HAZUS-MH: Earthquake Event Report

Region Name: Washington Earthquake Mw 6.5 ShakeMap Scenario

Earthquake Scenario: Washington Earthquake Mw 6.5 ShakeMap Scenario

Print Date: October 19, 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 21 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 71,323.38 square miles and contains 364 census tracts. There are over 561 thousand households in the region and has a total population of 1,796,163 people (2005 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 469 thousand buildings in the region with a total building replacement value (excluding contents) of 94,131 (millions of dollars). Approximately 94.00 % 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 43,985 and 6,853 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 469 thousand buildings in the region which have an aggregate total replacement value of 94,131 (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 48% 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 5,480 beds. There are 766 schools, 269 fire stations, 96 police stations and 6 emergency operation facilities. With respect to HPL facilities, there are 457 dams identified within the region. Of these, 158 of the dams are classified as 'high hazard'. The inventory also includes 474 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 50,838.00 (millions of dollars). This inventory includes over 7,364 kilometers of highways, 2,177 bridges, 200,992 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	2,177	2,638.80
	Segments	1,015	37,509.30
	Tunnels	4	2.00
		Subtotal	**40,150.10**
Railways	Bridges	24	2.70
	Facilities	9	24.00
	Segments	1,051	1,990.50
	Tunnels	0	0.00
		Subtotal	**2,017.20**
Light Rail	Bridges	0	0.00
	Facilities	24	63.90
	Segments	24	37.20
	Tunnels	0	0.00
		Subtotal	**101.10**
Bus	Facilities	5	5.30
		Subtotal	**5.30**
Ferry	Facilities	2	2.70
		Subtotal	**2.70**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	25	266.30
	Runways	38	1,442.60
		Subtotal	**1,708.90**
		Total	**43,985.30**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	2,457.20
	Facilities	1	32.60
	Pipelines	0	0.00
		Subtotal	**2,489.80**
Waste Water	Distribution Lines	NA	1,474.30
	Facilities	34	2,219.10
	Pipelines	0	0.00
		Subtotal	**3,693.40**
Natural Gas	Distribution Lines	NA	982.90
	Facilities	7	7.50
	Pipelines	698	1,536.00
		Subtotal	**2,526.40**
Oil Systems	Facilities	19	1.90
	Pipelines	245	459.80
		Subtotal	**461.60**
Electrical Power	Facilities	24	2,587.20
		Subtotal	**2,587.20**
Communication	Facilities	93	9.10
		Subtotal	**9.10**
		Total	**11,767.60**

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	Washington Earthquake Mw 6.5 SM 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 3,992 buildings will be at least moderately damaged. This is over 1.00 % of the total number of buildings in the region. There are an estimated 80 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	522	0.11	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	17,603	3.84	104	1.34	153	5.01	68	7.98	8	10.31
Education	613	0.13	7	0.09	8	0.27	3	0.41	0	0.47
Government	1,448	0.32	7	0.08	5	0.18	2	0.21	0	0.24
Industrial	6,437	1.41	22	0.29	32	1.04	15	1.78	2	2.59
Other Residential	55,761	12.18	1,172	15.05	981	32.04	237	27.85	33	40.59
Religion	1,975	0.43	29	0.37	33	1.07	17	1.97	2	2.66
Single Family	373,478	81.57	6,446	82.78	1,849	60.40	509	59.80	35	43.14
Total	**457,836**		**7,787**		**3,061**		**852**		**80**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	217,198	47.44	5920	76.03	696	22.73	9	1.02	0	0.15
Steel	4,888	1.07	36	0.46	65	2.14	42	4.94	8	10.37
Concrete	3,892	0.85	41	0.53	61	1.98	28	3.30	3	4.03
Precast	3,054	0.67	18	0.23	36	1.18	23	2.74	3	4.27
RM	79,794	17.43	651	8.36	1,101	35.98	478	56.18	30	37.64
URM	132,065	28.85	160	2.06	199	6.50	69	8.15	8	10.17
MH	16,945	3.70	960	12.33	903	29.50	202	23.68	27	33.36
Total	**457,836**		**7,787**		**3,061**		**852**		**80**	

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

Essential Facility Damage

Before the earthquake, the region had 5,480 hospital beds available for use. On the day of the earthquake, the model estimates that only 5,302 hospital beds (97.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 98.00% 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	1	0	44
Schools	766	0	0	754
EOCs	6	0	0	6
PoliceStations	96	0	0	96
FireStations	269	0	0	267

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	1,015	0	0	1,015	1,015
	Bridges	2,177	7	0	2,170	2,175
	Tunnels	4	0	0	4	4
Railways	Segments	1,051	0	0	1,051	1,051
	Bridges	24	0	0	24	24
	Tunnels	0	0	0	0	0
	Facilities	9	0	0	9	9
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	5	0	0	5	5
Ferry	Facilities	2	0	0	2	2
Port	Facilities	0	0	0	0	0
Airport	Facilities	25	0	0	25	25
	Runways	38	0	0	38	38

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	34	0	0	33	34
Natural Gas	7	0	0	7	7
Oil Systems	19	0	0	19	19
Electrical Power	24	0	0	23	24
Communication	93	0	0	93	93

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	122,860	268	67
Waste Water	73,716	212	53
Natural Gas	2,979	0	0
Oil	1,436	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	561,421	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 4 ignitions that will burn about 0.23 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 253 people and burn about 13 (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 0.230 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 25.00% 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 9,080 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 325 households to be displaced due to the earthquake. Of these, 237 people (out of a total population of 1,796,163) 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	2	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	2	0	0	0
	Industrial	2	0	0	0
	Other-Residential	36	6	1	1
	Single Family	52	7	1	1
	Total	**95**	**15**	**1**	**3**
2 PM	Commercial	112	24	3	6
	Commuting	0	0	0	0
	Educational	25	5	1	1
	Hotels	0	0	0	0
	Industrial	13	2	0	1
	Other-Residential	8	1	0	0
	Single Family	12	2	0	0
	Total	**171**	**35**	**5**	**9**
5 PM	Commercial	79	16	2	4
	Commuting	2	2	4	1
	Educational	4	1	0	0
	Hotels	1	0	0	0
	Industrial	8	2	0	0
	Other-Residential	13	2	0	0
	Single Family	20	3	0	1
	Total	**127**	**26**	**7**	**7**

Economic Loss

The total economic loss estimated for the earthquake is 434.83 (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 403.73 (millions of dollars); 32 % 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 Loses							
	Wage	0.00	2.41	25.36	0.63	3.59	32.00
	Capital-Related	0.00	1.04	20.78	0.38	1.26	23.46
	Rental	3.43	5.38	12.07	0.19	1.22	22.29
	Relocation	12.49	4.06	18.42	1.33	16.32	52.61
	Subtotal	**15.92**	**12.89**	**76.63**	**2.53**	**22.39**	**130.36**
Capital Stock Loses							
	Structural	17.39	7.48	19.30	3.05	9.42	56.64
	Non_Structural	59.00	26.63	38.26	6.75	25.21	155.85
	Content	22.97	5.84	16.31	3.84	10.44	59.39
	Inventory	0.00	0.00	0.57	0.92	0.00	1.48
	Subtotal	**99.36**	**39.95**	**74.43**	**14.55**	**45.07**	**273.37**
	Total	**115.28**	**52.84**	**151.06**	**17.09**	**67.46**	**403.73**

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	37,509.32	$0.00	0.00
	Bridges	2,638.84	$3.55	0.13
	Tunnels	1.96	$0.00	0.00
	Subtotal	**40150.10**	**3.50**	
Railways	Segments	1,990.49	$0.00	0.00
	Bridges	2.73	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	23.97	$0.03	0.11
	Subtotal	**2017.20**	**0.00**	
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	$0.07	0.11
	Subtotal	**101.10**	**0.10**	
Bus	Facilities	5.34	$0.01	0.11
	Subtotal	**5.30**	**0.00**	
Ferry	Facilities	2.66	$0.00	0.11
	Subtotal	**2.70**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	266.28	$2.96	1.11
	Runways	1,442.63	$0.00	0.00
	Subtotal	**1708.90**	**3.00**	
	Total	**43985.30**	**6.60**	

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	$0.00	0.00
	Distribution Lines	2,457.20	$1.21	0.05
	Subtotal	**2,489.84**	**$1.21**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	2,219.10	$9.73	0.44
	Distribution Lines	1,474.30	$0.96	0.06
	Subtotal	**3,693.44**	**$10.69**	
Natural Gas	Pipelines	1,536.00	$0.00	0.00
	Facilities	7.50	$0.00	0.00
	Distribution Lines	982.90	$1.02	0.10
	Subtotal	**2,526.36**	**$1.02**	
Oil Systems	Pipelines	459.80	$0.00	0.00
	Facilities	1.90	$0.00	0.00
	Subtotal	**461.63**	**$0.00**	
Electrical Power	Facilities	2,587.20	$11.48	0.44
	Subtotal	**2,587.20**	**$11.48**	
Communication	Facilities	9.10	$0.08	0.92
	Subtotal	**9.11**	**$0.08**	
	Total	**11,767.58**	**$24.49**	

Table 14. Indirect Economic Impact with outside aid

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

LOSS		Total	%
First Year			
	Employment Impact	2,904	0.49
	Income Impact	4	0.02
Second Year			
	Employment Impact	1,218	0.20
	Income Impact	(4)	-0.02
Third Year			
	Employment Impact	25	0.00
	Income Impact	(9)	-0.04
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(10)	-0.05
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(10)	-0.05
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(10)	-0.05

Appendix A: County Listing for the Region

Beaver,UT

Carbon,UT

Duchesne,UT

Emery,UT

Garfield,UT

Grand,UT

Iron,UT

Juab,UT

Kane,UT

Millard,UT

Piute,UT

Salt Lake,UT

San Juan,UT

Sanpete,UT

Sevier,UT

Tooele,UT

Uintah,UT

Utah,UT

Wasatch,UT

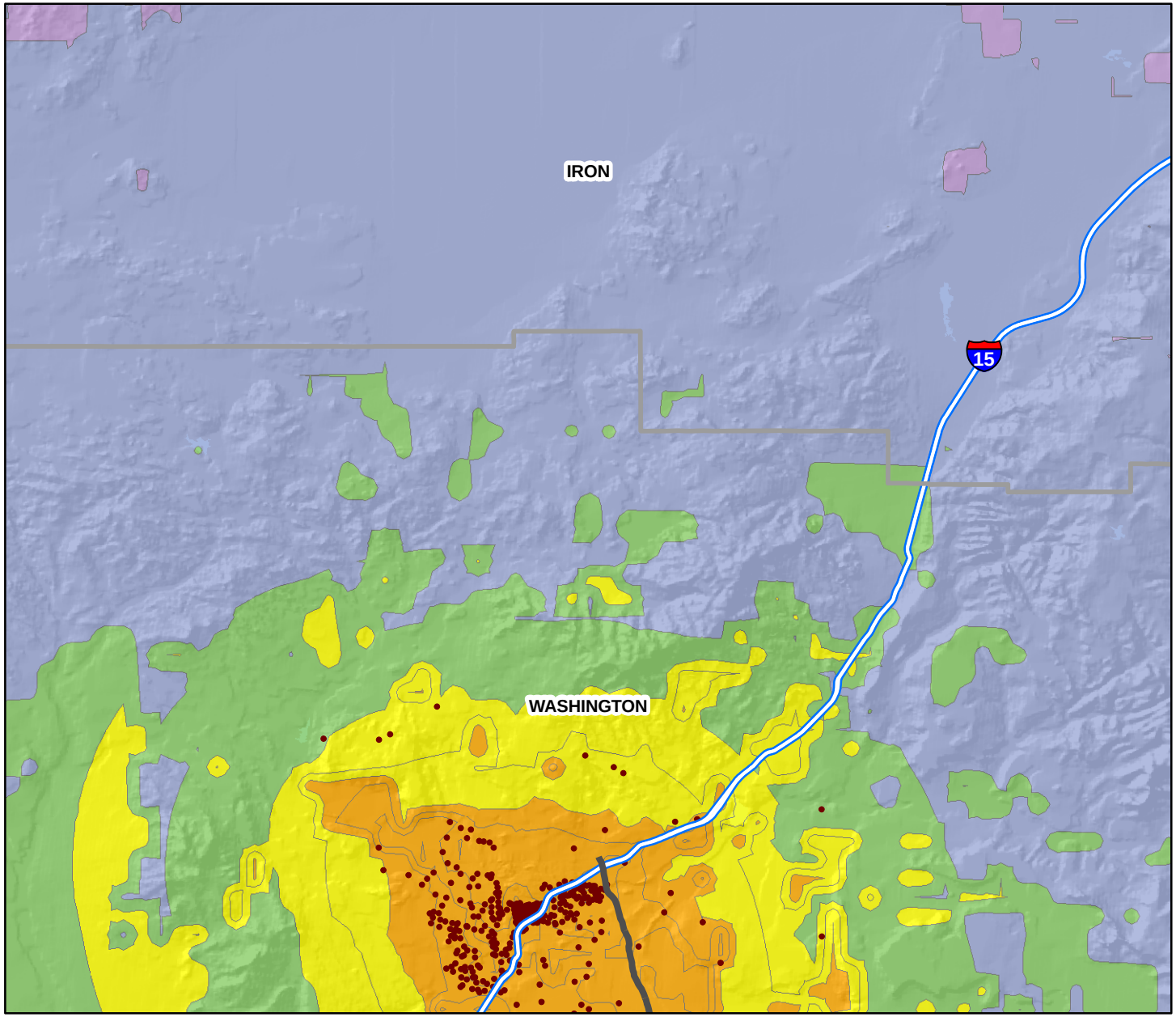
Washington,UT

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
	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
	Piute	1,439	69	24	93
	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
	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
Total State		**1,796,163**	**62,857**	**31,255**	**94,121**
Total Region		**1,796,163**	**62,857**	**31,255**	**94,121**

Direct Building Economic Loss - Earthquake Scenario: Washington, UT



M 6.5 Washington Earthquake

1 Dot = $1,000,000

PGA (g's)

- > 0.02
- 0.02 - 0.04
- 0.04 - 0.09
- 0.09 - 0.18
- 0.18 - 0.34

Counties

Potential fault source

County	Cost Strucutral Damage	Cost Non-Structural Damage	Total Loss*
Beaver	$0	$2	$3
Garfield	$0	$2	$4
Iron	$11	$145	$275
Washington	$56,632	$155,699	$403,453
Total	**$56,643**	**$155,848**	**$403,735**

All values are thousands of dollars

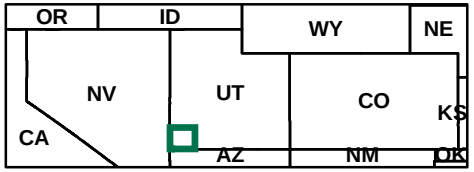
* Total loss = structural, nonstructural, contents, and inventory damage, as well as income losses resulted form relocation,capital related losses, wage loss, and rental income loss

N

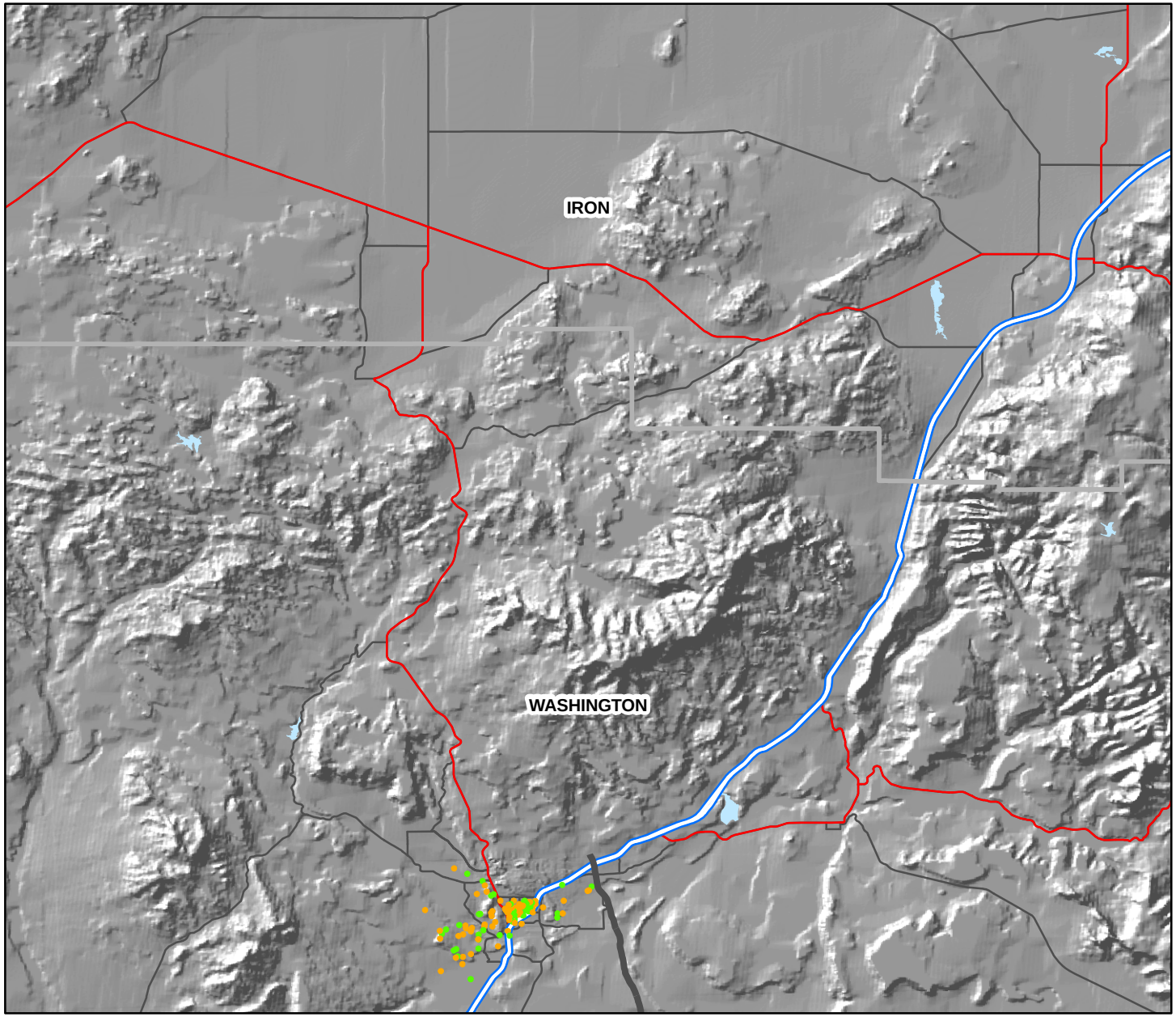
0 2.5 5 7.5 10 12.5 15

Miles

03-19-10 FEMA & URS Corporation



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



M 6.5 Washington Earthquake

	Total #
Public Shelter Needs (Individuals)	238
Displaced Households	325

1 Dot = 5 Displaced Households*

1 Dot = 5 Public Shelter Needs (Individuals)*

* delineated by census tract

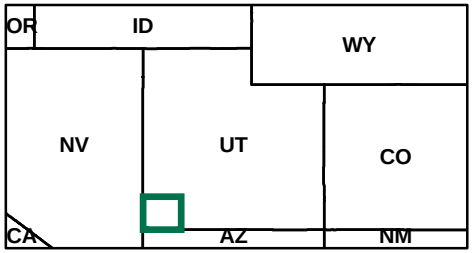
Roads

Counties
Potential fault source
Interstate
Highway
Major Road

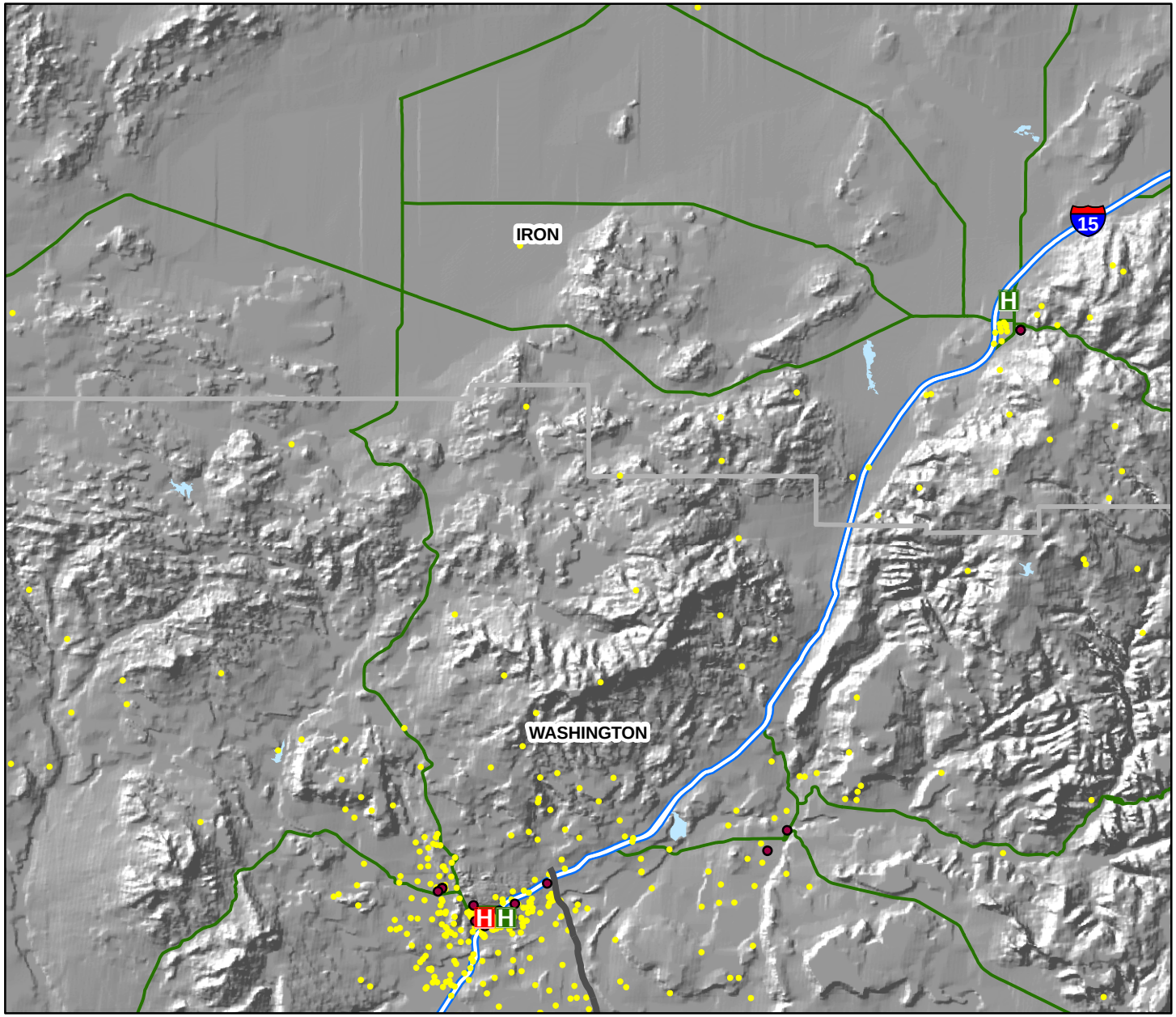
N

0 3 6 9 12 15 18 Miles

12-15-09 FEMA & URS Corporation



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



M 6.5 Washington Earthquake

Highway Impacts

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

1 Dot = 30 People over 65

Nursing Home

Highway

high

moderate

low

Impaired Hospitals at Day 1

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

H high

H moderate

H low

County	Total # Hospital Beds	Hospital Beds Available	Injuries Requiring Hospital Treatment 2pm
Wasington	296	80	211
Total	**296**	**80**	**211**

* Injuries are of Severity 1,2 &3.

Counties

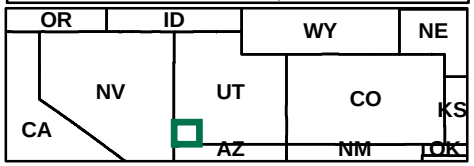
Potential fault source

0 2.5 5 7.5 10 12.5 15

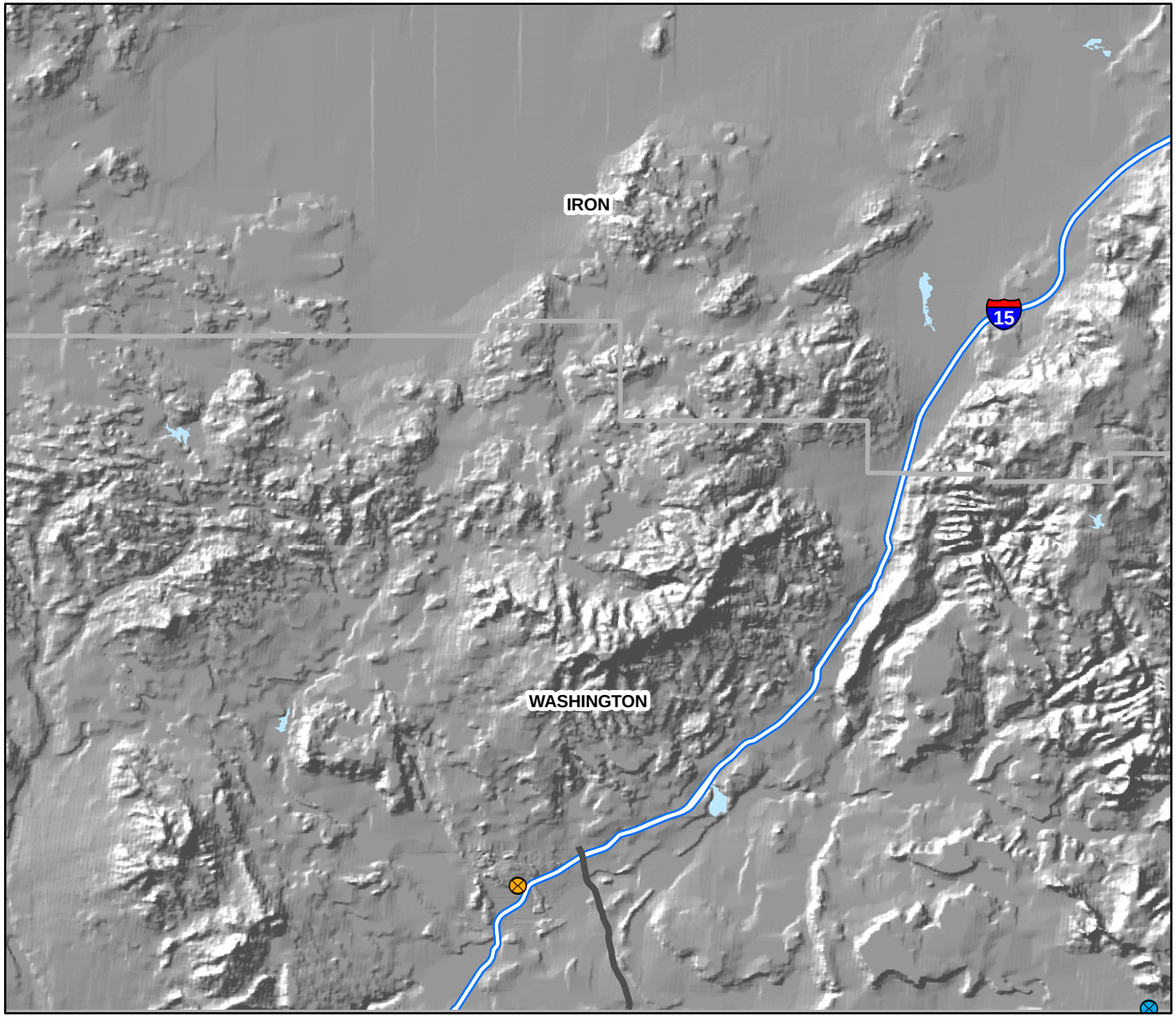
Miles

N

03-19-10 FEMA & URS Corporation



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



M 6.5 Washington Earthquake

Utility Damage (at least moderate)

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

Oil Facility
- low
- moderate
- high

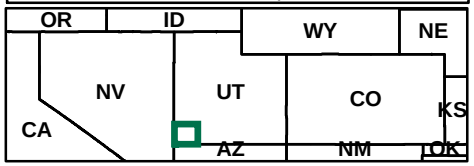
Electric Power Facility	Natural Gas Facility
low	low
moderate	moderate
high	high

Counties
Potential fault source

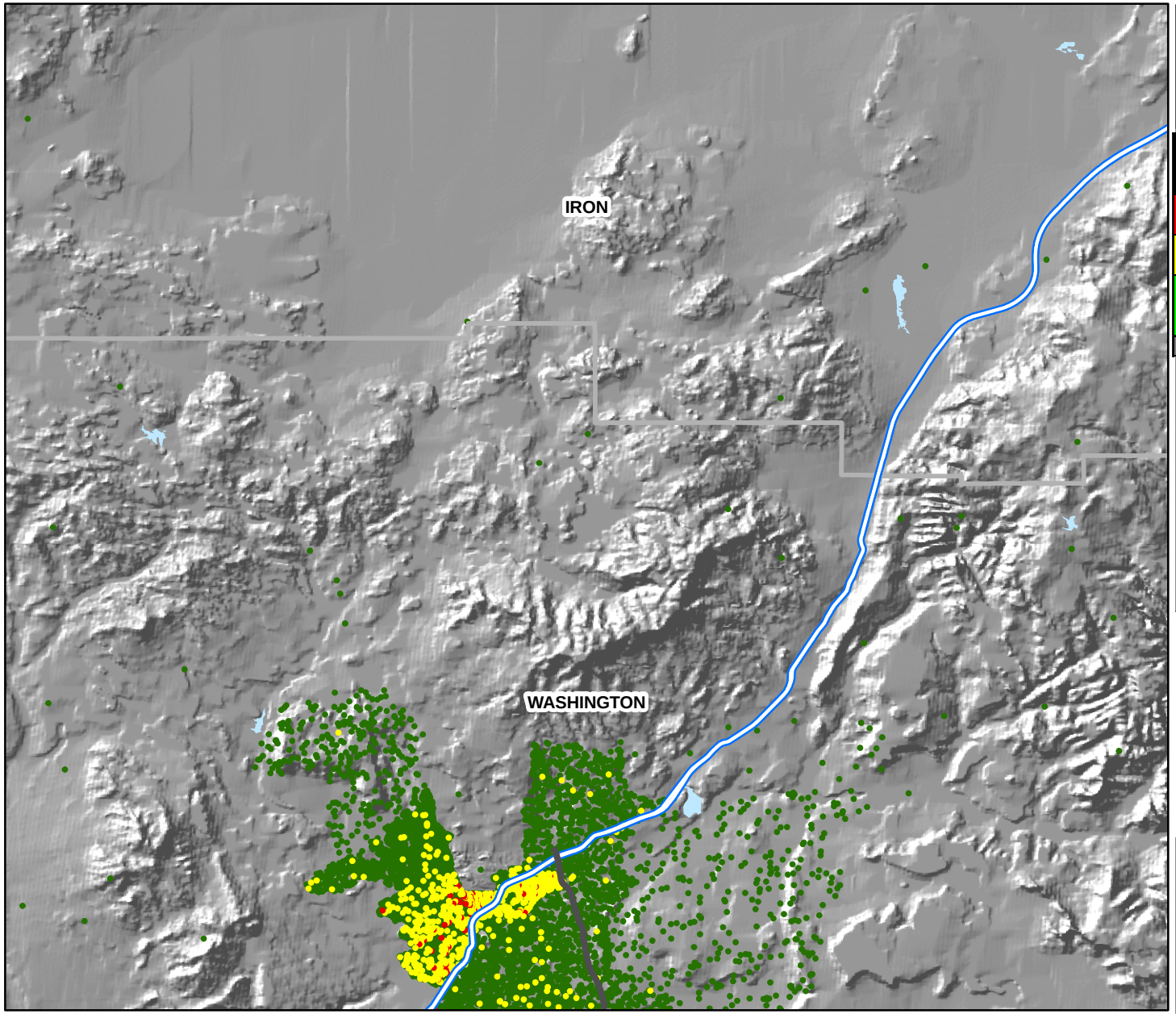
0 2.5 5 7.5 10 12.5 15
Miles

N

03-19-10 FEMA & URS Corporation



Estimated Building Inspection Needs - Earthquake Scenario: Washington, UT



M 6.5 Washington Earthquake

	Estimated # of Structures	Estimated # of Inspectors Needed
Red (Complete)	80	1
Yellow (Extensive)	852	11
Light Green (Slight/ Moderate)	10,849	72
Total	11,781	84

*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)

Counties

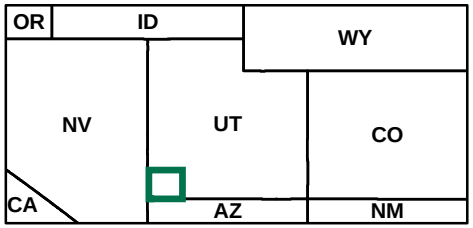
Potential fault source

N

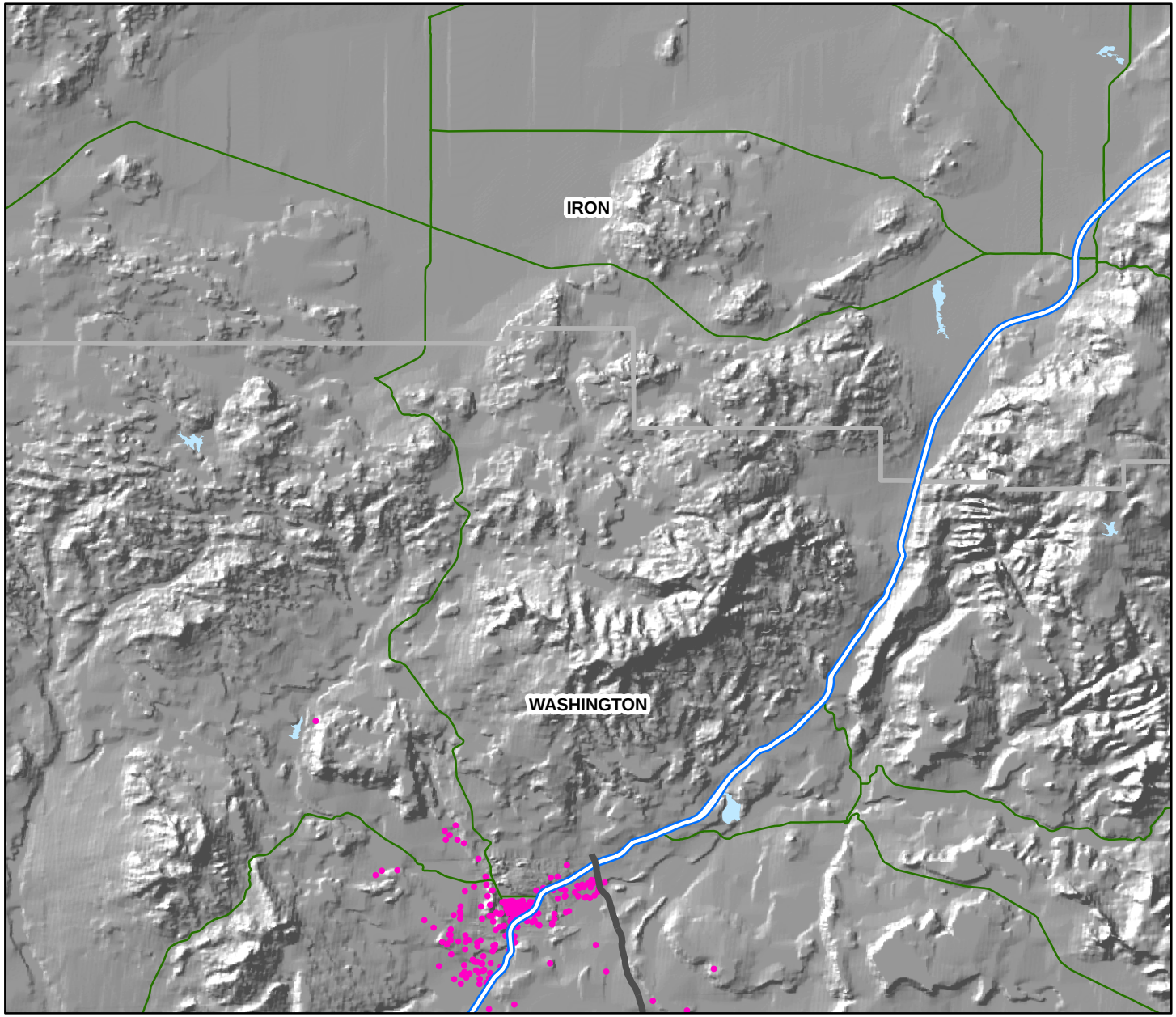
0 2.5 5 7.5 10 12.5 15

Miles

12-16-09 FEMA & URS Corporation



Estimated Concrete, Steel Debris and Highway Damage - Earthquake Scenario: Washington, UT



M 6.5 Washington Earthquake

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

Highway Impacts

- low
- moderate
- high

Damage is expressed as the probability that a Highway segment will realize at least moderate damage.

County	Brick and Wood (tons)	Concrete and Steel (tons)	Estimated Truck Loads*
Washington	56,000	171,000	9,080
Total	**56,000**	**171,000**	**9,080**

* Truck loads estimated at 25 tons per truck

Counties

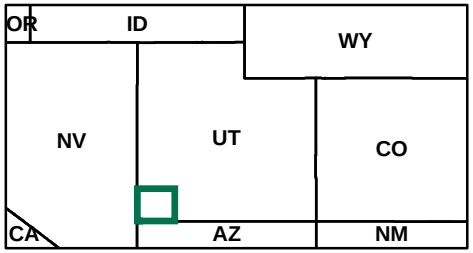
Potential fault source

0 2 4 6 8 10 12

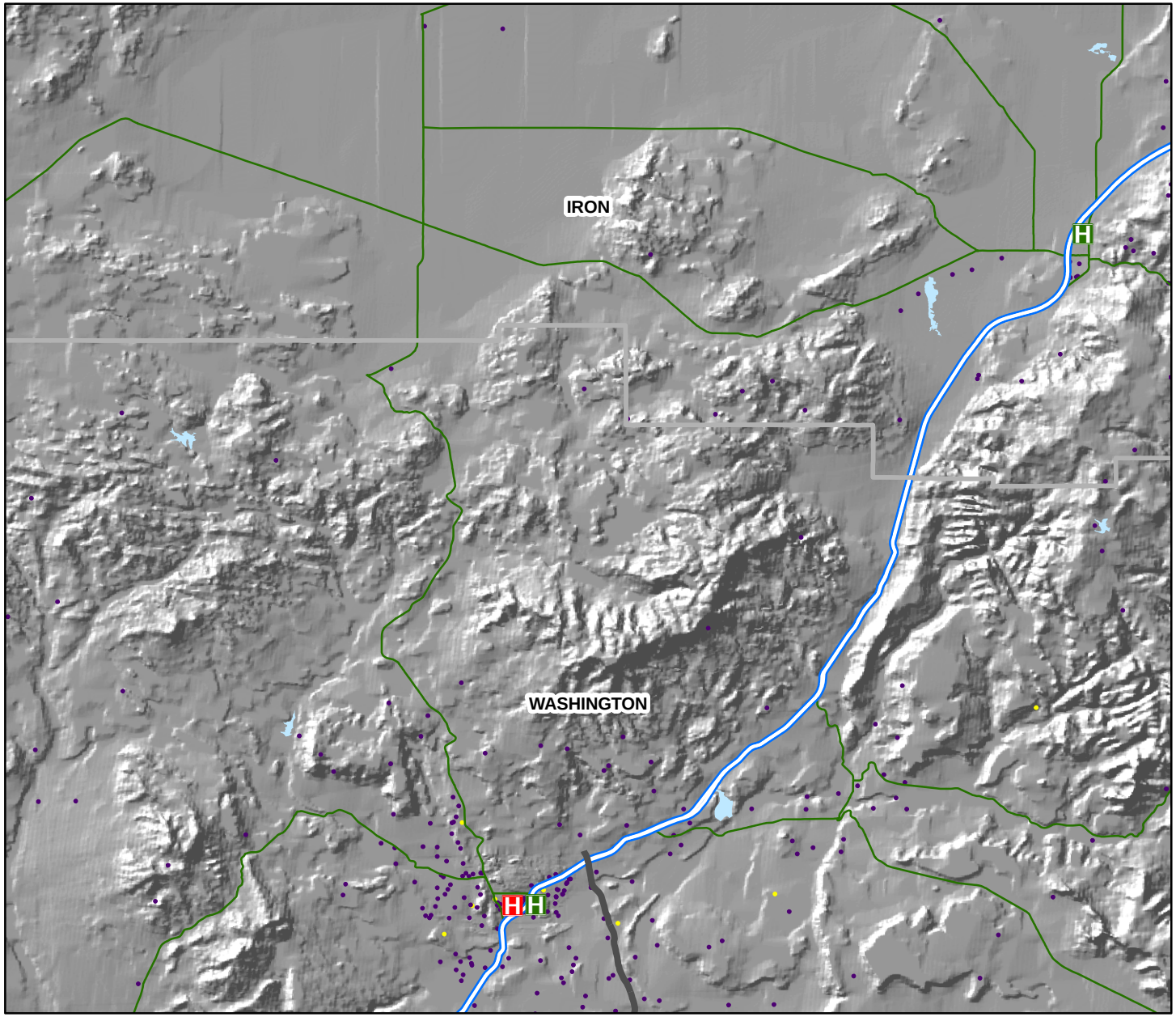
Miles

N

03-19-10 FEMA & URS Corporation



Demographic Distribution and Highway Impacts - Earthquake Scenario: Washington, UT



M 6.5 Washington Earthquake

Highway Impacts

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

Highway

- high
- moderate
- low

Demographics

1 Dot = 500 People (by census tract)

- English Speaking
- Potentially Non-English Speaking

Impaired Hospitals (Day1)

- high
- moderate
- low

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

Counties

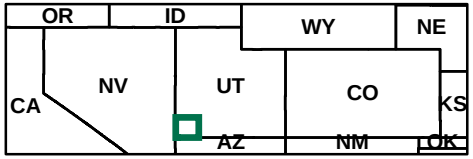
Potantial fault source

0 2.5 5 7.5 10 12.5 15

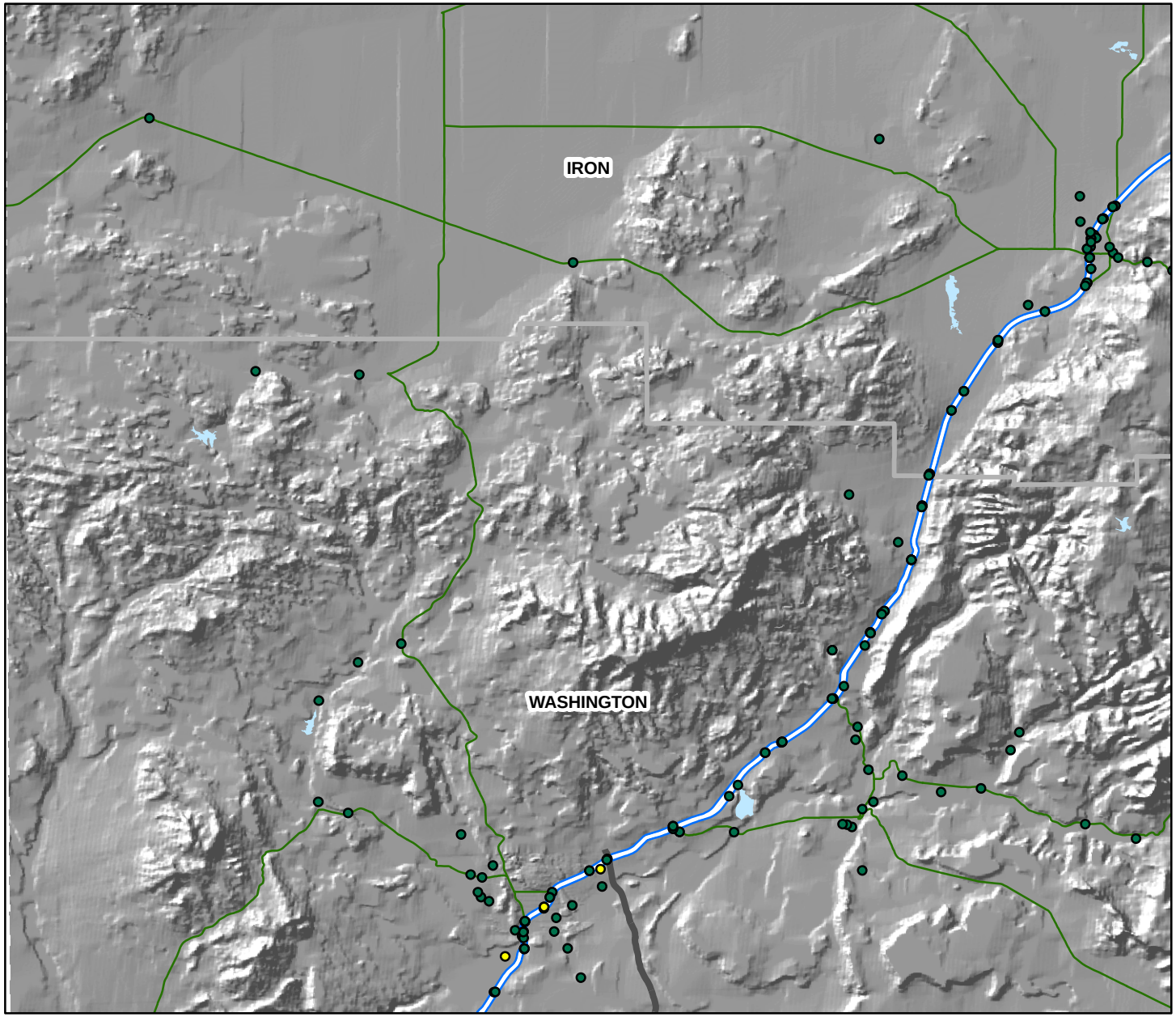
Miles

03-16-10 FEMA & URS Corporation

N



Estimated Highway Infrastructure Damage - Earthquake Scenario: Washington, UT



M 6.5 Washington Earthquake

Highway Impacts

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

Highway Segment	Major Roadway Bridge
low	low
moderate	moderate
high	high

County	# of Bridges Needing Inspection	# of Bridges Needing Priority Inspection	# of Bridge Engineers Needed*
Beaver	54	0	7
Garfield	57	0	2
Iron	89	0	12
Washington	109	2.18	15
Total	**309**	**2**	**28**

* For priority inspections only, assuming that 2 engineers can inspect 5 bridges a day for 3 days

Counties

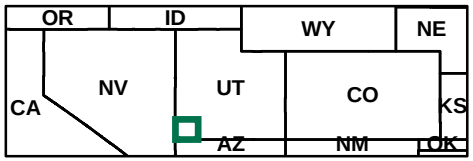
Potential fault source

0 2.5 5 7.5 10 12.5 15

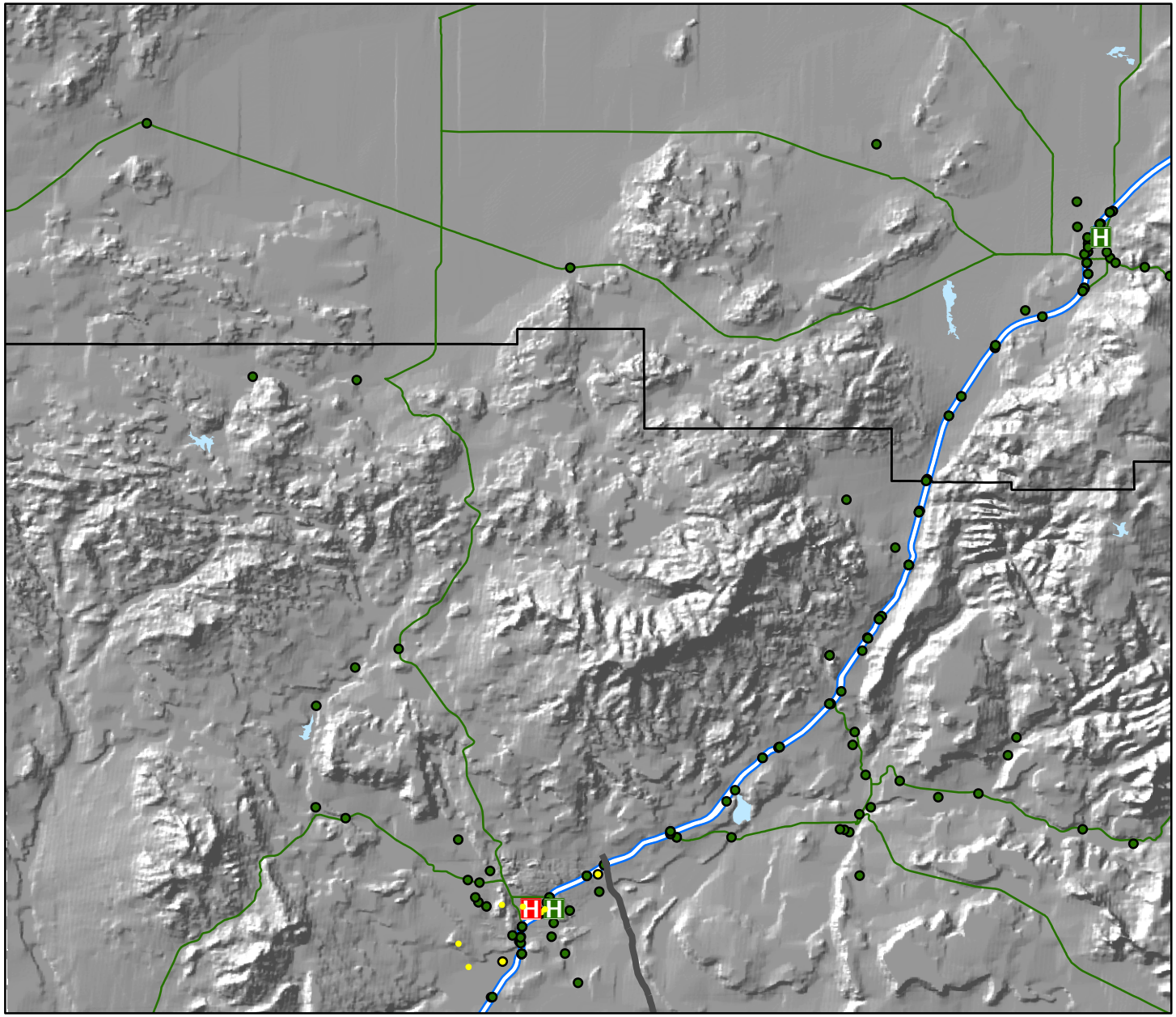
Miles

N

03-16-10 FEMA & URS Corporation



Injuries, Impaired Hospitals (Day 1), Hospital Bed Availability, & Highway Impacts - Earthquake Scenario: Washington, UT



M 6.5 Washington Earthquake

Highway Impacts

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

Bridge Seg.	Highway
high	high
moderate	moderate
low	low

1 Dot = 1 Life Threatening Injury (Severity Level 3 delineated by census tract)

Impaired Hospitals at Day 1

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

- high
- moderate
- low

County	Total # Hospital Beds	Hospital Beds Available	Injuries Requiring Hospital Treatment 2pm
Wasington	296	80	211
Total	**296**	**80**	**211**

Counties

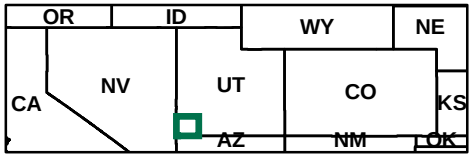
Potential fault source

0 2.5 5 7.5 10 12.5 15

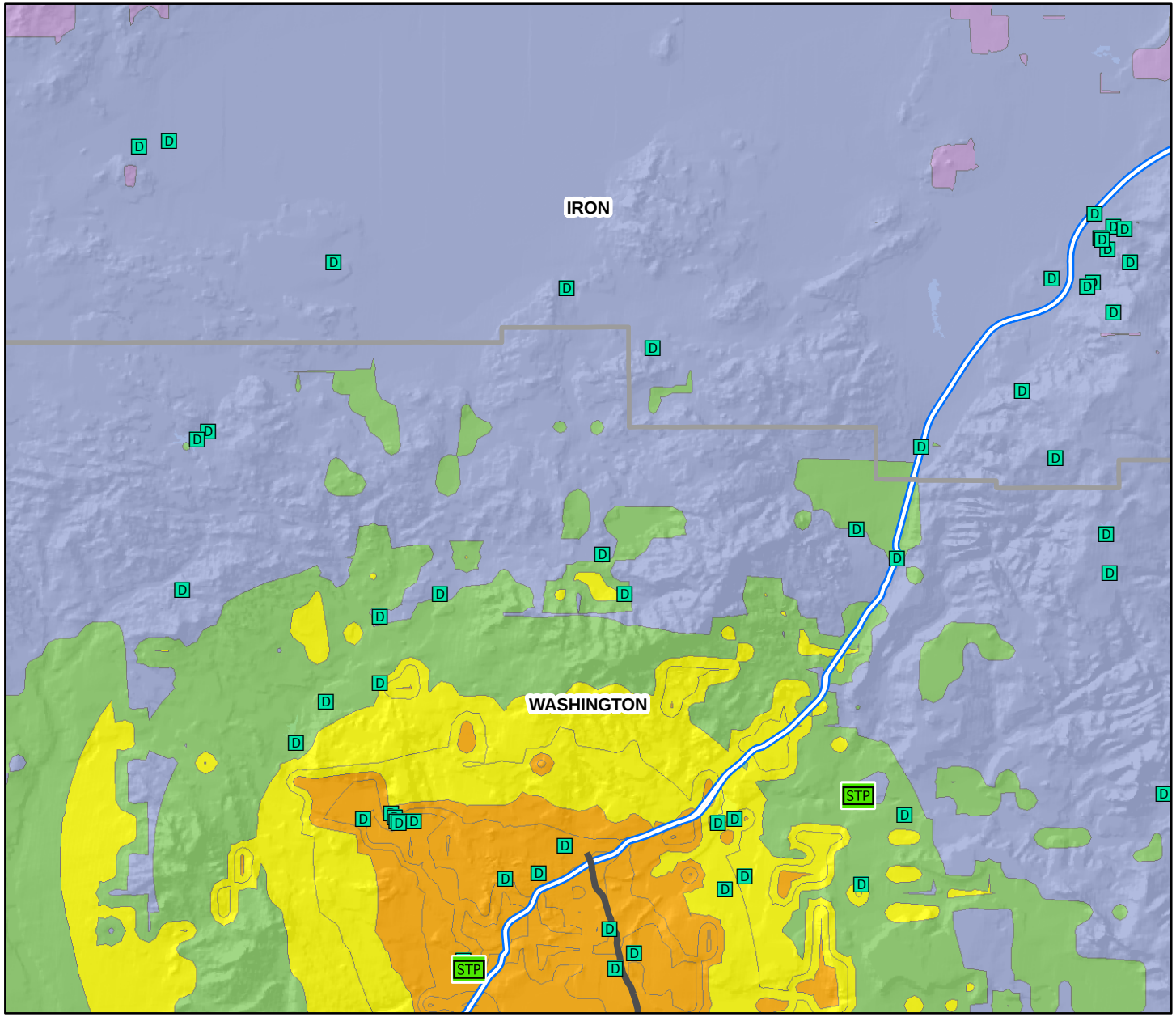
Miles

03-19-10 FEMA & URS Corporation

N



Dams and Sewage Treatment Facility Distribution - Earthquake Scenario: Washington, UT



M 6.5 Washington Earthquake

PGA (g's)

- > 0.02
- 0.02 - 0.04
- 0.04 - 0.09
- 0.09 - 0.18
- 0.18 - 0.34

STP Sewage Treatment Facilities

D Dams

Counties

Potential fault source

N

0 3 6 9 12 15 18 Miles

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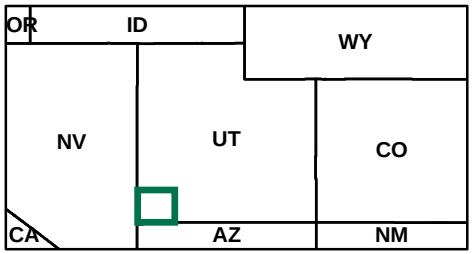
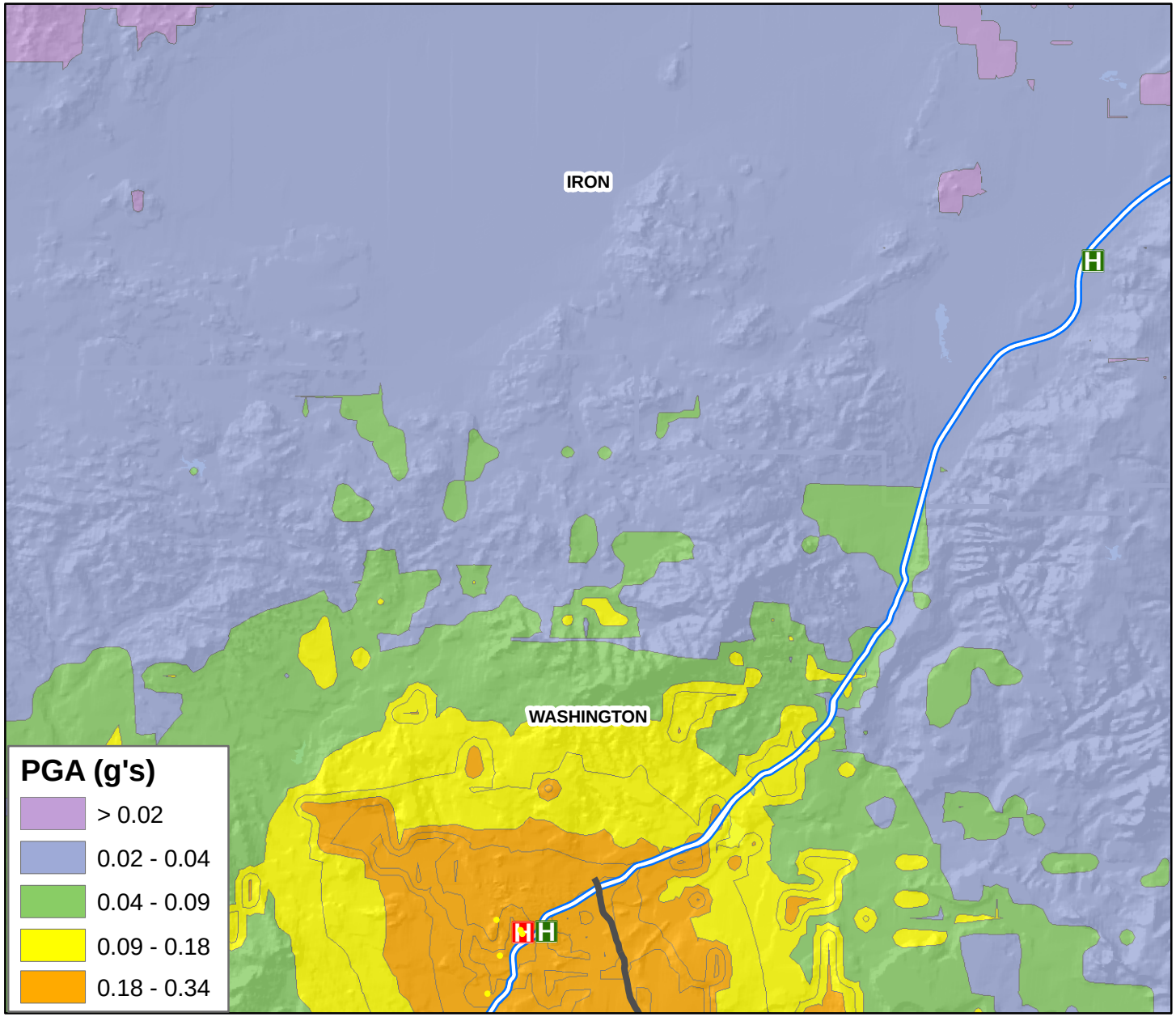


Potential Search and Rescue Needs - Earthquake Scenario: Washington, UT



M 6.5 Washington Earthquake

Impaired Hospitals (Day1)

- high
- moderate
- low

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

1 Dot = 1 Life Threatening Injury (Severtiy 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	6,683	0%	0
Steel	513	8%	41
Concrete	439	3%	13
Precast	385	3%	12
Reinforced Masonry	684	30%	205
Unreinforced Masonry	482	8%	39
Manufactured Housing	1,157	27%	312
Total	10,343		622

Counties

Potential fault source

N

0 2.5 5 7.5 10 12.5 15 Miles

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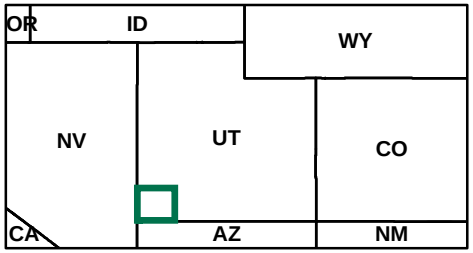
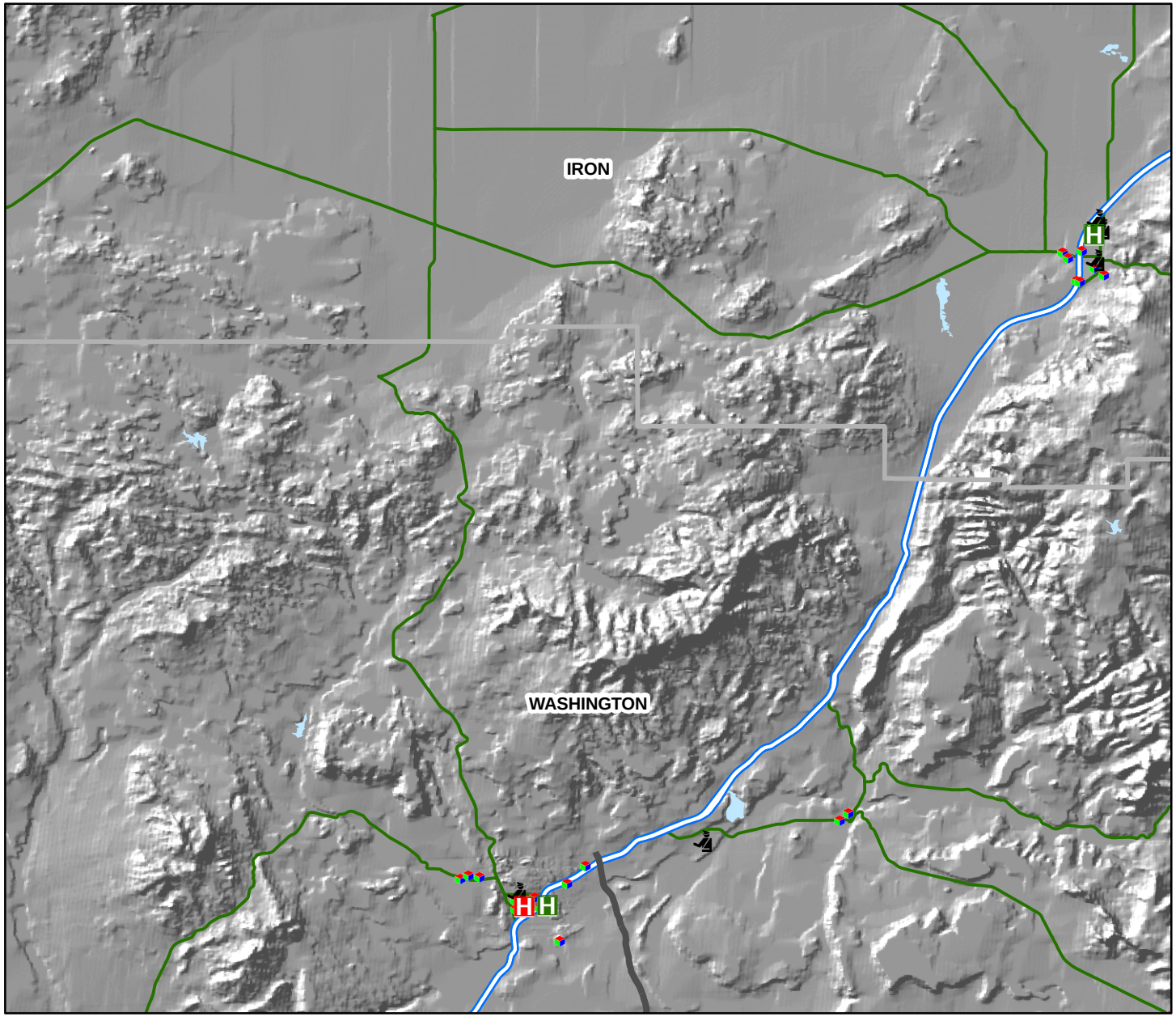


Correctional and Daycare Facilities, Impaired Hospitals, and Highway Impacts - Earthquake Scenario: Washington, UT



M 6.5 Washington Earthquake

Highway Impacts

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

Highway
- high
- moderate
- low

Impaired Hospitals at Day 1

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

- high
- moderate
- low

- Correctional Facilities
- Daycare Facilities
- Counties
- Potential fault source

0 2.5 5 7.5 10 12.5 15

Miles

N

03-19-10 FEMA & URS Corporation