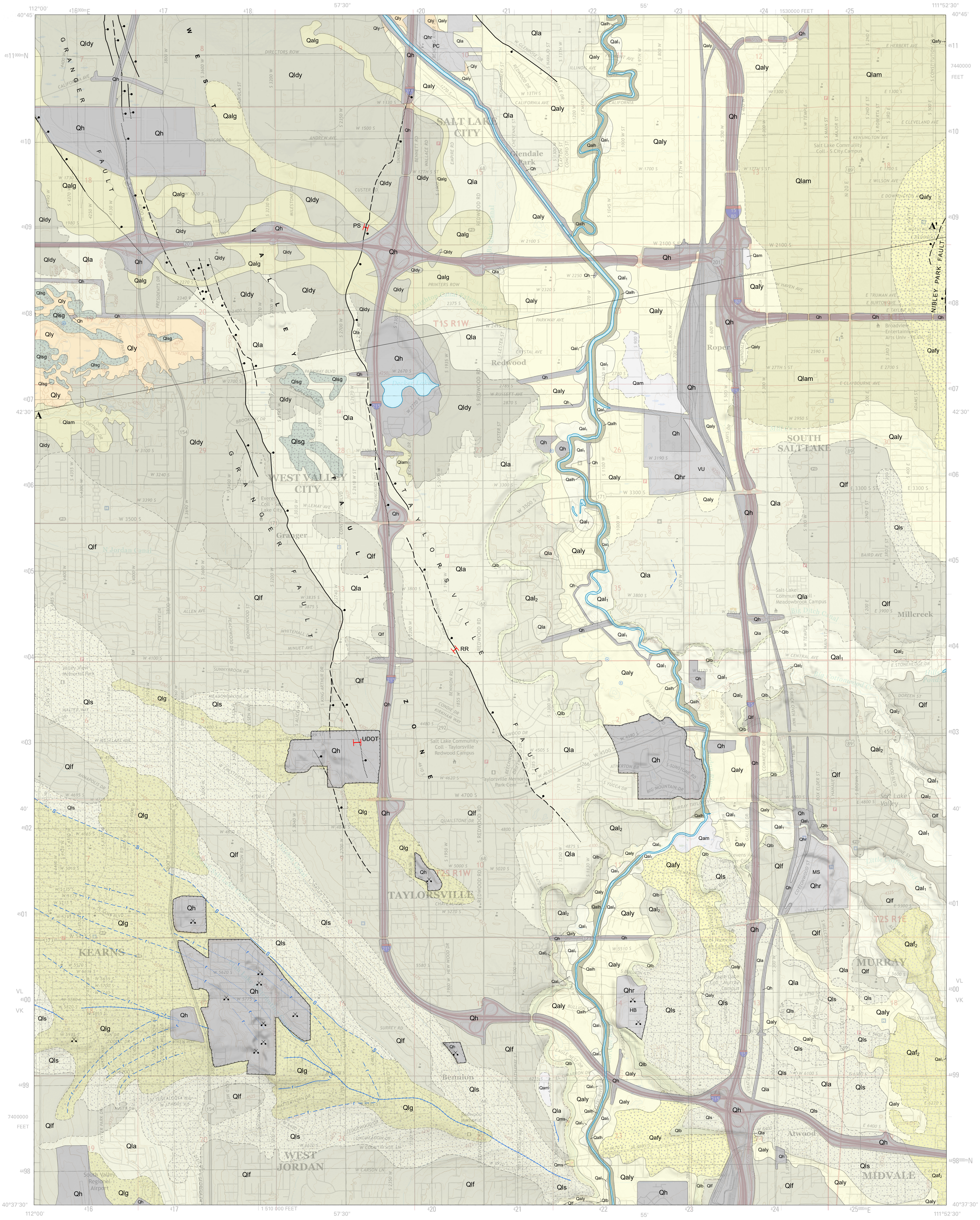
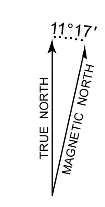
UTAH GEOLOGICAL SURVEY
a division of
Utah Department of Natural Resources



Although this product represents the work of professional scientists, the Utah Department of Natural Resources, Utah Geological Survey, makes no warranty, expressed or implied, regarding its suitability for a particular use, and does not guarantee accuracy or completeness of the data. The Utah Department of Natural Resources, Utah Geological Survey, shall not be liable under any circumstances for any direct, indirect, special, incidental, or consequential damages with respect to claims by users of this product. Geology intended for use at 1:24,000 scale.

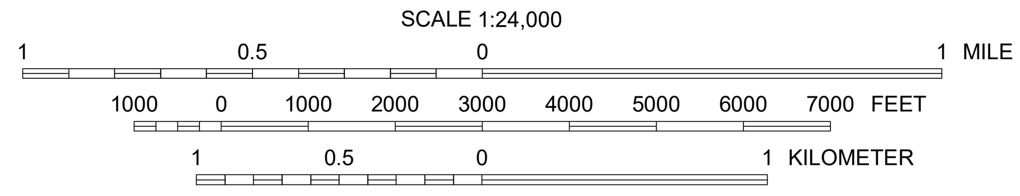
The geologic map of the Salt Lake City South quadrangle was funded by the Utah Geological Survey and the U.S. Geological Survey, National Cooperative Geologic Mapping Program, through USGS STATEMAP award number G16AC00191 (2016). The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

This map was created from geographic information system (GIS) files. Persons or agencies using these data specifically agree not to misrepresent the data, nor to imply that changes they made were approved by the Utah Geological Survey, and should indicate the data source and any modifications they make on plots, digital copies, derivative products, and in metadata.



APPROXIMATE MEAN MAGNETIC DECLINATION, 2019

SCALE 1:24,000



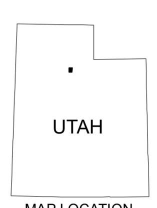
CONTOUR INTERVAL 5 FEET

GEOLOGIC MAP OF THE SALT LAKE CITY SOUTH QUADRANGLE, SALT LAKE COUNTY, UTAH

by

Adam P. McKean

2019



MAP LOCATION

Base from USGS US Topo Salt Lake City South 7.5′ Quadrangle (2017)
Projection and datum for base map and GIS data are UTM NAD83. To conform to adjoining geologic maps, the geology is mapped to the 7.5' boundary of older UTM NAD27 base maps to the west and newer UTM NAD83 base maps to the east. The geology is accurately shown relative to cultural and topographic features on the US Topo base map. Shaded relief generated from 10-meter NED.

Project Manager: Jon K. King
Aerial photo and field mapping of geology: Adam P. McKean, 2016-2017
GIS and Cartography: Adam P. McKean and Lori Steadman

Utah Geological Survey
1594 West North Temple, Suite 3110
Salt Lake City, UT 84116
(801) 537-3300
geology.utah.gov

1	2	3
4		5
6	7	8

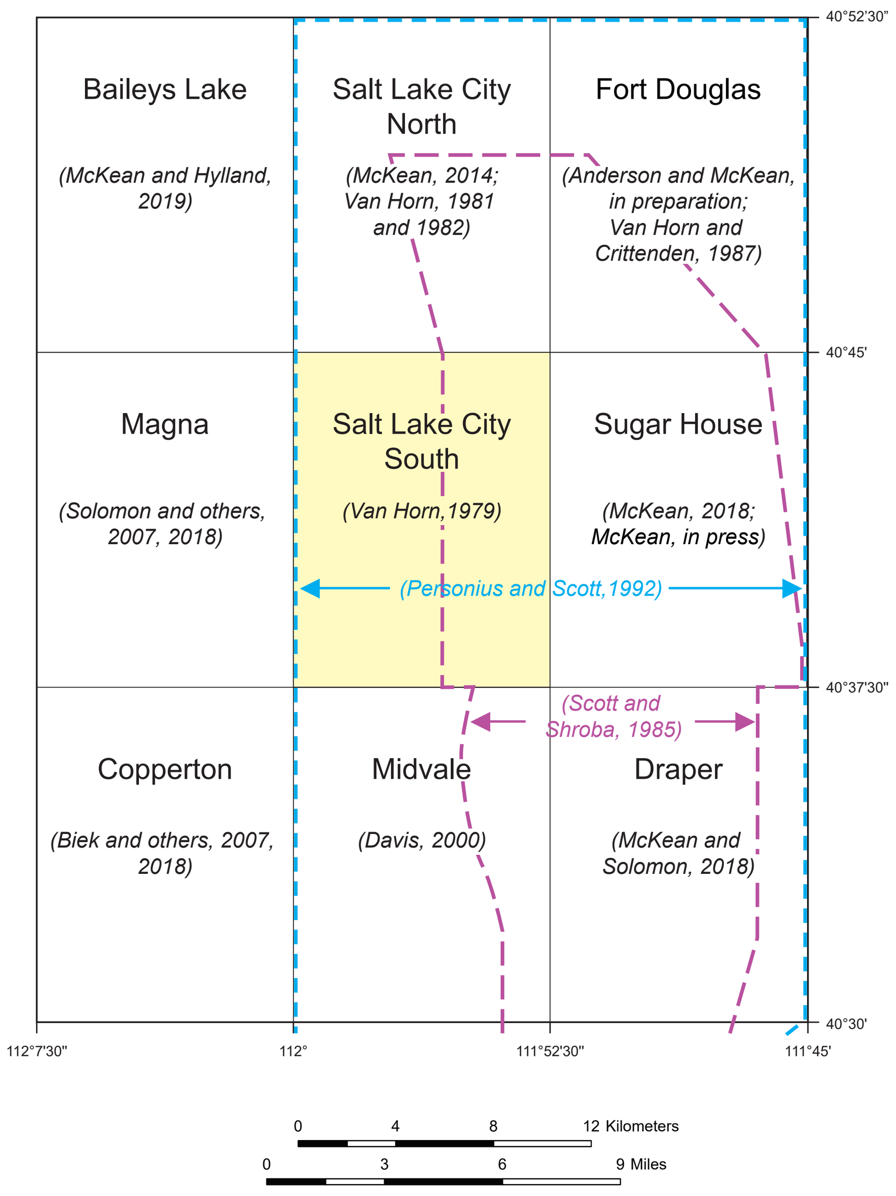
1. Baileys Lake
2. Salt Lake City North
3. Fort Douglas
4. Magna
5. Sugar House
6. Copperton
7. Midvale
8. Draper

ADJOINING 7.5' QUADRANGLE NAMES

Utah Geological Survey
a division of
Utah Department of Natural Resources

MAP UNITS

- Qal_1 — Active floodplain and stream deposits
- Qal_2 — Level-2 floodplain and stream deposits
- Qaly — Young floodplain and stream deposits, undivided
- Qalg — Stream deposits related to Gilbert-episode lake and/or Great Salt Lake
- Qaf_2 — Level-2 alluvial-fan deposits
- Qafy — Younger alluvial-fan deposits, undivided
- Qh — Fill and disturbed land
- Qhr — Remediated land
- Qly — Young lacustrine deposits
- Qlsg — Lacustrine sand and silt related to Gilbert-episode lake
- Qlf — Lacustrine silt and clay related to Lake Bonneville
- Qls — Lacustrine sand and silt related to Lake Bonneville
- Qlg — Lacustrine gravel and sand related to Lake Bonneville
- Qlb — Transgressive-phase deposits of Lake Bonneville, undivided
- Qms — Landslide deposits
- Qalh — Historical alluvial deposits and artificial levees, undivided
- Qam — Alluvial and marsh deposits, undivided
- Qla — Lacustrine and alluvial deposits, undivided
- Qlam — Lacustrine, alluvial, and marsh deposits, undivided
- Qldy — Young lacustrine and deltaic deposits

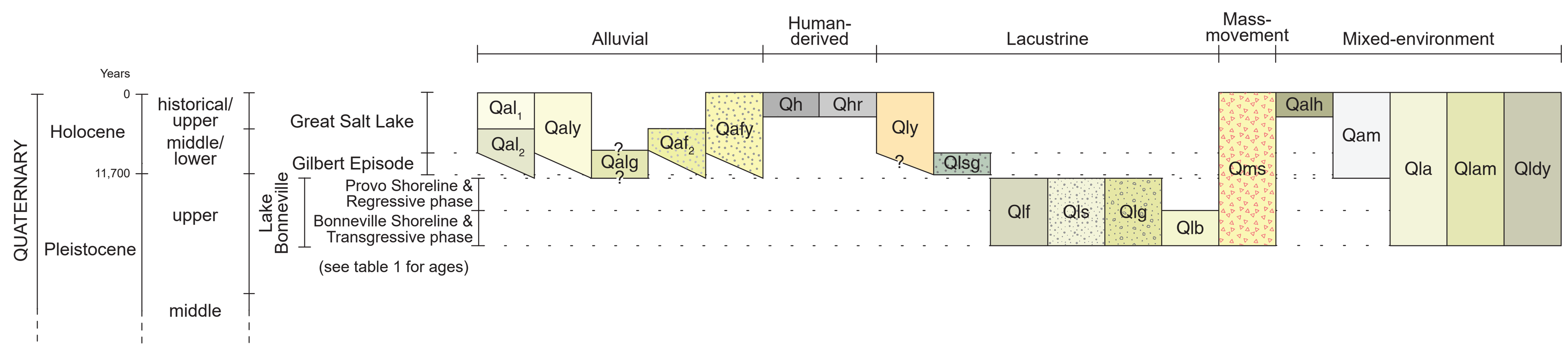


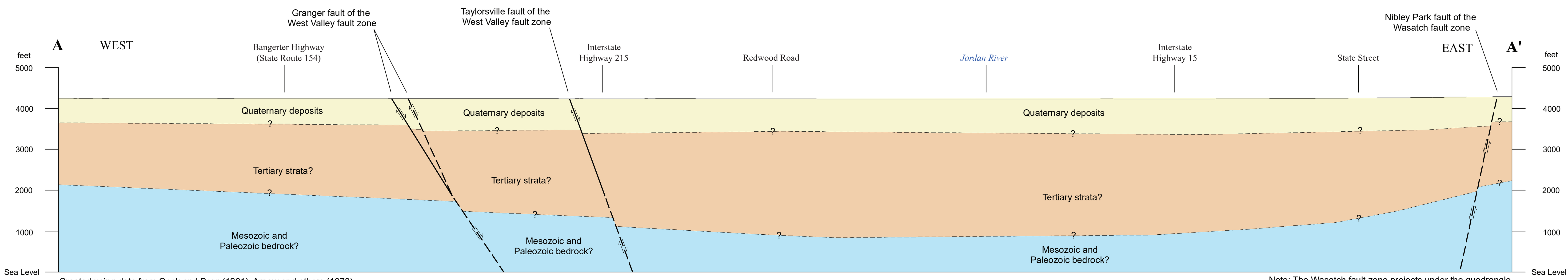
Index map showing selected geologic maps available for the Salt Lake City South and surrounding 7.5' quadrangles.

GEOLOGIC SYMBOLS

- Contact – Dashed where approximately located; dotted where concealed; queried on cross section where uncertain
- Normal fault – Dashed where approximately located, dotted where concealed; bar and ball on downthrown side; queried where existence uncertain; arrows on cross section indicate direction of relative movement
- Lacustrine shorelines – Stansbury and regressive shorelines of the Bonneville lake cycle, mapped at the top of constructional bars and barrier beaches; may coincide with geologic contacts
- S — Stansbury shoreline – Dashed where approximately located
- r — Regressive shorelines (present below the Provo shoreline) – Dashed where approximately located, dotted where destroyed but present on older photographs; some shorelines mapped as regressive could have formed during the transgressive phase
- Crest of lacustrine barrier bar or spit – Dotted where destroyed but present on older photographs
- Alluvial terrace scarp – Dashed where approximately located (only mapped in two locations where prominent)
- A — A' Line of cross section
- Outline of sand and gravel pit operations, contact based on 2016 orthophotography (Utah Automated Geographic Reference Center, 2016), some pits reclaimed and now used for other purposes
- Water well (selected)
- Sand and gravel pit
- UDOT — Trench sites for paleoseismic investigations: UDOT - Utah Department of Transportation (Keaton and others, 1987); PS - Pioneer Square (Keaton and others, 1987; Keaton and Currey, 1989); RR - 4100 South Street and Redwood Road (Keaton and others, 1987)
- VU — Selected environmentally remediated sites (Qhr): VU - Vitro Corporation of America uranium and vanadium mill; MS - Murray lead smelter site; PC - Portland Cement kiln dust #2 and #3 site; HB - Highland Boy copper smelter site

CORRELATION CHART





Created using data from Cook and Berg (1961), Arnow and others (1970), Meiiji Resource Consultants (1983), Zoback (1983), Case (1985), Hill and others (1990), and data from the PACES (2012) gravity database and UGS, undated.

Note: The Wasatch fault zone projects under the quadrangle

GEOLOGIC MAP OF THE SALT LAKE CITY SOUTH QUADRANGLE, SALT LAKE COUNTY, UTAH

by Adam P. McKean

MAP 283DM
UTAH GEOLOGICAL SURVEY
a division of
UTAH DEPARTMENT OF NATURAL RESOURCES
2019

Blank pages are intentional for printing purposes

GEOLOGIC MAP OF THE SALT LAKE CITY SOUTH QUADRANGLE, SALT LAKE COUNTY, UTAH

by
Adam P. McKean

Cover photo: View to the east of an abandoned Jordan River channel (oxbow lake) and wetlands at the Kennecott Nature Center of Murray southwest of the intersection of 4800 South and Murray Boulevard.

Suggested citation:
McKean, A.P., 2019, Geologic map of the Salt Lake City South quadrangle, Salt Lake County, Utah: Utah Geological Survey Map 283DM, 13 p., 2 plates, scale 1:24,000, https://doi.org/10.34191/M-283DM.

MAP 283DM
UTAH GEOLOGICAL SURVEY
a division of
UTAH DEPARTMENT OF NATURAL RESOURCES
2019

STATE OF UTAH
Gary R. Herbert, Governor

DEPARTMENT OF NATURAL RESOURCES
Brian C. Steed, Executive Director

UTAH GEOLOGICAL SURVEY
R. William Keach II, Director

PUBLICATIONS
contact
Natural Resources Map & Bookstore
1594 W. North Temple
Salt Lake City, UT 84116
telephone: 801-537-3320
toll-free: 1-888-UTAH MAP
website: utahmapstore.com
email: geostore@utah.gov

UTAH GEOLOGICAL SURVEY
contact
1594 W. North Temple, Suite 3110
Salt Lake City, UT 84116
telephone: 801-537-3300
website: https://geology.utah.gov

This geologic map was funded by the Utah Geological Survey and the U.S. Geological Survey, National Cooperative Geologic Mapping Program, through USGS STATEMAP award number G16AC00191 (2016). The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

CONTENTS

TABLES

GEOLOGIC MAP OF THE SALT LAKE CITY SOUTH QUADRANGLE, SALT LAKE COUNTY, UTAH

by
Adam P. McKean

INTRODUCTION

The Salt Lake City South 7.5' quadrangle is located in central Salt Lake County (see figure on plate 2). The quadrangle contains parts of Salt Lake City, City of South Salt Lake, West Valley City, City of Taylorsville, Murray City, Kearns Township, City of West Jordan, Midvale City, City of Millcreek, and the northern part of South Valley Regional Airport. In addition to the metropolitan areas, the Jordan River, Mill Creek, and Big and Little Cottonwood Creeks flow through the quadrangle. No bedrock is exposed in the quadrangle. The study area contains the southern parts of the Granger and Taylorsville faults of the West Valley fault zone. The surficial geology is composed of alluvial, deltaic, lacustrine, marsh, and mass-movement deposits. The Salt Lake City South quadrangle was mapped partly to provide the basis for identifying and delimiting potential geologic hazards in future derivative Utah Geological Survey (UGS) geologic hazard mapping of urban and rapidly developing areas as part of the UGS Geologic Hazards Mapping Initiative (Christenson and Ashland, 2007; Castleton and McKean, 2012).

GEOLOGY

Surficial unconsolidated geologic deposits within the quadrangle consist of alluvial, lacustrine, deltaic, marsh, and mass-movement deposits of Quaternary age. Lacustrine and deltaic sediments were deposited in late Pleistocene Lake Bonneville (30 to 13 ka), the Gilbert-episode lake (~11.5 ka), and Holocene Great Salt Lake (since ~11 ka) (see table 1; all ages in this report are in calibrated years). Following Oviatt (2014), the Gilbert-episode lake is regarded as a separate lake, rather than a phase of the Bonneville or Great Salt Lake cycles. Table 1 is based on features produced by Lake Bonneville, the Gilbert-episode lake, and Great Salt Lake, and provides time constraints and elevations for many geologic units.

Lake Bonneville transgressive, overflow, and regressive deposits (Qlf, Qls, Qlg, Qlb) are likely the oldest exposed Quaternary deposits in the quadrangle. Following regression of Lake Bonneville, streams flowed northwest into the Gilbert-episode lake and Holocene Great Salt Lake, forming alluvial, lacustrine, and deltaic deposits (Qlsg, Qla, Qldy, Qalg). During and after the regression of Lake Bonneville, the Jordan River and Big and Little Cottonwood Creeks incised through the older alluvial and lacustrine deposits forming Holocene floodplains, alluvial fans, and marsh deposits (Qal_1, Qal_2, Qaly, Qafy, Qam, Qlam). Shallow Holocene (including historical) lakes (Qly) occupied topographically low areas.

A number of mapped and unmapped geologic hazards are present in the quadrangle, including small landslide deposits (Qms) and surface fault ruptures (scarps). The quadrangle contains the Granger and Taylorsville normal faults, which have Holocene scarps and form the north-south-trending, predominantly east-dipping West Valley fault zone. The West Valley fault zone is partially antithetic to and likely coseismic with or triggered by faulting on the Salt Lake City segment of the Wasatch fault zone (Hylland and others, 2014; DuRoss and Hylland, 2015). On the eastern boundary of the quadrangle the west-dipping Nibley Park fault of the Wasatch fault zone, enters the quadrangle. The East Bench fault of the Salt Lake City segment of the Wasatch fault zone dips westward beneath the quadrangle. These faults and earthquake-related hazards are described and discussed in more detail in the "Surface Fault Rupture" subsection of the "Selected Geologic Hazards" section of this report.

Human disturbances are widespread throughout the quadrangle; areas of large disturbance are mapped as Qh and environmentally remediated land is mapped as Qhr, which is an important distinction in this quadrangle due to remediated smelting and other industrial operations. Many of these sites have been redeveloped following their remediation work. The Jordan River has been modified significantly by channelization and diversion by levee construction compared to its pre-development floodplain, as seen by the difference of Qal_1 (pre-1937 floodplain) and Qalh (historical modified channel and levees). See map unit descriptions for more information regarding the characteristics of each geologic unit.

Table 1. *Ages of major shoreline occupations of Lake Bonneville, Gilbert-episode lake, and Great Salt Lake and shoreline elevations in the Salt Lake City South quadrangle.*

Lake Cycle and Phase	Shoreline (map symbol)	Age		Elevation feet (meters)
		radiocarbon years (^{14}C yr B.P.)	calibrated years (cal yr B.P.)[1]	
Lake Bonneville				
Transgressive phase	Stansbury (S) shorelines	22,000–20,000[2]	26,000–24,000	4480–4500 (1365–1372)
	Bonneville (B)	~15,200–15,000[3]	~18,500–18,000	Not present[4]
	flood			
Overflowing phase	Provo (P)	15,000–12,600[5]	18,000–15,000	Not present[4]
Regressive phase	Regressive shorelines (r)	12,600–11,500[5]	15,000–13,000	~4500–4600+ (~1371–1402+)
Gilbert-episode lake	Gilbert	10,000[6]	11,500	Not recognized [7]
Great Salt Lake				
	early Holocene highstand	9700–9400[8]	11,000–10,500	Not recognized [7]
	late Holocene highstand	4200–2100[9]	5000–2000	Not present[4]
	Historical highstand		late 1860s to early 1870s and 1986–87[10]	Not present[4]

[1] All calibrations made using OxCal ^{14}C calibration and analysis software (version 4.3.2; Bronk Ramsey, 2009; using the IntCal13 calibration curve of Reimer and others, 2013), rounded to the nearest 500 years. B.P. = before present, meaning the number of years before A.D. 1950

[2] Oviatt and others (1990)

[3] Oviatt (2015), Miller (2016), and references therein

[4] Shoreline ages are provided for reference only, as they are present only above and below the highest and lowest elevations, respectively, in the quadrangle. In the vicinity of the quadrangle, Lake Bonneville highstand is at 5180 to 5200 feet (1579–1585 m), Provo shoreline is at 4820 to 4860 feet (1469–1482 m), and Great Salt Lake late Holocene highstand is at 4217 to 4221 (1285–1287 m) and historical highstand is at 4212 feet (1284 m)

[5] Godsey and others (2005, 2011), Oviatt (2015), Miller (2016) for the timing of the occupation of the Provo shoreline and subsequent regression of Lake Bonneville to near Great Salt Lake level. Alternatively, data in Godsey and others (2005) suggest that regression began shortly after 16.5 cal ka (for example sample Beta-153158, with an age of 13,660 ± 50 ^{14}C yr B.P. [16.5 cal ka] from 1.5 m below the Provo shoreline). Also, lacustrine carbonate deposits in caves reported by McGee and others (2012) seem to support an earlier Lake Bonneville regression beginning around 16.4 cal ka

[6] Gilbert-episode highstand may have been very short lived; age represents lake culmination (Oviatt and others, 2005; Oviatt, 2014)

[7] Gilbert-episode and early Holocene Great Salt Lake highstand shoreline formed at 4245 to 4250 feet (1294–1295 m) and 4225 to 4230? feet (1288–1289? m), respectively; although these elevations occur within the quadrangle, the shorelines were either weakly developed or poorly preserved and have not been identified

[8] Murchison (1989), Currey and James (1982)

[9] Miller and others (2005)

[10] Arnow and Stephens (1990)

PREVIOUS MAPPING

Previous detailed surficial geologic maps of the study area include Van Horn's (1979) Salt Lake City South quadrangle (a 1:24,000-scale map) and a regional surficial geologic map of the Wasatch Front by Miller (1980) at a scale of 1:100,000. However, neither map shows the Granger and Taylorsville faults of the West Valley fault zone. Personius and Scott (1992) compiled a surficial geologic map of the Salt Lake City segment of the Wasatch fault zone at 1:50,000 scale, using the 1:24,000-scale map of Scott and Shroba (1985) as the primary source. Scott and Shroba's (1985) mapping does not extend far enough west to include the West Valley fault zone (see figure on plate 2).

My mapping consulted these previous surficial geologic maps (Van Horn, 1979; Miller, 1980; Personius and Scott, 1992) and soil maps (U.S. Natural Resources Conservation Service [NRCS], 2015). When compared with previous maps, the most significant changes are the addition of the West Valley fault zone and the revision of Quaternary stratigraphy, particularly of Lake Bonneville deposits. Contacts and units were mapped and field checked in 2016–17.

METHODS

My approach for mapping surficial deposits is the same as that used by the UGS Geologic Mapping Program which is based on age and depositional environment or origin. The letters of the map units in order indicate (1) age (geologic period, e.g., Q for Quaternary); (2) primary depositional environment or origin, usually determined from geologic setting, landform or morphology; (3) grain size(s), bedding, or other distinctive characteristics of the deposits; and (4) additional significant information, such as tighter age constraints (Doelling and Willis, 1995) as related to the phases of Lake Bonneville or numbered with 1 being the youngest. For example, unit Qal_1 is a Quaternary surficial deposit of alluvial origin (al), and the number one indicates it is young and potentially historically active.

Mapping for the project was accomplished using stereographic pairs of aerial photographs that included black-and-white photographs at a scale of approximately 1:20,000 from the U.S. Department of Agriculture (USDA) Agricultural Adjustment Administration (1937) and photographs of approximately 1:10,000 scale from the USDA Agricultural Stabilization and Conservation Service (1958). Some unit contacts were mapped with the aid of NRCS (2015) soil map data. Water boundaries were digitized from a 1999 U.S. Geological Survey topographic map of the Salt Lake City South quadrangle. Gravel pit outlines and some contacts were revised using 2016 orthophotographs (Utah Automated Geographic Reference Center [AGRC], 2016) and 0.5-meter lidar elevation data (AGRC, 2013–2014). The geologic map was made by transferring the geology from the aerial photographs to a geographic information system (GIS) database in ArcGIS for a target scale of 1:24,000, using the lidar data, orthophotographs of Salt Lake County (AGRC, 1977), and 2016 orthophotographs (AGRC, 2016).

Cross-section A-A′ was created by combining available subsurface and gravity data. Well logs from Meiiji Resource Consultants (1983), Case (1985), and others compiled online (UGS, undated) were used to estimate the subsurface contact between Quaternary unconsolidated deposits and Tertiary semiconsolidated to consolidated strata. Depth of unconsolidated to semiconsolidated material was also inferred from water well logs in the area (online well data from Utah Division of Water Rights, 2009). The top of semiconsolidated material described in well logs (Meiiji Resource Consultants, 1983; Case, 1985; UGS, undated) was marked mostly by a transition from unconsolidated clay, silt, sand, and gravel to more semiconsolidated deposits, typically described as hard pan, various types of cemented or hard material, conglomerate, or lava (Arnow and others, 1970), but also may include shale or limestone. These hypothesized contacts have not been dated and may not actually represent the transition from Quaternary to Tertiary deposits. While none of the reviewed well logs in the quadrangle specifically identified strata of the Pliocene to Miocene Salt Lake Formation or older Oligocene to Eocene volcanic and volcaniclastic rocks that are common along the Salt Lake Valley margins (see for example Van Horn, 1982; Van Horn and Crittenden, 1987; Biek, 2005a, 2005b; Biek and others, 2007, 2018; McKean, 2014), these units are likely part of the Tertiary strata in the subsurface. Based on exposures in nearby mountain ranges I hypothesize the Tertiary volcanic and sedimentary rocks are underlain by Mesozoic and/or Paleozoic sedimentary bedrock (see for example Biek and others, 2007, 2018; McKean, 2014, 2018). Depth to underlying Mesozoic and/or Paleozoic bedrock was estimated from gravity models by Meiiji Resource Consultants (1983) and Hill and others (1990). Basin depth and structure were estimated from gravity data from Cook and Berg (1961), Zoback (1983), and the Pan-American Center for Earth and Environmental Studies (PACES) (2012) gravity database. The actual depth to Mesozoic and Paleozoic bedrock is uncertain as no wells in the quadrangle penetrated the entire thickness of Tertiary strata.

SELECTED GEOLOGIC HAZARDS

Geologic hazards in the map area include surface fault rupture (normal faults), landsliding (Qms), and flooding (Qalh, Qal_1, Qal_2, Qaly, Qafy, Qam, and Qlam). Other potential geologic hazards that are not addressed in this report include debris flow (Qafy), earthquake ground shaking, liquefaction, tectonic subsidence/tilting, expansive soils, collapsible soils, shallow groundwater, corrosive soils, radon, and other problem soils. For example, spring and marsh deposits (Qam and Qlam) can indicate areas of shallow groundwater, while clay-rich lacustrine deposits (Qly, Qlf, Qldy, and Qlam) can indicate potentially problematic soils like expansive or impermeable soil. See the map unit descriptions and geologic map (plate 1) for more information and the location of potential hazards. Below is a brief discussion of the surface-fault-rupture and flooding hazards in the quadrangle. While only a few landslides (Qms) are mapped in the quadrangle (see plate 1 and unit description), there are numerous steep unconsolidated slopes along the Jordan River and other steep slopes in the quadrangle that have potential for mass movement. Additional geologic hazards may exist, but are not listed in this section. The UGS recommends comprehensive site-specific geotechnical and geologic hazard investigation per the guidelines in UGS Circular 122 (Bowman and Lund, 2016). Refer to the UGS website (geology.utah.gov) for additional information on these and other geologic hazards.

Surface Fault Rupture

The generally north-south-trending West Valley fault zone is partially antithetic to the Salt Lake City segment of the Wasatch fault zone. These fault zones bound an intrabasin graben in northern Salt Lake Valley, with the West Valley fault zone truncated by the Wasatch fault zone (main basin-bounding fault) at depth. The West Valley fault zone includes the Granger (western) and Taylorsville (eastern) faults. The southern parts of the Granger and Taylorsville faults are in the Salt Lake City South quadrangle. Surface traces of the West Valley fault zone were first shown as faults by Marsell and Threet (1960) on their 1:63,360-scale Salt Lake County geologic map. Cook and Berg (1961) correlated the Granger-area faults to their steep gravity gradient in what they called the Jordan Valley graben. Marine and Price (1964) named the faults the Granger and Taylorsville faults of the Jordan Valley fault zone, and provided drill-hole data for displacement minimums across the faults. Van Horn's (1979 and 1982) 1:24,000-scale surficial geologic maps of the area did not show the fault zone; instead, he attributed the scarps to differential erosion of distinct stratigraphic units (Van Horn, 1986, personal communication in Keaton and others, 1987). Miller's (1980) 1:100,000-scale surficial geologic mapping included the northern part of the Granger fault as scarps with uncertain origin. Keaton and others (1987) and Keaton and Currey (1989) conducted the first detailed investigations of the fault zone and confirmed, through geomorphic mapping, trenches, and boreholes, the existence of the Granger and Taylorsville faults. They proposed the West Valley fault zone name for the structure and retained the existing Granger and Taylorsville fault names. Only a few paleoseismic research investigations (Keaton and others, 1987; Keaton and Currey, 1989; Hylland and others, 2014, 2017) have been done on the fault zone, partly because development has obscured the scarps and prevented the excavation of trenches needed in investigations. These studies are discussed in the sections below.

The western part of the Nibley Park fault of the Salt Lake City segment of the Wasatch fault zone just enters the quadrangle on the eastern boundary with the Sugar House quadrangle (McKean, in press). It is a west-dipping fault that is part of a larger fault zone mapped in the Sugar House quadrangle west of the East Bench fault of the Salt Lake City segment of the Wasatch fault zone (for discussion of this fault see McKean, in press).

Granger Fault

The Granger fault, the western fault of the West Valley fault zone, is a down-to-the-east normal fault approximately 11.5 miles (~18.5 km) long end-to-end, and is discontinuously exposed in this quadrangle and the Baileys Lake and Salt Lake City North quadrangles (McKean and Hylland, 2019; McKean, 2014).

Keaton and others (1987) and Keaton and Currey (1989) conducted paleoseismic investigations of the Granger fault at three localities within the quadrangle. At two localities, they used boreholes to determine offset in correlatable subsurface strata across the Granger fault. One set of boreholes was where the fault crosses 1300 South (Keaton and Currey, 1989) and the other locality was in a lot at 3166 South 3200 West (Keaton and others, 1987). Keaton and others (1987) also excavated two trenches and drilled six boreholes at the Utah Department of Transportation facility near 4501 Constitution Boulevard (see UDOT on plate 1 for approximate trench location). They conducted geomorphic mapping of cross-cutting relationships between the Granger fault and several post-Bonneville alluvial channels (see figure 6a in Keaton and others, 1987; unit Qalg on plate 1). They also characterized surface faulting along the Granger fault as a typically discrete normal fault plane (Keaton and others, 1987). These studies provided definitive evidence for surface-fault ruptures on the Granger fault and long-term (140 kyr) cumulative displacements and slip rates for the West Valley fault zone. However, they were unable to provide individual earthquake timing and displacement data.

A recent paleoseismic investigation to the northwest of the quadrangle in the adjacent Baileys Lake quadrangle (Hylland and others, 2014) revealed that prehistoric earthquakes on the Granger fault have created 1- to 3-foot-high (0.4–1 m) fault scarps. The investigation documented four large (surface-faulting) earthquakes since the highstand of Lake Bonneville (~18 ka), the most recent having occurred about 5.5 ka. Although their earthquake data do not provide unequivocal evidence for a coseismic link between the Granger fault and Salt Lake City segment of the Wasatch fault zone, their data does suggest that large earthquakes on the West Valley fault zone are likely coseismic with, or triggered by, faulting on the Salt Lake City segment (Hylland and others, 2014; DuRoss and Hylland, 2015).

Taylorsville Fault

The Taylorsville fault is the eastern fault of the West Valley fault zone and is down-to-the-east in the southern part. The northern part that extends into the Salt Lake City North quadrangle has both down-to-the-east and down-to-the-west faults between the Granger fault and Warm Springs fault of the Wasatch fault zone (McKean, 2014). The Taylorsville fault is approximately 9.7 miles (~15.6 km) long end-to-end and is discontinuously exposed due to erosion and development.

Paleoseismic investigations of the Taylorsville fault by Keaton and others (1987) and Keaton and Currey (1989) included data from previous consultant reports of surface-fault-rupture-investigation trenching: one at the Pioneer Square locality (between Pioneer Road, 1700 South, Interstate Highway 215, and State Route 201; see PS on plate 1) and the other northwest of 4100 South Street and Redwood Road (see RR on plate 1; Keaton and others, 1987; Keaton and Currey, 1989). At the Pioneer Square locality, trenching revealed monoclinal warping of the deposits with minor down-to-the-east step faulting (Keaton and others, 1987; Keaton and Currey, 1989). At the 4100 South Street locality trenching revealed monoclinal warping of the deposits and only minor offset of a clay marker bed (Keaton and others, 1987). Keaton and others (1987) also conducted geomorphic mapping of the cross-cutting relationships between the Taylorsville fault and several post-Bonneville alluvial channels north of Decker Lake (see figure 6a in Keaton and others, 1987; unit Qalg on plate 1). These paleoseismic studies provided definitive evidence for surface-fault ruptures on the Taylorsville fault and long-term cumulative displacements and slip rates for the West Valley fault zone. However, like with the Granger fault, they were unable to provide individual earthquake timing and displacement data.

Within the Salt Lake City North quadrangle to the north of the Salt Lake City South quadrangle, several consultants' geotechnical investigations reported locating the Taylorsville fault (see McKean, 2014). An AGRA (1997) fault investigation documented surface faulting in trenches on the northernmost Taylorsville fault (east of about 1300 North on 2200 West Street in Salt Lake City; or about 3.3 miles [~5.3 km] north of the Salt Lake City South quadrangle). Two organic-rich bulk-soil samples from these trenches (one of the samples was interpreted as scarp-derived colluvium) yielded an average calibrated age of 2.2 ka (Solomon, 1998). The 2.2 ka age was interpreted as approximating the time of a surface-faulting earthquake.

A recent UGS paleoseismic investigation near the AGRA (1997) site on the Taylorsville fault (Hylland and others, 2017) yielded evidence for three late Holocene surface-faulting earthquakes on the fault. Trenching depth was limited due to shallow groundwater, and exposed deposits were only as old as mid-Holocene. The youngest event occurred at 0.4 ± 0.2 ka, the mean late Holocene (post-2 ka) recurrence interval is 800 years, and geologic (open-interval) slip rates range from 0.1–0.2 mm/yr over the past ~5000 years to 0.2–0.4 mm/yr over the past ~2500 years (Hylland and others, 2017). Combined with other West Valley fault zone paleoseismic data, four mid- to late Holocene earthquakes have mean modeled ages coincident with earthquakes on the Salt Lake City segment and the Weber segment of the Wasatch fault zone (Hylland and others, 2017). The new trenching results support the hypothesis that the West Valley fault zone moves coseismically with, or has faulting triggered by, earthquakes on the Salt Lake City or Weber segment of the Wasatch fault zone.

Flooding

Flood and debris-flow hazard areas are primarily in, but are not limited to, alluvial channels (Qalh, Qal_1, Qal_2, and Qaly) and areas mapped as alluvial-fan deposits (Qafy). Flood hazard exists along the Jordan River, Mill Creek, and Big and Little Cottonwood Creeks. Locations of these potential flood hazard units are on the geologic map (plate 1) and additional information is included in the unit descriptions. Flooding could also occur in areas of shallow groundwater. Delineation of exact flood and debris-flow hazards requires detailed geotechnical investigations.

MAP UNIT DESCRIPTIONS

QUATERNARY

Alluvial deposits

Qal_1 **Active floodplain and stream deposits** (upper Holocene) – Moderately to well-sorted, medium- to light-brown sand, silt, and minor clay; locally may contain gravel; very fine to medium-grained, rounded to angular sand grains; contains thin discontinuous sand lenses; thin to medium bedded; sand grains are quartz, lithic fragments, and mica flakes; mapped in channels and active floodplains of Jordan River, Big and Little Cottonwood Creeks, and on terraces less than 5 feet (1.5 m) above creek and river channels; includes oxbow lakes and marshy areas too small to map separately; equivalent to the younger part of Qaly; differentiated from Qaly where active channels incise older Qal_2 or Qaly along the Jordan River; this unit contains the historical alluvial floodplain and channel from 1937 aerial photographs (USDA, 1937) before human modification of much of its natural course; locally includes minor colluvial deposits along steep embankments and natural levees; some deposits are channelized in Big and Little Cottonwood Creeks and include channel embankments; may locally include small unmapped mixed alluvial and marsh deposits and channelization (Qalh) that cannot be shown individually at map scale; thickness variable, probably less than 30 feet (10 m).

Qal_2 **Level-2 floodplain and stream deposits** (middle Holocene to upper Pleistocene) – Moderately to well-sorted, medium- to light-brown sand, silt, and minor clay; locally may contain gravel; very fine to medium-grained, rounded to angular sand grains; contains thin discontinuous sand lenses; thin to medium bedded; sand grains are quartz, lithic fragments, and mica flakes; forms terraces 5 to 15 feet (1.5–5 m) above and adjacent to channels and floodplains of Jordan River and Big Cottonwood Creek; may be in the floodplain; includes oxbow lakes and marshy areas too small to map separately; inset into Lake Bonneville deposits and incised by Qal_1; equivalent to the older part of Qaly; thickness variable, probably less than 30 feet (10 m).

Qaly **Young floodplain and stream deposits, undivided** (Holocene to upper Pleistocene) – Moderately to well-sorted sand, silt, and minor clay; locally may include gravel; mapped in channels and active floodplains of Jordan River, Mill Creek and smaller creeks; includes oxbow lakes and marshy areas too small to map separately; locally includes small areas of alluvial-fan and colluvial deposits; inset into Lake Bonneville deposits; includes level-2 floodplain and stream deposits (Qal_2) incised by active floodplain and stream (Qal_1); Qaly mapped where Qal_1 and Qal_2 deposits cannot be mapped separately due to lack of bars and swales and because patches of deposits are too small to show separately at map scale; postdates regression of Lake Bonneville from the Provo shoreline and lower shorelines; thickness variable, probably less than 30 feet (10 m).

Qalg **Stream deposits related to Gilbert-episode lake and/or Great Salt Lake** (middle Holocene? to upper Pleistocene?) – Moderately sorted, light olive-gray sand, silt, and minor clay; very fine to medium-grained subangular to angular sand grains; contains thin discontinuous sand lenses; thin to medium bedded; sand grains are quartz, lithic fragments, and mica flakes; located west of the Jordan River and north of 3100 South Street and mapped in abandoned channels and floodplains of streams that once flowed into and through a regressive Gilbert-episode delta (Murchison, 1989) (Qalg, Qdg of McKean and Hylland, 2019); deposited 5 to 15 feet (1.5–5 m) above adjacent floodplains of Jordan River (Qal_1 and Qaly); delta and stream deposits mentioned above are located below the Gilbert-episode lake highstand elevation, so could also be related to early Holocene highstand of Great Salt Lake based on elevation (see table 1); unit correlative with regressive Gilbert-episode deltaic deposits in the undivided young deltaic deposits (Qldy) in the quadrangle; older then Qaly and Qal_2, but likely younger than Qal_3 on many other maps in the area; estimated thickness less than 15 feet (5 m).

Qaf_2 **Level-2 alluvial-fan deposits** (middle Holocene and upper Pleistocene) – Poorly sorted pebble and cobble gravel, in a matrix of sand, silt, and minor clay; clasts subangular to well rounded; thin to thick planar bedding and low-angle cross-bedding; deposited by debris flows, debris floods, and streams; mapped in the southeast part of the quadrangle; the alluvial fan is present downslope from regressive-phase Lake Bonneville deltaic deposits mapped in the Sugar House and Draper quadrangles (unit Qldp of McKean, 2018; McKean and Solomon, 2018) and incised by streams along Little Cottonwood Creek (Qal_1) and Qaly near 5900 South; equivalent to the older part of Qafy, but mapped separately based on incision by active streams; likely post-Lake Bonneville regression because these alluvial-fan deposits are not incised as much as Lake Bonneville regressive deposits (Qlf) by streams (Qal_1 and Qaly); exposed thickness less than 30 feet (10 m).

Qafy **Younger alluvial-fan deposits, undivided** (Holocene to upper Pleistocene) – Poorly to moderately sorted sand, silt, and clay on gentle distal slopes of alluvial fans; thin to thick, planar bedding and low-angle cross-bedding; deposited by debris flows, debris floods, and streams; mapped in the northeast part of the quadrangle at the distal margins of Emigration, Parleys, and Mill Creek alluvial fans; also mapped in the southeast corner of the quadrangle where alluvial channels (Qaly) empty into the Jordan River floodplain; these fans are cut by the Jordan River (Qal_1 and Qaly) but not mapped as Qaf_2 because in 1937 aerial photographs (USDA, 1937) they appear to have small potentially active stream channels (Qal_1 or Qaly) that cannot be subdivided from the alluvial-fan deposit; includes both ages of younger alluvial-fan deposits (Qaf_1 and Qaf_2); postdates the regression of Lake Bonneville from the Provo shoreline and lower shorelines; a more specific age cannot be determined because incision by active streams (Qal_1 or Qaly) is uncertain; Lake Bonneville shorelines are not present on these alluvial fans; estimated thickness less than 30 feet (10 m).

Human-derived deposits and disturbances

Qh **Fill and disturbed land** (historical) – Undifferentiated earthen fill and/or disturbed land related to construction of road, rail, and bridge embankments, water storage, canals, flood control structures, water treatment plants, settlement ponds, landfills, borrow pits, and sand and gravel mining operations (commonly in Lake Bonneville gravel and sand deposits [Qlg]); the map outlines of fill and disturbed land are based on 1958 aerial photographs and updated using 2016 orthophotography (AGRC, 2016) and 0.5-m lidar (AGRC, 2013–2014); only larger areas of disturbed land are mapped; unmapped fill and disturbed land are present in most developed areas (note the city street system on base map); land within developed areas contains a changed and still changing mix of cuts and fills; thickness unknown.

Keaton and others (1987) suggested that the large berm north of Decker Lake, seen in the pre-1958 aerial imagery and topographic maps, is an eolian lunette dune developed on the margin of a playa in a depression adjacent to the Taylorsville fault. However, the lack of other eolian features in the quadrangle and the large scale of the berm suggest that it is a pre-1937 artificial or modified feature used to create a dam for Decker Lake and thus is mapped as Qh along with the mostly now-filled-in lake.

Qhr **Remediated land** (historical) – Unit delineates approximate boundaries of selected environmentally remediated sites in the quadrangle, including the Vitro uranium mill and tailings, Murray lead smelter, Portland Cement kiln dust #2 and #3, and Highland Boy copper smelter site (these sites are described below); other remediated lands may exist in the quadrangle and the extent of surficial (soil) or groundwater contamination may exceed the mapped unit; areas near these remediated sites may contain latent contaminated material or groundwater and a comprehensive site-specific environmental investigation is recommended prior to development; thickness of remediated material is variable.

The Vitro Corporation of America uranium and vanadium mill was in operation from 1951 to 1968; as of July 1970, the uranium mill tailings at the mill site occupied about 107 acres north of 3300 South Street (east of 900 West Street and west of the railroad line; about 500 West Street), (see VU on plate 1) (Duncan and Eadie, 1974; U.S. Department of Energy [DOE], 2016). Clean-up of the site was conducted by the State of Utah under the direction of the DOE between 1984 and 1989; tailings and contaminated soil and debris were removed to the Clive Disposal Facility in Tooele County (DOE, 2016). Some radiation concentration levels indicate small pockets of contaminated material exceeding the radium-226 and thorium-230 clean-up standards were left in place along two underground utility lines (DOE, 2016). Groundwater monitoring at this site ended in 2007 (DOE, 2016). Elevated radon gas levels may also be a potential hazard in the area. The site is now occupied by the Central Valley Golf Course, a water treatment plant, a concrete plant, and a municipal waste transfer station.

The Murray lead smelter site, located near 5300 South Main Street in Murray (see MS on plate 1), was in operation from 1872 to 1902 by Germania Smelter and Refinery Works, and then from 1902 to 1949 by American Smelting and Refining Company (ASARCO) (Robbins, 2005; U.S. Environmental Protection Agency [EPA], undated a). The 142-acre site remediation occurred between 1995 and 2001 and included excavation of 580 tons of high-concentration arsenic waste and off-site disposal at a hazardous waste landfill; 84,000 cubic yards of lower concentration arsenic-contaminated soils and debris were placed in secure repositories at this site (Robbins, 2005; EPA, undated a). Long-term groundwater monitoring is ongoing (EPA, undated a). The site is now occupied by the Intermountain Medical Center, Costco warehouse store, and commuter train and light rail station.

Portland Cement kiln dust #2 and #3 site is an approximately 71-acre triangular area west of Redwood Road (~1000 South) between Indiana Ave and the Jordan River Surplus Canal (see PC on plate 1) (EPA, 1992). Between 1965 and 1983 waste cement kiln dust and chromium-bearing refractory kiln bricks were disposed of at the site (EPA, 1992); the dust and bricks were from a cement plant located at the southwest corner of 600 West Street and 800 South Street that was operated by several companies. The site remediation took place between 1995 and 1998 when the cement kiln dust and chromium-bearing bricks were removed, treated, and disposed of off-site (EPA, undated b). Groundwater monitoring is ongoing (EPA, undated b). The site is now being developed and is partially occupied by several warehouses.

The Highland Boy copper smelter site was located at about 5800 South 900 West in Murray (see HB on plate 1). The smelter operated from 1899 through 1908 when it closed as a result of a court injunction requiring that smelters in the area reduce sulfur emissions (Lamborn and Peterson, 1985). The lawsuit was brought by organized farmers whose crops, orchards, and animals had been damaged due to sulfur dioxide emissions (when mixed with water/moisture forms sulfuric acid) from the stacks of five smelters; all but one closed as a result (Lamborn and Peterson, 1985). Apparently, prior to mitigation, slag was removed from the site and used to construct Interstate Highway 15 (Hansen, 1986). During remediation, remaining debris was removed and buried in a clay-lined pit within the adjacent Utah Light and Power utility transmission line right-of-way (Resource Recovery and Conservation Company, 1986). The site is now occupied by residential, church, and commercial properties.

Lacustrine deposits

Qly **Young lacustrine deposits** (Holocene to upper Pleistocene?) – Moderately sorted, dark yellowish-brown silt, olive-gray quartz sand, light olive-gray clay, and yellowish-gray marl; subangular to angular, fine to coarse quartz sand; mapped where standing water or mud flat playas are visible on the 1937 aerial photographs (USDA, 1937); includes historical lakes shown on Van Horn's (1979) surficial geologic map including Hunter Lake, Moon Lake, and Silver Lake (also shown on the 1951 U.S. Geological Survey topographic map of the quadrangle) and one Van Horn called White Lake, that he cited from a 1906 map (source of map reference has not been found); all these lakes have been drained and built over; distinguished from young lacustrine and deltaic deposits (Qldy) by the lack of natural levee deposits and deltaic distributary channels; distinguished from Qlf by the presence of standing water and dry lake bed (playa) surfaces visible on aerial 1937 and 1958 photographs (USDA, 1937, 1958); might include deposits related to the Gilbert-episode lake as the unit surrounds Gilbert sands (Qlsg) but a constructed water control feature may be causing the water to pond and form lakes; similar deposits mapped as Qlay in the Magna quadrangle (Solomon and others, 2007, 2018); estimated thickness 15 feet (5 m).

Deposits of the Gilbert-episode lake – Only mapped below the Gilbert shoreline; shoreline features not preserved in the quadrangle but the shoreline is at elevations of about 4245 to 4250 feet [1294–1295 m] in the surrounding area (McKean, 2014).

Qlsg **Lacustrine sand and silt** (middle Holocene to upper Pleistocene) – Moderately sorted, subrounded to rounded, fine to coarse sand and silt with minor pebbly gravel; thick to very thick bedded; commonly planar bedded, with some ripple marks and scour features; described as barrier beaches along the Gilbert shoreline (Solomon and others, 2007, 2018); mapped as Qlsp in the Magna quadrangle (Solomon and others, 2007, 2018); estimated thickness 15 feet (5 m).

Undivided deposits of the transgressive, overflow, and regressive phases of Lake Bonneville – Throughout the region transgressive-, overflow-, and regressive-phase deposits of late Pleistocene Lake Bonneville are mapped separately where possible based on mappable shoreline features (example Qlgb, Qlgp). In the Salt Lake City South quadrangle, most deposits of these phases are combined (Qlf, Qls, and Qlg) because they are difficult to distinguish as all elevations are below the Provo shoreline. Some mappable transgressive-phase deposits (Qlb) are exposed in cutbanks along the Jordan River.

Qlf **Lacustrine silt and clay** (upper Pleistocene) – Moderately sorted silt, clay, fine sand, and minor pebbly gravel; typically laminated or thin bedded; variably calcareous; may locally contain ostracods; deposited in shallow to moderately deep parts of Lake Bonneville; commonly gradational upslope into lacustrine sand and silt (Qls); locally concealed by loess veneer; regressive Lake Bonneville shorelines typically poorly developed in contrast to shorelines on unit Qlg; distinguished from Qls and Qlg by the presence of silty sand, silt, and clay as indicated in soil maps (NRCS, 2015); mapped as Qlmbp in the Magna quadrangle (Solomon and others, 2007, 2018); exposed thickness more than 25 feet (7 m).

Qls **Lacustrine sand and silt** (upper Pleistocene) – Moderately sorted fine to coarse sand, silt, clay, and minor pebbly gravel; thin to thick bedded; commonly has ripple marks and scour features; deposited in relatively shallow water nearshore, downslope from gravel and sand (Qlg); distinguished from Qlf and Qlg by the presence of silty sand and sand as indicated in soil maps (NRCS, 2015); mapped as Qlsbp in the Magna quadrangle (Solomon and others, 2007; 2018); exposed thickness more than 30 feet (10 m).

Qlg **Lacustrine gravel and sand** (upper Pleistocene) – Moderately to poorly sorted, subrounded to rounded, pebble to cobble gravel in a matrix of pebbly sand, sand, and silt; locally interbedded with and containing lenses of silt and sand; thin to thick planar and cross-beds; mapped near Kearns and Bennion on an east-southeast-oriented spit that developed during both Lake Bonneville transgression (see S [Stansbury] shoreline on plate 1) and regression (see r [regressive] shorelines on plate 1); some shorelines mapped as regressive could have formed during the transgressive phase; shorelines typically well developed in contrast to the lack of shorelines on units Qlf and Qls; distinguished from Qlf and Qls by the presence of gravel and sand as indicated in soil maps (NRCS, 2015); commonly interbedded with or laterally gradational with lacustrine sand and silt (Qls); mapped as Qlgbp in the Magna quadrangle (Solomon and others, 2007, 2018); exposed thickness more than 60 feet (20 m).

Deposits of the transgressive phase of Lake Bonneville – Mapped below the Bonneville and Provo shorelines in bluffs along the incised Jordan River where transgressive-phase deposits likely underlie the undivided deposits of the transgressive, overflow, and regressive phases of Lake Bonneville.

Qlb **Transgressive-phase deposits of Lake Bonneville, undivided** (upper Pleistocene) – Moderately sorted, subrounded to rounded, fine to coarse sand, silt, and clay with pebbly gravel; locally includes beds of gravel and sand; limited to exposures in bluffs along Jordan River and stream terraces where slope colluvium conceals the relative amounts of gravel, sand, silt, and clay in these transgressive deposits; may include pre-Bonneville deposits; exposed thickness less than 100 feet (30 m).

Mass-movement deposits

Qms **Landslide deposits** (historical to upper Pleistocene) – Poorly sorted, clay- to pebble-sized material in two small mapped landslides; composition depends on Qlf, Qls, and Qlb source material; landslides characterized by hummocky topography and main scarp; one landslide is mapped on the western bluff above the Jordan River just southeast of Winchester Street (~6500 South) and 1300 West; apparent age is post-incision of Jordan River, likely after Lake Bonneville began to regress from the Provo shoreline (see table 1 for shoreline age); the other landslide is mapped on the western bluff above the Jordan River just north of Winchester Street (~6500 South) and east of Easy Putt Drive (~1200 West) above the canal, this landslide moved in August 2005; even landslides with subdued morphology (suggesting that they are older, weathered, and have not moved recently) may continue to exhibit slow creep or are capable of renewed movement if stability thresholds are exceeded (Ashland, 2003); stability determinations require detailed geotechnical investigations; other unmapped landslides or unstable slopes may be present along the Jordan River bluff or other steep slopes; thickness unknown.

Mixed-environment deposits

Qalh **Historical alluvial deposits and artificial levees, undivided** (historical) – Moderately sorted sand, silt, and minor clay alluvial deposits and artificial earthen levees, undifferentiated along channelized Jordan River; very fine to medium-grained sand; rounded to angular sand grains; thin to medium bedded; mapped in active channels, modified channel margins and minor terraces less than 10 feet (3 m) above active channels; includes artificial channels and levees; locally includes minor colluvial deposits along steep embankments; most streams have been modified from their natural course and are channelized; estimated thickness less than 15 feet (5 m).

Qam **Alluvial and marsh deposits, undivided (**Holocene to upper Pleistocene) – Moderately sorted sand, silt, clay, and organic-rich sediment associated with springs, ponds, seeps, and wetlands; commonly wet, but may be seasonally dry; may locally contain peat deposits; mapped at: (1) about 900 West and 2760 South and partially concealed by the water treatment plant and old Vitro uranium mill, (2) near 2100 South and Interstate Highway 15, and (3) along the Jordan River floodplain just south of the confluence with Little Cottonwood Creek where low-lying meandering alluvial channels, oxbow lakes, and marsh lands are intermixed where the water table is high; growth of tall reeds aids mapping on aerial photographs; another deposit is mapped above the Jordan River floodplain (near the southwest corner of Bennion Boulevard, at approximately 6235 South and 1300 West) where 1937 aerial photographs (USDA, 1937) show that a small depression was wet and supported a marsh; deposit may be the result of a perched water table and/or an abandoned Jordan River channel, note terrace scarp just to south and in line with the depression; areas of mixed alluvial and marsh deposits too small to be mapped separately may be included in units Qal_1, Qal_2, and Qaly; estimated thickness 15 feet (5 m).

Qla **Lacustrine and alluvial deposits, undivided** (Holocene to upper Pleistocene) – Moderately sorted sand, silt, and clay in areas of mixed alluvial and lacustrine deposits that cannot be shown separately at map scale, or because the deposits are gradational with each other, or thin patches of one unit overlie the other; locally may include closed depressions that may have been marsh areas and areas near the Gilbert-episode lake shoreline that may have been small deltas; mapped above the Jordan River floodplain where post-regression streams flowed north toward the Gilbert-episode lake and Great Salt Lake before incision of the Jordan River to its current drainage; also mapped in areas around the quadrangle where lacustrine units are likely overlain by thin alluvial deposits; exposed thickness more than 20 feet (6 m).

Qlam **Lacustrine, alluvial, and marsh deposits, undivided** (Holocene to upper Pleistocene) – Silt, clay, and minor sand and pebbles, with organic-rich sediment associated with springs, ponds, seeps, and other wetlands; commonly wet, but seasonally dry; mapped in northeast corner of the quadrangle, south of Decker Lake, and west of Bangerter Highway and north of 3100 South Street where marsh, alluvial, and lacustrine deposits may be patchy and intermixed, and cannot be shown separately at map scale; estimated thickness 15 feet (5 m).

Qldy **Young lacustrine and deltaic deposits** (Holocene to upper Pleistocene) – Moderately sorted, light olive-gray to moderate yellowish-brown, silty sand and clay; commonly more clay rich with very little silt and sand; sand is fine to medium grained; contains thin discontinuous sand, clay, and silt lenses; subangular to rounded sand grains; thin to medium bedded; sand grains are composed of quartz, lithic fragments, and mica flakes; distinguished from lacustrine and alluvial deposits (Qla) by its broad, uniformly flat geomorphic surface along the northwest-flowing pre-Jordan River alluvial channels (Qalg), and from young lacustrine deposits (Qly and Qlf) by the presence of alluvial channels (Qalg); to the northwest in the Baileys Lake quadrangle the unit includes a loess veneer and buried soil, is underlain by the Gilbert-episode lake tufa breccia and clays, and Lake Bonneville olive-gray and red-brown clays and olive-gray quartz sands (McKean and Hylland, 2019; Hylland and others, 2014); estimated thickness 15 feet (5 m).

ACKNOWLEDGMENTS

This geologic map was funded by the Utah Geological Survey and the U.S. Geological Survey (USGS), National Cooperative Geologic Mapping Program through USGS STATEMAP award number G16AC00191 (2016). Discussions with many individuals helped in the development of this map and report, including consultant Greg Schlenker, and UGS staff Jon K. King, Mike Hylland, Bob Biek, Don Clark, and Gregg Beukelman. UGS staff members Greg McDonald, Jon K. King, Grant Willis, Stephanie Carney, Kimm Harty, and Mike Hylland also improved this map through their reviews. I am grateful to all the property owners who allowed access to their property for field mapping purposes.

REFERENCES

AGRA Earth & Environmental, Inc., 1997, Report, fault rupture hazard study, proposed 80-acre office park, between 2200 West and West Interstate I-215 and between 800 and 1200 North, Salt Lake City, Utah: unpublished consultant report prepared for The Boyer Company, 18 p.

Anderson, Z.W., and McKean, A.P., in preparation, Interim geologic map of the Fort Douglas quadrangle, Salt Lake and Davis Counties, Utah: Utah Geological Survey Open-File Report, scale 1:24,000.

Arnow, T., and Stephens, D., 1990, Hydrologic characteristics of the Great Salt Lake, Utah—1847–1986: U.S. Geological Survey Water-Supply Paper 2332, 32 p., scale 1:125,000.

Arnow, T., Van Horn, R., and LaPray, R., 1970, The pre-Quaternary surface in the Jordan Valley, Utah, *in* Geological Survey Research, 1970: U.S. Geological Survey Professional Paper 700-D, p. D257–261.

Ashland, F.X., 2003, Characteristics, causes, and implications of the 1998 Wasatch Front landslides, Utah: Utah Geological Survey Special Study 105, 49 p., https://doi.org/10.34191/SS-105.

Biek, R.F., 2005a, Geologic map of the Jordan Narrows quadrangle, Salt Lake and Utah Counties, Utah: Utah Geological Survey Map 208, 2 plates, scale 1:24,000, https://doi.org/10.34191/M-208.

Biek, R.F., 2005b, Geologic map of the Lehi quadrangle and part of the Timpanogos Cave quadrangle, Salt Lake and Utah Counties, Utah: Utah Geological Survey Map 210, 2 plates, scale 1:24,000, https://doi.org/10.34191/M-210.

Biek, R.F., Solomon, B.J., Smith, T.W., Keith, J.D., 2007, Geologic map of the Copperton quadrangle, Salt Lake County, Utah: Utah Geological Survey Map 219, 2 plates, scale 1:24,000, https://doi.org/10.34191/M-219DM.

Biek, R.F., Solomon, B.J., Smith, T.W., Keith, J.D., 2018, Geologic map of the Copperton quadrangle, Salt Lake County, Utah (GIS reproduction of 2007 map): Utah Geological Survey Map 219DM, 2 plates, scale 1:24,000, https://doi.org/10.34191/M-219DM.

Bowman, S.D., and Lund, W.R., editors, 2016, Guidelines for investigating geologic hazards and preparing engineering-geology reports, with a suggested approach to geologic-hazard ordinances in Utah: Utah Geological Survey Circular 122, 156 p., 7 appendices, https://doi.org/10.34191/C-122.

Bronk Ramsey, C., 2009, Bayesian analysis of radiocarbon dates: Radiocarbon, v. 51, no. 1, p. 337–360.

Case, W.F., 1985, Significant drill holes of the Wasatch Front valleys including Cache Valley and Tooele Valley: Utah Geological and Mineral Survey Open-File Report 82, 181 p., https://doi.org/10.34191/OFR-82.

Castleton, J.J., and McKean, A.P., 2012, The Utah Geological Survey geologic hazards mapping initiative, *in* Hylland, M.D., and Harty, K.M., editors, Selected topics in engineering and environmental geology in Utah: Utah Geological Association Publication 41, p. 51–67.

Christenson, G.E., and Ashland, F.X., 2007, A plan to reduce losses from geologic hazards in Utah—recommendations of the Governor's Geologic Hazards Working Group 2006–2007: Utah Geological Survey Circular 104, 30 p., https://doi.org/10.34191/C-104.

Cook, K.L., and Berg, J.W., 1961, Regional gravity survey along the central and southern Wasatch Front, Utah: U.S. Geological Survey Professional Paper 316-E, plate 13, p. 75–89.

Currey, D.R., and James, S.R., 1982, Paleoenvironments of the northeastern Great Basin and northeastern Basin Rim region—a review of geological and biological evidence, *in* Madsen, D.B., and O'Connell, J.F., editors, Man and environment in the Great Basin: Society for American Archeology Papers, no. 2, p. 27–52.

Davis, F.D., 2000, Geologic map of the Midvale quadrangle, Salt Lake County, Utah: Utah Geological Survey Map 177, 11 p., 2 plates, scale 1:24,000, https://doi.org/10.34191/M-177.

Doelling, H.H., and Willis, G.C., 1995, Guide to authors of geologic maps and text booklets of the Utah Geological Survey: Utah Geological Survey Circular 89, 98 p., https://doi.org/10.34191/C-89.

Duncan, D.L., and Eadie, G.G., 1974, Environmental surveys of the uranium mill tailings pile and surrounding areas, Salt Lake City, Utah: U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, Nevada, uranium mining and mill tailings project, report number EPA-520/6-74-006, variously paginated, accessed online https://www.epa.gov/nscep, April 25, 2017.

DuRoss, C.B., and Hylland, M.D., 2015, Synchronous ruptures along a major graben-forming fault system—Wasatch and West Valley fault zones, Utah: Bulletin of the Seismological Society of America, v. 105, no. 1, p. 14–37, https://doi.org/10.1785/0120140064.

Godsey, H.S., Currey, D.R., and Chan, M.A., 2005, New evidence for an extended occupation of the Provo shoreline and implications for regional climate change, Pleistocene Lake Bonneville, Utah, USA: Quaternary Research, v. 63, p. 212–223.

Godsey, H.S., Oviatt, C.G., Miller, D.M., and Chan, M.A., 2011, Stratigraphy and chronology of offshore to nearshore deposits associated with the Provo shoreline, Pleistocene Lake Bonneville, Utah: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 310, issues 3–4, p. 442–450.

Hansen, W., 1986, Site inspection of Highland Boy smelter site Murray, Utah: Unpublished draft of Utah State Division of Environmental Health, Bureau of Solid and Hazardous Waste, CERCLA report submitted to Kelcey Y. Land, EPA Region VIII, dated September 29, 1986, variously paginated, available online, http://eqedocs.utah.gov/, accessed June 28, 2017.

Hill, J., Benz, H., Murphy, M., and Schuster, G., 1990, Propagation and resonance of SH waves in the Salt Lake Valley, Utah: Bulletin of the Seismological Society of America, v. 80, no. 1, p. 23–42.

Hylland, M.D., DuRoss, C.B., McDonald, G.N., Olig, S.S., Oviatt, C.G., Mahan, S.A., Crone, A.J., and Personius, S.F., 2014, Late Quaternary paleoseismology of the West Valley fault zone—insights from the Baileys Lake trench site, *in* DuRoss, C.B., and Hylland, M.D., editors, Evaluating surface faulting chronologies of graben-bounding faults in Salt Lake Valley, Utah—new paleoseismic data from the Salt Lake City segment of the Wasatch fault zone and the West Valley fault zone—Paleoseismology of Utah, Volume 24: Utah Geological Survey Special Study 149, p. 41–76, 8 appendices, 1 plate, https://doi.org/10.34191/SS-149.

Hylland, M.D., Hiscock, A.I., McDonald, G.N., 2017, Paleoseismic investigation of the Taylorsville fault, West Valley fault zone, Salt Lake County, Utah: unpublished Utah Geological Survey final technical report to the U.S. Geological Survey, National Earthquake Hazards Reduction Program, award no. G15AP00117, 41 p., 7 appendices, 2 plates.

Keaton, J.R., and Currey, D.R., 1989, Earthquake hazard evaluation of the West Valley fault zone in the Salt Lake City urban area, Utah: Salt Lake City, Dames & Moore, unpublished technical report prepared for U.S. Geological Survey, contract no. 14-08-0001-G1397, 69 p. (published in 1993 as Utah Geological Survey Contract Report 93-7), https://doi.org/10.34191/CR-93-7.

Keaton, J.R., Currey, D.R., and Olig, S.J., 1987, Paleoseismicity and earthquake hazards evaluation of the West Valley fault zone, Salt Lake City urban area, Utah: Salt Lake City, Dames & Moore and University of Utah Department of Geography, unpublished technical report prepared for U.S. Geological Survey, contract no. 14-08-0001-22048, 55 p., plus 33 p. appendix (published in 1993 as Utah Geological Survey Contract Report 93-8), https://doi.org/10.34191/CR-93-8.

Lamborn, J.E., and Peterson, C.S., 1985, The substance of the land—agriculture v. industry in the smelter cases of 1904 and 1906: Utah Historical Quarterly, v. 53, no. 4, p. 308–325.

Marine, I.W., and Price, D., 1964, Geology and ground-water resources of the Jordan Valley, Utah: Utah Geological and Mineralogical Survey, Water-Resources Bulletin 7, 67 p., https://doi.org/10.34191/WRB-7.

Marsell, R.E., and Threet, R.L., 1960, Geologic map of Salt Lake County, Utah, included *in* Crawford, A.L., editor, 1964, Geology of Salt Lake County: Utah Geological and Mineralogical Survey Bulletin 69, 190 p., 1 plate, scale 1:63,360, https://doi.org/10.34191/B-69.

McGee, D., Quade, J., Edwards, R.L., Broecker, W.S., Cheng, H., Reiners, P.W., and Evenson, P., 2012, Lacustrine cave carbonates—novel archives of paleohydrologic change in the Bonneville Basin (Utah, USA): Earth and Planetary Science Letters, v. 351–352, p. 182–194.

McKean, A.P., 2014, Interim geologic map of the Salt Lake City North quadrangle, Salt Lake and Davis Counties, Utah: unpublished Utah Geological Survey contract deliverable map prepared for U.S. Geological Survey, USGS STATEMAP award no. G135AC00169, 42 p., 1 plate, scale 1:24,000.

McKean, A.P., 2018, Interim geologic map of the Sugar House quadrangle, Salt Lake County, Utah: Utah Geological Survey Open-File Report 687DM, 28 p., 2 plates, scale 1:24,000, https://doi.org/10.34191/OFR-687DM.

McKean, A.P., in press, Geologic map of the Sugar House quadrangle, Salt Lake County, Utah: Utah Geological Survey Map 285DM, scale 1:24,000.

McKean, A.P., and Hylland, M.D., 2019, Geologic map of the Baileys Lake quadrangle, Salt Lake and Davis Counties, Utah: Utah Geological Survey Map 281DM, 28 p., 2 plates, scale 1:24,000, https://doi.org/10.34191/M-281DM.

McKean, A.P., and Solomon, B.J., 2018, Interim geologic map of the Draper quadrangle, Salt Lake and Utah Counties, Utah: Utah Geological Survey Open-File Report 683DM, 33 p., 1 plate, scale 1:24,000, https://doi.org/10.34191/OFR-683DM.

Meiiji Resource Consultants, 1983, Gravity based interpretive bedrock geology of Jordan Valley, Salt Lake County, Utah: Utah Geological and Mineral Survey Open-File Report 38, 21 p., 4 plates, https://doi.org/10.34191/OFR-38.

Miller, D.M., 2016, The Provo shoreline of Lake Bonneville, *in* Oviatt, C.G., and Shroder, J.F., Jr., editors, Lake Bonneville—a scientific update: Amsterdam, Netherlands, Elsevier, Developments in earth surface processes, v. 20, chapter 7, p. 127–144.

Miller, D.M., Oviatt, C.G., Dudash, S.L., and McGeehin, J.P., 2005, Late Holocene highstands of Great Salt Lake at Locomotive Springs, Utah: Geological Society of America Abstracts with Programs, v. 37, no. 7, p. 335.

Miller, R.D., 1980, Surficial geologic map along part of the Wasatch Front, Salt Lake Valley, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1198, 13 p., 2 plates, scale 1:100,000.

Murchison, S.B., 1989, Fluctuation history of Great Salt Lake, Utah, during the last 13,000 years: Salt Lake City, University of Utah, Ph.D. dissertation, 137 p.

Oviatt, C.G., 2014, The Gilbert episode in the Great Salt Lake basin, Utah: Utah Geological Survey Miscellaneous Publication 14-3, 20 p., https://doi.org/10.34191/MP-14-3.

Oviatt, C.G., 2015, Chronology of Lake Bonneville, 30,000 to 10,000 yr B.P.: Quaternary Science Reviews, v. 110, p. 166–171, Appendix A supplementary data available online, http://dx.doi.org/10.1016/j.quascirev.2014.12.016.

Oviatt, C.G., Currey, D.R., and Miller, D.M., 1990, Age and paleoclimatic significance of the Stansbury shoreline of Lake Bonneville, northeastern Great Basin: Quaternary Research, v. 33, p. 291–305.

Oviatt, C.G., Miller, D.M., McGeehin, J.P., Zachary, C., and Mahan, S., 2005, The Younger Dryas phase of Great Salt Lake, Utah, USA: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 219, no. 3-4, p. 263–284.

Pan-American Center for Earth and Environmental Studies (PACES), University of Texas, El Paso, 2012, Gravity database of the US: Online, http://research.utep.edu/paces, accessed June 26, 2012.

Personius, S.F., and Scott, W.E., 1992, Surficial geologic map of the Salt Lake City segment and parts of adjacent segments of the Wasatch fault zone, Davis, Salt Lake, and Utah Counties, Utah: U.S. Geological Survey Miscellaneous Investigations Series Map I-2106, scale 1:50,000.

Resource Recovery and Conservation Company, 1986, Report of site investigation and remediation activity for Highland Boy site, Murray, Salt Lake County, Utah: unpublished consultant report prepared for Peterson Development Company, dated August 1986, variously paginated, available online http://eqedocs.utah.gov/, accessed June 28, 2017.

Reimer, P.J., Bard, E., Bayliss, A., Beck, J.W., Blackwell, P.G., Bronk Ramsey, C., Buck, C.E., Cheng, H., Edwards, R.L., Friedrich, M., Grootes, P.M., Guilderson, T.P., Haflidason, H., Hajdas, I., Hatté, C., Heaton, T.J., Hoffmann, D.L., Hogg, A.G., Hughen, K.A., Kaiser, K.F., Kromer, B., Manning, S.W., Niu, M., Reimer, R.W., Richards, D.A., Scott, E.M., Southon, J.R., Staff, R.A., Turney, C.S.M., and van der Plicht, J., 2013, IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP: Radiocarbon, v. 55, no. 4, p. 1869–1887.

Robbins, D.A., 2005, From industry to healthcare—the Murray smelter redevelopment is a resounding success!—Phoenix Award Application for the Murray Smelter Site, Murray, Utah: unpublished application for the Phoenix Award, summitted by ASARCO LLC, dated June 23, 2005, variously paginated, available online, http://eqedocs.utah.gov/, accessed June 28, 2017.

Scott, W.E., and Shroba, R.R., 1985, Surficial geologic map of an area along the Wasatch fault zone in Salt Lake Valley, Utah: U.S. Geological Survey Open-File Report 85-448, 18 p., 2 plates, scale 1:24,000.

Solomon, B.J., 1998, New evidence for the age of faulting on the West Valley fault zone: Utah Geological Survey, Survey Notes, v. 30, no. 3, p. 8 and 13.

Solomon, B.J., Biek, R.F., and Smith, T.W., 2007, Geologic map of the Magna quadrangle, Salt Lake County, Utah: Utah Geological Survey Map 216, 2 plates, scale 1:24,000, https://doi.org/10.34191/M-216DM.

Solomon, B.J., Biek, R.F., and Smith, T.W., 2018, Geologic map of the Magna quadrangle, Salt Lake County, Utah (GIS reproduction of 2007 map): Utah Geological Survey Map 216DM, 2 plates, scale 1:24,000, https://doi.org/10.34191/M-216DM.

USDA Agricultural Adjustment Administration, 1937, Aerial photography, Project AAL frames 1–18 to 31, 1–51 to 64, 1–99 to 110, 2–1 to 2, 2–20 to 33, 2–62 to 74 dated 9–19–1937, black and white, approximate scale 1:20,000.

USDA Agricultural Stabilization and Conservation Service, 1958, Aerial photography, Project AAL frames 6V–30 to 52, 6V–87 to 106, 11V–51 to 71, 11V–117 to 136, 11V–165 to 184, 12V–26 to 46, and 12V–71 to 89 dated 5–27–1958, black and white, scale 1:10,000.

U.S. Department of Energy (DOE), 2016, Fact sheet—Salt Lake City, Utah, processing and disposal sites (Vitro Uranium Mill Tailings): U.S. Department of Energy, dated 11/30/2016, 3 p., available online, https://www.lm.doe.gov/Salt_Lake/Processing/Documents.aspx, accessed April 25, 2017.

U.S. Environmental Protection Agency (EPA), undated a, Superfund site—Murray smelter, Murray City, UT—site details: Online, https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.docdata&id=0800697#content, accessed June 28, 2017.

U.S. Environmental Protection Agency (EPA), undated b, Superfund site—Portland Cement (kiln dust 2 & 3) Salt Lake City, UT—site details: Online, https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.docdata&id=0800690#content, accessed June 28, 2017.

U.S. Environmental Protection Agency (EPA), 1992, Superfund record of decision—Portland Cement (kiln dust #2 & #3), UT: U.S. Environmental Protection Agency Region VIII, Office of Emergency and Remedial Response, report number EPA/ROD/R08-92/056, variously paginated, available online https://www.epa.gov/nscep, accessed April 27, 2017.

U.S. Natural Resources Conservation Service (NRCS), 2015, Web soil survey (WSS) database for Salt Lake area, Utah: Online, http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx, accessed February 16, 2016.

Utah Automated Geographic Reference Center (AGRC), State Geographic Information Database, 1977, 1 meter black and white DOQs (Salt Lake County Only): Online, Utah Automated Geographic Reference Center, https://gis.utah.gov/data/aerial-photography/1977-1-meter-black-white-doqs-salt-lake-county-only/, accessed January 2016.

Utah Automated Geographic Reference Center (AGRC), State Geographic Information Database, 2013–2014, 0.5-meter Wasatch Front LiDAR elevation data: Online, Utah Automated Geographic Reference Center, http://gis.utah.gov/data/elevation-terrain-data/2013-2014-lidar/.

Utah Automated Geographic Reference Center (AGRC), State Geographic Information Database, 2016, National Agricultural Imagery Program 1 meter orthophotography: Online, Utah Automated Geographic Reference Center, https://gis.utah.gov/data/aerial-photography/2016-naip-1-meter-orthophotography/.

Utah Division of Water Rights, 2009, Utah Division of Water Rights: Online, http://www.waterrights.utah.gov/wellInfo/wellInfo.asp, accessed August 2016.

Utah Geological Survey, undated, Deep-basin-structure data: Online, https://geology.utah.gov/about-us/geologic-programs/geologic-hazards-program/for-consultants-and-design-professionals/community-velocity-model-cvm-and-other-geophysical-data/deep-basin-structure-data/, accessed September 2015.

Van Horn, R., 1979, Surficial geologic map of the Salt Lake City South quadrangle, Salt Lake County, Utah: U.S. Geological Survey Miscellaneous Investigations Series Map I-1173, 1 plate, scale 1:24,000.

Van Horn, R., 1981, Geologic map of pre-Quaternary rocks of the Salt Lake City North quadrangle, Davis and Salt Lake Counties, Utah: U.S. Geological Survey Miscellaneous Investigations Series Map I–1330, 1 plate, scale 1:24,000.

Van Horn, R., 1982, Surficial geologic map of the Salt Lake City North quadrangle, Davis and Salt Lake Counties, Utah: U.S. Geological Survey Miscellaneous Investigations Series Map I-1404, 1 plate, scale 1:24,000.

Van Horn, R., and Crittenden, M.D., Jr.,1987, Map showing surficial units and bedrock geology of the Fort Douglas quadrangle and parts of the Mountain Dell and Salt Lake City North quadrangles, Davis, Salt Lake, and Morgan Counties, Utah: U.S. Geological Survey Miscellaneous Investigations Series Map I-1762, 1 plate, scale 1:24,000.

Zoback, M.L., 1983, Structure and Cenozoic tectonism along the Wasatch fault zone, Utah, *in* Miller, D.M., Todd, V.R., and Howard, K.A., editors, Tectonic and stratigraphic studies in the eastern Great Basin: Geological Society of America Memoir 157, p. 3–27.