2017 UTAH EARTHQUAKE WORKING GROUP MEETINGS
UTAH QUATERNARY FAULT PARAMETERS WORKING GROUP
AGENDA

Wednesday, February 8, 2017
Utah Department of Natural Resources Building, Auditorium (1st floor)
1594 West North Temple, Salt Lake City, Utah

8:00 Breakfast (register at http://2017uewg.eventbrite.com for on-site, hot breakfast)

8:15 Welcome, Overview of Meeting, and Review of Last Year's Activities: Steve Bowman, Utah Geological Survey

8:30 Technical Presentations of Work Completed or In Progress

- 8:30 – Results from the Airport East Trench Site, Taylorsville Fault, West Valley Fault Zone: Adam Hiscock and Mike Hylland, Utah Geological Survey
- 9:00 – Paleoseismic Insight into Normal Fault Segmentation of the Wasatch Fault Zone: Chris DuRoss, U.S. Geological Survey
- 9:30 – Seismic Imaging of the Wasatch Fault Beneath Salt Lake City – Results and New Field Campaign Plans: Lee Liberty, Boise State University
- 10:00 – Investigating the History of Large Earthquakes of the Wasatch Fault at the Traverse Ridge Paleoseismic Site in Draper, Utah: Nathan Toke and others, Utah Valley University

10:30 Break (15 minutes)

10:45 Technical Presentations of Work Completed or In Progress

- 10:45 – Characterization of Segmentation and Long-Term Slip Rates of the Wasatch Fault Zone, Utah: Julie Howe, University of Utah
- 11:00 – Constraints on the Timing, Surface Displacement, and Lateral Extent of the Oquirrh Fault's Most Recent Surface-Rupturing Event from High Resolution Topography: Mike Bunds, Utah Valley University
- 11:15 – Update on Bear River Fault Research: Suzanne Hecker and Dave Schwartz, U.S. Geological Survey
- 11:30 – Updating Quaternary Fault Parameters for the Reno and Las Vegas Areas, Nevada: Rich Koehler, Nevada Bureau of Mines & Geology
- 11:45 – Comparison of Geodetic and Geological/Seismological Moment Rates for the Wasatch Front Region, Utah: Jim Pechmann, University of Utah Seismograph Stations; Y. Zeng and Mark Petersen, U.S. Geological Survey; and Patricia Thomas, Lettis Consultants International

12:00 Lunch (1 hour, register at http://2017uewg.eventbrite.com for on-site lunch)

1:00 Technical Presentations of Work Completed or In Progress

1:00 – Using Consultant Surface Fault Rupture Investigations to Supplement Geologic Mapping in Salt Lake Valley: Adam McKean, Utah Geological Survey

1:15 – The Impact on Seismic Hazard from Modeling the Time-Dependent Behavior of the Wasatch Fault: Ivan Wong and Patricia Thomas, Lettis Consultants International

1:30 – Update of Ongoing Geologic Studies to Evaluate the Seismic Potential of the Joes Valley Fault Zone, East-Central Utah: Lucy Piety, Vanessa King, and Joanna Redwine, U.S. Bureau of Reclamation

1:45 – Utah Geological Survey Earthquake Hazards Projects for the Upcoming Year: Adam Hiscock, Utah Geological Survey

2:00 – Status of the Utah Quaternary Fault and Fold Database and the new UGS/UUSS/UDEM Utah Earthquakes (1850 to 2015) and Quaternary Fault Map: Emily Kleber and Steve Bowman, Utah Geological Survey

2:15 Update of Utah Consensus Quaternary Fault Parameters Discussion
Led by William Lund, Utah Geological Survey, Emeritus
Since the publication of UGS Bulletin 134, a considerable amount of new paleoseismic research in Utah has been published, including the recent results from the Working Group on Utah Earthquake Probabilities. It is time to update the Utah Quaternary Fault Parameters Working Group (UQFPWG) consensus fault parameters database (Lund, 2005) by incorporating currently available, published data.

Current, Published Working Group Consensus Quaternary Fault Parameters
Lund, W.R., 2005, Consensus preferred recurrence-interval and vertical slip-rate estimates – review of Utah paleoseismic-trenching data by the Utah Quaternary Fault Parameters Working Group: Utah Geological Survey Bulletin 134, 109 p., http://ugspub.nr.utah.gov/publications/bulletins/B-134.pdf.

Latest, Available Quaternary Fault Parameters
Lund, W.R., 2014, Hazus loss estimation software earthquake model revised Utah fault database, updated through 2013: Utah Geological Survey Open-File Report 631, 11 p., http://ugspub.nr.utah.gov/publications/open_file_reports/ofr-631.pdf.
Working Group on Utah Earthquake Probabilities, 2016, Earthquake probabilities for the Wasatch Front region in Utah, Idaho, and Wyoming: Utah Geological Survey Miscellaneous Publication 16-3, 164 p., 5 appendices, http://ugspub.nr.utah.gov/publications/misc_pubs/mp-16-3/mp-16-3.pdf.

3:00 Break (15 minutes)

3:15 Update of Utah Consensus Quaternary Fault Parameters Discussion – continued

4:30 Working Group 2018 Fault Investigation Priorities Discussion
See figure 1 for a map of Utah and surrounding area Quaternary faults, table 1 for the UQFPWG list of faults requiring additional investigation, table 2 and figure 2 for the list of faults included in the U.S. Geological Survey National Seismic Hazard Maps and/or the UGS Hazus Utah fault database, table 3 for a status of current paleoseismic investigations for Utah priority faults and fault segments, and tables 4 and 5 for the UQFPWG 2017 fault priority list.

5:00 Adjourn

Working Group Members

Steve Bowman	Utah Geological Survey (UQFPWG Chair)
Rich Briggs	U.S. Geological Survey, Earthquake Hazards Program
Michael Bunds	Utah Valley University
David Dinter	University of Utah, Department of Geology & Geophysics
Chris DuRoss	U.S. Geological Survey, Earthquake Hazards Program
Adam Hiscock	Utah Geological Survey (UQFPWG UGS Liaison)
Michael Hylland	Utah Geological Survey
Susanne Janecke	Utah State University
William Lund	Utah Geological Survey, Emeritus
Johnny MacLean	Southern Utah University
Jim Pechmann	University of Utah Seismograph Stations
Steve Personius	U.S. Geological Survey, Earthquake Hazards Program
Mark Petersen	U.S. Geological Survey, National Seismic Hazard Maps Liaison
Joanna Redwine	U.S. Bureau of Reclamation
Nathan Toke	Utah Valley University
Ivan Wong	Lettis Consultants International
Adolph Yonkee	Weber State University

Publications

Paleoseismic investigations published by the Utah Geological Survey (UGS) are found in the Paleoseismology of Utah Series (http://geology.utah.gov/?page_id=5283). Most of the U.S. Geological Survey (USGS) National Earthquake Hazards Reduction Program funded investigations for Utah that were not published by the UGS are compiled in UGS Miscellaneous Publication 13-03 (http://ugspub.nr.utah.gov/publications/misc_pubs/mp-13-3/mp-13-3.pdf).

Utah Quaternary Fault and Fold Database

The UGS updated the *Utah Quaternary Fault and Fold Database* on July 1, 2015, incorporating new data and a complete review of previously published data through the end of 2013. Users of any Quaternary fault trace and related data acquired from the UGS or the Utah Automated Geographic Reference Center (AGRC) State Geographic Information Database (SGID) in the past are advised to use the updated database available from the AGRC SGID (https://gis.utah.gov/data/geoscience/quaternary-faults/). This single, comprehensive feature class will be periodically updated as new/updated data become available and replaces the six previously available feature classes of variable completeness. A web map application for the database is available at http://geology.utah.gov/resources/data-databases/qfaults/.

Working Group Fault Investigation Priorities

In 2005, the UQFPWG developed a list of Quaternary faults and fault segments (table 1) that the working group identified as requiring additional investigation to adequately characterize Utah's earthquake hazard to a minimally acceptable level. The list was expanded during subsequent UQFPWG meetings in 2007, 2009, 2010, 2011, 2012, 2013, 2014, 2015, and 2016. Table 2 lists the faults and fault segments (earthquake sources) incorporated in the USGS National Seismic Hazard Maps and/or the UGS Hazus Utah fault database (updated through 2013, UGS Open-File Report 631) not listed in table 1 that may need additional investigation. Table 3 lists the current status of paleoseismic investigations for priority faults and fault segments in table 1. Tables 4 and 5 list the 2017 UQFPWG priority faults and fault segments. The UQFPWG will review the 2017 fault-investigation priorities and make changes as necessary for the 2018 priority list.

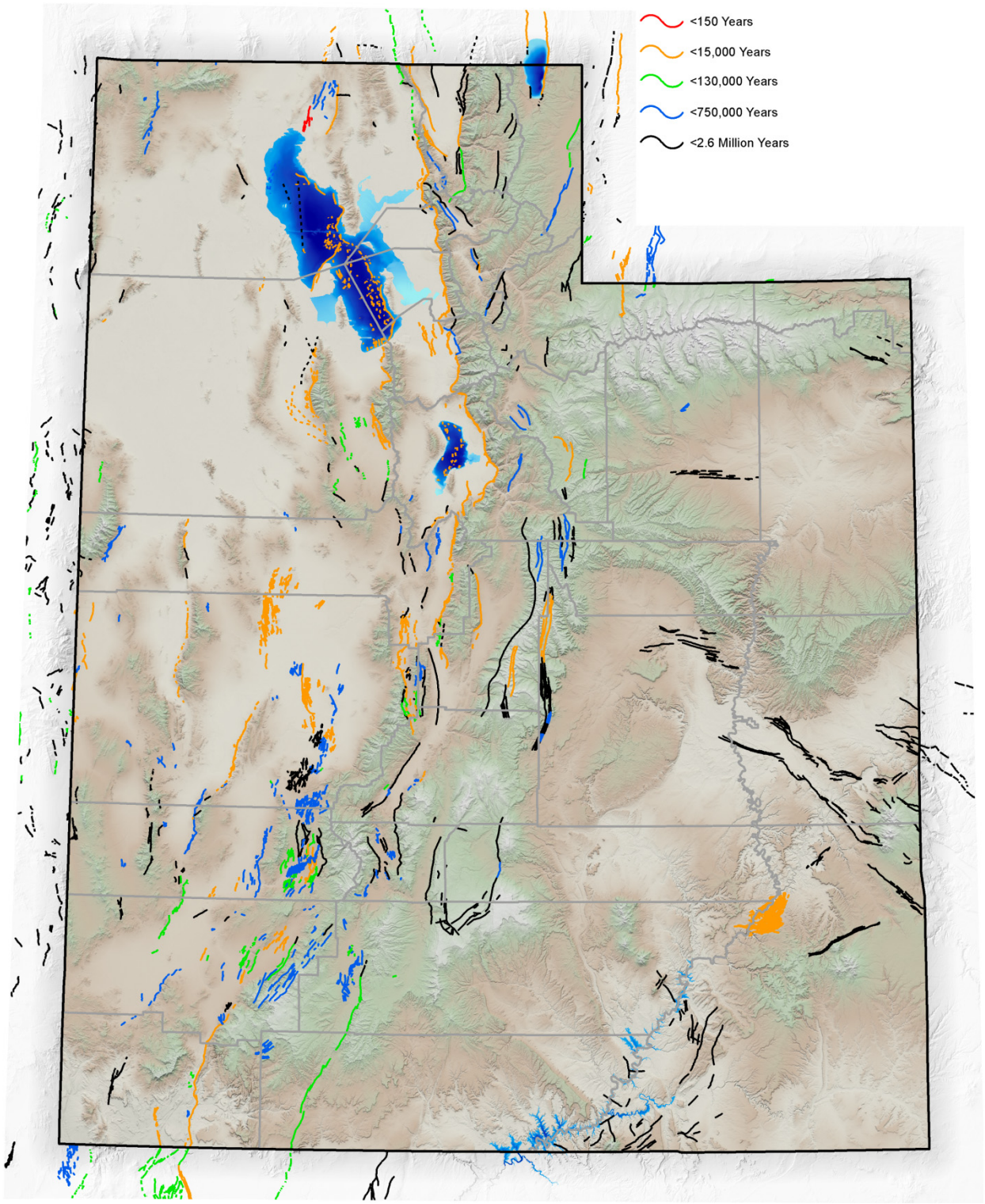

Figure 1. Utah and surrounding area Quaternary faults and folds (for Utah from the *Utah Quaternary Fault and Fold Database* [Utah Geological Survey, 2016], for Nevada faults from the *Quaternary Faults in Nevada* map database [dePolo, 2008], and faults in Arizona, Colorado, Idaho, and Wyoming are from the *Quaternary Fault and Fold Database of the United States* [USGS, 2006]. Additional Quaternary faults may exist that have not been mapped, may not have surface exposures, or were mapped subsequent to the latest database revisions.

Table 1. *Current list of Quaternary faults and fault segments identified by the UQFPWG as requiring additional investigation to adequately characterize Utah's earthquake hazard to a minimally acceptable level.*

Utah Fault or Fault Segment	UQFPWG Priorities	
	2005[1]	Additions
Nephi segment, Wasatch fault zone[2,3]	1	--
West Valley fault zone[2,3]	2	--
Weber segment, Wasatch fault zone[2,3] – most recent event	3	--
Weber segment, Wasatch fault zone[2,3] – multiple events	4	--
Utah Lake faults and folds[3]	5	--
Great Salt Lake fault zone[2,3]	6	--
Collinston and Clarkston Mountain segments, Wasatch fault zone[3]	7	--
Sevier and Toroweap faults[2,3]	8	--
Washington fault zone[3] (includes Dutchman Draw fault[2])	9	--
Cedar City-Parowan monocline (removed 2016)[3,4] and Paragonah fault[2,3]	10	--
Enoch graben[3]	11	--
East Cache fault zone[2,3]	12	--
Clarkston fault[2,3]	13	--
Wasatch Range back-valley faults (includes Morgan fault[2] and Main Canyon fault[3])	14	--
Hurricane fault zone[2,3]	15	--
Levan segment, Wasatch fault zone[2,3]	16	--
Gunnison fault[3]	17	--
Scipio Valley faults[3]	18	--
Faults beneath Bear Lake	19	--
Eastern Bear Lake fault zone[2,3]	20	--
Bear River fault zone[2,3]	--	2007
Brigham City segment, Wasatch fault zone[2,3] – most recent event	--	
Carrington fault, Great Salt Lake fault zone[3]	--	
Provo segment, Wasatch fault zone[2,3] – penultimate event	--	
Rozelle section, East Great Salt Lake fault[3]	--	
Salt Lake City segment, Wasatch fault zone[2,3] – northern part	--	2009
Warm Springs fault/East Bench fault[2,3] subsurface geometry and connection	--	2010
Brigham City segment, Wasatch fault zone[2,3] rupture extent (north and south ends)	--	2011
Northern Provo segment, Wasatch fault zone[2,3] – long-term earthquake record	--	
Hansel Valley fault[2,3]	--	
Acquire new paleoseismic information to address paleoseismic data gaps for the five central segments of the Wasatch fault zone.	--	2012
West Cache fault zone[2,3] – long-term earthquake record	--	2013
Use recently acquired lidar[5] data to more accurately map the traces of the Wasatch, West Valley, and Hurricane fault zones, and search for and map as appropriate previously undiscovered mid-valley Quaternary faults.	--	2014
Acquire high-resolution aerial imagery (lidar, Structure from Motion, etc.)[5] and map high-risk (chiefly urban) Utah hazardous faults. Identify future paleoseismic trench sites.	--	2015
Northern segment of the Oquirrh fault zone[2,3]	--	
Acquire and analyze information on salt tectonics and its relation to the Main Canyon fault[3], Sevier detachment/Drum Mountains fault zone[3], Bear River fault zone[2,3], Spanish Valley (Moab area) faults, Joes Valley fault zone[2,3], Levan and Fayette segments[2,3] of the Wasatch fault zone, Scipio Valley faults[3], and the Gunnison fault[3].	--	2016
Refine the latest Quaternary earthquake chronology for the Topliff Hills fault[3].	--	

[1] Original priorities from the 2005 UQFPWG meeting.
[2] Earthquake source on the USGS National Seismic Hazard Maps.
[3] Earthquake source listed in the UGS Hazus Utah fault database (UGS Open-File Report 631).
[4] Fault removed from the list at the 2016 UQFPWG meeting, based on new information about the structure.
[5] See figure 3 for a map of lidar data availability in Utah and the surrounding area.

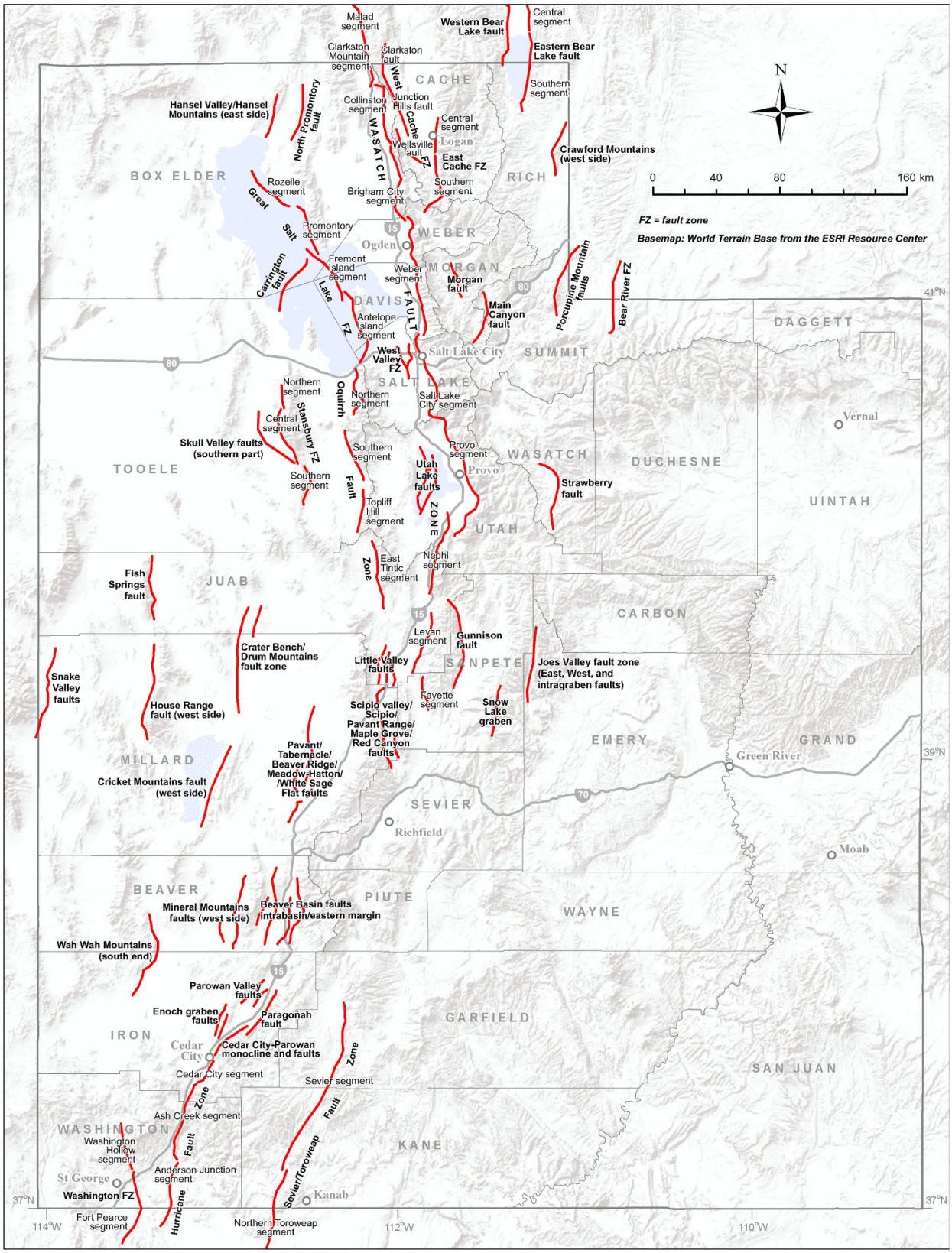

Figure 2. Faults included in the UGS Hazus Utah fault database, except the Cedar City-Parowan monocline and faults were removed in 2016 (see table 1; database updated through 2013, UGS Open-File Report 631).

Table 2. *Earthquake sources (faults and fault segments) in the USGS National Seismic Hazard Maps (NSHM) or the UGS Hazus Utah fault database (UGS Open-File Report 631) not listed in table 1 and that may warrant additional investigation.*

Utah Fault or Fault Segment	Included In	
	NSHM	Utah Hazus
Beaver Basin intrabasin/eastern margin faults	--	Yes
Crater Bench/Drum Mountains fault zone	--	Yes
Crawford Mountains (west side)	--	Yes
Cricket Mountains fault (west side)	--	Yes
Fish Springs fault	--	Yes
House Range (west side) fault	--	Yes
Joes Valley fault zone	Yes	Yes
Little Valley faults	--	Yes
Malad segment, Wasatch fault zone	--	Yes
Mineral Mountains (west side) faults	--	Yes
North Promontory fault	Yes	Yes
Oquirrh fault zone	--	Yes
Oquirrh-Southern Oquirrh Mountains fault zone	Yes	Yes
Parowan Valley faults	--	Yes
Pavant/Tabernacle/Beaver Ridge/Meadow-Hatton/White Sage Flat faults	--	Yes
Porcupine Mountain faults	--	Yes
Scipio/Pavant Range/Maple Canyon/Red Canyon faults	--	Yes
Skull Valley faults (southern part)	--	Yes
Snake Valley faults	--	Yes
Snow Lake graben	--	Yes
Stansbury fault zone	Yes	Yes
Strawberry fault	Yes	Yes
Wah Wah Mountains (south end)	--	Yes
West Cache fault, Wellsville section	Yes	Yes
Western Bear Lake fault	--	Yes

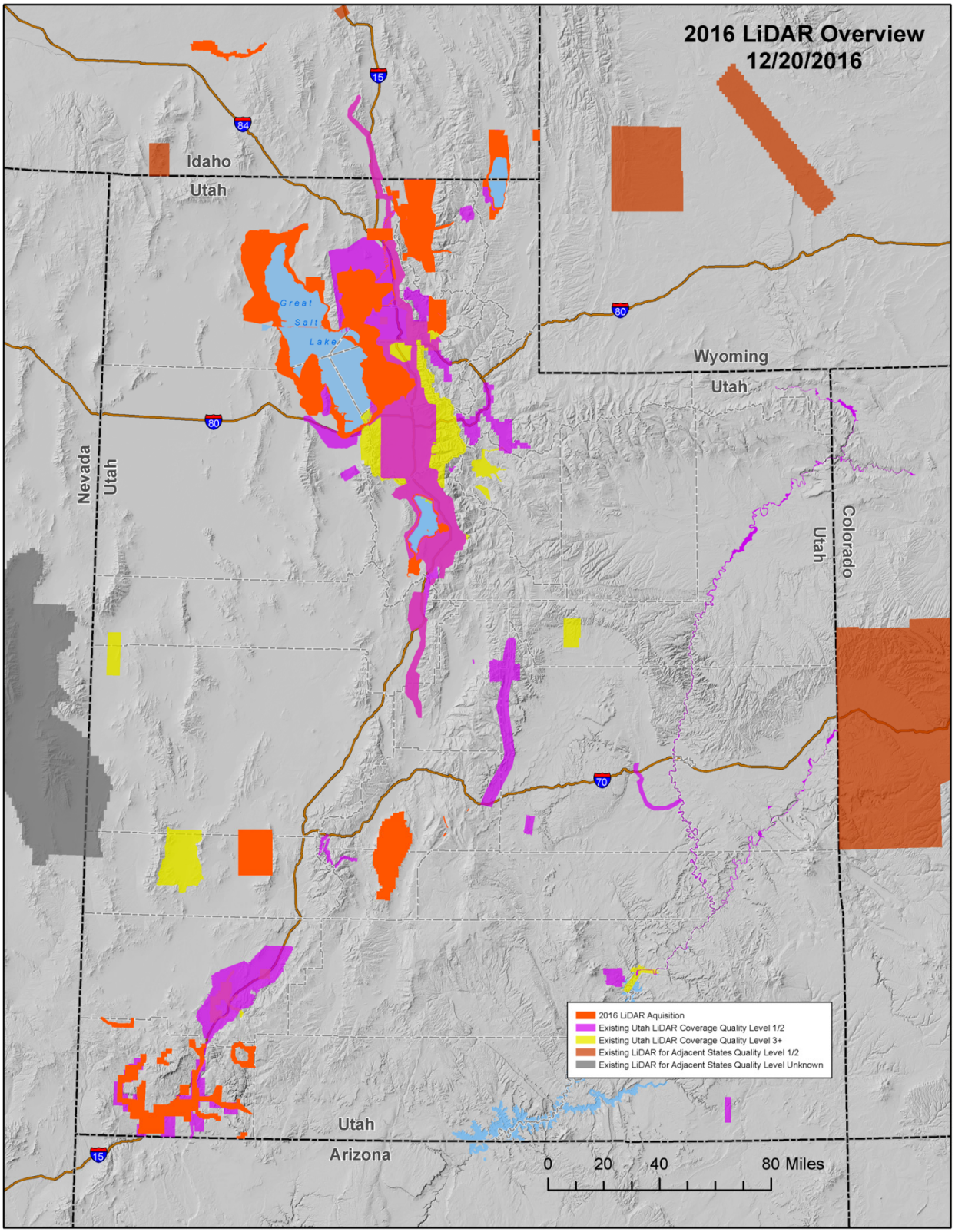

Figure 3. Map of lidar data availability in Utah and the surrounding area. Data acquired in 2016 (bright orange; to be publically available summer 2017), and data acquired prior to 2016 with USGS Quality Level (QL) 1 (0.5 m) or 2 (1 m) in purple and dark orange, QL 3 or greater (≥ 2 m) in yellow, and unknown QL in dark gray.

Table 3. *Current status of paleoseismic investigations for Utah priority faults and fault segments identified by the UQFPWG as requiring additional investigation to adequately characterize Utah's earthquake hazard to a minimally acceptable level.*

Fault or Fault Segment	UQFPWG Priority[1]	Investigations	
		Status[2,3] (as of 12/2016)	Institution[4]
Nephi segment, Wasatch fault zone[5,6]	1	UGS Special Study 124 and 151 USGS SI Map 2966 UGS FTR Report	UGS/USGS
West Valley fault zone[5,6]	2	--	--
Granger fault		UGS Special Study 149	UGS/USGS
Taylorsville fault		Ongoing	UGS/USGS
Weber segment, Wasatch fault zone[5,6] – most recent event	3	UGS Special Study 130	UGS/USGS
Weber segment, Wasatch fault zone[5,6] – multiple events	4	UGS Special Study 130	UGS/USGS
Utah Lake faults and folds[6]	5	UUGG FTR Report	UUGG/BYU
Great Salt Lake fault zone[5,6]	6	UUGG FTR Report	UUGG
Collinston and Clarkston Mountain segments, Wasatch fault zone[6]	7	UGS Special Study 121 Map: UGS Open-File Report 638	UGS
Sevier and Toroweap faults[5,6]	8	UGS Special Study 122	UGS
Washington fault zone[6]	9	UGS Miscellaneous Publication 15-6	UGS
East Cache fault zone[5,6]	12	USU FTR Report	USU
Wasatch Range back-valley faults	14	No activity	--
Main Canyon fault[6]		UGS Miscellaneous Publication 10-5	USBR
Hurricane fault zone[5,6]	15	UGS Special Study 119	UGS
Levan segment, Wasatch fault zone[5,6]	16	UGS Map 229 Map: UGS Open-File Report 640 Proposal submitted, awaiting funding	UGS
Brigham City segment, Wasatch fault zone[5,6] – most recent event	2007	UGS Special Study 142	UGS/USGS
Bear River fault zone[5,6]	2007	AGU Abstracts: 2012 and 2013 USGS ongoing	USGS/UGS
Salt Lake City segment, Wasatch fault zone[5,6] – north part	2009	UGS Special Study 149	UGS/USGS
Hansel Valley fault zone[5,6]	2011	McCalpin (1985), Robinson (1986), McCalpin and others (1992) UUGG ongoing	UUGG
Nephi segment, Wasatch fault zone[5,6] – long-term earthquake record	2012	UGS FTR Report	UGS/USGS
Provo, Salt Lake City and Nephi segments, Wasatch fault zone[5,6] segmentation	2012	--	--
Flat, Maple, and Corner Canyons, and Alpine sites		USGS work ongoing UGS FTR Report	USGS/UGS
Fort Canyon fault, Traverse Mountains salient		Ongoing	UVU
Cottonwood fault, Corner Canyon site		UGS FTR Report	UGS/USGS
West Cache fault zone[5,6] – long-term earthquake record	2013	No activity	--
Using lidar[7] to map portions of the Hurricane[5,6], Wasatch[5,6], and West Valley[5,6] fault zones	2014	UGS Open-File Reports 638 and 640 Additional work ongoing	UGS
Northern segment of the Oquirrh fault zone[5,6]	2015	No activity	--
Acquire high-resolution imagery (lidar, Structure from Motion, etc.)[7] and map Utah hazardous faults.		Wasatch fault zone mapping proposal funded, awaiting award of East and West Cache fault zones mapping proposal.	UGS
		Lidar data for portions of the Bear Lake area, Cache Valley, and Great Salt Lake acquired fall 2016.	UGS/Others/ State of Utah
Refine the latest Quaternary earthquake chronology for the Topliff Hills fault[6].	2016	No activity	--

Fault or Fault Segment	UQFPWG Priority[1]	Investigations	
		Status[2,3] (as of 12/2016)	Institution[4]
Acquire and analyze information on salt tectonics and its relation to the Main Canyon fault[6], Sevier detachment/Drum Mountains fault zone[6], Bear River fault zone[5,6], Spanish Valley (Moab area) faults, Joes Valley fault zone[5,6], Levan and Fayette segments[5,6] of the Wasatch fault zone, Scipio Valley faults[6], and the Gunnison fault[6].	2016	Levan and Fayette segments paleoseismic investigation proposal submitted, awaiting funding.	UGS

[1] See table 1 for complete working group priority list.
[2] FTR (Final Technical Report) to the USGS, Earthquake Hazards Program.
[3] Click on URL links to investigation report files available online.
[4] BYU (Brigham Young University), USBR (U.S. Bureau of Reclamation), USGS (U.S. Geological Survey, Earthquake Hazards Program), UGS (Utah Geological Survey), USU (Utah State University), UUGG (University of Utah Department of Geology & Geophysics), UVU (Utah Valley University).
[5] Earthquake source on the USGS National Seismic Hazard Maps.
[6] Earthquake source listed in the UGS Hazus Utah fault database (UGS Open-File Report 631).
[7] See figure 3 for a map of lidar data availability in Utah and the surrounding area.

Table 4. *Utah Quaternary Fault Parameters Working Group 2017 list of highest priority Quaternary faults or fault segments requiring additional investigation to adequately characterize Utah's earthquake hazard to a minimally acceptable level. The list will be reviewed at this meeting and revised as needed to develop the 2018 priority list.*

Fault or Fault Segment (Not in Priority Order)	Investigations	
	Status (as of 12/2016)[1,2]	Institution
Acquire paleoseismic information to address paleoseismic data gaps for (1) the five central segments of the Wasatch fault zone[3,4], (2) the Oquirrh fault zone[3,4], (3) refining the latest Quaternary earthquake chronology for the Topliff Hills fault, and (4) the East and West Cache fault zones[3,4]. Examples of paleoseismic data to acquire include extent of surface-faulting rupture, earthquake timing, displacement, and subsurface fault geometry.	Nephi segment, Spring Lake and North Creek sites: UGS FTR Report, Special Study ongoing	UGS/USGS
	Provo segment, Flat Canyon site: USGS ongoing, UGS FTR Report	USGS/UGS
	Salt Lake City segment, Corner Canyon site: UGS FTR Report	UGS/USGS
	Provo segment, Dry Creek and Maple Canyon sites: USGS ongoing, UGS FTR Report	USGS/UGS
	Fort Canyon fault, Traverse Mountains salient: ongoing	UVU
	Southern segment, East Cache fault zone: FTR Report	USU/GEO-HAZ
Use recently acquired lidar[5] data to more accurately map the traces of the Wasatch[3,4], West Valley[3,4], and Hurricane[3,4] fault zones, and search for and map as appropriate previously undiscovered mid-valley Quaternary faults.	UGS Open-File Reports 638 and 640 The UGS is mapping portions of the Hurricane, Wasatch, and West Valley fault zones.	UGS
Acquire earthquake timing information for the Utah Lake faults[3] to investigate the relation of earthquakes on that fault system to large earthquakes on the adjacent Provo segment of the Wasatch fault zone[2,3] (independent or coseismic ruptures, fault pairs?).	No activity	--
Acquire high resolution aerial imagery (lidar, Structure from Motion, etc.)[5] and map high-risk (chiefly urban) Utah hazardous faults. Identify future paleoseismic trench sites.	Wasatch fault zone mapping proposal funded, awaiting possible award of East and West Cache fault zones mapping proposal.	UGS
	Lidar data for portions of the Bear Lake area, Cache Valley, and Great Salt Lake acquired fall 2016, data to be publically available summer 2017.	UGS/Others/ State of Utah
Acquire and analyze information on salt tectonics and its relation to the Main Canyon fault[3], Sevier detachment/Drum Mountains[4] faults, Bear River fault zone[3,4], Spanish Valley (Moab area) faults, Joes Valley fault zone[3,4], Levan[3,4] and Fayette segments of the Wasatch fault zone, Scipio Valley faults[4], and the Gunnison fault[4].	Levan and Fayette segments paleoseismic investigation proposal submitted, awaiting funding.	UGS

[1] FTR (Final Technical Report) to the USGS, Earthquake Hazards Program.
[2] Click on URL link to investigation report files available online.
[3] Earthquake source on the USGS National Seismic Hazard Maps.
[4] Earthquake source listed in the UGS Hazus Utah fault database (UGS Open-File Report 631).
[5] See figure 3 for a map of lidar data availability in Utah and the surrounding area.

Table 5. *Utah Quaternary Fault Parameters Working Group 2017 list of other priority faults or fault segments requiring further investigation to adequately characterize Utah's earthquake hazard to a minimally acceptable level. The list will be reviewed at this meeting and revised as needed to develop the 2018 priority list.*

Fault or Fault Segment	UQFPWG Priority[1]	Investigations	
		Status (as of 12/2016)[2]	Institution
Paragonah fault[3,4]	10[5]	No activity	--
Enoch graben[4]	11	Map: UGS Open-File Report 628	UGS
Clarkston fault, West Cache fault zone[3,4]	13	UGS Special Study 98 Mapping proposal submitted, awaiting funding	UGS
Gunnison fault[4]	17	No activity	--
Scipio Valley faults[4]	18	No activity	--
Faults beneath Bear Lake	19	No activity	--
Eastern Bear Lake fault zone[4]	20	No activity	--
Carrington fault, Great Salt Lake fault zone[4]	2007	No activity	--
Rozelle section, Great Salt Lake fault zone[4,6]	2007	No activity	--

[1] See table 1 for complete working group priority list.
[2] Click on URL link to investigation report files available online.
[3] Earthquake source on the USGS National Seismic Hazard Maps.
[4] Earthquake source listed in the UGS Hazus Utah fault database (UGS Open-File Report 631).
[5] The Cedar City-Parowan monocline was removed from Priority 10 in the 2016 meeting, based on new information from geologic mapping in the area (UGS Map 270 and 2016 presentation file).
[6] Previous highest priority fault or fault segment.