

# HAZUS-MH: Earthquake Event Report

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**Region Name:** Brigham City

**Earthquake Scenario:** Brigham City Segment Mw 70 SM Scenario

**Print Date:** February 19, 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 29 county(ies) from the following state(s):

Utah

Note:

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

The geographical size of the region is 84,798.76 square miles and contains 496 census tracts. There are over 773 thousand households in the region and has a total population of 2,474,258 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 653 thousand buildings in the region with a total building replacement value (excluding contents) of 131,629 (millions of dollars). Approximately 95.00 % 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 54,677 and 9,370 (millions of dollars) , respectively.

## Building and Lifeline Inventory

### **Building Inventory**

HAZUS estimates that there are 653 thousand buildings in the region which have an aggregate total replacement value of 131,629 (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 46% 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 56 hospitals in the region with a total bed capacity of 6,868 beds. There are 1,076 schools, 358 fire stations, 133 police stations and 7 emergency operation facilities. With respect to HPL facilities, there are 599 dams identified within the region. Of these, 212 of the dams are classified as 'high hazard'. The inventory also includes 711 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 64,047.00 (millions of dollars). This inventory includes over 8,874 kilometers of highways, 3,009 bridges, 242,427 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	3,009	3,453.80
	Segments	1,303	46,184.60
	Tunnels	4	2.00
	Subtotal		<b>49,640.40</b>
<b>Railways</b>	Bridges	33	3.90
	Facilities	12	32.00
	Segments	1,485	2,821.00
	Tunnels	0	0.00
	Subtotal		<b>2,856.90</b>
<b>Light Rail</b>	Bridges	0	0.00
	Facilities	24	63.90
	Segments	24	37.20
	Tunnels	0	0.00
	Subtotal		<b>101.10</b>
<b>Bus</b>	Facilities	10	10.70
	Subtotal		<b>10.70</b>
<b>Ferry</b>	Facilities	2	2.70
	Subtotal		<b>2.70</b>
<b>Port</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Airport</b>	Facilities	30	319.50
	Runways	46	1,746.30
	Subtotal		<b>2,065.90</b>
		Total	<b>54,677.60</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	2,948.60
	Facilities	2	65.30
	Pipelines	0	0.00
	Subtotal		<b>3,013.90</b>
<b>Waste Water</b>	Distribution Lines	NA	1,769.20
	Facilities	56	3,655.00
	Pipelines	0	0.00
	Subtotal		<b>5,424.20</b>
<b>Natural Gas</b>	Distribution Lines	NA	1,179.50
	Facilities	8	8.50
	Pipelines	957	2,089.80
	Subtotal		<b>3,277.80</b>
<b>Oil Systems</b>	Facilities	31	3.00
	Pipelines	465	733.60
	Subtotal		<b>736.60</b>
<b>Electrical Power</b>	Facilities	26	2,802.80
	Subtotal		<b>2,802.80</b>
<b>Communication</b>	Facilities	128	12.50
	Subtotal		<b>12.50</b>
		<b>Total</b>	<b>15,267.90</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>	Brigham City Segment Mw 7.0 SM Scenario
<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>	7.00
<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 26,895 buildings will be at least moderately damaged. This is over 4.00 % of the total number of buildings in the region. There are an estimated 1,009 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>	516	0.09	5	0.01	1	0.00	0	0.00	0	0.00
<b>Commercial</b>	19,616	3.33	728	1.97	495	2.52	187	2.99	55	5.48
<b>Education</b>	763	0.13	42	0.11	44	0.22	26	0.42	9	0.85
<b>Government</b>	1,653	0.28	64	0.17	84	0.43	53	0.85	15	1.51
<b>Industrial</b>	6,864	1.16	235	0.64	189	0.96	87	1.39	26	2.61
<b>Other Residential</b>	66,124	11.22	5,016	13.57	3,591	18.28	1,181	18.91	194	19.26
<b>Religion</b>	2,471	0.42	127	0.34	124	0.63	67	1.07	22	2.15
<b>Single Family</b>	491,361	83.37	30,742	83.18	15,114	76.95	4,645	74.38	688	68.13
<b>Total</b>	<b>589,368</b>		<b>36,959</b>		<b>19,641</b>		<b>6,245</b>		<b>1,009</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>	287,512	48.78	12125	32.81	897	4.57	240	3.85	57	5.65
<b>Steel</b>	5,561	0.94	200	0.54	262	1.33	141	2.26	54	5.35
<b>Concrete</b>	4,581	0.78	215	0.58	233	1.19	114	1.83	38	3.80
<b>Precast</b>	3,375	0.57	82	0.22	126	0.64	80	1.29	28	2.75
<b>RM</b>	114,539	19.43	3735	10.11	1,448	7.37	220	3.52	52	5.13
<b>URM</b>	150,216	25.49	18408	49.81	14,456	73.60	4,682	74.97	665	65.85
<b>MH</b>	23,584	4.00	2194	5.94	2,219	11.30	768	12.30	116	11.47
<b>Total</b>	<b>589,368</b>		<b>36,959</b>		<b>19,641</b>		<b>6,245</b>		<b>1,009</b>	

\*Note:

RM      Reinforced Masonry  
URM     Unreinforced Masonry  
MH      Manufactured Housing



## **Essential Facility Damage**

Before the earthquake, the region had 6,868 hospital beds available for use. On the day of the earthquake, the model estimates that only 6,602 hospital beds (96.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 99.00% of the beds will be back in service. By 30 days, 100.00% 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	56	0	0	54
Schools	1,076	0	0	1,053
EOCs	7	0	0	7
PoliceStations	133	0	0	129
FireStations	358	0	0	353

## Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

**Table 6: Expected Damage to the Transportation Systems**

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	1,303	0	0	1,303	1,303
	Bridges	3,009	76	21	2,935	2,952
	Tunnels	4	0	0	4	4
Railways	Segments	1,485	0	0	1,485	1,485
	Bridges	33	0	0	33	33
	Tunnels	0	0	0	0	0
	Facilities	12	0	0	12	12
Light Rail	Segments	24	0	0	24	24
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	24	0	0	24	24
Bus	Facilities	10	0	0	10	10
Ferry	Facilities	2	0	0	2	2
Port	Facilities	0	0	0	0	0
Airport	Facilities	30	0	0	30	30
	Runways	46	0	0	46	46

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	2	1	0	1	2
Waste Water	56	4	0	46	56
Natural Gas	8	0	0	8	8
Oil Systems	31	0	0	30	31
Electrical Power	26	0	0	26	26
Communication	128	2	0	128	128

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	147,432	1806	591
Waste Water	88,459	1428	468
Natural Gas	4,166	10	8
Oil	2,370	15	26

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	773,352	34,988	27,298	9,345	0	0
Electric Power		0	0	0	0	0

## Induced Earthquake Damage

### **Fire Following Earthquake**

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 24 ignitions that will burn about 0.72 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 1,700 people and burn about 83 (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 1.460 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 49.00% 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 58,240,000 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

## 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 2,728 households to be displaced due to the earthquake. Of these, 2,094 people (out of a total population of 2,474,258) 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	7	2	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	9	2	0	1
	Industrial	18	4	1	1
	Other-Residential	261	48	5	10
	Single Family	832	157	19	37
	<b>Total</b>	<b>1,127</b>	<b>214</b>	<b>25</b>	<b>49</b>
<b>2 PM</b>	Commercial	454	105	15	30
	Commuting	1	1	2	0
	Educational	227	58	9	18
	Hotels	2	0	0	0
	Industrial	135	31	4	8
	Other-Residential	53	10	1	2
	Single Family	166	32	4	7
	<b>Total</b>	<b>1,038</b>	<b>238</b>	<b>36</b>	<b>66</b>
<b>5 PM</b>	Commercial	390	92	14	26
	Commuting	23	30	52	10
	Educational	24	6	1	2
	Hotels	3	1	0	0
	Industrial	84	19	3	5
	Other-Residential	101	19	2	4
	Single Family	333	64	8	15
	<b>Total</b>	<b>959</b>	<b>231</b>	<b>79</b>	<b>62</b>

## Economic Loss

The total economic loss estimated for the earthquake is 2,381.92 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

### Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 2,170.62 (millions of dollars); 27 % 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 46 % 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	7.49	67.80	6.29	24.68	106.25
	Capital-Related	0.00	3.20	52.61	3.84	6.20	65.84
	Rental	31.22	31.81	40.35	2.12	7.37	112.87
	Relocation	115.32	24.77	61.71	10.70	82.20	294.69
	<b>Subtotal</b>	<b>146.54</b>	<b>67.27</b>	<b>222.46</b>	<b>22.95</b>	<b>120.44</b>	<b>579.66</b>
<b>Capital Stock Losses</b>							
	Structural	149.37	36.60	79.34	30.10	62.67	358.07
	Non_Structural	337.15	127.96	168.12	75.89	172.66	881.78
	Content	109.01	29.63	82.62	46.08	68.25	335.60
	Inventory	0.00	0.00	3.91	11.57	0.03	15.52
	<b>Subtotal</b>	<b>595.53</b>	<b>194.19</b>	<b>334.00</b>	<b>163.63</b>	<b>303.62</b>	<b>1,590.96</b>
	<b>Total</b>	<b>742.07</b>	<b>261.46</b>	<b>556.45</b>	<b>186.58</b>	<b>424.06</b>	<b>2,170.62</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	46,184.62	\$10.65	0.02
	Bridges	3,453.84	\$39.15	1.13
	Tunnels	1.96	\$0.00	0.00
	Subtotal	<b>49640.40</b>	<b>49.80</b>	
Railways	Segments	2,821.00	\$1.38	0.05
	Bridges	3.92	\$0.02	0.43
	Tunnels	0.00	\$0.00	0.00
	Facilities	31.96	\$2.32	7.27
	Subtotal	<b>2856.90</b>	<b>3.70</b>	
Light Rail	Segments	37.15	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	63.91	\$1.54	2.41
	Subtotal	<b>101.10</b>	<b>1.50</b>	
Bus	Facilities	10.68	\$0.95	8.91
	Subtotal	<b>10.70</b>	<b>1.00</b>	
Ferry	Facilities	2.66	\$0.00	0.11
	Subtotal	<b>2.70</b>	<b>0.00</b>	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Airport	Facilities	319.53	\$9.26	2.90
	Runways	1,746.34	\$0.14	0.01
	Subtotal	<b>2065.90</b>	<b>9.40</b>	
	<b>Total</b>	<b>54677.60</b>	<b>65.40</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	65.30	\$6.53	10.00
	Distribution Lines	2,948.60	\$9.53	0.32
	Subtotal	<b>3,013.92</b>	<b>\$16.05</b>	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	3,655.00	\$100.00	2.74
	Distribution Lines	1,769.20	\$7.53	0.43
	Subtotal	<b>5,424.20</b>	<b>\$107.54</b>	
Natural Gas	Pipelines	2,089.80	\$0.06	0.00
	Facilities	8.50	\$0.00	0.01
	Distribution Lines	1,179.50	\$8.05	0.68
	Subtotal	<b>3,277.83</b>	<b>\$8.11</b>	
Oil Systems	Pipelines	733.60	\$0.15	0.02
	Facilities	3.00	\$0.03	1.10
	Subtotal	<b>736.60</b>	<b>\$0.18</b>	
Electrical Power	Facilities	2,802.80	\$13.81	0.49
	Subtotal	<b>2,802.80</b>	<b>\$13.81</b>	
Communication	Facilities	12.50	\$0.19	1.54
	Subtotal	<b>12.54</b>	<b>\$0.19</b>	
	Total	<b>15,267.88</b>	<b>\$145.88</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	38,439	4.95
	Income Impact	80	0.28
<b>Second Year</b>			
	Employment Impact	16,116	2.07
	Income Impact	13	0.04
<b>Third Year</b>			
	Employment Impact	389	0.05
	Income Impact	(42)	-0.14
<b>Fourth Year</b>			
	Employment Impact	19	0.00
	Income Impact	(57)	-0.20
<b>Fifth Year</b>			
	Employment Impact	0	0.00
	Income Impact	(58)	-0.20
<b>Years 6 to 15</b>			
	Employment Impact	0	0.00
	Income Impact	(58)	-0.20

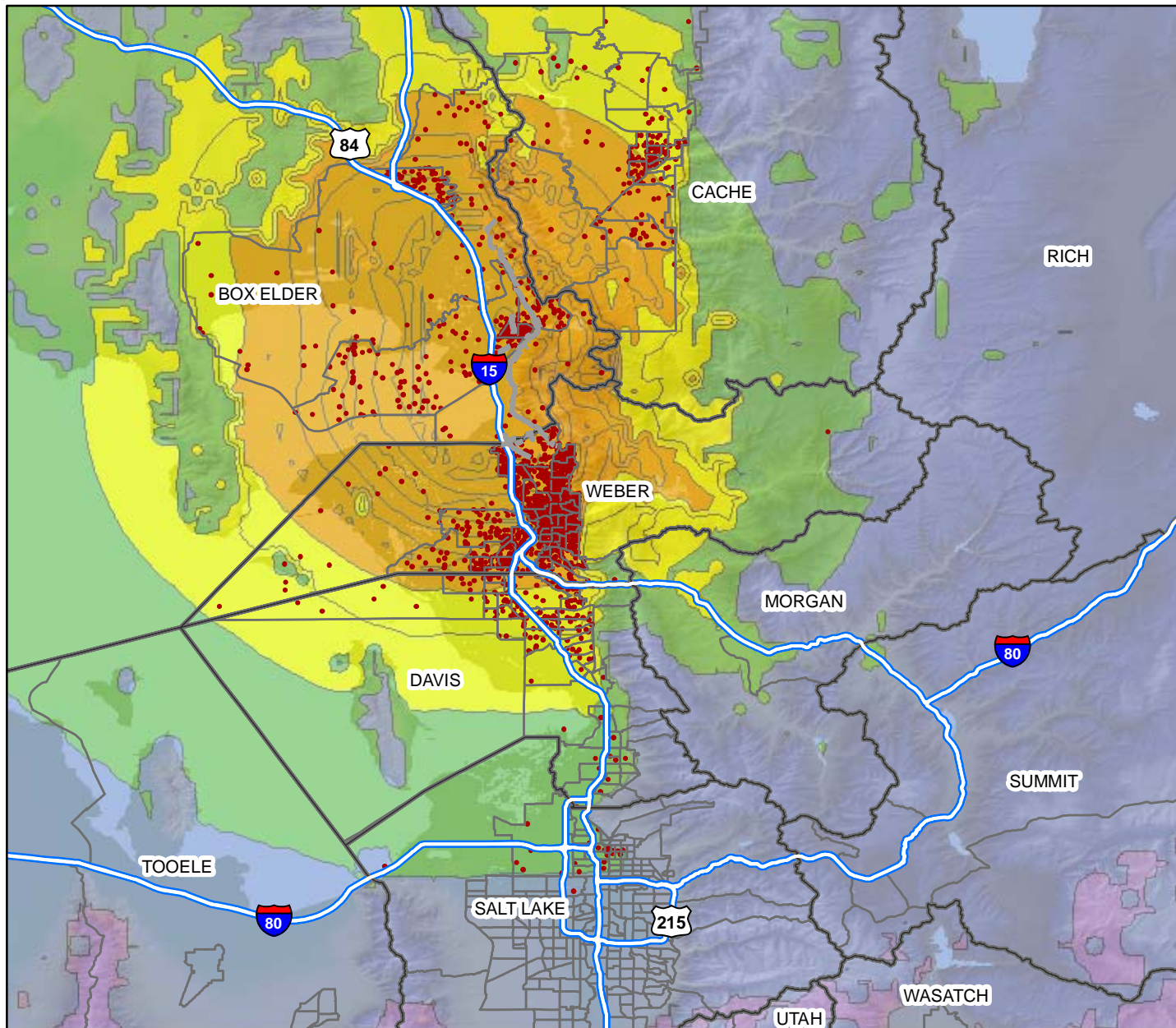
## **Appendix A: County Listing for the Region**

Beaver,UT  
Box Elder,UT  
Cache,UT  
Carbon,UT  
Daggett,UT  
Davis,UT  
Duchesne,UT  
Emery,UT  
Garfield,UT  
Grand,UT  
Iron,UT  
Juab,UT  
Kane,UT  
Millard,UT  
Morgan,UT  
Piute,UT  
Rich,UT  
Salt Lake,UT  
San Juan,UT  
Sanpete,UT  
Sevier,UT  
Summit,UT  
Tooele,UT  
Uintah,UT  
Utah,UT  
Wasatch,UT  
Washington,UT  
Wayne,UT  
Weber,UT

## Appendix B: Regional Population and Building Value Data

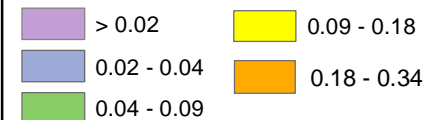
State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah	Beaver	6,295	252	89	341
	Box Elder	45,659	1,658	687	2,346
	Cache	100,585	3,382	1,703	5,085
	Carbon	19,947	825	395	1,220
	Daggett	884	74	18	92
	Davis	270,344	10,230	3,870	14,101
	Duchesne	15,233	496	248	744
	Emery	10,885	403	142	546
	Garfield	4,957	276	94	370
	Grand	8,891	350	195	546
	Iron	37,498	1,323	741	2,065
	Juab	9,240	291	190	481
	Kane	6,385	323	127	450
	Millard	12,713	447	233	681
	Morgan	7,910	305	139	444
	Piute	1,439	69	24	93
	Rich	2,327	249	38	288
	Salt Lake	962,837	39,526	18,636	58,162
	San Juan	14,341	443	164	608
	Sanpete	24,037	708	387	1,095
	Sevier	19,623	697	315	1,013
	Summit	35,804	2,598	708	3,307
	Tooele	50,184	1,782	564	2,347
	Uintah	26,973	851	460	1,312
	Utah	429,727	9,780	6,285	16,065
	Wasatch	18,879	0	89	89
	Washington	113,489	3,900	1,839	5,739
	Wayne	2,590	115	38	154
	Weber	214,582	8,462	3,369	11,831
Total State		2,474,258	89,815	41,787	131,615
Total Region		2,474,258	89,815	41,787	131,615

# Direct Building Economic Loss - Earthquake Scenario: Brigham City Segment, UT



## M 7.0 Brigham City Segment Earthquake

### PGA (g's)



1 Dot =  
\$1,000,000

Potential Fault Source  
Counties

County	Cost Structural Damage	Cost Non-Structural Damage	Total Loss (Including Contents)
Utah	\$146	\$1,055	\$2,148
Wasatch	\$0	\$8	\$16
Box Elder	\$81,889	\$202,819	\$485,791
Tooele	\$54	\$151	\$326
Salt Lake	\$6,166	\$20,457	\$49,171
Juab	\$0	\$3	\$6
Weber	\$217,453	\$502,374	\$1,261,632
Summit	\$6	\$79	\$145
Cache	\$23,865	\$64,549	\$164,085
Duchesne	\$0	\$2	\$4
Morgan	\$45	\$108	\$248
Rich	\$8	\$22	\$44
Davis	\$28,436	\$90,158	\$207,006
<b>Total</b>	<b>\$358,068</b>	<b>\$881,785</b>	<b>\$2,170,621</b>

\* All values are thousands of dollars



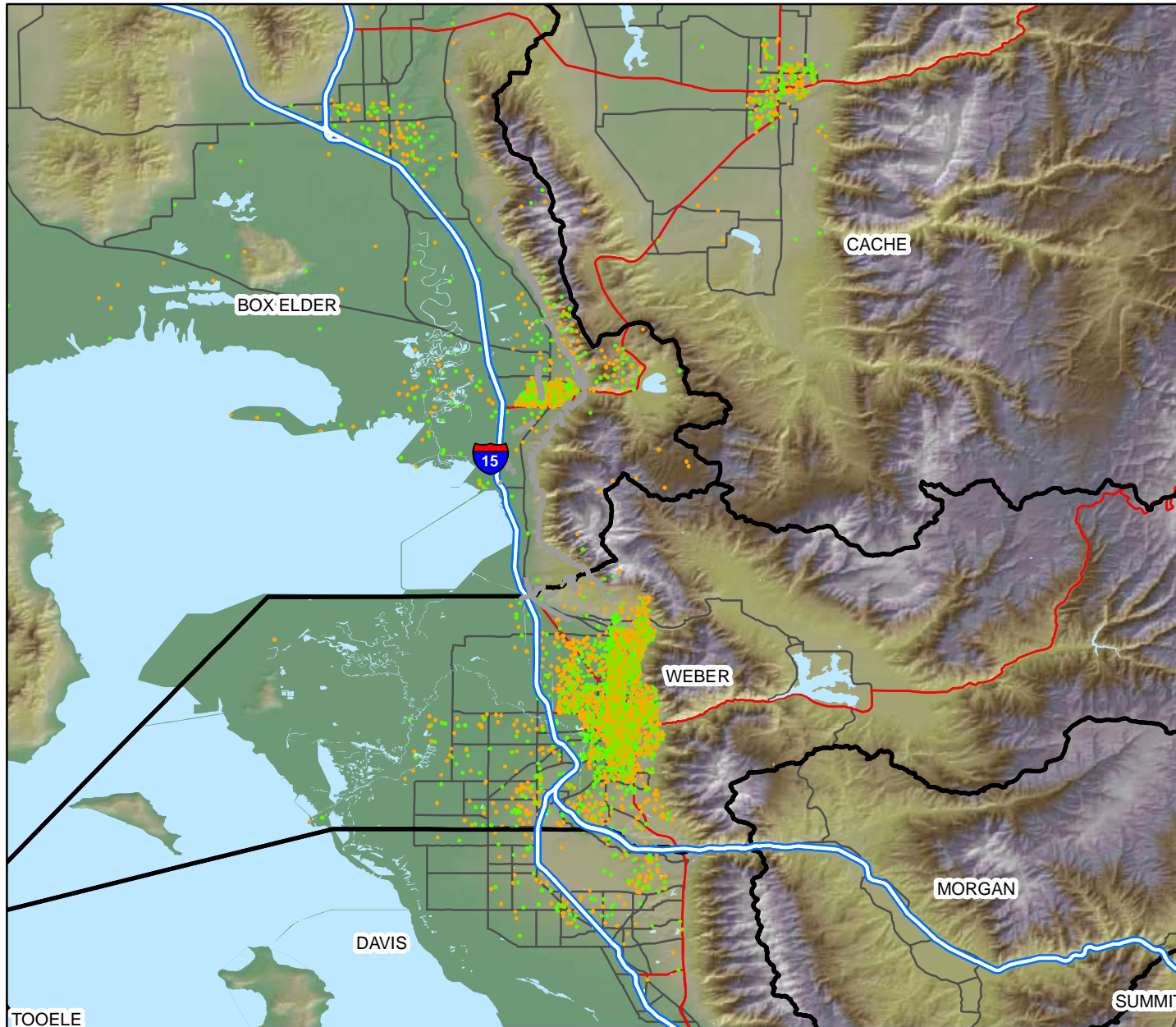
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Miles

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OR	ID	WY
NV	UT	CO
CA	AZ	NM

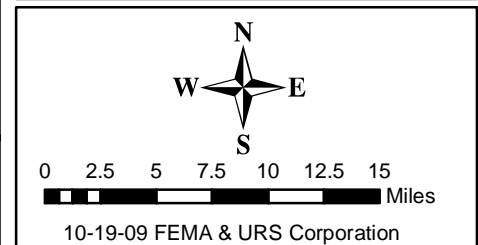


# Estimated Displaced Households & Short Term Public Shelter Needs - Earthquake Scenario: Brigham City Segment, UT



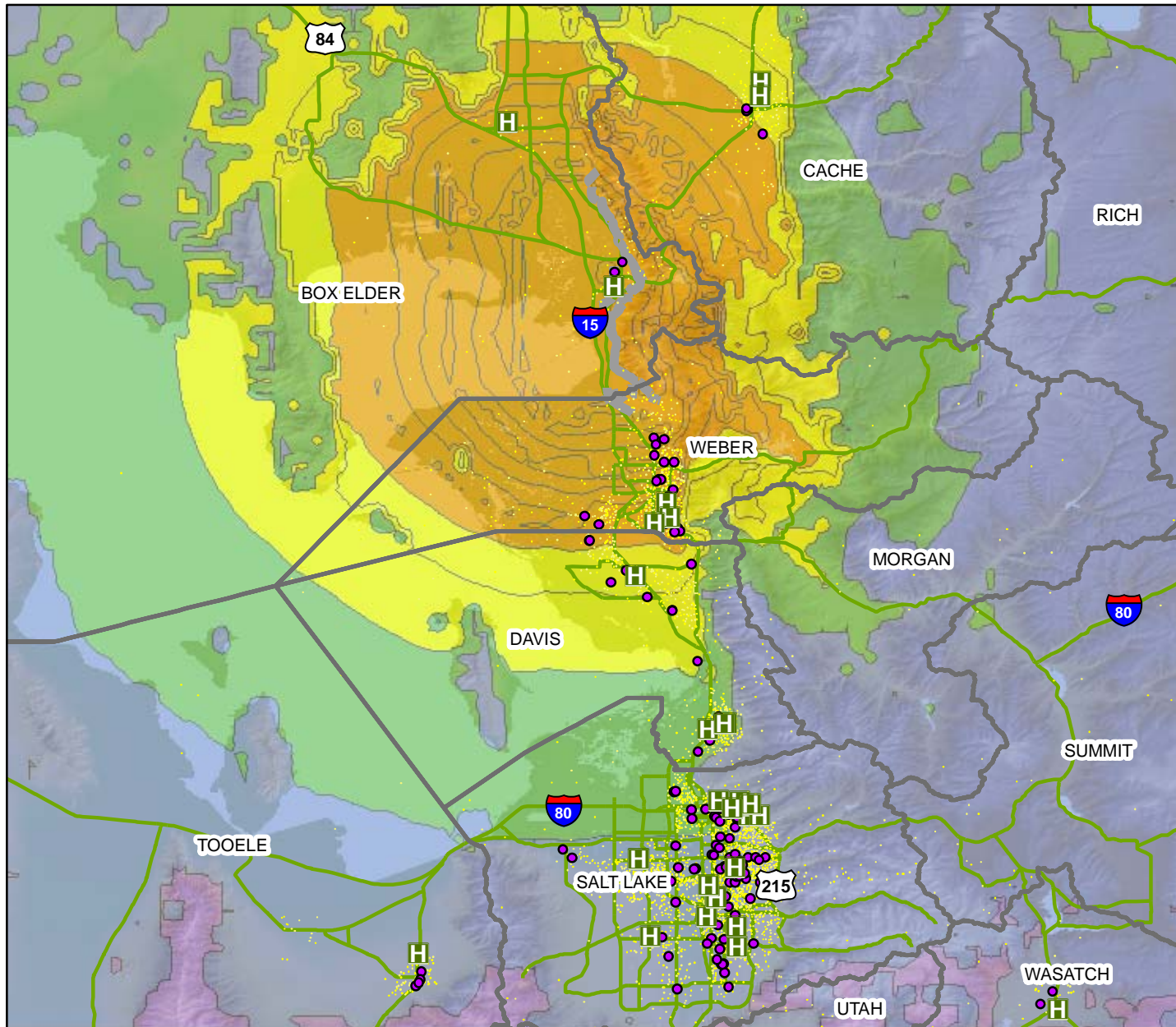
## M 7.0 Brigham City Segment Earthquake

	Total #
Public Shelter Needs (Individuals)	2,095
Displaced Households	2,728
<ul style="list-style-type: none"> <li>1 Dot = 1 Displaced Household*</li> <li>1 Dot = 1 Public Shelter Need (Individuals)*</li> </ul> <p>* delineated by census tract</p>	
<ul style="list-style-type: none"> <li>Potential Fault Source</li> <li>Interstate</li> <li>Highways</li> <li>Major Roads</li> </ul>	
<p>Counties</p>	



OR	ID	WY
NV	UT	CO
CA	AZ	NM

# Distribution of Elderly, Impaired Hospitals (Day 1), & Hospital Bed Availability - Earthquake Scenario: Brigham City Segment, UT



## M 7.0 Brigham City Segment Earthquake

### Highway Functionality - Day 1

Damage is expressed as the percentage chance that a given highway segment will realize at least moderate damage.

Low Medium High

### Impaired Hospitals (Day 1)

Damage is expressed as the percentage chance that a given hospital will realize at least moderate damage.

Low  
Medium  
High

Nursing Home 1 Dot = 30 People over 65 Potential Fault Source Counties

County	Total # Hospital Beds	Hospital Beds Available	Injuries Requiring Hospital Treatment 2pm
Box Elder	107	43	15
Cache	158	142	0
Carbon	84	84	0
Davis	468	455	1
Juab	31	31	0
Salt Lake	3,440	3,437	0
San Juan	36	36	0
San Pete	44	44	0
Sevier	42	42	0
Tooele	118	118	0
Uintah	39	39	0
Utah	1,013	1,012	0
Wasatch	20	20	0
Weber	655	519	20
<b>Total</b>	<b>6,255</b>	<b>6,022</b>	<b>36</b>

0 3 6 9 12 15 18  
Miles

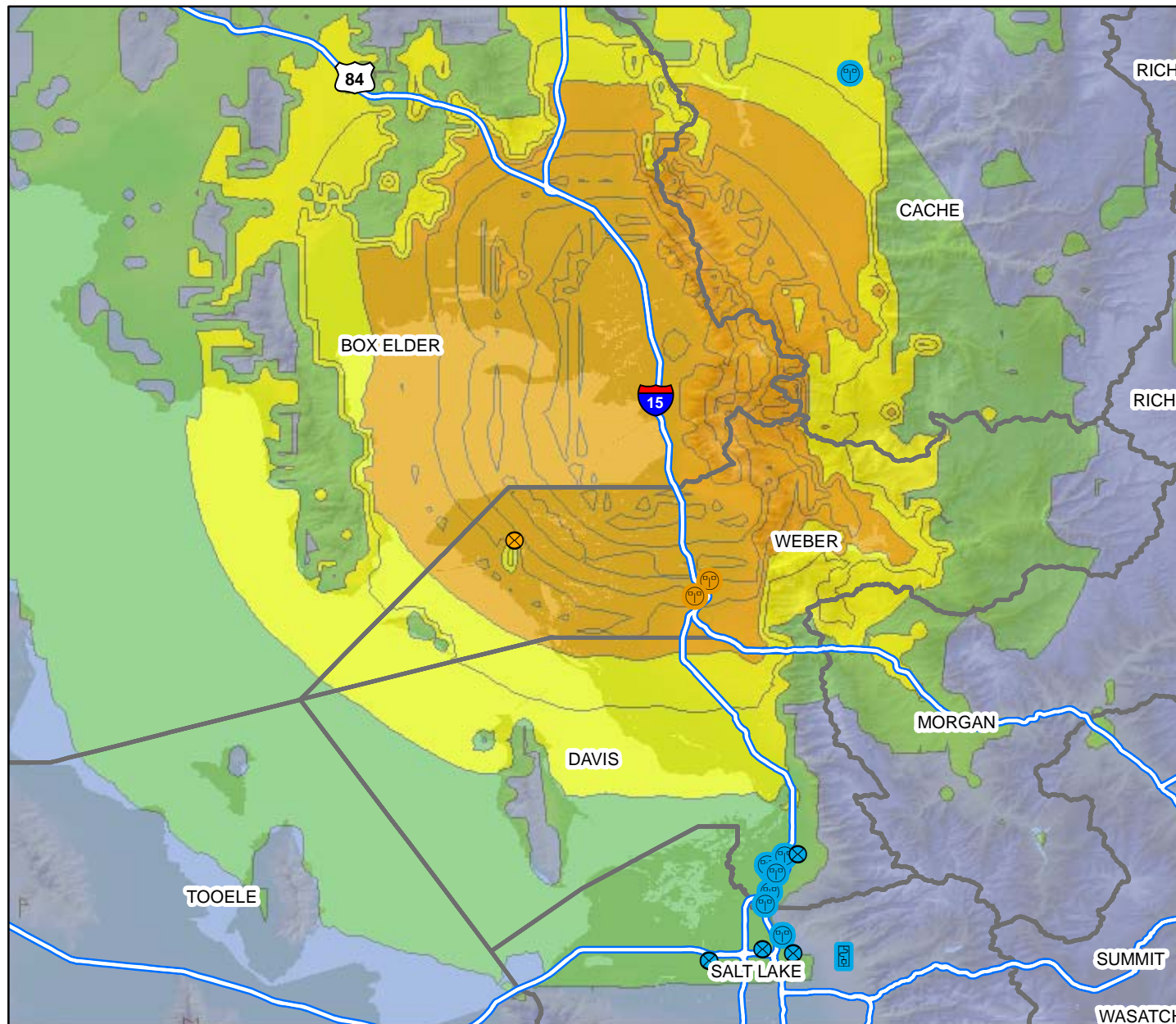


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OR	ID	WY	NE
CA	NV	UT	CO



# Electrical, Natural Gas, and Oil Facility Damage - Earthquake Scenario: Brigham City Segment, UT

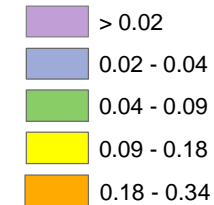


## M 7.0 Brigham City Segment Earthquake

### Utility Damage (at least moderate)

Damage is expressed as the percentage chance that a given Utility System will realize at least moderate damage.

#### PGA (g's)



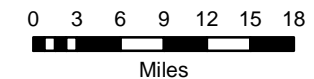
#### Oil Facility



#### Electric Power Facility



#### Natural Gas Facility

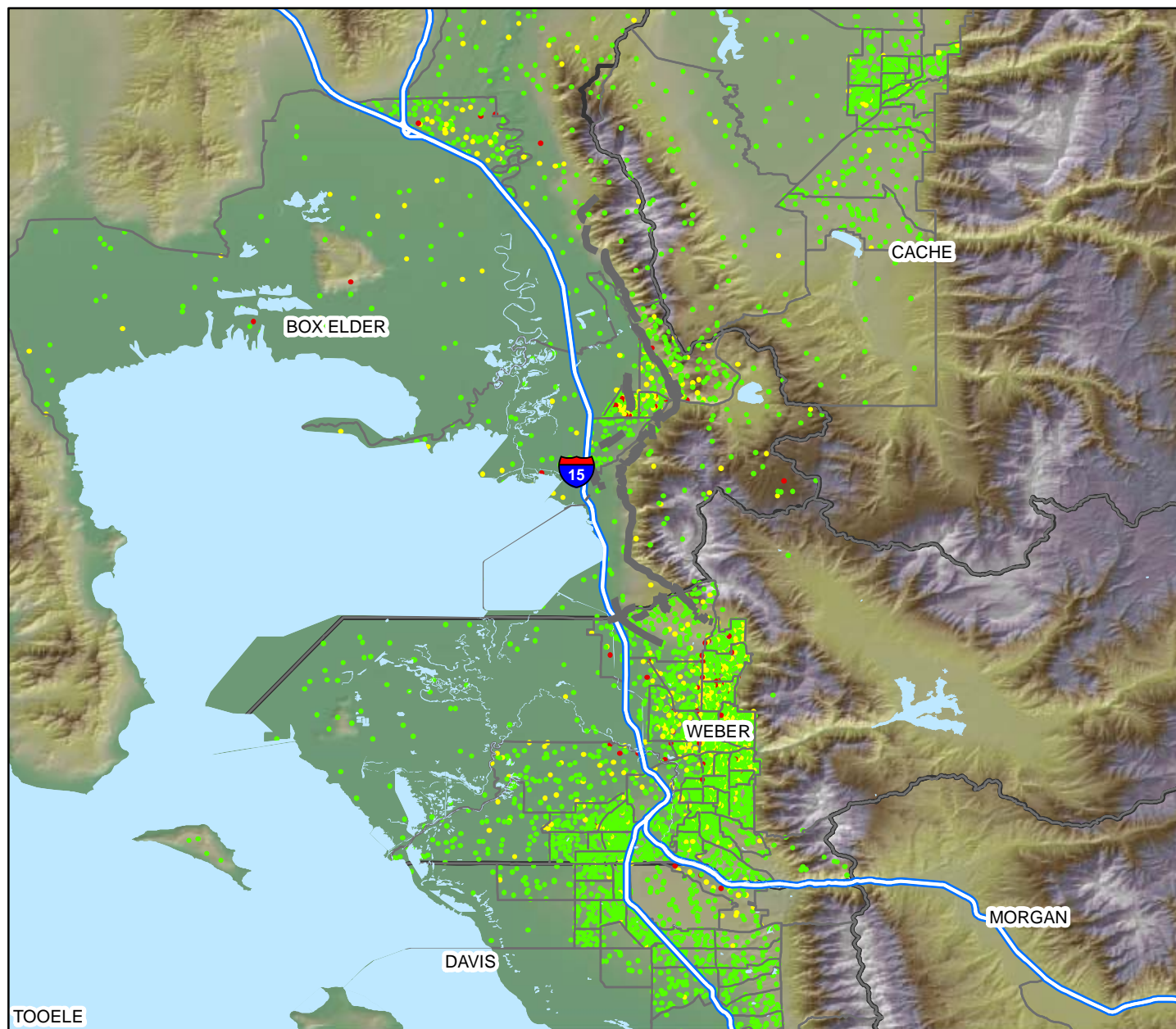


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OR	ID	WY	SD
NV	UT	CO	KS



# Estimated Building Inspection Needs - Earthquake Scenario: Brigham City Segment, UT



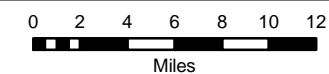
## M 7.0 Brigham City Segment Earthquake

	Estimated # of Structures	Estimated # of Inspectors Needed
Red (Complete)	1,010	7
Yellow (Extensive)	6,244	83
Light Green (Slight/Moderate)	56,600	377
Total	63,854	467

\*Estimated number of inspectors needed to complete inspections in 30 days.

- 1 Dot = 10 (by census tract)
- Red Tag (Complete Damage)
- Yellow Tag (Extensive Damage)
- Green Tag (Slight/Moderate Damage)

- Potential Fault Source
- Interstate
- Counties

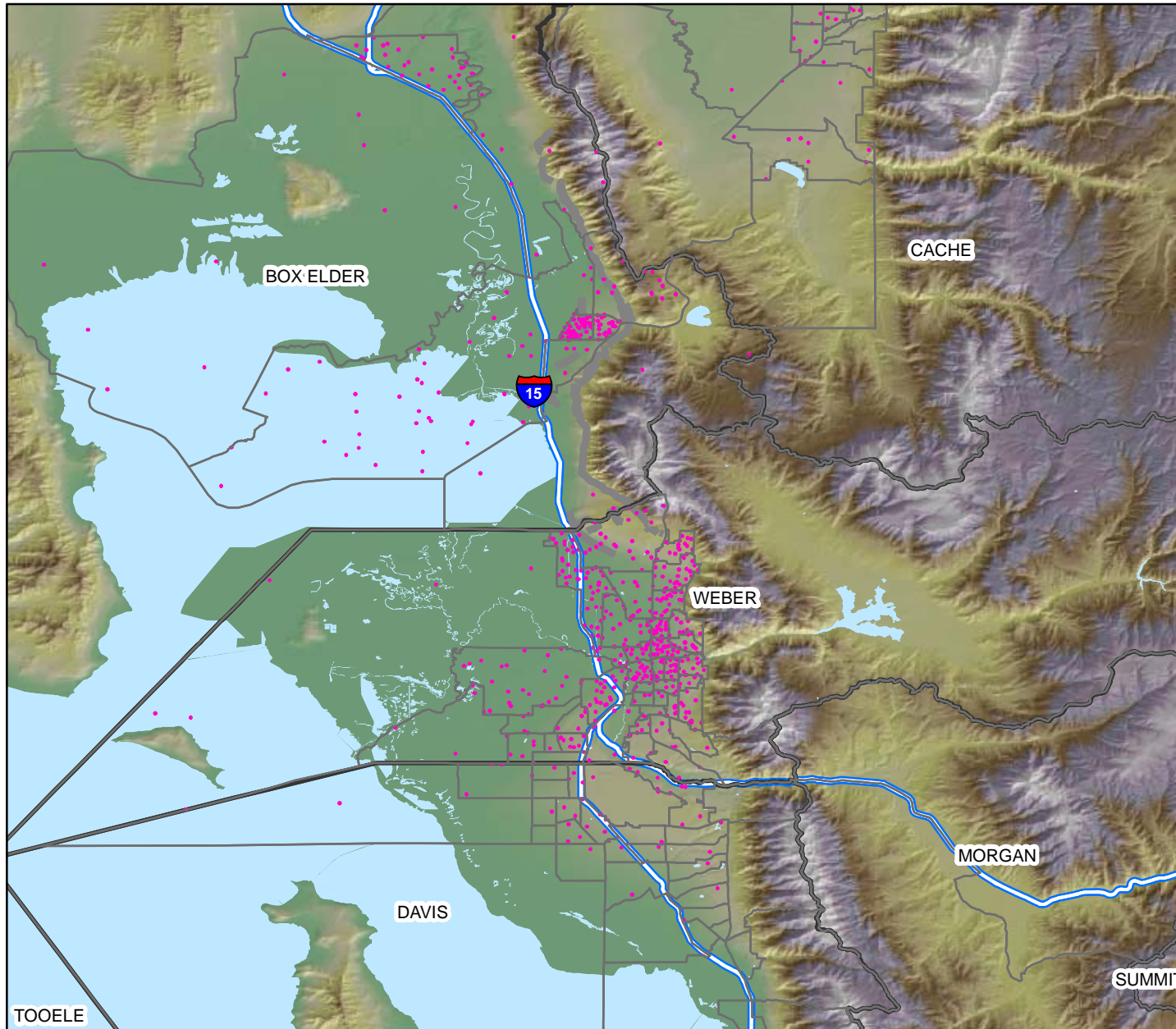


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OR	ID	WY
NV	UT	CO
CA	AZ	NM

# Estimated Concrete, Steel Debris and Highway Damage - Earthquake Scenario: Brigham City Segment, UT



## M 7.0 Brigham City Segment

1 Dot = 1 thousand tons of  
Concrete and Steel Debris  
(by census tract)

- Counties
- Potential Fault Source
- Interstate

County	Brick and Wood (tons)	Concrete and Steel (tons)	Estimated Truck Loads*
Box Elder	135,000	200,000	13,400
Cache	50,000	40,000	3,600
Davis	53,000	42,000	3,800
Salt Lake	38,000	3,000	1,640
Weber	433,000	464,000	35,880
<b>Total</b>	<b>709,000</b>	<b>749,000</b>	<b>58,320</b>

\* Truck loads estimated at 25 tons per truck



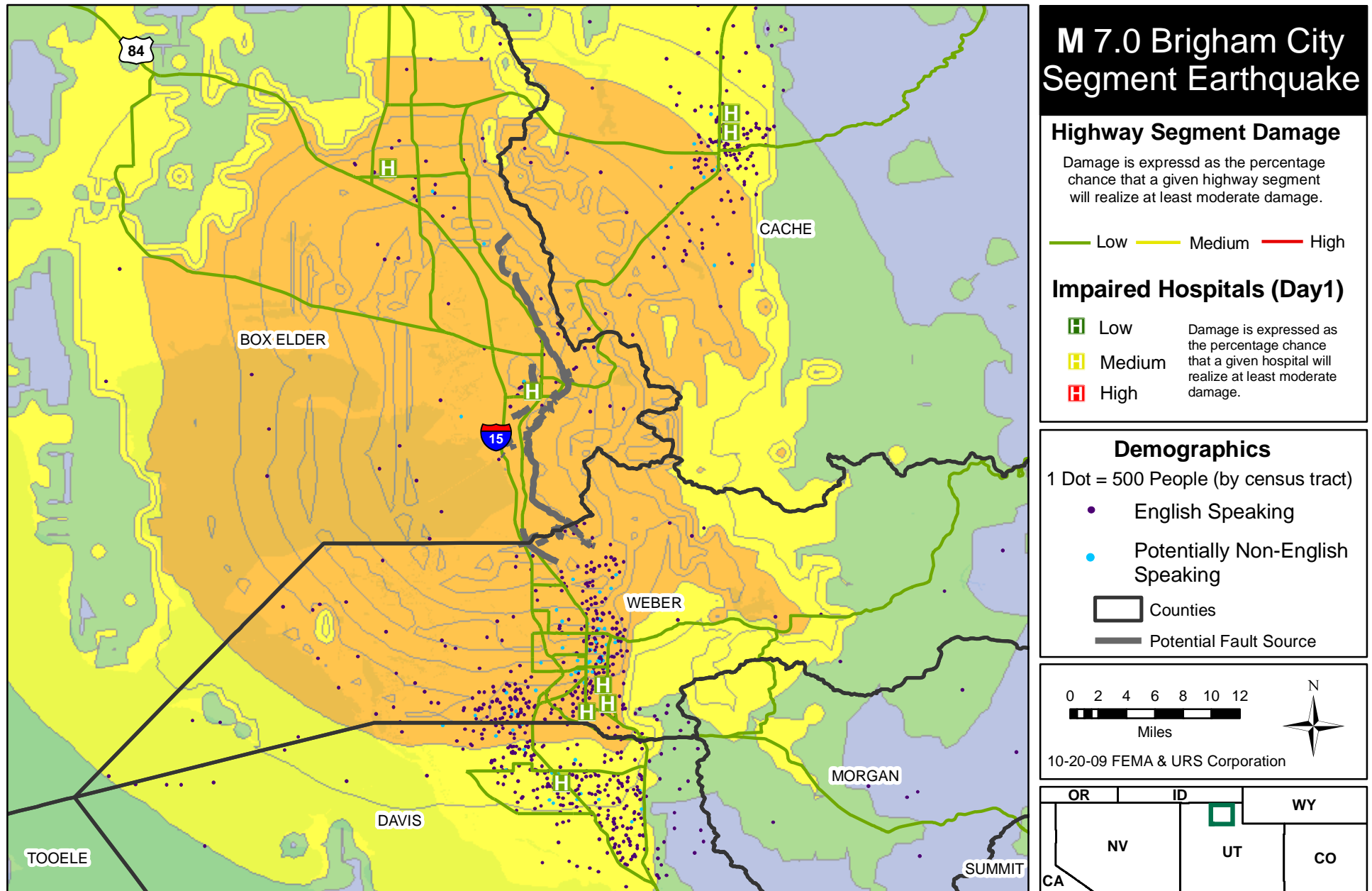
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Miles

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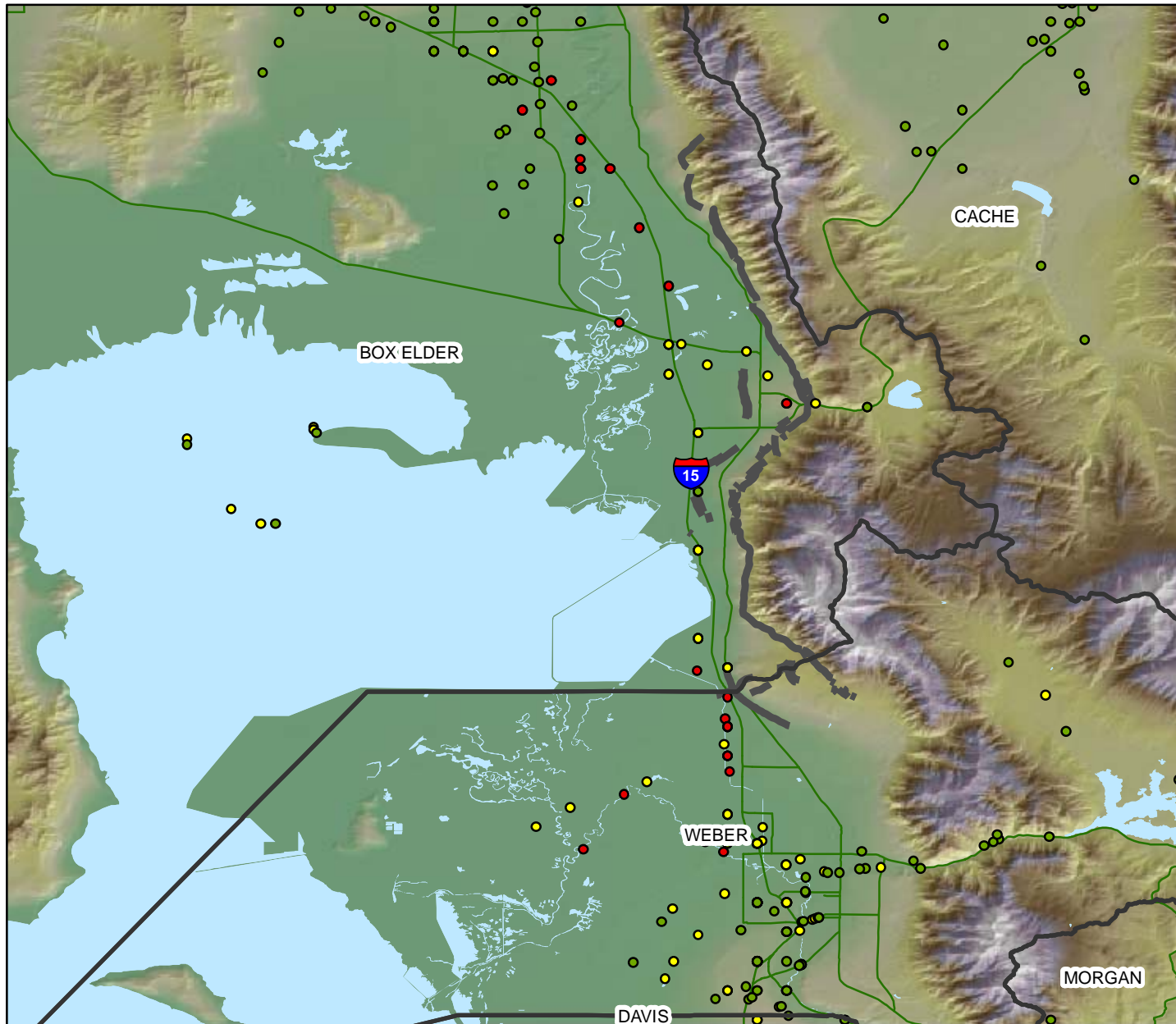
OR	ID	WY
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NV	UT	CO
CA	AZ	NM



# Demographic Distribution and Highway Functionality (Day 1) - Earthquake Scenario: Brigham City Segment, UT



# Estimated Highway Infrastructure Damage - Earthquake Scenario: Brigham City Segment, UT



## M 7.0 Brigham City Segment Earthquake

### Highway Damage

Damage is expressed as the percentage chance that a given Bridge or Highway segment will realize at least moderate damage.

#### Highway Segment

- Low
- Medium
- High

#### Major Roadway Bridge

- Low
- Medium
- High

□ Counties

— Potential Fault Source

County	Total # of Bridges	# of Bridges Needing Priority Inspection	# of Bridge Engineers Needed*
Box Elder	230	51	7
Davis	130	3	1
Cache	62	1	1
Morgan	80	0	0
Weber	141	41	5
<b>Total</b>	<b>643</b>	<b>96</b>	<b>14</b>

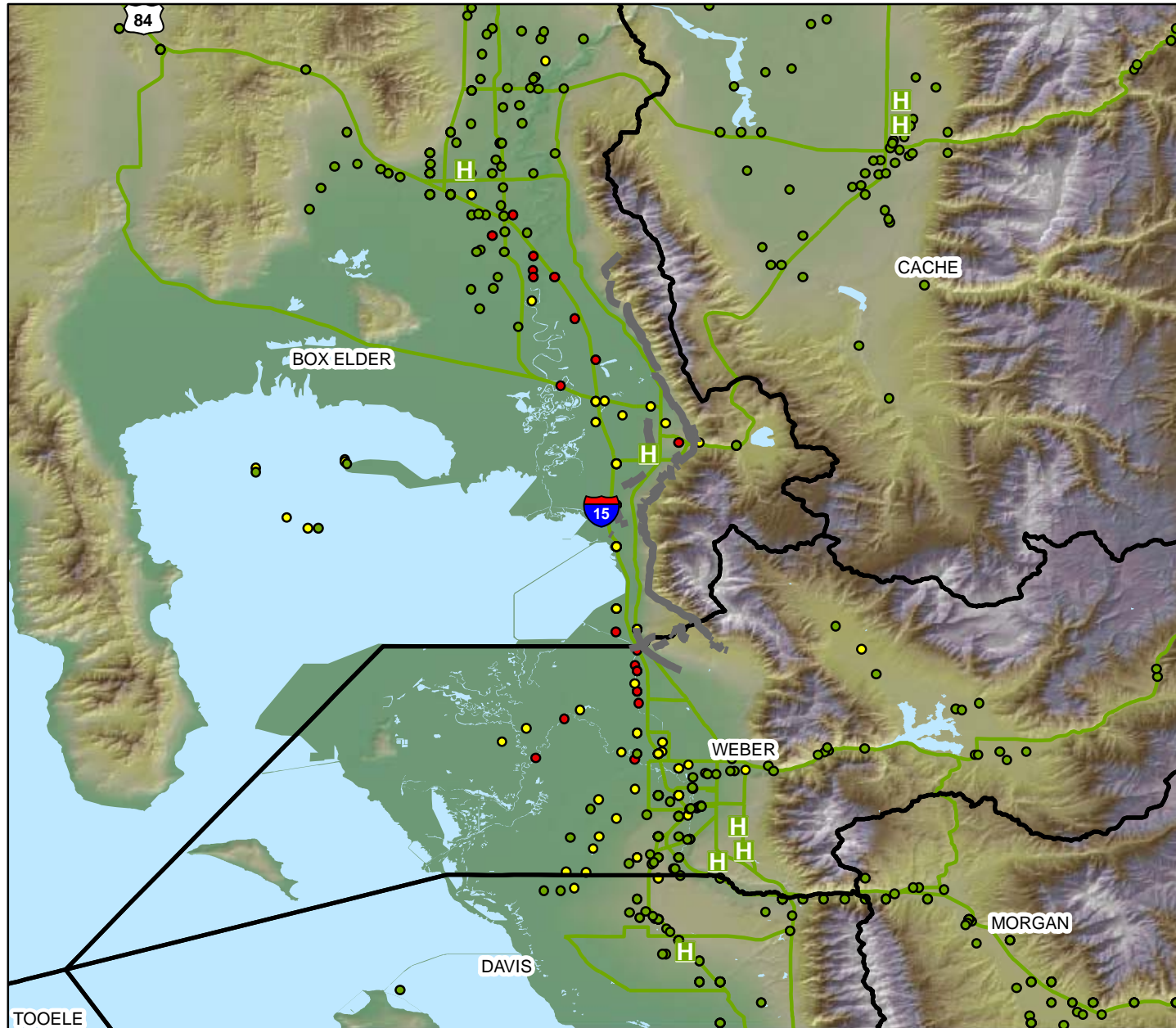
\* 2 engineers can inspect 5 bridges a day for 3 days



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ID		WY	NE
NV	UT	CO	

# Impaired Hospitals (Day 1), Hospital Bed Availability, & Highway Functionality - Earthquake Scenario: Brigham City Segment, UT



## M 7.0 Brigham City Segment Earthquake

### Highway Functionality

Damage is expressed as the percentage chance that a given highway or bridge segment will realize at least moderate damage.

#### Highway Damage

Low  
Medium  
High

#### Bridge Damage

Low  
Medium  
High

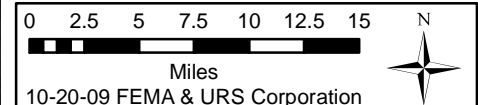
### Impaired Hospitals (Day 1)

Damage is expressed as the percentage chance that a given hospital will realize at least moderate damage.

Low  
Medium  
High

Potential Fault Source  
Counties

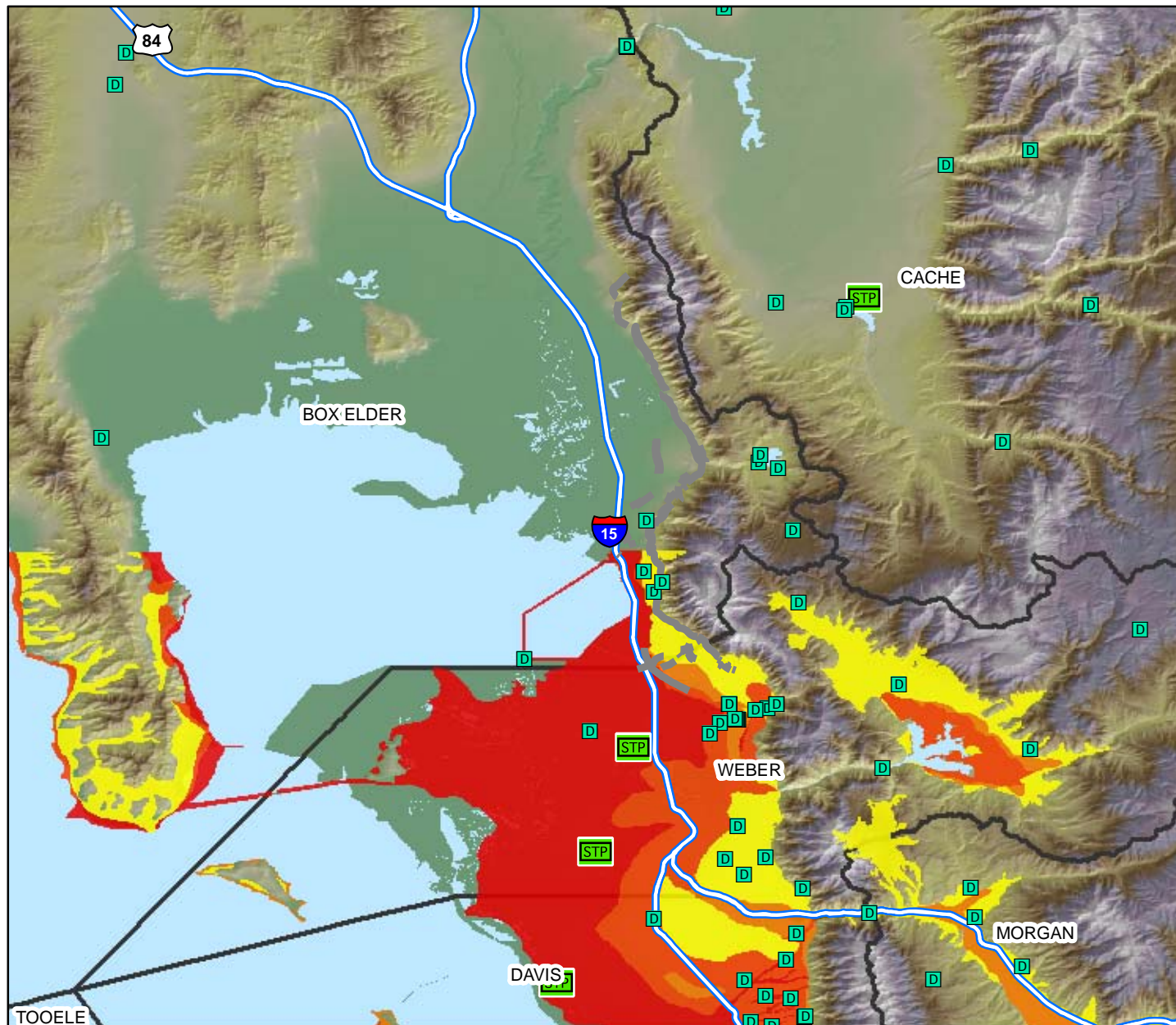
County	Total # Hospital Beds	Hospital Beds Available	Injuries Requiring Hospital Treatment 2pm
Box Elder	107	43	15
Cache	158	142	0
Carbon	84	84	0
Davis	468	455	1
Juab	31	31	0
Salt Lake	3,440	3,437	0
San Juan	36	36	0
San Pete	44	44	0
Sevier	42	42	0
Tooele	118	118	0
Uintah	39	39	0
Utah	1,013	1,012	0
Wasatch	20	20	0
Weber	655	519	20
<b>Total</b>	<b>6,255</b>	<b>6,022</b>	<b>36</b>



OR	ID	WY
NV	UT	CO



# Water Line, Sewage Treatment Facility Distribution and Liquefaction Susceptibility - Earthquake Scenario: Brigham City Segment, UT



## M7.0 Brigham City Segment

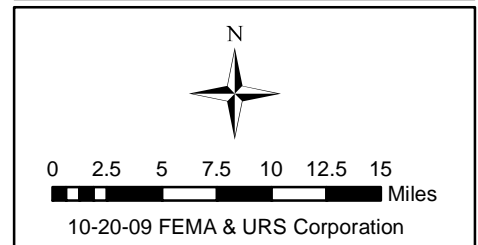
### Liquefaction Susceptibility



- Dams
- STP Sewage Treatment Facilities
- Salt Lake County Water Lines
- Potential Fault Source
- Counties

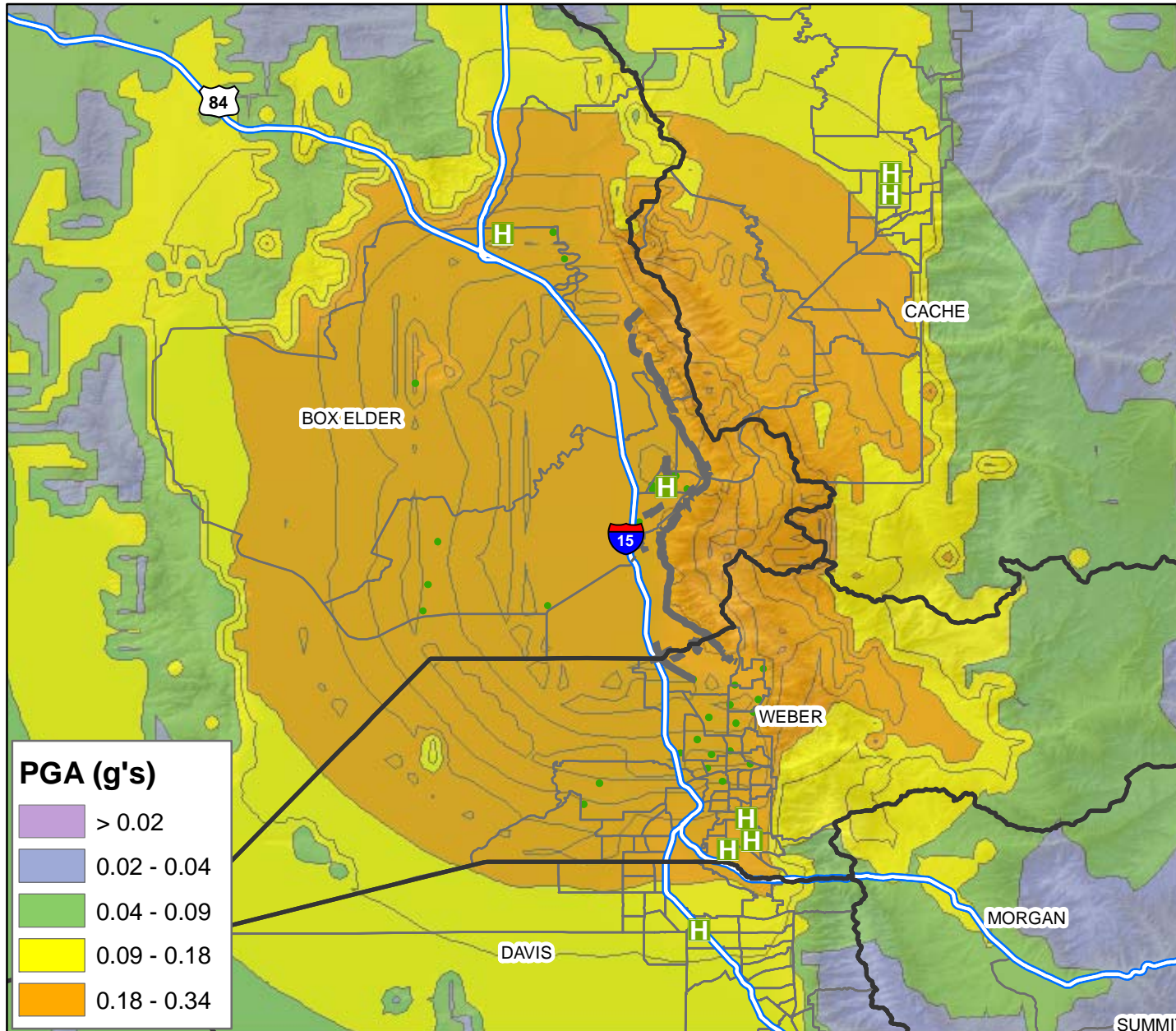
County	# Households without Potable Water (at Day 1)	Daily Potable Water Needs Per Person (Gallons/day)	Number of Truckloads needed Daily
Box Elder	540	1,620	0
Weber	34,442	103,326	22

\* Based on U.S. Army Corp Mission Guidebook  
(Daily water is based on an estimated 3 people per household.  
One truck can transport an estimated 5000 gallons of water.)



OR	ID	WY
NV	UT	CO
CA	AZ	NM

# Potential Search and Rescue Needs - Earthquake Scenario: Brigham City Segment, UT



## M 7.0 Brigham City Segment Earthquake

### Impaired Hospitals (Day1)

- H High Damage is expressed as the percentage chance that a given hospital will realize at least moderate damage.
- H Medium
- H Low

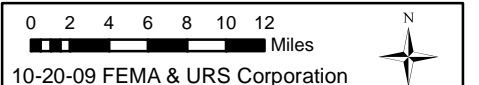
— Potential Fault Source

□ Counties

• 1 Dot = 1 Life Threatening Injury (Severity Level 3)

\*Severity Level 3 is defined as injuries that require hospitalization and can become life threatening if not promptly treated.

Requiring Hospital Treatment		Immediate Life Threatening Injuries	
1,312		36	
Structure Type	Red (Complete)	Collapse Rates for Complete Damage	Total Collapse
Wood	57	3%	2
Steel	54	6%	3
Concrete	38	10%	4
Precast	28	13%	4
Reinforced Masonry	52	10%	5
Unreinforced Masonry	665	15%	100
Manufactured Housing	116	3%	3
Total	1,010		121



OR	ID	WY	NE
NV	UT	CO	
CA	AZ	NM	



# Correctional and Daycare Facilities, Impaired Hospitals (Day 1), and Highway Functionality - Earthquake Scenario: Brigham City, UT

