

**Scenario: M 9.0 Cascadia Fault  
Clallam County**

**Casualties Summary Report**

	Injury Severity Level														
	Severity 1			Severity 2			Severity 3			Severity 4			Total		
	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	12:00 AM	2:00 PM	5:00 PM
Commuting	0	0	1	0	0	3	0	0	4	0	0	1	0	0	9
Commercial	1	100	80	0	24	19	0	4	3	0	7	5	1	135	107
Educational	0	29	2	0	7	1	0	1	0	0	2	0	0	39	3
Hotels	3	29	1	1	0	0	0	0	0	0	0	0	4	29	1
Industrial	2	1	8	0	3	2	0	0	0	0	1	1	2	5	11
Other-Residential	90	13	32	16	4	6	1	0	0	2	1	1	109	18	39
Single Family	28	24	11	3	1	1	0	0	0	0	0	0	31	25	12
<b>Total Clallam</b>	<b>124</b>	<b>8</b>	<b>135</b>	<b>20</b>	<b>39</b>	<b>32</b>	<b>1</b>	<b>5</b>	<b>7</b>	<b>2</b>	<b>11</b>	<b>8</b>	<b>147</b>	<b>251</b>	<b>182</b>

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

**Number of Buildings Damaged by General Occupancy Class**

	Number of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
Agriculture	47	50	38	19	5	159
Commercial	286	511	583	257	59	1,695
Education	15	19	18	10	2	64
Government	8	14	17	8	2	49
Industrial	84	158	196	94	25	556
Religion	29	38	33	16	4	120
Other Residential	1,842	2,462	3,305	1,893	340	9,843
Single Family	10,800	9,563	1,265	157	35	21,820

Structural damage states vary by building type. See HAZUS Technical Manual Vol. I. "Complete damage" indicates structural collapse or is in imminent danger of collapse.

**Direct Economic Losses For Buildings**

Capital Stock Losses				Income Losses					Total Loss
Cost Structural Damage	Cost Non-structural Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Loss	Wages Losses	Rental Income Loss	
\$63,077,000	\$221,028,000	\$83,036,000	\$2,211,000	6	\$43,335,000	\$22,761,000	\$31,039,000	\$22,158,000	\$488,646,000

**Hospital Functionality**

	Total Number of Beds	At Day 1		At day 3		At day 7		At day 30		At day 90	
		Number of Beds	%								
Large											
Medium	178	34	19	36	20	120	67	174	98	176	99
Small											
<b>Total</b>	<b>178</b>	<b>34</b>	<b>—</b>	<b>36</b>	<b>—</b>	<b>120</b>	<b>—</b>	<b>174</b>	<b>—</b>	<b>176</b>	<b>—</b>

Large Hospital: > 150 beds

Medium Hospital: 50-150 beds

Small Hospital: < 50 beds

**Highway Bridge Damage**

Total Number of Bridges	Average Number for Damage State				
	None	Slight	Moderate	Extensive	Complete
95 (97*)	70	7	5	6	9

\* values in parentheses include rounding error.

**Scenario: M 9.0 Cascadia Fault  
Clallam County**

**Fire Following Analysis Summary Report**

Number of Ignitions	Population Exposed	Value Exposed
3	171	\$10,392,000

**Potable Water System Performance**

Total Households	Number of Households Without Water									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
28,764	2,874	10	1,482	5	41	0	0	0	0	0

**Electrical Power System Performance**

Total Households	Number of Households Without Power									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
28,764	0	0	0	0	0	0	0	0	0	0

**Debris Summary Report**

Brick, Wood & Others (tons)	Concrete & Steel (tons)	Total (tons)	Number of Truckloads
73,000	114,000	187,000	7,480

**Shelter Summary Report**

Number of Displaced Households	Number of People Needing Short Term Shelter
401	255

**Essential Facilities Functionality**

	Count	Functionality (%)
		At Day 1
Emergency Operation Center	2	52
Fire Station Facilities	21	45
Police Station Facilities	5	44
School	34	44

**Scenario: M 9.0 Cascadia Fault  
Grays Harbor County**

**Casualties Summary Report**

	Injury Severity Level														
	Severity 1			Severity 2			Severity 3			Severity 4			Total		
	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	12:00 AM	2:00 PM	5:00 PM
Commuting	0	1	11	0	1	17	0	0	25	0	0	5	0	2	58
Commercial	7	565	463	2	178	145	0	31	25	1	60	48	10	834	681
Educational	0	160	10	0	50	3	0	9	1	0	17	1	0	236	15
Hotels	25	5	8	8	1	2	1	0	0	3	0	1	37	6	11
Industrial	11	83	52	3	25	16	1	4	3	1	8	5	16	120	76
Other-Residential	279	67	102	70	17	26	7	2	3	13	3	5	369	89	136
Single Family	116	30	45	20	5	7	2	0	1	4	1	1	142	36	54
<b>Total Grays Harbor</b>	<b>438</b>	<b>911</b>	<b>691</b>	<b>103</b>	<b>277</b>	<b>216</b>	<b>11</b>	<b>46</b>	<b>58</b>	<b>22</b>	<b>89</b>	<b>66</b>	<b>574</b>	<b>1323</b>	<b>1031</b>

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

**Number of Buildings Damaged by General Occupancy Class**

	Number of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
Agriculture	9	30	33	41	34	147
Commercial	5	48	378	700	527	1,658
Education	2	6	11	19	14	53
Government	1	3	11	24	17	56
Industrial	2	15	106	202	166	491
Religion	5	19	33	56	43	156
Other Residential	606	2,625	3,409	3,036	2,118	11,794
Single Family	2,464	10,289	8,739	1,113	214	22,819

Structural damage states vary by building type. See HAZUS Technical Manual Vol. I. "Complete damage" indicates structural collapse or is in imminent danger of collapse.

**Direct Economic Losses For Buildings**

Capital Stock Losses				Income Losses					Total Loss
Cost Structural Damage	Cost Non-structural Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Loss	Wages Losses	Rental Income Loss	
\$233,805,000	\$801,437,000	\$285,636,000	\$16,065,000	20	\$146,209,000	\$75,913,000	\$99,997,000	\$73,224,000	\$1,732,286,000

**Hospital Functionality**

	At Day 1			At day 3		At day 7		At day 30		At day 90	
	Total Number of Beds	Number of Beds	%								
Large											
Medium	140	0	0	0	0	0	0	2	1	21	15
Small	24	0	1	0	2	5	21	21	88	22	94
<b>Total</b>	<b>164</b>	<b>0</b>	<b>—</b>	<b>0</b>	<b>—</b>	<b>5</b>	<b>—</b>	<b>23</b>	<b>—</b>	<b>43</b>	<b>—</b>

Large Hospital: > 150 beds

Medium Hospital: 50-150 beds

Small Hospital: < 50 beds

**Highway Bridge Damage**

Total Number of Bridges	Average Number for Damage State				
	None	Slight	Moderate	Extensive	Complete
272	153	30	22	35	32

**Scenario: M 9.0 Cascadia Fault  
Grays Harbor County**

**Fire Following Analysis Summary Report**

Number of Ignitions	Population Exposed	Value Exposed
4	215	\$14,398,000

**Potable Water System Performance**

Total Households	Number of Households Without Water									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
27,930	3,920	14	2,681	10	710	3	0	0	0	0

**Electrical Power System Performance**

Total Households	Number of Households Without Power									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
27,930	2,017	7	1,133	4	400	1	68	0	3	0

**Debris Summary Report**

Brick, Wood & Others (tons)	Concrete & Steel (tons)	Total (tons)	Number of Truckloads
208,000	531,000	740,000	29,600

**Shelter Summary Report**

Number of Displaced Households	Number of People Needing Short Term Shelter
1,670	1170

**Essential Facilities Functionality**

	Count	Functionality (%)
	At Day 1	
Emergency Operation Center	1	37
Fire Station Facilities	39	13
Police Station Facilities	11	17
School	44	12

**Scenario: M 9.0 Cascadia Fault  
Jefferson County**

**Casualties Summary Report**

	Injury Severity Level														
	Severity 1			Severity 2			Severity 3			Severity 4			Total		
	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	12:00 AM	2:00 PM	5:00 PM
Commuting	0	0	1	0	0	3	0	0	3	0	0	1	0	0	8
Commercial	0	14	12	0	2	2	0	0	0	0	0	0	0	16	14
Educational	0	3	0	0	1	0	0	0	0	0	0	0	0	4	0
Hotels	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	3	2	0	1	0	0	0	0	0	0	0	0	4	2
Other-Residential	13	3	5	2	0	1	0	0	0	0	0	0	15	3	6
Single Family	5	1	2	0	0	0	0	0	0	0	0	0	5	1	2
<b>Total Jefferson</b>	<b>18</b>	<b>24</b>	<b>22</b>	<b>2</b>	<b>4</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>20</b>	<b>28</b>	<b>32</b>

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

**Number of Buildings Damaged by General Occupancy Class**

	Number of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
Agriculture	44	25	16	5	1	91
Commercial	347	259	190	51	5	852
Education	13	8	6	2	0	29
Government	12	9	7	3	0	31
Industrial	115	97	83	27	3	324
Religion	32	19	12	3	0	66
Other Residential	1,705	1,247	1,312	390	32	4,686
Single Family	7,207	3,067	197	1	0	10,473

Structural damage states vary by building type. See HAZUS Technical Manual Vol. I. "Complete damage" indicates structural collapse or is in imminent danger of collapse.

**Direct Economic Losses For Buildings**

Capital Stock Losses				Income Losses					Total Loss
Cost Structural Damage	Cost Non-structural Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Loss	Wages Losses	Rental Income Loss	
\$12,399,000	\$46,039,000	\$19,413,000	\$602,000	3	\$8,753,000	\$4,366,000	\$5,460,000	\$3,938,000	\$100,971,000

**Hospital Functionality**

	Total Number of Beds	At Day 1		At day 3		At day 7		At day 30		At day 90	
		Number of Beds	%								
Large											
Medium											
Small	43	28	64	28	65	41	96	43	100	43	100
<b>Total</b>	<b>43</b>	<b>28</b>	<b>—</b>	<b>28</b>	<b>—</b>	<b>41</b>	<b>—</b>	<b>43</b>	<b>—</b>	<b>43</b>	<b>—</b>

Large Hospital: > 150 beds

Medium Hospital: 50-150 beds

Small Hospital: < 50 beds

**Highway Bridge Damage**

Total Number of Bridges	Average Number for Damage State				
	None	Slight	Moderate	Extensive	Complete
54	44	3	2	2	3

**Scenario: M 9.0 Cascadia Fault  
Jefferson County**

**Fire Following Analysis Summary Report**

Number of Ignitions	Population Exposed	Value Exposed
1	45	\$4,151,000

**Potable Water System Performance**

Total Households	Number of Households Without Water									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
12,634	9	0	0	0	0	0	0	0	0	0

**Electrical Power System Performance**

Total Households	Number of Households Without Power									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
12,634	0	0	0	0	0	0	0	0	0	0

**Debris Summary Report**

Brick, Wood & Others (tons)	Concrete & Steel (tons)	Total (tons)	Number of Truckloads
15,000	19,000	34,000	1,360

**Shelter Summary Report**

Number of Displaced Households	Number of People Needing Short Term Shelter
24	15

**Essential Facilities Functionality**

	Count	Functionality (%)
		At Day 1
Emergency Operation Center	1	70
Fire Station Facilities	21	64
Police Station Facilities	2	73
School	17	68

**Scenario: M 9.0 Cascadia Fault  
King County**

**Casualties Summary Report**

	Injury Severity Level														
	Severity 1			Severity 2			Severity 3			Severity 4			Total		
	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	12:00 AM	2:00 PM	5:00 PM
Commuting	0	1	35	0	1	56	0	1	83	0	0	17	0	3	191
Commercial	19	1,066	738	3	162	112	0	16	11	1	30	20	23	1274	881
Educational	0	174	30	0	26	4	0	2	0	0	5	1	0	207	35
Hotels	12	2	4	2	0	1	0	0	0	0	0	0	14	2	5
Industrial	23	170	107	4	30	19	0	3	2	1	6	4	28	209	132
Other-Residential	366	65	135	47	9	18	3	0	1	5	1	2	421	75	156
Single Family	159	27	59	10	2	4	0	0	0	1	0	0	170	29	63
<b>Total King</b>	<b>579</b>	<b>1505</b>	<b>1108</b>	<b>66</b>	<b>230</b>	<b>214</b>	<b>3</b>	<b>22</b>	<b>97</b>	<b>8</b>	<b>42</b>	<b>44</b>	<b>656</b>	<b>1799</b>	<b>1463</b>

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

**Number of Buildings Damaged by General Occupancy Class**

	Number of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
Agriculture	1,222	382	237	73	6	1,920
Commercial	20,714	8,664	6,024	1,611	101	37,113
Education	787	275	212	65	4	1,342
Government	307	124	9	29	2	555
Industrial	5,074	2,326	1,869	626	50	9,944
Religion	1,449	480	309	88	5	2,330
Other Residential	51,816	17,952	12,625	3,279	228	85,900
Single Family	375,837	69,891	2,274	456	112	448,571

Structural damage states vary by building type. See HAZUS Technical Manual Vol. I. "Complete damage" indicates structural collapse or is in imminent danger of collapse.

**Direct Economic Losses For Buildings**

Capital Stock Losses				Income Losses					
Cost Structural Damage	Cost Non-structural Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Loss	Wages Losses	Rental Income Loss	Total Loss
\$543,585,000	\$2,054,686,000	\$870,571,000	\$25,459,000	2	\$338,713,000	\$236,134,000	\$278,502,000	\$219,168,000	\$4,566,818,000

**Hospital Functionality**

	Total Number of Beds	At Day 1		At day 3		At day 7		At day 30		At day 90	
		Number of Beds	%								
Large	4,943	4,013	81	4,033	82	4,878	99	4,938	100	4,938	100
Medium	684	497	73	501	73	660	96	681	100	682	100
Small	100	79	79	79	79	98	98	100	100	100	100
<b>Total</b>	<b>5,727</b>	<b>4,589</b>	<b>—</b>	<b>4,613</b>	<b>—</b>	<b>5,636</b>	<b>—</b>	<b>5,719</b>	<b>—</b>	<b>5,720</b>	<b>—</b>

Large Hospital: > 150 beds

Medium Hospital: 50-150 beds

Small Hospital: < 50 beds

**Highway Bridge Damage**

Total Number of Bridges	Average Number for Damage State				
	None	Slight	Moderate	Extensive	Complete
1,033 (1,032*)	919	41	31	31	10

\* values in parentheses include rounding error.

**Scenario: M 9.0 Cascadia Fault  
King County**

**Fire Following Analysis Summary Report**

Number of Ignitions	Population Exposed	Value Exposed
78	9042	\$801,211,000

**Potable Water System Performance**

Total Households	Number of Households Without Water									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
745,853	42,180	6	31,433	4	14,178	2	0	0	0	0

**Electrical Power System Performance**

Total Households	Number of Households Without Power									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
745,853	0	0	0	0	0	0	0	0	0	0

**Debris Summary Report**

Brick, Wood & Others (tons)	Concrete & Steel (tons)	Total (tons)	Number of Truckloads
454,000	911,000	1,365,000	54,600

**Shelter Summary Report**

Number of Displaced Households	Number of People Needing Short Term Shelter
5,630	3,299

**Essential Facilities Functionality**

	Count	Functionality (%)
	At Day 1	
Emergency Operation Center	18	84
Fire Station Facilities	164	84
Police Station Facilities	52	84
School	721	84

**Scenario: M 9.0 Cascadia Fault  
Mason County**

**Casualties Summary Report**

	Injury Severity Level														
	Severity 1			Severity 2			Severity 3			Severity 4			Total		
	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	12:00 AM	2:00 PM	5:00 PM
Commuting	0	0	2	0	0	4	0	0	6	0	0	1	0	0	13
Commercial	1	67	61	0	17	15	0	3	2	0	5	4	1	92	82
Educational	0	25	2	0	6	1	0	1	0	0	2	0	0	34	3
Hotels	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Industrial	1	7	5	0	2	1	0	0	0	0	0	0	1	9	6
Other-Residential	77	20	28	14	4	5	1	0	0	2	0	1	94	24	34
Single Family	21	6	8	2	0	1	0	0	0	0	0	0	23	6	9
<b>Total Mason</b>	<b>101</b>	<b>125</b>	<b>106</b>	<b>16</b>	<b>29</b>	<b>27</b>	<b>1</b>	<b>4</b>	<b>8</b>	<b>2</b>	<b>7</b>	<b>6</b>	<b>120</b>	<b>165</b>	<b>147</b>

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

**Number of Buildings Damaged by General Occupancy Class**

	Number of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
Agriculture	25	35	29	13	4	106
Commercial	131	301	405	173	43	1,053
Education	6	10	11	6	2	35
Government	5	11	14	7	2	39
Industrial	49	111	154	71	20	404
Religion	14	24	23	10	3	74
Other Residential	888	1,749	3,245	1,857	323	8,062
Single Family	7,556	9,029	1,492	36	4	18,117

Structural damage states vary by building type. See HAZUS Technical Manual Vol. I. "Complete damage" indicates structural collapse or is in imminent danger of collapse.

**Direct Economic Losses For Buildings**

Capital Stock Losses				Income Losses					Total Loss
Cost Structural Damage	Cost Non-structural Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Loss	Wages Losses	Rental Income Loss	
\$45,313,000	\$163,975,000	\$59,590,000	\$1,567,000	6	\$31,868,000	\$11,650,000	\$15,713,000	\$12,014,000	\$341,689,000

**Hospital Functionality**

	At Day 1			At day 3		At day 7		At day 30		At day 90	
	Total Number of Beds	Number of Beds	%								
Large											
Medium	68	6	9	6	9	32	46	64	94	66	97
Small											
<b>Total</b>	<b>68</b>	<b>6</b>	<b>—</b>	<b>6</b>	<b>—</b>	<b>32</b>	<b>—</b>	<b>64</b>	<b>—</b>	<b>66</b>	<b>—</b>

Large Hospital: > 150 beds  
 Medium Hospital: 50-150 beds  
 Small Hospital: < 50 beds

**Highway Bridge Damage**

Total Number of Bridges	Average Number for Damage State				
	None	Slight	Moderate	Extensive	Complete
92 (94*)	72	6	4	6	6

\* values in parentheses include rounding error.

**Scenario: M 9.0 Cascadia Fault  
Mason County**

**Fire Following Analysis Summary Report**

Number of Ignitions	Population Exposed	Value Exposed
3	18	\$1,197,000

**Potable Water System Performance**

Total Households	Number of Households Without Water									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
20,412	1,007	5	239	1	0	0	0	0	0	0

**Electrical Power System Performance**

Total Households	Number of Households Without Power									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
20,412	0	0	0	0	0	0	0	0	0	0

**Debris Summary Report**

Brick, Wood & Others (tons)	Concrete & Steel (tons)	Total (tons)	Number of Truckloads
60,000	77,000	137,000	5,480

**Shelter Summary Report**

Number of Displaced Households	Number of People Needing Short Term Shelter
132	98

**Essential Facilities Functionality**

	Count	Functionality (%)
		At Day 1
Emergency Operation Center	2	35
Fire Station Facilities	31	43
Police Station Facilities	3	36
School	23	42

**Scenario: M 9.0 Cascadia Fault  
Pacific County**

**Casualties Summary Report**

	Injury Severity Level														
	Severity 1			Severity 2			Severity 3			Severity 4			Total		
	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	12:00 AM	2:00 PM	5:00 PM
Commuting	0	0	2	0	0	5	0	0	5	0	0	1	0	0	13
Commercial	2	141	117	0	43	36	0	7	6	0	14	12	2	205	171
Educational	0	29	2	0	8	1	0	1	0	0	3	0	0	41	3
Hotels	15	3	5	5	1	1	1	0	0	2	0	0	23	4	6
Industrial	2	18	11	1	5	3	0	1	1	0	2	1	3	26	16
Other-Residential	97	26	35	23	6	8	2	0	1	3	1	1	125	33	45
Single Family	29	9	11	5	1	2	0	0	0	1	0	0	35	10	13
<b>Total Pacific</b>	<b>145</b>	<b>226</b>	<b>183</b>	<b>34</b>	<b>64</b>	<b>56</b>	<b>3</b>	<b>9</b>	<b>13</b>	<b>6</b>	<b>20</b>	<b>15</b>	<b>188</b>	<b>319</b>	<b>267</b>

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

**Number of Buildings Damaged by General Occupancy Class**

	Number of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
Agriculture	7	17	17	23	16	80
Commercial	3	26	161	272	177	639
Education	1	3	5	8	4	21
Government	1	2	7	13	9	32
Industrial	1	7	41	66	43	158
Religion	3	8	13	21	12	57
Other Residential	401	1,369	1,543	1,802	1,326	6,441
Single Family	1,739	4,694	2,487	485	121	9,526

Structural damage states vary by building type. See HAZUS Technical Manual Vol. I. "Complete damage" indicates structural collapse or is in imminent danger of collapse.

**Direct Economic Losses For Buildings**

Capital Stock Losses				Income Losses					Total Loss
Cost Structural Damage	Cost Non-structural Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Loss	Wages Losses	Rental Income Loss	
\$73,897,000	\$262,424,000	\$86,836,000	\$2,191,000	18	\$48,408,000	\$45,414,000	\$49,858,000	\$25,346,000	\$594,374,000

**Hospital Functionality**

	Total Number of Beds	At Day 1		At day 3		At day 7		At day 30		At day 90	
		Number of Beds	%								
Large											
Medium											
Small	53	0	0	0	0	2	4	29	55	40	75
<b>Total</b>	<b>53</b>	<b>0</b>	<b>—</b>	<b>0</b>	<b>—</b>	<b>2</b>	<b>—</b>	<b>29</b>	<b>—</b>	<b>40</b>	<b>—</b>

Large Hospital: > 150 beds

Medium Hospital: 50-150 beds

Small Hospital: < 50 beds

**Highway Bridge Damage**

Total Number of Bridges	Average Number for Damage State				
	None	Slight	Moderate	Extensive	Complete
110	75	8	6	9	12

**Scenario: M 9.0 Cascadia Fault  
Pacific County**

**Fire Following Analysis Summary Report**

Number of Ignitions	Population Exposed	Value Exposed
1	5	\$411,000

**Potable Water System Performance**

Total Households	Number of Households Without Water									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
9,028	3,504	39	2,863	32	1,457	16	0	0	0	0

**Electrical Power System Performance**

Total Households	Number of Households Without Power									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
9,028	0	0	0	0	0	0	0	0	0	0

**Debris Summary Report**

Brick, Wood & Others (tons)	Concrete & Steel (tons)	Total (tons)	Number of Truckloads
88,000	167,000	255,000	10,200

**Shelter Summary Report**

Number of Displaced Households	Number of People Needing Short Term Shelter
323	211

**Essential Facilities Functionality**

	Count	Functionality (%)
	At Day 1	
Emergency Operation Center	1	32
Fire Station Facilities	18	14
Police Station Facilities	3	14
School	19	19

**Scenario: M 9.0 Cascadia Fault  
Pierce County**

**Casualties Summary Report**

	Injury Severity Level														
	Severity 1			Severity 2			Severity 3			Severity 4			Total		
	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM	12:00 AM	2:00 PM	5:00 PM
Commuting	0	0	15	0	0	33	0	0	40	0	0	9	0	0	97
Commercial	6	369	291	1	60	48	0	6	5	0	12	9	7	447	353
Educational	0	91	10	0	14	2	0	1	0	0	3	0	0	109	12
Hotels	3	1	1	0	0	0	0	0	0	0	0	0	3	1	1
Industrial	6	46	29	1	8	5	0	1	0	0	1	1	7	56	35
Other Residential	235	48	86	31	6	11	2	0	1	3	1	1	271	55	99
Single Family	85	17	31	4	1	2	0	0	0	0	0	0	89	18	33
<b>Total Pierce</b>	<b>335</b>	<b>572</b>	<b>463</b>	<b>37</b>	<b>89</b>	<b>101</b>	<b>2</b>	<b>8</b>	<b>46</b>	<b>3</b>	<b>17</b>	<b>20</b>	<b>377</b>	<b>686</b>	<b>630</b>

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

**Number of Buildings Damaged by General Occupancy Class**

	Number of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
Agriculture	429	174	112	37	3	755
Commercial	5,754	3,236	2,389	704	51	12,135
Education	223	102	79	26	2	432
Government	109	57	44	15	1	226
Industrial	1,648	1,006	837	289	25	3,806
Religion	487	222	143	43	3	898
Other Residential	22,431	13,675	12,593	3,121	180	52,001
Single Family	144,392	40,028	1,767	151	37	186,374

Structural damage states vary by building type. See HAZUS Technical Manual Vol. I. "Complete damage" indicates structural collapse or is in imminent danger of collapse.

**Direct Economic Losses For Buildings**

Capital Stock Losses				Income Losses					Total Loss
Cost Structural Damage	Cost Non-structural Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Loss	Wages Losses	Rental Income Loss	
\$226,055,000	\$838,364,000	\$341,804,000	\$10,001,000	2	\$139,313,000	\$76,943,000	\$93,862,000	\$78,857,000	\$1,805,199,000

**Hospital Functionality**

	Total Number of Beds	At Day 1		At day 3		At day 7		At day 30		At day 90	
		Number of Beds	%								
Large	2,873	1,937	67	1,957	68	2,784	97	2,870	100	2,870	100
Medium	397	265	67	267	67	384	97	397	100	397	100
Small											
<b>Total</b>	<b>3,270</b>	<b>2,202</b>	<b>—</b>	<b>2,224</b>	<b>—</b>	<b>3,168</b>	<b>—</b>	<b>3,267</b>	<b>—</b>	<b>3,267</b>	<b>—</b>

Large Hospital: > 150 beds

Medium Hospital: 50-150 beds

Small Hospital: < 50 beds

**Highway Bridge Damage**

Total Number of Bridges	Average Number for Damage State				
	None	Slight	Moderate	Extensive	Complete
404 (408*)	360	16	16	12	4

\* values in parentheses include rounding error.

**Scenario: M 9.0 Cascadia Fault  
Pierce County**

**Fire Following Analysis Summary Report**

Number of Ignitions	Population Exposed	Value Exposed
28	2,457	\$164,149,000

**Potable Water System Performance**

Total Households	Number of Households Without Water									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
282,052	5,271	2	1,961	1	0	0	0	0	0	0

**Electrical Power System Performance**

Total Households	Number of Households Without Power									
	At day 1		At day 3		At day 7		At day 30		At day 90	
	Count	%	Count	%	Count	%	Count	%	Count	%
282,052	0	0	0	0	0	0	0	0	0	0

**Debris Summary Report**

Brick, Wood & Others (tons)	Concrete & Steel (tons)	Total (tons)	Number of Truckloads
222,000	361,000	583,000	23,320

**Shelter Summary Report**

Number of Displaced Households	Number of People Needing Short Term Shelter
1,901	1,257

**Essential Facilities Functionality**

	Count	Functionality (%)
	At Day 1	
Emergency Operation Center	5	79
Fire Station Facilities	86	79
Police Station Facilities	26	79
School	299	77

# HAZUS-MH: Earthquake Event Report

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**Region Name:** CascadiaM9

**Earthquake Scenario:** CascadiaM9.0

**Print Date:** March 10, 2010

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

**Disclaimer:**

*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 23 county(ies) from the following state(s):

Washington

Note:

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

The geographical size of the region is 36,495.82 square miles and contains 1,084 census tracts. There are over 2,043 thousand households in the region and has a total population of 5,283,432 people (2005 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1,877 thousand buildings in the region with a total building replacement value (excluding contents) of 402,081 (millions of dollars). Approximately 92.00 % of the buildings (and 0.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 151,145 and 21,726 (millions of dollars) , respectively.

## Building and Lifeline Inventory

### **Building Inventory**

HAZUS estimates that there are 1,877 thousand buildings in the region which have an aggregate total replacement value of 402,081 (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 (HPL) facilities. 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 75 hospitals in the region with a total bed capacity of 14,258 beds. There are 2,254 schools, 938 fire stations, 226 police stations and 55 emergency operation facilities. With respect to HPL facilities, there are 450 dams identified within the region. Of these, 146 of the dams are classified as 'high hazard'. The inventory also includes 839 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 172,871.00 (millions of dollars). This inventory includes over 9,562 kilometers of highways, 4,996 bridges, 286,170 kilometers of pipes.

**Table 1: Transportation System Lifeline Inventory**

<b>System</b>	<b>Component</b>	<b># locations/ # Segments</b>	<b>Replacement value (millions of dollars)</b>
<b>Highway</b>	Bridges	4,996	90,051.60
	Segments	3,454	53,323.90
	Tunnels	29	67.00
		<b>Subtotal</b>	<b>143,442.50</b>
<b>Railways</b>	Bridges	77	20.00
	Facilities	68	181.10
	Segments	1,407	2,642.40
	Tunnels	0	0.00
		<b>Subtotal</b>	<b>2,843.50</b>
<b>Light Rail</b>	Bridges	0	0.00
	Facilities	38	101.20
	Segments	48	203.90
	Tunnels	0	0.00
		<b>Subtotal</b>	<b>305.00</b>
<b>Bus</b>	Facilities	45	54.00
		<b>Subtotal</b>	<b>54.00</b>
<b>Ferry</b>	Facilities	45	59.90
		<b>Subtotal</b>	<b>59.90</b>
<b>Port</b>	Facilities	486	970.50
		<b>Subtotal</b>	<b>970.50</b>
<b>Airport</b>	Facilities	62	660.40
	Runways	74	2,809.30
		<b>Subtotal</b>	<b>3,469.70</b>
		<b>Total</b>	<b>151,145.10</b>

**Table 2: Utility System Lifeline Inventory**

<b>System</b>	<b>Component</b>	<b># Locations / Segments</b>	<b>Replacement value (millions of dollars)</b>
<b>Potable Water</b>	Distribution Lines	NA	2,861.70
	Facilities	41	1,501.80
	Pipelines	0	0.00
		<b>Subtotal</b>	<b>4,363.50</b>
<b>Waste Water</b>	Distribution Lines	NA	1,717.00
	Facilities	146	10,696.00
	Pipelines	0	0.00
		<b>Subtotal</b>	<b>12,413.00</b>
<b>Natural Gas</b>	Distribution Lines	NA	1,144.70
	Facilities	56	67.10
	Pipelines	0	0.00
		<b>Subtotal</b>	<b>1,211.80</b>
<b>Oil Systems</b>	Facilities	15	1.70
	Pipelines	0	0.00
		<b>Subtotal</b>	<b>1.70</b>
<b>Electrical Power</b>	Facilities	78	9,438.00
		<b>Subtotal</b>	<b>9,438.00</b>
<b>Communication</b>	Facilities	196	21.60
		<b>Subtotal</b>	<b>21.60</b>
		<b>Total</b>	<b>27,449.60</b>

## 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>	CascadiaM9.0
<b>Type of Earthquake</b>	User-defined
<b>Fault Name</b>	NA
<b>Historical Epicenter ID #</b>	NA
<b>Probabilistic Return Period</b>	NA
<b>Longitude of Epicenter</b>	NA
<b>Latitude of Epicenter</b>	NA
<b>Earthquake Magnitude</b>	8.50
<b>Depth (Km)</b>	NA
<b>Rupture Length (Km)</b>	NA
<b>Rupture Orientation (degrees)</b>	NA
<b>Attenuation Function</b>	NA

## Building Damage

### Building Damage

HAZUS estimates that about 181,101 buildings will be at least moderately damaged. This is over 10.00 % of the total number of buildings in the region. There are an estimated 8,768 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 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	(%)
<b>Agriculture</b>	5,366	0.40	1,416	0.40	1,025	0.80	448	1.03	98	1.12
<b>Commercial</b>	50,091	3.74	21,808	6.10	18,583	14.44	7,027	16.09	1,325	15.11
<b>Education</b>	1,974	0.15	694	0.19	603	0.47	247	0.57	39	0.45
<b>Government</b>	1,144	0.09	475	0.13	470	0.37	228	0.52	53	0.60
<b>Industrial</b>	14,380	1.07	6,708	1.88	6,384	4.96	2,669	6.11	487	5.55
<b>Other Residential</b>	194,712	14.54	79,237	22.17	75,190	58.44	28,491	65.23	5,844	66.65
<b>Religion</b>	3,917	0.29	1,353	0.38	1,056	0.82	445	1.02	91	1.04
<b>Single Family</b>	1,067,767	79.72	245,653	68.74	25,339	19.70	4,125	9.44	831	9.48
<b>Total</b>	<b>1,339,351</b>		<b>357,345</b>		<b>128,652</b>		<b>43,681</b>		<b>8,768</b>	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Wood</b>	1,198,129	89.46	282,296	79.00	31,328	24.35	4,142	9.48	755	8.61
<b>Steel</b>	18,271	1.36	8,917	2.50	8,600	6.68	3,635	8.32	1,144	13.05
<b>Concrete</b>	18,880	1.41	8,760	2.45	8,093	6.29	3,225	7.38	612	6.98
<b>Precast</b>	13,968	1.04	5,545	1.55	5,816	4.52	3,139	7.19	626	7.14
<b>RM</b>	47,009	3.51	9,155	2.56	8,958	6.96	4,042	9.25	651	7.43
<b>URM</b>	4,042	0.30	4,225	1.18	4,890	3.80	1,799	4.12	421	4.80
<b>MH</b>	39,052	2.92	38,446	10.76	60,967	47.39	23,698	54.25	4,559	52.00
<b>Total</b>	<b>1,339,351</b>		<b>357,345</b>		<b>128,652</b>		<b>43,681</b>		<b>8,768</b>	

\*Note:

RM Reinforced Masonry  
 URM Unreinforced Masonry  
 MH Manufactured Housing

## **Essential Facility Damage**

Before the earthquake, the region had 14,258 hospital beds available for use. On the day of the earthquake, the model estimates that only 9,542 hospital beds (67.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 88.00% of the beds will be back in service. By 30 days, 97.00% 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	75	6	1	58
Schools	2,254	18	0	2,131
EOCs	55	0	0	49
PoliceStations	226	3	0	199
FireStations	938	13	0	826

## 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	3,454	0	0	3,454	3,454
	Bridges	4,996	140	0	4,864	4,957
	Tunnels	29	0	0	29	29
Railways	Segments	1,407	0	0	1,407	1,407
	Bridges	77	0	0	77	77
	Tunnels	0	0	0	0	0
	Facilities	68	0	0	68	68
Light Rail	Segments	48	0	0	48	48
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	38	0	0	38	38
Bus	Facilities	45	1	0	45	45
Ferry	Facilities	45	0	0	45	45
Port	Facilities	486	10	0	486	486
Airport	Facilities	62	4	0	62	62
	Runways	74	0	0	74	74

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	41	2	0	37	41
Waste Water	146	16	0	60	146
Natural Gas	56	2	0	53	56
Oil Systems	15	0	0	15	15
Electrical Power	78	7	0	59	78
Communication	196	21	0	196	196

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	143,085	5108	3118
Waste Water	85,851	4040	2466
Natural Gas	57,234	4318	2636
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	2,043,617	131,035	95,665	40,043	0	0
Electric Power		2,017	1,133	400	68	3

### **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 202 ignitions that will burn about 7.14 sq. mi (0.02 % of the region's total area.) The model also estimates that the fires will displace about 17,690 people and burn about 1,391 (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 5.680 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 227,240,000 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 18,385 households to be displaced due to the earthquake. Of these, 11,630 people (out of a total population of 5,283,432) 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
<b>2 AM</b>	Commercial	61	12	2	3
	Commuting	0	1	1	0
	Educational	0	0	0	0
	Hotels	71	18	3	5
	Industrial	81	17	2	4
	Other-Residential	1,971	326	23	41
	Single Family	742	70	5	9
	<b>Total</b>	<b>2,927</b>	<b>443</b>	<b>34</b>	<b>62</b>
<b>2 PM</b>	Commercial	3,847	778	102	198
	Commuting	3	6	7	2
	Educational	881	178	23	45
	Hotels	14	3	1	1
	Industrial	593	122	15	30
	Other-Residential	423	73	5	10
	Single Family	156	16	1	2
	<b>Total</b>	<b>5,915</b>	<b>1,176</b>	<b>155</b>	<b>288</b>
<b>5 PM</b>	Commercial	2,926	595	79	151
	Commuting	109	195	270	55
	Educational	99	18	2	4
	Hotels	21	5	1	2
	Industrial	370	76	10	19
	Other-Residential	719	120	9	15
	Single Family	278	27	2	3
	<b>Total</b>	<b>4,523</b>	<b>1,037</b>	<b>372</b>	<b>249</b>

## Economic Loss

The total economic loss estimated for the earthquake is 21,001.80 (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 15,804.90 (millions of dollars); 24 % 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 47 % 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
<b>Income Losses</b>							
	Wage	0.00	74.18	812.95	36.21	51.95	975.28
	Capital-Related	0.00	31.58	722.65	21.92	11.93	788.08
	Rental	50.39	233.35	409.59	13.38	26.49	733.20
	Relocation	159.53	277.98	623.57	67.13	186.27	1,314.49
	<b>Subtotal</b>	<b>209.92</b>	<b>617.09</b>	<b>2,568.76</b>	<b>138.63</b>	<b>276.65</b>	<b>3,811.05</b>
<b>Capital Stock Losses</b>							
	Structural	411.45	455.93	803.38	191.97	193.20	2,055.93
	Non_Structural	2,507.74	1,762.90	1,892.40	472.05	434.59	7,069.66
	Content	1,048.94	379.86	862.79	289.48	196.40	2,777.47
	Inventory	0.00	0.00	24.57	62.56	3.65	90.79
	<b>Subtotal</b>	<b>3,968.12</b>	<b>2,598.69</b>	<b>3,583.14</b>	<b>1,016.06</b>	<b>827.84</b>	<b>11,993.85</b>
	<b>Total</b>	<b>4,178.04</b>	<b>3,215.78</b>	<b>6,151.90</b>	<b>1,154.69</b>	<b>1,104.49</b>	<b>15,804.90</b>

## 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	53,323.90	\$480.70	0.90
	Bridges	90,051.61	\$2546.23	2.83
	Tunnels	66.98	\$0.50	0.74
	<b>Subtotal</b>	<b>143442.50</b>	<b>3,027.40</b>	
Railways	Segments	2,642.42	\$11.02	0.42
	Bridges	19.99	\$0.35	1.75
	Tunnels	0.00	\$0.00	0.00
	Facilities	181.08	\$27.01	14.91
	<b>Subtotal</b>	<b>2843.50</b>	<b>38.40</b>	
Light Rail	Segments	203.85	\$0.89	0.44
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	101.19	\$15.62	15.44
	<b>Subtotal</b>	<b>305.00</b>	<b>16.50</b>	
Bus	Facilities	53.96	\$8.03	14.89
	<b>Subtotal</b>	<b>54.00</b>	<b>8.00</b>	
Ferry	Facilities	59.90	\$8.64	14.42
	<b>Subtotal</b>	<b>59.90</b>	<b>8.60</b>	
Port	Facilities	970.54	\$161.69	16.66
	<b>Subtotal</b>	<b>970.50</b>	<b>161.70</b>	
Airport	Facilities	660.36	\$105.35	15.95
	Runways	2,809.34	\$32.43	1.15
	<b>Subtotal</b>	<b>3469.70</b>	<b>137.80</b>	
<b>Total</b>		<b>151145.10</b>	<b>3,398.50</b>	

**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	1,501.80	\$118.57	7.90
	Distribution Lines	2,861.70	\$41.40	1.45
	<b>Subtotal</b>	<b>4,363.54</b>	<b>\$159.97</b>	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	10,696.00	\$885.64	8.28
	Distribution Lines	1,717.00	\$32.74	1.91
	<b>Subtotal</b>	<b>12,412.98</b>	<b>\$918.38</b>	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	67.10	\$3.70	5.51
	Distribution Lines	1,144.70	\$35.00	3.06
	<b>Subtotal</b>	<b>1,211.83</b>	<b>\$38.70</b>	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	1.70	\$0.11	6.45
	<b>Subtotal</b>	<b>1.65</b>	<b>\$0.11</b>	
Electrical Power	Facilities	9,438.00	\$679.72	7.20
	<b>Subtotal</b>	<b>9,438.00</b>	<b>\$679.72</b>	
Communication	Facilities	21.60	\$1.57	7.28
	<b>Subtotal</b>	<b>21.56</b>	<b>\$1.57</b>	
	<b>Total</b>	<b>27,449.55</b>	<b>\$1,798.45</b>	

**Table 14. Indirect Economic Impact with outside aid**  
 (Employment as # of people and Income in millions of \$)

	LOSS	Total	%
<b>First Year</b>			
	Employment Impact	2,873,093	159.61
	Income Impact	8,572	9.60
<b>Second Year</b>			
	Employment Impact	1,044,318	58.01
	Income Impact	4,346	4.87
<b>Third Year</b>			
	Employment Impact	24,071	1.34
	Income Impact	865	0.97
<b>Fourth Year</b>			
	Employment Impact	1,357	0.08
	Income Impact	(356)	-0.40
<b>Fifth Year</b>			
	Employment Impact	78	0.00
	Income Impact	(425)	-0.48
<b>Years 6 to 15</b>			
	Employment Impact	0	0.00
	Income Impact	(429)	-0.48

## **Appendix A: County Listing for the Region**

Chelan,WA

Clallam,WA

Clark,WA

Cowlitz,WA

Grays Harbor,WA

Island,WA

Jefferson,WA

King,WA

Kitsap,WA

Kittitas,WA

Klickitat,WA

Lewis,WA

Mason,WA

Pacific,WA

Pierce,WA

San Juan,WA

Skagit,WA

Skamania,WA

Snohomish,WA

Thurston,WA

Wahkiakum,WA

Whatcom,WA

Yakima,WA

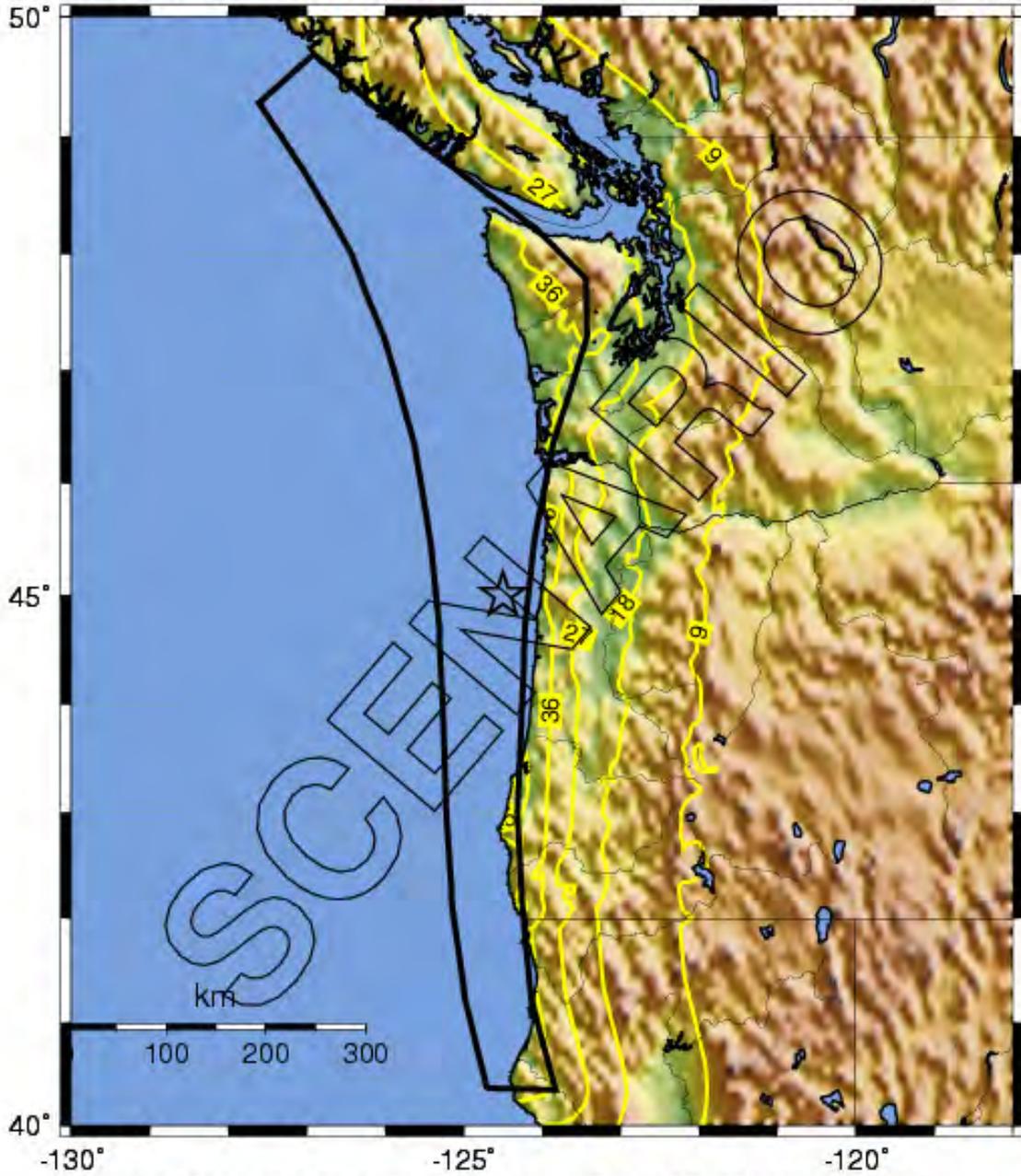
**Appendix B: Regional Population and Building Value Data**

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Washington	Chelan	68,646	3,915	1,524	5,439
	Clallam	68,232	3,789	1,128	4,917
	Clark	395,707	21,358	5,081	26,439
	Cowlitz	96,113	5,167	1,575	6,742
	Grays Harbor	69,881	3,866	1,228	5,095
	Island	78,149	5,289	842	6,132
	Jefferson	28,169	1,741	517	2,258
	King	1,828,516	123,492	35,829	159,322
	Kitsap	245,278	14,460	2,974	17,435
	Kittitas	37,701	2,087	539	2,627
	Klickitat	20,162	908	287	1,195
	Lewis	70,750	3,424	1,286	4,711
	Mason	53,236	3,094	593	3,687
	Pacific	20,855	1,443	384	1,828
	Pierce	757,734	42,208	10,185	52,394
	San Juan	15,413	1,454	350	1,805
	Skagit	111,356	6,119	1,896	8,015
	Skamania	10,300	551	118	670
	Snohomish	661,444	38,562	8,570	47,132
	Thurston	226,721	12,793	3,286	16,080
Wahkiakum	3,900	204	62	267	
Whatcom	185,545	10,528	3,715	14,244	
Yakima	229,624	9,899	3,738	13,637	
<b>Total State</b>		<b>5,283,432</b>	<b>316,351</b>	<b>85,707</b>	<b>402,071</b>
<b>Total Region</b>		<b>5,283,432</b>	<b>316,351</b>	<b>85,707</b>	<b>402,071</b>

-- Earthquake Planning Scenario --

Peak Accel. Map (in %g) for Casc9.0 Scenario

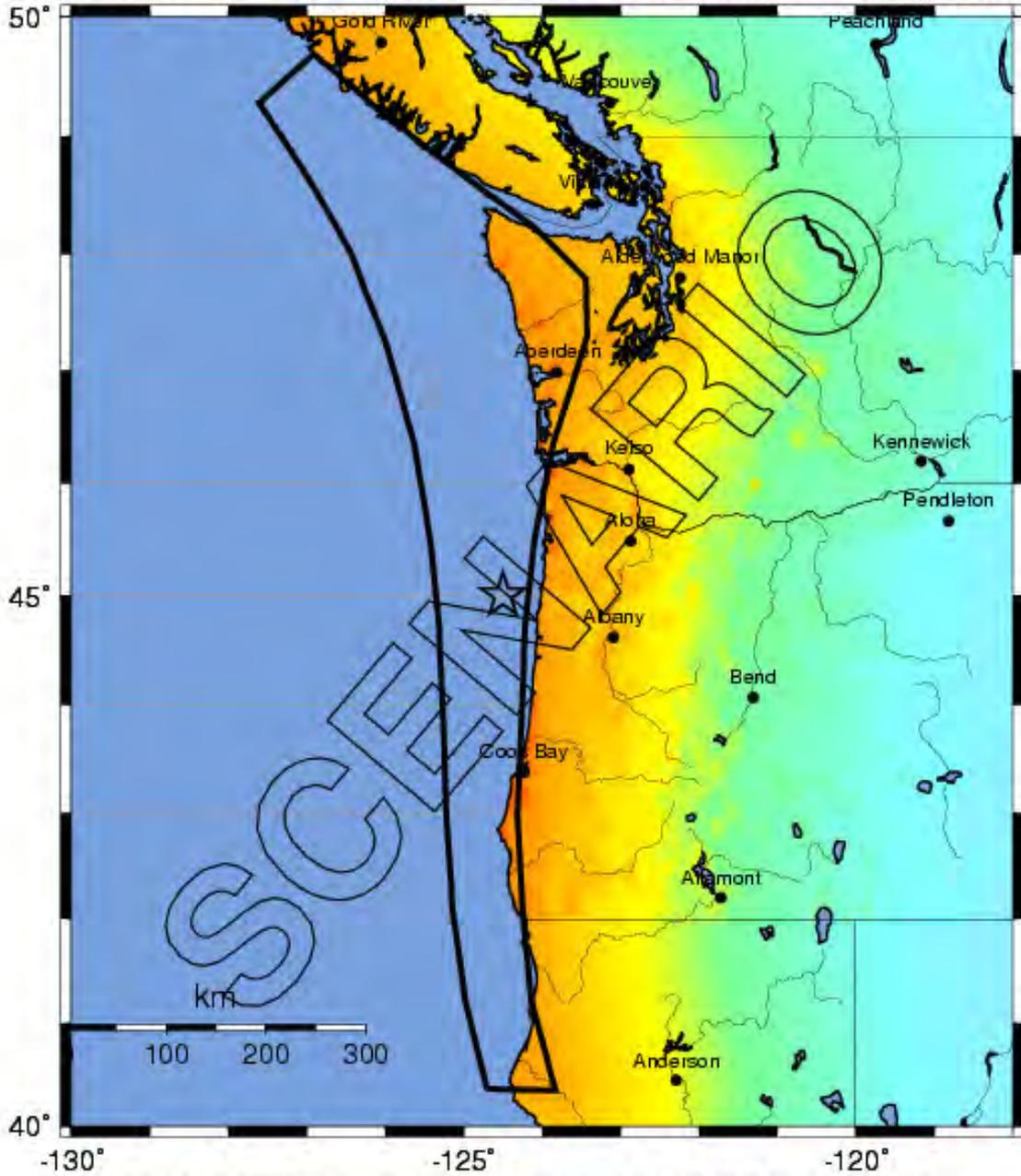
Scenario Date: JUL 16 2009 09:00:00 PM PST PST M 9.0 N45.00 W124.50 Depth: 10.0km



PLANNING SCENARIO ONLY -- Map Version 2 Processed Thu Jul 23, 2009 10:39:35 AM MDT

-- Earthquake Planning Scenario --  
 ShakeMap for Casc9.0 Scenario

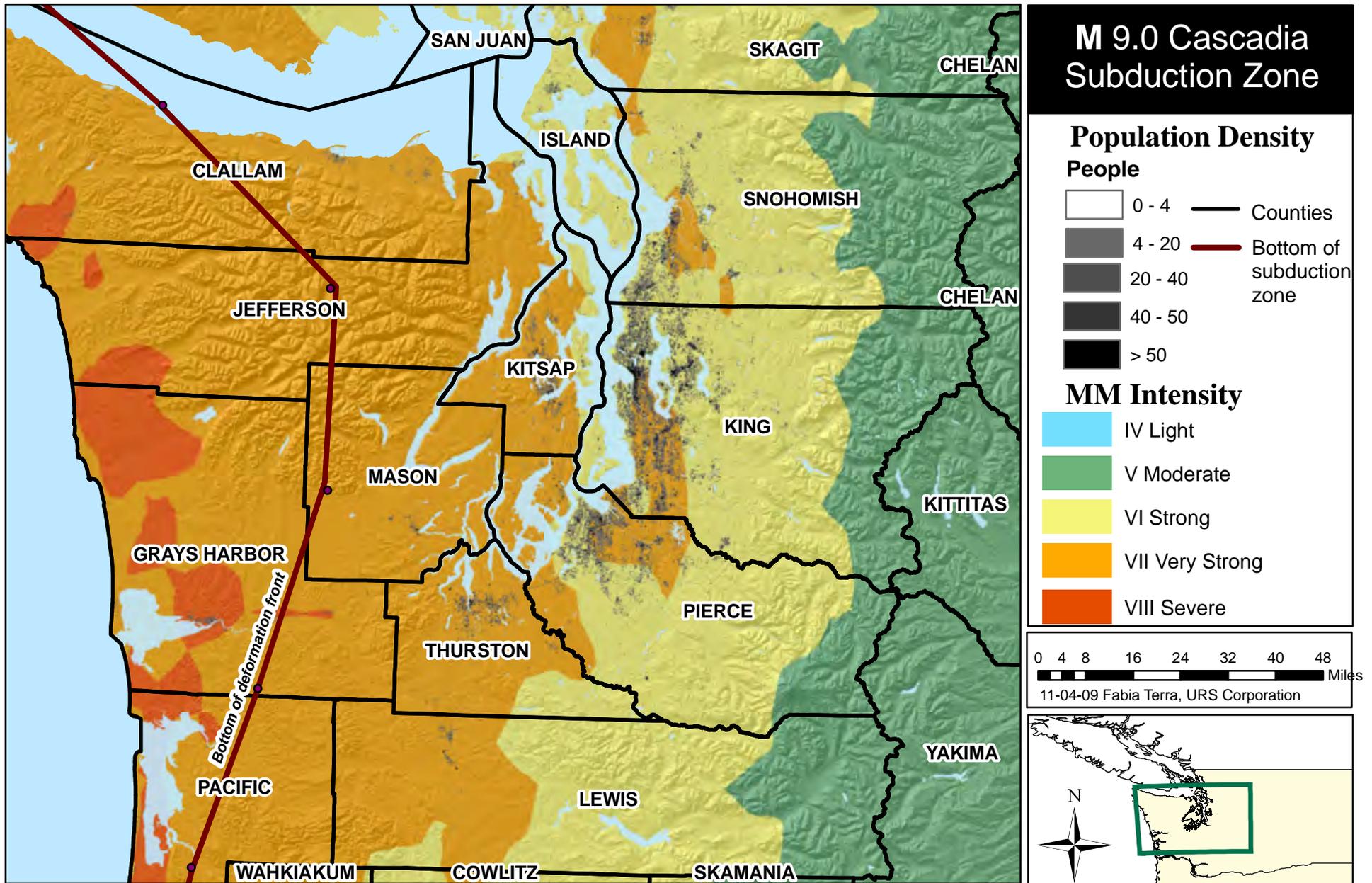
Scenario Date: JUL 16 2009 09:00:00 PM PST PST M 9.0 N45.00 W124.50 Depth: 10.0km



PLANNING SCENARIO ONLY -- Map Version 2 Processed Thu Jul 23, 2009 10:39:35 AM MDT

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC. (%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL. (cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

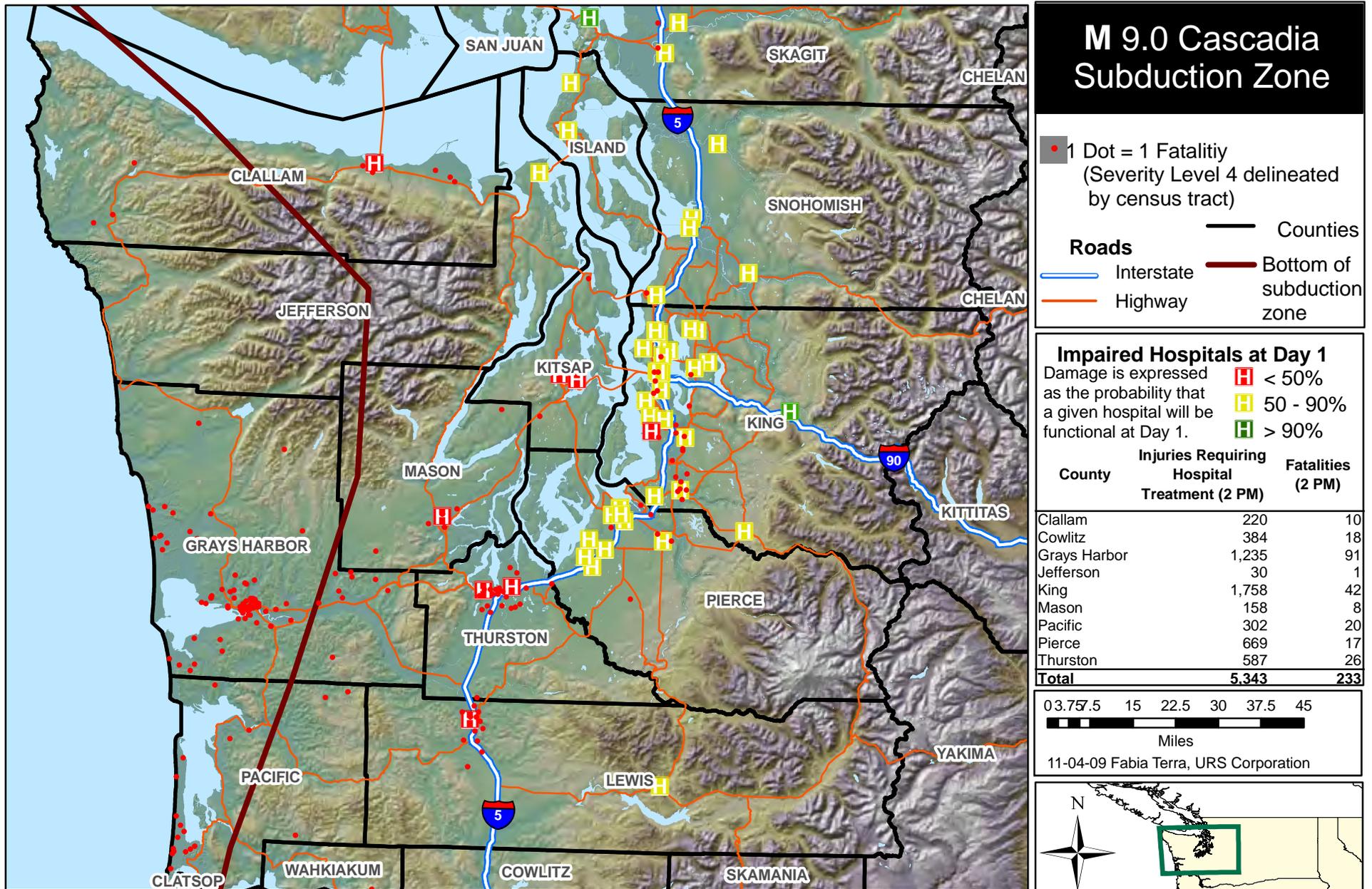
# Population Density and Ground Shaking Intensities - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, MMI Map USGS 2009  
Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 1

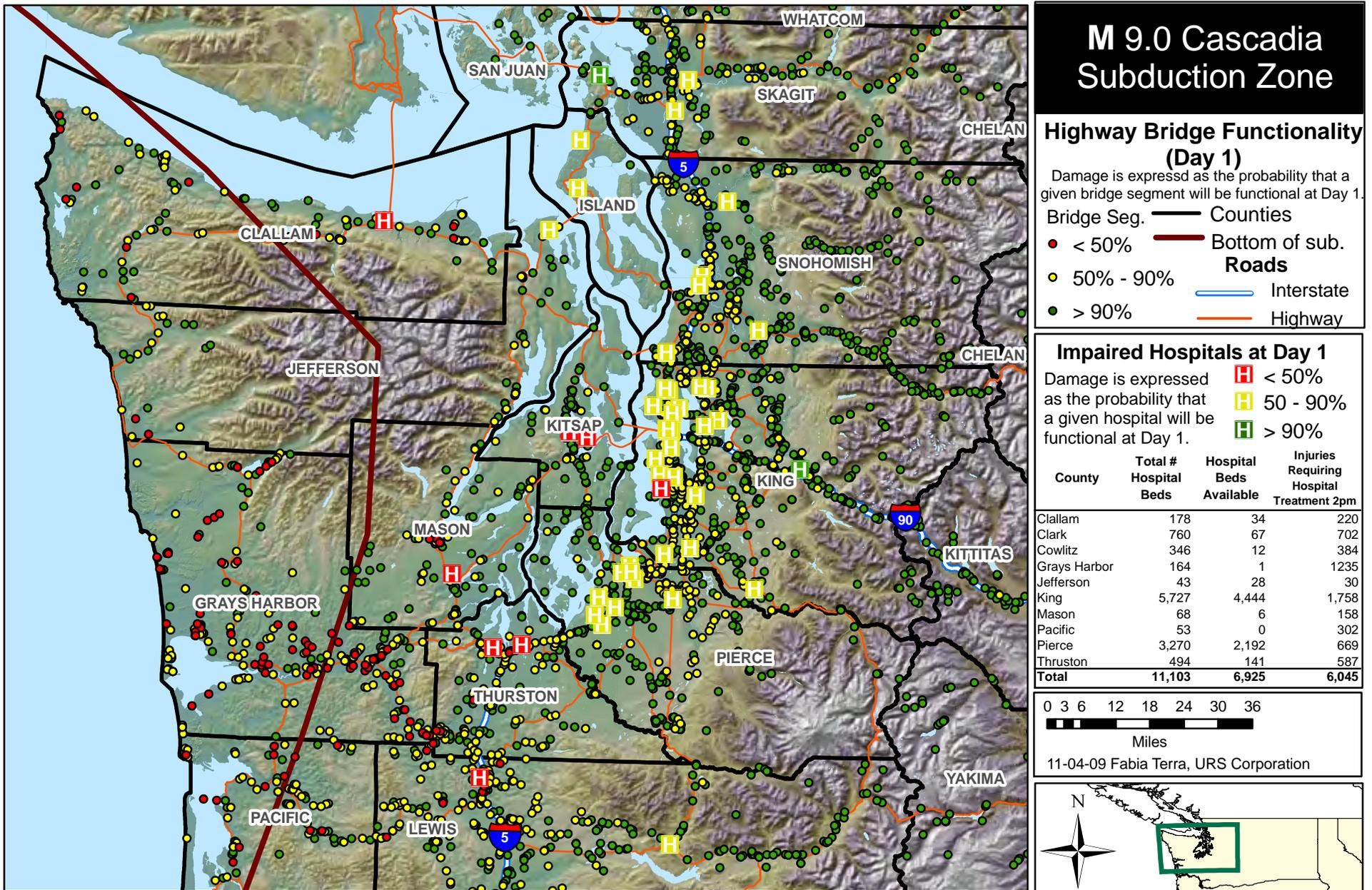
# Fatalities (2 pm) and Impaired Hospitals (Day 1) - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 2

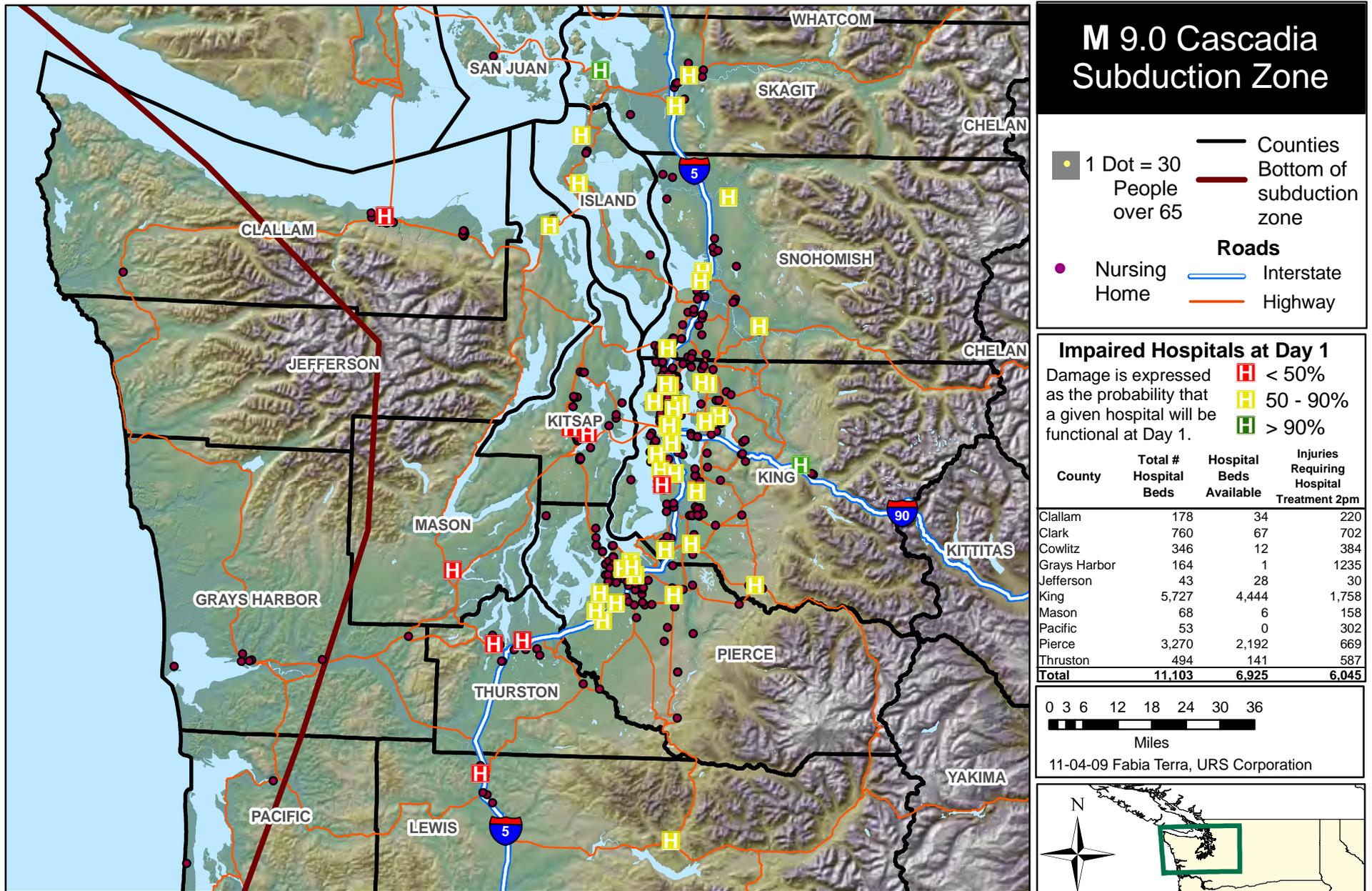
# Impaired Hospitals (Day 1), Hospital Bed Availability, & Bridge Functionality - Earthquake Scenario: Washington



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 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 3

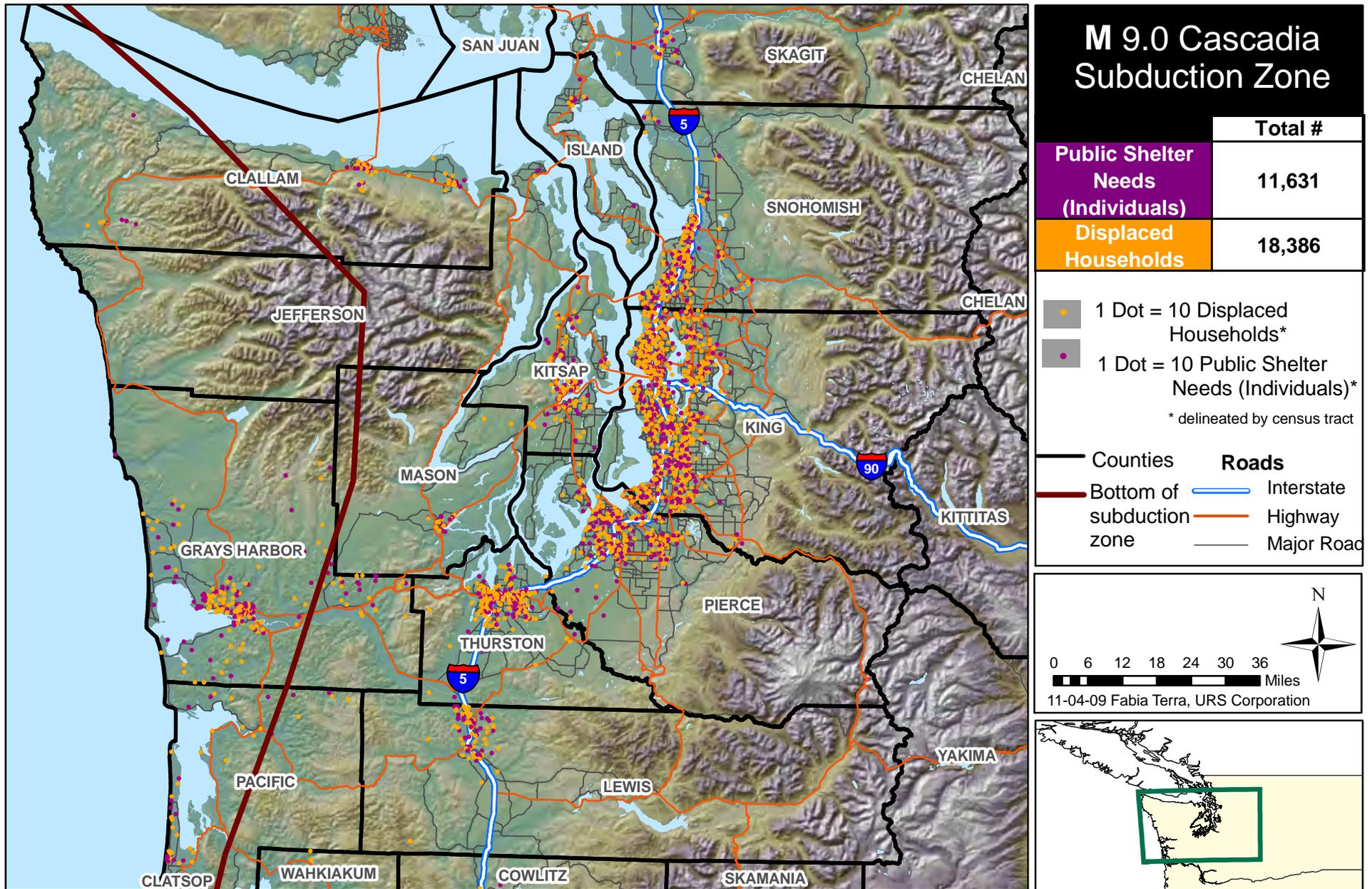
# Distribution of Elderly, Impaired Hospitals (Day 1), & Hospital Bed Availability - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways and Nursing homes HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 4

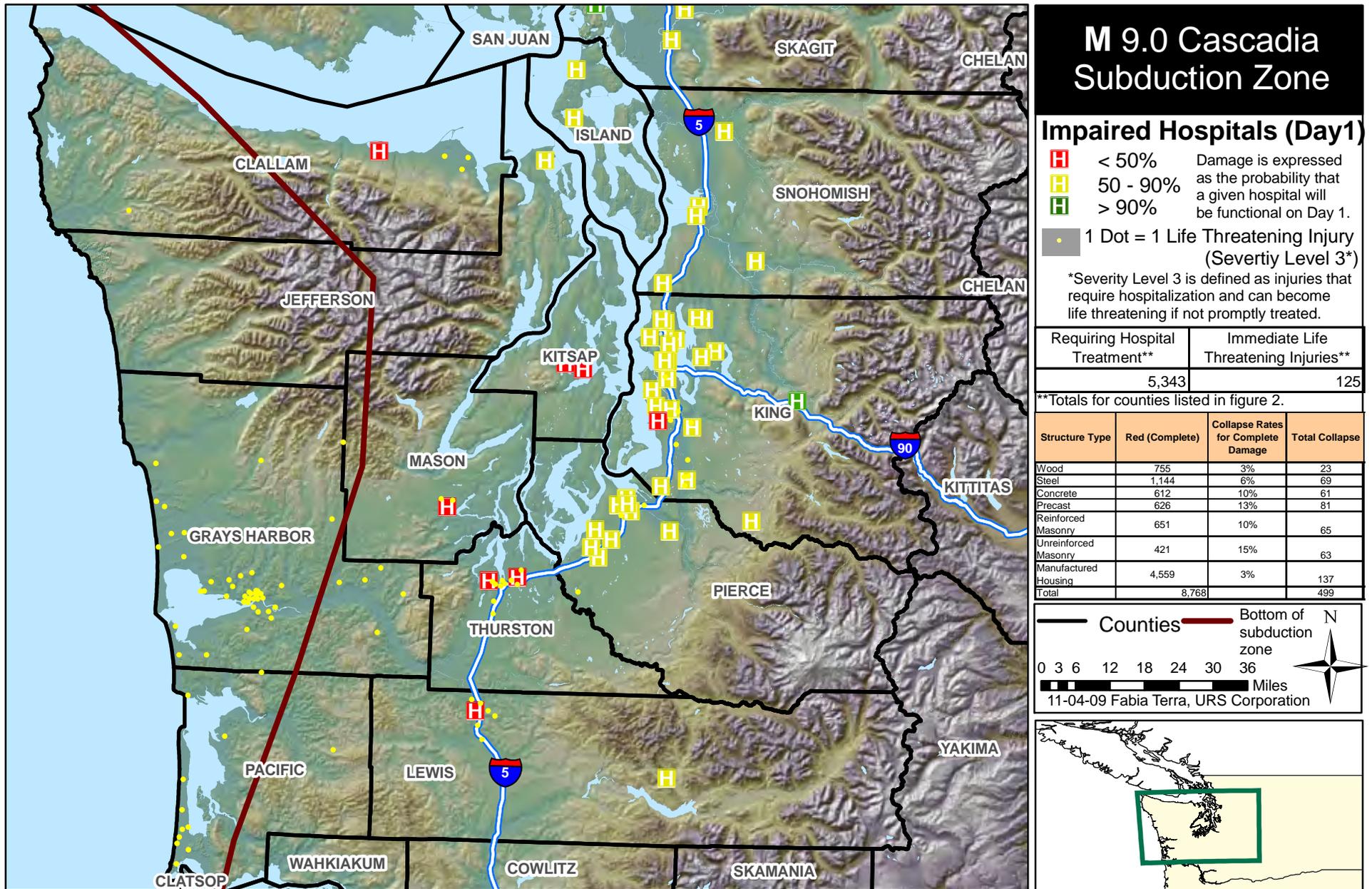
# Estimated Displaced Households & Short Term Public Shelter Needs - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 5

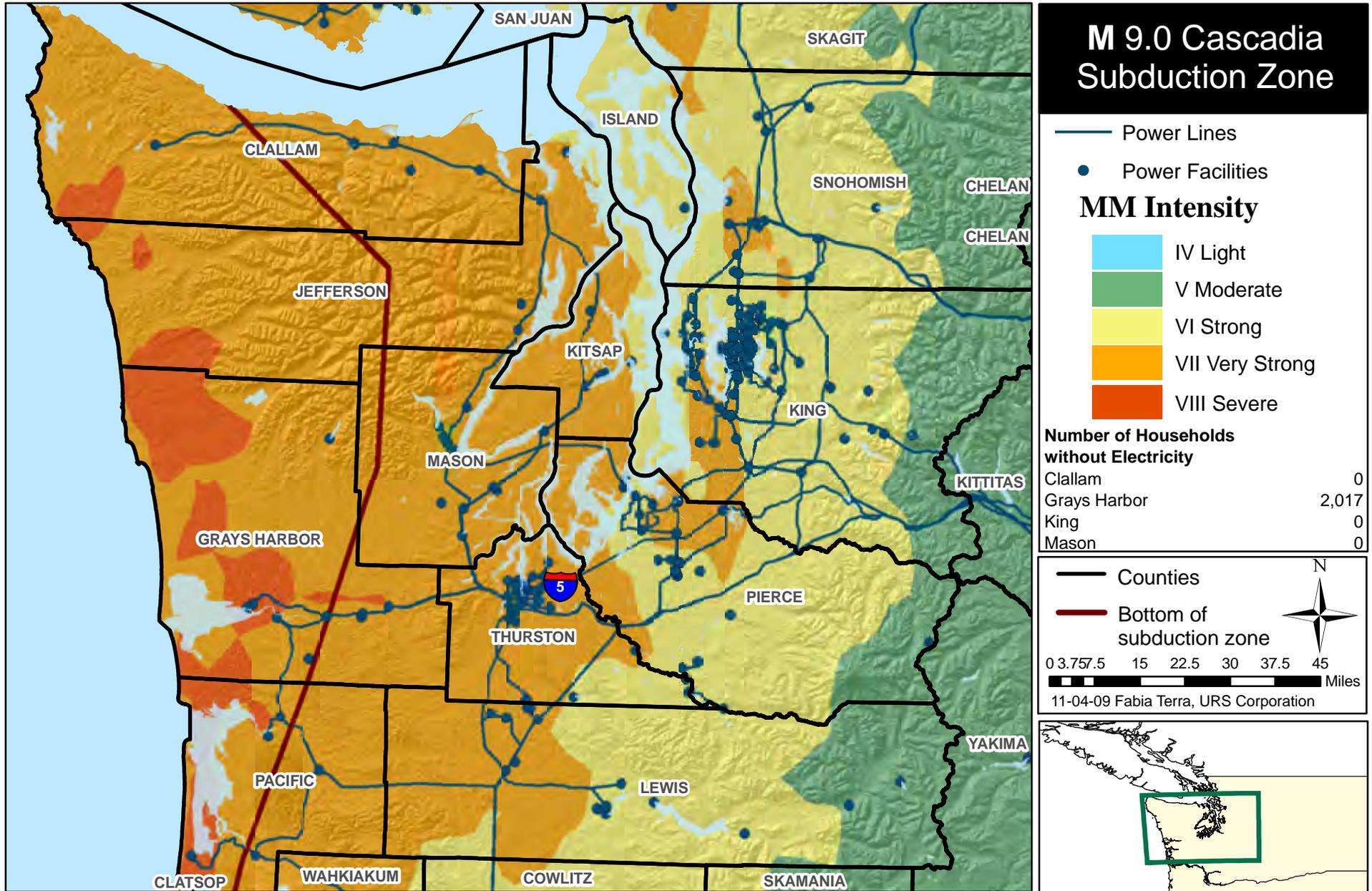
# Injuries 2pm, Collapsed Structures, and Impaired Hospitals - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 6

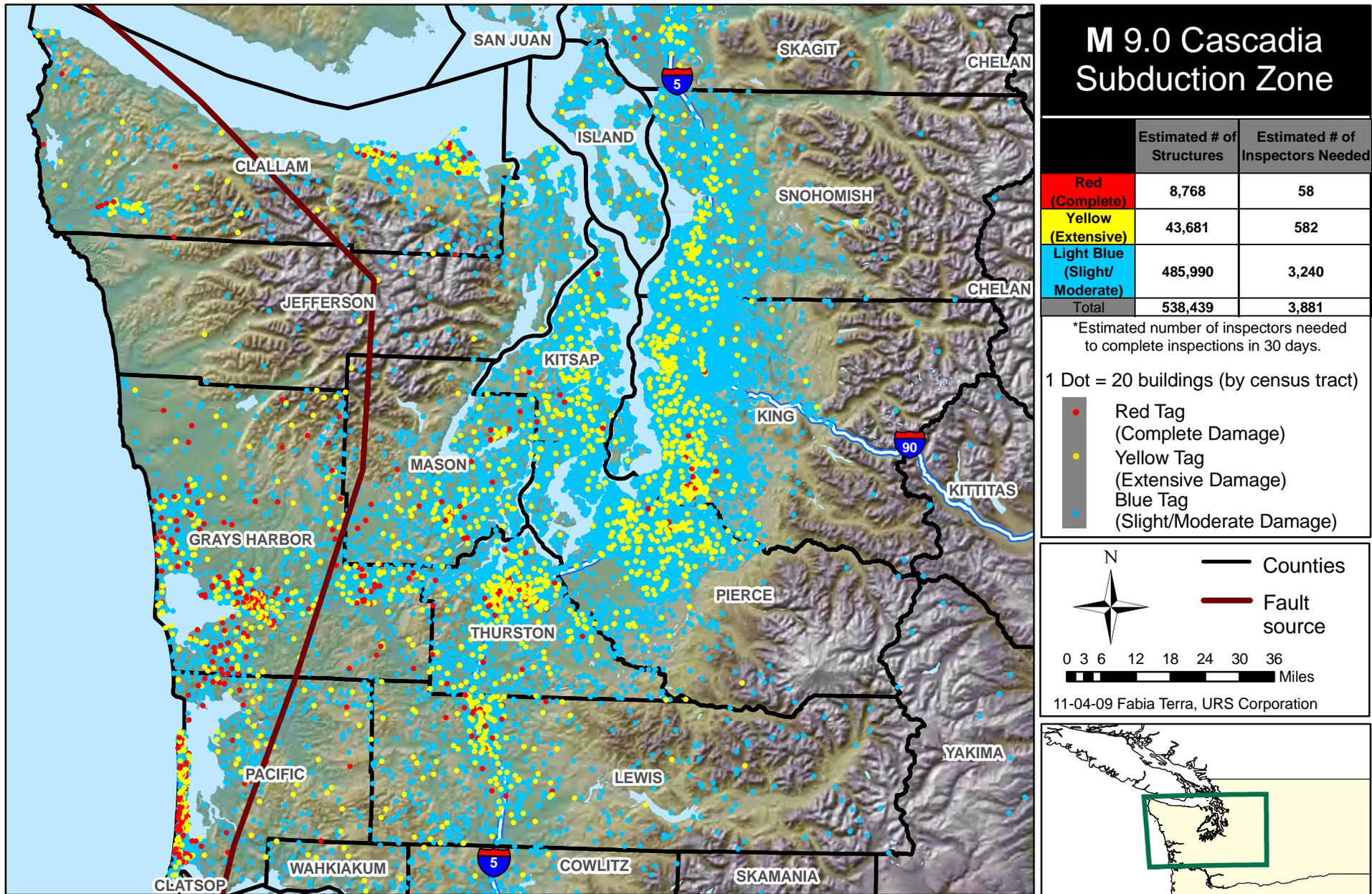
# Power Lines and Facilities, Households Without Electricity, and Ground Shaking Intensities - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Power lines and facilities HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 7

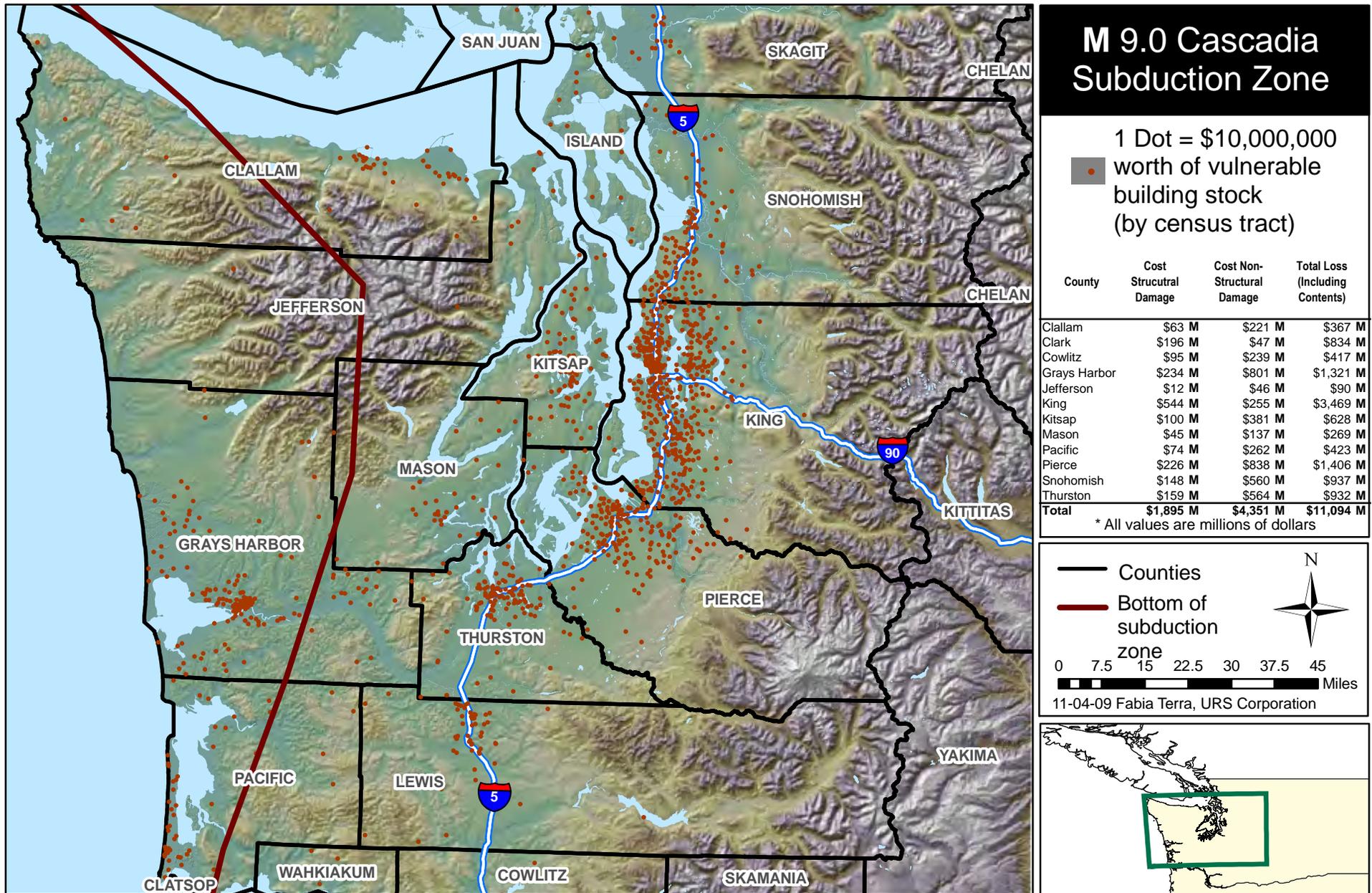
# Estimated Building Inspection Needs - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 8

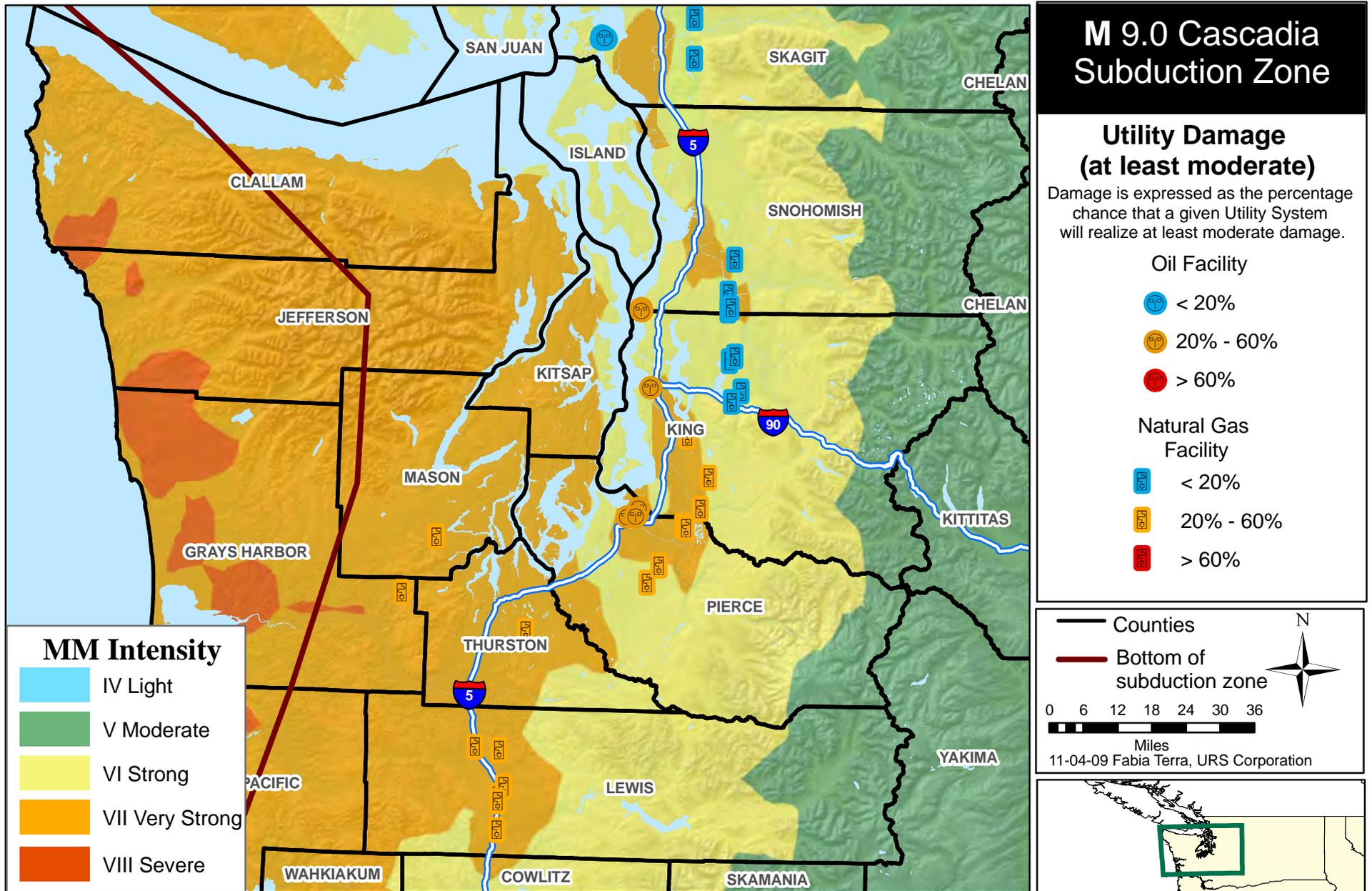
# Direct Building Economic Loss - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 9

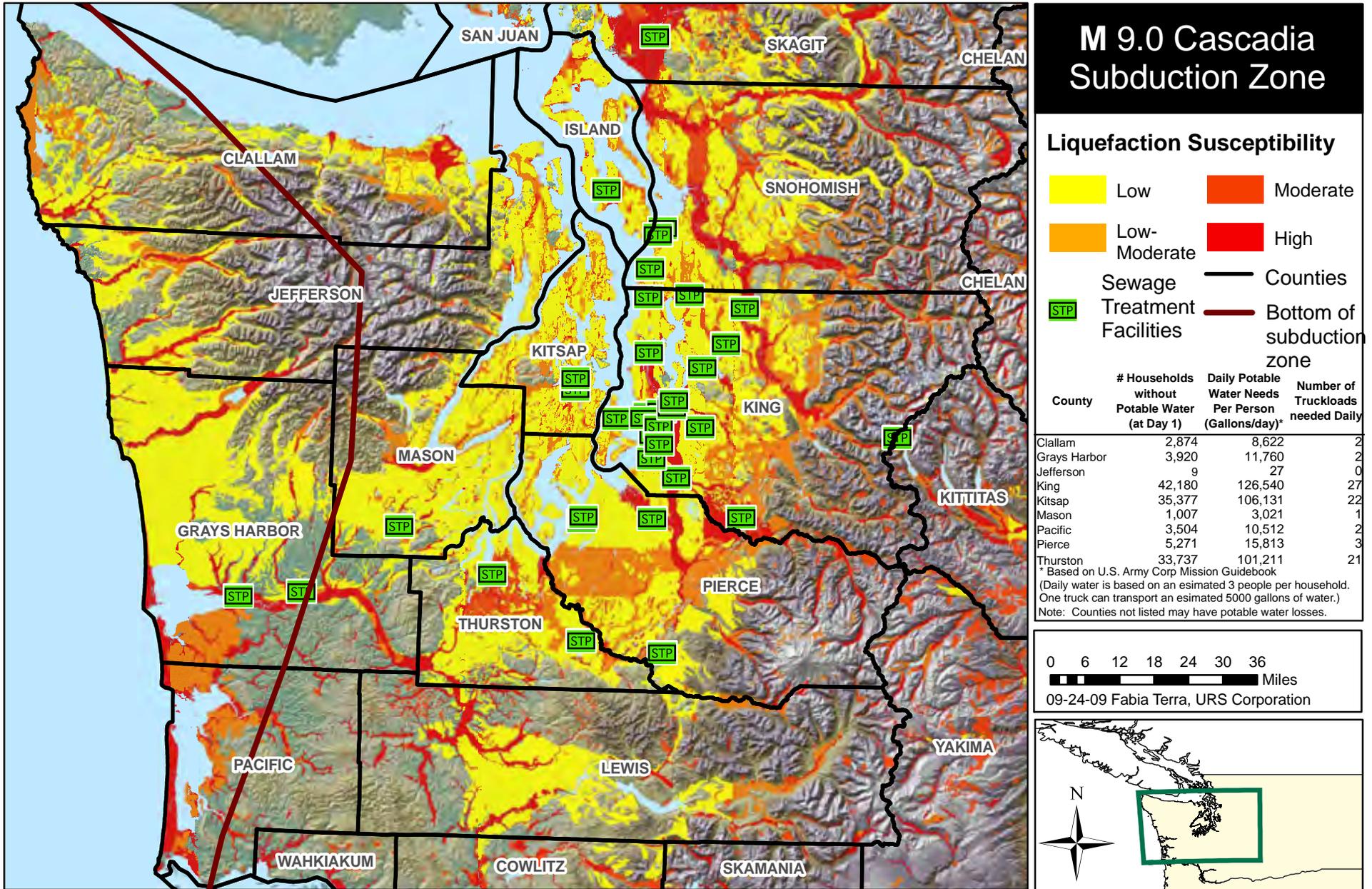
# Natural Gas, and Oil Facility Damage - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007, MMI Map USGS 2009  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 10

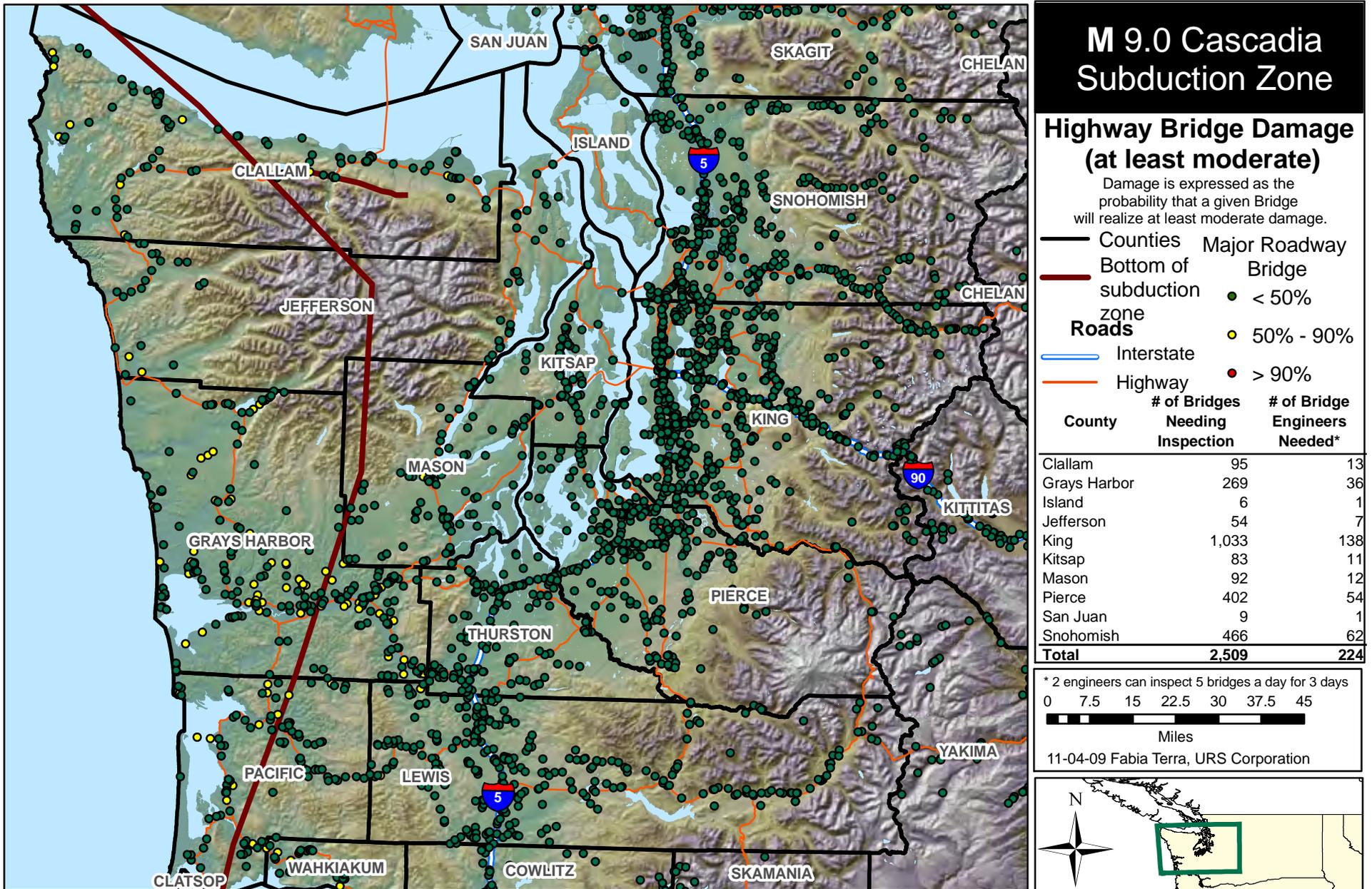
# Sewage Treatment Facility Distribution, Households Without Potable Water, and Liquefaction Susceptibility - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Sewage Treatment Facilities HSIP Gold 2007, Liquefaction The Wash State Geological Survey  
Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 11

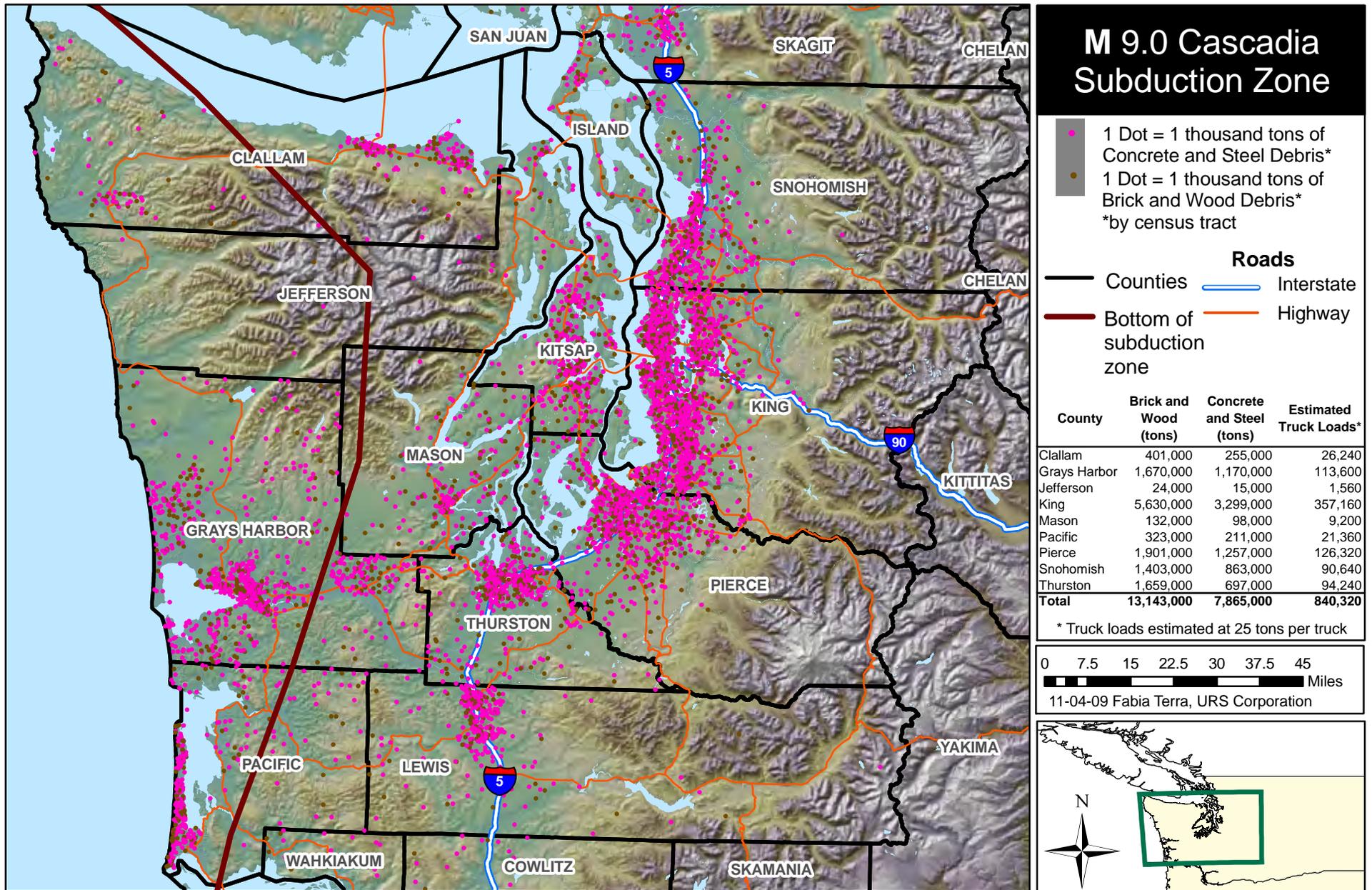
# Estimated Highway Bridge Damage - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 12

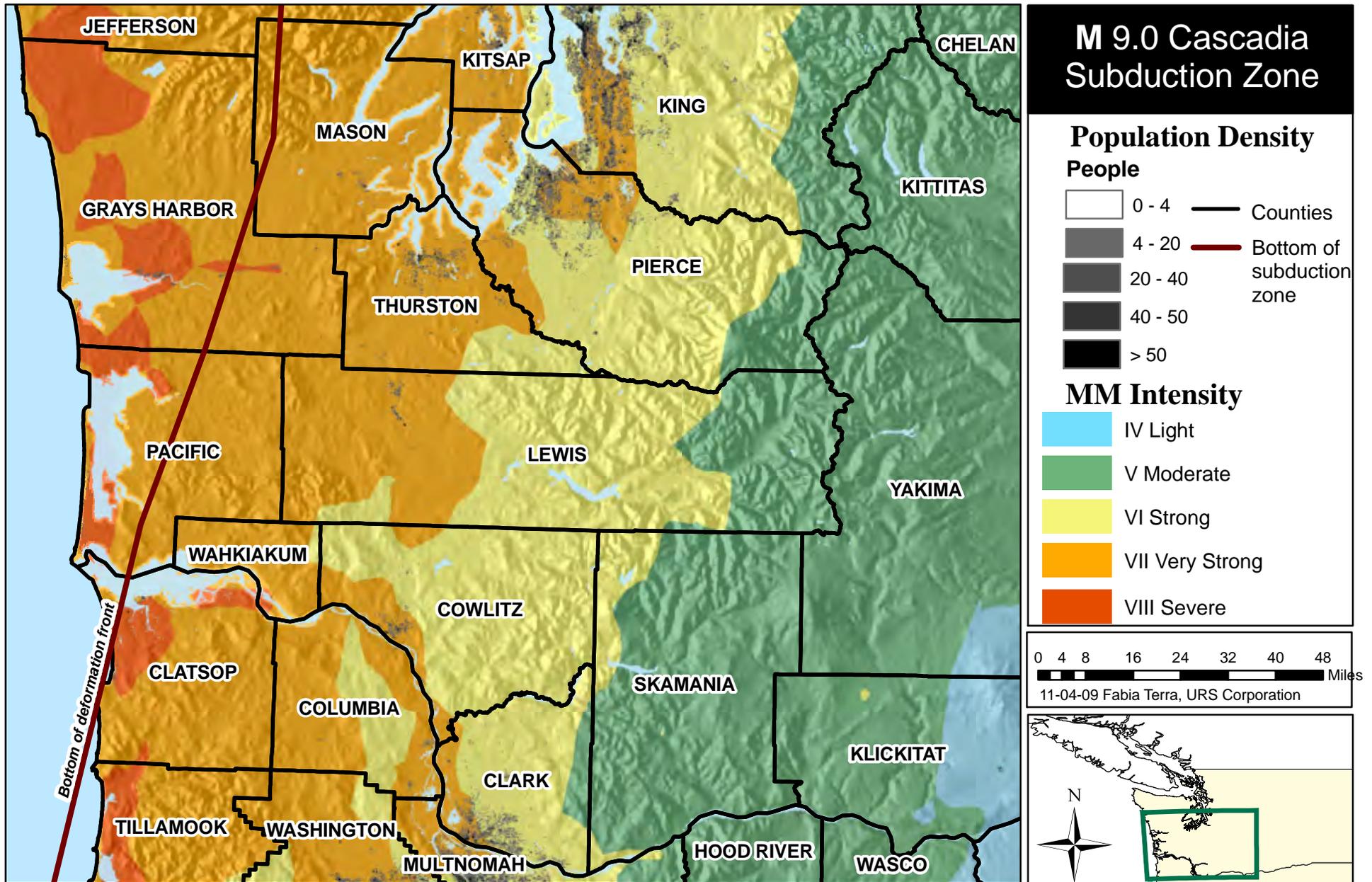
# Estimated Brick, Concrete, Steel, and Wood Debris - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 13

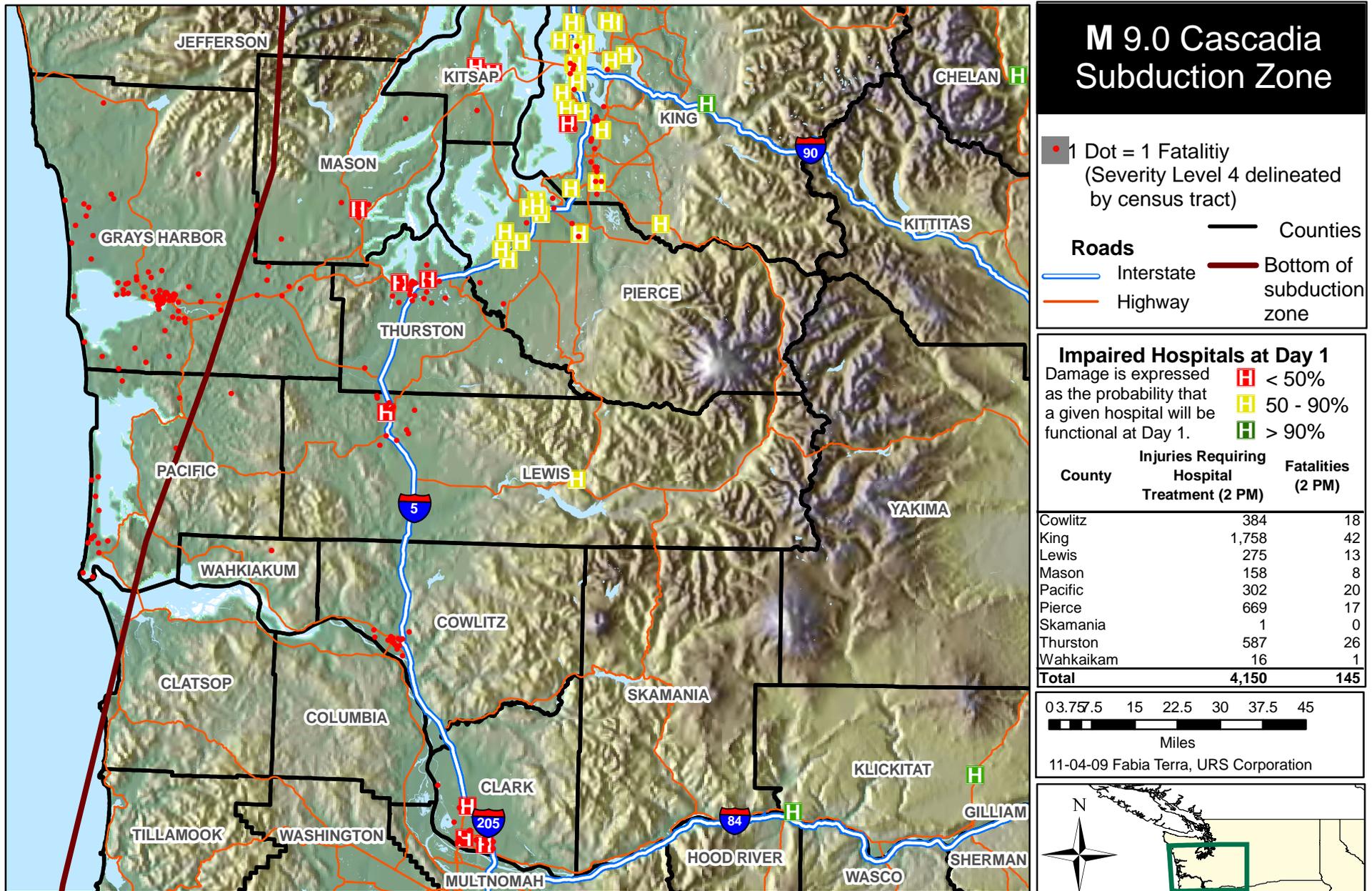
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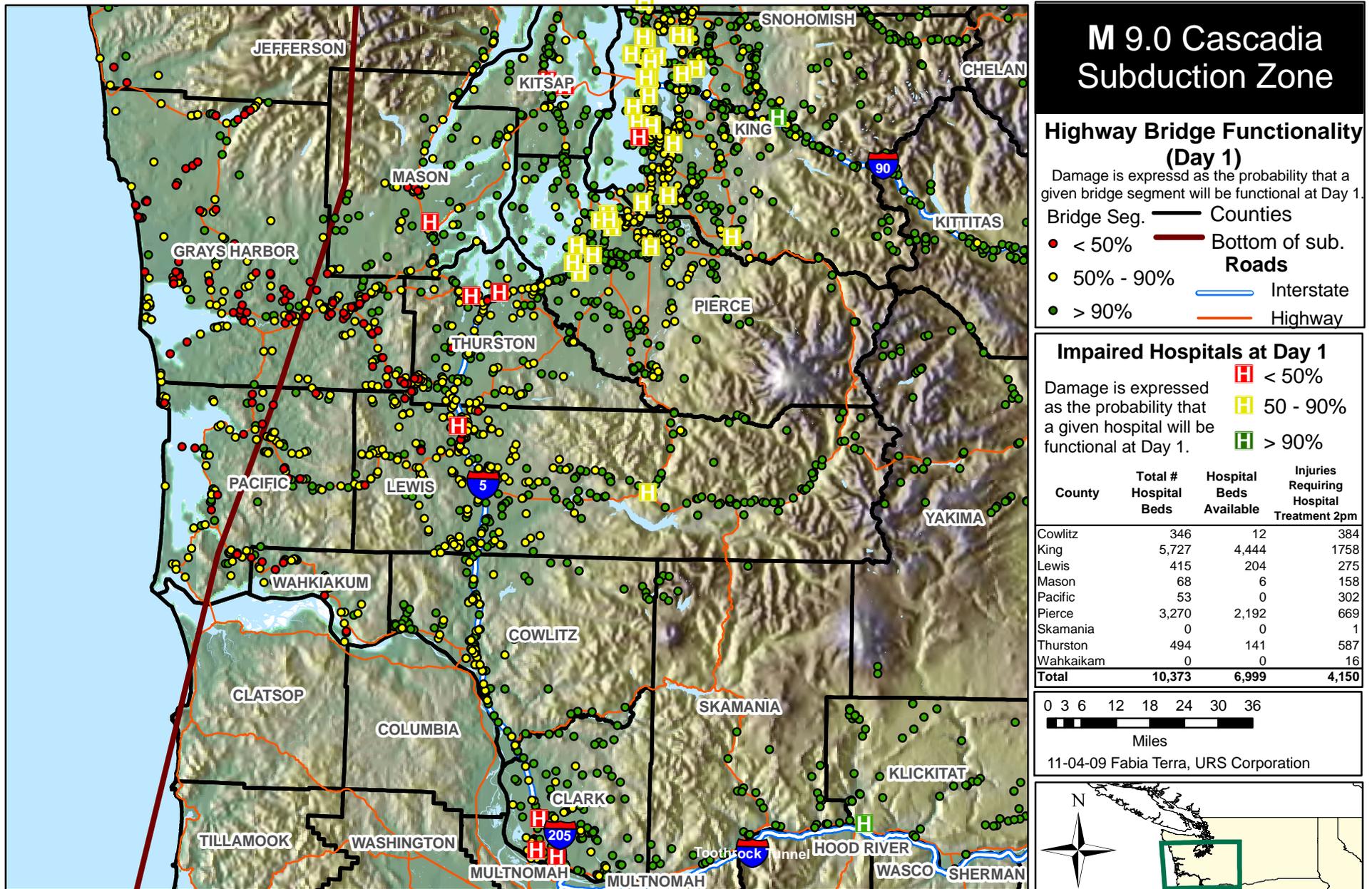
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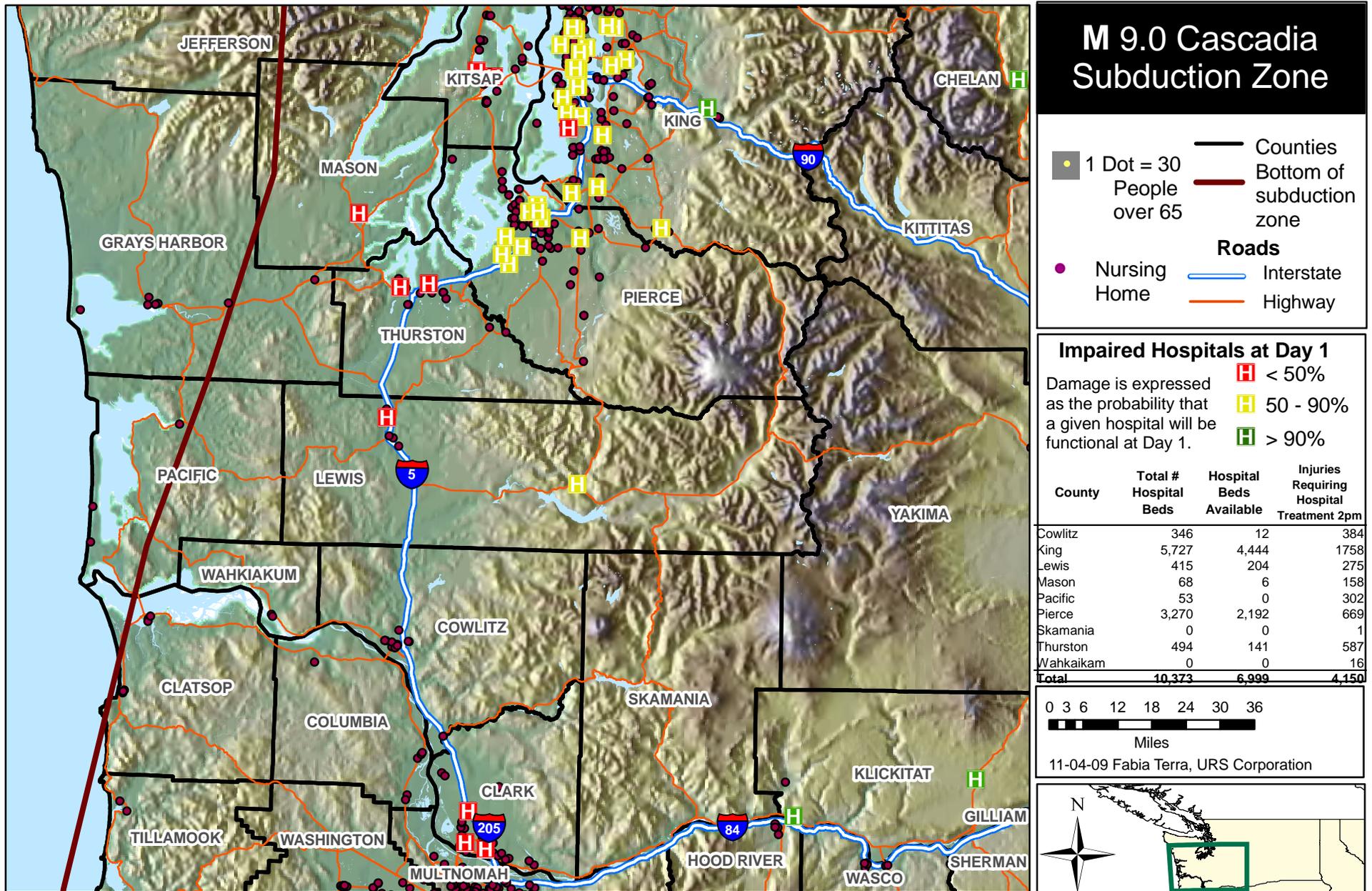
# Impaired Hospitals (Day 1), Hospital Bed Availability, & Bridge Functionality - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 3

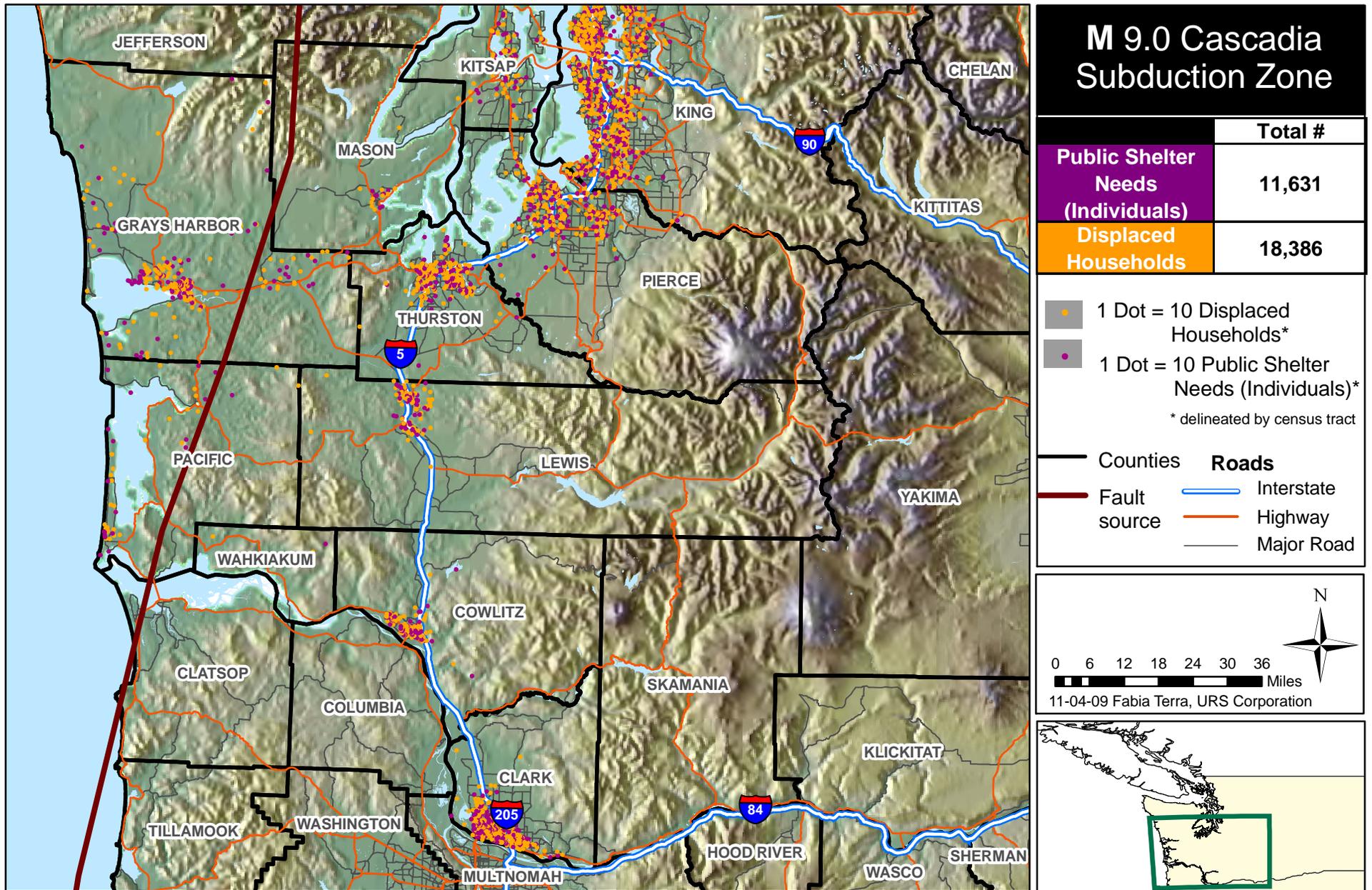
# Distribution of Elderly, Impaired Hospitals (Day 1), & Hospital Bed Availability - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways and Nursing homes HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 4

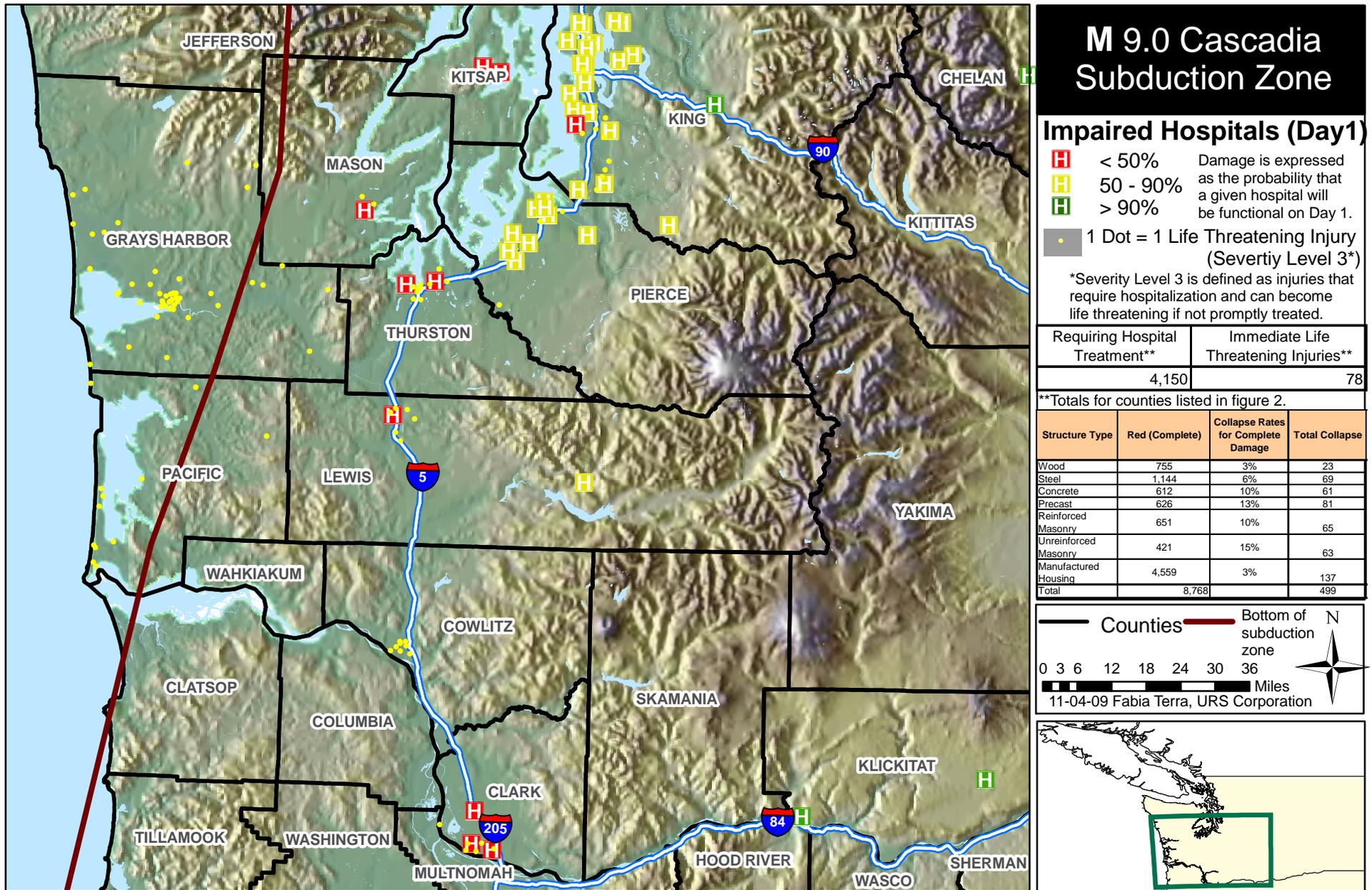
# Estimated Displaced Households & Short Term Public Shelter Needs - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 5

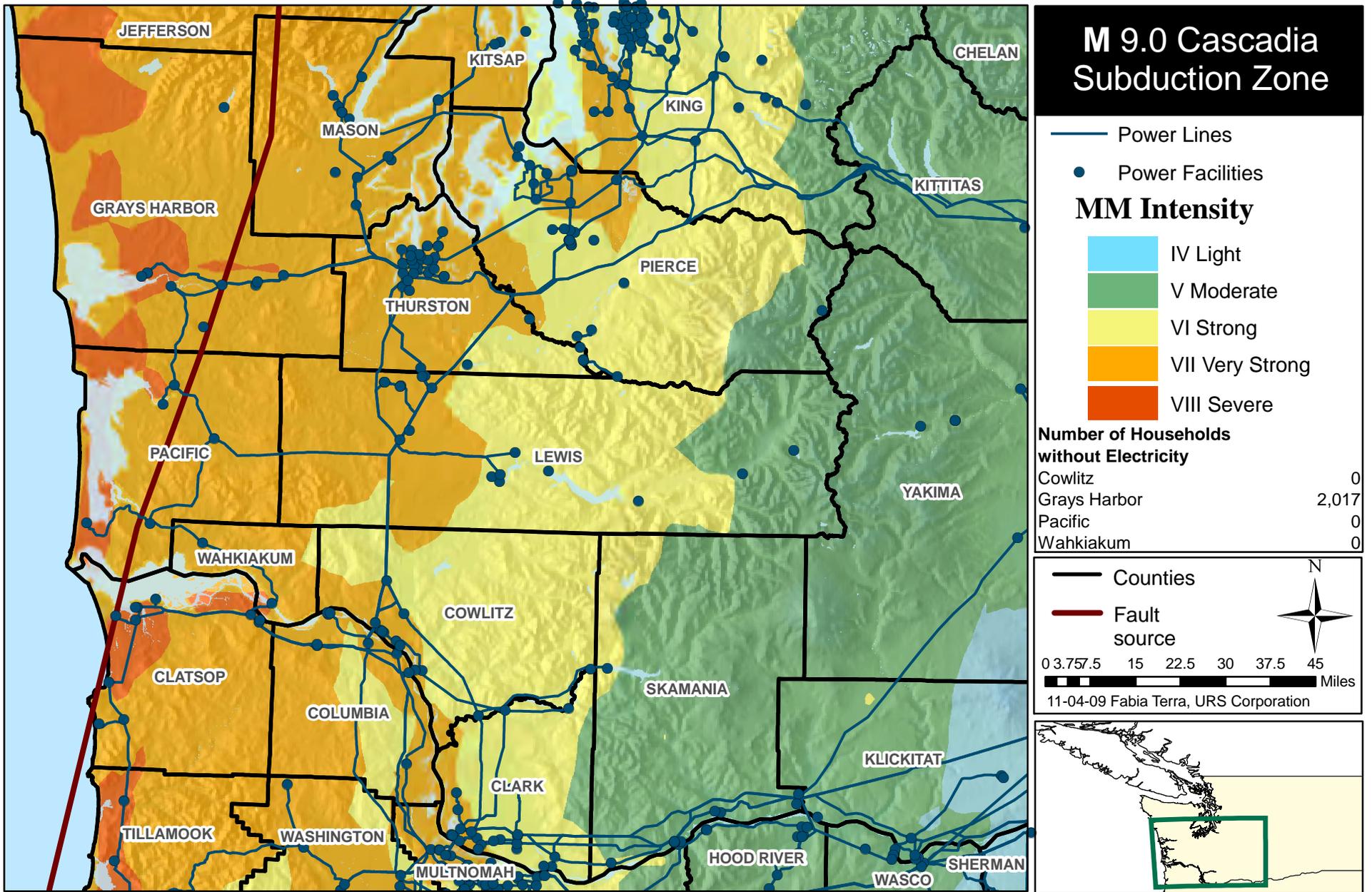
# Injuries 2pm, Collapsed Structures, and Impaired Hospitals - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 6

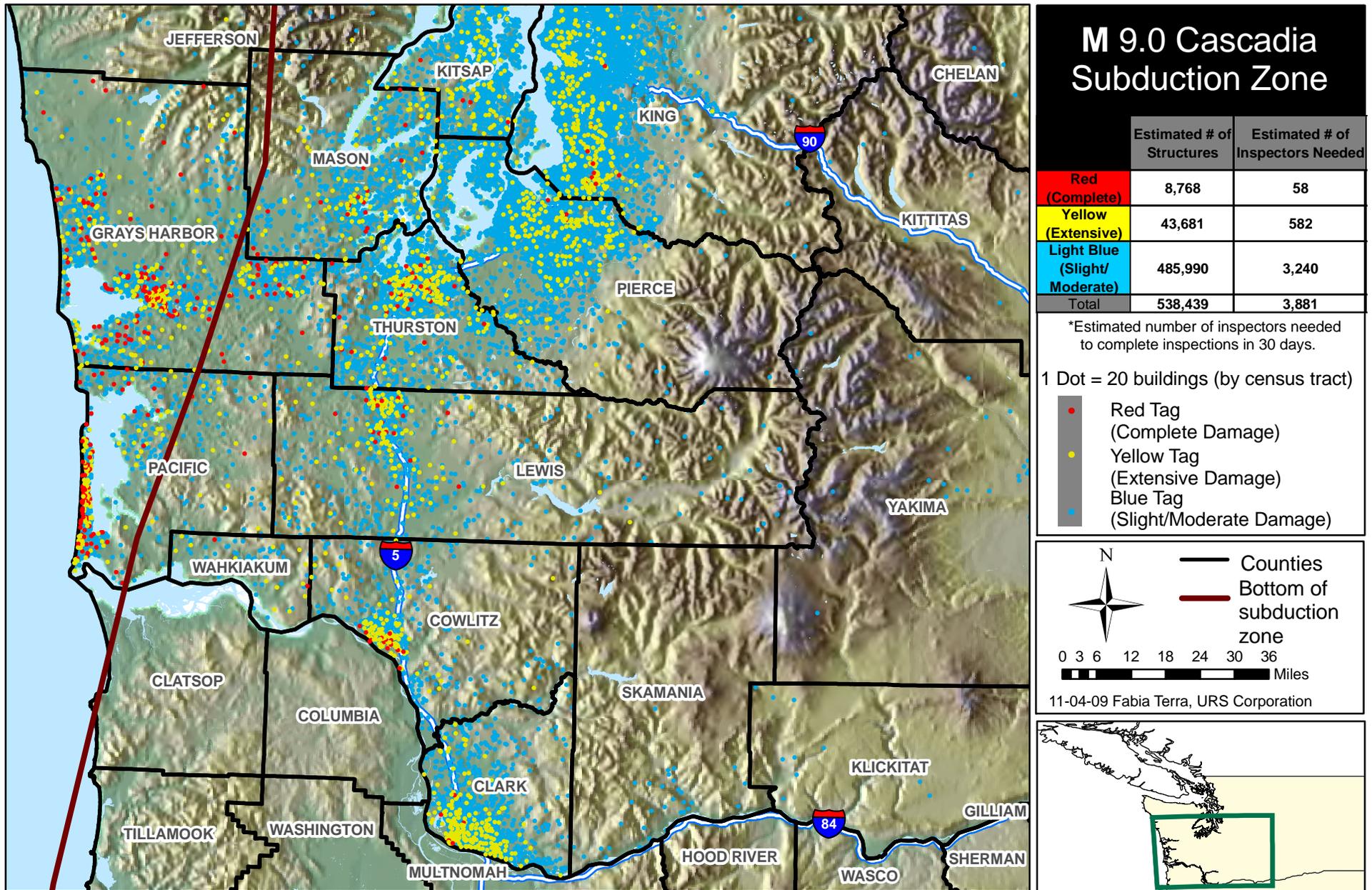
# Power Lines and Facilities, Households Without Electricity, and Ground Shaking Intensities - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Power lines and facilities HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 7

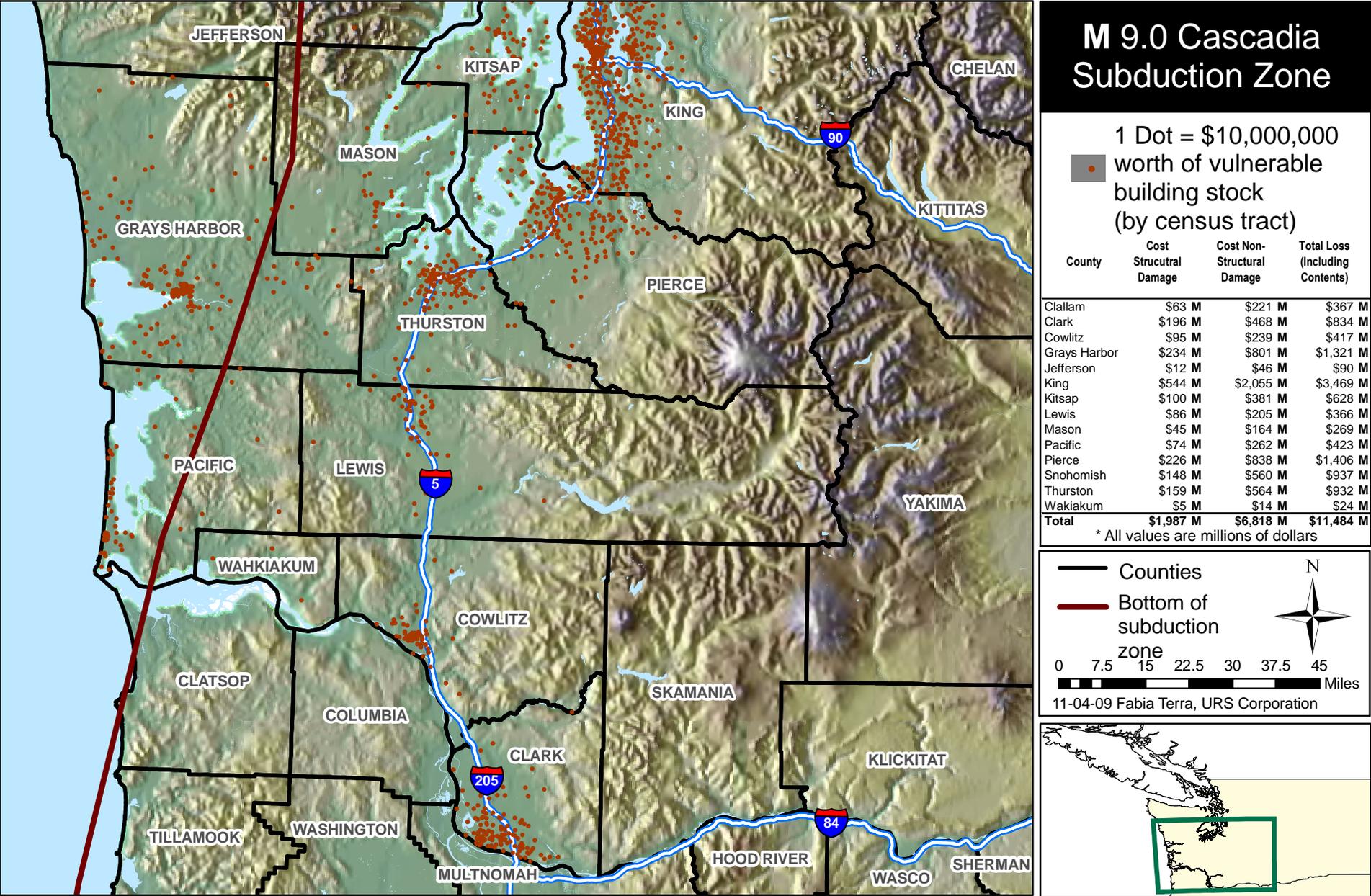
# Estimated Building Inspection Needs - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 8

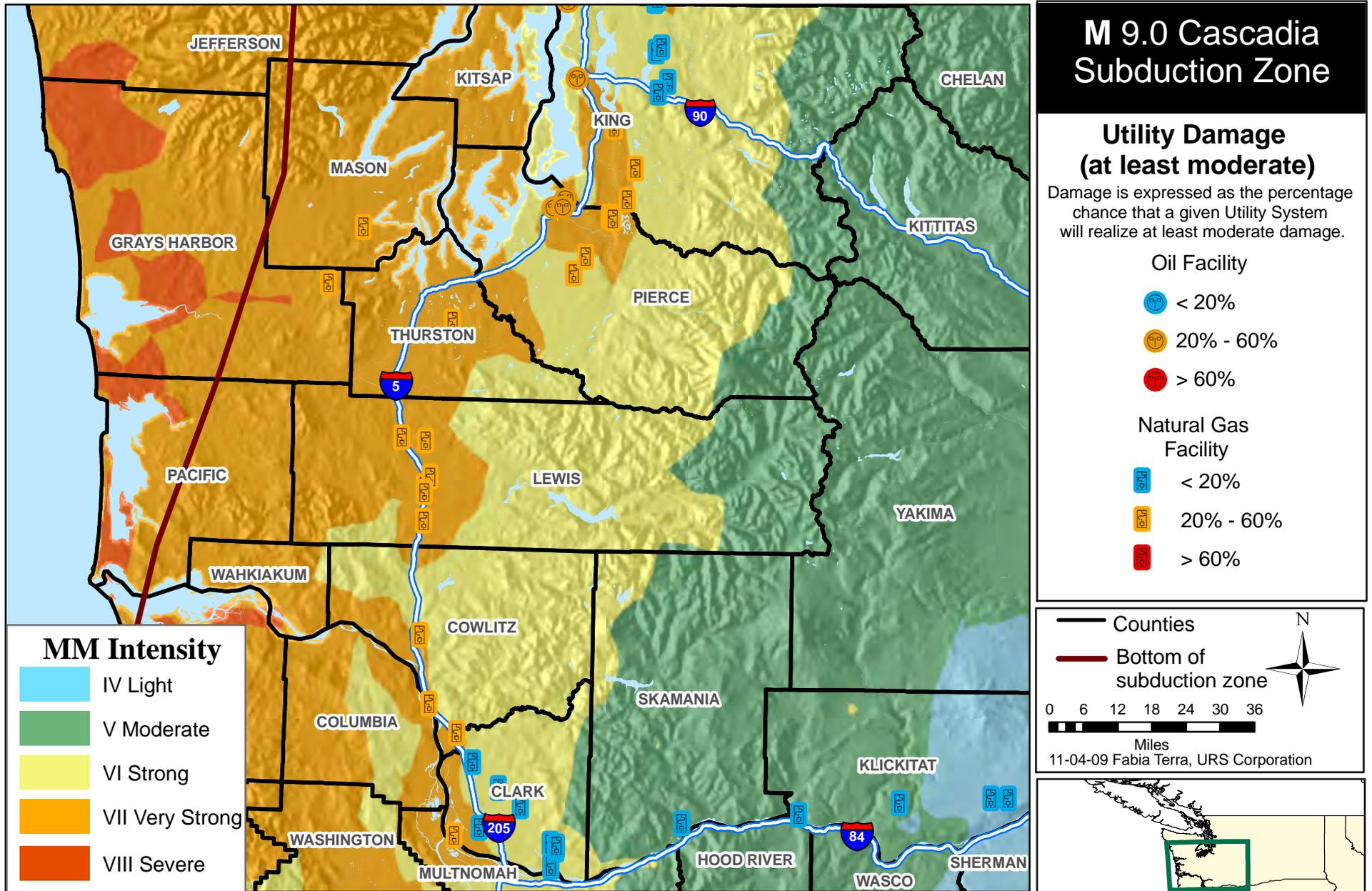
# Direct Building Economic Loss - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 9

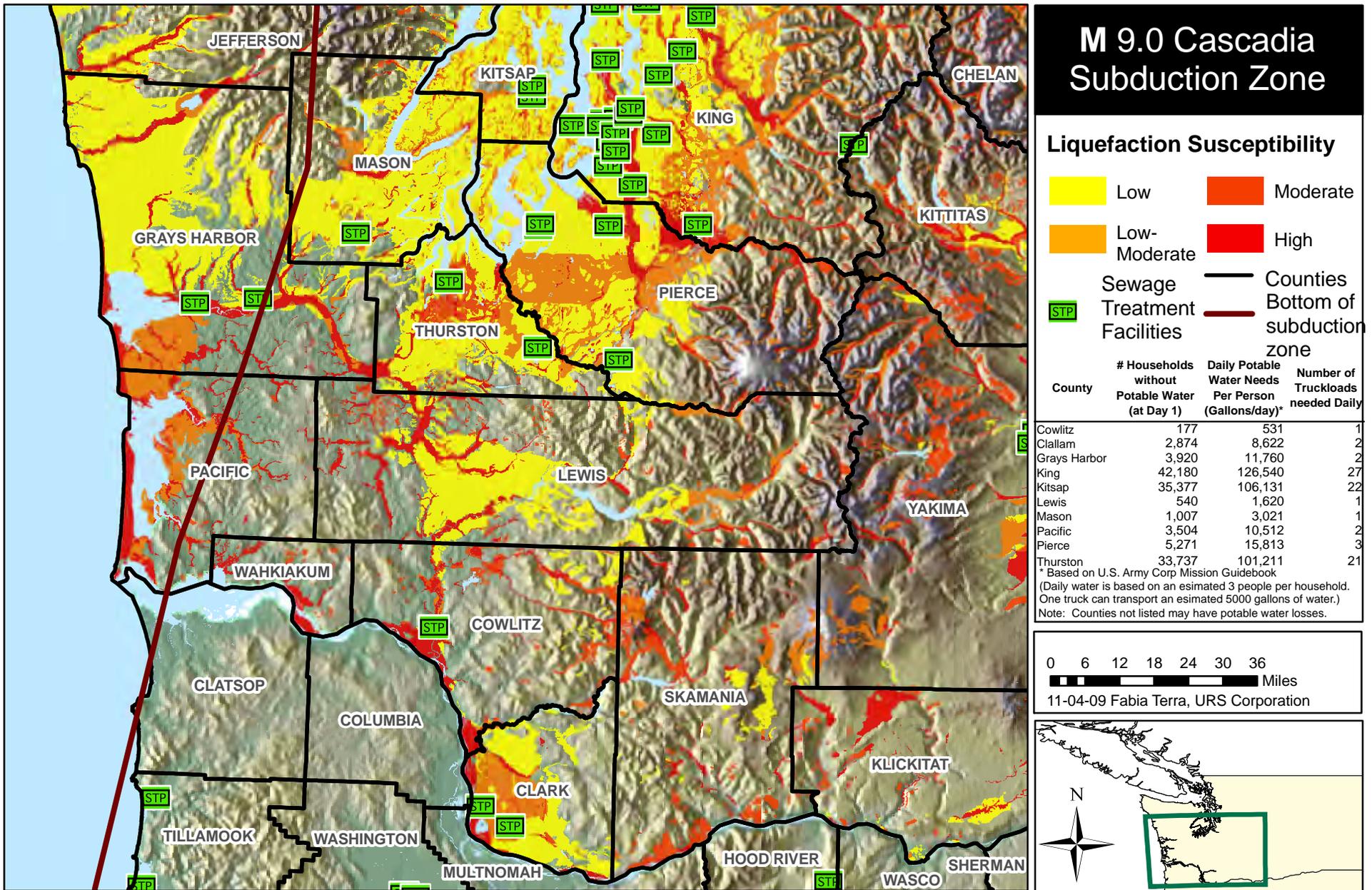
# Natural Gas, and Oil Facility Damage - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007, MMI Map USGS 2009  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 10

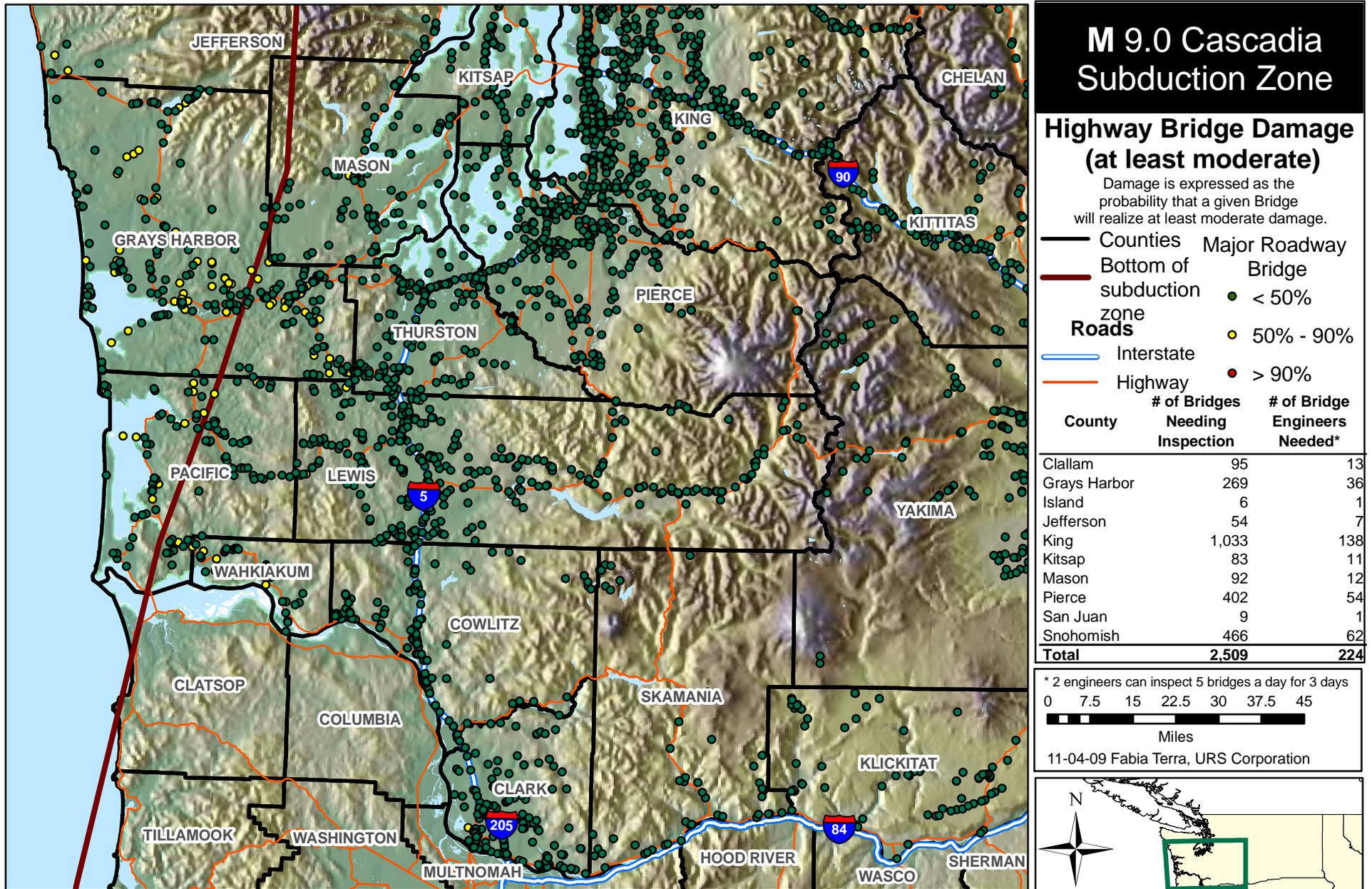
# Sewage Treatment Facility Distribution, Households Without Potable Water, and Liquefaction Susceptibility - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Sewage Treatment Facilities HSIP Gold 2007, Liquefaction The Wash State Geological Survey  
Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 11

# Estimated Highway Bridge Damage - Earthquake Scenario: Washington



## M 9.0 Cascadia Subduction Zone

### Highway Bridge Damage (at least moderate)

Damage is expressed as the probability that a given Bridge will realize at least moderate damage.

- Counties
- Major Roadway
- Bottom of subduction zone
- Bridge
- < 50%
- 50% - 90%
- > 90%
- Interstate
- Highway

County	# of Bridges Needing Inspection	# of Bridge Engineers Needed*
Clallam	95	13
Grays Harbor	269	36
Island	6	1
Jefferson	54	7
King	1,033	138
Kitsap	83	11
Mason	92	12
Pierce	402	54
San Juan	9	1
Snohomish	466	62
<b>Total</b>	<b>2,509</b>	<b>224</b>

\* 2 engineers can inspect 5 bridges a day for 3 days

0 7.5 15 22.5 30 37.5 45

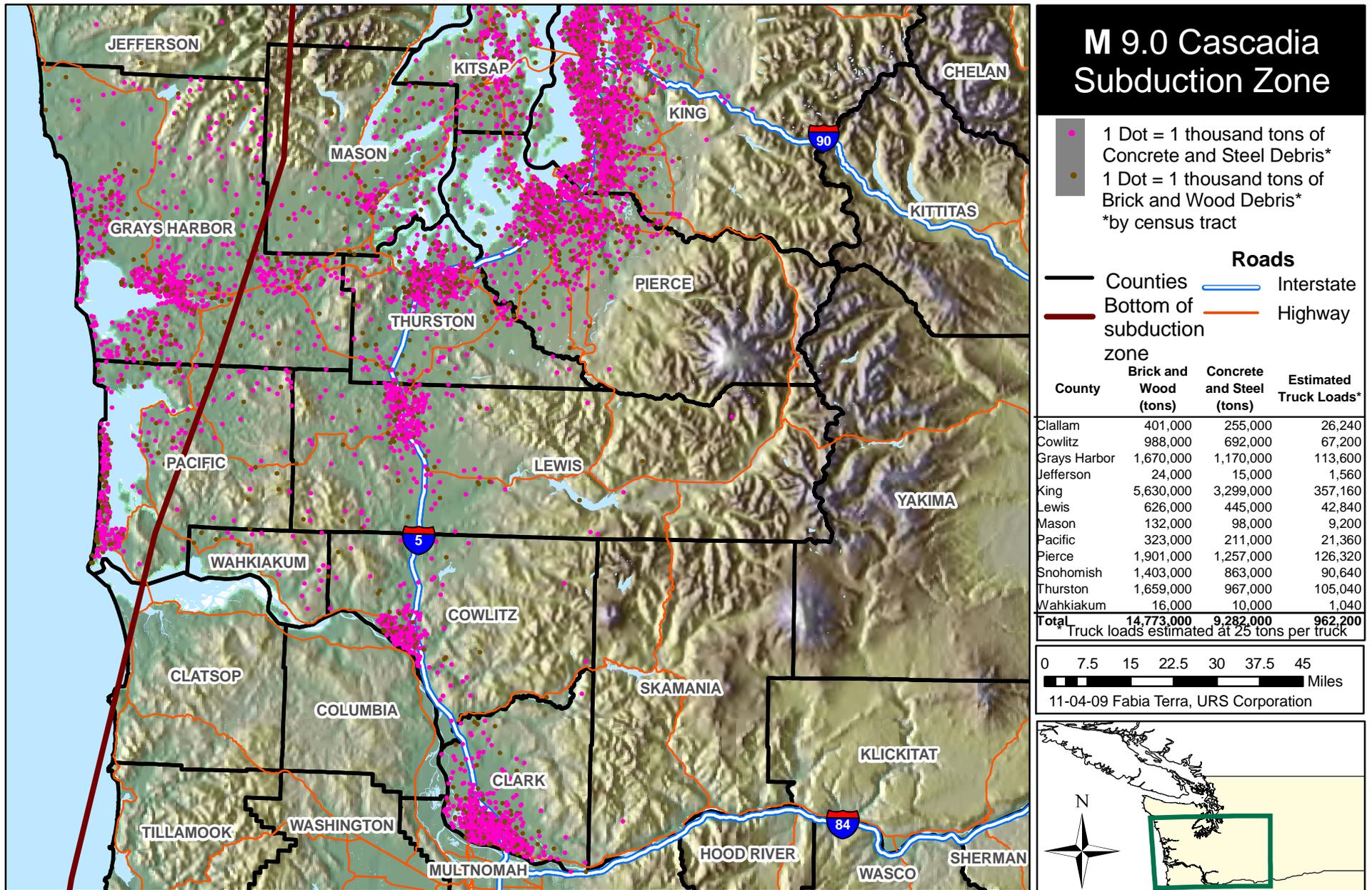
Miles

11-04-09 Fabia Terra, URS Corporation

Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
 Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 12

# Estimated Brick, Concrete, Steel, and Wood Debris - Earthquake Scenario: Washington



Sources: 2009 HAZUS runs by URS Corporation, Highways HSIP Gold 2007  
Projection: NAD83 Harn State Plane Washington 4602 (feet)

Figure 13