HAZUS-MH: Earthquake Event Report

Region Name: Richfield

Earthquake Scenario: Richfield Mw 6.5 Scenario

Print Date: March 26, 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 11 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 34,000.65 square miles and contains 39 census tracts. There are over 47 thousand households in the region and has a total population of 149,224 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 52 thousand buildings in the region with a total building replacement value (excluding contents) of 8,064 (millions of dollars). Approximately 97.00 % of the buildings (and 67.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 21,431 and 2,149 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 52 thousand buildings in the region which have an aggregate total replacement value of 8,064 (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 11 hospitals in the region with a total bed capacity of 403 beds. There are 121 schools, 86 fire stations, 29 police stations and 1 emergency operation facilities. With respect to HPL facilities, there are 193 dams identified within the region. Of these, 52 of the dams are classified as 'high hazard'. The inventory also includes 67 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 23,580.00 (millions of dollars). This inventory includes over 3,865 kilometers of highways, 757 bridges, 91,834 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	757	571.40
	Segments	380	19,140.80
	Tunnels	2	0.20
		Subtotal	**19,712.40**
Railways	Bridges	2	0.10
	Facilities	2	5.30
	Segments	407	816.10
	Tunnels	0	0.00
		Subtotal	**821.50**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	13	138.50
	Runways	20	759.30
		Subtotal	**897.70**
		Total	**21,431.70**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	1,137.70
	Facilities	1	32.60
	Pipelines	0	0.00
		Subtotal	**1,170.30**
Waste Water	Distribution Lines	NA	682.60
	Facilities	10	652.70
	Pipelines	0	0.00
		Subtotal	**1,335.30**
Natural Gas	Distribution Lines	NA	455.10
	Facilities	1	1.10
	Pipelines	83	490.30
		Subtotal	**946.40**
Oil Systems	Facilities	5	0.50
	Pipelines	0	0.00
		Subtotal	**0.50**
Electrical Power	Facilities	9	970.20
		Subtotal	**970.20**
Communication	Facilities	21	2.10
		Subtotal	**2.10**
		Total	**4,424.80**

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	Richfield Mw 6.5 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	6.50
Depth (Km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

HAZUS estimates that about 1,880 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 69 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	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	725	1.51	15	0.58	43	3.59	32	5.12	4	6.31
Education	96	0.20	3	0.12	5	0.44	4	0.71	1	0.86
Government	308	0.64	7	0.28	16	1.35	13	2.14	2	2.65
Industrial	186	0.39	4	0.16	13	1.07	10	1.69	2	2.31
Other Residential	6,609	13.81	159	6.04	288	24.23	242	39.07	40	57.25
Religion	203	0.42	5	0.20	9	0.79	7	1.21	1	1.35
Single Family	39,729	83.02	2,441	92.62	816	68.53	310	50.06	20	29.27
Total	**47,855**		**2,635**		**1,191**		**619**		**70**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	21,500	44.93	2165	82.15	312	26.20	4	0.68	0	0.08
Steel	370	0.77	5	0.20	23	1.89	25	4.02	5	6.97
Concrete	354	0.74	7	0.26	23	1.97	17	2.71	2	2.71
Precast	178	0.37	2	0.09	10	0.86	13	2.17	2	3.39
RM	6,150	12.85	142	5.37	467	39.22	296	47.74	18	25.65
URM	13,948	29.15	198	7.53	86	7.22	34	5.41	5	6.44
MH	5,356	11.19	116	4.39	270	22.64	231	37.25	38	54.77
Total	**47,855**		**2,635**		**1,191**		**619**		**70**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 403 hospital beds available for use. On the day of the earthquake, the model estimates that only 380 hospital beds (94.00%) 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	11	0	0	10
Schools	121	0	0	121
EOCs	1	0	0	1
PoliceStations	29	0	0	29
FireStations	86	0	0	86

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	380	0	0	380	380
	Bridges	757	0	0	757	757
	Tunnels	2	0	0	2	2
Railways	Segments	407	0	0	407	407
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
	Facilities	2	0	0	2	2
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	13	0	0	13	13
	Runways	20	0	0	20	20

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	1	0	0	1	1
Waste Water	10	0	0	9	10
Natural Gas	1	0	0	1	1
Oil Systems	5	0	0	5	5
Electrical Power	9	0	0	9	9
Communication	21	0	0	21	21

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	56,884	2914	728
Waste Water	34,130	2305	576
Natural Gas	820	0	0
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	47,569	4,457	4,247	3,739	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 1 ignitions that will burn about 0.02 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 1 people and burn about 0 (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 0.120 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 23.00% 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 4,680,000 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 56 households to be displaced due to the earthquake. Of these, 44 people (out of a total population of 149,224) 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	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	1	0	0	0
	Other-Residential	20	4	0	0
	Single Family	24	4	0	1
	Total	**47**	**8**	**1**	**1**
2 PM	Commercial	38	9	1	2
	Commuting	0	0	0	0
	Educational	15	3	0	1
	Hotels	0	0	0	0
	Industrial	5	1	0	0
	Other-Residential	4	1	0	0
	Single Family	5	1	0	0
	Total	**67**	**14**	**2**	**4**
5 PM	Commercial	32	7	1	2
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	3	1	0	0
	Other-Residential	7	1	0	0
	Single Family	9	1	0	0
	Total	**52**	**11**	**2**	**3**

Economic Loss

The total economic loss estimated for the earthquake is 205.79 (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 160.26 (millions of dollars); 34 % 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 40 % 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 Loses							
	Wage	0.00	2.21	7.93	0.47	3.41	14.01
	Capital-Related	0.00	0.95	6.49	0.29	0.47	8.21
	Rental	1.67	2.50	4.52	0.17	0.67	9.54
	Relocation	6.08	1.89	6.88	0.80	6.99	22.64
	Subtotal	**7.75**	**7.55**	**25.82**	**1.74**	**11.54**	**54.40**
Capital Stock Loses							
	Structural	7.14	3.11	7.94	2.02	5.30	25.50
	Non_Structural	20.40	9.18	13.54	3.84	12.19	59.14
	Content	7.12	1.60	5.01	2.23	4.46	20.41
	Inventory	0.00	0.00	0.23	0.57	0.00	0.81
	Subtotal	**34.66**	**13.89**	**26.72**	**8.66**	**21.94**	**105.86**
	Total	**42.41**	**21.44**	**52.54**	**10.39**	**33.48**	**160.26**

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	19,140.78	$0.00	0.00
	Bridges	571.45	$1.65	0.29
	Tunnels	0.20	$0.00	0.00
	Subtotal	**19712.40**	**1.60**	
Railways	Segments	816.07	$0.00	0.00
	Bridges	0.13	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	5.33	$0.00	0.00
	Subtotal	**821.50**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
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	138.46	$3.85	2.78
	Runways	759.28	$0.00	0.00
	Subtotal	**897.70**	**3.90**	
	Total	**21431.70**	**5.50**	

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	32.60	$0.02	0.07
	Distribution Lines	1,137.70	$13.11	1.15
	Subtotal	**1,170.31**	**$13.14**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	652.70	$5.15	0.79
	Distribution Lines	682.60	$10.37	1.52
	Subtotal	**1,335.28**	**$15.52**	
Natural Gas	Pipelines	490.30	$0.00	0.00
	Facilities	1.10	$0.01	0.89
	Distribution Lines	455.10	$11.09	2.44
	Subtotal	**946.44**	**$11.10**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.50	$0.00	0.00
	Subtotal	**0.49**	**$0.00**	
Electrical Power	Facilities	970.20	$0.24	0.02
	Subtotal	**970.20**	**$0.24**	
Communication	Facilities	2.10	$0.03	1.42
	Subtotal	**2.06**	**$0.03**	
	Total	**4,424.78**	**$40.02**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.17
Second Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-0.52
Third Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.67
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.67
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.67
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.67

Appendix A: County Listing for the Region

Beaver,UT

Carbon,UT

Emery,UT

Garfield,UT

Iron,UT

Juab,UT

Millard,UT

Piute,UT

Sanpete,UT

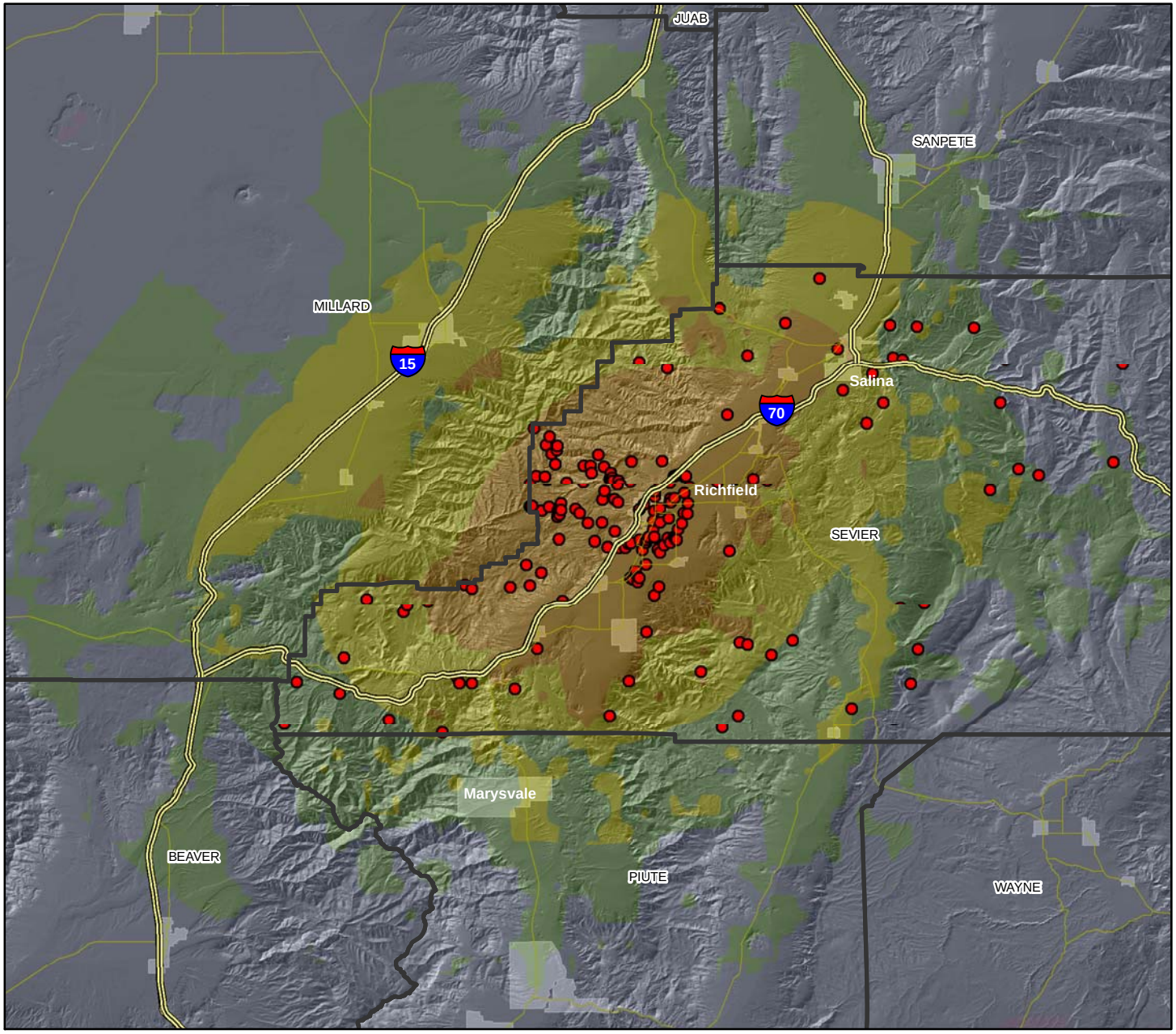
Sevier,UT

Wayne,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
	Carbon	19,947	825	395	1,220
	Emery	10,885	403	142	546
	Garfield	4,957	276	94	370
	Iron	37,498	1,323	741	2,065
	Juab	9,240	291	190	481
	Millard	12,713	447	233	681
	Piute	1,439	69	24	93
	Sanpete	24,037	708	387	1,095
	Sevier	19,623	697	315	1,013
	Wayne	2,590	115	38	154
Total State		**149,224**	**5,406**	**2,648**	**8,059**
Total Region		**149,224**	**5,406**	**2,648**	**8,059**

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



M 6.5 Richfield Segment Earthquake

PGA (% g's)

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

1 Dot = $1,000,000

County	Cost Structural Damage	Cost Non-Structural Damage	Total Loss (Including Contents)
Puite	25	168	344
Emery	6	20	41
Sevier	25,290	58,209	158,277
Sanpete	81	335	734
Beaver	24	246	466
Millard	72	167	401
Total	**$25,498**	**$59,145**	**$160,263**

** All values are thousands of dollars*

Counties

Interstate

Major Roads

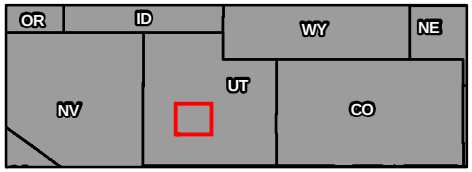
City Boundaries

0 3 6 9 12 15 18

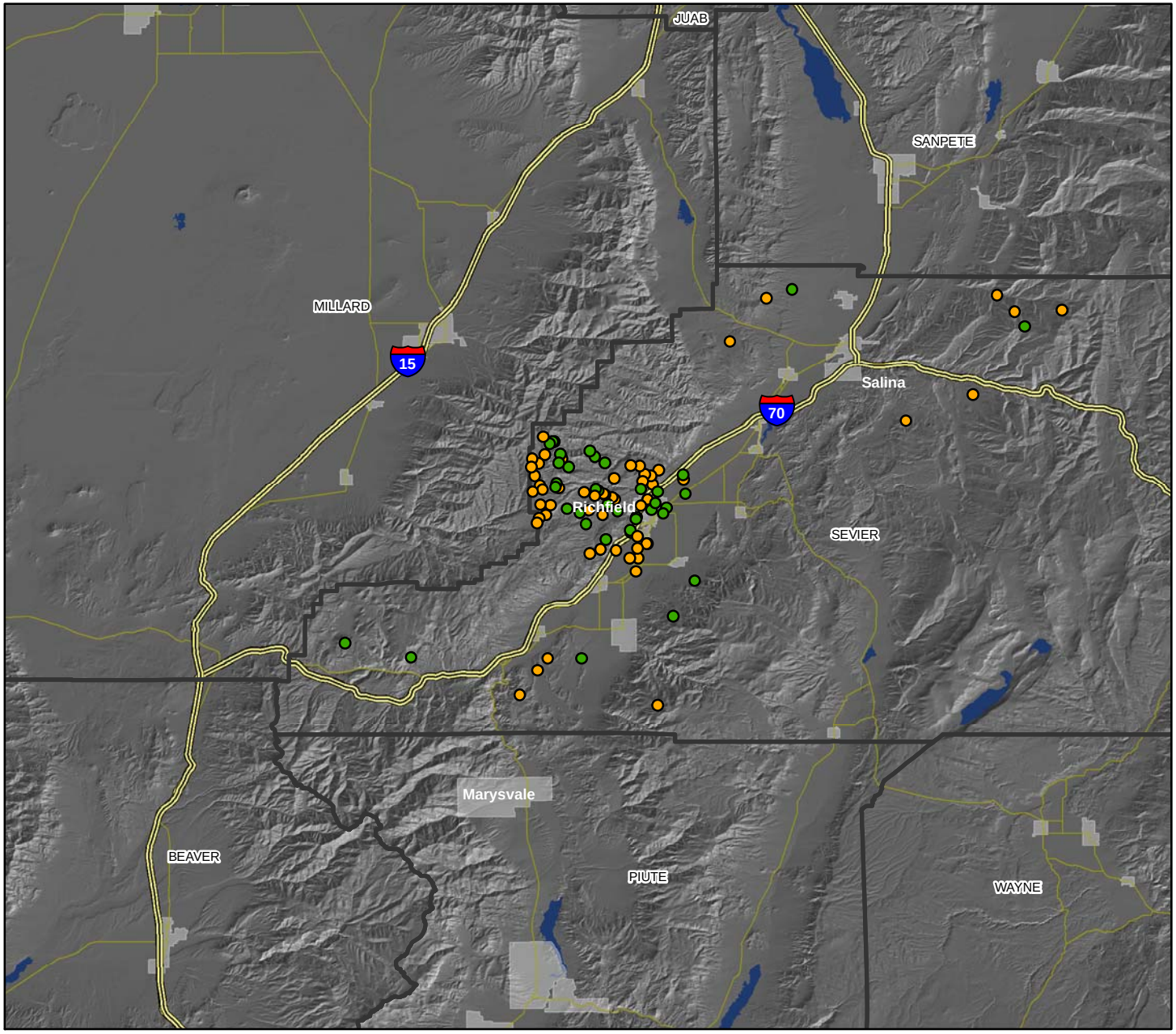
Miles

N

3-26-10 FEMA & URS Corporation



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



M 6.5 Richfield Segment Earthquake

	Total #
Public Shelter Needs (Individuals)	44
Displaced Households	56

1 Dot = 1 Public Shelter Need (Individuals)*

1 Dot = 1 Displaced Household*

** delineated by census tract*

Counties

Interstate

Major Roads

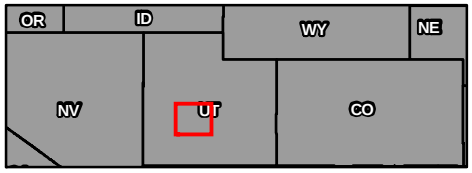
City Boundaries

0 3 6 9 12 15 18

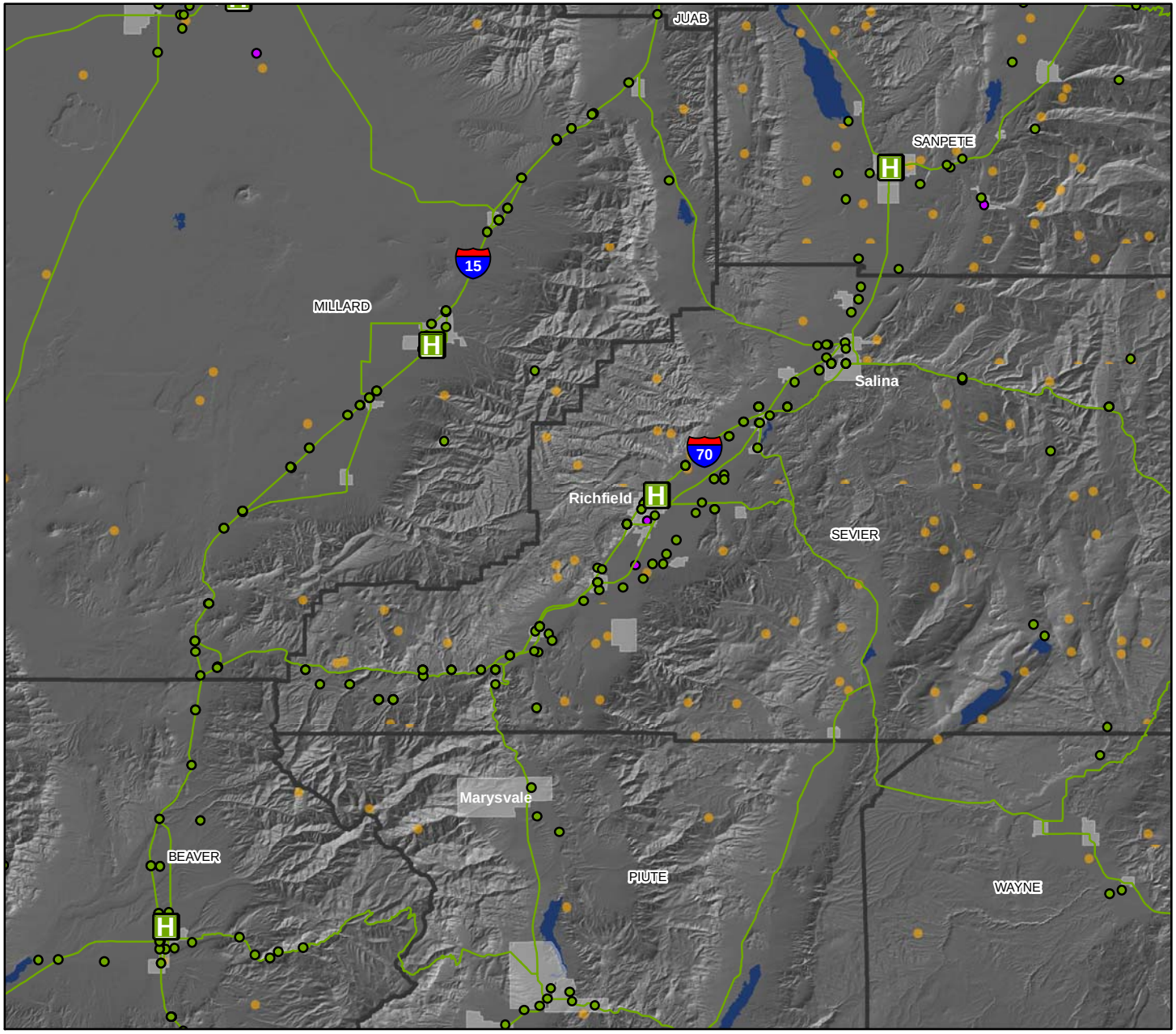
Miles

N

3-26-10 FEMA & URS Corporation



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



M 6.5 Richfield 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 probablility 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
Beaver	70	70	0
Carbon	84	84	0
Garfield	44	44	0
Iron	48	48	0
Juab	31	31	0
Sanpete	44	44	0
Sevier	42	20	36
Millard	40	39	0
Total	**403**	**380**	**36**

Nursing Home

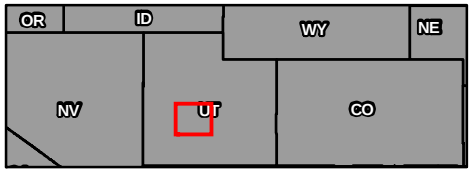
1 Dot = 30 People Over 65

0 3 6 9 12 15 18

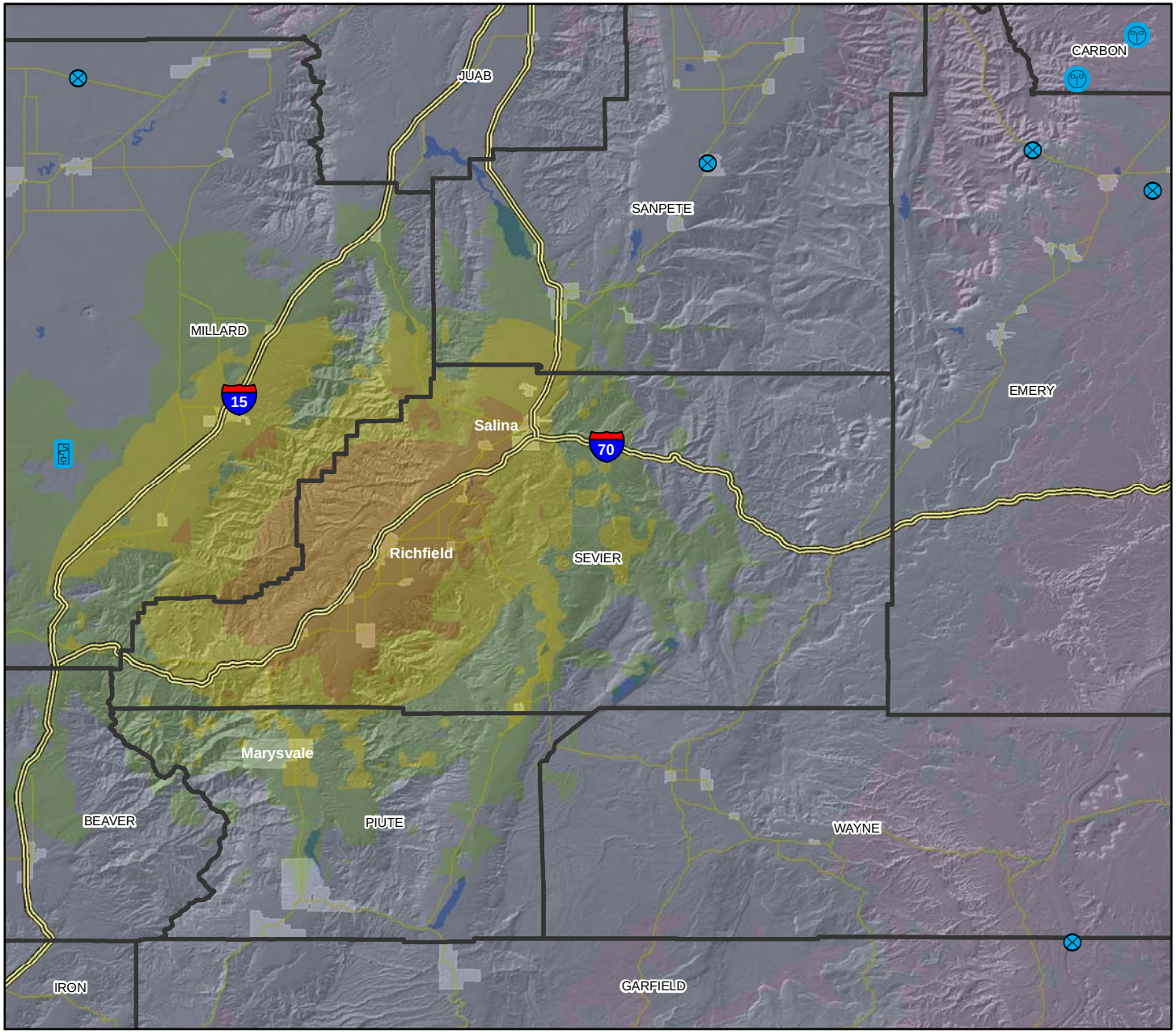
Miles

N

3-26-10 FEMA & URS Corporation



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



M 6.5 Richfield 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

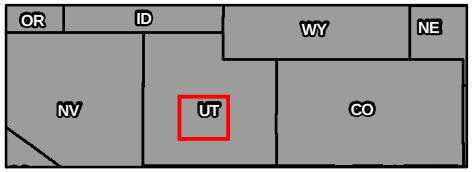
PGA (% g's)
- < 0.02
- 0.02 - 0.04
- 0.04 - 0.09
- 0.09 - 0.18
- > 0.18

- Counties
- Interstate
- Major Roads
- City Boundaries

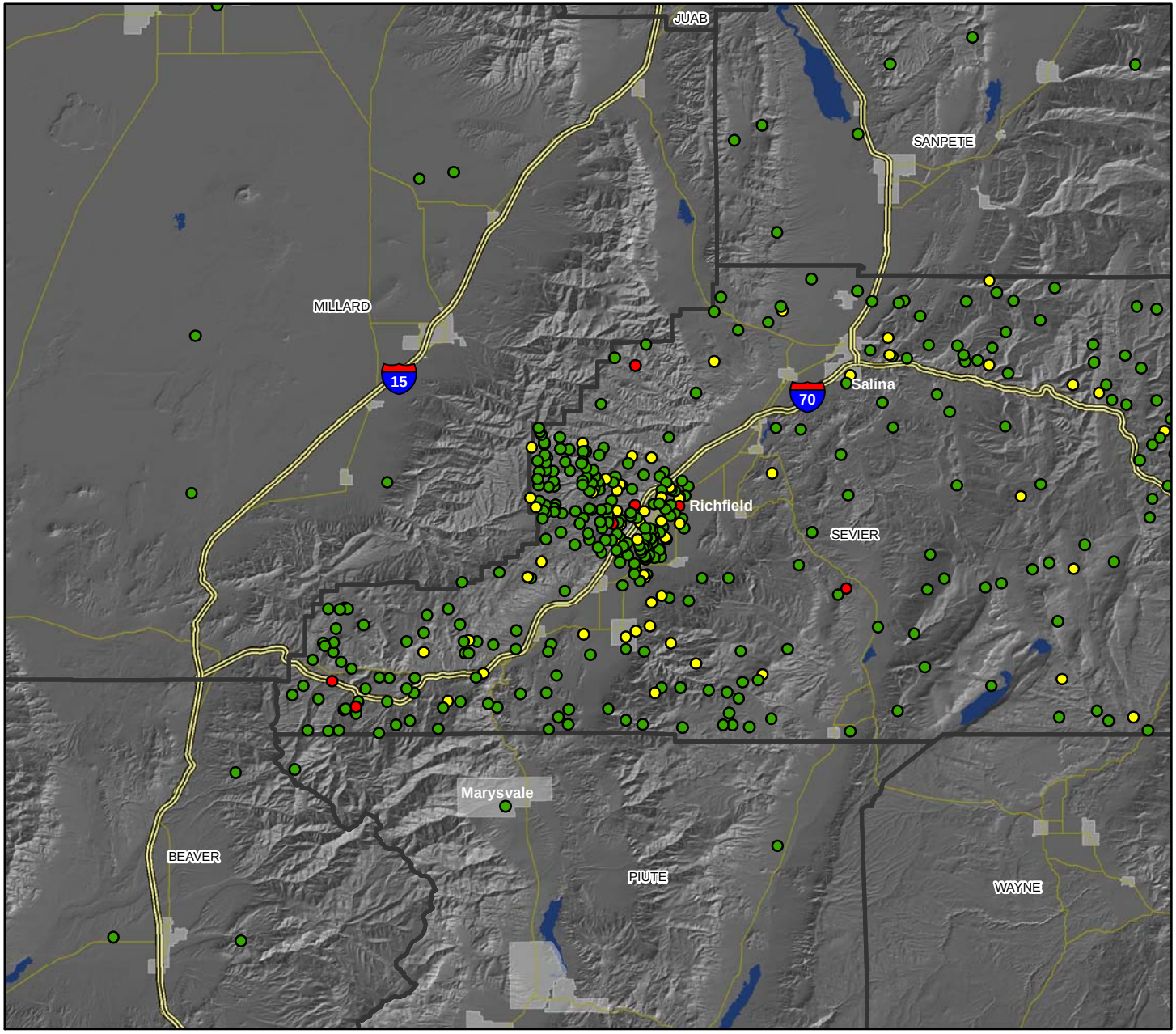
0 4 8 12 16 20 24
Miles

N

3-26-10 FEMA & URS Corporation



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



M 6.5 Richfield Segment Earthquake

	Estimated # of Structures	Estimated # of Inspectors Needed
Red (Complete)	70	1
Yellow (Extensive)	620	8
Light Green (Slight/ Moderate)	3,829	26
Total	4,519	35

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

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

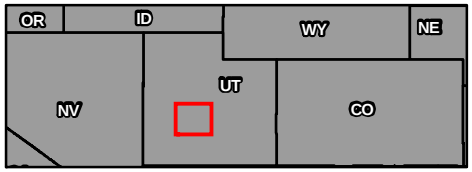
1 Dot = 10 (by census tract)

0 2.5 5 7.5 10 12.5 15

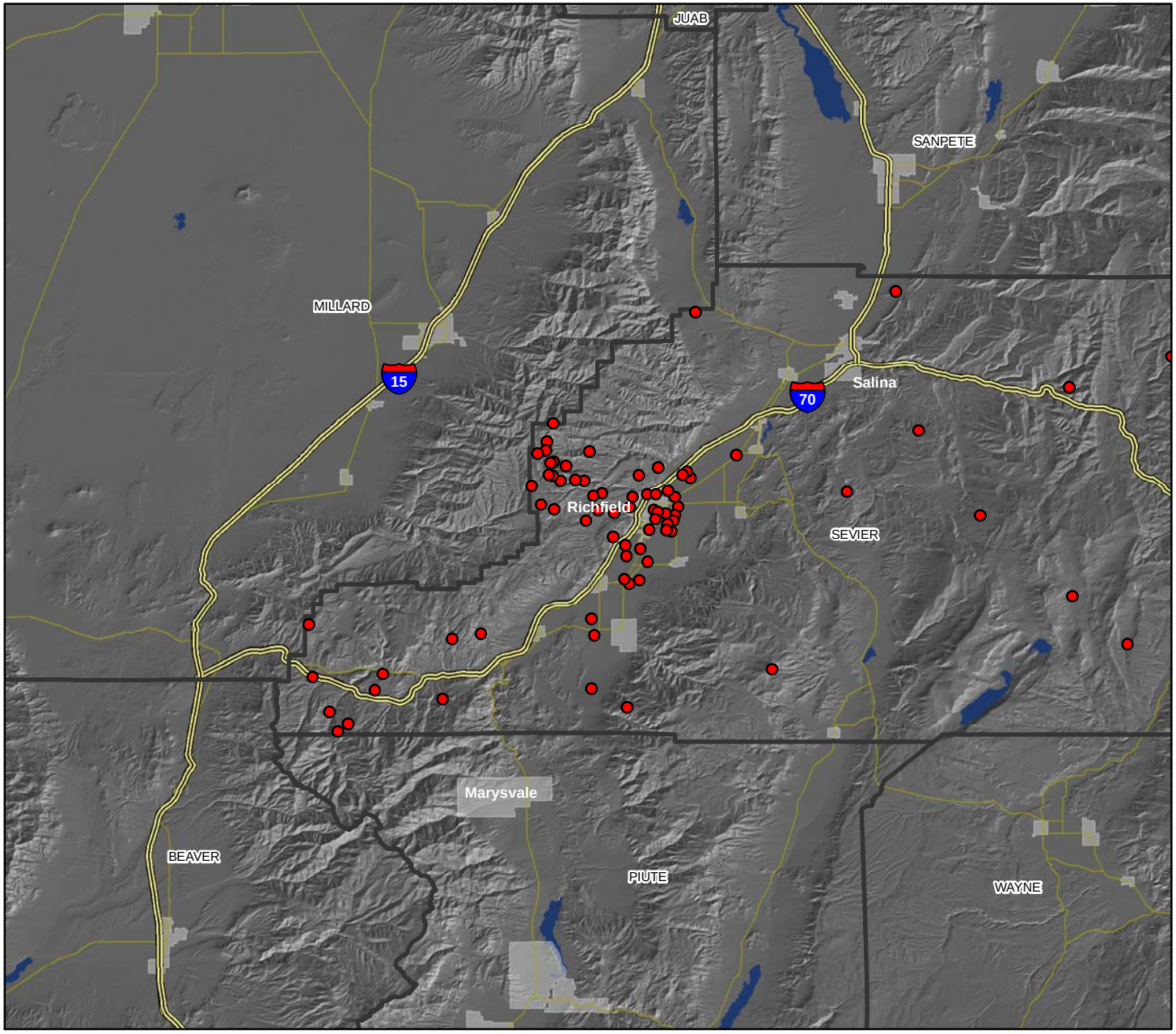
Miles

N

3-26-10 FEMA & URS Corporation



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



M 6.5 Richfield 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
Beaver	0	0	0
Carbon	0	0	0
Emery	0	0	0
Garfield	0	0	0
Iron	0	0	0
Juab	0	0	0
Millard	0	0	0
Piute	0	0	0
Sanpete	0	0	0
Sevier	26,000	90,000	4,640
Wayne	0	0	0
Total	**26,000**	**90,000**	**4,640**

Counties

Interstate

Major Roads

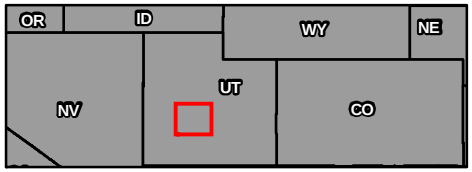
City Boundaries

0 2.5 5 7.5 10 12.5 15

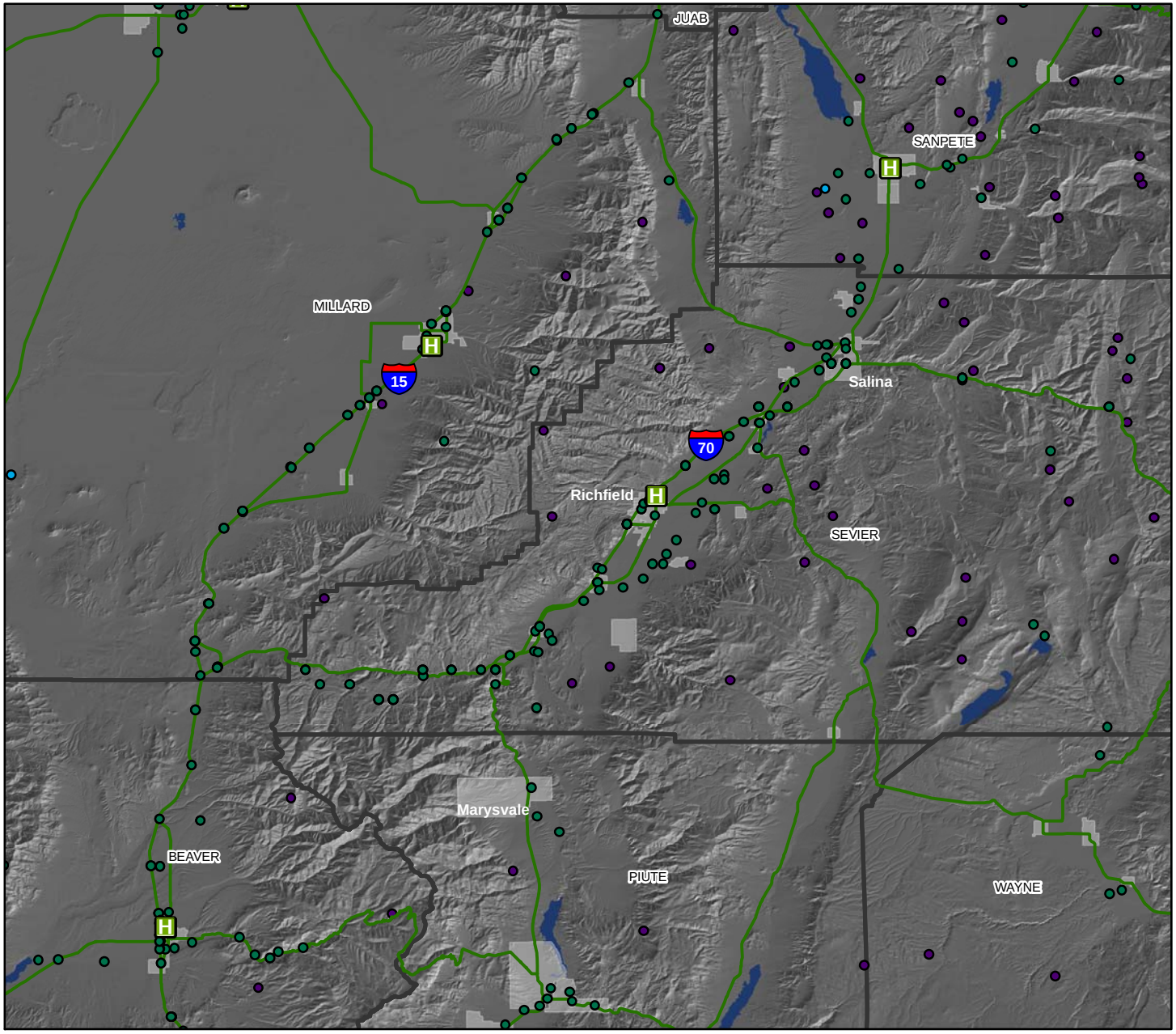
Miles

N

3-26-10 FEMA & URS Corporation



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



M 6.5 Richfield 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 probablility that a given hospital will realize at least moderate damage.

- Low
- Moderate
- High

Demographics

- English Speaking
- Potentially Non-English Speaking

1 Dot = 500 People (by census tract)

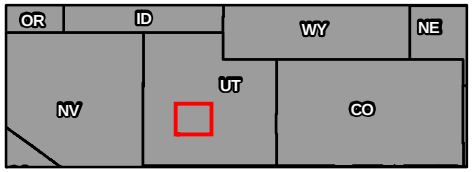
- Counties
- City Boundaries

0 2.5 5 7.5 10 12.5 15

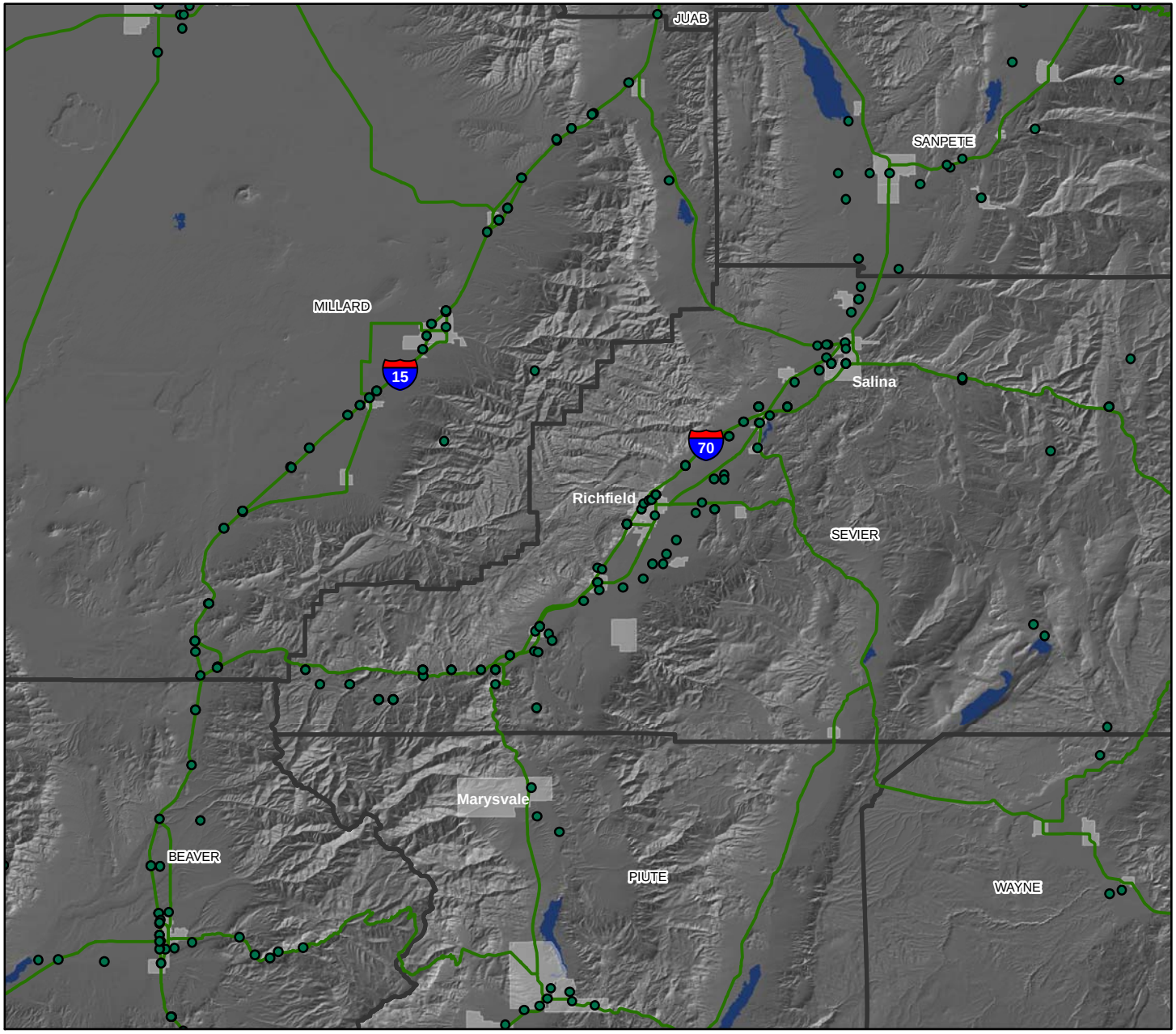
Miles

N

3-26-10 FEMA & URS Corporation



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



M 6.5 Richfield 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

County	Total # of Bridges	# Bridges Needing Priority Inspection	*# of Bridge Engineers Needed
Beaver	54	0	0
Carbon	67	0	0
Emery	90	0	0
Garfield	57	0	0
Iron	89	0	0
Juab	80	0	0
Millard	93	1	1
Piute	17	0	0
Sanpete	38	0	0
Sevier	157	3	1
Wayne	15	0	0
Total	**757**	**4**	**2**

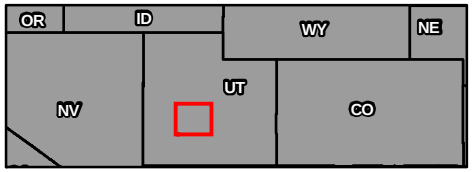
*Based on assuming that 2 engineers can inspect 5 bridges a day for 3 days.

0 2.5 5 7.5 10 12.5 15

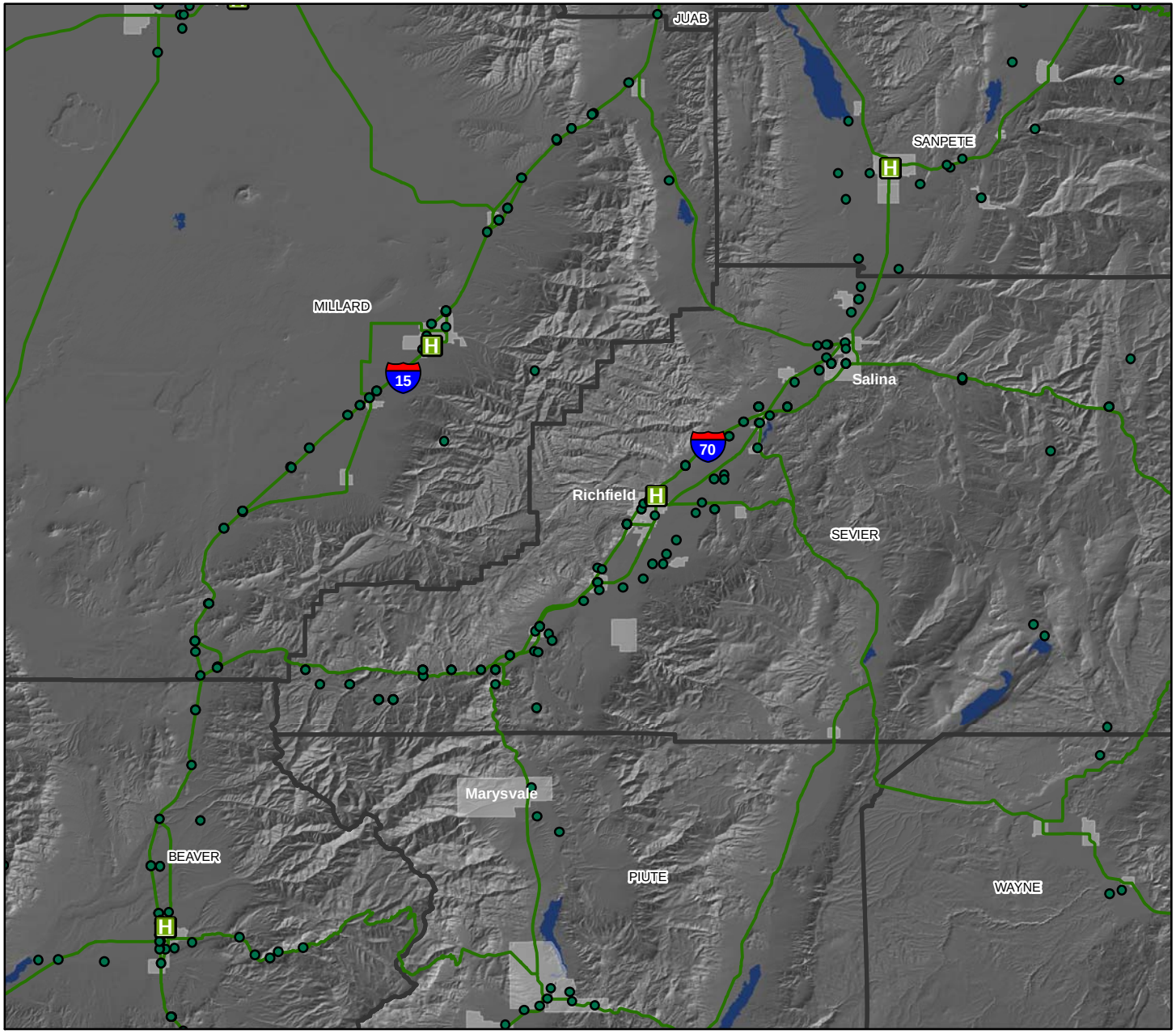
Miles

N

3-26-10 FEMA & URS Corporation



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



M 6.5 Richfield 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 probablility that a given hospital will realize at least moderate damage.

- Low
- Moderate
- High

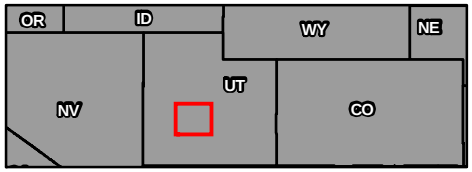
County	Total # Hospital Beds	Hospital Beds Available	Injuries Requiring Hospital Treatment 2pm
Beaver	70	70	0
Carbon	84	84	0
Garfield	44	44	0
Iron	48	48	0
Juab	31	31	0
Sanpete	44	44	0
Sevier	42	20	36
Millard	40	39	0
Total	**403**	**380**	**36**

0 2.5 5 7.5 10 12.5 15

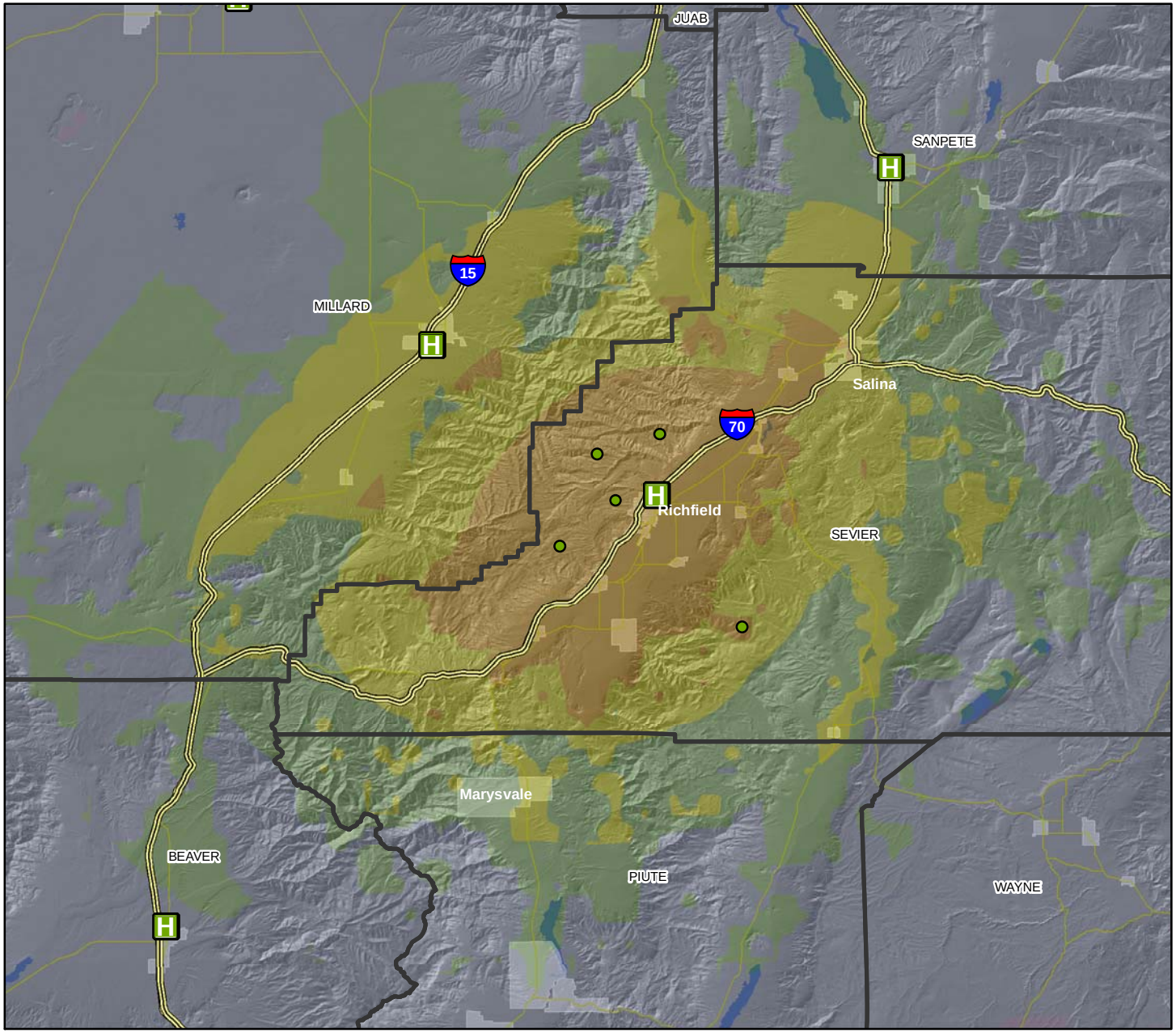
Miles

N

3-26-10 FEMA & URS Corporation



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



M 6.5 Richfield Segment Earthquake

Impaired Hospitals (Day 1)

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

- Low
- Moderate
- 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	5	6%	0
Concrete	2	10%	0
Precast	2	13%	0
Reinforced Masonry	18	10%	2
Unreinforced Masonry	5	15%	1
Manufactured Housing	38	3%	1
Total	70		4

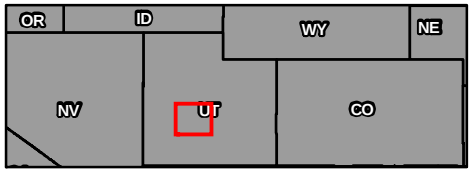
Requiring Hospital Treatment	Immediate Life Threatening Injuries
36	5

0 2.5 5 7.5 10 12.5 15

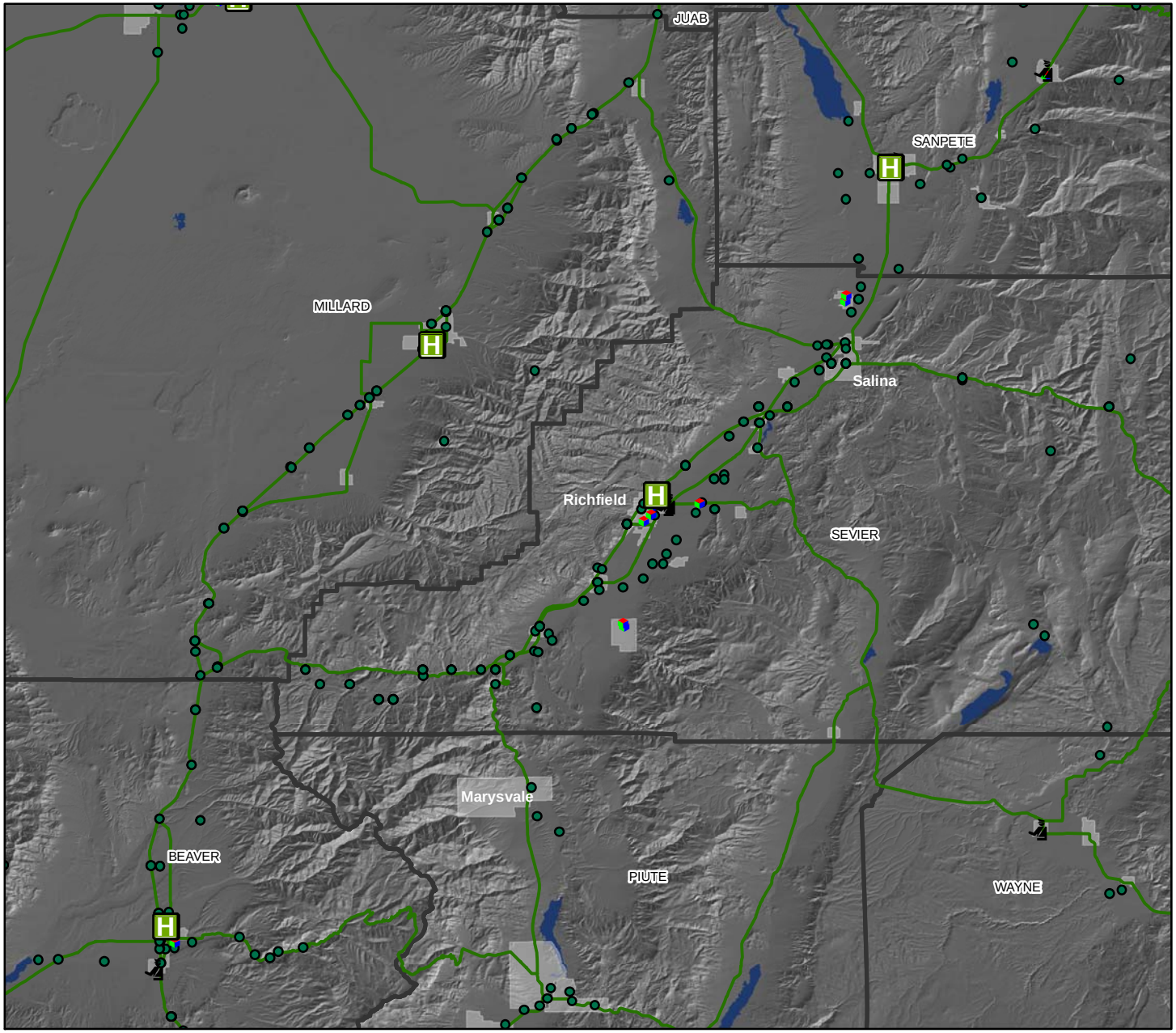
Miles

N

3-26-10 FEMA & URS Corporation



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



M 6.5 Richfield 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 probablility that a given hospital will realize at least moderate damage.

- Low
- Moderate
- High

- Daycare Facilities
- Correctional Facilities

0 2.5 5 7.5 10 12.5 15

Miles

N

3-26-10 FEMA & URS Corporation