Intermountain GeoEnvironmental Services, Inc.
12429 South 300 East, Suite 100, Draper, Utah 84020
T: (801) 748-4044 ~ F: (801) 748-4045

2702 South 1030 West, Ste. 10, SLC, UT 84107
T: (801) 270-9400 ~ F: (801) 270-9401

May 25, 2018

Peak Street Management, LLC
8650 Sunset Blvd, Suite 413
West Hollywood, California 84414
Attn: Mr. Ross Hinkle

IGES Project No. 02787-001

Subject: Reconnaissance-Level Geologic Hazards Assessment
Under the Sun Ranch
Weber County Parcel #22-007-0011
East of State Road 162
Liberty, Utah

Mr. Hinkle:

At your request, IGES has performed a reconnaissance-level geologic hazards assessment for the Under the Sun Ranch property, Weber County Parcel #22-007-0011, located east of State Road 162 in the city of Liberty in Weber County, Utah (Figure A-1, *Site Vicinity Map*). This letter report identifies the nature and associated risk of the applicable geologic hazards associated with the property, based upon the results of the literature review and site reconnaissance conducted as part of this assessment.

INTRODUCTION

The Under the Sun Ranch property is an approximately 24.1-acre parcel, located in the southeastern quarter of the southwestern quarter of Section 17, Township 7 North, Range 1 East, approximately 3.9 miles northwest of Pineview Reservoir (Figure A-1). The property is bound on the west by State Road 162, and on the north, east, and south by undeveloped farmland.

It is our understanding that the proposed development on the parcel will consist of a multi-story primary ranch house and a number of appurtenant structures, including a farm stand, meeting house, farm house, greenhouses, and other ranch accessory features. A driveway for access and joint utilities are also anticipated improvements to the property. Construction plans were not available for our review; however, based on our experience with similar projects, we assume the primary ranch house will be a multi-story conventional wood-framed structure founded on spread footings. We anticipate the ranch house will have a basement unless groundwater or other subsurface conditions preclude the practical construction of a basement. All other structures are expected to be on-grade buildings.

PURPOSE AND SCOPE

This study was performed as a reconnaissance-level geologic hazards assessment to identify any surficial or subsurface geologic hazards that may be extant on the property or have the capability to adversely impact the property. Specifically, this study was conducted to:

- Analyze the existing geologic conditions present on the property and relevant adjacent areas;
- Assess the geologic hazards that pose a risk to development across the property, and determine an associated risk for each hazard; and
- Identify the most significant geologic hazard risks, and provide recommendations for appropriate additional studies and/or mitigation practices, if necessary.

In order to achieve the purpose and scope outlined above, the following services were performed as part of this investigation:

- Review of available published geologic reports and maps for the subject property and surrounding areas;
- Stereoscopic review of aerial photographs and analysis of additional available aerial imagery, including LiDAR;
- Site reconnaissance by an engineering geologist licensed in the state of Utah to map the surficial geology, determine site conditions, and assess the property for geologic hazards; and
- Preparation of this report, which is based upon the data reviewed and collected in this investigation.

REVIEW OF GEOLOGIC LITERATURE

A number of pertinent publications were reviewed as part of this assessment. Sorensen and Crittenden, Jr. (1979) provides the most recent published 1:24,000 scale geologic mapping that covers the area in which the property of interest is located. Coogan and King (2016) provide more recent geologic mapping of the area, but at a regional (1:62,500) scale; this map is an updated version of a previous map by the same authors (Coogan and King, 2001) that had long been used as the most recent geologic map of the area. A United States Geological Survey (USGS) topographic map for the Huntsville Quadrangle (2017) provides physiographic and hydrologic data for the project area. A Federal Emergency Management Agency (FEMA) flood map (effective in 2015) that covers the project area was reviewed. Regional-scale geologic hazard maps pertaining to landslides (Elliott and Harty, 2010; Colton, 1991), faults (Christenson and Shaw, 2008a; USGS and Utah Geological Survey (UGS), 2006), debris-flows (Christenson and Shaw, 2008b), liquefaction (Christenson and Shaw, 2008c; Anderson et al., 1994), and radon (Solomon, 1996) that cover the project area were also reviewed.

General Geologic Setting

The Under the Sun Ranch property is situated within the northwestern part of the Ogden Valley, on low hilly terrain that separates the southeast-trending North Fork Ogden River drainage on the east and an unnamed north-south trending drainage on the west along the eastern margin of the western flank of the Wasatch Mountains (see Figure A-1). Ogden Valley separates the western part of the Wasatch Range from the Bear River Range to the east, a subgroup of mountains that are part of the parent Wasatch Range. The Wasatch Mountains contain a broad depositional history of thick Precambrian and Paleozoic sediments that have been subsequently modified by various tectonic episodes that have included thrusting, folding, intrusion, and volcanics, as well as scouring by glacial and fluvial processes (Stokes, 1987). The uplift of the Wasatch Mountains occurred relatively recently during the Late Tertiary Period (Miocene Epoch) between 12 and 17 million years ago (Milligan, 2000). Since uplift, the Wasatch Front has seen substantial modification due to such occurrences as movement along the Wasatch Fault and associated spurs, the development of the numerous canyons that empty into the current Salt Lake Valley and Utah Valley and their associated alluvial fans, erosion and deposition from Lake Bonneville, and localized mass movement events (Hintze, 1988). The Wasatch Mountains, as part of the Middle Rocky Mountains Province (Milligan, 2000), were uplifted as a fault block along the Wasatch Fault (Hintze, 1988). Ogden Valley itself is a fault-bounded trough that was occupied by Lake Bonneville (Sorensen and Crittenden, Jr, 1979) before being cut through by the Ogden River and subsequently dammed to form the Pineview Reservoir.

Surficial Geology

According to Sorensen and Crittenden, Jr. (1979), the property is located entirely on Pleistocene-aged silt deposits (unit Qs on Figure A-2, *Regional Geology Map 1*). In this map, a concealed northwest-trending fault is shown to pass approximately 530 feet southwest of the southwestern corner of the property. Most recently, Coogan and King (2016; Figure A-3, *Regional Geology Map 2*) map the property with three distinct geologic units. Most of the property is mapped as being underlain by upper Pleistocene-aged "Transgressive and Bonneville-shoreline deltaic and lacustrine deposits" (unit Qdlb), which are described as "Mostly sand, silty sand, and gravelly sand deposited near shore in Lake Bonneville." Unit Qalp? is mapped along the western margin of the property, denoted as "Lake Bonneville regression-age stream alluvium." This queried unit is described as "Pebble and cobble gravel, gravelly sand and silty sand, with minor clay in channel incised into Lake Bonneville deltaic and lacustrine deposits (Qldb) in Ogden Valley." In the eastern portion of the property, a northeast-southwest trending sliver of unit Qla? is mapped. This unit is identified as undivided Lake Bonneville lacustrine deposits and post- and pre-Lake Bonneville alluvial deposits, and is described as "Mostly poorly sorted and poorly bedded sand, silt, and clay, with some gravel; mapped where Lake Bonneville deposits are reworked by later stream action or covered by thin stream and fan deposits…unit queried where may be dominantly alluvium." An inactive, concealed thrust fault (Willard Thrust) is shown as trending roughly to the northwest approximately 0.79 miles to the south-southwest of the property. No faults, landslide scarps, or other adverse geologic features are shown on or projecting toward the property.

Hydrology

The USGS topographic map for the Huntsville Quadrangle (2017) shows that Under the Sun Ranch property is on the broad topographic high that separates the North Fork Ogden River on the east from the unnamed north-south trending drainage to the west (Figure A-1). The map shows an intermittent pond located in the west-central portion of the property, though no such feature was observed in the site reconnaissance. A notable northwest-southeast trending swale passes through the eastern part of the property, which was observed to be dry during the site reconnaissance and corresponds to unit Qla? in Coogan and King (2016; Figure A-3). No springs are known to occur on the property, and springs are not anticipated to occur on the property, even during peak spring runoff times.

Baseline groundwater depths for the Under the Sun Ranch property are currently unknown but are anticipated to fluctuate both seasonally and annually. The annual high groundwater level is likely to be attained following peak spring runoff.

The FEMA flood map that covers the Under the Sun Ranch property shows that the property is outside of the 500-year flood floodplain for the North Fork Ogden River (FEMA, 2015).

Geologic Hazards

Based upon the available geologic literature, regional-scale geologic hazard maps that cover the Under the Sun Ranch property have been produced for landslide, fault, debris-flow, liquefaction, and radon hazards. The following is a summary of the data presented in these regional geologic hazard maps.

Landslides

Two regional-scale landslide hazard maps have been produced that cover the project area. Neither Colton (1991) nor Elliott and Harty (2010) show the property to be located within an area denoted as landslide deposits or having a landslide hazard. Additionally, the most recent geologic map of the area (Coogan and King, 2016; see Figure A-3) shows the property to be located outside of any mapped landslide deposits.

Faults

Neither Christenson and Shaw (2008a) nor the Quaternary Fault and Fold Database of the United States (USGS and UGS, 2006) show any Quaternary-aged (~2.6 million years ago to the present) faults to be present on or projecting towards the subject property. The closest Quaternary-aged fault to the property is the Ogden Valley North Fork Fault, which trends northwest to southeast approximately 800 feet southwest of the property (USGS and UGS, 2006). The Weber County Natural Hazards Overlay Districts defines an active fault to be “a fault displaying evidence of greater than four inches of displacement along one or more of its traces during Holocene time (about 11,000 years ago to the present)” (Weber County, 2015). The closest mapped active fault to the property is the Weber Segment of the Wasatch Fault Zone, located approximately 3.6 miles west of the western margin of the property (USGS and UGS, 2006).

Debris-Flows
Christenson and Shaw (2008b) do not show the project area to be located within a debris-flow hazard special study area, and Coogan and King (2016) do not show any mapped alluvial fan deposits on the property.

Liquefaction
Anderson, et al. (1994) and Christensen and Shaw (2008c) both show the project area to be located in an area with very low potential for liquefaction.

Radon
Solomon (1996) shows the property to be located in an area with moderate radon levels, but immediately adjacent to an area of high radon levels to the west.

REVIEW OF AERIAL IMAGERY

A series of aerial photographs that cover project area were taken from the UGS Aerial Imagery Collection (UGS, 2018) and analyzed stereoscopically for the presence of adverse geologic conditions across the property. This included a review of photos collected from the years 1963 and 1970. A table displaying the details of the aerial photographs reviewed can be found in the *References* section at the end of this report.

No geologic lineaments, fault scarps, landslide headscarps, or landslide deposits were observed in the aerial photography on the subject property. The property was observed to consist predominantly of cultivated farmland, and a small pond was observed in the east-central portion of the property. The pond likely corresponds to the intermittent pond shown on the USGS (2017) topographic map.

Google Earth imagery of the property from between the years of 1993 and 2017 were also reviewed. No landslide or other geological hazard features were noted in the imagery. The property was observed to remain largely unchanged across this time frame, with changes in cultivated areas being the only notable change. The outline of what could be the old pond area was visible in the east-central part of the property only in the earliest imagery.

Utah Geological Survey 1-meter LiDAR data (UGS, 2011) for the project area was reviewed. No landslide or other geologic hazard features were readily identified on the property. Irregular morphology of the swale was readily observed, and a round depression in the middle of the property likely corresponding to the old pond location was also observed in the imagery.

SITE RECONNAISSANCE

Mr. Peter E. Doumit, P.G., C.P.G., of IGES conducted reconnaissance of the site and the immediate adjacent properties on May 3, 2018. The site reconnaissance was conducted with the intent to assess the general geologic conditions present across the property, with specific interest in those areas identified in the geologic literature and aerial imagery reviews as potential geologic hazard areas (if identified). Additionally, the site reconnaissance provided the opportunity to geologically map the surficial geology of the area. The local geology was observed to be largely consistent with that as-mapped and described by Coogan and King

(2016); a site-specific geologic map based on observations made during the site reconnaissance is shown in Figure A-4.

The property was found to consist largely of broad, low hills, with gentle slopes. The western approximately one-third of the property was found to have been recently cultivated. The eastern portion of the property was covered in low grasses, though the soil showed evidence of having been tilled in the past. The ground surface was uneven, though not hummocky; in large part the product of years of human disturbance. Surficial soils were observed to be a dark yellowish brown, moist, silty sand with gravel gradational to sandy lean clay with gravel. Variously-sized cobbles were commonly observed scattered across the property and appeared alluvial/deltaic in origin. These clasts were rounded to subrounded to subangular, and up to 5 inches in diameter, though most commonly were observed to be between ½ inch and 1 inch in diameter. The clasts consisted predominantly of medium gray to moderate reddish brown granular quartzite, though some white to dark yellowish orange amorphous quartzite was observed; minor medium gray limestone and conglomerate were also present.

A broad, north-south trending linear hill was present in the west-central portion of the property, which represents the topographic high on the property. East of this linear hill, a prominent southwest-trending swale was observed. Surficial soils in the bottom of the swale may be slightly more clay-rich than observed on the linear hill, but appeared very similar.

Northeast of the swale was another hill that is the proposed location for the primary ranch house. Within this area, a small test pit/excavation was observed to have been left open (see Figure A-4). The excavation was approximately 12 feet long and 5 feet deep, and exposed Lake Bonneville deltaic deposits (Qdlb) to total depth. The uppermost approximately 3 feet of the soils were observed to be dark yellowish brown to grayish brown A/B Soil Horizon, consisting of a sandy lean clay with gravel that was medium dense, moist, low plasticity, and massive. Gravel and larger-sized clasts comprised approximately 20-25% of the A/B Soil Horizon; these were subrounded to subangular and up to 1½ inches in diameter, though the mode size was less than ½ inch. The A/B Horizon was also observed to be highly porous, with common voids consisting of root, worm, and bug holes up to 1 centimeter in diameter; 1- to 2-millimeter (mm) diameter pinhole voids were also common. The basal approximately 2 feet exposed in the excavation consisted of largely unaltered delta deposits comprised of moderate reddish brown clayey sand with gravel that was medium dense to dense, moist, contained low plasticity fines, and was massive. Gravel and larger-sized clasts comprised approximately 5 to 10% of these deposits, with subrounded to subangular clasts up to 1 inch in diameter. Pinhole voids up to 1 mm in diameter were also commonly observed. It should be noted that pinhole voids are a common characteristic of collapsible soils (addressed in later sections of this report). The subsurface materials exposed in the excavation are likely to be consistent across the property, however this cannot be definitively concluded as extrapolation from a single data point becomes increasingly unreliable with distance.

No surface water or ground water was observed on the property. Aside from the possible collapsible soil hazard, no other evident geologic hazards were observed to be associated with the property during the site reconnaissance.

GEOLOGIC HAZARD ASSESSMENT

Geologic hazard assessments are necessary to determine the potential risk associated with particular geologic hazards that are capable of adversely affecting a proposed development area. As such, they are essential in evaluating the suitability of an area for development and provide critical data in both the planning and design stages of a proposed development. The geologic hazard assessment discussion below is based upon a qualitative assessment of the risk associated with a particular geologic hazard, based upon the data reviewed and collected as part of this investigation.

A "low" hazard rating is an indication that the hazard is either absent, is present in such a remote possibility so as to pose limited or little risk, or is not anticipated to impact the project in an adverse way. Areas with a low-risk determination for a particular geologic hazard do not require additional site-specific studies or associated mitigation practices with regard to the geologic hazard in question. A "moderate" hazard rating is an indication that the hazard has the capability of adversely affecting the project at least in part, and that the conditions necessary for the geologic hazard are present in a significant, though not abundant, manner. Areas with a moderate-risk determination for a particular geologic hazard may require additional site-specific studies and associated mitigation practices in the areas that have been identified as the most prone to susceptibility to the particular geologic hazard. A "high" hazard rating is an indication that the hazard is very capable of adversely affecting the project, that the geologic conditions pertaining to the particular hazard are present in abundance, and/or that there is geologic evidence of the hazard having occurred at the area in the historic or geologic past. Areas with a high-risk determination always require additional site-specific hazard investigations and associated mitigation practices. For areas with a high-risk geologic hazard, simple avoidance is often considered.

The following are the results of the reconnaissance-level geologic hazards assessment for the Under the Sun Ranch property.

Landslides/Mass Movement/Slope Stability

On the geologic maps reviewed for this assessment, the surficial geology of the property is not mapped as a landslide, and the landslide hazard maps that cover the Under the Sun property do not show the property within a landslide hazard area. Additionally, no landslide hazards for the property were observed in the aerial imagery or during the site reconnaissance.

The hilly topographic highs on the property are largely flat-lying, though there are several areas where there is a considerable slope. The western margin of the linear hill in the west-central portion of the property and the slopes leading into and out of the swale in the east-central portion of the property have slopes of up to 10.5% grade (9.5:1 horizontal to vertical). As such, slope stability issues are not a concern for the property. Given this data, the landslide, mass-movement, and slope stability hazards associated with the property are considered to be low.

It should be noted, however, that the surficial deposits that cover the property are possibly underlain by the Norwood Tuff, a geologic unit known to be landslide-prone (Ashland, 2010).

Rockfall

No bedrock is exposed immediately upslope of the property, therefore there is no rockfall source area. As such, the rockfall hazard associated with the property is considered to be low.

Surface-Fault-Rupture and Earthquake-Related Hazards

No faults are known to be present on or projecting towards the property; the closest mapped active fault to the property is the Weber Segment of the Wasatch Fault Zone, located approximately 3.6 miles to the west of the property (USGS and UGS, 2006). Given this information, the risk associated with surface-fault-rupture on the property is considered low.

The entire property is subject to earthquake-related ground shaking from a large earthquake generated along the active Wasatch Fault. Given the distance from the Wasatch Fault, the hazard associated with ground shaking is considered to be moderate. Proper building design according to appropriate building code and design parameters can assist in mitigating the hazard associated with earthquake ground shaking.

Liquefaction

According to the existing geologic literature for the area, the risk associated with earthquake-induced liquefaction is expected to be low. However, both shallow groundwater and granular soils are possible to be present on the property; therefore, we cannot preclude the possibility for liquefaction to occur onsite. A liquefaction study, which would include borings and/or CPT soundings to a depth of at least 50 feet, was not performed for this project and is not a part of our scope of work.

Debris-Flows and Flooding Hazards

The site is located on a broad topographic high between two drainages, and no alluvial fan deposits have been mapped on the property. Additionally, the property is located outside of the 500-year floodplain for both of the drainages (FEMA, 2015). Given this information, the risk associated with debris-flows and flooding hazards on the property is considered to be low.

Shallow Groundwater

Groundwater levels are currently unknown for the property but are not anticipated to be near-surface. The presence of shallow groundwater (if encountered) could necessitate localized dewatering for construction of foundations and/or utilities. Although site-specific subsurface data is not available to assess shallow groundwater, the absence of hydrophilic plants on the lot suggests shallow groundwater is not present.

Radon

Limited data is available to address the radon hazard across the property. However, at least one study (Solomon, 1996) shows the site situated within an area designated as having a moderate radon hazard, and immediately adjacent to a high radon hazard area to the west. As such, the radon hazard associated with the property is considered to be moderate.

Problem Soils

Problem soils include swelling (expansive) soils and collapsible soils. Expansive soils typically consist of highly plastic clays (USCS classification Fat CLAY (CH)); soils meeting this description were not observed onsite. Collapsible soils (often referred to as 'hydro-collapsible') are soils that compress under load when inundated with water; collapsible soils typically consist of silt and fine sand, are typically dry, have a low dry unit weight, and have an open, porous grain structure. Soils not meeting this description can also be potentially collapsible. Granular, highly porous and 'pinholed' soils were observed in the open excavation on the property. Therefore, the risk associated with swelling soils is considered to be low, though the risk associated with collapsible soils is considered to be moderate to high.

CONCLUSIONS AND RECOMMENDATIONS

Based upon the data collected and reviewed as part of this assessment, IGES makes the following reconnaissance-level conclusions regarding the geological hazards present at the Under the Sun Ranch property:

- **From a reconnaissance-level perspective, the Under the Sun Ranch property does not appear to have geological hazards that would adversely affect the development as currently proposed. As such, no subsurface geologic hazards investigative methods are considered to be necessary for the property preceding development, and the property is considered buildable from a geologic perspective.** However, a geotechnical investigation to evaluate the collapsible soil potential from an engineering perspective is recommended.

- Collapsible soils, earthquake ground shaking, and radon are the only hazards that may potentially affect all parts of the project area, while other hazards pose minimal risk.

- Landslide, rockfall, surface-fault-rupture, debris-flow, flooding, and swelling soil hazards are considered to be low for the property.

- Groundwater levels are currently unknown, but are not anticipated to be near-surface. Shallow groundwater hazards are not considered to pose significant risk to development, but the possibility for the presence of shallow groundwater cannot be ruled out. If structures with a basement are planned, the Owner should consider site-specific subsurface investigation to assess the presence (or absence) of groundwater.

- Published literature indicates that the liquefaction potential for the site is expected to be low. However, due to the presence of granular soils, unknown depth to groundwater, and the unknown character of the subsurface soils, the potential for liquefaction occurring at the site cannot be ruled out.

Given the conclusions listed above, IGES makes the following recommendations:

- To adequately address the collapsible soil hazard, it is recommended that a geotechnical investigation be performed for the property, with appropriate soil sampling and

laboratory testing to evaluate the characteristics of the collapsible soils and to provide engineering recommendations with regard to mitigating the potential hazard (if necessary). Alternatively, the Owner may anticipate over-excavating any soils identified as potentially collapsible by a geotechnical engineer during construction. The amount of over-excavation could be negligible, but also could be several feet – the degree to which over-excavation is required (if any) will be dependent on the characteristics of the soils exposed in the foundation subgrade during construction.

- To adequately address the radon hazard for the property, a site-specific radon assessment is recommended.

- Though no landslide features were observed on the property, the surficial deposits present on the property are potentially underlain by the Norwood Tuff, which is a known landslide-prone unit. The Owner should understand and accept that, while the potential for landslides impacting the site is qualitatively assessed to be low, considering the potential for the site to be underlain by Norwood Tuff, the risk associated with landslide hazards is not zero.

LIMITATIONS

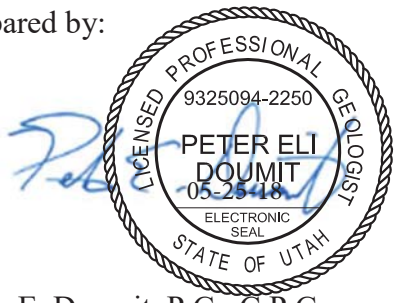
The conclusions and recommendations presented in this report are based on limited geologic literature review and site reconnaissance, and our understanding of the proposed construction. It should be noted that these conclusions are based solely upon the readily-available geological data available at the time of the preparation of this report. It is possible that geologic hazards are present that may not be identified until construction activities expose adverse geologic conditions. Therefore, the geologic hazard classifications as denoted in this report are potentially subject to change with data collected from site-specific excavations across the property. This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, expressed or implied, is made.

CLOSURE

We appreciate the opportunity to provide you with our services. If you have any questions, please contact the undersigned at your convenience at (801) 748-4044.

Respectfully Submitted,
IGES, Inc.

Prepared by:



Peter E. Doumit, P.G., C.P.G.
Senior Geologist

Reviewed by:

David A. Glass, P.E.
Senior Geotechnical Engineer

Attachments:

References
Figure A-1: Site Vicinity Map
Figure A-2: Regional Geology Map 1
Figure A-3: Regional Geology Map 2
Figure A-4: Local Geology Map

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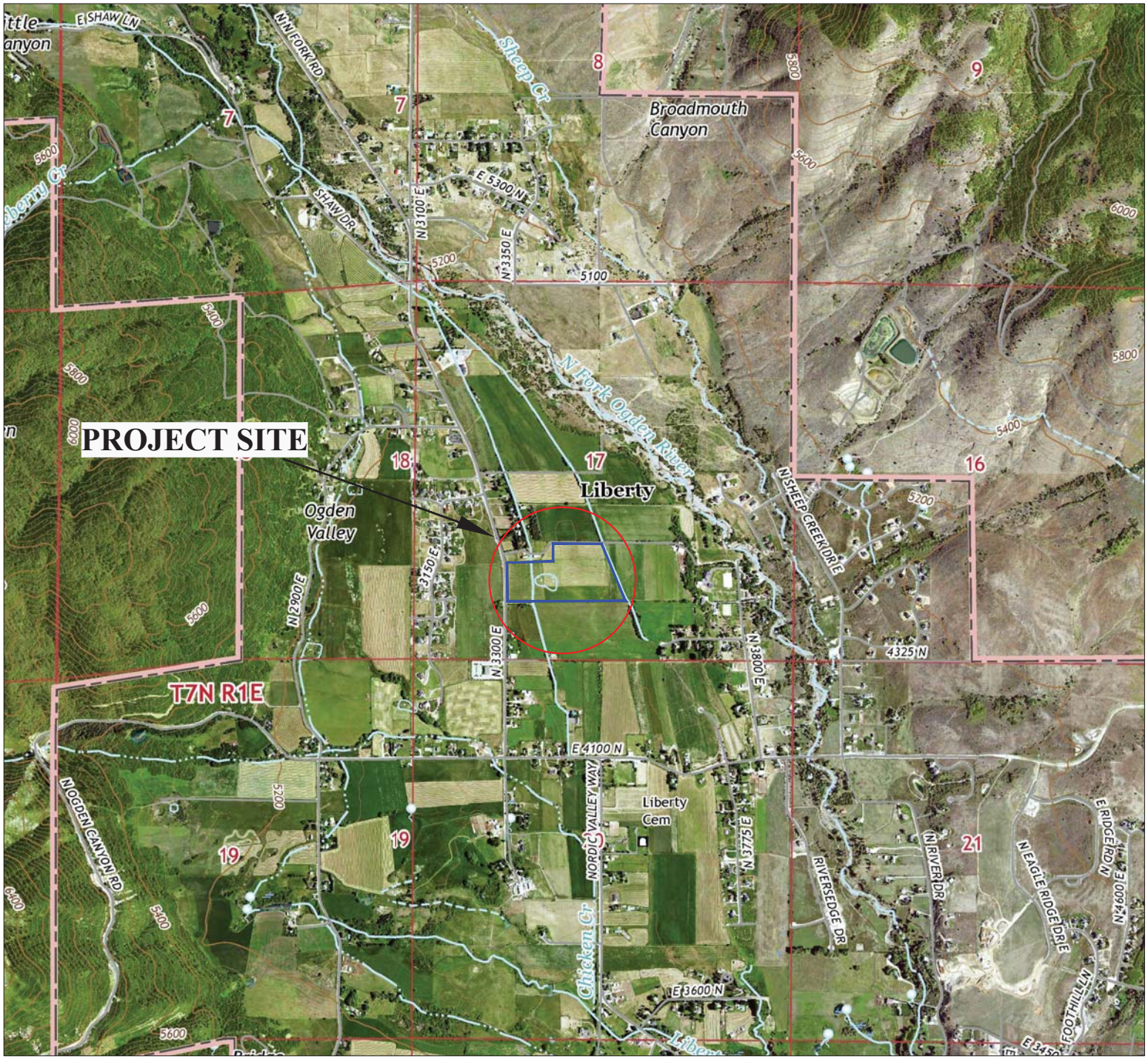
AERIAL PHOTOGRAPHS

Data Set	Date	Flight	Photographs	Scale
1963 ELK	June 25, 1963	2	169, 170	1:15,840
1970 WF	1970	2	002, 003	1:12,000

*https://geodata.geology.utah.gov/imagery/



Base Maps:

-USGS *Huntsville and North Ogden* 7.5-Minute Quadrangles (2017)

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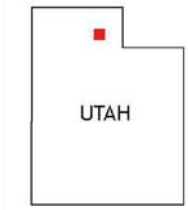
FEET

1" = 2000'



IGES®

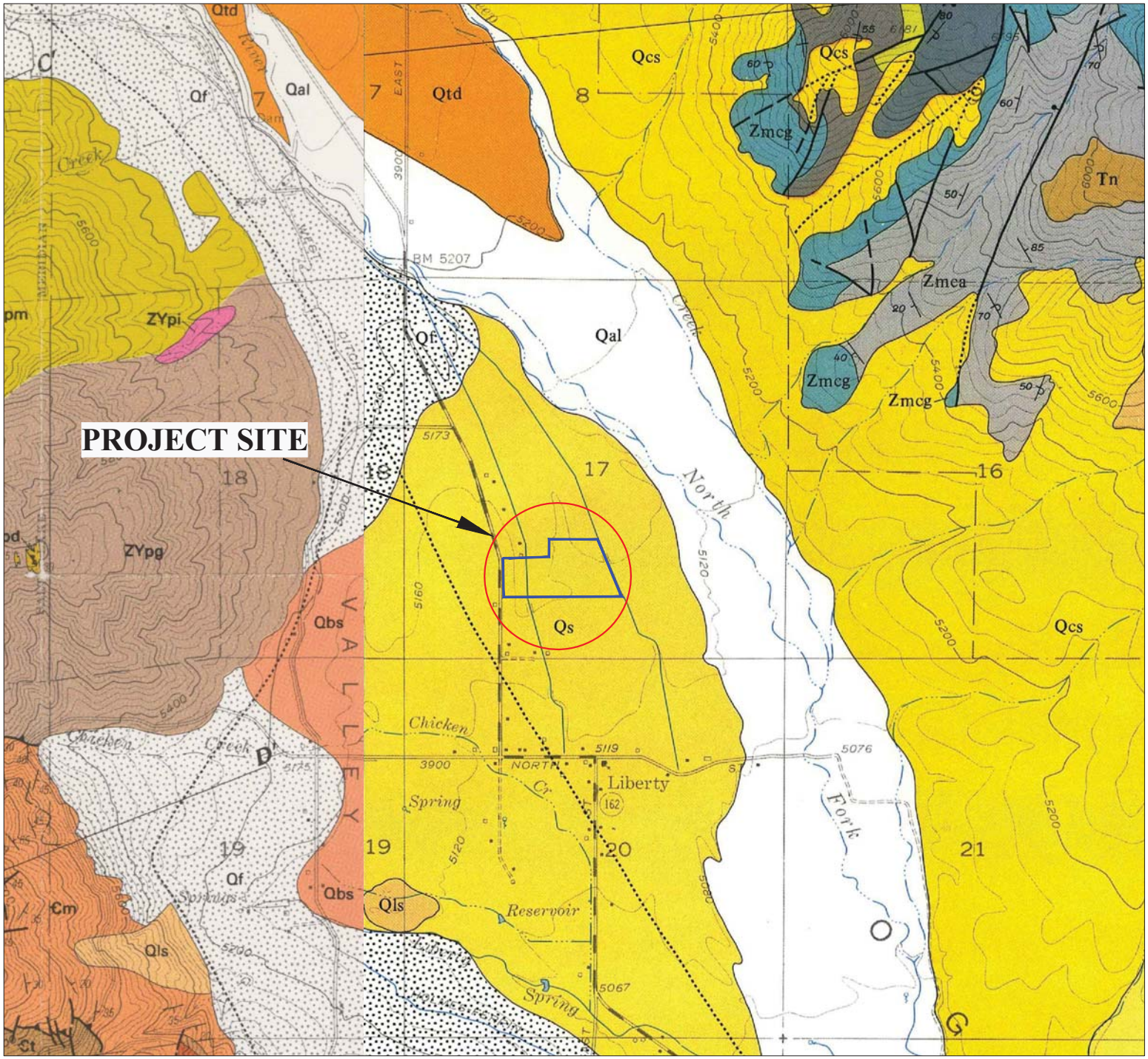
PROJECT NO: 02787-001

Reconnaissance-Level Geologic Hazards Assessment
Under the Sun Ranch
Parcel #22-007-0011
Liberty, Utah

SITE VICINITY MAP

FIGURE

A-1



Base Maps:

-USGS *Huntsville* 7.5-Minute Geologic Quadrangle (GQ-1503), Sorensen and Crittenden Jr. (1979)

-USGS *North Ogden* 7.5-Minute Geologic Quadrangle (I-1606), Crittenden, Jr. and Sorensen (1985)

N

0 1000 2000
FEET

1" = 2000'

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REGIONAL GEOLOGY MAP 1

FIGURE

A-2a

MAP LEGEND

Qal	ALLUVIAL DEPOSITS, UNDIFFERENTIATED (Holocene) – Unconsolidated gravel, sand, and silt deposits in presently active stream channels and floodplains; thickness 0-6 m
Qcs	COLLUVIUM AND SLOPEWASH (Holocene) – Bouldery colluvium and slopewash chiefly along eastern margin of Ogden Valley; in part, lag from Tertiary units; thickness 0-30 m
Qf	ALLUVIAL FAN DEPOSITS (Holocene) – Alluvial fan deposits; postdate, at least in part, time of highest stand of former Lake Bonneville; thickness 0-30 m
Qls	LANDSLIDE DEPOSITS (Holocene) – thickness 0-6 m
Qt	TALUS DEPOSITS (Holocene) – thickness 0-6 m
Qtd	TERRACE AND DELTA(?) DEPOSITS (Pleistocene) – In North Fork Ogden River, gravel, sand, and silt in stream terraces graded to high stand of former Lake Bonneville; at mouth of Middle and South Fork Ogden River, pinkish-tan sand and silt in delta(?) remnants deposited during high stands of Lake Bonneville; thickness 0-45 m
Qs	SILT DEPOSITS (Pleistocene) – Tan silt and sand forming extensive flats in Ogden Valley; deposited during high stands of Lake Bonneville, but may include older alluvial units; thickness 0-60 m
Qg	GRAVEL AND COBBLE DEPOSITS (Pleistocene) – In Ogden Canyon, gravel and cobble terrace remnants, probably deposited after time of highest stand of Lake Bonneville; thickness 0-3 m
Qog	OLDER GRAVEL DEPOSITS (Pleistocene) – North of Huntsville, cobble, gravel, and sand deposit that probably predates high stands of Lake Bonneville; thickness 21 m
Tn	NORWOOD TUFF (lower Oligocene and upper Eocene) – Fine- to medium-bedded, fine-grained, friable, white- to buff-weathering tuff and sandy tuff, probably waterlain and in part reworked; thickness 0-450+(?) m

Pre-Tertiary normal fault – Dotted where concealed
Bar and ball on downthrown side

Thrust fault – Dashed where inferred
Sawteeth on upper plate

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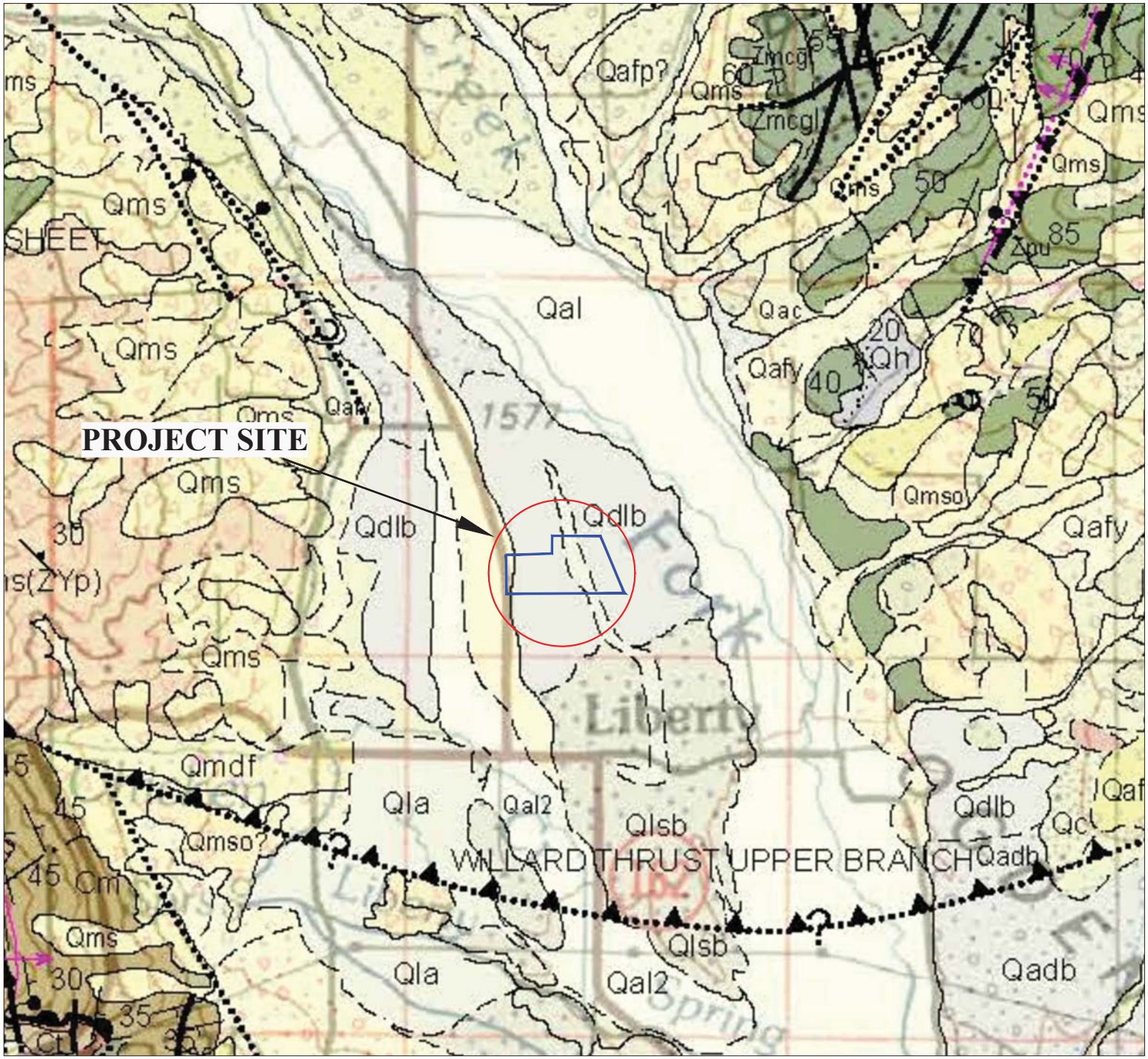
REGIONAL GEOLOGY MAP 1

FIGURE

A-2b



Base Map:

-UGS *Ogden* 30' x 60' Geologic Quadrangle
(OFR-653DM, Plate 1), Coogan and King (2016)

N

0 1000 2000
FEET

1" = 2000'

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REGIONAL GEOLOGY MAP 2

FIGURE

A-3a

MAP LEGEND

Qal, Qal1, Qal2, Qal2?

Stream alluvium and flood-plain deposits (Holocene and uppermost Pleistocene) – Sand, silt, clay, and gravel in channels, flood plains, and terraces typically less than 16 feet (5 m) above river and stream level; moderately sorted; unconsolidated; along the same drainage Qal2 is lower than Qat2 and has likely been subject to flooding, at least prior to dam building; present in broad plains along the Bear, Ogden, and Weber Rivers and larger tributaries like Deep, Cottonwood, East Canyon, Lost, and Saleratus Creeks, along Box Elder, Heiners, and Yellow Creeks, and in narrower plains of larger tributary streams; locally includes muddy, organic overbank and oxbow lake deposits; composition depends on source area, so in back valleys typically contains many quartzite cobbles recycled from the Wasatch Formation; mostly Holocene, but deposited after regression of Lake Bonneville from the late Pleistocene Provo shoreline; width in Morgan Valley is combined flood plain of Weber River and East Canyon and Deep Creeks; 6 to 20 feet (2-6 m) thick and possibly as much as 50 feet (15 m) along Weber River and thinner in the Kaysville quadrangle; greater thicknesses (>50 feet [15 m]) are reported in Morgan Valley (Utah Division of Water Rights, well drilling database), but likely include Lake Bonneville and older Pleistocene deposits.

Qalp? **Lake Bonneville regression-age stream alluvium (upper Pleistocene?)** – Pebble and cobble gravel, gravelly sand and silty sand, with minor clay in channel incised into Lake Bonneville deltaic and lacustrine deposits (Qldb) in Ogden Valley; queried because age uncertain; thickness uncertain.

Qls, Qls?, Qlsp, Qlsb, Qlsb?

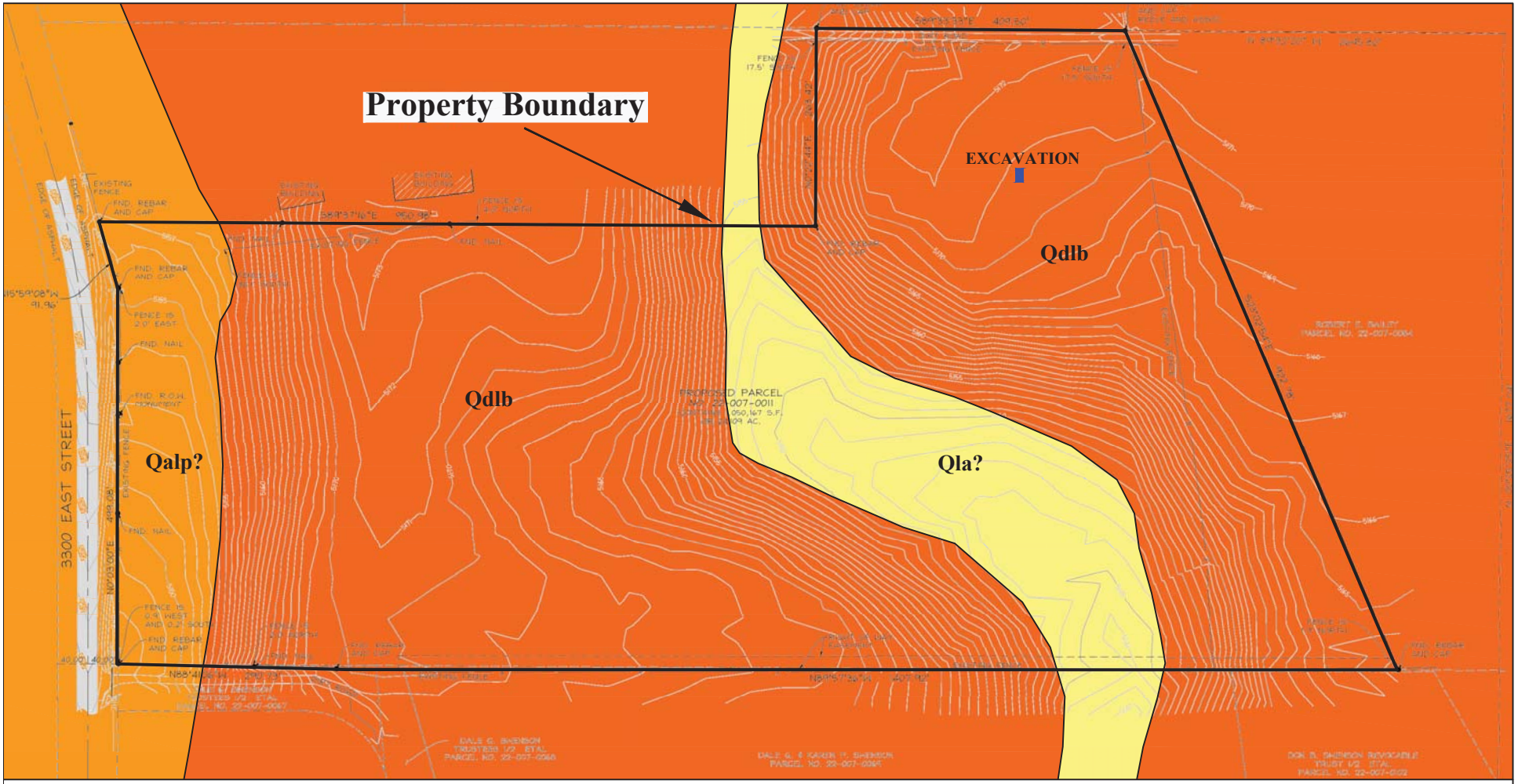
Lake Bonneville sand (upper Pleistocene) – Mostly sand with some silt and gravel deposited nearshore below and near the Provo shoreline (Qlsp) and between the Provo and Bonneville shorelines (Qlsb); Qls mapped downslope from slope break below Provo shoreline beach deposits where thin Lake Bonneville regressional sand may overlie transgressional sand; grades downslope into unit Qlf with decreasing sand content and laterally with more gravel into units Qdlp, Qdlb, and upslope with more gravel into unit Qlgb; Qls and Qlsb queried where grain size or unit identification uncertain; may be as much as 75 feet (25 m) thick, and thickest near Ogden; typically less than 20 feet (6 m) thick in Morgan Valley; may include small deltas and deltas that lack typical delta shape.

Qdlb, Qdlb?

Transgressive and Bonneville-shoreline deltaic and lacustrine deposits (upper Pleistocene) – Mostly sand, silty sand, and gravelly sand deposited near shore in Lake Bonneville; extensive at mouth of Weber Canyon; related to transgression to and occupation of the Bonneville shoreline with lacustrine deposits covering deltaic deposits; in Morgan Valley and near mouth of Coldwater Canyon (North Ogden quadrangle) contain more cobbles and overall more gravel; 0 to at least 40 feet (12 m) thick in Ogden and Morgan Valleys; about 400 feet (120 m) thick in bluff at the mouth of Weber Canyon. These deposits are prone to slope failures.

Qla, Qla?

Lake Bonneville lacustrine deposits and post- and pre-Lake Bonneville alluvial deposits, undivided (Holocene and upper? Pleistocene) – Mostly poorly sorted and poorly bedded sand, silt, and clay, with some gravel; mapped where Lake Bonneville deposits are reworked by later stream action or covered by thin stream and fan deposits, and where lake deposits are thin and overlie older alluvial deposits; unit queried where may be dominantly alluvium; deposits typically eroded from shallow Norwood Formation; mostly mapped near Bonneville shoreline; also mapped in Peterson quadrangle along upper Deep Creek above Bonneville shoreline where lake deposits seem to indicate landslide dam of creek; thickness uncertain.



Base Map:

Talisman Civil Map, titled "Bisnow Residence, Preliminary Boundary and Topographic Survey," dated 12-8-17.

-Contour Interval: 1 foot

LEGEND

- **Qdlb: Lake Bonneville Deltaic and Lacustrine Deposits**
- **Qalp?: Stream Alluvium**
- **Qla?: Post-Lake Bonneville Alluvial Deposits**
- **Existing Open Excavation**

N

0 100 200
FEET

1" = 200'

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LOCAL GEOLOGY MAP

FIGURE

A-4