

# Scenario for a Magnitude 7.0 Earthquake on the Wasatch Fault–Salt Lake City Segment

## Hazards and Loss Estimates



Developed by the  
Earthquake Engineering Research Institute,  
Utah Chapter

Prepared for the  
Utah Seismic Safety Commission



June 4, 2015



Presentation for  
2016 UCEA Conference

By

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Chair - USSC

(Utah Seismic Safety Commission)

January 13, 2016

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Past EERI Chapter President

# Utah Seismic Safety Commission

a volunteer, multidisciplinary state commission focused on reducing Utah's earthquake risk





# Utah Seismic Safety Commission

http://ussc.utah.gov

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Salt Lake County Recorder

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GPS Tracking

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KSL

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MSN

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The Commission advises the Legislature, Governor, state and local government agencies, and the private sector on earthquake safety issues. The USSC acts as a source of information for individuals and groups concerned with earthquake safety, promotes earthquake-loss-reduction measures and legislation, and implements education and awareness campaigns in order to save lives, prevent injuries, protect property, and reduce social and economic disruption from the effects of severe seismic activity in Utah.



Where To Find Earthquake Information



Putting Down Roots Handbook

Information on earthquakes in Utah and how to prepare.



Salt Lake City M7 Earthquake Scenario



Publications

USSC meeting materials and seismic-hazard related reports, photographs, and other data.



Utah Earthquake Program

Professional partnership to reduce risk in Utah.



Meeting Agendas

(1994-present)

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11:21 AM

# Earthquake Engineering Research Institute (EERI) Utah Chapter

<http://utah.eeri.org>

Wednesday, September 16, 2015 NEWS FEED

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**Wasatch Fault Scenario Report**  
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**Video – Utah: Preparedness Now**  
What can happen if a 7.0 magnitude earthquake strikes the Wasatch Fault? This video,...

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**CALENDAR OF EVENTS**

Oct 15, 2015  
Combined SEAU/EERI Meeting Nepal Earthquake Reconnaissance

**TWITTER**

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# Message of the Earthquake Scenario Report Prepare!

- ▶ Prepare to WITHSTAND
- ▶ Prepare to RESPOND
- ▶ Prepare to RECOVER

# Audience for Report

- ▶ Utah Seismic Safety Commission
- ▶ Utah Governor and Legislature
- ▶ Local Governments
- ▶ Private Businesses
- ▶ Non-profit Organizations
- ▶ Families and YOU!

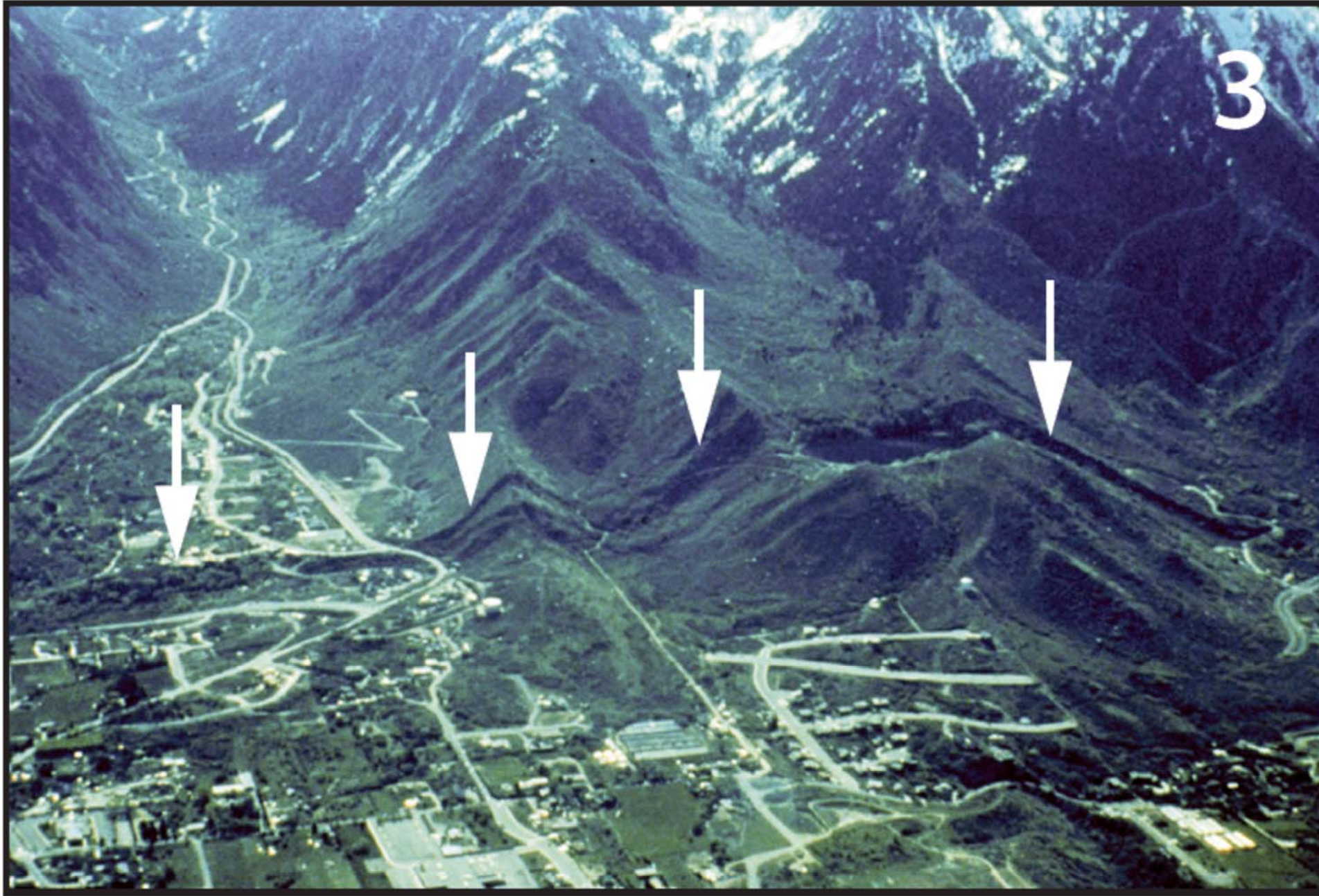




Photo Credit: Rod Millar

# Highland Drive





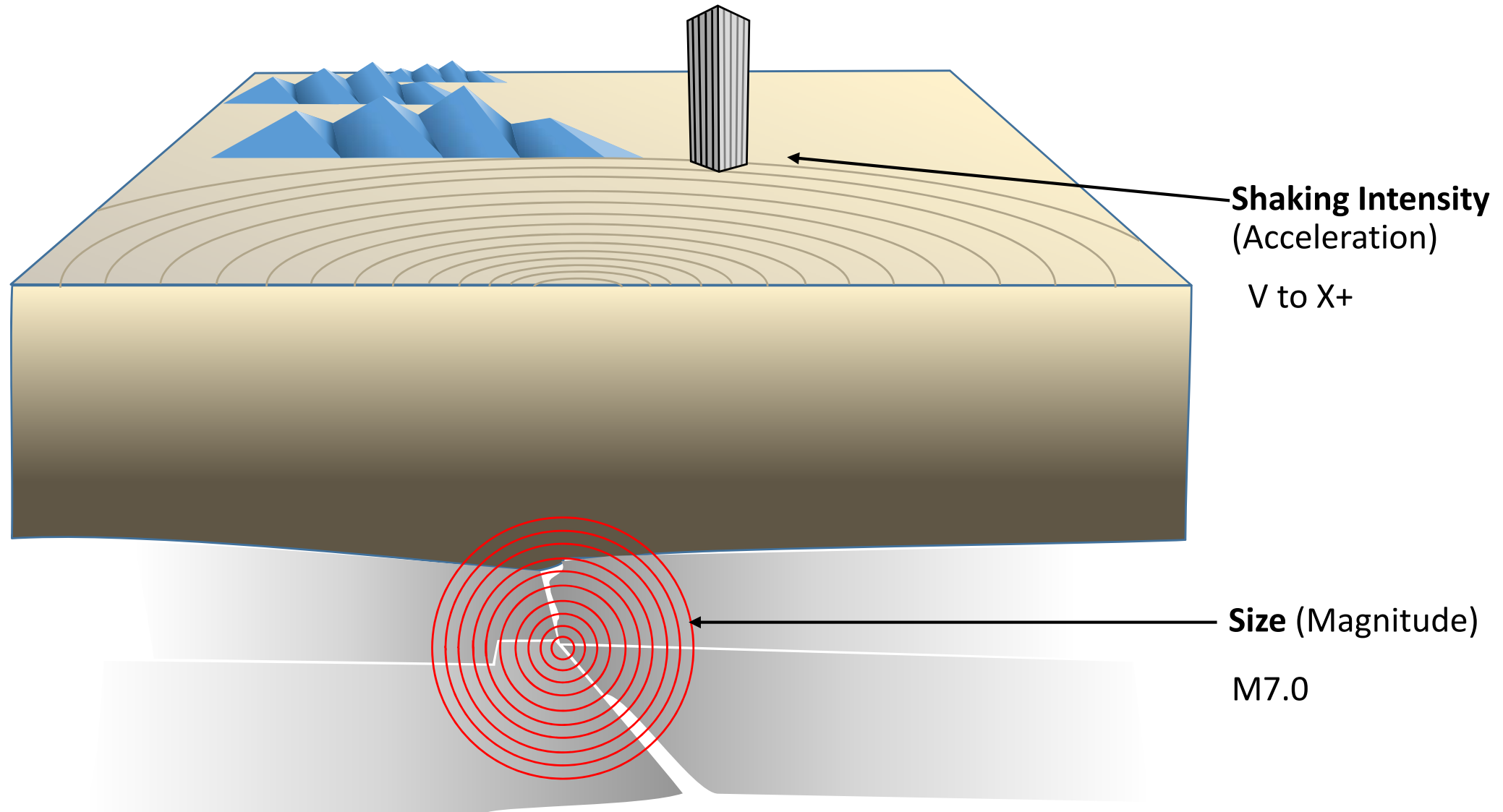
# Little Cottonwood Canyon

Photo Credit: Utah Geological Survey



# Magnitude 7.0 vs Shaking Intensity

The background of the slide features abstract, overlapping green geometric shapes on the right side, transitioning from light to dark green. The rest of the slide is a solid light gray.





# What is the Scenario?

- ▶ Possible outcome
- ▶ Based on expected average

# What the Scenario is NOT?

- ▶ Prediction
- ▶ Not the worst case



80% of Utah Population

75% of Utah Economy

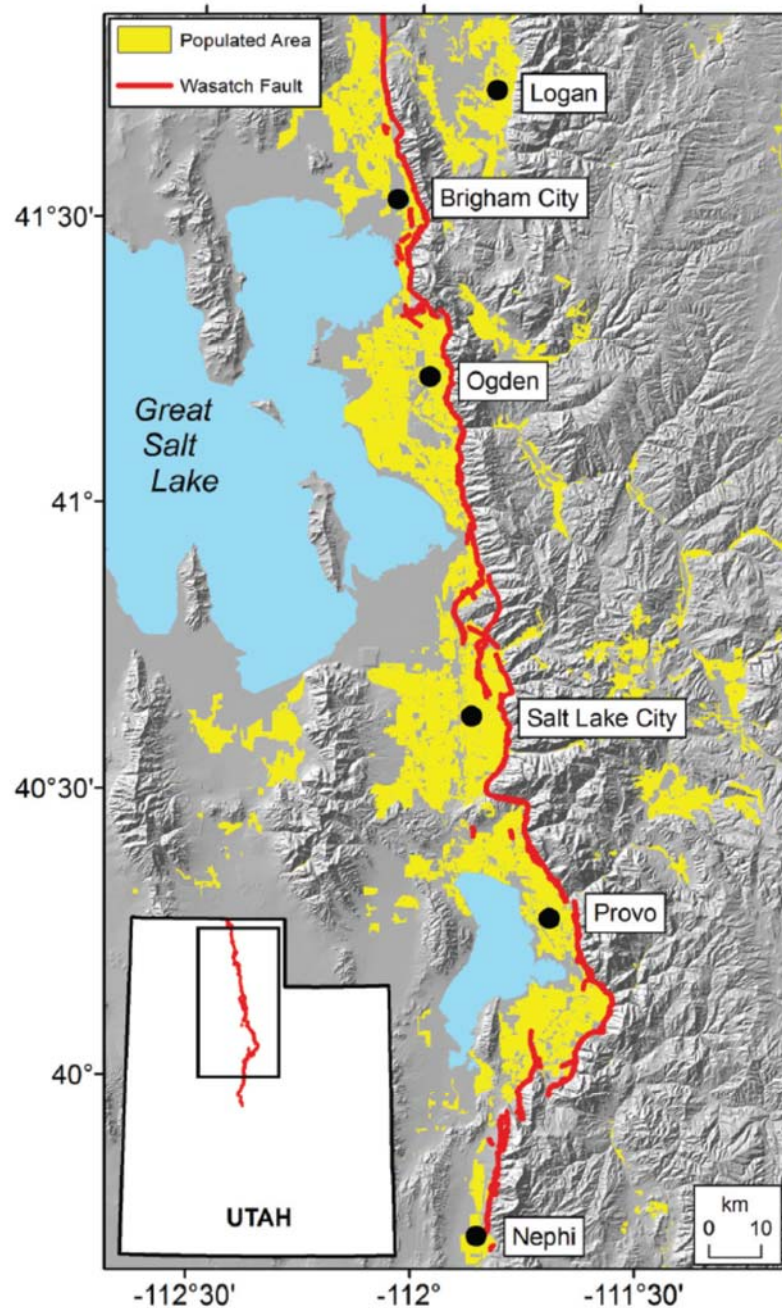
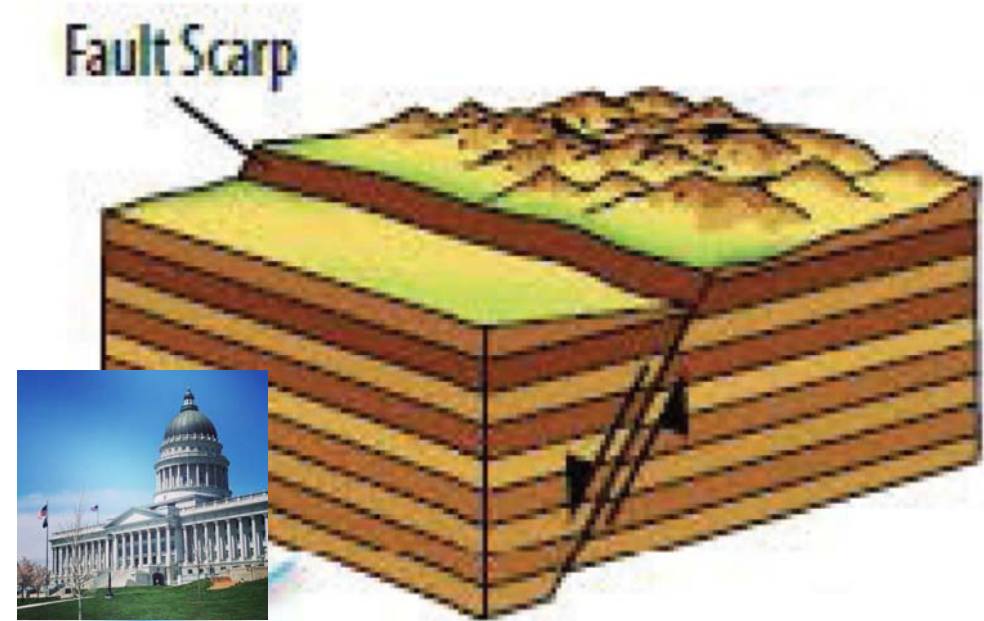


Figure 1. Map of Utah's Wasatch Front urban corridor showing populated areas (in yellow) along the Wasatch fault (in red). Population data from 2010 (figure courtesy of the University of Utah Seismograph Stations).



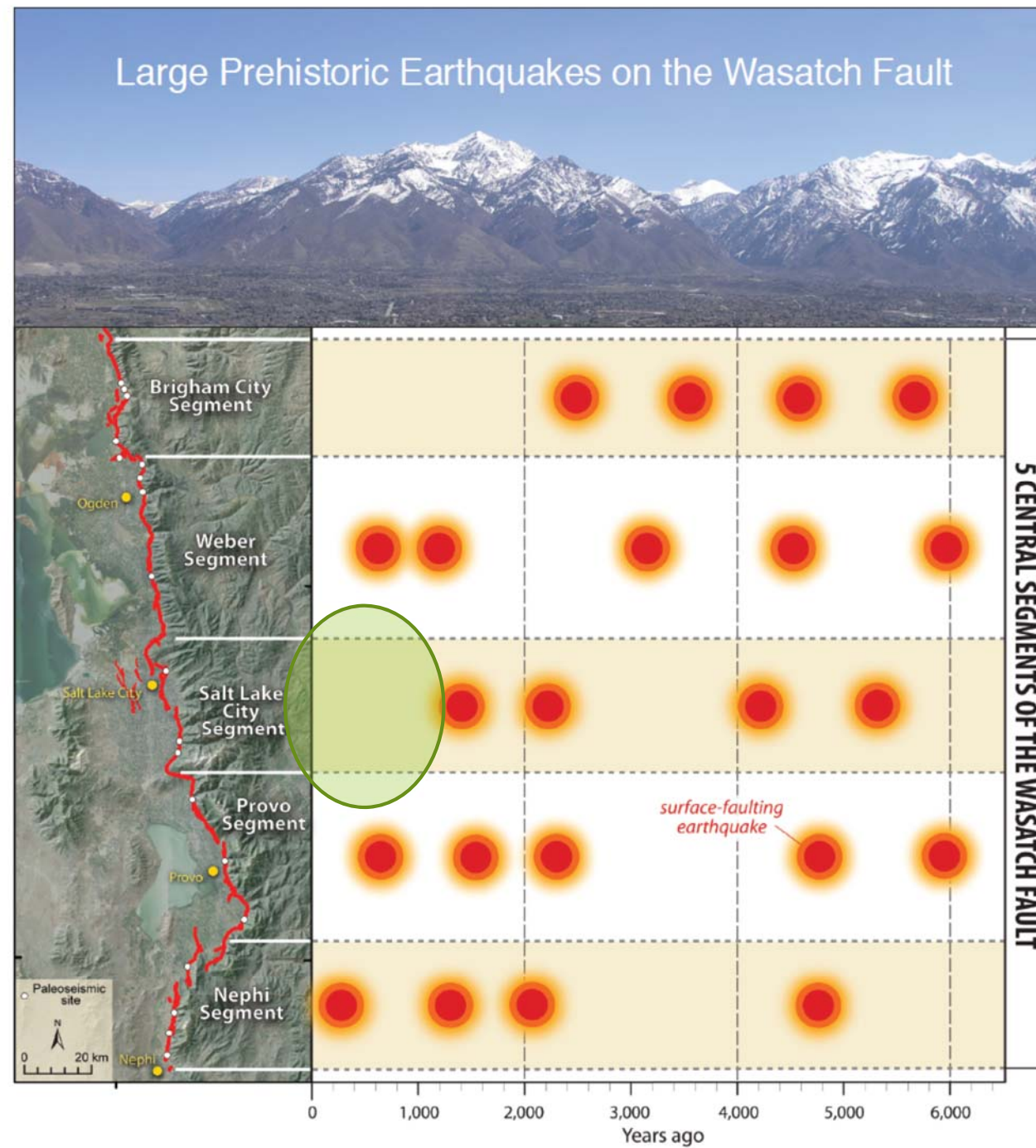
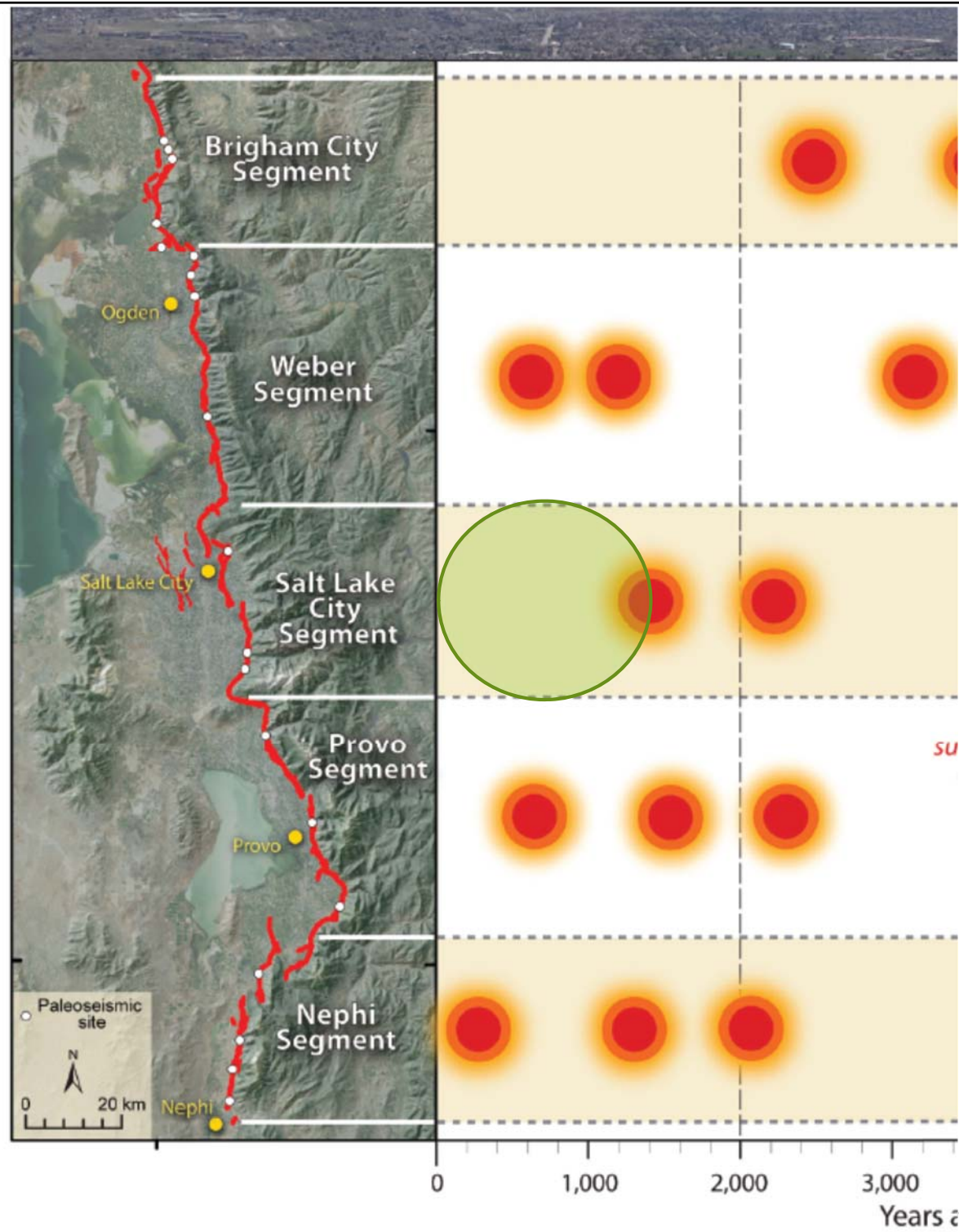


Figure 4. Schematic plot showing the timing of large prehistoric earthquakes on the Wasatch fault (elements of the figure provided by the Utah Geological Survey).





*su*

# Prepared to WITHSTAND

- ▶ Strengthen Weak Buildings

  - Unreinforced Masonry (URM)
  - Non-ductile Concrete (NDC)

- ▶ Retrofit government URM and NDC buildings!

- ▶ Private Sector

  - ▶ Mandatory retrofit?
  - ▶ Incentive funds?
  - ▶ Public outreach and information
  - ▶ Make building owner economics work
    - ▶ Safe = ↑ Rent
    - ▶ Unsafe = ↓ Rent



*Collapse of URM building - 2011 Mw 6.1 Christchurch, New Zealand earthquake. Photo: EERI/Justin Marshall.*

**90,000 damaged  
structures**

**Majority of Deaths  
come from structural  
failures**

# Christchurch New Zealand Earthquake



# Prepared to WITHSTAND

- ▶ The building code saves lives
- ▶ It does not prevent economic damage and economic loss
- ▶ Encourage business owners to consider economic loss when constructing new buildings by building beyond the building code.
  - ▶ Loss goes beyond the cost to fix or rebuild
  - ▶ Lost business income
  - ▶ Income loss to employees who can't work
  - ▶ Loss to community due to lost sales tax
  - ▶ How long can a business be closed before they go out-of-business?

# Prepared to RESPOND

- ▶ YOU!
- ▶ Your Family
- ▶ Your Community
- ▶ Your City or Town
- ▶ Your County
- ▶ State

# Prepared to RESPOND

- 2,400
- Inspectors

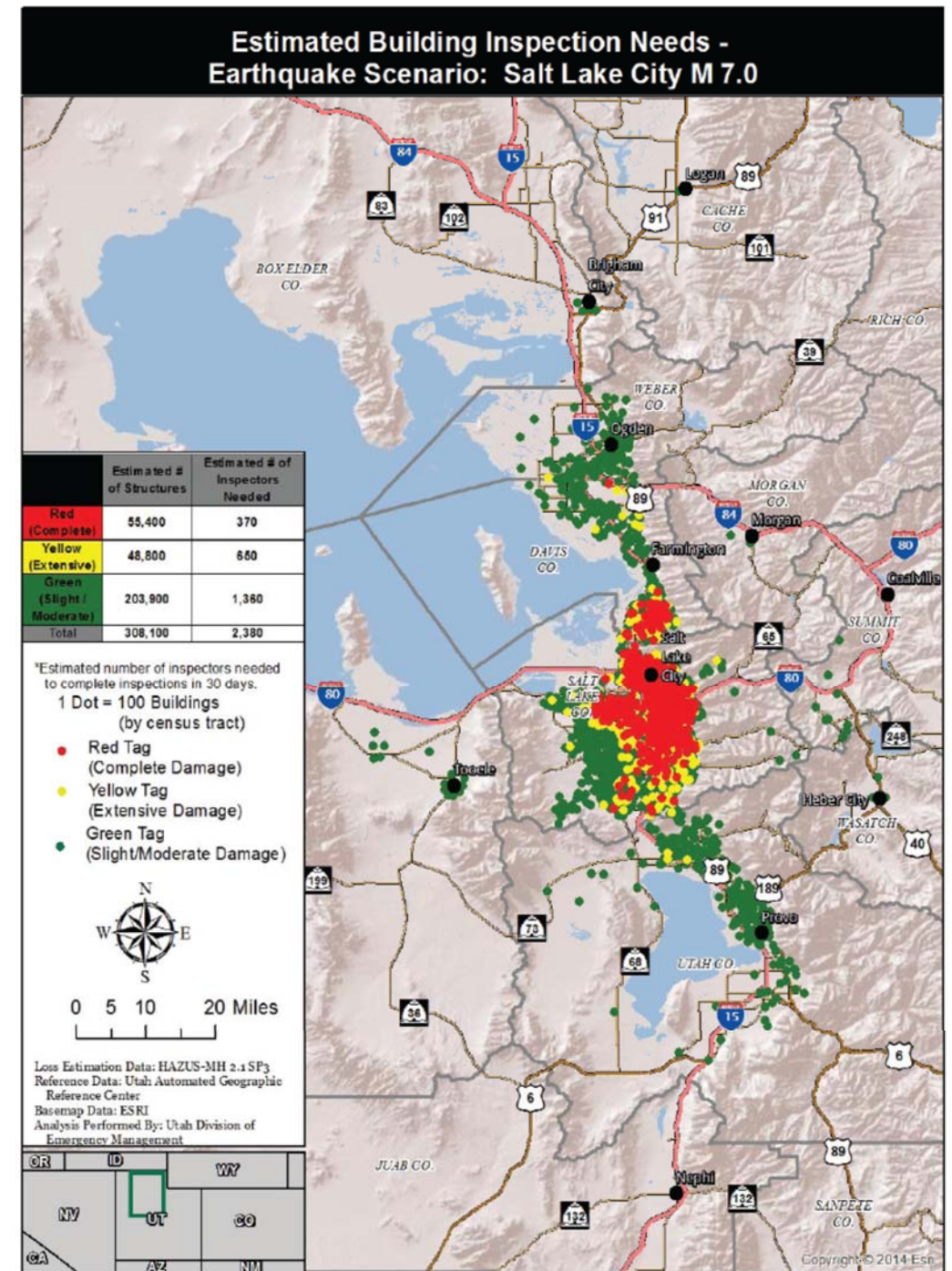


Figure 27. This map highlights where Hazus estimates the building damage will occur. Each dot represents 100 buildings per census tract. When the damaged building count falls below this level, there will be no indication of any damage on the map. However, there may be many areas that need safety inspections that do not appear on the map.



# Prepared to RESPOND

- ▶ Encourage the adoption of BORP
- ▶ Building Occupancy Resumption Program
- ▶ (Salt Lake City & Murray City have adopted it)
- ▶ Allows business to preauthorize post earthquake inspection

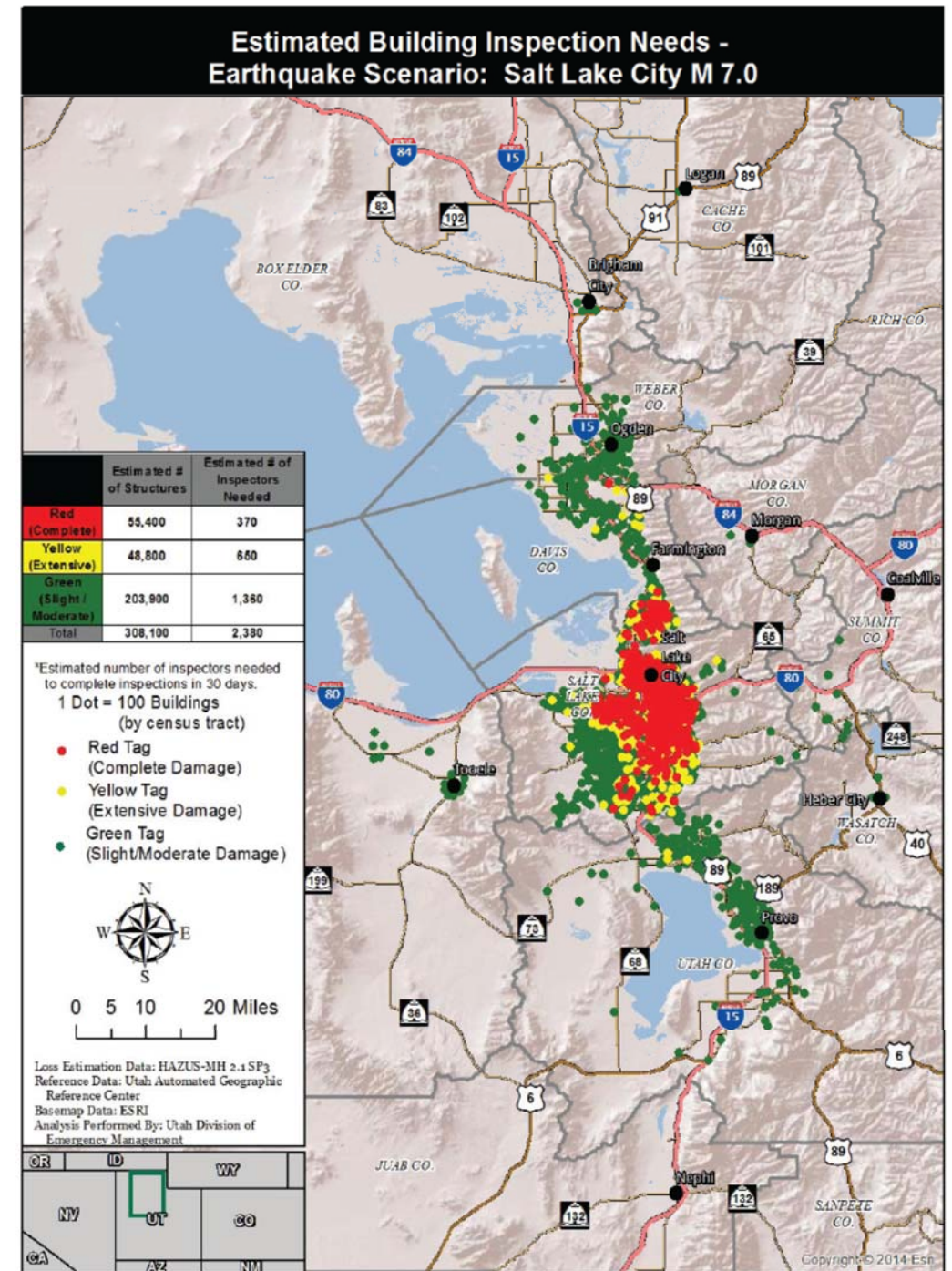


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# Prepared to RESPOND

- ▶ 53,000
- ▶ Public Shelter Needs

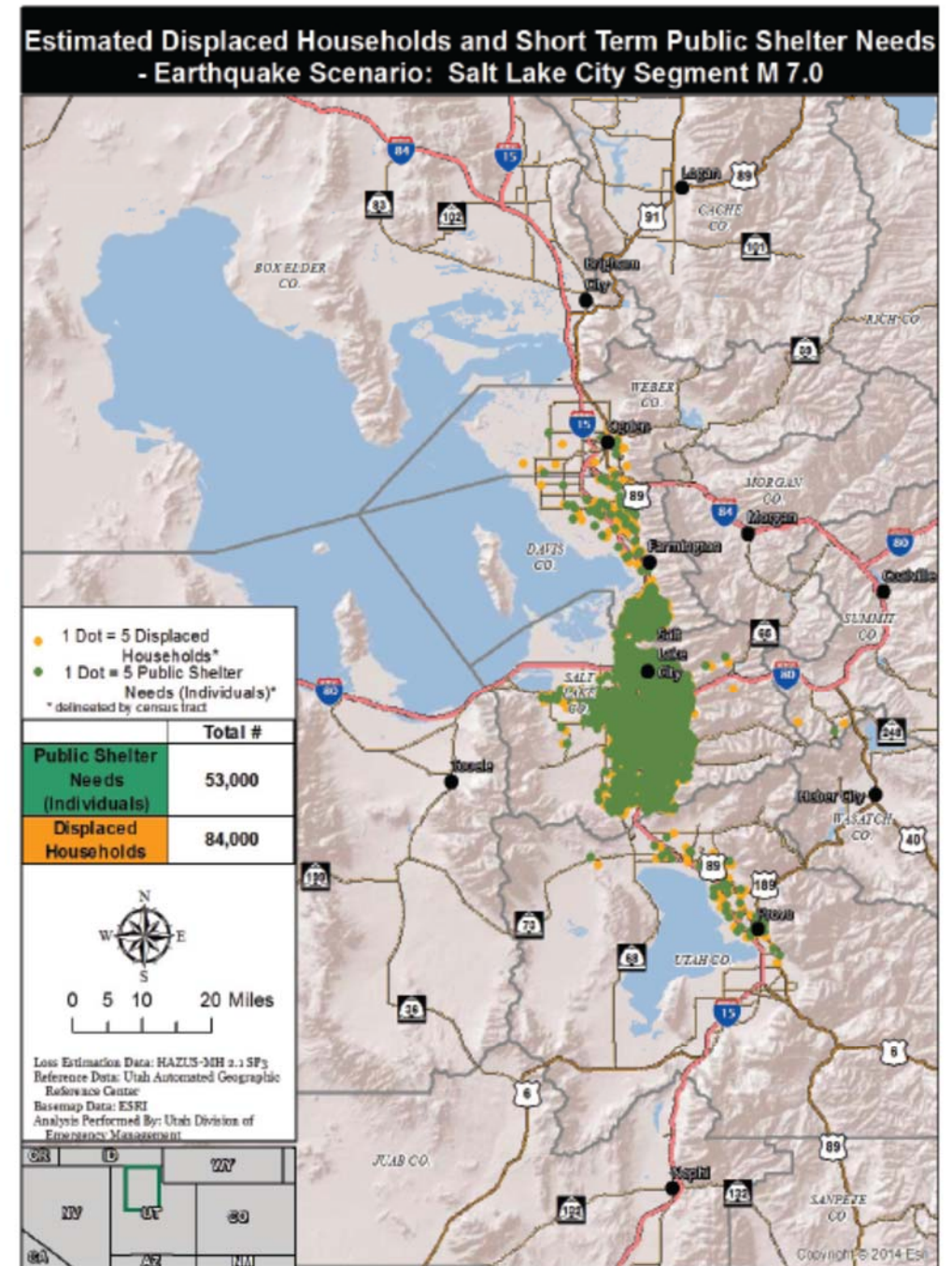


Figure 28. This map highlights where Hazus estimates displaced households and individuals seeking shelters will occur. The orange dots represent the number of displaced households and the green dots represent individuals seeking shelter (five each, respectively) per census tract. But if the count falls below this level, the map will indicate no displacement or shelter needs, even though there may be many areas of displaced households or individuals seeking shelters.



# Prepared to RESPOND

- High probability of moderate HOSPITAL damage

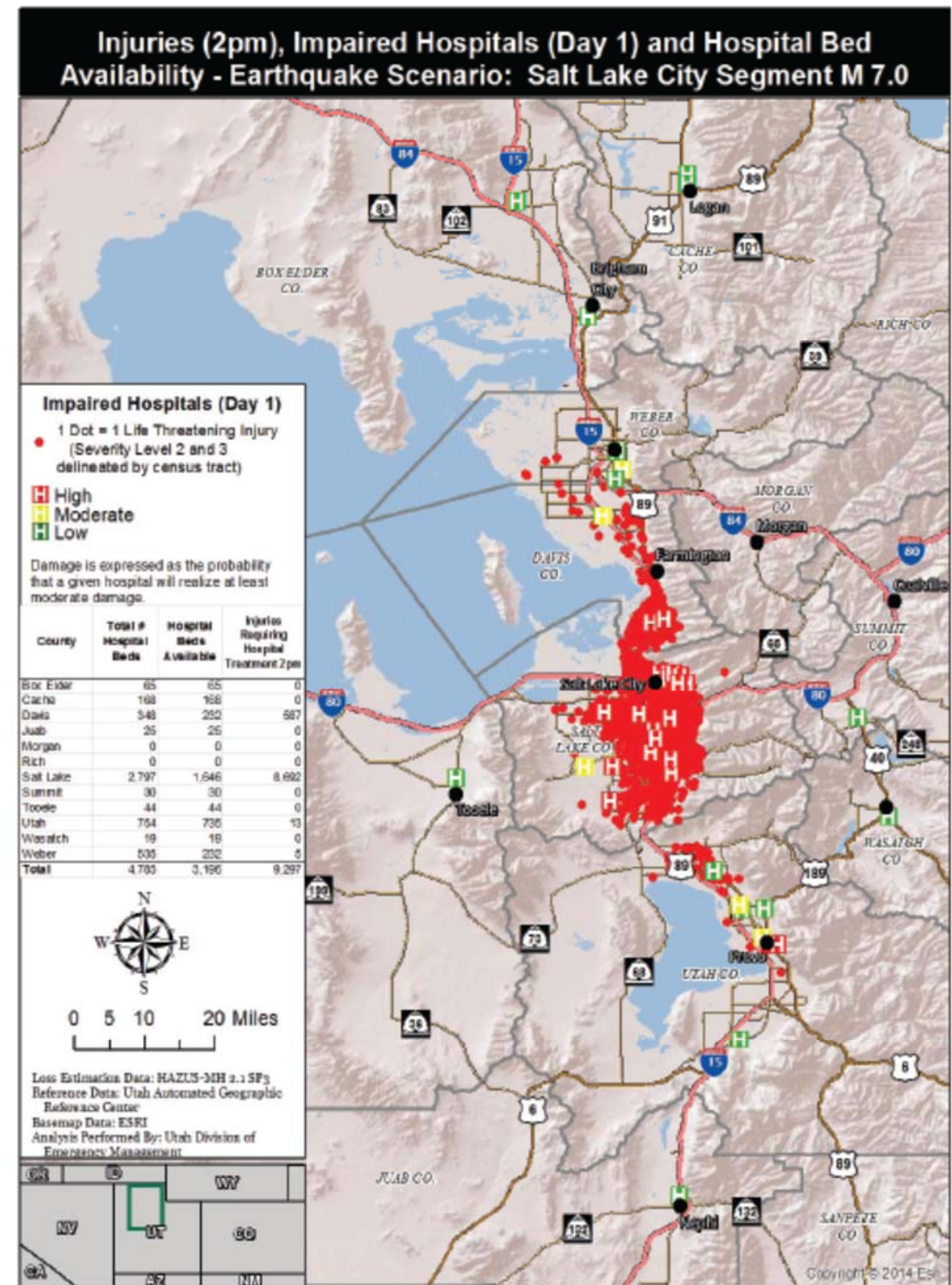


Figure 30. This map illustrates the relationship of injuries to damaged hospitals. Planners using the highway bridge and road segment map and the impaired hospital and injury map can develop strategies on how best to move patients to area hospitals or out-of-area hospitals.



# Prepared to RESPOND

## Lifelines

### Utility System Performance

|                                  | Day 1   | Day 3   | Day 7   | Day 30  | Day 90  |
|----------------------------------|---------|---------|---------|---------|---------|
| Households without Potable Water | 483,600 | 466,100 | 442,800 | 362,900 | 332,800 |
| Households without Electricity   | 444,600 | 251,200 | 105,900 | 27,300  | 800     |

### Transportation

|                               |                  |
|-------------------------------|------------------|
| Impaired <sup>‡</sup> Roads   | *                |
| Impaired <sup>§</sup> Bridges | 595 out of 1,805 |

<sup>‡</sup> At least "moderate" damage—or several inches of settlement or offset of the ground.

<sup>§</sup> At least "moderate" damage—or column cracking or chipping, movement of the abutment, settlement of the approach, etc., but where the columns are structurally sound.

### Debris Generated

|                            |            |
|----------------------------|------------|
| Tons                       | 21,000,000 |
| Truckloads (25 tons/truck) | 821,600    |

\* Insufficient data for Hazus calculation

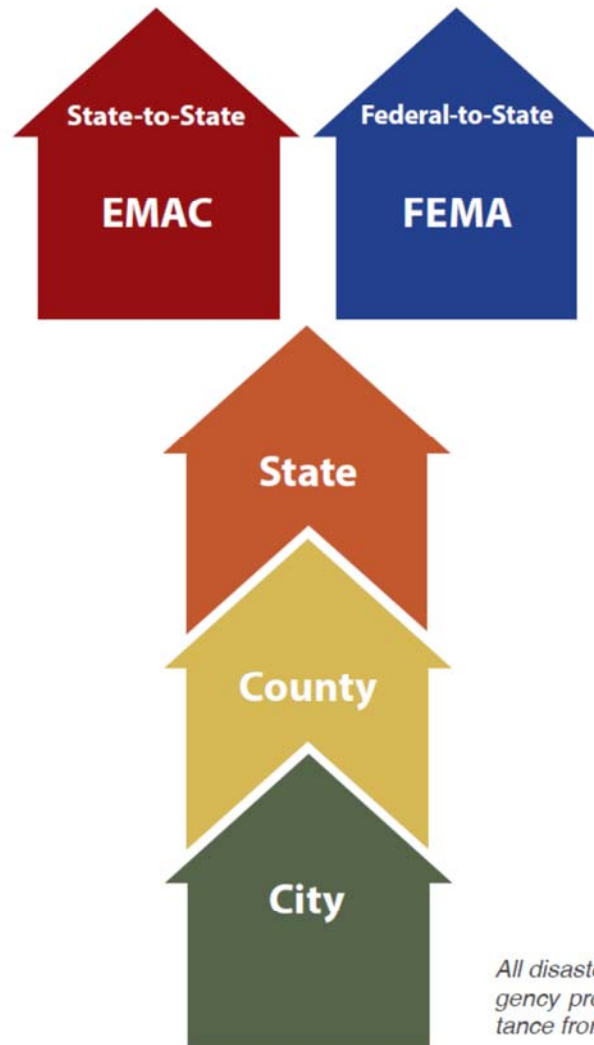
# Prepared to RESPOND

## **Prepared to RESPOND**

- Understand the Scope of Needed Response
- Prepare to be Without Utilities
- Exercise for Response
- Prepare for Building Inspection
- Adopt Policies to Get Businesses, Schools and Essential Services Back Into Their Buildings

# Prepared to RESPOND

## Mutual Aid Agreements



### Additional Response and Recovery Resources:

- **National Disaster Recovery Framework** designed to meet the needs of states and communities in their recoveries
- **Public Assistance Grant Program** provides assistance to State, Tribal and local governments
- **Individual and Household Program** provides assistance for individuals with limited resources
- **Community Emergency Response Teams** provide neighborhood teams for local response
- **Disaster Recovery Center** provides recovery services for individuals

*All disasters start at the local level. Through the declaration of emergency process, lower level jurisdictions can request disaster assistance from the next higher level of government.*



# Prepared to RECOVER

- ▶ Recovery will take years and even a decade for some things
- ▶ Recovery will exceed -  
**\$33 Billion dollars**

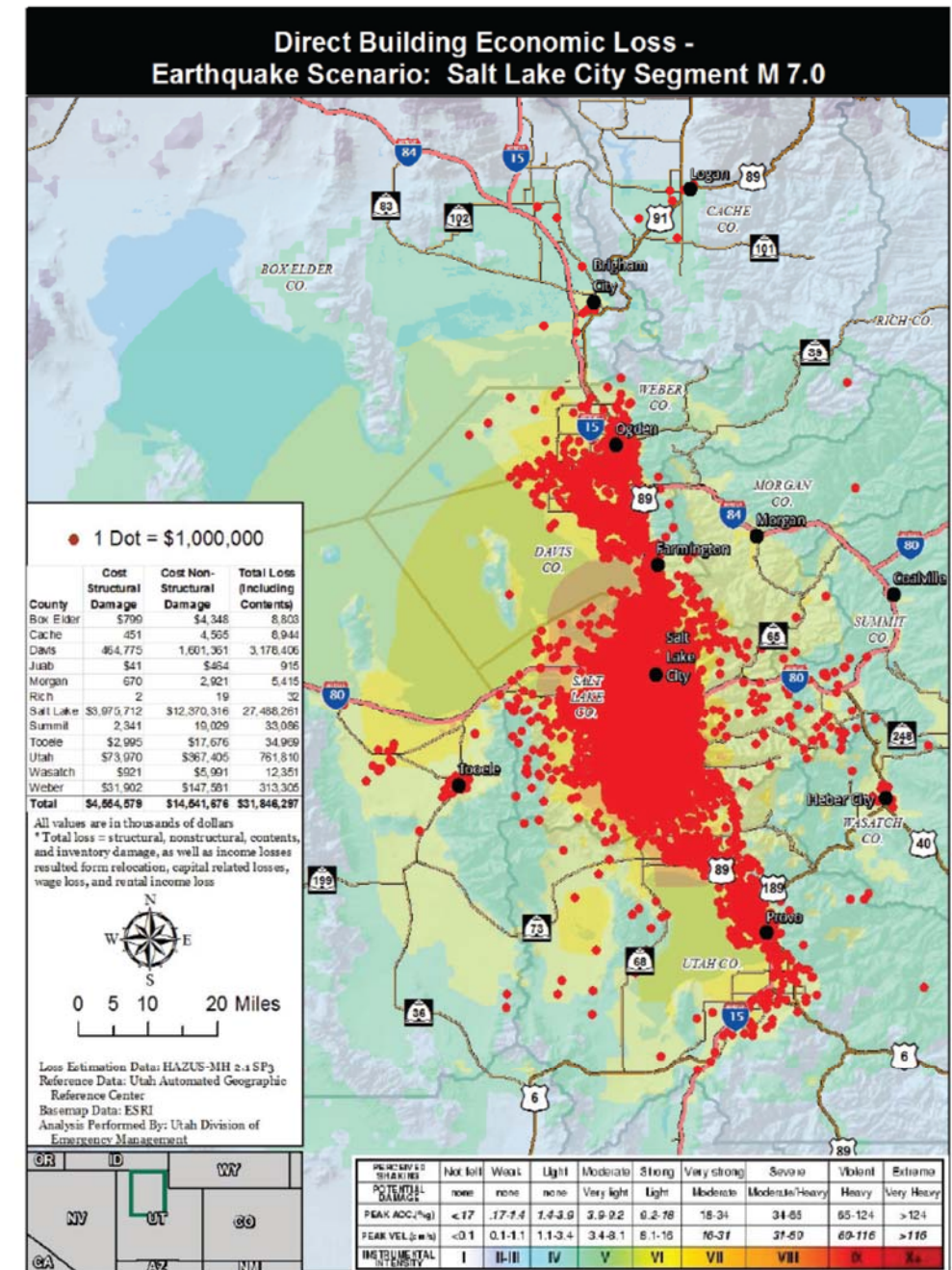


Figure 33. This map provides monetary estimates of losses for building damage across all categories of buildings. Each dot represents an estimated \$1 million in building damage per census tract. When the dollar value falls below this level, there will be no indication of any dollar losses on the map. However, there may be many more areas that have losses that do not appear on the map. For these areas, refer to the table on the map.

# Prepared to RECOVER

- ▶ Ounce of Preparation = Pound of Response & Recovery



# Prepared to RECOVER

- ▶ Damage Resistant Buildings = Less \$ spent in recovery & Helps keep Businesses in Business
- ▶ Educate public on the benefits of more robust building design



# Prepared to RECOVER

- ▶ Develop Business (or government, or school) Continuity Plans

<http://www.utah.gov/beready/business/>

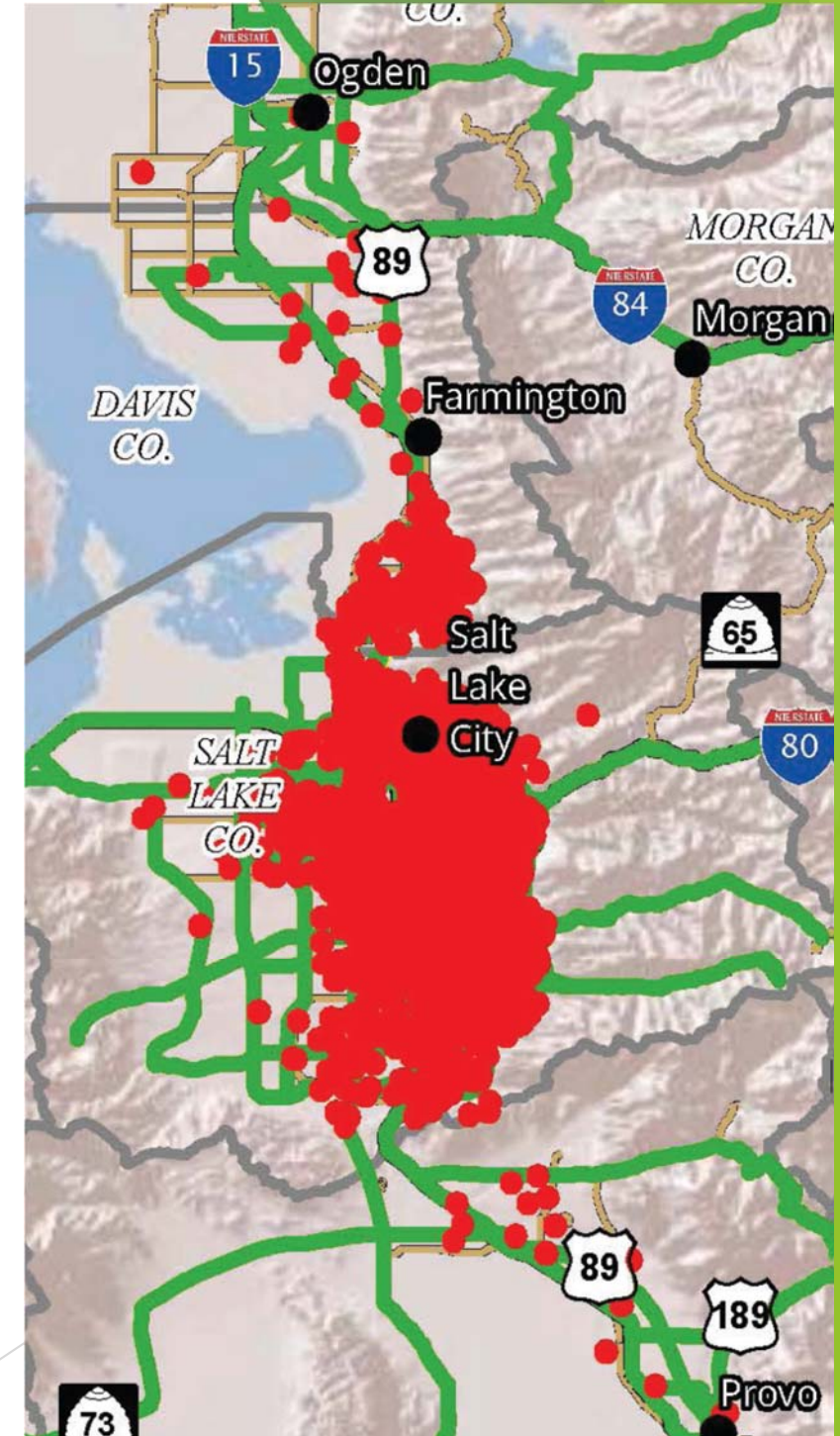
# Prepared to RECOVER

- ▶ Establish laws, rules, and Ordinances that address issues related to recovery.

# Prepared to RECOVER

► Where will we put the debris?

Each dot represents 5,000 tons (10 million pounds) of debris





# Prepared to RECOVER

## ► How will essential utilities and services be restored?

- Roadways
- Power
- Water
- Natural gas
- Sewage
- Communications

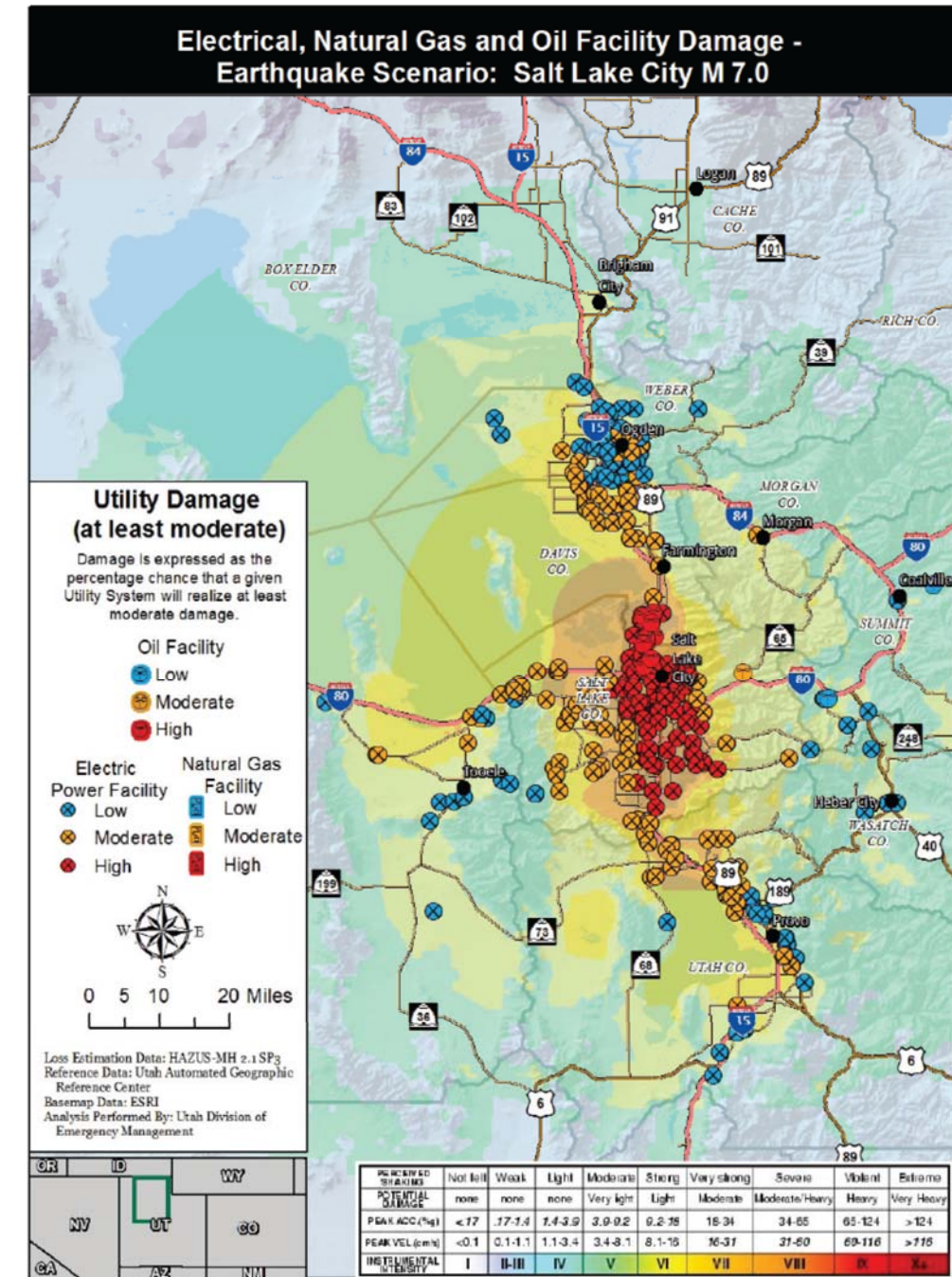


Figure 34. This map represents the probability of at least moderate damage to the electric, natural gas, and oil facilities. The map does not show damage to the different distribution systems.

# MAJOR CONCERNS INCLUDE:

- ▶ How will the estimated economic losses of more than \$33 billion be dealt with?
- ▶ How will the state of Utah cope with added long-term losses to its economic and social health?
- ▶ What will be done to keep large employers who have operations elsewhere from leaving?
- ▶ How are residents going to be able to take care of themselves if their businesses, or the companies they work for are no longer viable?

This report does not seek to answer such questions, but raises them to motivate pre-disaster planning at all levels of government.



# Recommendations to the Utah Seismic Safety Commission

## 1

### INFORM THE GOVERNOR'S OFFICE AND THE UTAH STATE LEGISLATURE

Inform the Governor's Office and the Utah State Legislature of the expected physical, economic, and social impacts of a major Wasatch fault earthquake in the Salt Lake Valley. Emphasize what will cripple the state's recovery and what will prevent a catastrophe. State leaders should be encouraged to form a high-level public/private task force to address, as a priority, the resiliency and post-earthquake recovery of critical infrastructure and vital elements of Utah's economy.

## 2

### INFORM STAKEHOLDERS

Inform public and private stakeholders in local jurisdictions, businesses, school districts, higher education, and neighborhoods of the grim reality following an earthquake. This could occur through press releases, public outreach, and town hall meetings. Provide these stakeholders with short-term and long-term actions they can take to make their response and recovery more efficient. We advise a proactive approach with the news media, helping them write compelling stories about this potential post-earthquake scenario along the Wasatch Front. The after-effects of this scenario earthquake must not be a surprise to anyone.

## 3



not be a surprise to anyone.

### 3

#### **ASSESS THE OPERABILITY OF CRITICAL FACILITIES**

Identify critical facilities including schools, police stations, fire stations, and acute care hospital buildings that have risk of inoperability after an earthquake. Establish a long-range plan to improve their post-earthquake operability.

### 4

#### **PROMOTE POST-EARTHQUAKE RECOVERY PLANNING BY UTILITY PROVIDERS**

Encourage every utility (public, private, and municipal) to create action plans that address the issues raised in this scenario report so that they can maintain services or restore them as soon as possible following an earthquake.

### 5

#### **ADVOCATE SEISMIC RETROFITTING OF VULNERABLE BUILDINGS**

Advocate the development of local and state legislation, as well as the necessary funding, requiring mandatory seismic retrofits of buildings that pose a life-safety risk, such as unreinforced masonry

# Recommendations to the Utah Seismic Safety Commission

and non-ductile concrete structures that are for public use. Encourage local jurisdictions to create incentives for private building owners to increase resilience of their communities through seismic improvements to vulnerable structures.

## 6

### **ENCOURAGE ADOPTION OF POLICIES FOR BUILDING OCCUPANCY RESUMPTION**

Encourage the adoption of the Building Occupancy Resumption Program (BORP) in all jurisdictions along the Wasatch Front and by the Utah Division of Facilities and Construction Management for state-owned buildings. This program (already adopted by Salt Lake City and Murray City) allows businesses and other building owners to pre-certify inspectors for emergency, post-earthquake evaluation of their facilities—which will enable them to quickly assess their buildings, begin recovery, and resume operations significantly faster.

## 7

### **PROMOTE IMPROVEMENT AND APPLICATION OF GEOLOGIC HAZARDS INFORMATION**

Advocate continued state and federal support to improve information and maps on earthquakes and related geologic hazards. Promote these tools to the state, counties, and cities for land-use planning, development decisions, scenario planning, emergency response, and recovery planning.



## 8

### **ADVOCATE CONTINUED SUPPORT FOR CRITICAL SEISMIC MONITORING IN UTAH**

Advocate continued state and federal support for operating and enhancing Utah's regional/urban seismograph network to ensure the availability of critical information for emergency management, emergency response, and future earthquake engineering. In the event of a large earthquake as outlined in this scenario, near-real-time information on the extent and severity of ground shaking will be vital for situational awareness. The ensuing earthquake information products from the network will be needed to guide short-term and long-term recovery efforts.

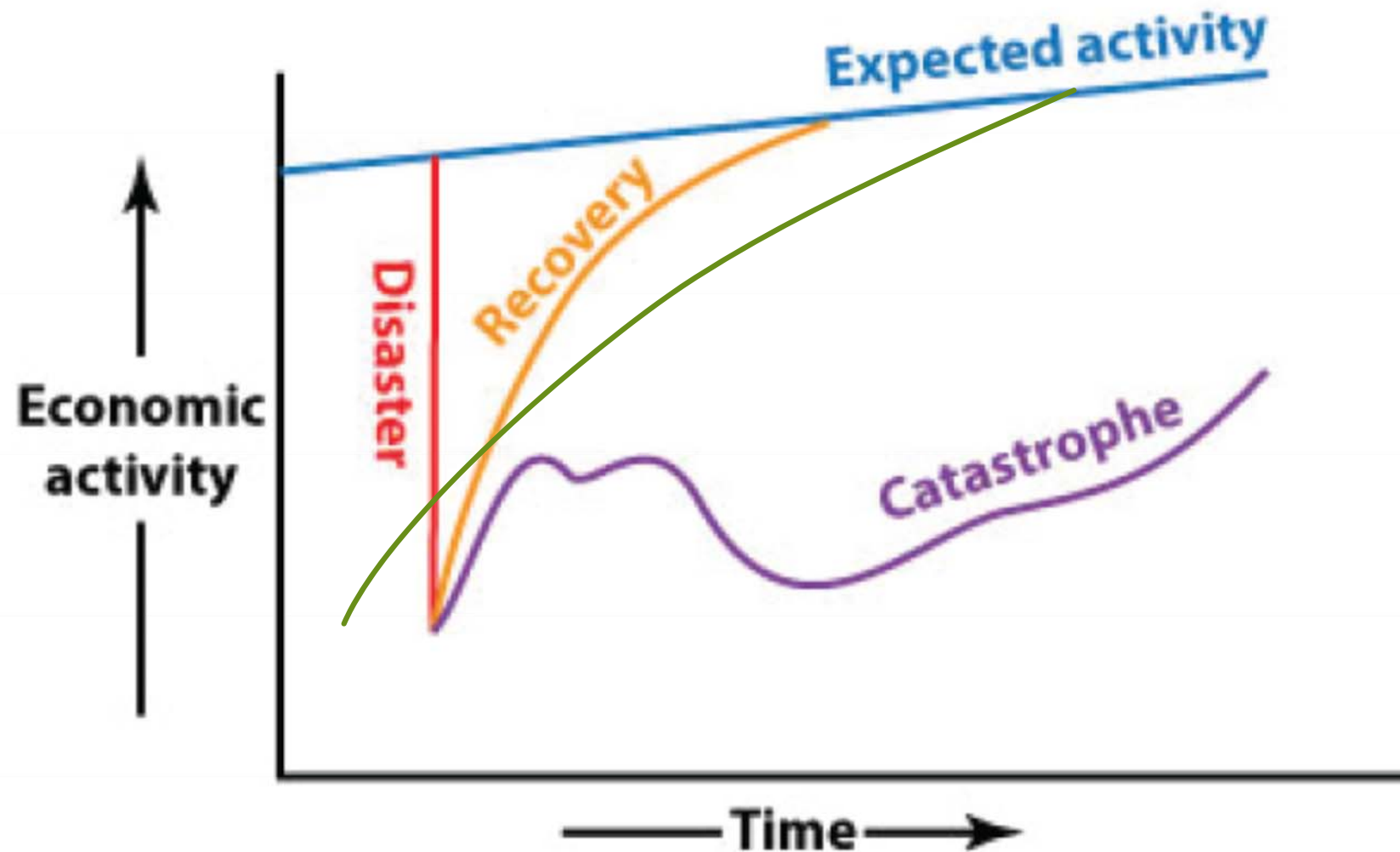
## 9

### **ADVOCATE DISASTER RESILIENCY PLANNING**

Use the work done for this scenario to more fully engage stakeholders in developing disaster resiliency plans. This report is a first step that outlines the enormity of what will likely happen in this scenario earthquake, which can serve as a lesson for the rest of the state. What is needed next are plans that will expedite recovery and prevent catastrophe—whether after a large earthquake or any other large-scale disaster.



Which line will we take to recovery?  
Be PREPARED to prevent catastrophe!



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- ▶ <http://utah.eeri.org>
- ▶ <http://USSC.utah.gov>

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