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Wasatch fault zone, Weber section (Class A) No. 2351e

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Compiled in cooperation with the Utah Geological Survey

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Synopsis	**General:** The Wasatch fault zone is one of the longest and most tectonically active normal faults in North America. The fault zone shows abundant evidence of recurrent Holocene surface faulting and has been the subject of detailed studies for over three decades. Half of the estimated 50 to 120 post-Bonneville surface-faulting earthquakes in the Wasatch Front region have been on the Wasatch fault zone. Earthquake-timing, recurrence-interval, and displacement-rate estimates for the Brigham City, Weber, Salt Lake City, Provo, Nephi, and Levan sections of the Wasatch fault

	zone reflect the consensus values of the Utah Quaternary Fault Parameters Working Group (Lund, 2005 #6733). Lund (2005 #6733) did not evaluate the Clarkston Mountain, Collinston, and Fayette sections due to a lack of fault-trench data. The preferred values reported in Lund (2005 #6733) approximate mean values based on available paleoseismic-trenching data, and the minimum and maximum values approximate two-sigma (5th and 95th percentile) confidence limits. The confidence limits incorporate both epistemic (data limitation) and aleatory (process variability) uncertainty (Lund, 2005 #6733). **Sections:** This fault has 10 sections. The nearly 350-km-long Wasatch fault zone has traditionally been divided into seismogenic segments that are thought to rupture at least somewhat independently. The established model is used to define the sections described in this report. The southern eight sections are entirely in Utah. To the north, the Clarkston Mountain section straddles the state line between Idaho and Utah and the northernmost (Malad City) section is entirely in Idaho. The chronology of surface-faulting earthquakes on the Wasatch fault is one of the best dated chronologies in the world and includes 16 earthquakes since 5.6 ka, with an average repeat time of 350 yr. Four of the central five sections [2351e-h] ruptured in the last hundreds to about a thousand years ago, whereas the next section to the north, Brigham City [2351d], has not ruptured in the past 2,125 yr. Vertical displacement rates of 1–2 mm/yr are typical for the central sections during Holocene time. In contrast, middle and late Quaternary (<150–250 ka) rates on these sections are about an order of magnitude lower. This substantial change in the displacement rate may indicate a causal relation between increased Holocene rates of deformation and isostatic rebound/crustal relaxation following deep lake cycles such as Bonneville.
Name comments	**General:** **Section:** All section names follow those proposed by Machette and others (1991 #189; 1992 #607).
County(s) and State(s)	DAVIS COUNTY, UTAH WEBER COUNTY, UTAH
Physiographic province(s)	BASIN AND RANGE
Reliability of	Good

location	Compiled at 1:50,000 scale. *Comments:* From 1:50,000 scale mapping of Nelson and Personius (1993 #620).
Geologic setting	Generally north-trending, range-bounding normal fault along the western side of the Malad Range (Clarkston Mountain), Wellsville Mountains, Wasatch Range, and San Pitch Mountains. The Wasatch fault zone marks the eastern boundary of the Basin and Range in northern Utah. Alluvial-fan deposits and lacustrine deposits of Pleistocene Lake Bonneville dominate the surficial geology along the fault zone.
Length (km)	This section is 56 km of a total fault length of 357 km.
Average strike	N6°W (for section) versus N10°W (for whole fault)
Sense of movement	Normal
Dip	68–78° W. *Comments:* 68–78° W. measured in Kaysville trench A (Swan and others, 1980 #88) and 68–70° W. measured in re-opened Kaysville trench A (McCalpin and Forman, 1994 #4626) in lacustrine deposits juxtaposed against slope colluvium.
Paleoseismology studies	One of the earliest detailed paleoseismic investigations of the Wasatch fault (1978) was conducted on the Weber section between Bair (or Baer; variant spelling) and Shepard Creeks, about 3 km east-southeast of Kaysville. This study was particularly important from the standpoint of developing two fundamental concepts of modern paleoseismology: colluvial-wedge stratigraphy (Swan and others, 1980 #88), and characteristic earthquakes (Schwartz and Coppersmith, 1984 #347). The Kaysville site (site 2351-1) included five test pits and seven trenches, which exposed evidence for at least three surface-faulting earthquakes since about 12 ka (Swan and others, 1980 #88; Swan, Schwartz, and others, 1981 #347). A single radiocarbon age estimate on detrital charcoal indicated that two earthquakes had occurred since 1,580±150 yr B.P. The Kaysville site was reoccupied in 1988 (site 2351-18) to refine the paleoearthquake chronology; a trench was excavated parallel to and slightly deeper than the 1978 trench A. Detailed stratigraphic analysis and geometrical reconstructions based on data from both

	the 1978 and 1988 trenches indicate five or six surface-faulting earthquakes since 13 ka (McCalpin and others, 1994 #3167). Radiocarbon and thermoluminescence age estimates on bulk-soil samples from paleosols constrain the timing of the three youngest faulting events. The earlier two or three events could not be directly dated because stratigraphic evidence for these postulated events was not exposed. At Garner Canyon (site 2351-10), 2 km south of Coldwater Canyon near North Ogden, an artificial exposure across the fault revealed stratigraphic evidence for four surface-faulting earthquakes (Nelson and others, 1987 #5001; Machette and others, 1992 #607; Nelson and Personius, 1993 #620). Radiocarbon age estimates on bulk-soil samples from paleosols developed on colluvial wedges constrain the timing of the two youngest paleoearthquakes. In 1986, five trenches were excavated across multiple scarps of the Weber section at the East Ogden site (site 2351-11), about 1.5 km north-northwest of the mouth of Ogden Canyon. The trenches exposed evidence for three, and possibly four, surface-faulting earthquakes since middle Holocene time (Nelson, 1988 #4628; Machette and others, 1992 #607). Radiocarbon age estimates on bulk-soil samples from paleosols developed on colluvial wedges provided poor constraint on paleoearthquake timing (Nelson, 1988 #4628), but thermoluminescence age estimates on fault-related colluvial sediments reduced some of the uncertainty (Forman and others, 1991 #542). One of the trenches (EO-3) showed stratigraphic evidence for a small-displacement event within the past 500-600 years, but obscure stratigraphic relations and problems with radiocarbon age estimates make interpretation of this event tenuous (Nelson, 1988 #4628). Although Nelson and Personius (1993 #620) characterize this event as "probable," it has not been observed in any other trenches on the Weber section.
Geomorphic expression	West-facing scarps along the western base of the Wasatch Range. The Weber section is the longest Wasatch fault zone section. The southern boundary of the section is at the prominent Salt Lake salient, but fault scarps in this area are easily confused with nontectonic features and scarp distribution is less certain (Machette and others, 1992 #607). The northern section boundary is at the Pleasant View salient. Scarp heights in the northern part of the Weber section suggest a higher rate of late Holocene faulting than on the Brigham City section to the north (Machette

	and others, 1992 #607). Net displacement measured at three sites (Garner Canyon, East Ogden, and Kaysville), which are about 20 km apart, is from 1.0 to 3.5 m per event. Individual faulting events may not have ruptured the entire section, although the general timing of events at the three sites appears similar.
Age of faulted surficial deposits	Holocene alluvial fan, debris-flow and stream deposits; late Pleistocene glacial, lacustrine, and alluvial fan deposits, and middle (?) Pleistocene alluvial-fan deposits.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Lund (2005 #6733) reports the following earthquake chronology, which includes the four-earthquake model of McCalpin and Nishenko (1996 #6770) (events W, X, Y, and Zb), and honors the Kaysville and East Ogden trench site results, which indicate a most recent (partial rupture ?) event (Za) at ~0.5 ka (Machette and others, 1992 #4529; Nelson and Personius, 1993 #620; McCalpin and others, 1994 #3167). Uncertainties in the event ages incorporate both geologic and laboratory error. Za 500±300 cal yr B.P. (partial section rupture ?) Zb 950±450 cal yr B.P. Y 3000±700 cal yr B.P. X 4500±700 cal yr B.P. W 6100±700 cal yr B.P
Recurrence interval	1400 yr (preferred); minimum 500, maximum 2400 yr (<6.1 ka) *Comments:* Consensus recurrence-interval range reported in Lund (2005 #6733), based on the four interevent times between the five youngest paleoearthquakes on the Weber section (W-Za). The minimum and maximum values reflect the possibility of an interevent time as short as 500 years; however, if a partial rupture has occurred, then the short recurrence interval may only apply to an undefined part of the section (Lund, 2005 #6733).
Slip-rate category	Between 1.0 and 5.0 mm/yr *Comments:* Lund (2005 #6733) indicates a Holocene paleoseismic slip rate of 1.2 mm/yr (preferred) and a consensus minimum-maximum range of 0.6–4.3 mm/yr, based on the displacement measurements of McCalpin and others (1994 #3167) and Nelson and Personius (1993 #620), and the four recurrence intervals between events W and Za. The long-term

	geologic slip rate is as high as 2.0 mm/yr based on offset Bonneville-phase deposits (~18 ka), and up to 1.3 mm/yr based on displaced Provo-phase deposits (<16.2 ka). Field and aerial photo-derived scarp profiles by Nelson and Personius (1993 #620) indicate that latest Pleistocene and Holocene slip is greatest along the central and northern part of the section, decreasing toward the ends.
Date and Compiler(s)	2004 Bill D. Black, Utah Geological Survey Christopher B. DuRoss, Utah Geological Survey Michael D. Hylland, Utah Geological Survey Greg N. McDonald, Utah Geological Survey Suzanne Hecker, U.S. Geological Survey
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