

HAZUS-MH: Earthquake Event Report

Region Name: Magna Earthquake Mw 5.2 ShakeMap Scenario

Earthquake Scenario: Magna Earthquake Mw 5.2 ShakeMap Scenario

Print Date: October 16, 2009

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 17 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 45,195.05 square miles and contains 444 census tracts. There are over 693 thousand households in the region and has a total population of 2,230,893 people (2005 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 572 thousand buildings in the region with a total building replacement value (excluding contents) of 118,840 (millions of dollars). Approximately 94.00 % 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 35,756 and 6,886 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 572 thousand buildings in the region which have an aggregate total replacement value of 118,840 (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 43% 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 45 hospitals in the region with a total bed capacity of 6,220 beds. There are 924 schools, 254 fire stations, 104 police stations and 4 emergency operation facilities. With respect to HPL facilities, there are 399 dams identified within the region. Of these, 148 of the dams are classified as 'high hazard'. The inventory also includes 694 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 42,642.00 (millions of dollars). This inventory includes over 5,178 kilometers of highways, 2,270 bridges, 141,774 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	2,270	2,894.80
	Segments	986	29,012.40
	Tunnels	2	1.80
	Subtotal		31,909.00
Railways	Bridges	33	3.90
	Facilities	12	32.00
	Segments	1,310	2,381.80
	Tunnels	0	0.00
	Subtotal		2,417.70
Light Rail	Bridges	0	0.00
	Facilities	24	63.90
	Segments	24	37.20
	Tunnels	0	0.00
	Subtotal		101.10
Bus	Facilities	8	8.50
	Subtotal		8.50
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	17	181.10
	Runways	30	1,138.90
	Subtotal		1,320.00
		Total	35,756.30

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	1,721.50
	Facilities	2	65.30
	Pipelines	0	0.00
	Subtotal		1,786.80
Waste Water	Distribution Lines	NA	1,032.90
	Facilities	47	3,067.60
	Pipelines	0	0.00
	Subtotal		4,100.50
Natural Gas	Distribution Lines	NA	688.60
	Facilities	2	2.10
	Pipelines	479	1,341.60
	Subtotal		2,032.40
Oil Systems	Facilities	24	2.40
	Pipelines	257	348.90
	Subtotal		351.20
Electrical Power	Facilities	19	2,048.20
	Subtotal		2,048.20
Communication	Facilities	104	10.20
	Subtotal		10.20
		Total	10,329.30

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Magna Earthquake Mw 5.2 ShakeMap Scenario
Type of Earthquake	User-defined
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	5.20
Depth (Km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

HAZUS estimates that about 793 buildings will be at least moderately damaged. This is over 0.00 % of the total number of buildings in the region. There are an estimated 0 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 summaries the expected damage by general occupancy for the buildings in the region. Table 4 summaries the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	514	0.09	7	0.10	1	0.17	0	0.15	0	0.02
Commercial	19,521	3.46	167	2.54	21	2.71	1	2.61	0	4.26
Education	747	0.13	5	0.08	1	0.11	0	0.10	0	0.03
Government	1,477	0.26	12	0.18	2	0.23	0	0.15	0	0.02
Industrial	6,978	1.24	109	1.65	15	1.99	0	1.17	0	0.56
Other Residential	60,787	10.76	1,306	19.87	160	20.79	4	18.00	0	19.77
Religion	2,423	0.43	15	0.23	2	0.28	0	0.22	0	0.09
Single Family	472,376	83.63	4,950	75.34	568	73.73	17	77.59	0	75.25
Total	564,823		6,570		771		22		0	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	244,790	43.34	990	15.07	10	1.28	2	7.00	0	0.00
Steel	5,422	0.96	47	0.72	8	1.09	0	0.53	0	0.00
Concrete	4,517	0.80	19	0.30	1	0.19	0	0.07	0	0.00
Precast	3,339	0.59	12	0.18	2	0.25	0	0.15	0	0.00
RM	108,923	19.28	134	2.04	14	1.86	0	1.23	0	0.00
URM	180,790	32.01	5285	80.45	725	94.09	20	90.48	0	100.00
MH	17,042	3.02	82	1.25	10	1.24	0	0.54	0	0.00
Total	564,823		6,570		771		22		0	

*Note:

RM Reinforced Masonry
 URM Unreinforced Masonry
 MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 6,220 hospital beds available for use. On the day of the earthquake, the model estimates that only 6,212 hospital beds (100.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 100.00% 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	45	0	0	45
Schools	924	0	0	924
EOCs	4	0	0	4
PoliceStations	104	0	0	104
FireStations	254	0	0	254

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	986	0	0	986	986
	Bridges	2,270	0	0	2,270	2,270
	Tunnels	2	0	0	2	2
Railways	Segments	1,310	0	0	1,310	1,310
	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	8	0	0	8	8
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	17	0	0	17	17
	Runways	30	0	0	30	30

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	0	0	2	2
Waste Water	47	0	0	46	47
Natural Gas	2	0	0	2	2
Oil Systems	24	0	0	24	24
Electrical Power	19	0	0	19	19
Communication	104	0	0	104	104

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	86,076	144	54
Waste Water	51,646	114	43
Natural Gas	2,856	1	1
Oil	1,197	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	693,383	0	0	0	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 32 ignitions that will burn about 0.79 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 3,417 people and burn about 166 (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 0.050 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 89.00% 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 2,160 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 5 households to be displaced due to the earthquake. Of these, 4 people (out of a total population of 2,230,893) 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
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	5	0	0	0
	Single Family	16	1	0	0
	Total	21	1	0	0
2 PM	Commercial	6	0	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	1	0	0	0
	Single Family	3	0	0	0
	Total	13	1	0	0
5 PM	Commercial	5	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	2	0	0	0
	Single Family	6	0	0	0
	Total	14	1	0	0

Economic Loss

The total economic loss estimated for the earthquake is 183.47 (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 142.00 (millions of dollars); 9 % 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 42 % 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
Income Losses							
	Wage	0.00	0.08	0.91	0.14	0.32	1.46
	Capital-Related	0.00	0.04	0.78	0.08	0.07	0.98
	Rental	1.00	1.06	1.31	0.24	0.07	3.69
	Relocation	3.21	0.53	1.00	1.04	0.59	6.36
	Subtotal	4.21	1.71	4.01	1.51	1.06	12.49
Capital Stock Losses							
	Structural	4.63	0.95	1.37	1.24	0.70	8.89
	Non_Structural	22.51	9.03	12.09	17.99	8.19	69.81
	Content	12.72	3.63	9.56	14.28	7.67	47.86
	Inventory	0.00	0.00	0.58	2.26	0.11	2.95
	Subtotal	39.85	13.61	23.60	35.77	16.67	129.50
	Total	44.06	15.32	27.61	37.27	17.73	142.00

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	29,012.41	\$0.03	0.00
	Bridges	2,894.82	\$0.19	0.01
	Tunnels	1.76	\$0.00	0.00
	Subtotal	31909.00	0.20	
Railways	Segments	2,381.81	\$0.00	0.00
	Bridges	3.92	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	31.96	\$1.13	3.55
	Subtotal	2417.70	1.10	
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	\$3.37	5.28
	Subtotal	101.10	3.40	
Bus	Facilities	8.55	\$0.12	1.43
	Subtotal	8.50	0.10	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	181.07	\$2.67	1.47
	Runways	1,138.92	\$0.00	0.00
	Subtotal	1320.00	2.70	
	Total	35756.30	7.50	

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	\$0.02	0.04
	Distribution Lines	1,721.50	\$0.83	0.05
	Subtotal	1,786.79	\$0.86	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	3,067.60	\$14.18	0.46
	Distribution Lines	1,032.90	\$0.66	0.06
	Subtotal	4,100.51	\$14.84	
Natural Gas	Pipelines	1,341.60	\$0.01	0.00
	Facilities	2.10	\$0.00	0.04
	Distribution Lines	688.60	\$0.70	0.10
	Subtotal	2,032.35	\$0.71	
Oil Systems	Pipelines	348.90	\$0.00	0.00
	Facilities	2.40	\$0.01	0.31
	Subtotal	351.25	\$0.01	
Electrical Power	Facilities	2,048.20	\$17.47	0.85
	Subtotal	2,048.20	\$17.47	
Communication	Facilities	10.20	\$0.07	0.66
	Subtotal	10.19	\$0.07	
	Total	10,329.29	\$33.95	

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

	LOSS	Total	%
First Year			
	Employment Impact	3,290	0.46
	Income Impact	7	0.03
Second Year			
	Employment Impact	1,237	0.17
	Income Impact	2	0.01
Third Year			
	Employment Impact	27	0.00
	Income Impact	(2)	-0.01
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.01
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.01
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.01

Appendix A: County Listing for the Region

Box Elder,UT

Cache,UT

Carbon,UT

Davis,UT

Duchesne,UT

Emery,UT

Juab,UT

Millard,UT

Morgan,UT

Rich,UT

Salt Lake,UT

Sanpete,UT

Summit,UT

Tooele,UT

Utah,UT

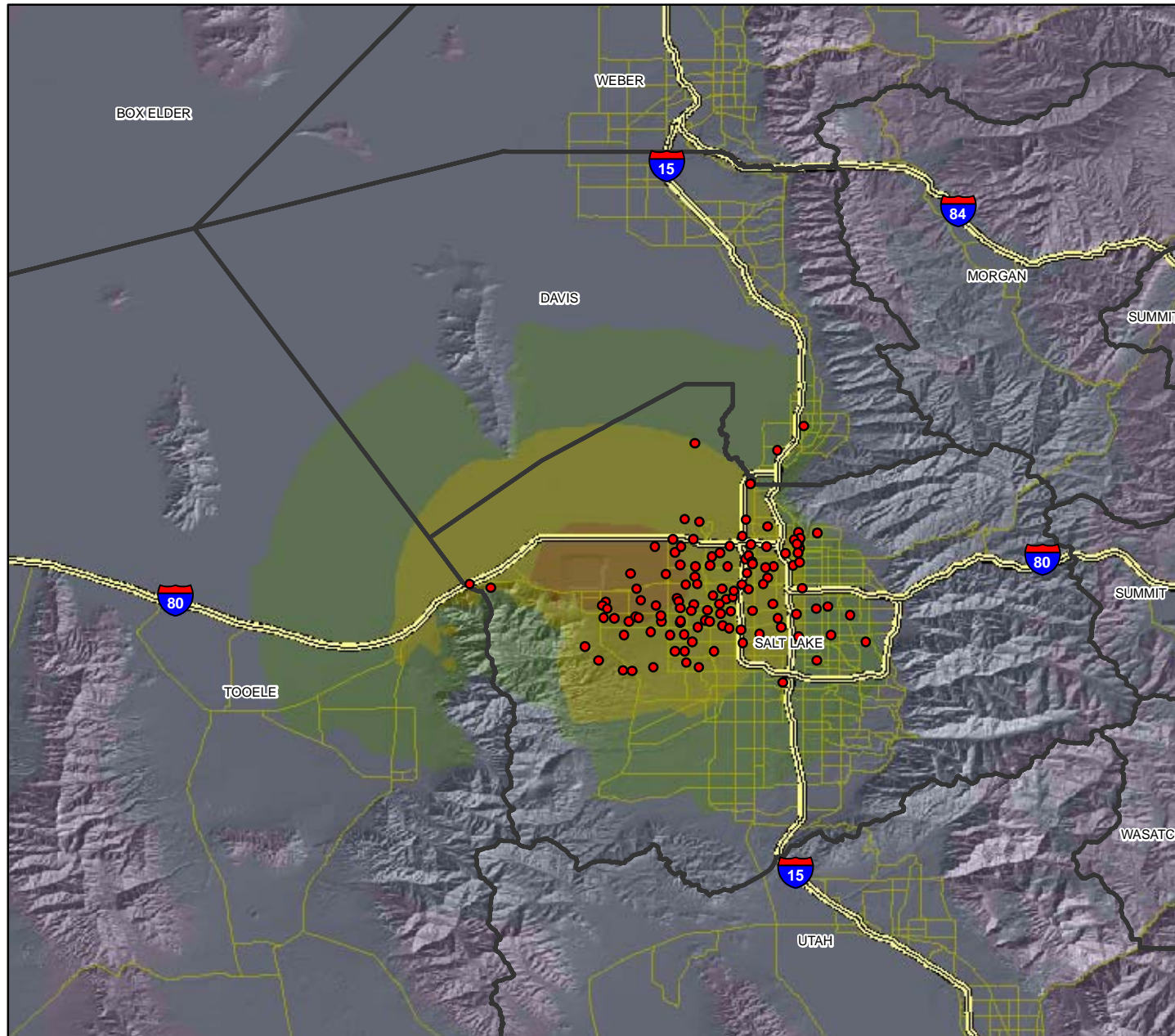
Wasatch,UT

Weber,UT

Appendix B: Regional Population and Building Value Data

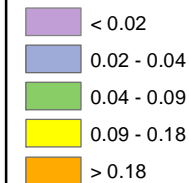
State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah	Box Elder	45,659	1,658	687	2,346
	Cache	100,585	3,382	1,703	5,085
	Carbon	19,947	825	395	1,220
	Davis	270,344	10,230	3,870	14,101
	Duchesne	15,233	496	248	744
	Emery	10,885	403	142	546
	Juab	9,240	291	190	481
	Millard	12,713	447	233	681
	Morgan	7,910	305	139	444
	Rich	2,327	249	38	288
	Salt Lake	962,837	39,526	18,636	58,162
	Sanpete	24,037	708	387	1,095
	Summit	35,804	2,598	708	3,307
	Tooele	50,184	1,782	564	2,347
	Utah	429,727	9,780	6,285	16,065
	Wasatch	18,879	0	89	89
	Weber	214,582	8,462	3,369	11,831
Total State		2,230,893	81,142	37,683	118,832
Total Region		2,230,893	81,142	37,683	118,832

Direct Building Economic Loss - Earthquake Scenario: Magna Segment, UT



M 5.2 Magna Segment Earthquake

PGA (% g's)

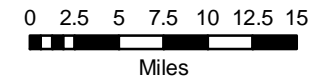


1 Dot =
\$1,000,000

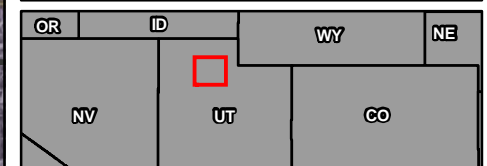
County	Cost Structural Damage	Cost Non-Structural Damage	Total Loss (Including Contents)
Utah	8	162	313
Wasatch	0	1	2
Tooele	25	87	180
Salt Lake	8,535	67,269	137,002
Weber	9	109	204
Summit	0	6	10
Morgan	0	1	1
Davis	314	2,175	4,285
Total	\$8,891	\$69,810	\$141,997

* All values are thousands of dollars

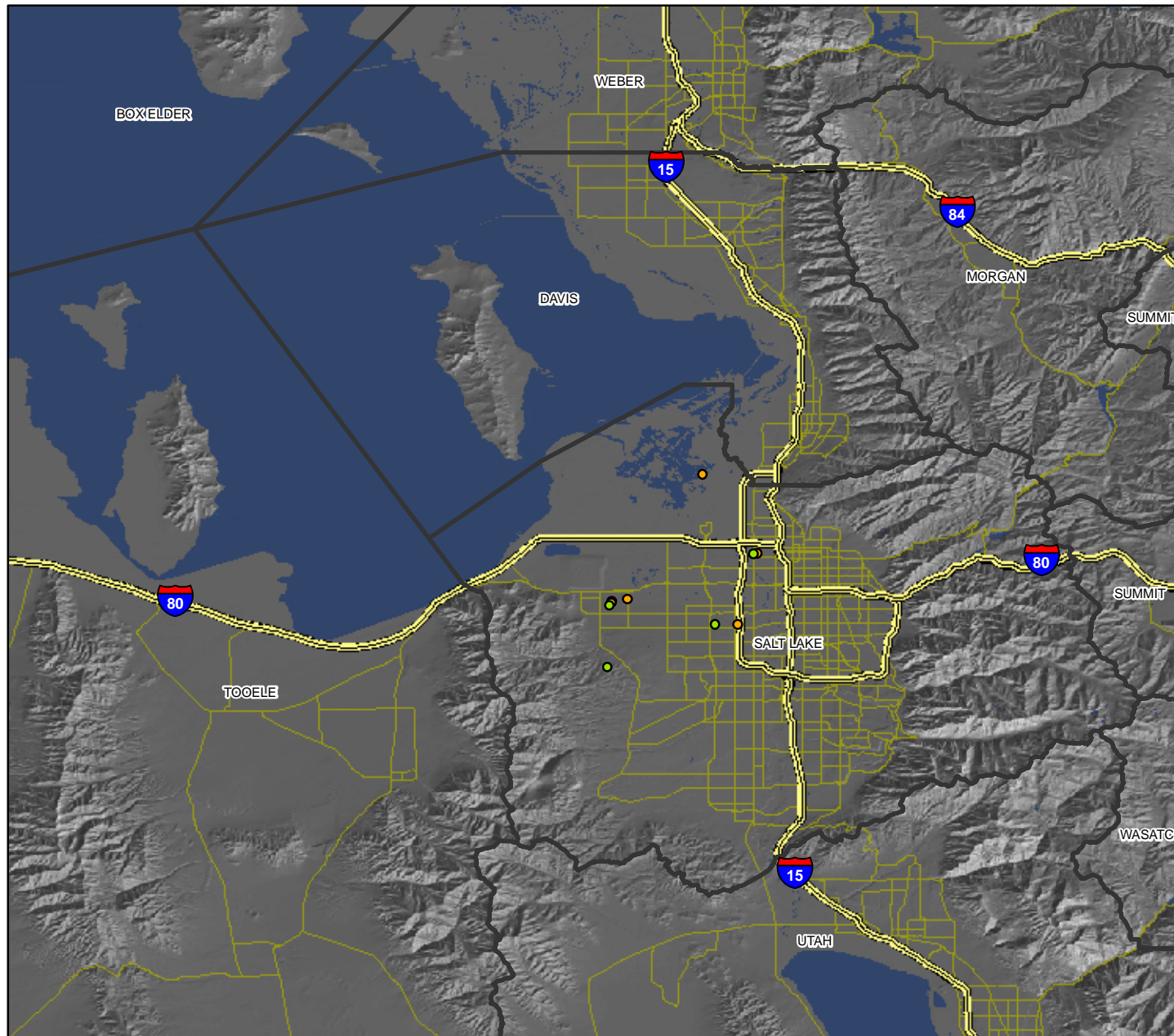
- Counties
- Interstate
- Major Roads
- City Boundaries



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



M 5.2 Magma Segment Earthquake

	Total #
Public Shelter Needs (Individuals)	4
Displaced Households	5

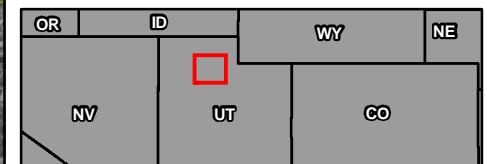
- 1 Dot = 1 Public Shelter Need (Individuals)*
 - 1 Dot = 1 Displaced Household*
- * delineated by census tract*

- Counties
- Interstate
- Major Roads
- City Boundaries

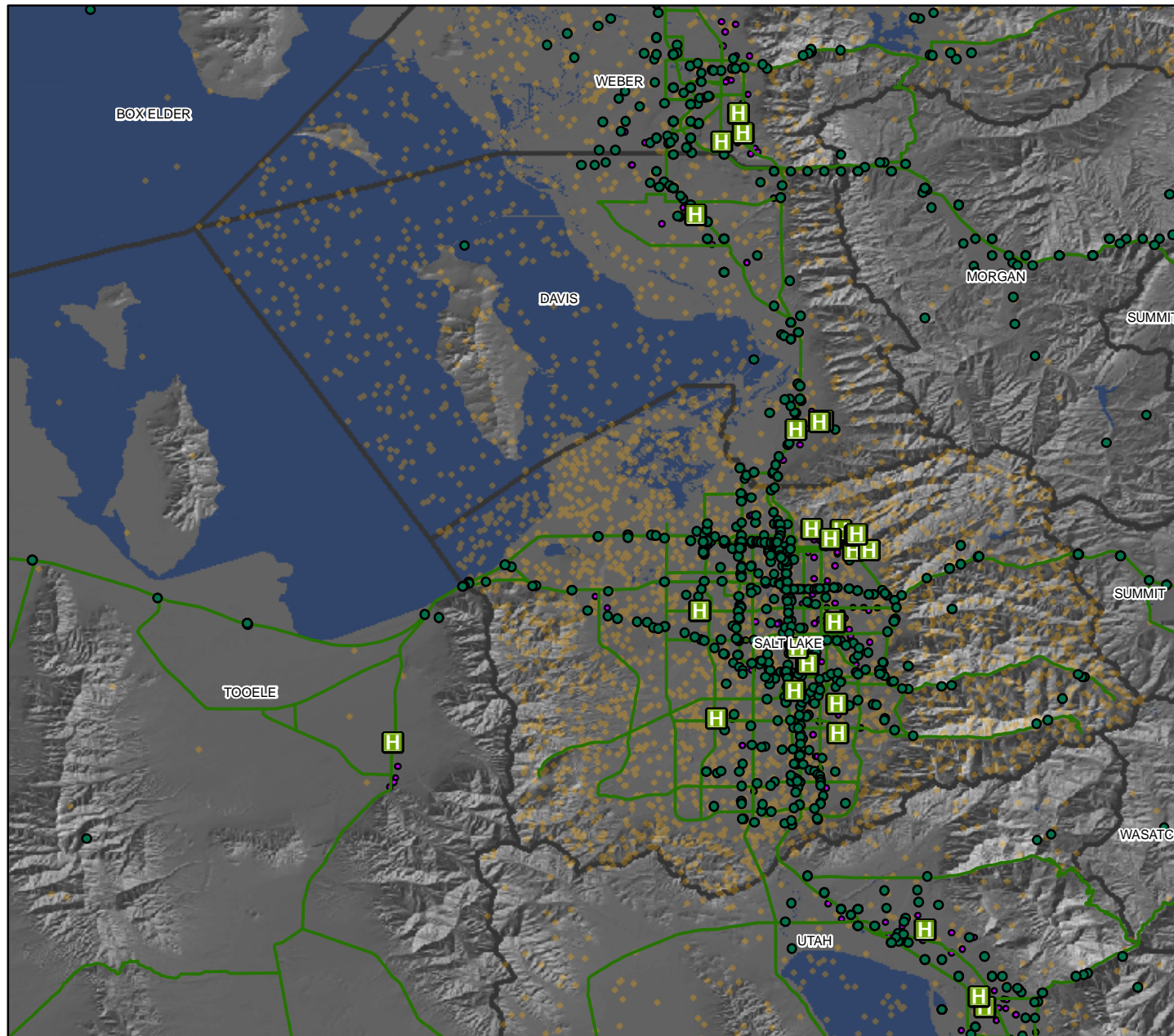
0 2.5 5 7.5 10 12.5 15
Miles



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



M 5.2 Magna Segment Earthquake

Highway Damage

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

Highway Segment Impact

- Low
- Moderate
- High

Major Roadway Bridge Impact

- Low
- Moderate
- High

Impaired Hospitals (Day 1)

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

- Low
- Moderate
- High

County	Total # Hospital Beds	Hospital Beds Available	Injuries Requiring Hospital Treatment 2pm
Utah	1,013	1,013	0
Wasatch	20	20	0
Tooele	118	118	0
Salt Lake	3,440	3,433	1
Weber	655	655	0
Davis	468	468	0
Total	5,714	5,707	1

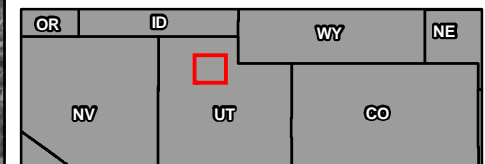
1 Dot = 30
People Over 65

Nursing
Home

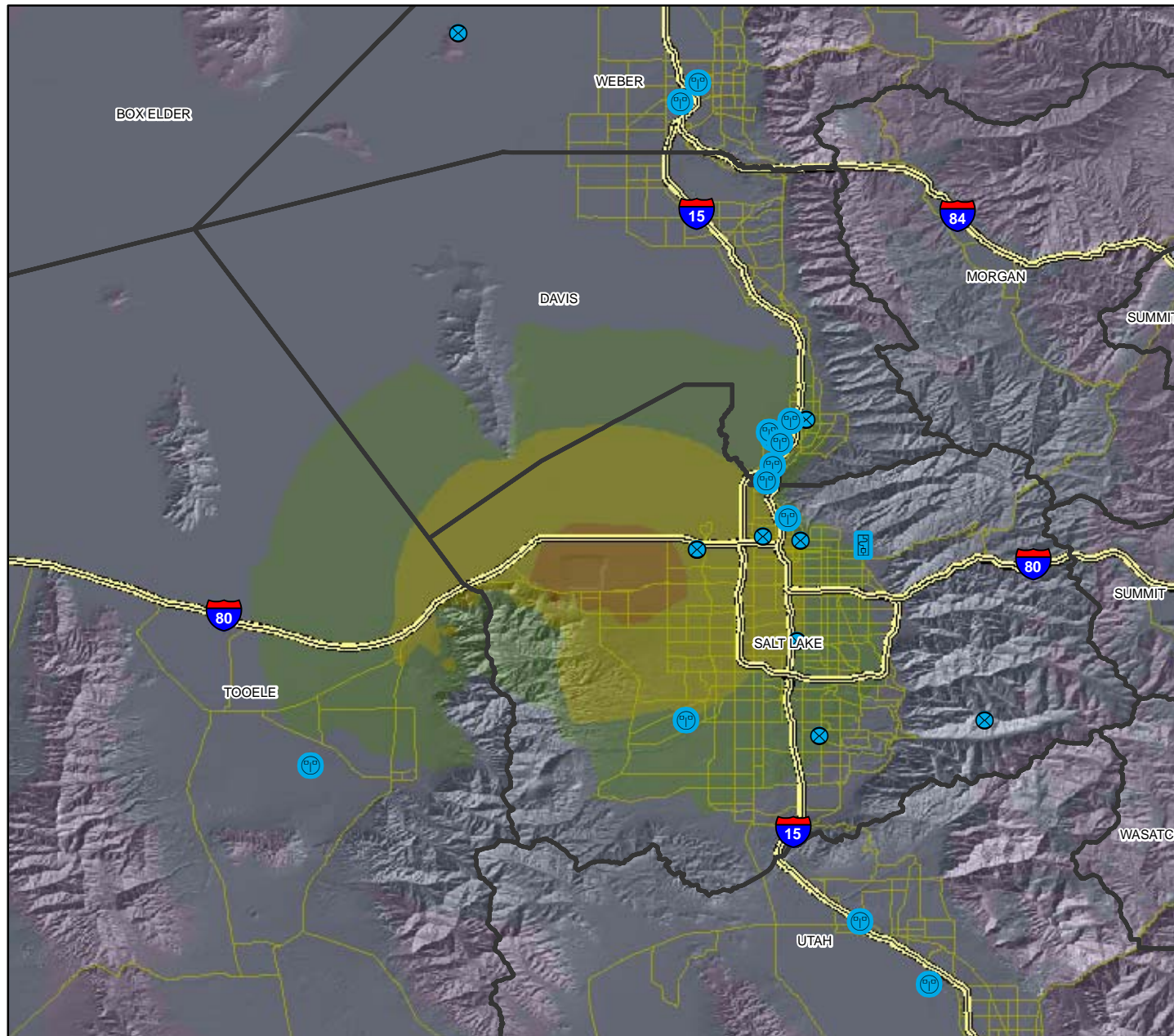
0 2.5 5 7.5 10 12.5 15
Miles



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Electrical, Natural Gas & Oil Facility Damage - Earthquake Scenario: Magna Segment, UT






M 5.2 Magna Segment Earthquake




Utility Damage (at least moderate)

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

Electric Power Facility

-  Low
-  Moderate
-  High



Oil Facility





-  Low
-  Moderate
-  High

Natural Gas Facility

-  Low
-  Moderate
-  High

PGA (% g's)

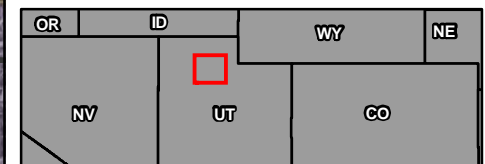
-  < 0.02
-  0.02 - 0.04
-  0.04 - 0.09
-  0.09 - 0.18
-  > 0.18

-  Counties
-  Interstate
-  Major Roads
-  City Boundaries

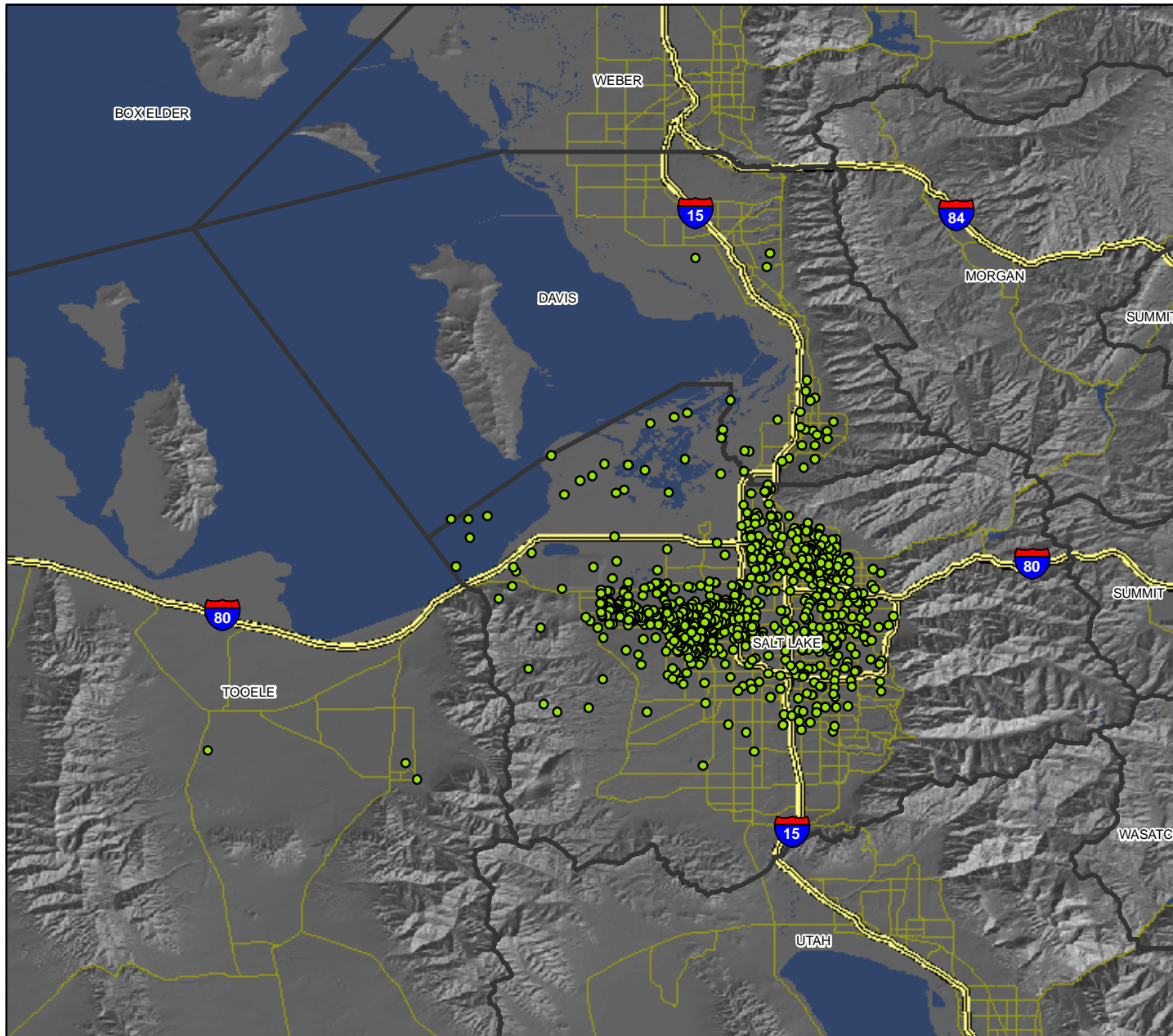
0 2.5 5 7.5 10 12.5 15
Miles



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Estimated Building Inspection Needs - Earthquake Scenario: Magma Segment, UT



M 5.2 Magma Segment Earthquake

	Estimated # of Structures	Estimated # of Inspectors Needed
Red (Complete)	0	0
Yellow (Extensive)	22	1
Light Green (Slight/ Moderate)	7,313	49
Total	7,335	50

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

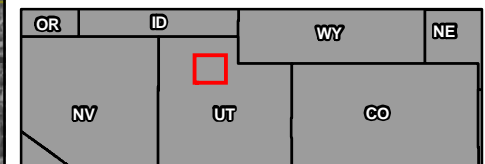
- Red Tag
(Complete Damage)
- Yellow Tag
(Extensive Damage)
- Green Tag
(Slight/Moderate Damage)

*1 Dot = 10 (by census tract)

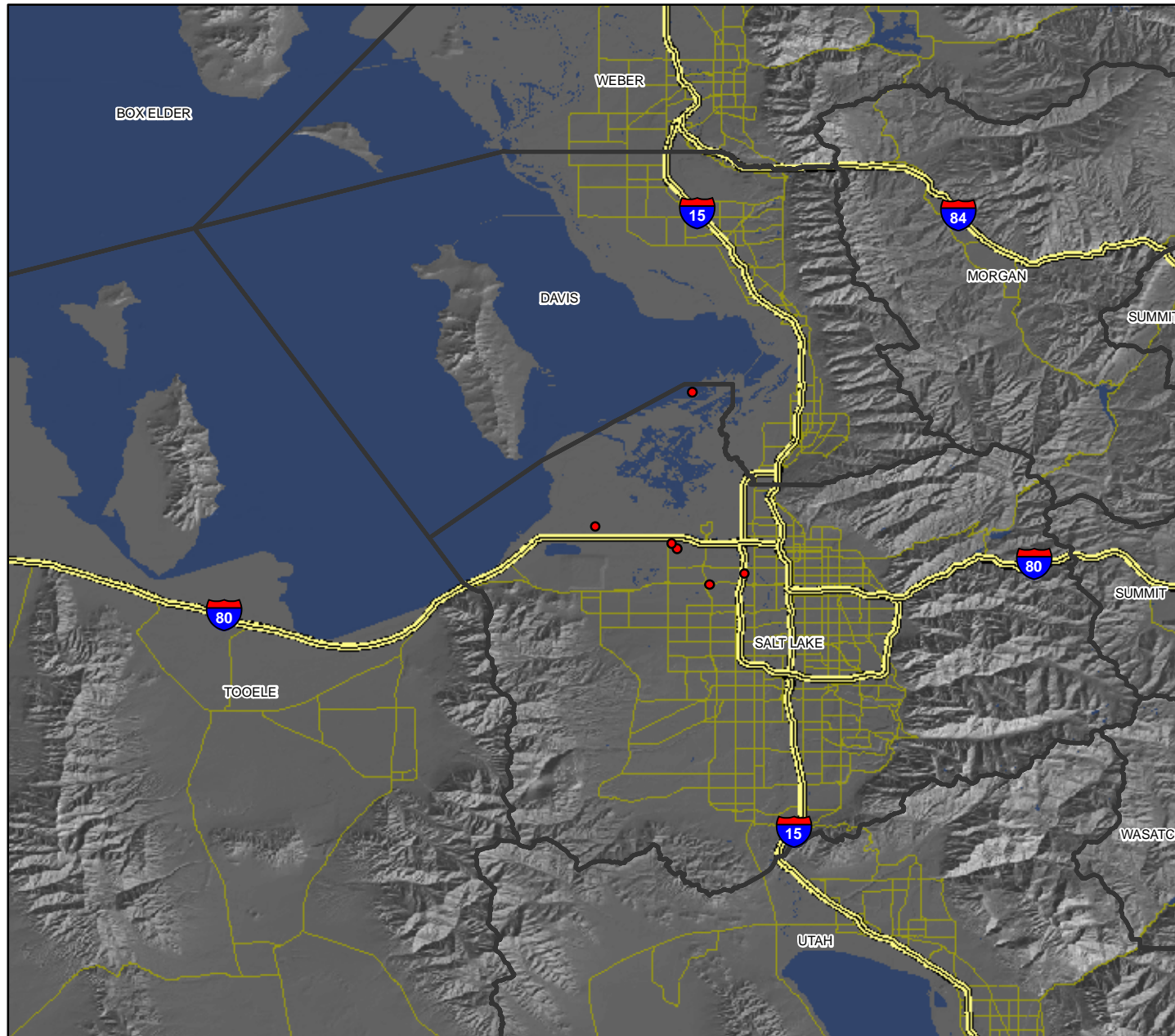
0 2.5 5 7.5 10 12.5 15
Miles



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Estimated Concrete, Steel Debris & Highway Damage - Earthquake Scenario: Magna Segment, UT



M 5.2 Magna Segment Earthquake

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

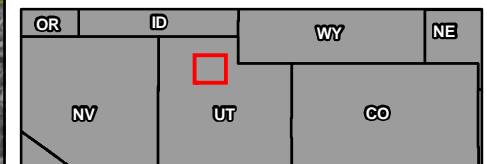
County	Brick and Wood (tons)	Concrete and Steel (tons)	*Estimated Truck Loads
Davis	1,000	0	40
Morgan	0	0	0
Salt Lake	47,000	6,000	2,110
Summit	0	0	0
Tooele	0	0	0
Utah	0	0	0
Wasatch	0	0	0
Weber	0	0	0
Total	48,000	6,000	2,150

-  Counties
-  Interstate
-  Major Roads
-  City Boundaries

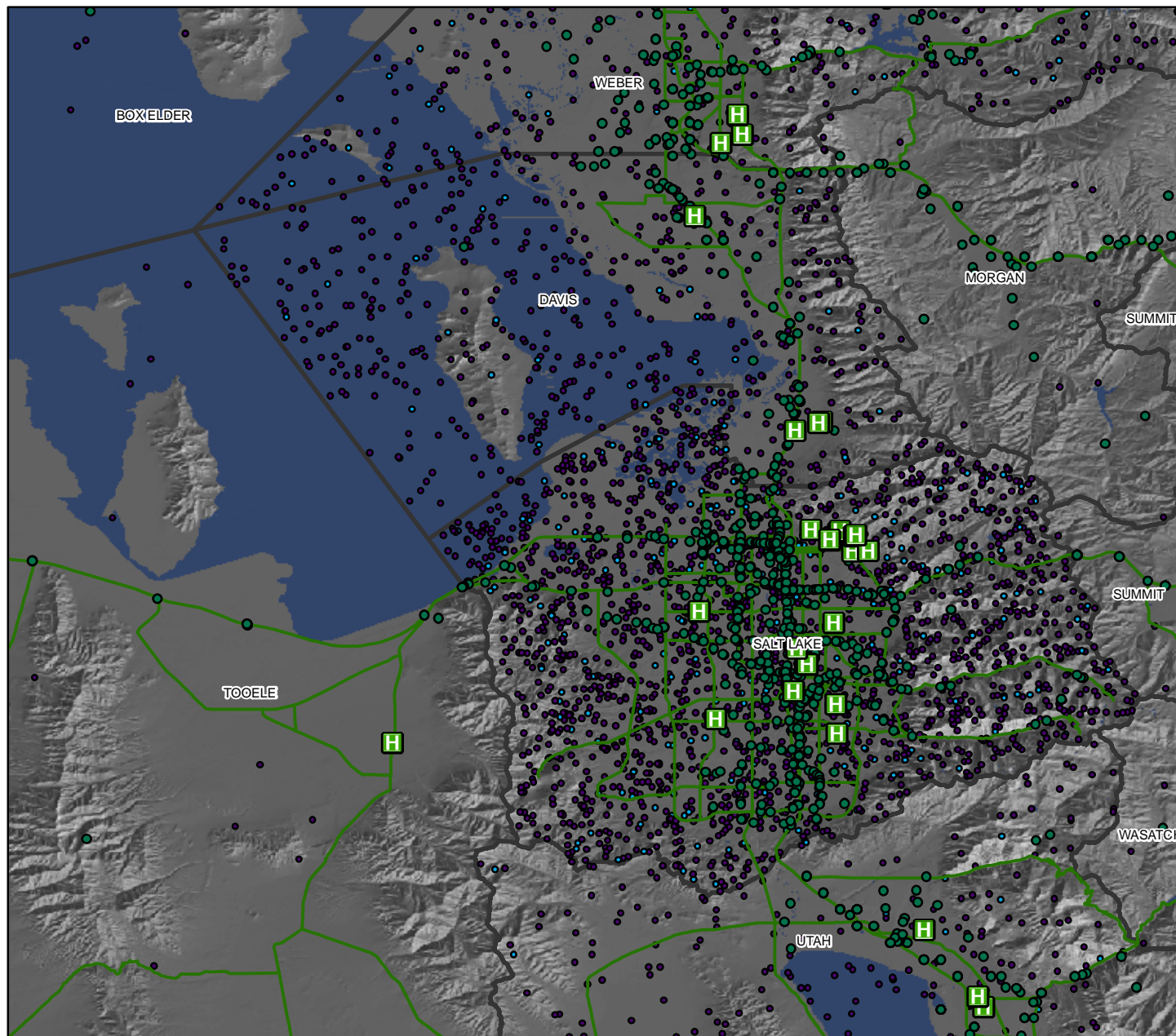
0 2.5 5 7.5 10 12.5 15
Miles



12-22-09 FEMA & URS Corporation



Demographic Distribution & Highway Damage - Earthquake Scenario: Magna Segment, UT



M 5.2 Magna Segment Earthquake

Highway Damage

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

Highway Segment Impact	Major Roadway Bridge Impact
Low	Low
Moderate	Moderate
High	High

Impaired Hospitals (Day 1)

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

H	Low
H	Moderate
H	High

Demographics

- English Speaking
- Potentially Non-English Speaking

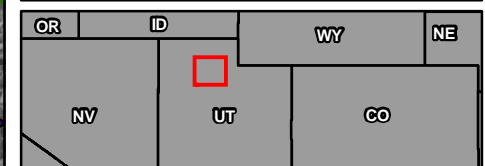
*1 Dot = 500 People (by census tract)

Counties
City Boundaries

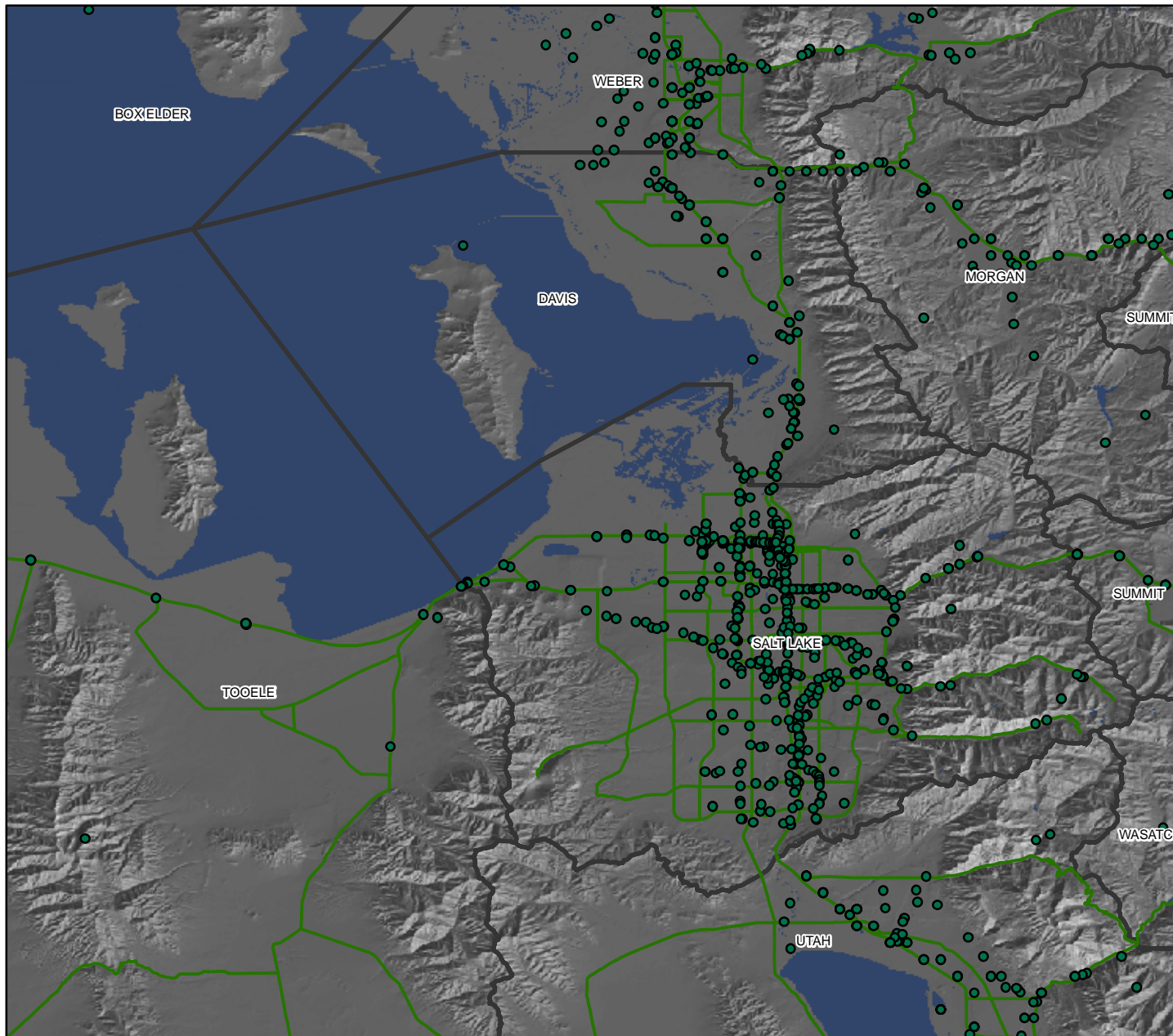
0 2.5 5 7.5 10 12.5 15
Miles



12-22-09 FEMA & URS Corporation



Estimated Highway Infrastructure Damage - Earthquake Scenario: Magna Segment, UT



M 5.2 Magna Segment Earthquake

Highway Damage

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

Highway Segment Impact

- Low
- Moderate
- High

Major Roadway Bridge Impact

- Low
- Moderate
- High

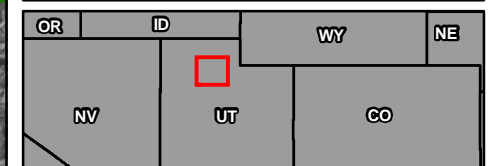
County	Total # of Bridges	# Bridges Needing Priority Inspection	*# of Bridge Engineers Needed
Utah	314	0	0
Box Elder	230	0	0
Wasatch	24	0	0
Tooele	54	0	0
Salt Lake	608	0	0
Weber	141	0	0
Summit	156	0	0
Morgan	80	0	0
Davis	130	0	0
Total	1,737	0	0

*Based on assuming that 2 engineers can inspect 5 bridges a day for 3 days.

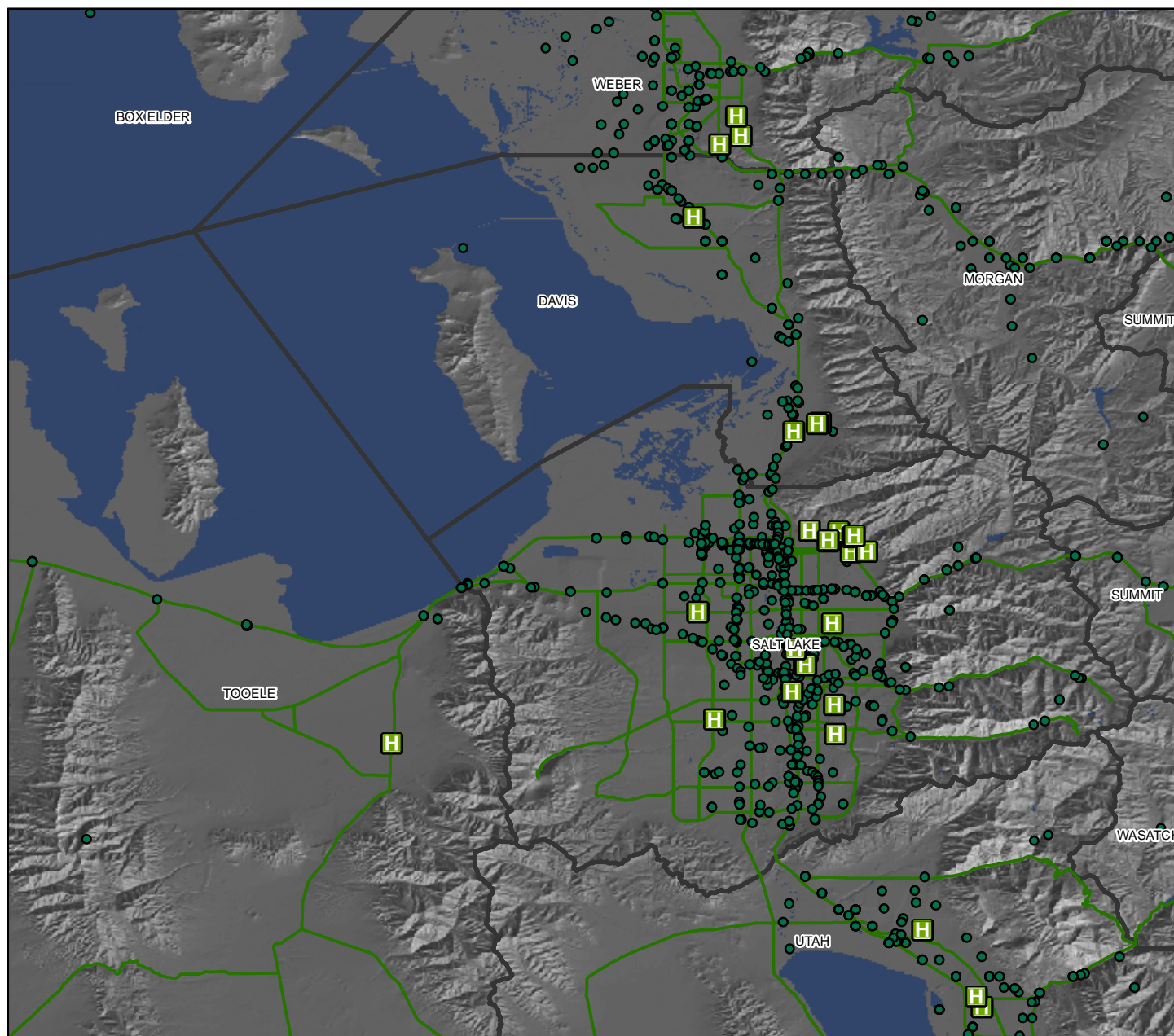
0 2.5 5 7.5 10 12.5 15
Miles



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Impaired Hospitals (Day 1), Hospital Availability & Highway Functionality - Earthquake Scenario: Magna Segment, UT



M 5.2 Magna Segment Earthquake

Highway Damage

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

Highway Segment Impact

- Low
- Moderate
- High

Major Roadway Bridge Impact

- Low
- Moderate
- High

Impaired Hospitals (Day 1)

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

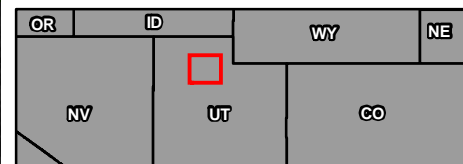
- Low
- Moderate
- High

County	Total # Hospital Beds	Hospital Beds Available	Injuries Requiring Hospital Treatment 2pm
Utah	1,013	1,013	0
Wasatch	20	20	0
Tooele	118	118	0
Salt Lake	3,440	3,433	1
Weber	655	655	0
Davis	468	468	0
Total	5,714	5,707	1

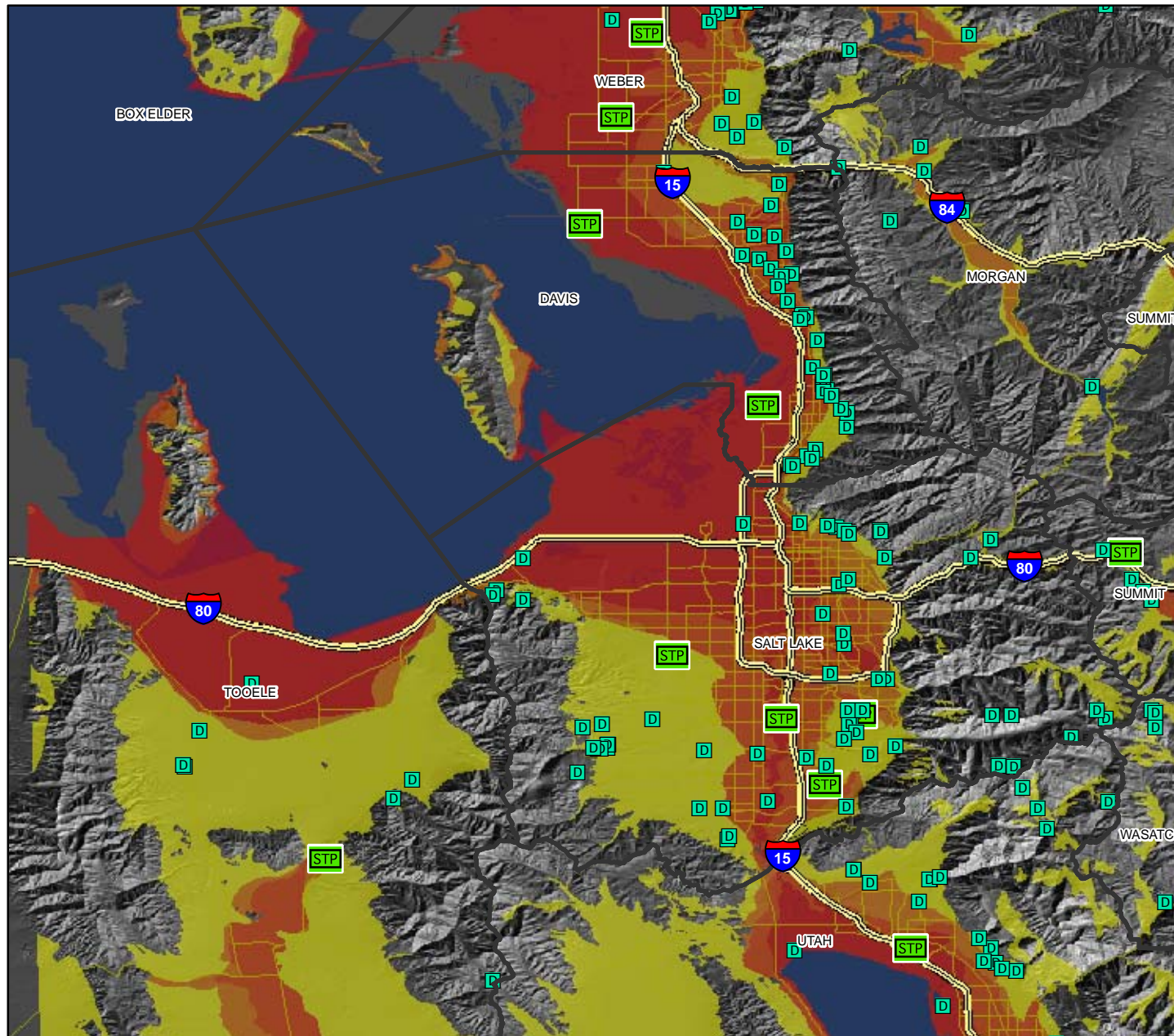
0 2.5 5 7.5 10 12.5 15
Miles



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



M 5.2 Magna Segment Earthquake

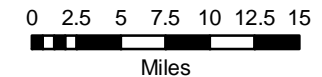
Liquefaction Susceptibility



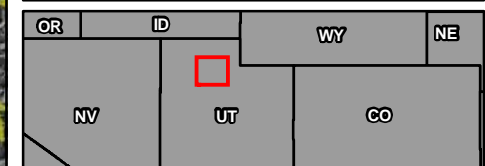
- Dams
- Sewage Treatment Facilities
- Counties
- Interstate
- Major Roads

County	# Households without Potable Water (at Day 1)	Daily Potable Water Needs Per Person (Gallons/day)	Number of Truckloads needed Daily
Utah	0	0	0
Wasatch	0	0	0
Tooele	0	0	0
Salt Lake	0	0	0
Weber	0	0	0
Summit	0	0	0
Morgan	0	0	0
Davis	0	0	0
Total	0	0	0

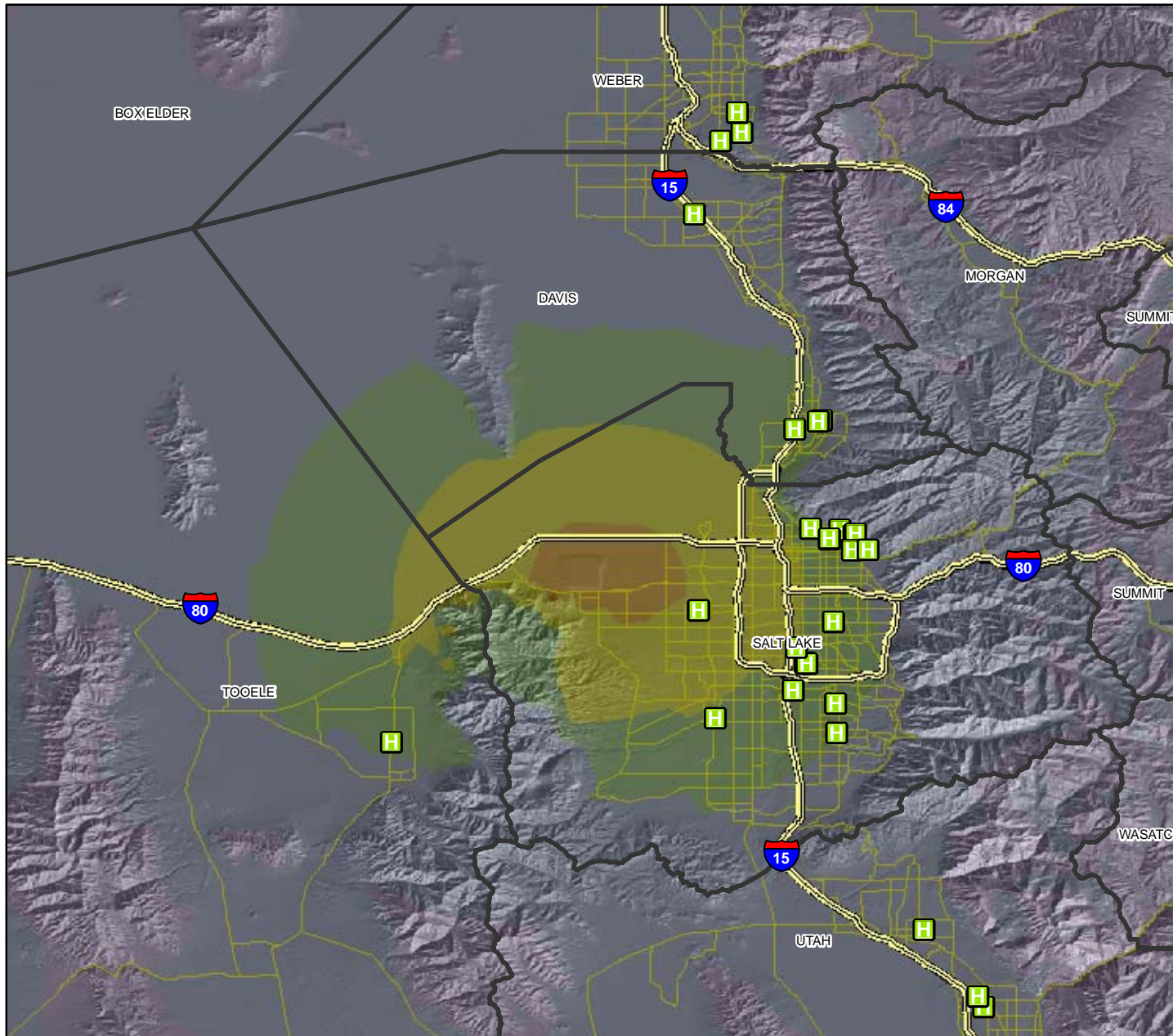
* Based on U.S. Army Corp Mission Guidebook
(Daily water is based on an estimated 3 people per household at a gallon per day per person.
One truck can transport an estimated 5000 gallons of water.)



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Potential Search & Rescue Needs - Earthquake Scenario: Magna Segment, UT



M 5.2 Magna Segment Earthquake

Impaired Hospitals (Day 1)

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

H Low
H Moderate
H High

PGA (% g's)

< 0.02
0.02 - 0.04
0.04 - 0.09
0.09 - 0.18
> 0.18

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

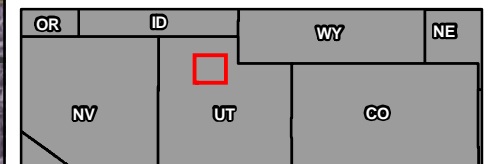
**Severity Level 3 is defined as injuries that require hospitalization and can become life threatening if not promptly treated.*

Structure Type	Red (Complete)	Collapse Rates for Complete Damage	Total Collapse
Wood	0	3%	0
Steel	0	6%	0
Concrete	0	10%	0
Precast	0	13%	0
Reinforced Masonry	0	10%	0
Unreinforced Masonry	0	15%	0
Manufactured Housing	0	3%	0
Total	0		0
Requiring Hospital Treatment		Immediate Life Threatening Injuries	
3		0	

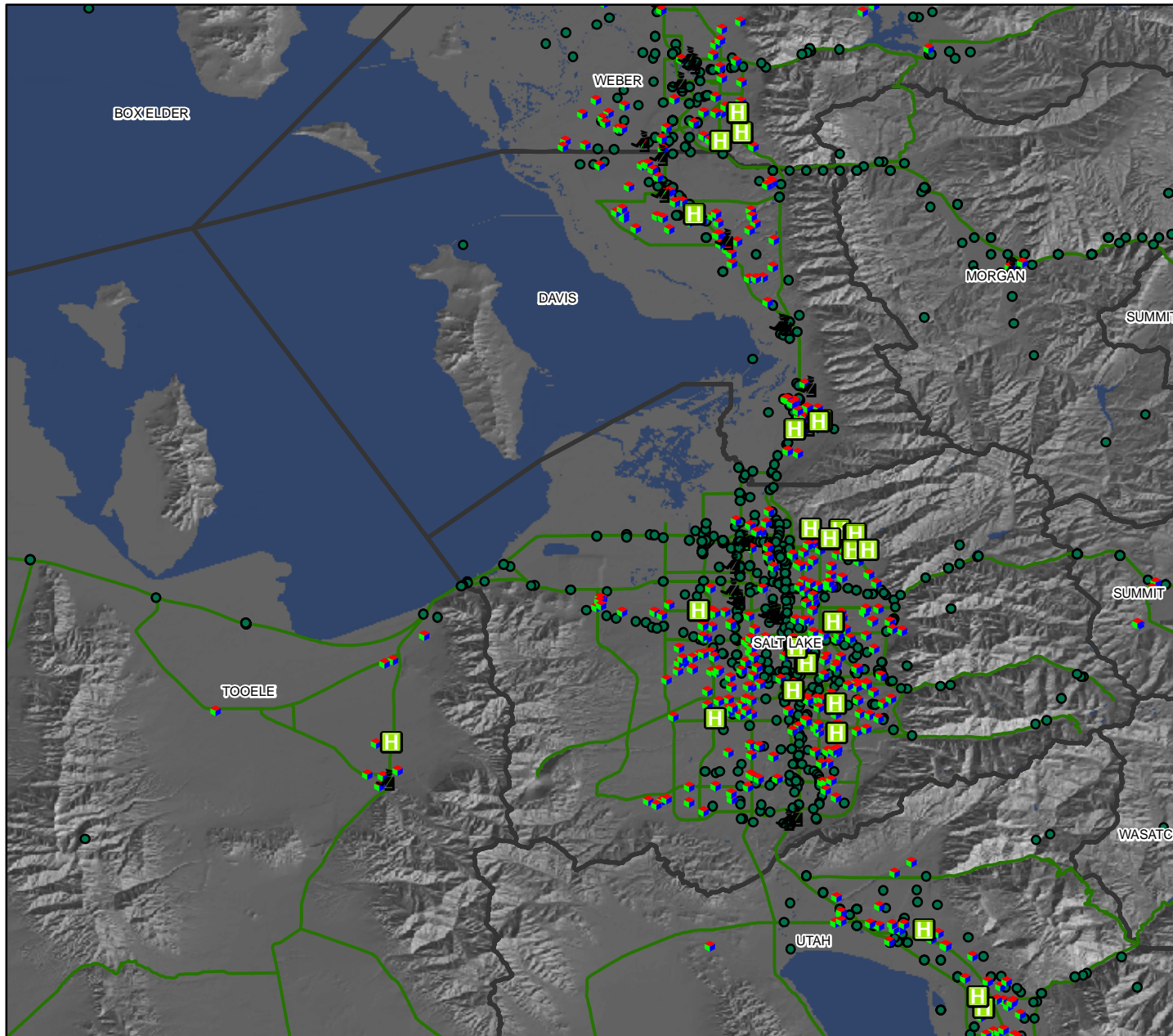
0 2.5 5 7.5 10 12.5 15
Miles



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Correctional and Daycare Facilities, Impaired Hospitals (Day 1) and Highway Functionality - Earthquake Scenario: Magna Segment, UT



M 5.2 Magna Segment Earthquake

Highway Damage

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

Highway Segment Impact	Major Roadway Bridge Impact
— Low	● Low
— Moderate	● Moderate
— High	● High

Impaired Hospitals (Day 1)

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

H Low
H Moderate
H High

- Daycare Facilities
- Correctional Facilities

0 2.5 5 7.5 10 12.5 15
Miles



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