

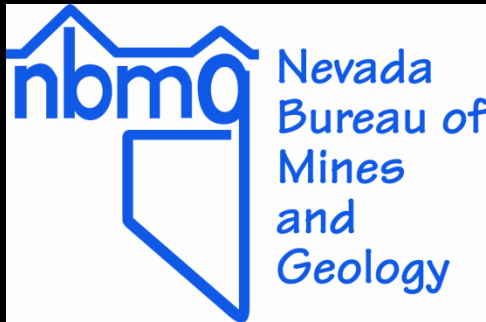
# Earthquake Hazards in Churchill County

Presentation to the Nevada Hazard Mitigation Planning Committee

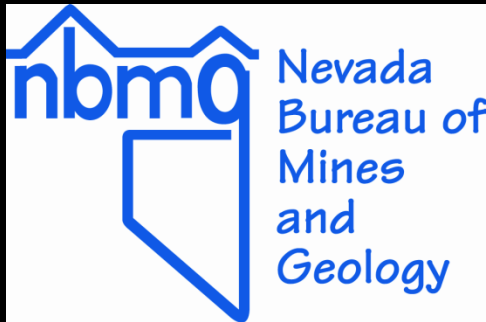
11 February 2010

by Jonathan G. Price

Nevada Bureau of Mines and Geology

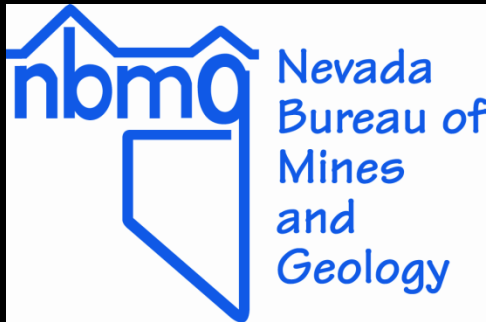


**Earthquake faults occur throughout Nevada,  
and potential losses from earthquakes are high  
for many communities.**



**Earthquake faults occur throughout Nevada,  
and potential losses from earthquakes are high  
for many communities.**

**NBMG Map 167, *Quaternary Faults in Nevada*, is now  
available not only as a poster but also as an interactive  
map (Open-File Report 09-9) on line at  
[www.nbm.unr.edu](http://www.nbm.unr.edu). You can use it to locate your home  
or business.**





## Age of Latest Fault Rupture

< 150 years (historical)

< 15,000 years

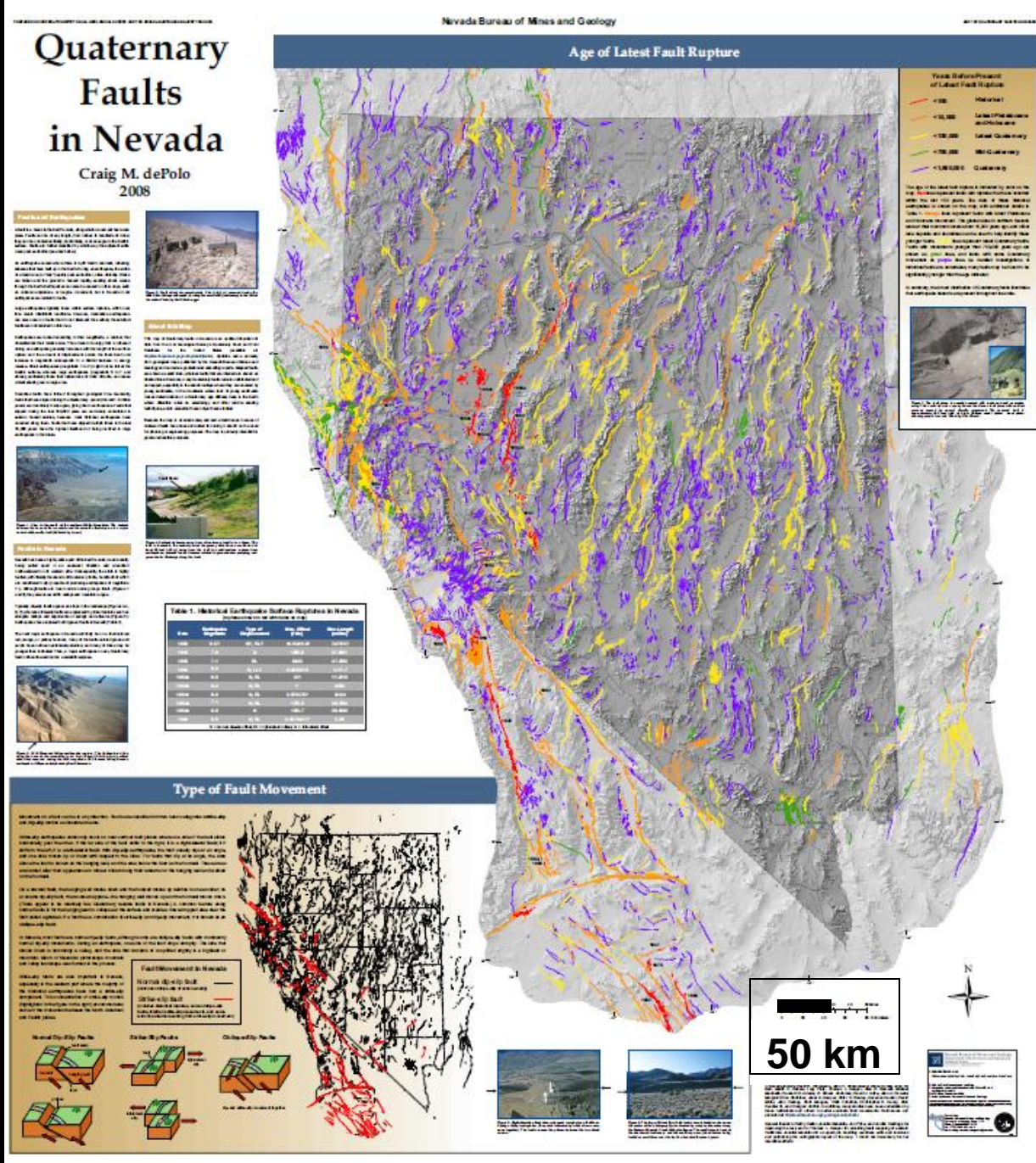
< 130,000 years

< 750,000 years

< 1,800,000 years  
(Quaternary)

There are active faults nearly everywhere in Nevada. A magnitude 6.0 earthquake can occur anywhere in Nevada.

[www.nbmng.unr.edu](http://www.nbmng.unr.edu)





**The map has ~130 major faults (with lengths >19 miles or 30 km), ~300 intermediate faults with lengths of 6-19 miles (10-30 km), and >1,150 smaller faults. Surface breakage typically occurs when an earthquake is greater than or equal to magnitude 6.5.**

# Quaternary Faults in Nevada

Craig M. dePolo  
2008

**Find Us at Your Next Meeting**

It is important to remember that the most common cause of a child's behavior problems is a family problem. The child is often a mirror of the family. If the family is in conflict, the child will be in conflict. If the family is happy and healthy, the child will be happy and healthy. If the family is in conflict, the child will be in conflict. If the family is happy and healthy, the child will be happy and healthy. If the family is in conflict, the child will be in conflict. If the family is happy and healthy, the child will be happy and healthy.

[illegible]

Figure 1. The shipwreck of the USS Arizona (BB-39) lying on the beach at the end of the 19th century. The ship was wrecked in 1899 and is now a national monument.

[illegible]

Figure 2. Aerial view of the coastal area showing the location of the study area (indicated by a black arrow) and the location of the study area (indicated by a black arrow).

Figure 2. The stone structure, the old oil processing plant.

[illegible]

Year	Earthquake Magnitude	Damage (Millions of Dollars)
1906	7.8	400
1994	7.3	100

1990年	0.3	4%
1995年	0.3	4%
2000年	0.3	4%
2005年	0.7	10%
2010年	0.3	4%
2015年	0.3	4%

资料来源：根据《中国统计年鉴》整理。

[illegible]

### Type of Fault Movement

creatively manipulate technology. And for individuals that place themselves almost entirely in technology, your mission, if the role calls for the field, will be the same. It is a digital world. Every device is meant to be connected to the Internet and always will be. The only reality going on is that you will have to make up for what is not in the field. For those that stay in or, at least, the occasional field, think of the things they would like to do but have not had the chance to. These are the things that you should think about when thinking that someone is taking someone's

From a top-down, macroeconomic perspective, the emerging and mature economies must move from a focus on short-term growth to a more long-term perspective. This requires a shift in the role of the state, from a focus on short-term growth to a more long-term perspective. This requires a shift in the role of the state, from a focus on short-term growth to a more long-term perspective. This requires a shift in the role of the state, from a focus on short-term growth to a more long-term perspective.

the traditional curriculum focus has been largely on the development of students' understanding of the basic concepts of physics. The traditional curriculum focus has been largely on the development of students' understanding of the basic concepts of physics.

**Age of Latest Fault Rupture**

**Years Before Present of Latest Fault Rupture**

- <100,000 (Red)
- 100,000-500,000 (Orange)
- 500,000-1,000,000 (Yellow)
- 1,000,000-5,000,000 (Green)
- >5,000,000 (Purple)

The age of the latest fault rupture is determined by radiocarbon dating of organic material (e.g., wood, charcoal, peat) found in the fault zone. The age of the latest rupture is the age of the youngest dated material found in the fault zone. The age of the latest rupture is the age of the youngest dated material found in the fault zone. The age of the latest rupture is the age of the youngest dated material found in the fault zone.

**Surface Ruptures in Nevada**

Fault Name	Length (km)	Last Rupture Date
Owens Valley Fault	115	1800-1850
Garlock Fault	100	1800-1850
San Jacinto Fault	100	1800-1850
San Andreas Fault	1200	1800-1850
San Gabriel Fault	100	1800-1850
San Joaquin Hills Fault	100	1800-1850
San Mateo Fault	100	1800-1850
San Rafael Fault	100	1800-1850
San Simeon Fault	100	1800-1850
San Ysidro Fault	100	1800-1850
San Juan Fault	100	1800-1850
San Luis Fault	100	1800-1850
San Marcos Fault	100	1800-1850
San Jacinto Fault	100	1800-1850
San Gabriel Fault	100	1800-1850
San Joaquin Hills Fault	100	1800-1850
San Mateo Fault	100	1800-1850
San Rafael Fault	100	1800-1850
San Simeon Fault	100	1800-1850
San Ysidro Fault	100	1800-1850
San Juan Fault	100	1800-1850
San Luis Fault	100	1800-1850
San Marcos Fault	100	1800-1850

**50 km**

**Scale**

**North Arrow**

**Inset Map**

**Inset Photograph**



# Quaternary Faults in Nevada - Online Interactive Map

Easy to pinpoint an address

Look for a fault **Find Address**

Results

Map Contents

☒ Quaternary  
+ Legend  
+ Base Data

☒ 9i10glj\_TC  
+ Base Data

☒ USGS\_aer  
+ ☒ Base Data

Find Address

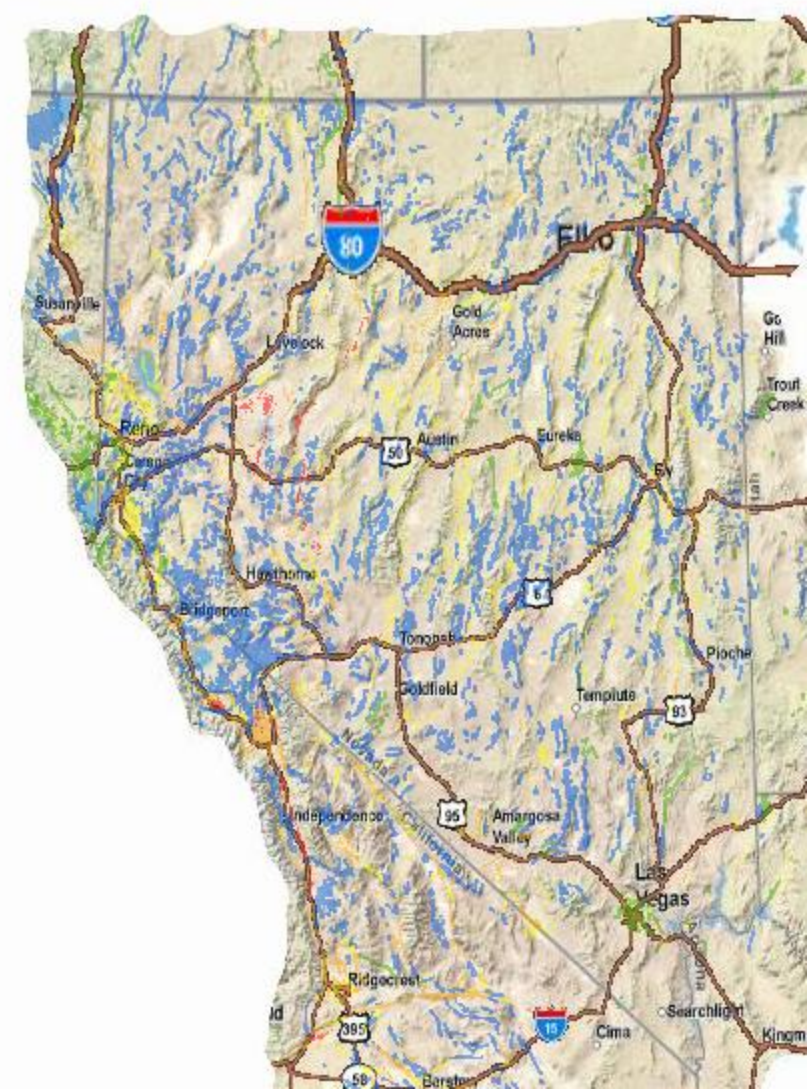
Street or Intersection: 155 North Taylor Street

City: Fallon

State: Nevada

ZIP:

Find Your Address



# Quaternary Faults in Nevada - Online Interactive Map

Easy to pinpoint an address

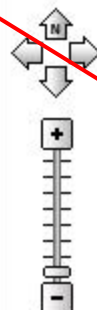
Look for a fault **Find Address**

## Results

- ☒ **155 North Taylor Street, Fallon,**
  - ☒ 155 N Taylor St, Fallon, NV, 8940

## Map Contents

- ☒ Quaternary\_Faults
  - ☐ Legend
  - ☐ Base Data
- ☒ 9i10glj\_TOPO\_data
  - ☐ Base Data
- ☒ USGS\_aerial\_photographs
  - ☒ Base Data





# Quaternary Faults in Nevada - Online Interactive Map


Easy to zoom in on an address

Look for a fault | Find Address

## Results

☒ 155 North Taylor Street, Fallon,

☒ 155 N Taylor St, Fallon, NV, 89401

 Zoom to


 Pan to

 Remove


## Map Contents

☒ Quaternary\_Faults

 Legend

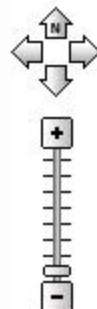
 Base Data

☒ 9i10glj\_TOPO\_data

 Base Data

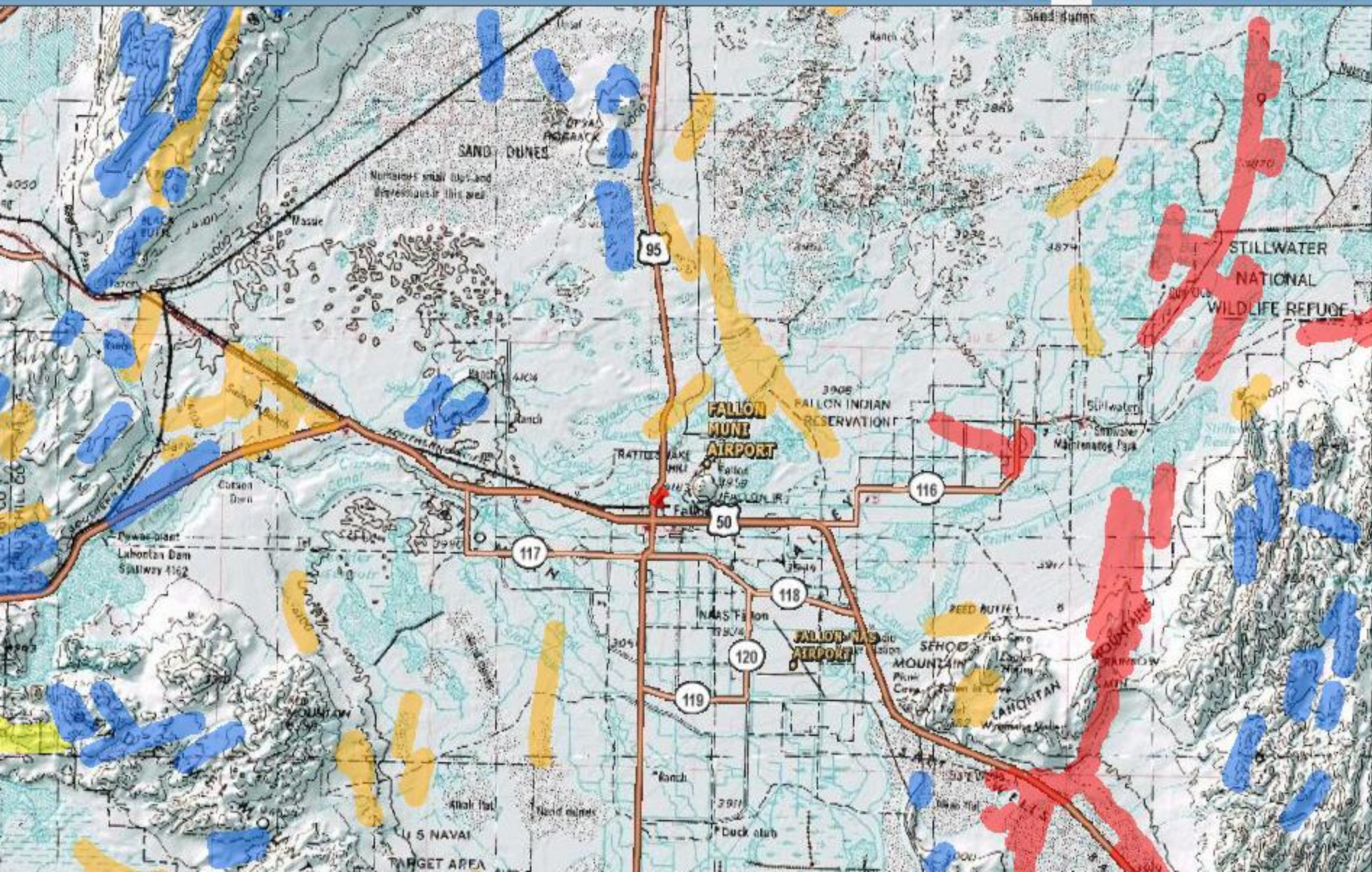
☒ USGS\_aerial\_photographs

 ☒ Base Data



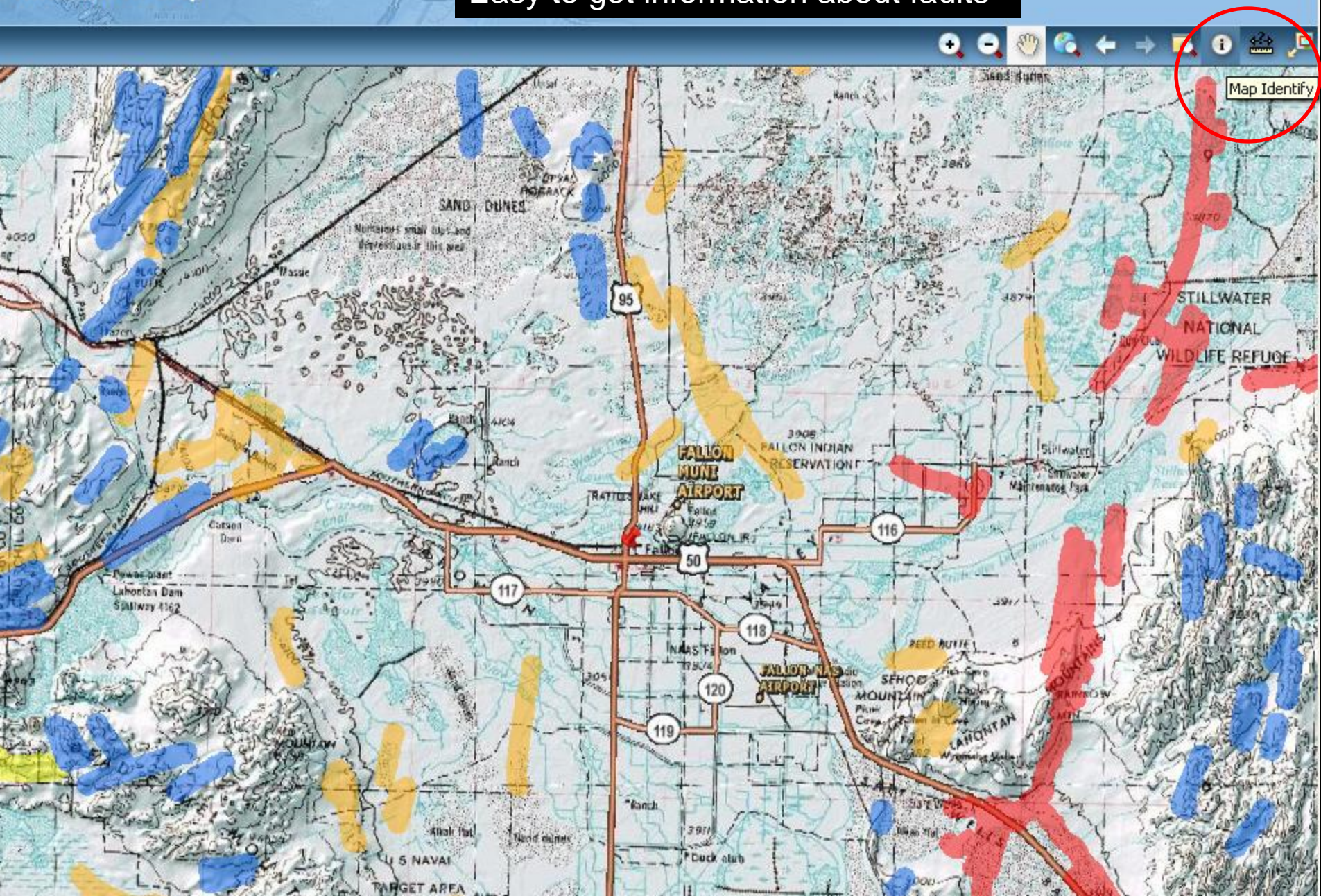


# Interactive Map

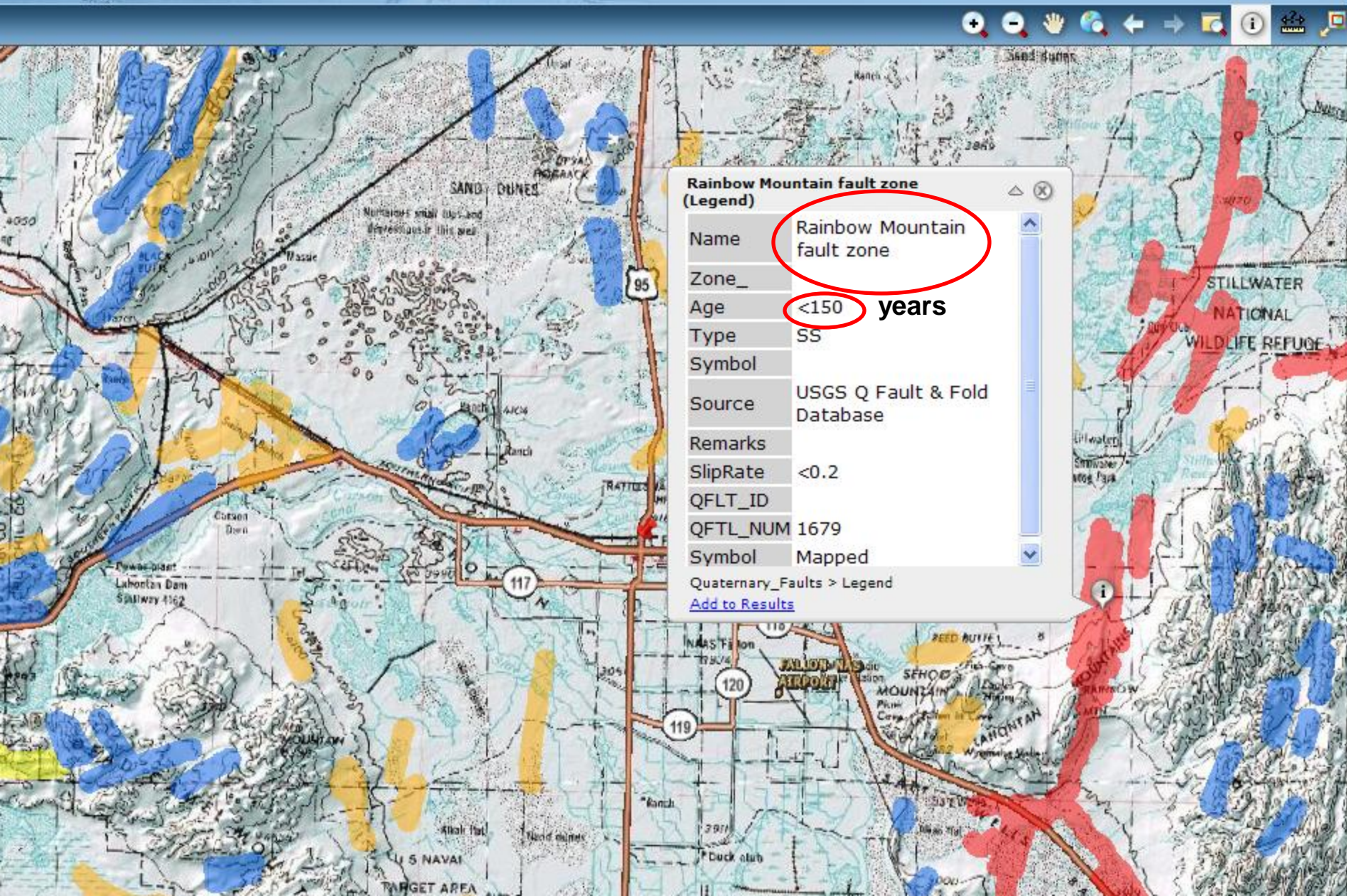




Easy to get information about faults

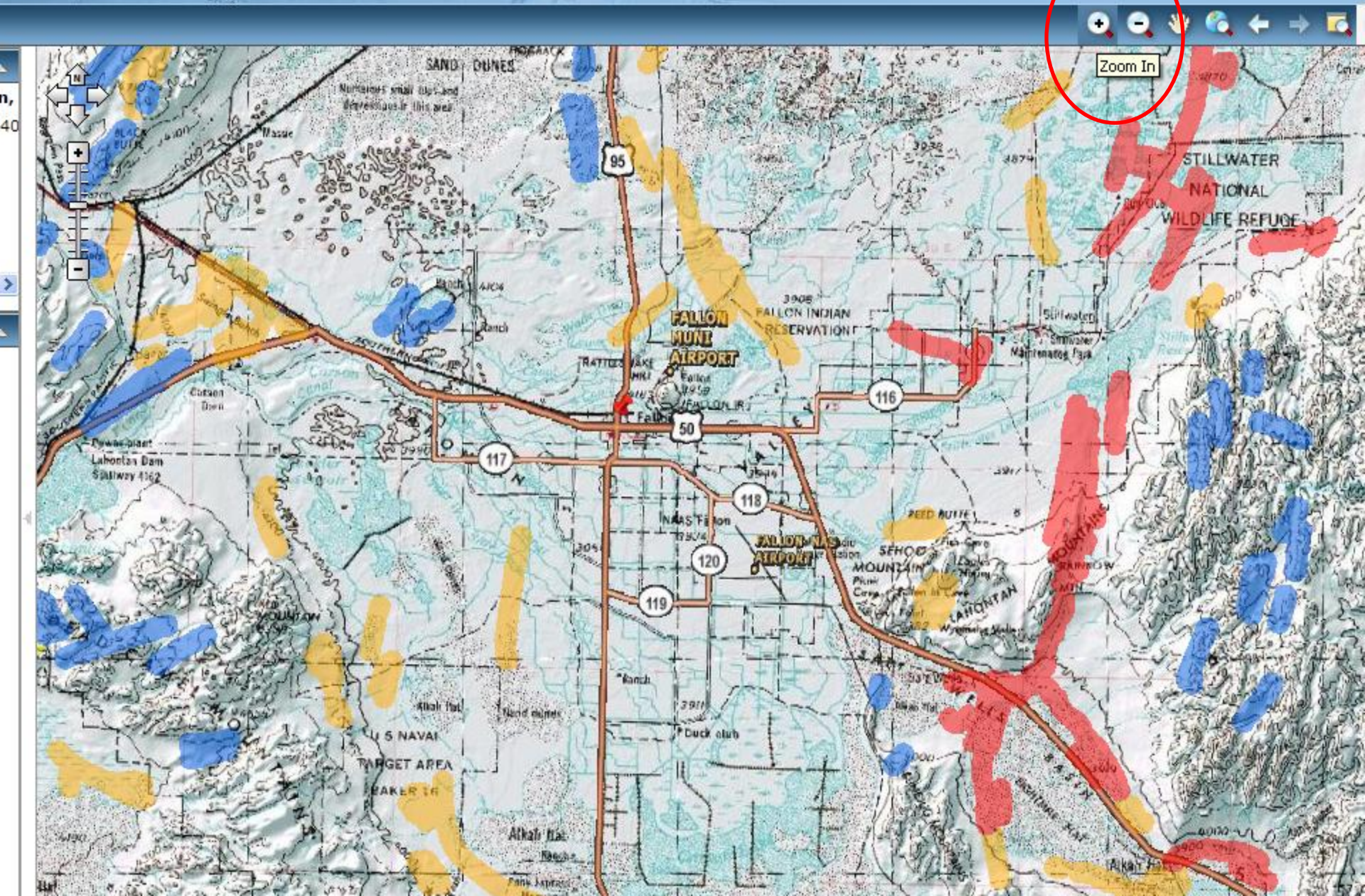






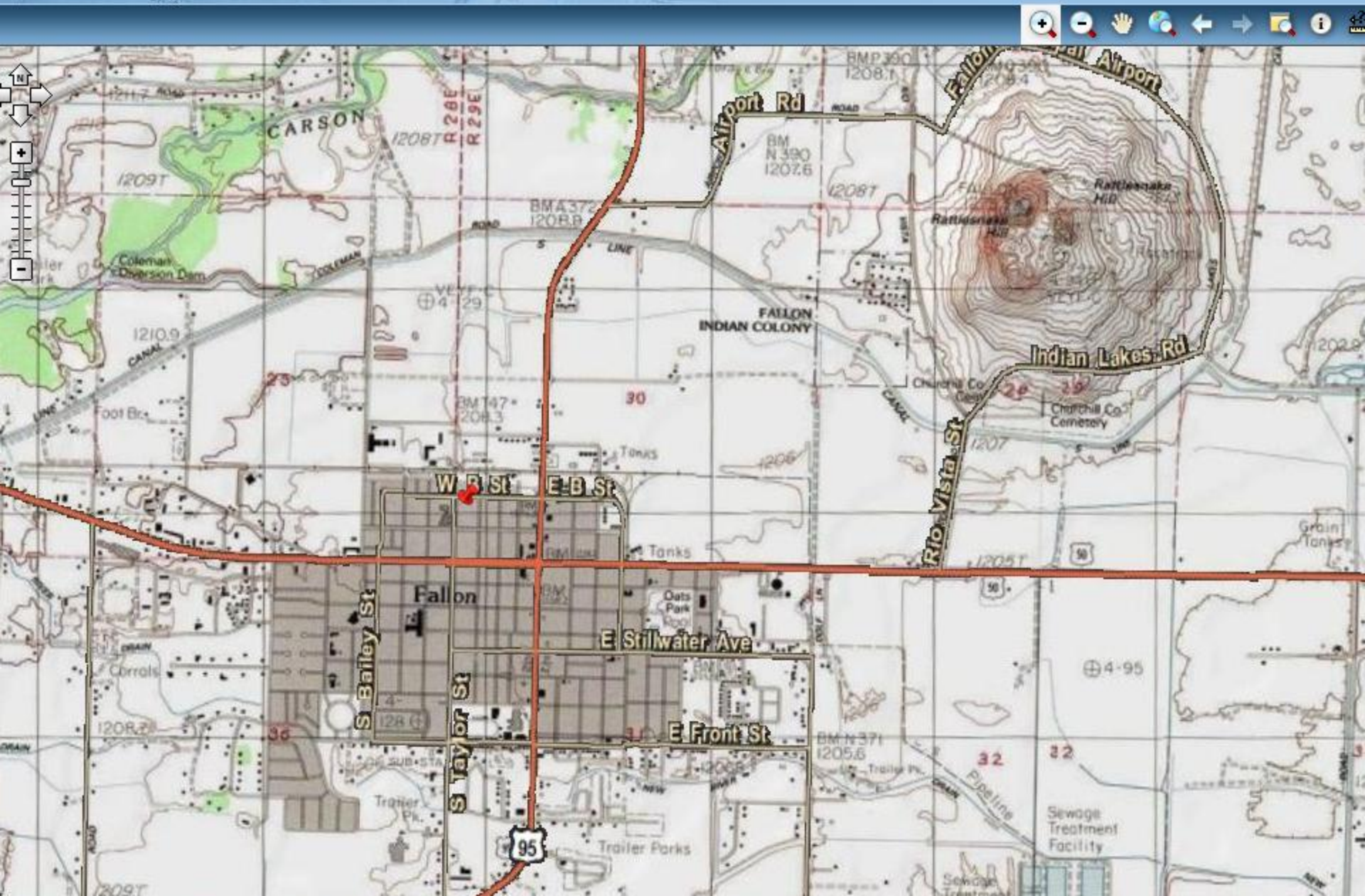


Multiple ways to zoom in



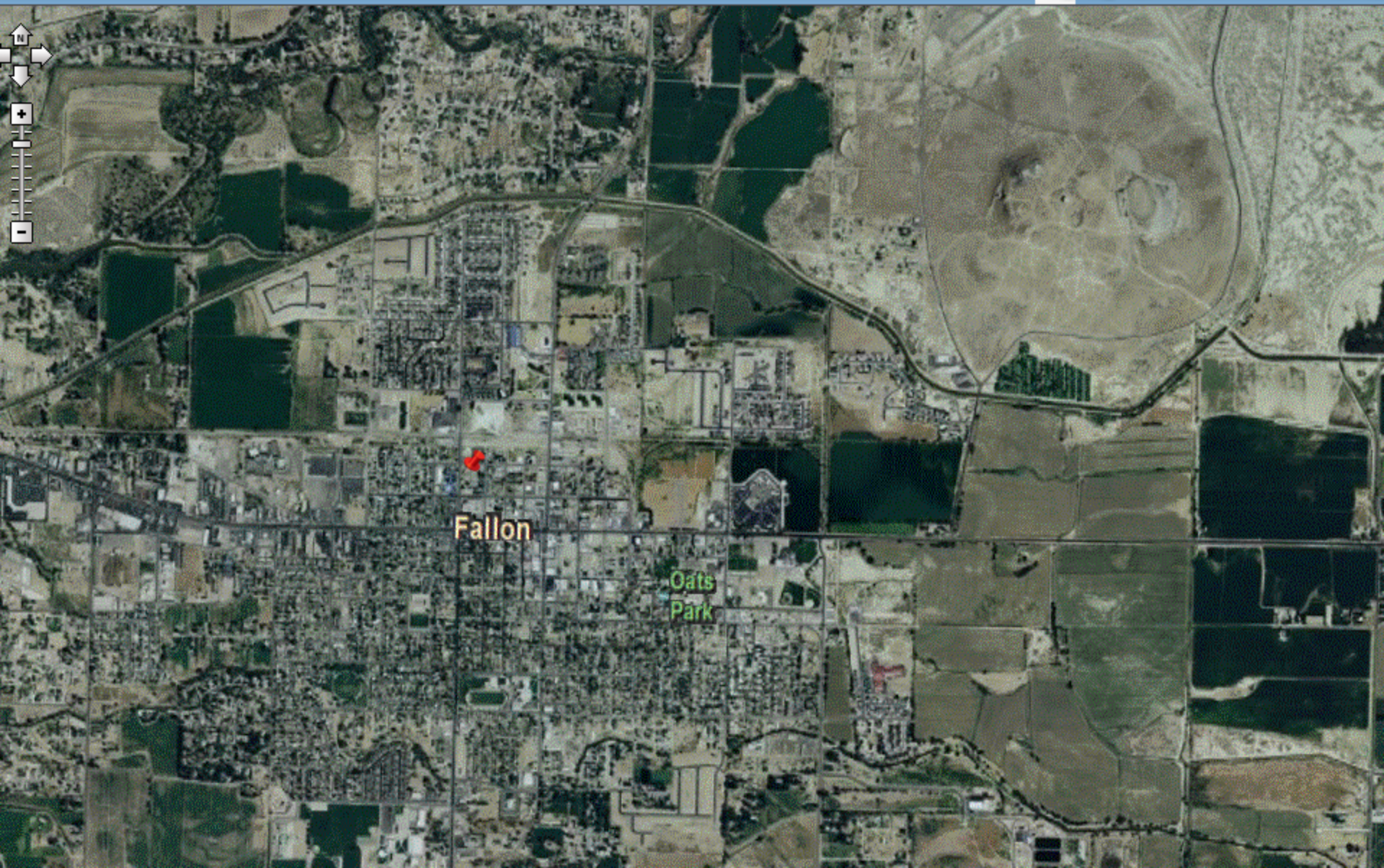


Zooming in takes you to more detailed maps.

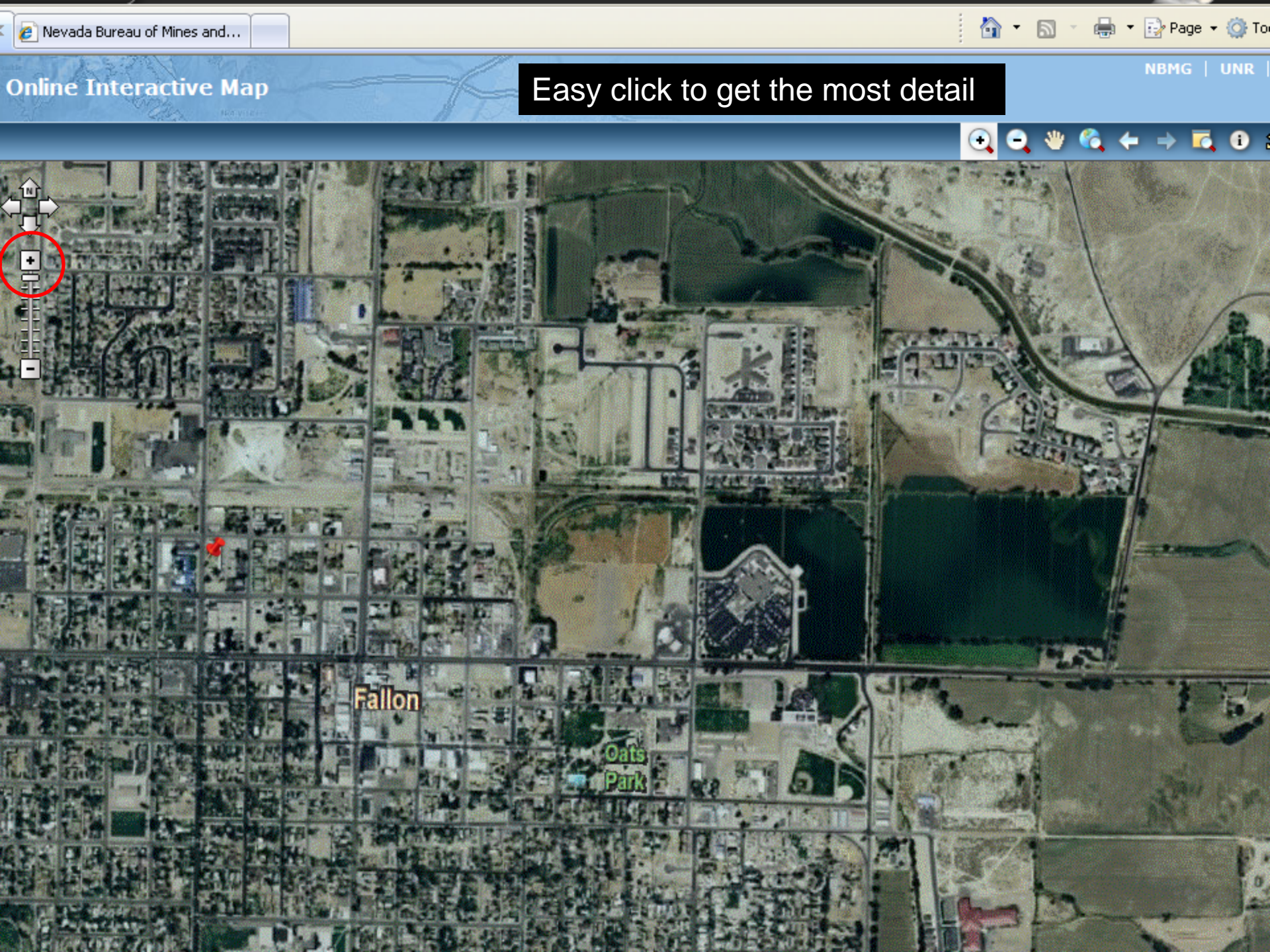




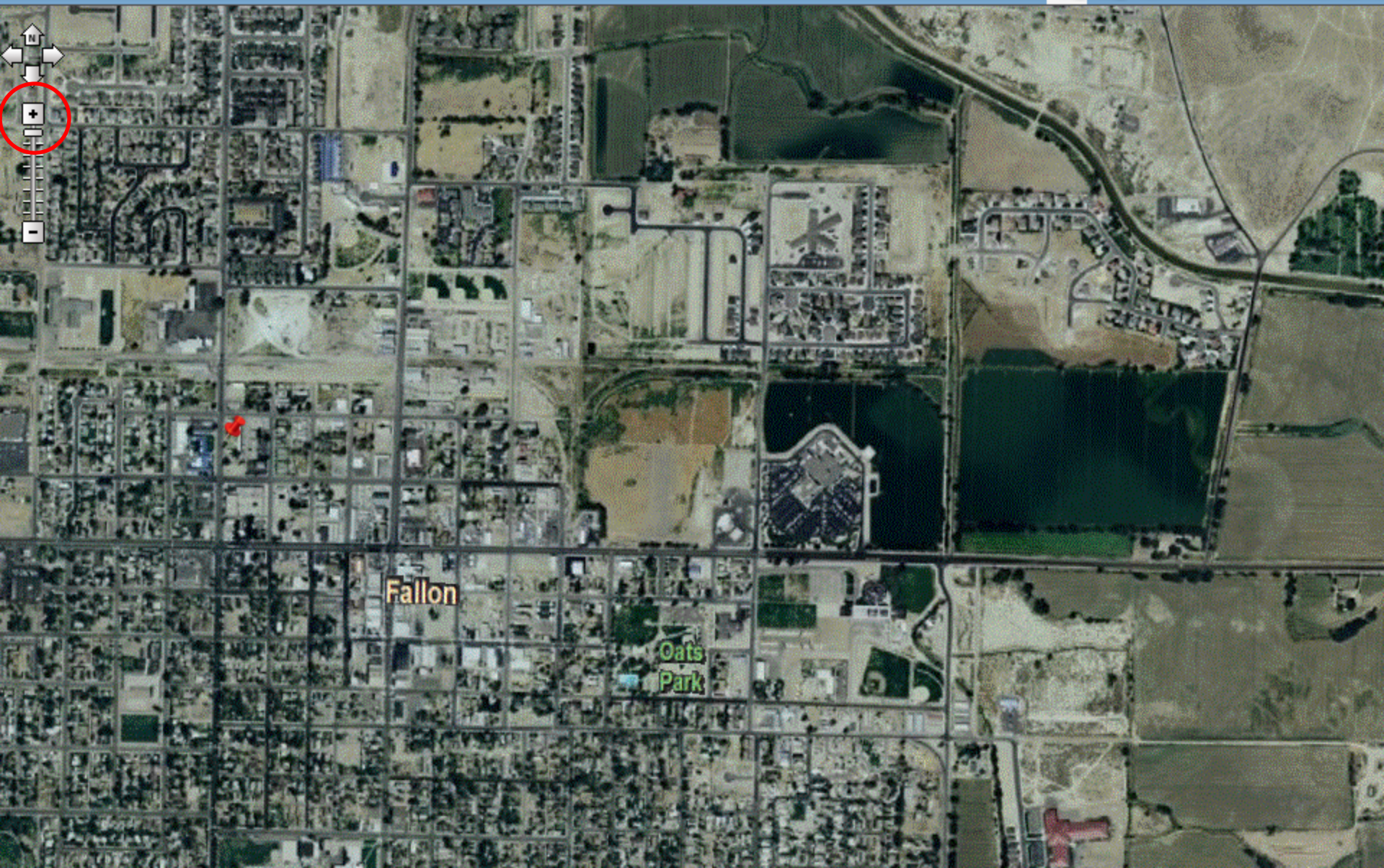
Easy click to show aerial photographs





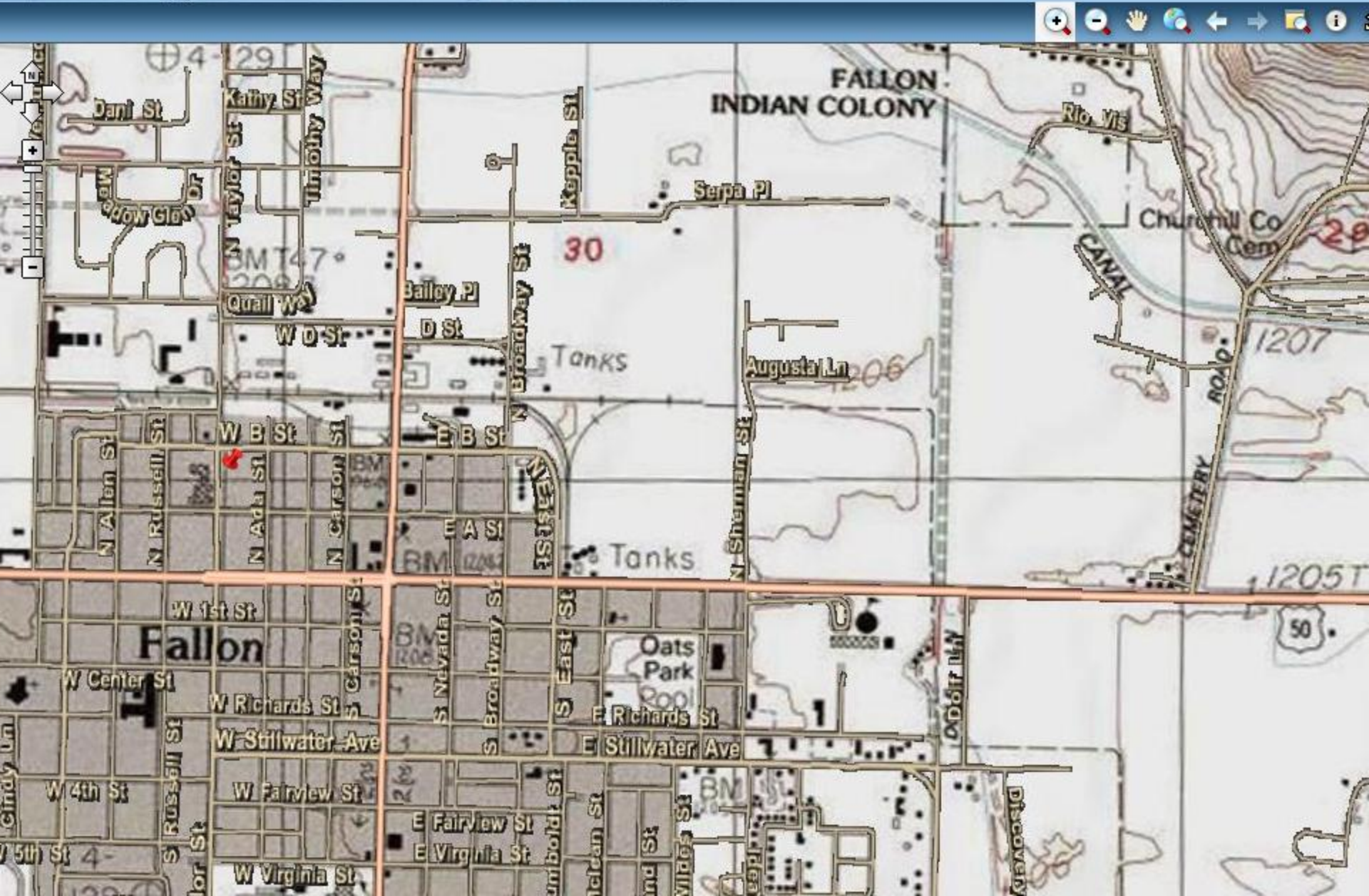


Easy click to get the most detail





Easy click to go back to the topographic map





## Quaternary Faults in Nevada - Online Interactive Map

Look for a fault



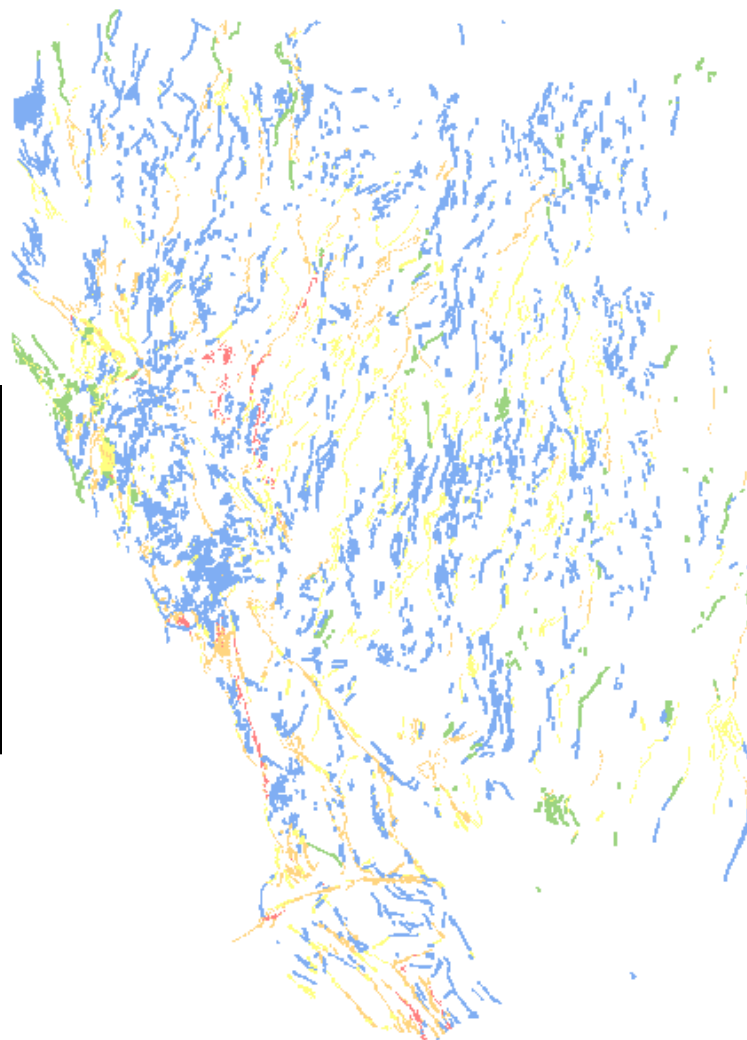
## Results

## Map Contents

- ☒ 9i10glj\_Q\_Faults
  - ☐ 500 Meter Fault Buffer
  - ☐ Base Data
- ☐ 9i10glj\_TOPO\_data
  - ☐ Base Data
- ☐ 9i10glj\_NAPS\_data
  - ☒ Base Data



The locations, ages of latest rupture, and other features of the faults are in a geographic information systems (GIS) database, which is accessible on line at [www.nbmj.unr.edu](http://www.nbmj.unr.edu).



0 19 38 76 114 152 Miles



## Quaternary Faults in Nevada - Online Interactive Map

Look for a fault



Results

Map Contents

- ☒ 9i10glj\_Q\_Faults
  - ☐ 500 Meter Fault Buffer
  - ☐ Base Data
- ☐ 9i10glj\_TOPO\_data
  - ☐ Base Data
- ☒ 9i10glj\_NAPS\_data
  - ☒ Base Data



By clicking map contents on and off, the faults can be viewed on aerial photographs.

0 19 38 76 114 152 Miles



## Quaternary Faults in Nevada - Online Interactive Map

NBMG | UNR | Help

Look for a fault

Results

Map Contents

- ☒ 9i10glj\_Q\_Faults
  - ☐ 500 Meter Fault Buffer
  - ☐ Base Data
- ☒ 9i10glj\_TOPO\_data
  - ☐ Base Data
- ☒ 9i10glj\_NAPS\_data
  - ☒ Base Data

By clicking map contents on and off, the faults can be viewed on aerial photographs or on topographic maps of the U.S. Geological Survey.





# Quaternary Faults in Nevada - Online Interactive Map

NBMG | UNR | Help

Look for a fault

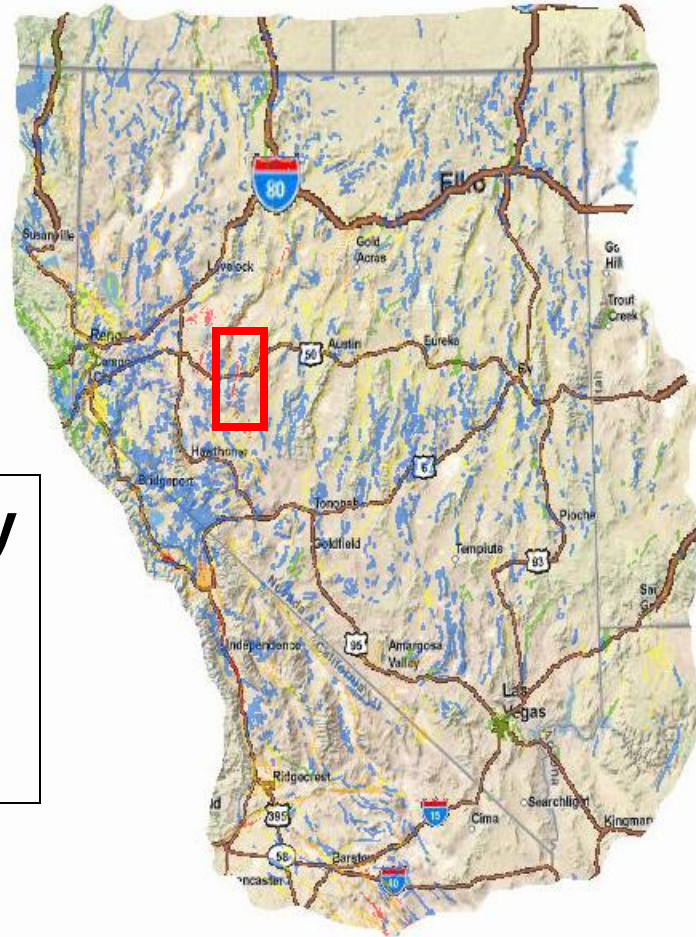
Results

Map Contents

- ☒ 9i10glj\_Q\_Faults
  - ☐ 500 Meter Fault Buffer
  - ☐ Base Data
- ☒ 9i10glj\_TOPO\_data
  - ☐ Base Data
- ☒ 9i10glj\_NAPS\_data
  - ☒ Base Data



**Expand any  
portion of  
the state to  
see details.**



0 19 38 76 114 152 Miles





# Quaternary Faults in Nevada - Online Interactive Map

Look for a fault

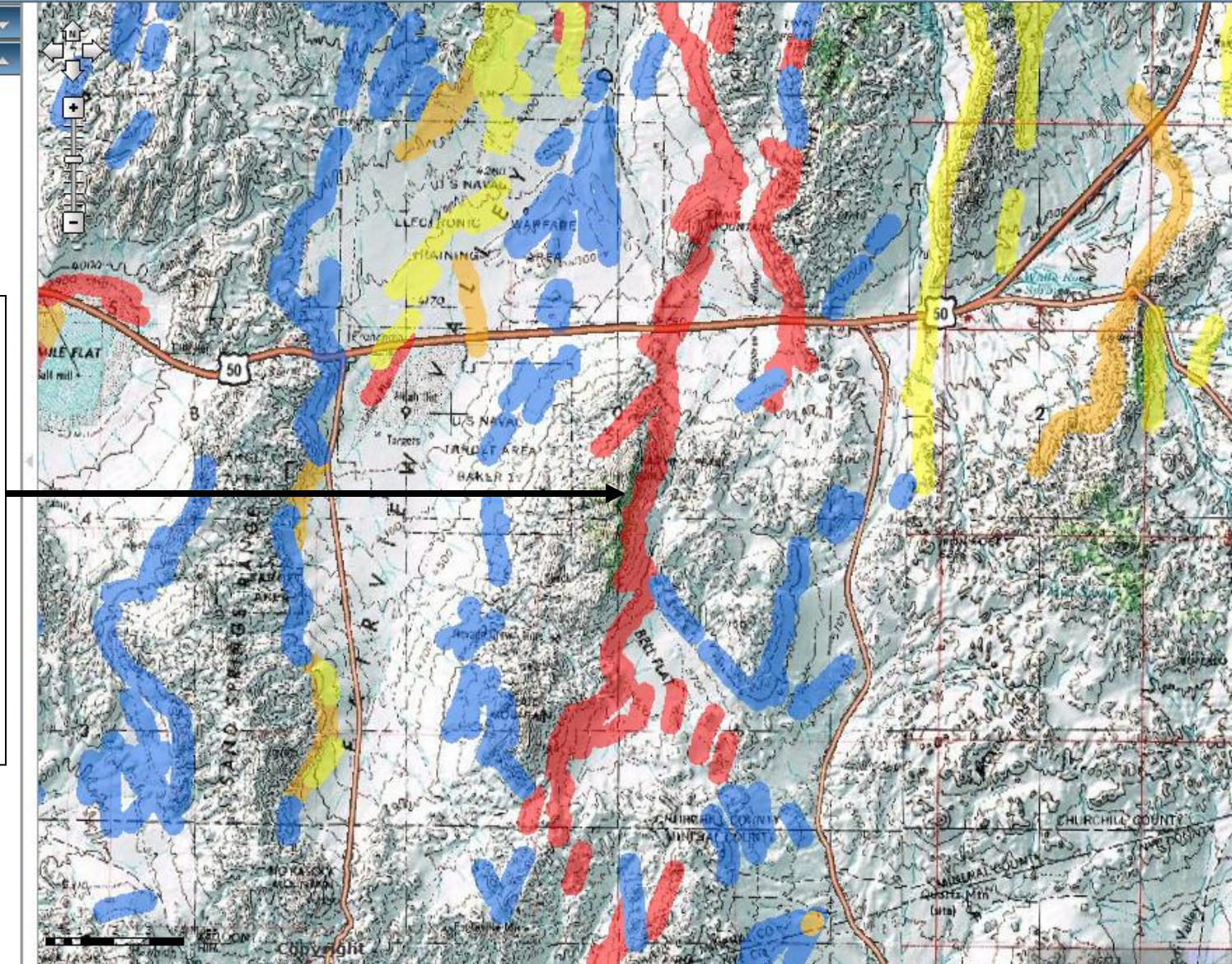
## Results

## Map Contents

- ☒ 9i10glj\_Q\_Faults
  - ☒ 500 Meter Fault Buffer
  - ☒ Base Data
- ☒ 9i10glj\_TOPO\_data
  - ☒ Base Data
- ☒ 9i10glj\_NAPS\_data
  - ☒ Base Data

**Example:**

**Fairview Peak  
fault (1954  
rupture,  
magnitude 7.1,  
5.3 meters of  
normal, right-  
lateral  
displacement)**





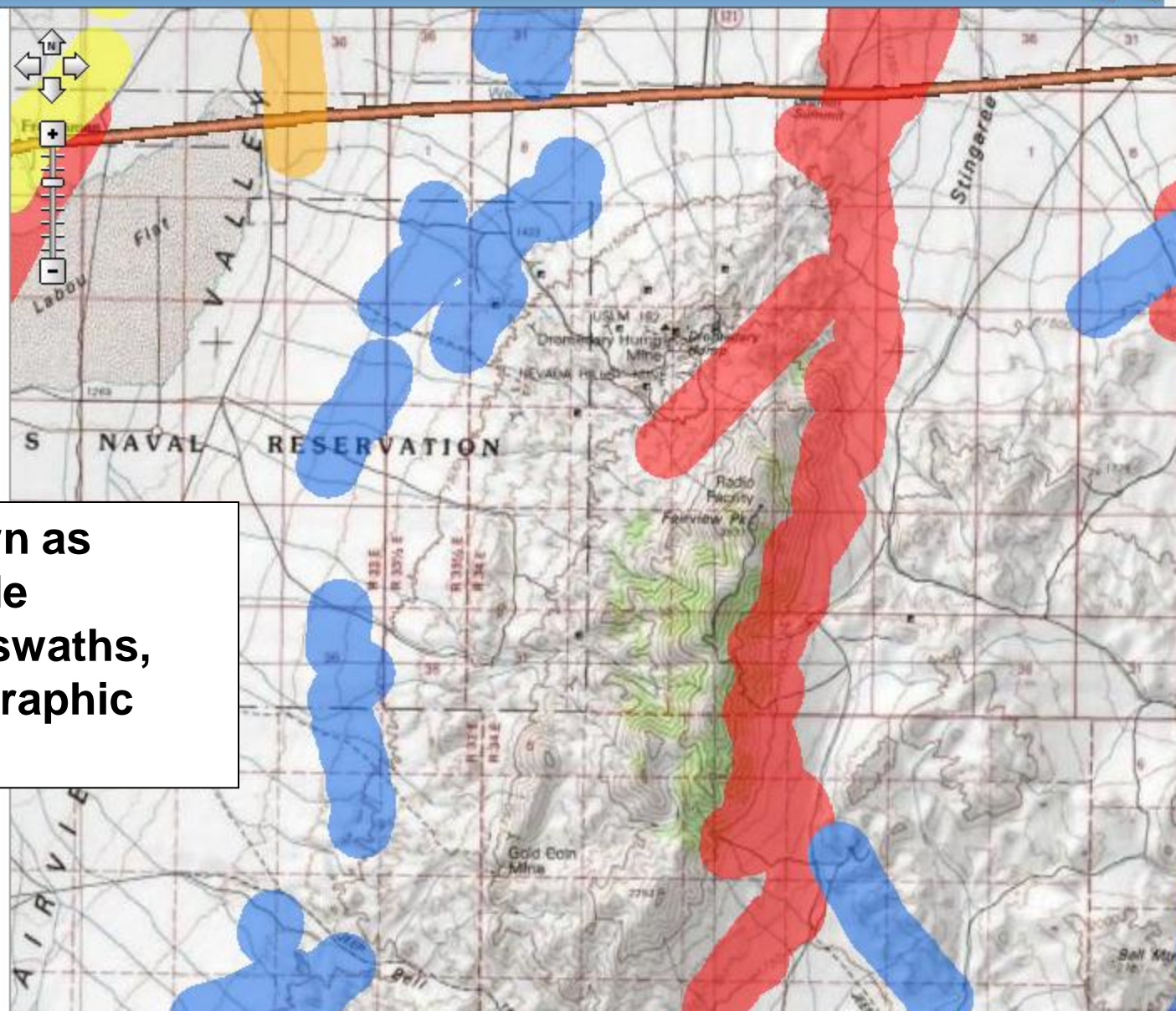
# Quaternary Faults in Nevada - Online Interactive Map

Look for a fault

## Results

## Map Contents

- ☒ 9i10glj\_Q\_Faults
  - ☐ 500 Meter Fault Buffer
  - ☐ Base Data
- ☒ 9i10glj\_TOPO\_data
  - ☐ Base Data
- ☒ 9i10glj\_NAPS\_data
  - ☒ Base Data



Faults are shown as 1,000-meter-wide (0.6-mile-wide) swaths, here on a topographic map base.



## Quaternary Faults in Nevada - Online Interactive Map

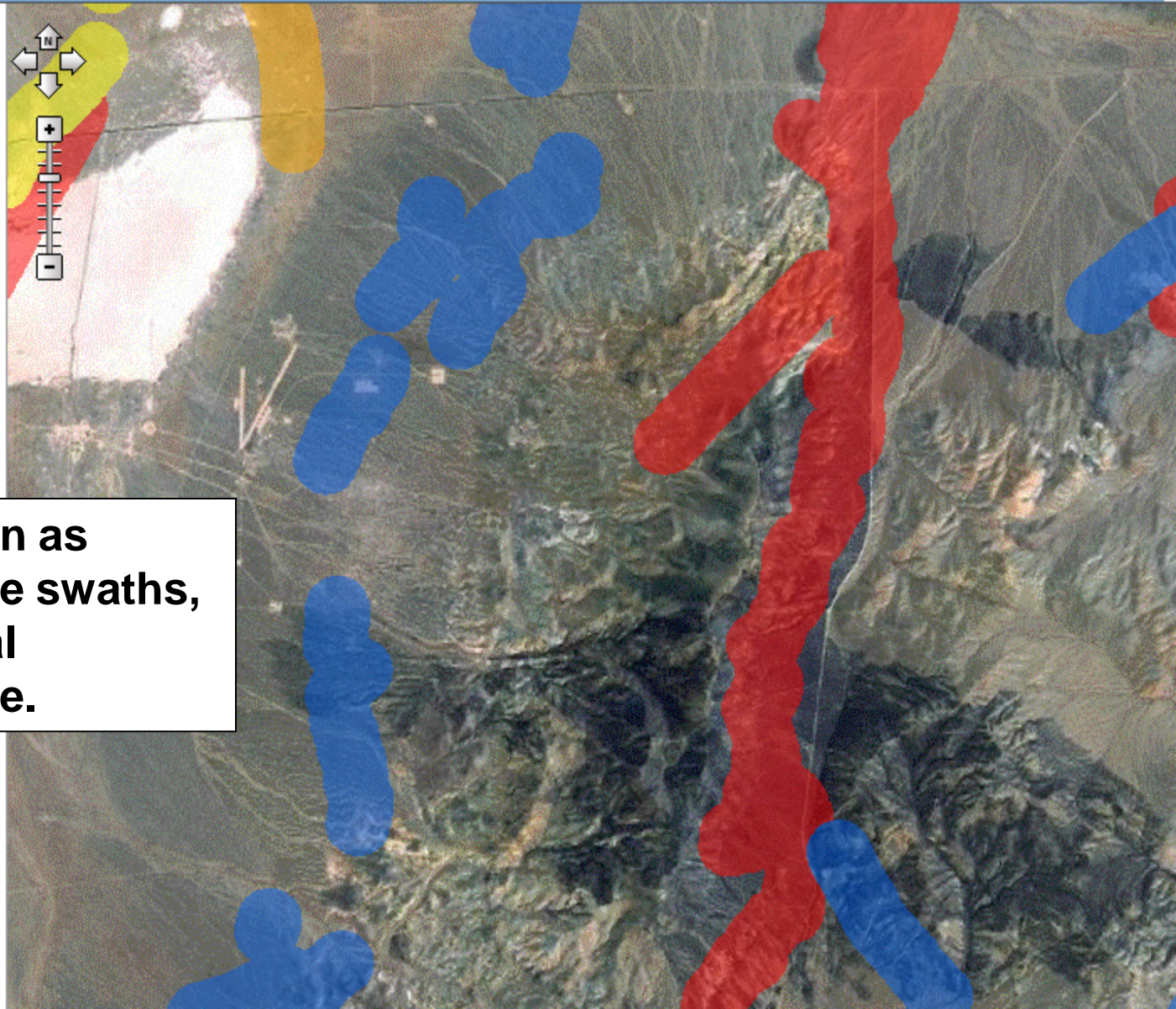
Look for a fault



### Results

### Map Contents

- ☒ 9i10glj\_Q\_Faults
  - ☒ 500 Meter Fault Buffer
  - ☒ Base Data
- ☐ 9i10glj\_TOPO\_data
  - ☒ Base Data
- ☒ 9i10glj\_NAPS\_data
  - ☒ Base Data



**Faults are shown as  
1,000-meter-wide swaths,  
here on an aerial  
photograph base.**



## Quaternary Faults in Nevada - Online Interactive Map

Look for a fault



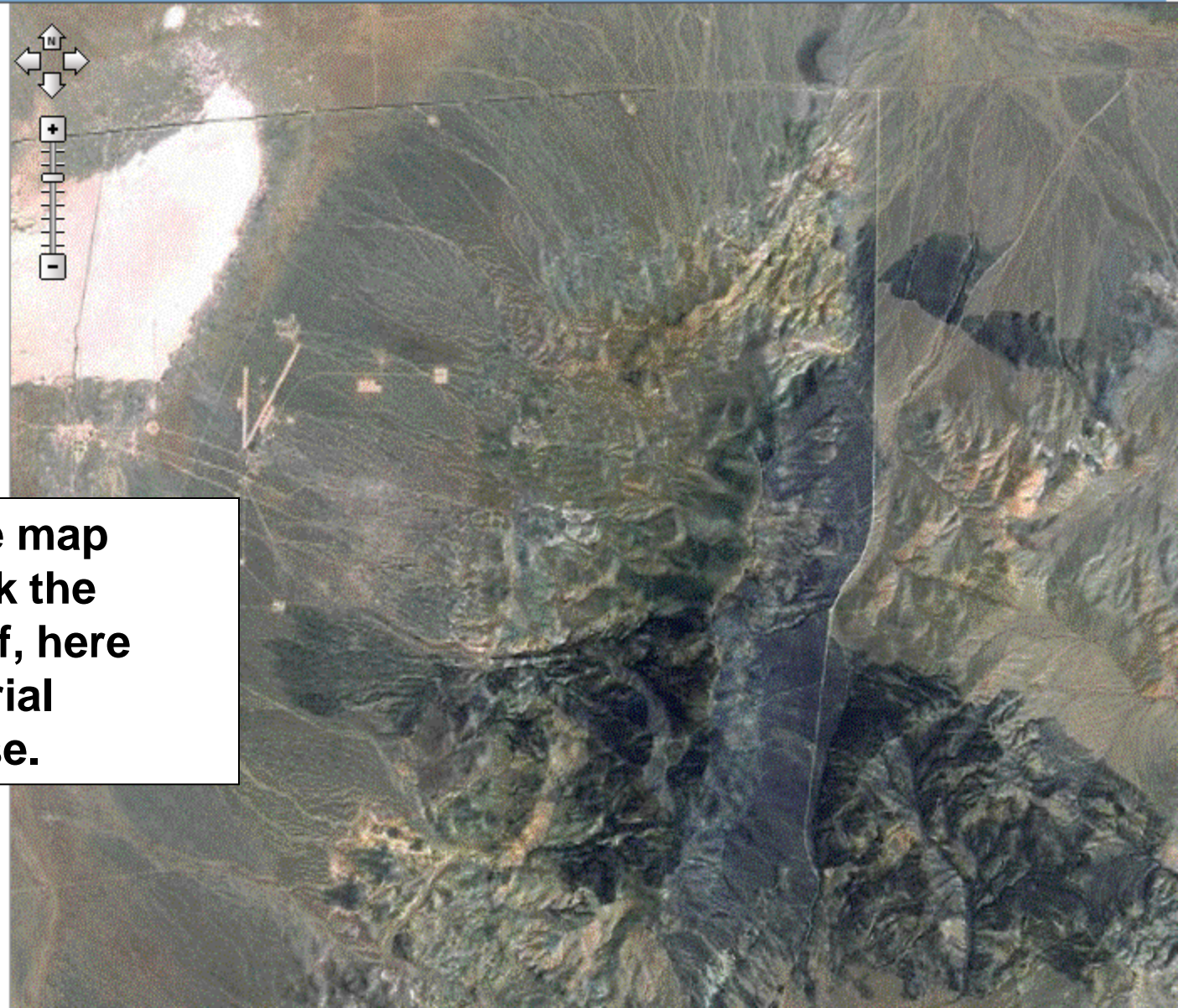
### Results

### Map Contents

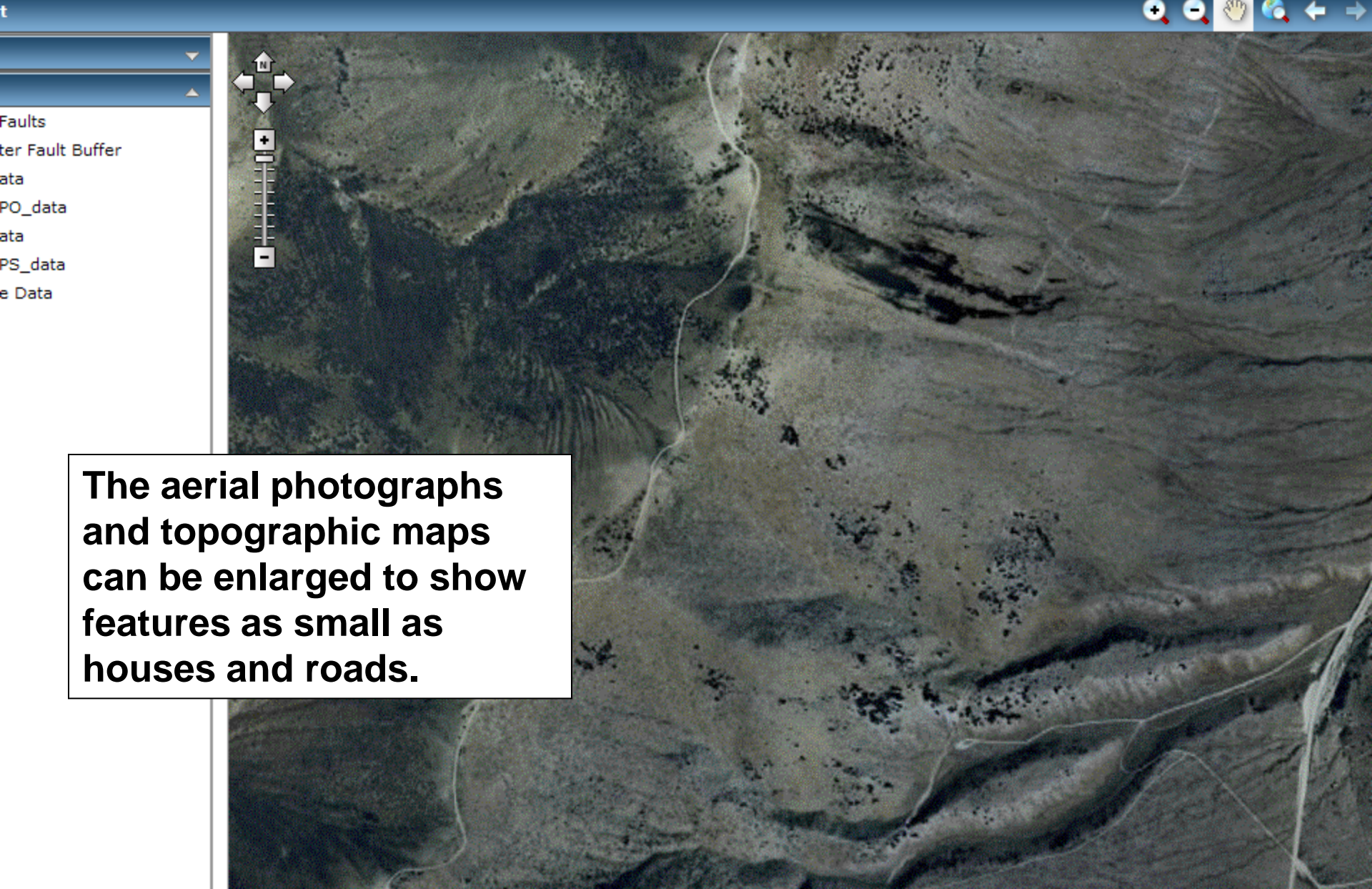
- ☐ 9i10glj\_Q\_Faults
  - ☒ 500 Meter Fault Buffer
  - ☒ Base Data
- ☐ 9i10glj\_TOPO\_data
  - ☒ Base Data
- ☒ 9i10glj\_NAPS\_data
  - ☒ Base Data



**You can use the map contents to click the faults on and off, here with just the aerial photograph base.**







**The aerial photographs and topographic maps can be enlarged to show features as small as houses and roads.**



t



Faults

Inter Fault Buffer

data

PO\_data

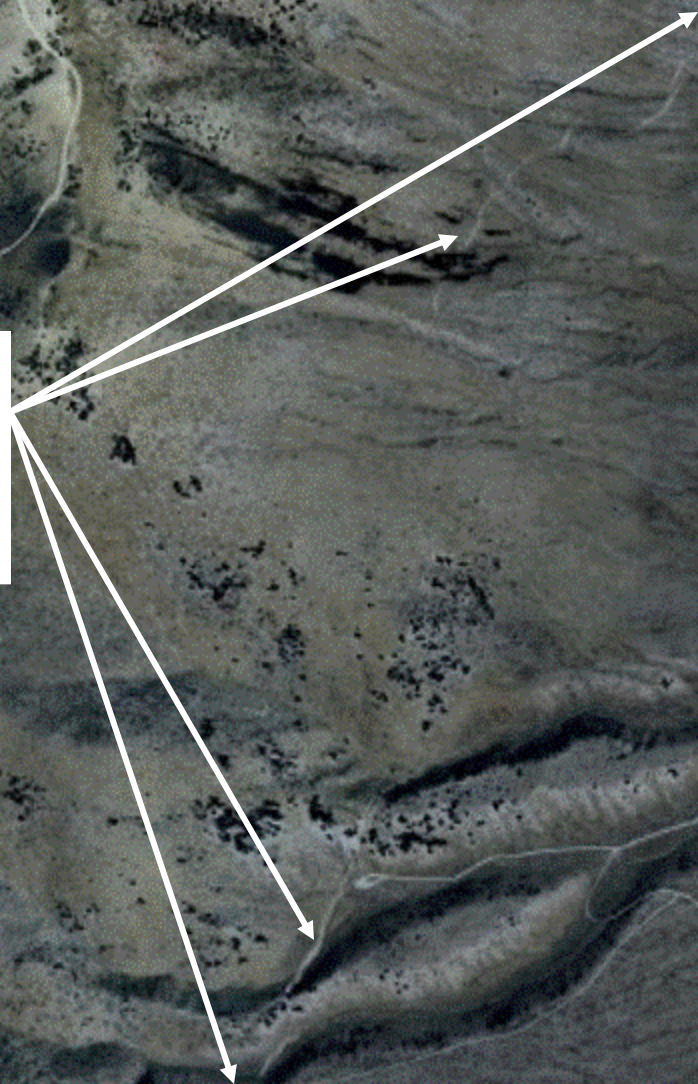
data

PS\_data

e Data



**Fault scarps  
from the 1954  
earthquake**

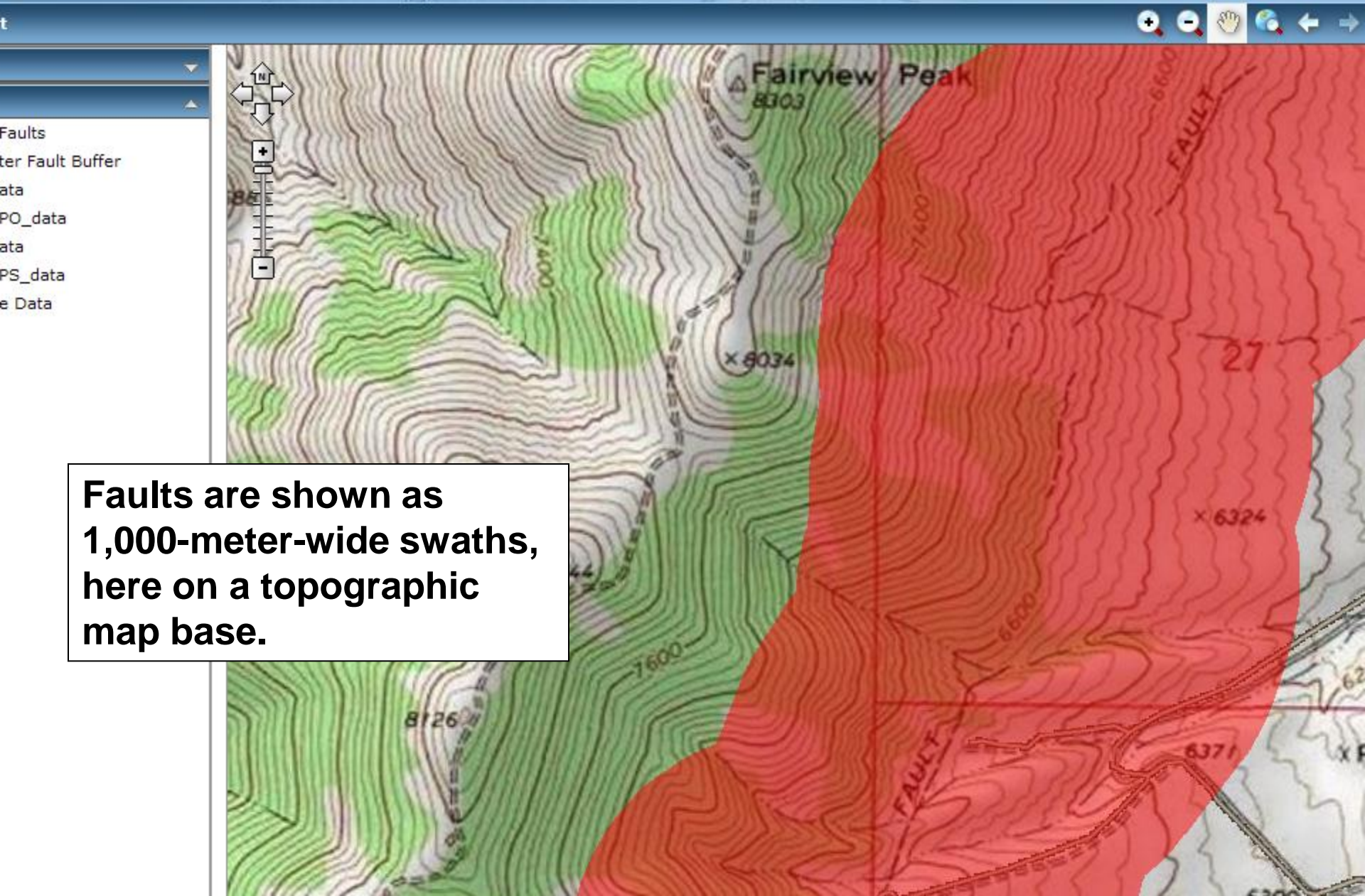






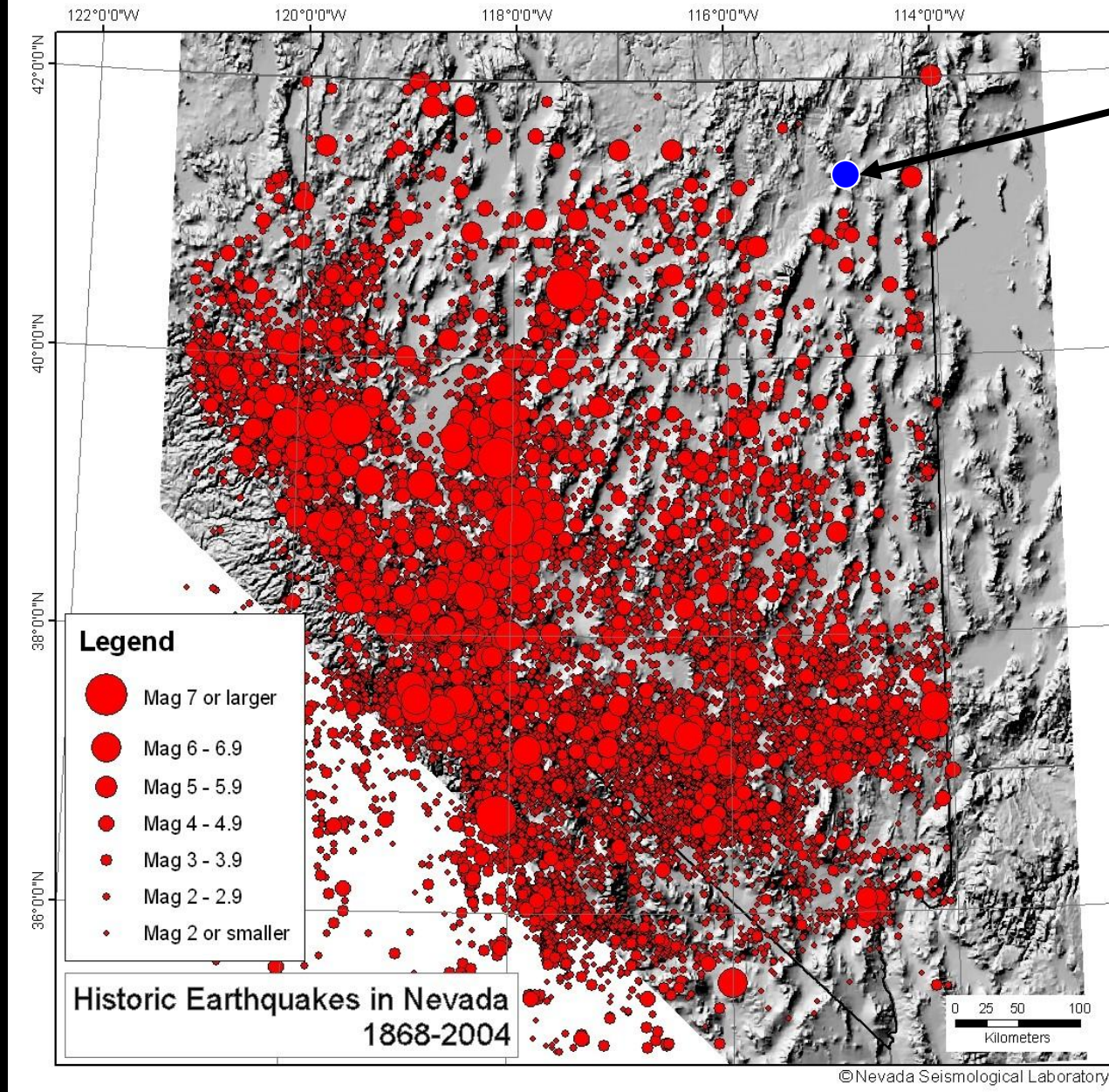
**Faults are shown as  
1,000-meter-wide swaths,  
here on an aerial  
photograph base.**





**Faults are shown as  
1,000-meter-wide swaths,  
here on a topographic  
map base.**





**Wells**  
**21 Feb 08**  
**M = 6.0**

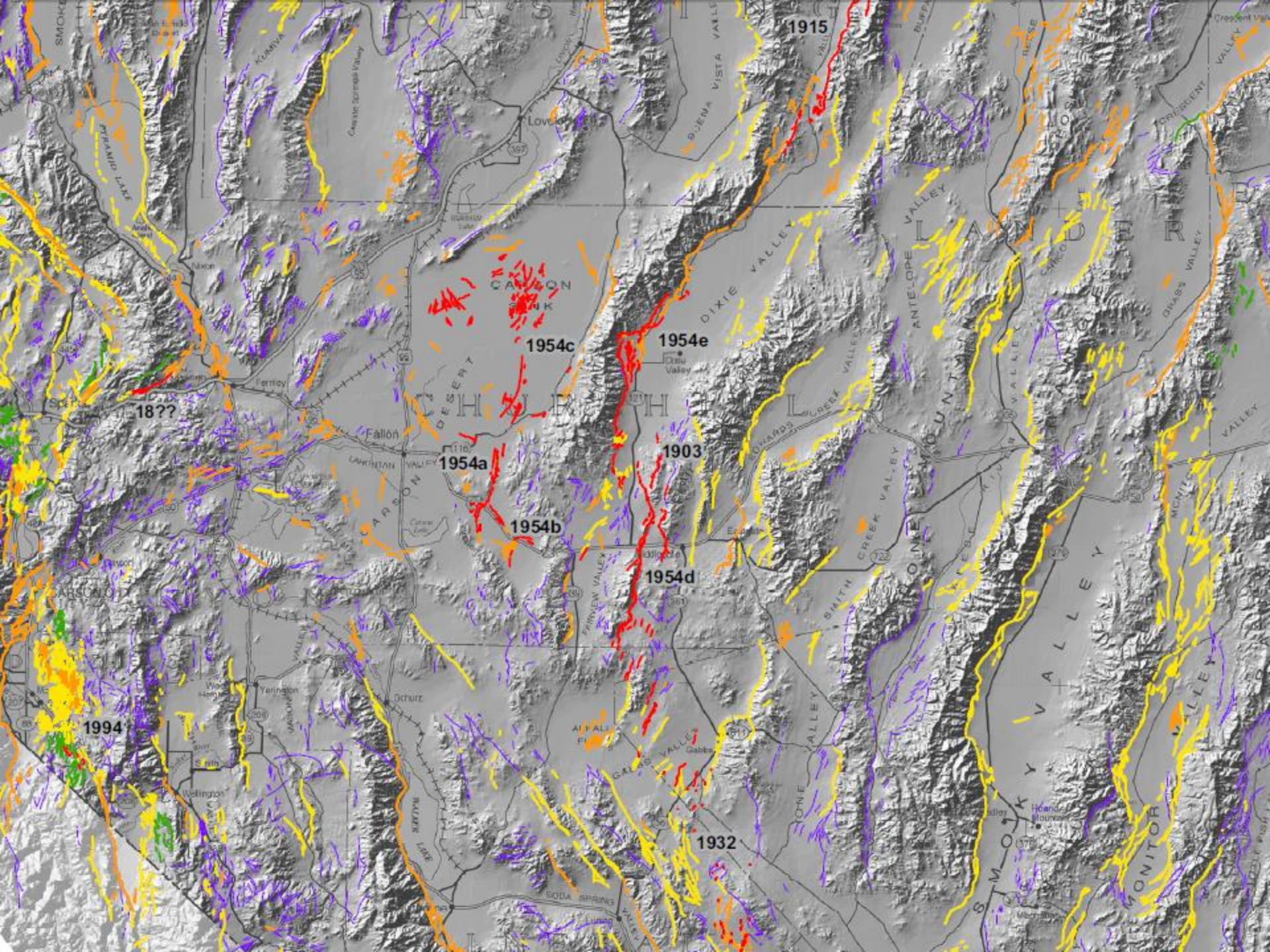
**Earthquakes have occurred throughout Nevada.**



## Large Historical Earthquakes in Churchill County

<u>Date</u>	<u>Magnitude</u>	<u>Near</u>
1852?	7.3	Fallon
July 6, 1954 (a)	6.6	Rainbow Mtn.
11 hours later (b)	6.0	Fourmile Flat
August 24, 1954 (c)	6.8	Stillwater
<b>December 16, 1954 (d)</b>	<b>7.1</b>	<b>Fairview Peak</b>
4 minutes later (e)	6.8	Dixie Valley
March 23, 1959	6.3	Dixie Valley

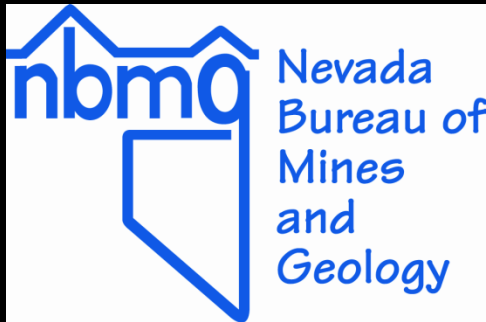






**Earthquake faults occur throughout Nevada,  
and potential losses from earthquakes are high  
for many communities.**

**NBMG Open-File Report 09-8, *Estimated Losses from Earthquakes near Nevada Communities*, demonstrates that the consequences of earthquakes can be huge in Nevada, particularly if individuals are not prepared.**





**Earthquake risks in Nevada are assessed by the Nevada Bureau of Mines and Geology using the Federal Emergency Management Agency's loss-estimation model, HAZUS-MH, and the U.S. Geological Survey's probabilistic seismic hazard analysis.**



These loss estimates are useful in hazard-mitigation planning, in building scenarios for emergency response and recovery exercises, and in helping emergency managers and the Governor make decisions on official disaster declarations after an actual earthquake.

INCIDENT NAME - VIGILANT GUARD <sup>TIME</sup> 0600  
7.1 MAGNITUDE EARTHQUAKE  
INITIAL DAMAGE REPORT -  
COLLEGE DORMITORY COLLAPSE w/ VICTIMS  
LABORATORY / CHEMICAL FACILITY COLLAPSE w/ VICTIMS  
INCIDENT COMMAND - RENO FIRE DEPT.  
RESOURCES - RENO FD USE, ON SCENE  
NEVADA TASK FORCE 1 - LAS VEGAS  
RENSA, SPARKS PD,  
REQUESTED - 92ND CIVIL SUPPORT TEAM - NATIONAL GUARD  
LAS VEGAS  
NATIONAL GUARD BATTALIONS + RESOURCES  
FROM CALIFORNIA, HAWAII, ARIZONA,  
UTAH, IDAHO, WASHINGTON STATE  
INITIAL REPORT -  
DAMAGE ALSO REPORTED - CARSON CITY, CHURCHILL CO.  
LYON COUNTY, DOUGLAS COUNTY  
STORSEY SE - VIRGINIA CITY +  
INDUSTRIAL DISTRICT  
AFTERSHOCKS POSSIBLE -





**Earthquake risks in Nevada are assessed by the Nevada Bureau of Mines and Geology using the Federal Emergency Management Agency's loss-estimation model, HAZUS-MH, and the U.S. Geological Survey's probabilistic seismic hazard analysis.**

**NBMG Open-File Report 09-8, *Estimated Losses from Earthquakes near Nevada Communities*, contains HAZUS scenarios for magnitude 5.0, 5.5, 6.0, 6.5, and 7.0 earthquakes near 38 communities in Nevada.**



**The hazard: expressed in terms of probability of an earthquake of a given magnitude occurring within 50 years and within 50 km of the community.**

Community	% Probability of magnitude greater than or equal to magnitude				
	5.0	5.5	6.0	6.5	7.0
Dayton	>90	~80	70-75	50-55	12-15
Carson City	>90	~80	70	50-55	12-15
Reno	>90	~80	67	50	12-15
Stateline	>90	~80	60-70	40-50	10
<b>Fallon</b>	<b>80-90</b>	<b>~60</b>	<b>35</b>	<b>20-25</b>	<b>6-8</b>
Las Vegas	40-50	~30	12	4-5	<0.5
Elko	30-40	~25	10-15	6-8	0.5-1
Wells	30-40	~20	9	6	0.5-1
Laughlin	10-20	~5	2-3	0.5-1	<0.5

Data are from the USGS at <http://eqint.cr.usgs.gov/eqprob/2002/index.php> .  
 Values for magnitude 5.5 are extrapolated between 5.0 and 6.0.



**Uncertainties in the location of epicenters, depths, and magnitude, when combined with changing population and uncertainties in local effects (soil and rock types, assumptions about attenuation, basin geometry, liquefaction potential, and directivity), make loss estimates generally consistent within one order of magnitude (a factor of 10).**



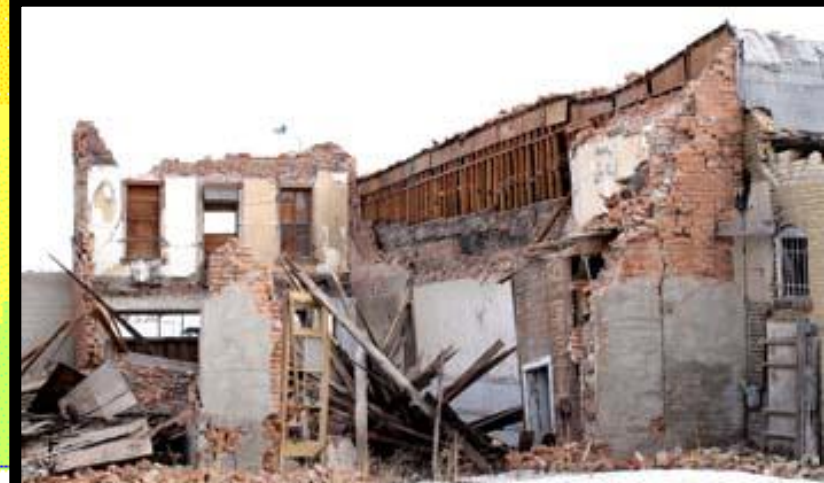
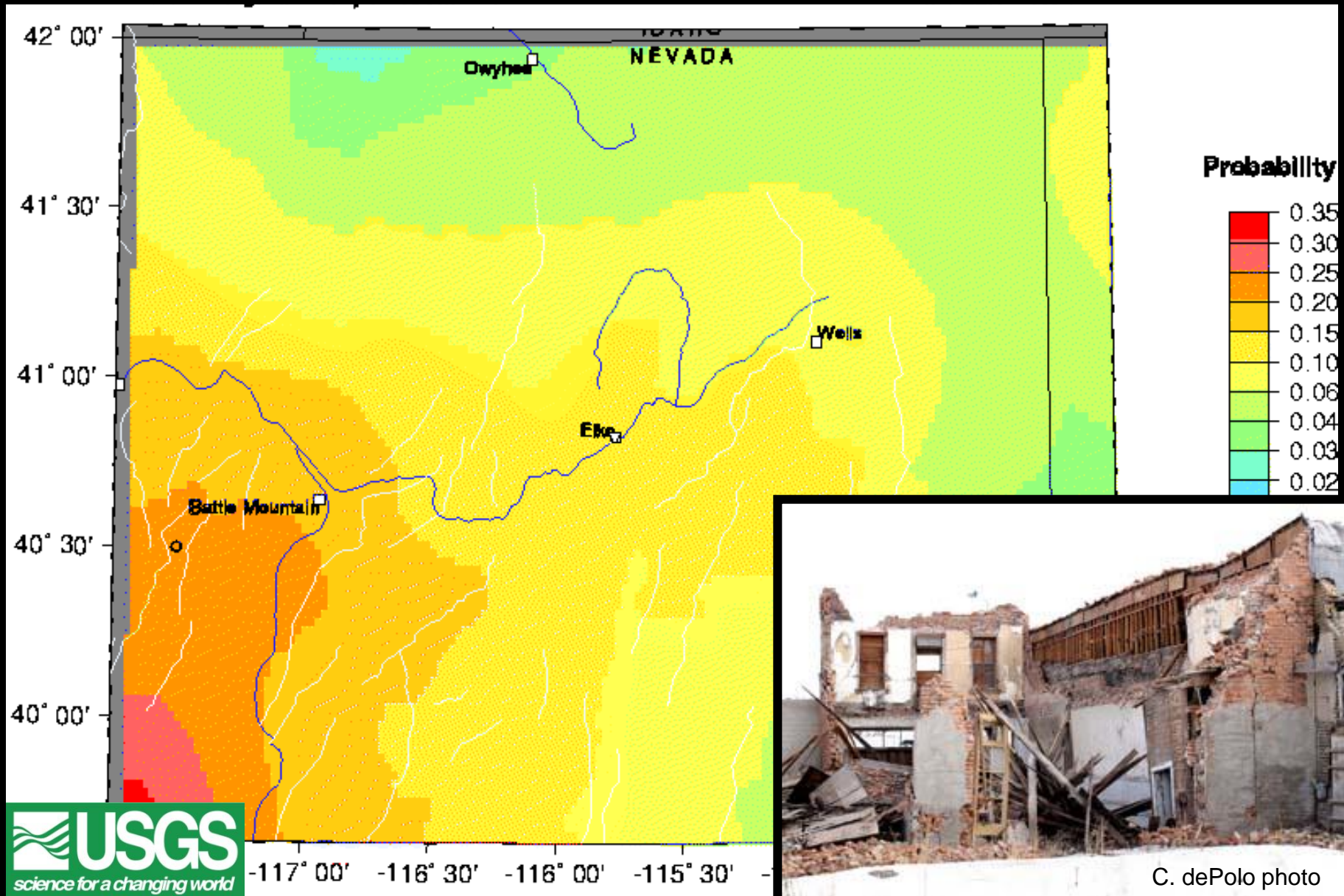
**HAZUS estimates for total economic loss from a magnitude 6.0 earthquake and probability of an earthquake of this magnitude or greater occurring within 50 years and within 50 km of the community.**

<b>Community</b>	<b>Total Economic Loss</b>	<b>Probability in 50 years within 50 km</b>
Las Vegas	\$7.2 billion	12%
Reno	\$1.9 billion	67%
Stateline	\$590 million	60 to 70%
Elko	\$160 million	10 to 15%
<b>Fallon</b>	<b>\$110 million</b>	<b>35%</b>
Wells	\$30 million	9%

Total economic loss is from HAZUS. Probabilities are from the USGS at <http://eqint.cr.usgs.gov/eqprob/2002/index.php> .

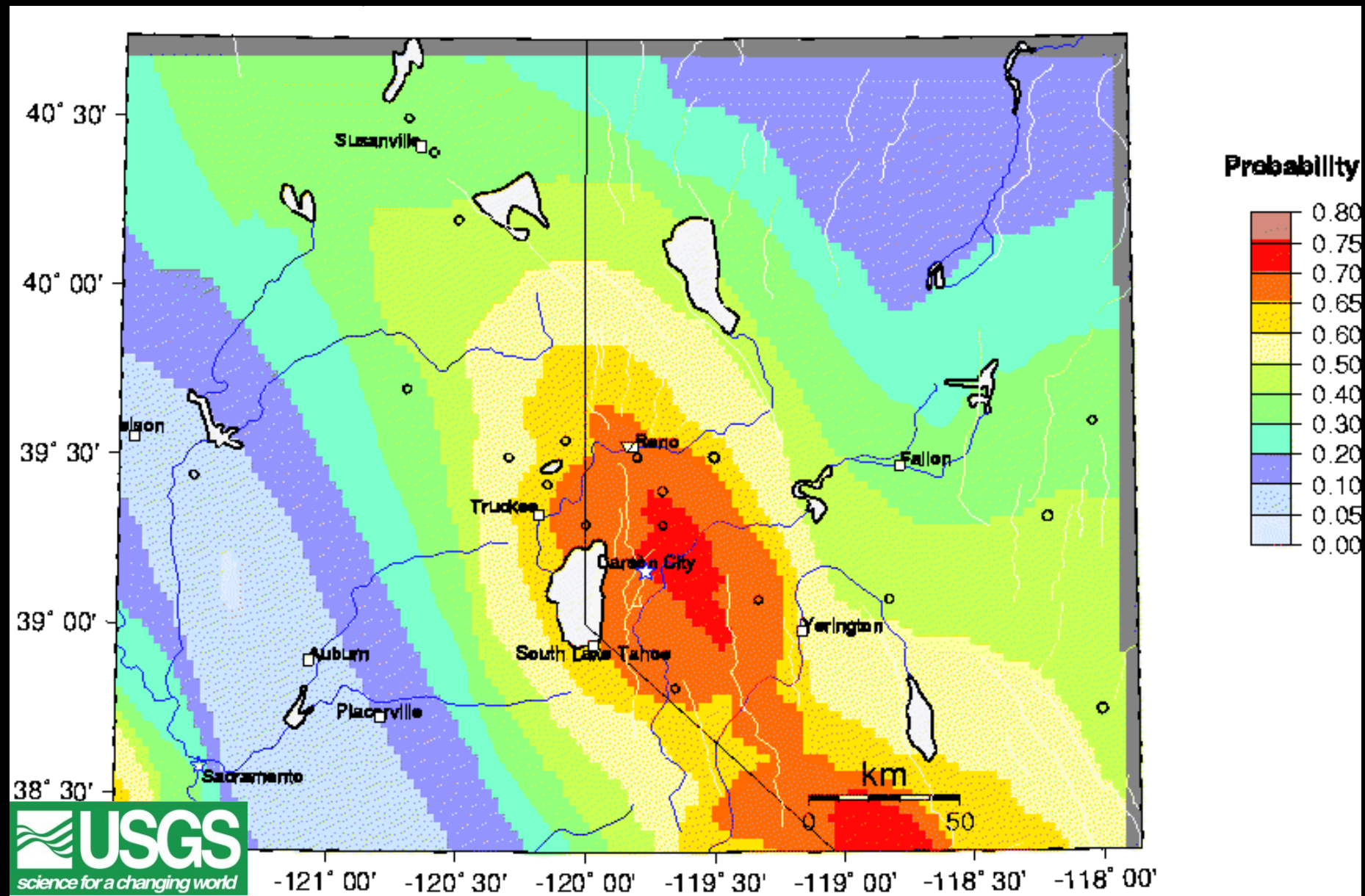


**The probability of a magnitude 6.0 earthquake occurring within 50 km of Wells, Nevada within the next 50 years is approximately 9%.**  
**It happened on 21 February 2008.**



C. dePolo photo

**The probability of a magnitude 6.0 earthquake occurring within 50 km of Fallon within the next 50 years is approximately 35%, 4 times higher than for Wells.**





**Earthquake faults occur throughout Nevada, and potential losses from earthquakes are high for many communities.**

**The consequences of earthquakes can be huge in Nevada, particularly if individuals are not prepared.**

**A. Be prepared to respond.**

**B. Mitigate structural risks, largely through building codes and avoiding faults and areas of liquefaction.**

**C. Mitigate nonstructural risks.**

Unreinforced masonry building (URM)  
that collapsed during the Wells  
earthquake on 21 February 2008



View from back, 20 May 2009

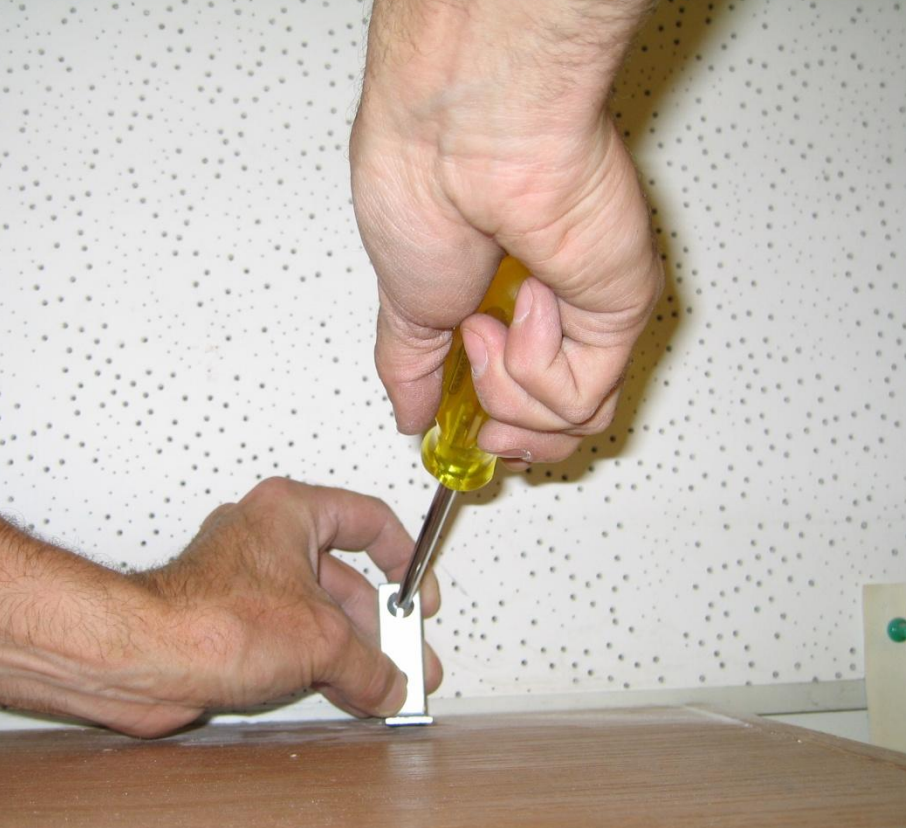


View from front, 20 May 2009





**Nonstructural damage often can be easily prevented.**



**Earthquake-secure bookshelves in the office of the State Geologist**





**Secured computers at the  
Clark County Building Department**

# Thank you!

And thanks to Gary Johnson, Christine Ballard, Heather Armeno, Irene Seeley, Linda D. Goar, and Jordan T. Hastings for their work on the open-file reports (OF 09-8 and 09-9), which are available as online documents at [www.nbmng.unr.edu](http://www.nbmng.unr.edu).

From there, go to online documents at <http://www.nbmng.unr.edu/dox/dox.htm>, then scroll down to OF 09-8 or 09-9. Link to the fault map from OF 09-9.

