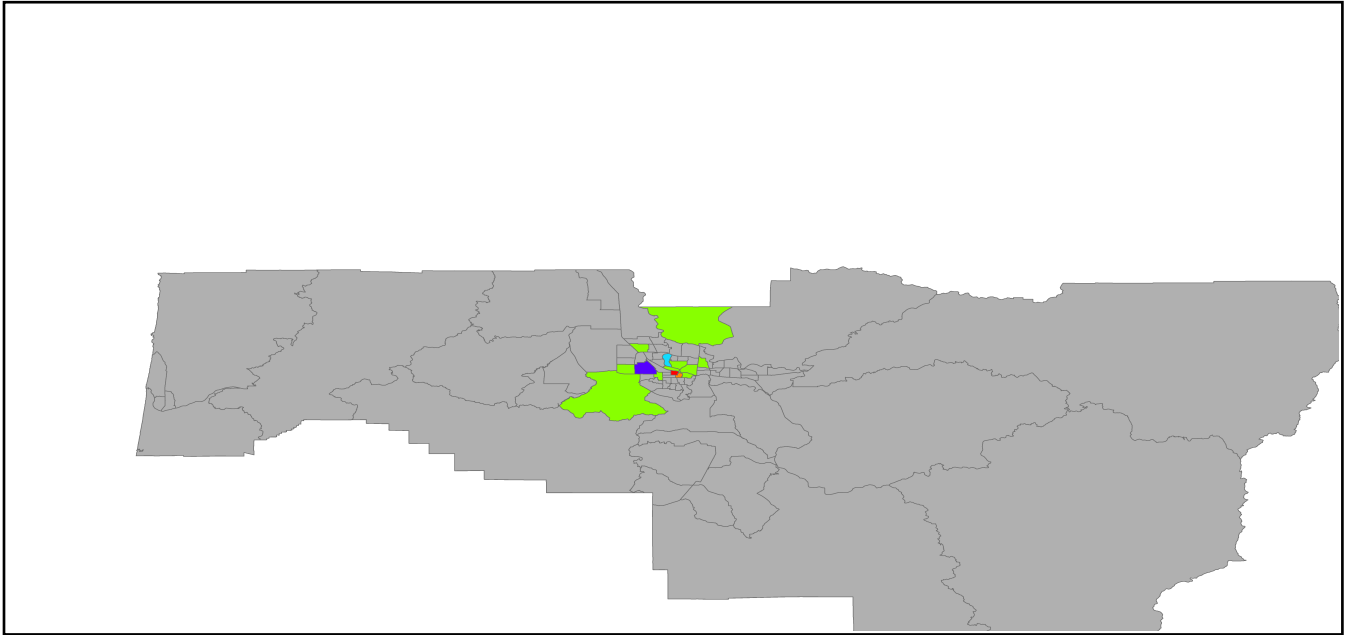

FEMA
Table 2: Utility System Lifeline Inventory

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


FEMA

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_CSZ_m9y
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


FEMA

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

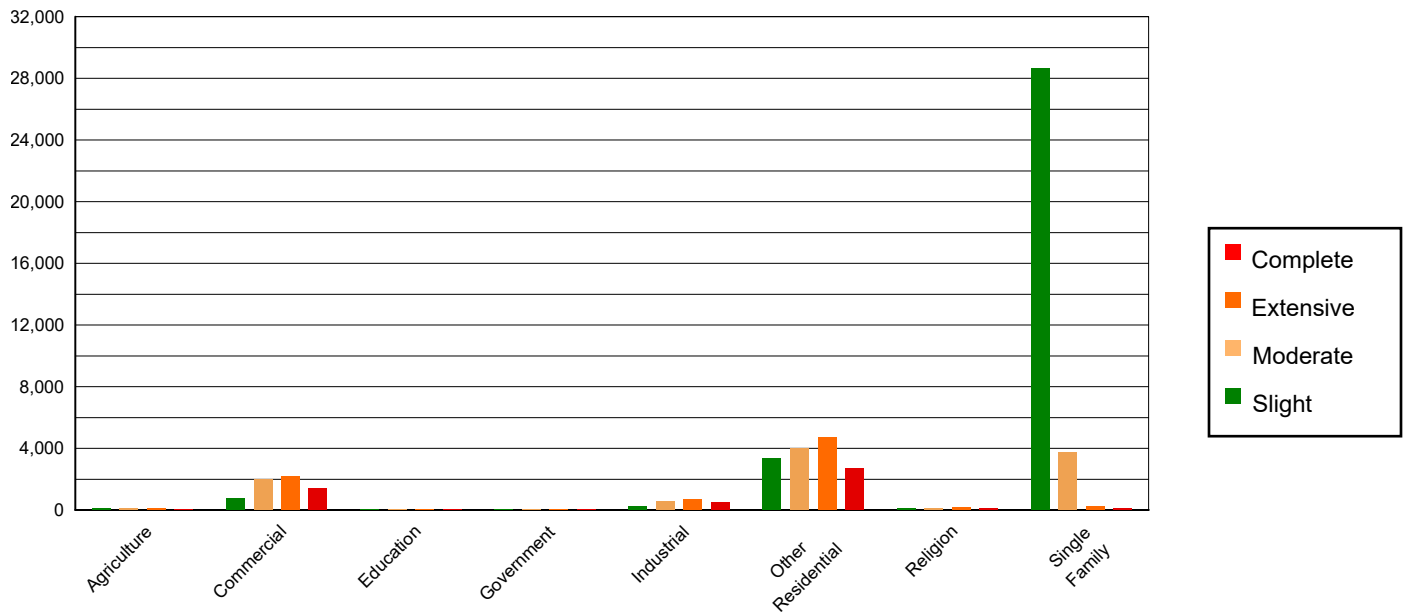


Table 3: Expected Building Damage by Occupancy

	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	



FEMA

[illegible]


FEMA

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.

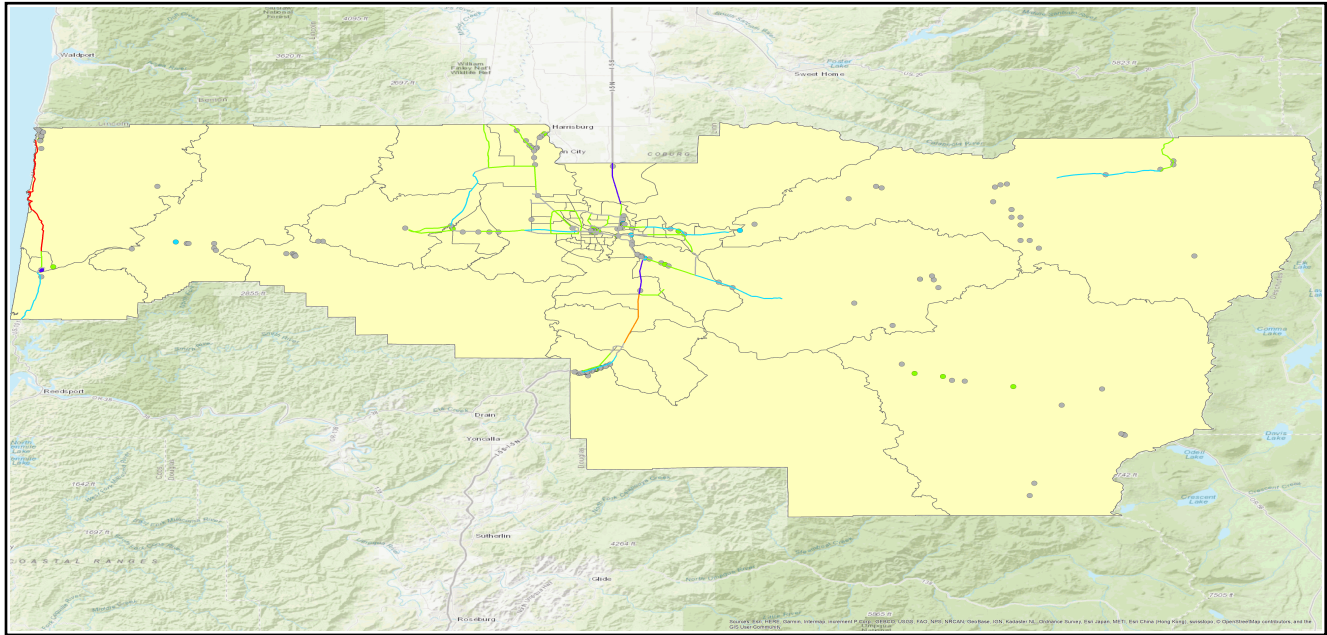
Table 5: Expected Damage to Essential Facilities

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



FEMA

Transportation Lifeline Damage




FEMA
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.



FEMA

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

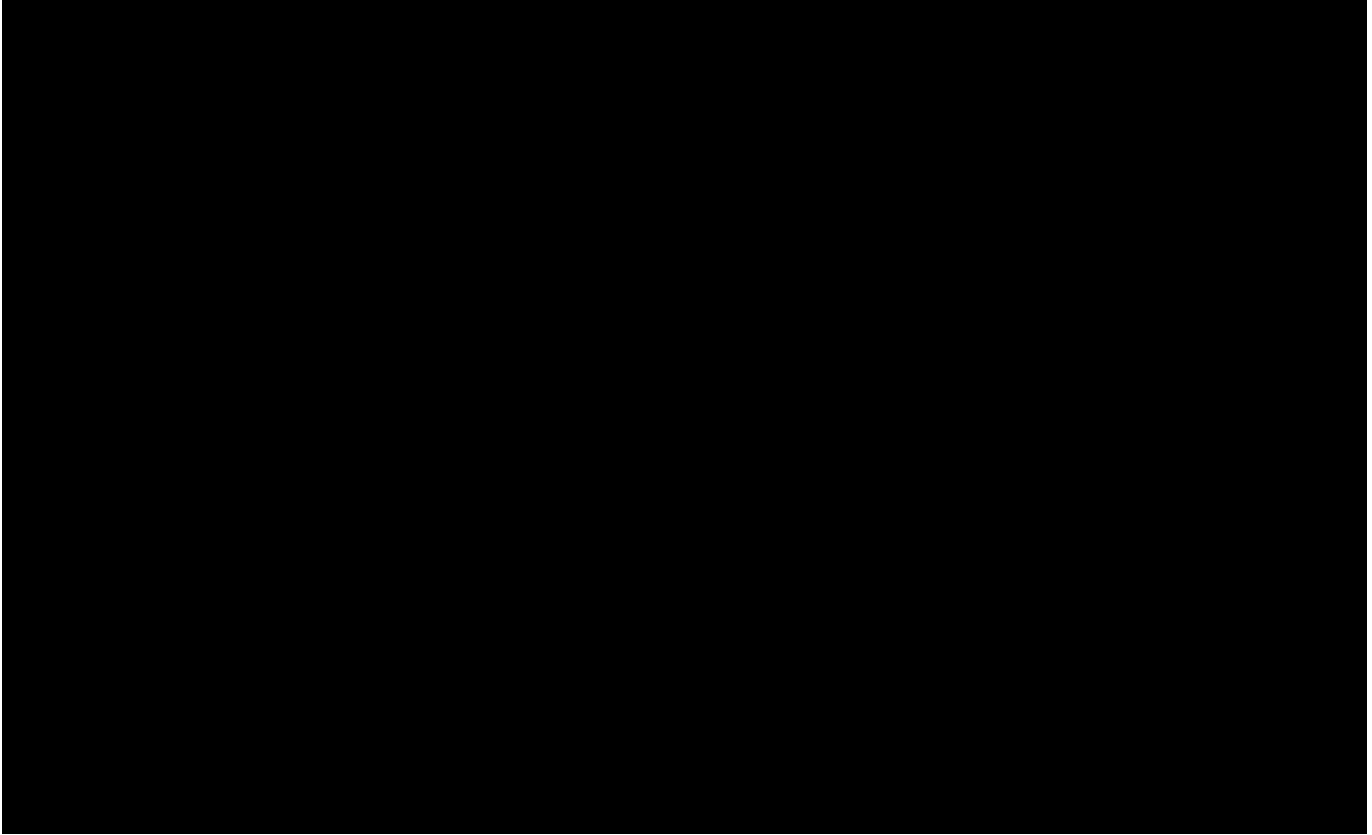
	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	145,966	13,704	10,710	5,532	0	0
Electric Power		0	0	0	0	0



FEMA

Induced Earthquake Damage

Debris Generation





FEMA

Social Impact

Shelter Requirement

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]



FEMA

[REDACTED]					
		[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]



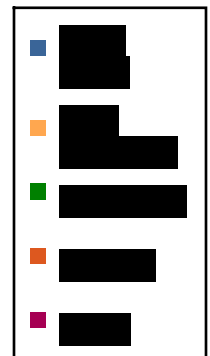
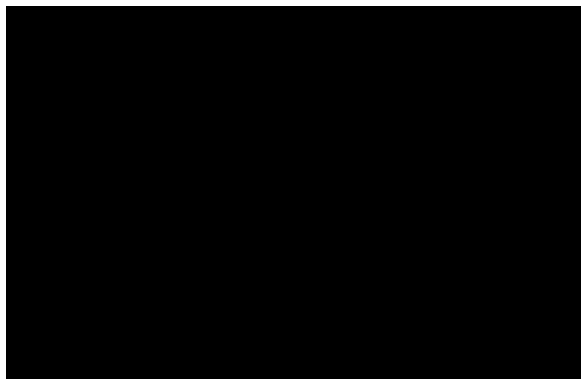
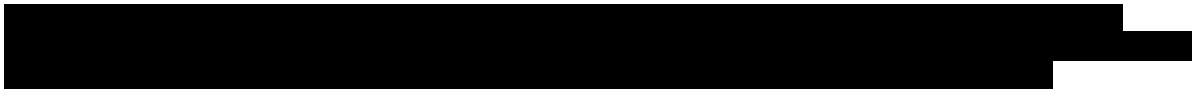
FEMA

Economic Loss

The total economic loss estimated for the earthquake is 6,424.38 (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.



FEMA

[illegible]

Category	Sub-category	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7
Category A	Sub-category A1	Item A1.1	Item A1.2	Item A1.3	Item A1.4	Item A1.5	Item A1.6	Item A1.7
	Sub-category A2	Item A2.1	Item A2.2	Item A2.3	Item A2.4	Item A2.5	Item A2.6	Item A2.7
	Sub-category A3	Item A3.1	Item A3.2	Item A3.3	Item A3.4	Item A3.5	Item A3.6	Item A3.7
	Sub-category A4	Item A4.1	Item A4.2	Item A4.3	Item A4.4	Item A4.5	Item A4.6	Item A4.7
	Sub-category A5	Item A5.1	Item A5.2	Item A5.3	Item A5.4	Item A5.5	Item A5.6	Item A5.7
	Sub-category A6	Item A6.1	Item A6.2	Item A6.3	Item A6.4	Item A6.5	Item A6.6	Item A6.7
Category B	Sub-category B1	Item B1.1	Item B1.2	Item B1.3	Item B1.4	Item B1.5	Item B1.6	Item B1.7
	Sub-category B2	Item B2.1	Item B2.2	Item B2.3	Item B2.4	Item B2.5	Item B2.6	Item B2.7
	Sub-category B3	Item B3.1	Item B3.2	Item B3.3	Item B3.4	Item B3.5	Item B3.6	Item B3.7
	Sub-category B4	Item B4.1	Item B4.2	Item B4.3	Item B4.4	Item B4.5	Item B4.6	Item B4.7
	Sub-category B5	Item B5.1	Item B5.2	Item B5.3	Item B5.4	Item B5.5	Item B5.6	Item B5.7
	Sub-category B6	Item B6.1	Item B6.2	Item B6.3	Item B6.4	Item B6.5	Item B6.6	Item B6.7


FEMA

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	\$3.32	0.12
	Bridges	3,407.19	\$153.80	4.51
	Tunnels	10.38	\$0.00	0.03
	Subtotal	6,194	157.10	
Railways	Segments	384.74	\$0.02	0.01
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	15.98	\$3.13	19.61
	Subtotal	401	3.20	
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	168.50	


FEMA
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	



FEMA

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