

REPORT

GEOLOGIC HAZARDS RECONNAISSANCE

PROPOSED SAMAREL SUBDIVISION

ABOUT 6200 EAST OLD SNOWBASIN ROAD

HUNTSVILLE, WEBER COUNTY, UTAH



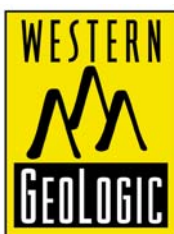
Prepared for

Lewis Homes
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September 13, 2022

Prepared by

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September 13, 2022

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SUBJECT: Geologic Hazards Reconnaissance
Proposed Samarel Subdivision
About 6200 East Old Snowbasin Road
Huntsville, Weber County, Utah

Dear Mr. Lewis:

This report presents the results of a reconnaissance-level engineering geology and geologic hazards review and evaluation conducted by Western Geologic & Environmental LLC (Western Geologic) for the proposed Samarel subdivision at about 6200 East Old Snowbasin Road, Huntsville, Utah (Figure 1 – Project Location). The Project consists of a 6.65-acre parcel identified as Weber County Assessor parcel number 20-035-0086. The Project is located in southern Ogden Valley on a northeast-trending ridge bounded by northwest- to southeast-facing slopes straddling the boundary between Sections 23 and 24, Township 6 North, Range 1 East (Salt Lake Base Line and Meridian; Figure 1). Elevation of the Project is 5,271 to 5,129 feet above sea level. Based on a July 2022 Great Basin Engineering Preliminary Plat, the Project is intended for development of a two-lot residential subdivision with lot sizes of 3.03 acres (Lot 1, on the west) and 3.62 acres (Lot 2, on the east).

PREVIOUS STUDIES

Western Geologic (2021) conducted a geologic hazards evaluation for the 284-acre Legacy Mountain Development bordering the Project on the west and north. The evaluation was conducted concurrently and combined with a geotechnical engineering study performed by Christensen Geotechnical (Christensen Geotechnical, 2021).

Western Geologic's (2021) investigation included logging of 34 walk-in test pits and preparation of ten geologic cross sections based on geoprocessed LIDAR data, site-specific subsurface data, and inferred conditions. Four test pits (TP-29, TP-30, TP-31 and TP-33) were in the vicinity of the Project and two cross sections (I-I' and J-J') were across slopes at the Project. Test pit TP-29 was about 80 feet northwest of the Project and exposed 1.5 feet of slope colluvium overlying weathered tuffaceous sandstone of the Tertiary Norwood Formation. Test pit TP-30 was adjacent to the northern Project boundary and exposed 2.5 to 3.1 feet of slope colluvium overlying weathered Norwood Formation sandstone. Test pit TP-31 was about 365 feet northeast of the Project and exposed 0.9 to 1.4 feet of slope colluvium overlying weathered Norwood Formation sandstone. Test pit TP-33 was about 510 feet northwest of the Project and

exposed 3.2 to 7.0 feet of slope colluvium overlying weathered Norwood Formation claystone. Cross Section I-I' trended northwestward for a total distance of 600 feet crosswise to the ridge at the Project, whereas J-J' trended northeastward for a total distance of 895 feet parallel to the ridge at the Project. Both cross sections displayed a veneer of slope colluvium overlying Tertiary Norwood Formation bedrock with dip-slope bedding. Groundwater was at an inferred depth of about 160 feet below the ground surface (bgs) in the cross sections. Based on their investigation, Western Geologic (2021) concluded that earthquake ground shaking and landslides posed a high risk to the Legacy Mountain Development, and problem soils posed a moderate (equivocal) risk.

Christensen Geotechnical's (2021) investigation included logging and sampling of the same 34 walk-in test pits as Western Geologic (2021), field compressive strength tests, laboratory testing of representative soil samples, and slope stability analyses along the cross section profiles provided in Western Geologic (2021). Christensen Geotechnical (2021) provides Atterberg limits, consolidation and direct shear test results on Plates 38 to 50, and slope stability analyses results on Plates 51 to 76. Based on their analyses, cross section I-I' showed a static factor of safety of 1.766 (Plate 73) and a pseudostatic factor of safety of 1.254 (Plate 74). Cross section J-J' showed a static factor of safety of 2.586 (Plate 75) and a pseudostatic factor of safety of 1.508 (Plate 76). All these results are above typical minimum factors of safety (1.5 for static conditions and 1.0 for pseudostatic conditions). Christensen Geotechnical (2021) further provides various development-related recommendations in Section 5.0 of their report, including Earthwork (Section 5.2, including general site preparation and grading, soft soil stabilization, temporary construction excavations, structural fill and compaction, excavatability, and permanent cut and fill slopes), Foundations (Section 5.3), Estimated Settlement (Section 5.4), Lateral Earth Pressures (Section 5.5), Concrete Slab-On-Grade Construction (Section 5.6), Moisture Protection and Surface Drainage (Section 5.7), Subsurface Drainage (Section (5.8), Slope Stability (Section 5.9) and Pavement Design (Section 5.10).

PURPOSE AND SCOPE

The purpose and scope of this investigation is to identify and interpret surficial geologic conditions at the Project and assess the potential risk from geologic hazards. This investigation is intended to: (1) provide preliminary geologic information and assessment of geologic conditions at the Project; (2) identify potential geologic hazards that may be present and qualitatively assess their risk to the intended Project use; and (3) provide recommendations for additional Project- and hazard-specific studies or mitigation measures, as may be needed based on our findings. No hazard-specific evaluations were conducted for this report or within the scope of our study.

The following services were performed in accordance with the above stated purpose and scope:

- A Project reconnaissance conducted by an experienced certified engineering geologist to assess the Project setting and look for adverse geologic conditions;
- Compilation and review of readily-available geologic maps, reports, and air photos; and

- Evaluation of available data and preparation of this report, which presents the results of our study.

The engineering geology section of this report has been prepared in accordance with Bowman and Lund (2016) and current generally accepted professional engineering geologic principles and practice in Utah, and meets specifications provided in Chapter 27 of the Weber County Land Use Code within the above-stated scope. However, we do not include discussion of radon hazard potential, as suggested in Bowman and Lund (2016), because radon gas poses an environmental health hazard and indoor levels are heavily influenced by several post-construction, non-geologic factors. The hazard from radon should be evaluated by long-term testing following construction.

HYDROLOGY

The U.S. Geological Survey (USGS) topographic map of the Huntsville Quadrangle shows the Project straddles a northeast-trending ridge about 3,600 feet southwest of Anderson Cove Campground (Figure 1). No active, perennial, or intermittent drainages or springs are mapped at the Project. The nearest active drainage is Smith Creek about 200 feet to the east (Figure 1).

The site is at the southern margin of Ogden Valley, which is dominated in the valley bottom by unconsolidated lacustrine and alluvial basin-fill deposits. Slopes in the site area are in weathered tuffaceous bedrock overlain by alluvium and colluvium from mixed sources, including landslides. The Utah Division of Water Rights Well Driller Database shows several water wells in the Project vicinity. The nearest of these wells about 200 feet southwest of the site reported static groundwater at a depth of 169 feet bgs. Based on our review of the well driller logs, we anticipate groundwater at the Project is generally more than 150 feet deep at the Project. However, groundwater depths at the site likely vary seasonally from snowmelt runoff and annually from climatic fluctuations, and may also vary locally with subsurface conditions. Such variations would be typical for Ogden Valley.

Avery (1994) indicates groundwater in Ogden Valley occurs under perched, confined, and unconfined conditions in the valley fill to depths of 750 feet or more. A well-stratified lacustrine silt layer forms a leaky confining bed in the upper part of the valley-fill aquifer. The aquifer below the confining beds is the principal aquifer, which is in primarily fluvial and alluvial-fan deposits. The principal aquifer is recharged from precipitation, seepage from surface water, and subsurface inflow from bedrock into valley fill along the valley margins (Avery, 1994). The confined aquifer is typically overlain by a shallow, unconfined aquifer recharged from surface flow and upward leakage. Groundwater flow is generally from the valley margins into the valley fill, and then toward the head of Ogden Canyon (Avery, 1994). Based on topography, we expect regional groundwater flow at the site to be northward toward Pineview Reservoir.

GEOLOGY

Surficial Geology

The site is located on the southern margin of Ogden Valley, a sediment-filled intermontane valley within the Wasatch Range, a major north-south trending mountain range marking the eastern boundary of the Basin and Range physiographic province (Stokes; 1977, 1986). Surficial

geology of the Project is mapped by Coogan and King (2016) as mainly Tertiary-age Norwood Formation bedrock (unit Tn), with a small area of Pleistocene- to Quaternary-age mass wasting colluvium (unit Qmc) in the northwest part of the site (Figure 2).

Coogan and King (2016) describe surficial geologic units in the Project area on Figure 2 as follows:

Qa2, Qa2?, Qay – *Younger alluvium (mostly Holocene)*. Like undivided alluvium, with Qay at to slightly above present drainages, unconsolidated, and not incised by active drainages; likely mostly Holocene in age and postdates late Pleistocene Provo shoreline of Lake Bonneville; height above present drainages is low and is within certain limits, with suffix 1 (not present on this map) being the youngest and being at to slightly (<10 feet [3 m]) above drainages and suffix 2 being slightly higher and older, with y suffix where ages 1 and 2 cannot be separated; Qa2 is up to about 20 feet (6 m) above drainage on south side of Round Valley indicating unit includes slightly older post Provo-shoreline alluvium; generally 6 to 20 feet (2-6 m) thick. Mapped as Qa2 (queried) where about 20 feet (6 m) above incised stream in Stephens Canyon (Devils Slide quadrangle).

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.

Suffixes 1 and 2 indicate ages where they can be separated, with 1 including active channels and 2 including low terraces 10 to 20 feet (3-6 m) above the Weber and Ogden Rivers, and the South Fork Ogden River that may have been in the flood plain prior to damming of these waterways. Qal2 queried in low terraces above Bear River, Saleratus Creek, and Dry Creek where deposits may not be in the flood plain.

Qac – *Alluvium and colluvium (Holocene and Pleistocene)*. Unsorted to variably sorted gravel, sand, silt, and clay in variable proportions; includes stream and fan alluvium, colluvium, and, locally, mass-movement deposits too small to show at map scale; typically mapped along smaller drainages that lack flat bottoms; more extensive east of Henefer where Wasatch Formation (Tw) strata easily weather to debris that “chokes” drainages; 6 to

20 feet (2-6 m) thick. Some deposits are “perched” on benches 80 feet (25 m) and more above present-day drainages like Left Fork Heiners Creek (Heiners Creek quadrangle) and Harris Canyon (Henefer quadrangle). In the Devils Slide quadrangle, some deposits are “perched” on benches about 60 to 130 feet (18-40 m) above Quarry Cottonwood Canyon indicating the alluvium is at least partly Lake Bonneville age and older (see Qab and Qao in tables 1 and 2).

Qat, Qat2, Qaty, Qatp, Qatp?, Qatpb, Qato – *Stream-terrace alluvium (Holocene and Pleistocene)*. Sand, silt, clay, and gravel in terraces above floodplains near late Pleistocene Lake Bonneville and are geographically in the Ogden and Weber River, and lower Bear River drainages; moderately sorted; variably consolidated; upper surfaces slope gently downstream; locally includes thin and small mass-movement and alluvial-fan deposits; where possible, subdivided into relative ages, indicated by number and letter suffixes, with 2 being the lowest/youngest terraces, typically about 10 to 20 feet (3-6 m) above adjacent flood plains; Qat with no suffix used where age unknown or age subdivisions of terraces cannot be shown separately at map scale; 6 to at least 20 feet (2-6+ m) thick, with Qatp 50 to 80 feet (15-24 m) thick in Mantua Valley.

Relative ages are largely from heights above adjacent drainages in Morgan and Round Valleys. This subdivision apparently works in and is applied in Ogden, Henefer, and Lost Creek Valleys and above the North, Middle, and South Forks of Ogden River (see tables 1 and 2). Despite the proximity to Lake Bonneville, terraces along and near Box Elder Creek in the northwest corner of the Ogden map area (Mantua quadrangle) seem to be slightly higher than comparable terraces in Morgan Valley. Terraces labeled Qat2 are post-Lake Bonneville and are likely mostly Holocene in age. A terrace labeled Qaty is up to 20 feet (6 m) above the South Fork Ogden River, but may be related to the Provo or regressional shorelines. Terraces labeled Qatp are likely related to the Provo and slightly lower shorelines of Lake Bonneville (at and less than ~4820 feet [1470 m] in area), and with Qap form “benches” at about 4900 feet (1494 m) along the Weber River and South Fork Ogden River. Qato terraces pre-date Lake Bonneville. Relative age queried (Qatp?) where age is uncertain, generally due to height not fitting into ranges in table 1 and/or typical order of surfaces contradicts height-derived age.

Qms, Qms?, Qmsy, Qmsy?, Qmso, Qmso? – *Landslide deposits (Holocene and upper and middle? Pleistocene)*. Poorly sorted clay- to boulder sized material; includes slides, slumps, and locally flows and floods; generally characterized by hummocky topography, main and internal scarps, and chaotic bedding in displaced blocks; composition depends on local sources; morphology becomes more subdued with time and amount of water in material during emplacement; Qms may be in contact with Qms when landslides are different/distinct; thickness highly variable, up to about 20 to 30 feet (6-9 m) for small slides, and 80 to 100 feet (25-30 m) thick for larger landslides. Qmsy and Qmso queried where relative age uncertain; Qms queried where classification uncertain. Numerous landslides are too small to show at map scale and more detailed maps shown in the index to geologic mapping should be examined.

Qms without a suffix is mapped where the age is uncertain (though likely Holocene and/or late Pleistocene), where portions of slide complexes have different ages but cannot be shown separately at map scale, or where boundaries between slides of different ages are not distinct. Estimated time of emplacement is indicated by relative-age letter suffixes with: Qmsy mapped where landslides deflect streams or failures are in Lake Bonneville deposits, and scarps are variably vegetated; Qmso typically mapped where deposits are “perched” above present drainages, rumpled morphology typical of mass movements has been diminished, and/or younger surficial deposits cover or cut Qmso. Lower perched Qmso deposits are at Qao heights above drainages (95 ka and older) and the higher perched deposits may correlate with high level alluvium (QTa_) (likely older than 780 ka) (see table 1). Suffixes y and o indicate probable Holocene and Pleistocene ages, respectively, with all Qmso likely emplaced before Lake Bonneville transgression. These older deposits are as unstable as other slides, and are easily reactivated with the addition of water, be it irrigation or septic tank drain fields.

Qmc – *Landslide and colluvial deposits, undivided (Holocene and Pleistocene)*. Poorly sorted to unsorted clay- to boulder-sized material; mapped where landslide deposits are difficult to distinguish from colluvium (slope wash and soil creep) and where mapping separate, small, intermingled areas of landslide and colluvial deposits is not possible at map scale; locally includes talus and debris flow and flood deposits; typically mapped where landslides are thin (“shallow”); also mapped where the blocky or rumpled morphology that is characteristic of landslides has been diminished (“smoothed”) by slope wash and soil creep; composition depends on local sources; 6 to 40 feet (2-12 m) thick. These deposits are as unstable as other landslide units (Qms, Qmsy, Qmso).

Qafp, Qafp?, Qafb, Qafb?, Qafpb, Qafpb? – *Lake Bonneville-age alluvial-fan deposits (upper Pleistocene)*. Like undivided alluvial fans, but height above present drainages appears to be related to shorelines of Lake Bonneville and is within certain limits (see table 1); these fans are inactive, unconsolidated to weakly consolidated, and locally dissected; fans labeled Qafp and Qafb are related to the Provo (and slightly lower) and Bonneville shorelines of late Pleistocene Lake Bonneville, respectively, while unit Qafpb is used where fans may be related to the Provo or Bonneville shoreline (for example Qafpb is ~40 feet [12 m] above Lost Creek Valley), or where fans of different ages cannot be shown separately at map scale; Qafp fans typically contain well-rounded, recycled Lake Bonneville gravel and sand and are moderately well sorted; generally 10 to less than 60 feet (3-18 m) thick. Lake Bonneville-age fans are queried where relative age is uncertain (see Qaf for details); fans labeled Qafpb? are above the Bonneville shoreline and might be Qafo or like Qafm; see the note under Qao about two possible ages of older alluvium (Qao, Qato, and Qafo).

Most of the Lake Bonneville-age fans in the James Peak quadrangle are far from the Bonneville shoreline and their age is inferred from their stratigraphic relationship(s) to coeval Pinedale glacial outwash (see age equality in Table 3).

The channels (Qafp/Qdlb) on the Weber River delta and Lake Bonneville fines (Qafp on Qlfb) probably record scour and fill during the rapid drawdown of the lake as it fell from the Bonneville shoreline to the Provo shoreline.

Qap, Qap?, Qab, Qab?, Qapb – *Lake Bonneville-age alluvium (upper Pleistocene)*. Like undivided alluvium but height above present drainages appears to be related to shorelines of Lake Bonneville and is within certain limits, and unconsolidated to weakly consolidated; alluvium labeled Qap and Qab is related to Provo (and slightly lower) and Bonneville shorelines of Lake Bonneville (at ~4800 to 4840 feet [1463-1475 m] and 5180 feet [1580 m] in Morgan Valley), respectively; suffixes partly based on heights above adjacent drainages near Morgan Valley (see tables 1 and 2); Qap is typically about 15 to 40 feet (5-12 m) above present adjacent drainages, but is locally 45 feet (12 m) above; Qapb is used where more exact age cannot be determined, typically away from Lake Bonneville, or where alluvium of different ages cannot be shown separately at map scale; Qap is up to about 50 feet (15 m) thick, with Qapb and Qab, at least locally up to 40 and 90 feet (12 and 27 m) thick, respectively. Queried where classification or relative age uncertain (see Qa).

A prominent surface (“bench”) is present on Qap and Qatp at about 4900 feet (1494 m) elevation and about 25 to 40 feet (8-12 m) above the Weber River in Morgan Valley and along the South Fork Ogden River.

In the Devils Slide quadrangle, the Qab that is mapped about 80 to 95 feet (24-29 m) above Round Valley and 40 to 50 feet (12-15 m) above adjacent drainages at the mouth of Geary Hollow appears unique. Based on heights above adjacent drainages, these deposits would be Qao (see table 1), but similar alluvial deposits to the east near Phil Shop Hollow have a Bonneville shoreline cut in them and are much thinner than 40 feet (12 m). The lack of a Bonneville shoreline, and small thickness and heights above drainages indicate the deposits could be a Bonneville shoreline fan-delta.

Ql, Ql? – *Lake Bonneville deposits, undivided (upper Pleistocene)*. Silt, clay, sand, and cobbly gravel in variable proportions; mapped where grain size is mixed, deposits of different materials cannot be shown separately at map scale, or surface weathering obscures grain size and deposits are not exposed in scarps or construction cuts; thickness uncertain.

Qlf, Qlf?, Qlfb, Qlfb? – *Fine-grained lacustrine deposits (Holocene and upper Pleistocene)*. Mostly silt, clay, and fine-grained sand deposited near- and off-shore in Lake Bonneville; typically mapped as Qlf below the Provo shoreline (P) because older transgressive (Qlfb) deposits are indistinguishable from younger regressive deposits; mapped as Qlfb above the Provo shoreline because these deposits can only be related to the Bonneville shoreline (B) and transgression; grades upslope with more sand into Qls or Qlsp; typically eroded from shallow Norwood Formation in Ogden and Morgan Valleys and at least 12 feet (4 m) thick near Mountain Green. Qlf and Qlfb queried where grain size is uncertain.

In the Kaysville quadrangle, Qlf deposits that are below the Gilbert (G) shoreline are at least partly the same age as this shoreline (Holocene-latest Pleistocene) and post-date late Pleistocene Lake Bonneville. Qlf deposits below the Holocene (H) highstand shoreline are Holocene. Both ages of deposits are generally less than 15 feet (5 m) thick.

Deeper water fine-grained deposits overlie older shoreline and delta gravels (Qlf/Qdlb) at the mouths of several drainages along the Weber River. These gravels were deposited above the Provo shoreline during transgression of Lake Bonneville to the Bonneville shoreline (see unit Qdlb).

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.

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.

Qao, Qao? – *Older alluvium (mostly upper Pleistocene)*. Sand, silt, clay, and gravel above and likely older than the Bonneville shoreline; mapped on surfaces above Lake Bonneville-age alluvium (Qap, Qab, Qapb); deposits lack fan shape (Qaf) and are distinguished from terraces (Qat) based on upper surface sloping toward adjacent streams from sides of drainage; also shown where areas of fans and terraces are too small to show separately at map scale; composition depends on source area; at least locally up to 110 feet (34 m) thick. Queried where classification or relative age is uncertain (see Qa for details); for example near head of Saleratus Creek.

Older alluvium is likely older than Lake Bonneville and the same age as Qafo, so likely Bull Lake age, 95,000 to 130,000 years old (see Chadwick and others, 1997, and Phillips and others, 1997); see table 1 and note revision from Coogan and King (2006) and King and others (2008). From our work in the Henefer (Coogan, 2010b) and Devils Slide quadrangles and ages in Sullivan and Nelson (1992) and Sullivan and others (1988), older alluvium (Qao, Qafo, Qato) may encompass an upper (pre-Bull Lake) and lower (Bull Lake) alluvial surface that is not easily recognized in Morgan Valley (see tables 1 and 2).

Tcg, Tcg? – *Unnamed Tertiary conglomeratic rocks (Oligocene?)*. Characterized by rounded, cobble- to boulder-sized, quartzite-clast conglomerate with pebbles and less than 10 percent to more than 50 percent gray, tan, or reddish-gray to reddish-tan matrix; conglomerate clasts locally angular to subangular Tintic Quartzite and angular to rounded lower Paleozoic carbonate rocks; interbedded with tan, gray, and reddish-brown, pebble-bearing mudstone to sandstone and some claystone (altered tuff); most beds poorly

indurated and poorly exposed; mudstone likely constitutes matrix of conglomeratic beds; in Morgan and Durst Mountain quadrangles, about 500 to 700 feet (150-210 m) thick and thickening northward to possibly 3000 feet (900 m), though faulting may make this estimate too large.

Reddish-hued Tcg strata mostly contain recycled Wasatch Formation clasts (quartzite and carbonate) with a distinct reddish patina in a reddish matrix. Some non-conglomeratic beds in Tcg look like gray upper Norwood Formation (Tn) and are locally tuffaceous, indicating the units are interbedded. Further, some Tcg pebble beds have carbonate and chert clasts (like the Norwood) and lesser quartzite clasts, and Tcg conglomerate includes rare altered tuff clasts from the Norwood Formation. Despite tuffaceous matrix, unit Tcg seems to be less prone to mass movements than Norwood strata.

Tn, Tn? – *Norwood Formation (lower Oligocene and upper Eocene)*. Typically light-gray to light-brown altered tuff (claystone), altered tuffaceous siltstone and sandstone, and conglomerate; unaltered tuff, present in type section south of Morgan, is rare; locally colored light shades of red and green; variable calcareous cement and zeolitization; involved in numerous landslides of various sizes; estimate 2000-foot (600 m) thick in exposures on west side of Ogden Valley (based on bedding dip, outcrop width, and topography). Norwood Formation queried where poor exposures may actually be surficial deposits. For detailed Norwood Formation information see description under heading “Sub-Willard Thrust - Ogden Canyon Area” since most of this unit is in and near Morgan Valley and covers the Willard thrust, Ogden Canyon, and Durst Mountain areas.

ZYp, ZYp? – *Formation of Perry Canyon (Neoproterozoic and possibly Mesoproterozoic)*. Argillite to metagraywacke upper unit, middle meta-diamictite, and basal slate, argillite, and meta-sandstone; phyllitic at least south of Pineview Reservoir; due to overturned folding, only one diamictite unit (Adolph Yonkee, Weber State University, February 2, 2011, email communication) rather than two (see Crittenden and others, 1983); total thickness likely less than 2000 feet (600 m) (this report). Queried in knob west of North Fork Ogden River in North Ogden quadrangle because rock is quartzite that may be in this unit or the Papoose Creek Formation. The formation of Perry Canyon is prone to slope failures.

Balgord’s (2011; Balgord and others, 2013) detrital zircon uranium-lead and lead-lead maximum depositional ages (~950-1030 Ma) on the basal mudstone unit straddle the Upper and Middle Proterozoic boundary, but other maximum ages (925 Ma) on this mudstone unit are Upper Proterozoic; her maximum ages on the upper unit are about 640, 660, and 690 Ma.

Lower part of formation not measured where thick in the Wasatch Range and stratigraphy not worked out, because upper and lower parts incompletely measured and at least locally the upper and lower parts in the Wasatch Range are lithologically indistinguishable. Unit (“member”) thicknesses vary due to syndepositional faulting (see Balgord and others, 2013). The best stratigraphic section of the lower unit (ZYpm), volcanic unit (Zpb), and diamictite (Zpd) is 30 miles (50 km) to the southwest on Fremont Island in Great Salt Lake, but the base of ZYpm is not exposed (see Balgord, 2011, figure 14, p. 51; Balgord and others, 2013, figure 5). The Fremont Island section is likely in a different Proterozoic

faulted basin; compare thicknesses and lithologies between Fremont Island and Willard Peak shown by Balgord (2011, Balgord and others (2013). Also, although both localities are shown on the Willard thrust sheet by Yonkee and Weil (2011), they may be on different thrust sheets. Therefore, the formal term Perry Canyon Formation is not used. Where possible divided into several lithosomes which have been called members.

Citations, tables, and/or figures in the above descriptions are not provided herein, but are provided in Coogan and King (2016).

Seismotectonic Setting

The Project is located on the southern margin of Ogden Valley, a roughly 40-square mile back valley described by Gilbert (1928) as a structural trough similar to Cache and Morgan Valleys to the north and south, respectively. The back valleys of the northern Wasatch Range are in a transition zone between the Basin and Range and Middle Rocky Mountains physiographic provinces (Stokes, 1977, 1986). The Basin and Range is characterized by a series of generally north-trending elongate mountain ranges, separated by predominately alluvial and lacustrine sediment-filled valleys and typically bounded on one or both sides by major normal faults (Stewart, 1978). The boundary between the Basin and Range and Middle Rocky Mountains provinces is marked by the Wasatch fault zone at the base of the Wasatch Range. Late Cenozoic normal faulting, a characteristic of the Basin and Range, began between about 17 and 10 million years ago in the Nevada (Stewart, 1980) and Utah (Anderson, 1989) portions of the province. The faulting is a result of a roughly east-west directed, regional extensional stress regime that has continued to the present (Zoback and Zoback, 1989; Zoback, 1989). The back valleys are morphologically similar to valleys in the Basin and Range, but exhibit less structural relief (Sullivan and others 1988).

Ogden Valley occupies a structural trough created by up to 2,000 feet of vertical displacement on normal faults bounding the east and west sides of the valley. The Utah Geological Survey Quaternary Fault Database (Black and others, 2003; 2020 update) maps the Ogden Valley Southwestern Margin faults about 1.1 miles southwest of the site, and the Ogden Valley; Northwestern Margin fault about 3.6 miles to the northeast. Sullivan and others (1986, 1988) indicate the most recent movement on this fault is pre-Holocene and Western Geologic (2006) found no evidence for active (Holocene) faulting in one trench across the presumed fault location a few hundred feet south of the Project. The nearest active (Holocene-age) fault to the Project is the Weber section of the Wasatch fault zone about 6.7 miles to the west.

The Project is also in the central portion of the Intermountain Seismic Belt (ISB), a generally north-south trending zone of historical seismicity along the eastern margin of the Basin and Range province extending from northern Arizona to northwestern Montana (Sbar and others, 1972; Smith and Sbar, 1974). At least 16 earthquakes of magnitude 6.0 or greater have occurred within the ISB since 1850; the largest of these earthquakes was a M 7.5 event in 1959 near Hebgen Lake, Montana. None of these earthquakes occurred along the WFZ or other known late Quaternary faults (Arabasz and others, 1992; Smith and Arabasz, 1991). The closest event was the 1934 Hansel Valley (M 6.6) event north of the Great Salt Lake. The March 18, 2020, M 5.7 Magna earthquake¹ reportedly showed a style, location, and slip depth consistent with an earthquake on the WFZ system. Despite being less than magnitude 6.0, this earthquake damaged

¹ <https://earthquake.usgs.gov/earthquakes/eventpage/uu60363602/executive>

multiple buildings and was felt from southern Idaho to south-central Utah². The University of Utah Seismograph Stations indicates the Magna earthquake³ was weakly felt in Ogden Valley, with a peak acceleration of about 0.005 g and an instrument intensity of II-III (on a Roman numeral scale of I-X).

Lake Bonneville History

Lakes occupied nearly 100 basins in the western United States during late-Quaternary time, the largest of which was Lake Bonneville in northwestern Utah. The Bonneville basin consists of several topographically closed basins created by regional extension in the Basin and Range (Gwynn, 1980; Miller, 1990), and has been an area of internal drainage for much of the past 15 million years. Lake Bonneville consisted of numerous topographically closed basins, including the Salt Lake and Cache Valleys (Oviatt and others, 1992). Portions of Ogden Valley were inundated by Lake Bonneville at its highstand. The highest lake shoreline is mapped on Figure 2 crossing the north part of the Project (blue line).

Timing of events related to the transgression and regression of Lake Bonneville is indicated by calendar age estimates of significant radiocarbon dates in the Bonneville Basin (Oviatt, 2015). Approximately 30,000 years ago, Lake Bonneville began a slow transgression (rise) to its highest level of 5,160 to 5,200 feet above mean sea level. The lake rise eventually slowed as water levels approached an external basin threshold in northern Cache Valley at Red Rock Pass near Zenda, Idaho. Lake Bonneville reached the Red Rock Pass threshold and occupied its highest shoreline, termed the Bonneville beach, around 18,000 years ago. During the transgression and highstand, major drainages that emanate from within the Wasatch Range (such as the Weber River) formed large deltaic complexes in the lake at their canyon mouths. Headward erosion of the Snake River-Bonneville basin drainage divide then caused a catastrophic incision of the threshold and the lake level lowered by roughly 360 feet in fewer than two months (Jarrett and Malde, 1987; O'Conner, 1993).

Following the Bonneville flood, the lake stabilized and formed a lower shoreline referred to as the Provo shoreline between about 16,500 and 15,000 years ago. Climatic factors then caused the lake to regress rapidly from the Provo shoreline, and by about 13,000 years ago the lake had eventually dropped below historic levels of Great Salt Lake. Drainages that fed Lake Bonneville began downcutting through stranded deltaic complexes and near-shore deposits as the lake receded from the Provo shoreline. Oviatt and others (1992) deem this low stage the end of the Bonneville lake cycle. Great Salt Lake then experienced a brief transgression around 11,600 years ago to the Gilbert level at about 4,250 feet before receding to and remaining within about 20 feet of its historic average level (Lund, 1990).

SITE CHARACTERIZATION

Empirical Observations

On September 2, 2022, Bill D. Black, P.G., of Western Geologic conducted a brief reconnaissance of the Project and nearby area. A photographic record of our reconnaissance is included in the Appendix. Weather at the time of the Project visit was clear and sunny with a temperature of about 61 °F.

² <https://www.ksl.com/article/46731630/>

³ <https://earthquakes.utah.gov/magna-quake/#>

The Project is on the southern margin of Ogden Valley on a northeast-trending ridge bounded by northwest- to southeast-facing slopes. Native vegetation consists mainly of grasses, sage brush and oak brush. No evidence of seeps, springs, surface water or active drainage courses were observed at the Project. The Project is currently undeveloped, but several stakes were observed marking proposed driveway locations. Light olive-brown sandstone bedrock of the Tertiary Norwood Formation was observed to be weathering out of the ridge top in several locations. No evidence for significant bedrock outcrops, rockfalls, characteristic debris flow features, landslides, or recent or ongoing slope instability was observed.

Air Photo Observations

High-resolution orthophotography from 2012 and bare earth DEM LIDAR (Light Detection and Ranging) imagery from 2016 were reviewed to obtain information about the geomorphology of the Project area (Figures 3A-B). The Project is situated on a northeast-trending ridge overlooking Pineview Reservoir that is mainly underlain by Tertiary Norwood Formation bedrock. The ridge is bounded by northwest- to southeast-facing slopes mantled by a veneer of colluvium from natural erosion. Figure 3C shows locations of nearby water wells and the test pits, measured strike and dips, and cross sections conducted by Western Geologic (2021). Site-specific geology is also provided on Figure 3C based on our empirical observations, air photo interpretation, and mapping in Western Geologic (2021). No seeps, springs, surface water or drainage courses, significant bedrock outcrops, rockfall features, characteristic debris flow features, or landslides are mapped or were evidence at the Project.

GEOLOGIC HAZARDS

Assessment of potential geologic hazards and the resulting risks imposed is critical in determining the suitability of the Project for development. Table 1 below shows a summary of the geologic hazards reviewed at the Project, as well as a relative (qualitative) assessment of risk to the Project for each hazard.

Table 1. *Geologic hazards summary.*

Hazard	H	M	L
Earthquake Ground Shaking	X		
Surface Fault Rupture			X
Liquefaction and Lateral-spread Ground Failure			X
Tectonic Deformation			X
Seismic Seiche and Storm Surge			X
Stream Flooding			X
Shallow Groundwater			X
Landslides and Slope Failures		X	
Debris Flows and Floods			X
Rock Fall			X
Problem Soil and Rock			X

A “high” hazard rating (H) indicates the hazard is present at the Project (whether currently or in the geologic past), and is likely to pose significant risk and/or may require further study or mitigation techniques. A “moderate” hazard rating (M) indicates a hazard that poses an equivocal risk. Moderate-risk hazards may also require further studies or mitigation. A “low” hazard rating (L) indicates the hazard is not present, poses little or no risk, and/or is not likely to significantly impact the Project development. Low-risk hazards typically require no additional studies or mitigation. We note that these hazard ratings represent a conservative assessment for the entire Project and risk may vary in some areas. Careful selection of development areas can minimize risk by avoiding known hazard areas.

Earthquake Ground Shaking

Ground shaking refers to the ground surface acceleration caused by seismic waves generated during an earthquake. Strong ground motion is likely to present a significant risk during moderate to large earthquakes located within a 60 mile radius of the Project area (Boore and others, 1993). Seismic sources include mapped active faults, as well as a random or “floating” earthquake source on faults not evident at the surface. The Utah Geological Survey Quaternary Fault Database (Black and others, 2003; 2020 update) shows numerous class A faults within 60 miles of the Project that may pose potential seismic sources.

The extent of property damage and loss of life due to ground shaking depends on factors such as: (1) proximity of the earthquake and strength of seismic waves at the surface (horizontal motions are the most damaging); (2) amplitude, duration, and frequency of ground motions; (3) nature of foundation materials; and (4) building design. Based on 2018 IBC provisions, a site class of B (Rock), and a risk category of II, calculated seismic values for the site (centered on the home location at 41.242918° N, -111.797427° W) are summarized below:

Table 2. *Seismic hazards summary.*

Type	Value
S_s	0.849 g
S_1	0.299 g
$S_{MS} (F_a \times S_s)$	0.764 g
$S_{M1} (F_v \times S_1)$	0.239 g
$S_{DS} (2/3 \times S_{MS})$	0.509 g
$S_{D1} (2/3 \times S_{M1})$	0.159 g
Seismic Design Category, SDC	<i>D</i>
Site Coefficient, F_a	= 0.9
Site Coefficient, F_v	= 0.8
Site-Modified Peak Ground Acceleration, PGA_M	= 0.338 g

The PGA_M for the site in Table 2 is about 70 times that reportedly experienced in Ogden Valley (0.005 g) from the March 18, 2020 M 5.7 Magna earthquake. Given the above information, we rate the hazard from earthquake ground shaking as high. Earthquake ground shaking is a regional hazard common to all Wasatch Front areas. The hazard is mitigated by design and construction of homes in accordance with the current adopted building code.

Surface Fault Rupture

Movement along faults at depth generates earthquakes. During earthquakes larger than Richter magnitude 6.5, ruptures along normal faults in the intermountain region generally propagate to the surface (Smith and Arabasz, 1991) as one side of the fault is uplifted and the other side down dropped. The resulting fault scarp has a near-vertical slope. The surface rupture may be expressed as a large singular rupture or several smaller ruptures in a broad zone. Ground displacement from surface fault rupture can cause significant damage or even collapse to structures located on an active fault.

No active faults are mapped and no evidence for active faulting was observed on air photos or during our reconnaissance at the site. The nearest active (Holocene-age) fault to the Project is the Weber section of the Wasatch fault zone about 6.7 miles to the west. Given all the above, we rate the risk from surface faulting as low. No additional investigation regarding surface faulting appears needed given the proposed development plan and current paleoseismic information.

Liquefaction and Lateral-spread Ground Failure

Liquefaction occurs when saturated, loose, cohesionless, soils lose their support capabilities during a seismic event because of the development of excessive pore pressure. Earthquake-induced liquefaction can present a significant risk to structures from bearing-capacity failures to structural footings and foundations, and can damage structures and roadway embankments by triggering lateral spread landslides. Earthquakes of Richter magnitude 5 are generally regarded as the lower threshold for liquefaction. Liquefaction potential at the Project is a combination of expected seismic (earthquake ground shaking) accelerations, groundwater conditions, and presence of susceptible soils.

Given subsurface conditions reported in the four nearby test pits in Western Geologic (2021), no sandy soils susceptible to liquefaction are likely present underlying the Project. Based on this, we rate the risk from liquefaction as low.

Tectonic Deformation

Tectonic deformation refers to subsidence from warping, lowering, and tilting of a valley floor that accompanies surface-faulting earthquakes on normal faults. Large-scale tectonic subsidence may accompany earthquakes along large normal faults (Lund, 1990). Tectonic subsidence is believed to mainly impact those areas immediately adjacent to the downthrown side of active normal faults. The Project is not in close proximity to and on the downthrown side of any mapped active (Holocene-age) faults. Based on this, we rate the risk from tectonic subsidence as low.

Seismic Seiche and Storm Surge

Earthquake-induced seiche presents a risk to structures within the wave-oscillation zone along the edges of large bodies of water, such as the Great Salt Lake. Given the elevation of the Project and distance from large bodies of water, we rate the risk from seismic seiches as low.

Stream Flooding

Stream flooding may be caused by direct precipitation, melting snow, or a combination of both. In much of Utah, floods are most common in April through June during spring snowmelt. High flows may be sustained from a few days to several weeks, and the potential for flooding depends on a variety of factors such as surface hydrology, Project grading and drainage, and runoff.

No perennial, intermittent or ephemeral drainages are mapped crossing the site, were evident on air photos, or were observed during our reconnaissance. Federal Emergency Management Agency flood insurance rate mapping (Map Number 49057C0475F, effective 06/02/2015) classifies the Project in "Zone X" (area of minimal flood hazard). Given the above, we rate the risk from stream flooding as low. The Project should follow recommendations regarding surface runoff provided in Section 5.7 of Christensen Geotechnical's (2021) report.

Shallow Groundwater

No seeps or springs are mapped at the Project or were observed during our reconnaissance or on air photos. Based on nearby water well data, groundwater at the Project appears to be more than 150 feet deep. However, groundwater depths at the site may vary seasonally (following spring snow melt), annually from climatic fluctuations, and locally depending subsurface conditions. Such variations are typical for Ogden Valley. The Project should follow recommendations regarding subsurface drainage provided in Section 5.8 of Christensen Geotechnical's (2021) report.

Landslides and Slope Failures

Slope stability hazards such as landslides, slumps, and other mass movements can develop along moderate to steep slopes where a slope has been disturbed, the head of a slope loaded, or where increased groundwater pore pressures result in driving forces within the slope exceeding restraining forces. Slopes exhibiting prior failures, and also deposits from large landslides, are particularly vulnerable to instability and reactivation.

No landslides are mapped at the site and no evidence for recent or ongoing landslides or slope instability was observed during our reconnaissance. Slope stability analyses conducted by Christensen Geotechnical along cross sections I-I' and J-J', as located on Figure 3C, also show adequate factors of safety. However, slopes steeper than 25% (shaded in red on Figure 3B) are present at the Project that could have marginal stability during times of seasonal and localized groundwater fluctuations. These slopes are discussed in Section 5.9 of Christensen Geotechnical (2021). Based on the steep slopes, we rate the risk from landsliding as moderate (equivocal). The Project should follow recommendations regarding slope stability provided in Christensen Geotechnical (2021). Care should also be taken to maintain proper site drainage, that site grading does not destabilize slopes at the site without prior geotechnical analysis and grading plans, and that water from man-made sources is minimized to the extent possible.

Debris Flows

Debris flow hazards are typically associated with unconsolidated alluvial fan deposits at the mouths of large range-front drainages, such as those along the Wasatch Front. Debris flows have historically caused significant damage in the Wasatch Front area. The site is not on an active alluvial fan and no evidence for debris-flow channels, levees, or other debris-flow features was observed at the Project on air photos or during our reconnaissance. Based on the above, we rate the hazard from debris flows to the Project as low.

Rock Fall

No bedrock outcrops were observed at the Project or in higher slopes that could present a source area for rock fall clasts. Based on the above, we rate the hazard from rock falls to the Project as low.

Swelling and Collapsible Soils

Soil conditions and specific recommendations for Project grading, subgrade preparation, and footing and foundation design should follow the recommendations provided Christensen Geotechnical (2021). A geotechnical engineer should observe the foundation excavation for the homes once they are open to check for subsurface conditions (such as problem soils) that could affect performance of the planned structure and may differ from those expected.

CONCLUSIONS AND RECOMMENDATIONS

Earthquake ground shaking is the only hazard identified as posing a high relative risk to the proposed development. Landslides also pose a moderate (equivocal) risk. The following recommendations are provided with regard to the geologic characterizations in this report:

- ***Seismic Design*** – All habitable structures developed at the property should be constructed to current adopted seismic building codes to reduce the risk of damage, injury, or loss of life from earthquake ground shaking. Earthquake ground shaking is a common hazard for all Wasatch Front areas.
- ***Geotechnical Considerations*** – Christensen Geotechnical (2021) provides various recommendations to address adverse conditions at the Legacy Mountain Development. These recommendations appear similarly applicable to the Project. Development at the Project should follow Christensen Geotechnical’s (2021) recommendations unless they are superseded by subsequent site-specific geotechnical recommendations. We further recommend that a Utah-licensed geotechnical engineer observe the foundation excavations for the homes once they are open to check for subsurface conditions that could affect performance of the planned structures and may differ from those expected by Christensen Geotechnical (2021).
- ***Site Modifications and Drainage*** – No unplanned cuts should be made in the slopes at the site without prior geotechnical analyses, and proper surface and subsurface drainage should be maintained.
- ***Hazard Disclosures and Report Availability*** – All hazards identified as posing a high risk at the site should be disclosed to future buyers so that they may understand and be willing to accept the risks posed by these hazards. This report should be made available to architects, building contractors, and in the event of a future property sale, real estate agents and potential buyers. The report should be referenced for information on technical data only as interpreted from observations and not as a warranty of conditions throughout the site. The report should be submitted in its entirety, or referenced appropriately, as part of any document submittal to a government agency responsible for planning decisions or geologic review. Incomplete submittals void the professional seals and signatures we provide herein. Although this report and the data herein are the property of the client, the report format is the intellectual property of Western Geologic and should not be copied, used, or modified without express permission of the authors.

LIMITATIONS

This investigation was performed at the request of the Client using the methods and procedures consistent with good commercial and customary practice designed to conform to acceptable industry standards. The analysis and recommendations submitted in this report are based upon the data obtained from Project-specific observations and compilation of known geologic information. This information and the conclusions of this report should not be interpolated to adjacent properties without additional Project-specific information. In the event that any changes are later made in the location of the proposed Project, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or approved in writing by the engineering geologist.

This report has been prepared by the staff of Western Geologic for the Client under the professional supervision of the principal and/or senior staff whose seal(s) and signatures appear hereon. Neither Western Geologic, nor any staff member assigned to this investigation has any interest or contemplated interest, financial or otherwise, in the subject or surrounding properties, or in any entity which owns, leases, or occupies the subject or surrounding properties or which may be responsible for environmental issues identified during the course of this investigation, and has no personal bias with respect to the parties involved.

The information contained in this report has received appropriate technical review and approval. The conclusions represent professional judgment and are founded upon the findings of the investigations identified in the report and the interpretation of such data based on our experience and expertise according to the existing standard of care. No other warranty or limitation exists, either expressed or implied.

The investigation was prepared in accordance with the approved scope of work outlined in our proposal for the use and benefit of the Client; its successors, and assignees. It is based, in part, upon documents, writings, and information owned, possessed, or secured by the Client. Neither this report, nor any information contained herein shall be used or relied upon for any purpose by any other person or entity without the express written permission of the Client. This report is not for the use or benefit of, nor may it be relied upon by any other person or entity, for any purpose without the advance written consent of Western Geologic.

In expressing the opinions stated in this report, Western Geologic has exercised the degree of skill and care ordinarily exercised by a reasonable prudent environmental professional in the same community and in the same time frame given the same or similar facts and circumstances. Documentation and data provided by the Client, designated representatives of the Client or other interested third parties, or from the public domain, and referred to in the preparation of this assessment, have been used and referenced with the understanding that Western Geologic assumes no responsibility or liability for their accuracy. The independent conclusions represent our professional judgment based on information and data available to us during the course of this assignment. Factual information regarding operations, conditions, and test data provided by the Client or their representative has been assumed to be correct and complete. The conclusions presented are based on the data provided, observations, and conditions that existed at the time of the field exploration.

It has been a pleasure working with you on the Project. Should you have any questions, please call.

Sincerely,
Western Geologic & Environmental LLC

Reviewed By:



Bill. D. Black, P.G.
Subcontract Geologist

/



Kevin J. Thomas, P.G.
Principal Geologist

ATTACHMENTS

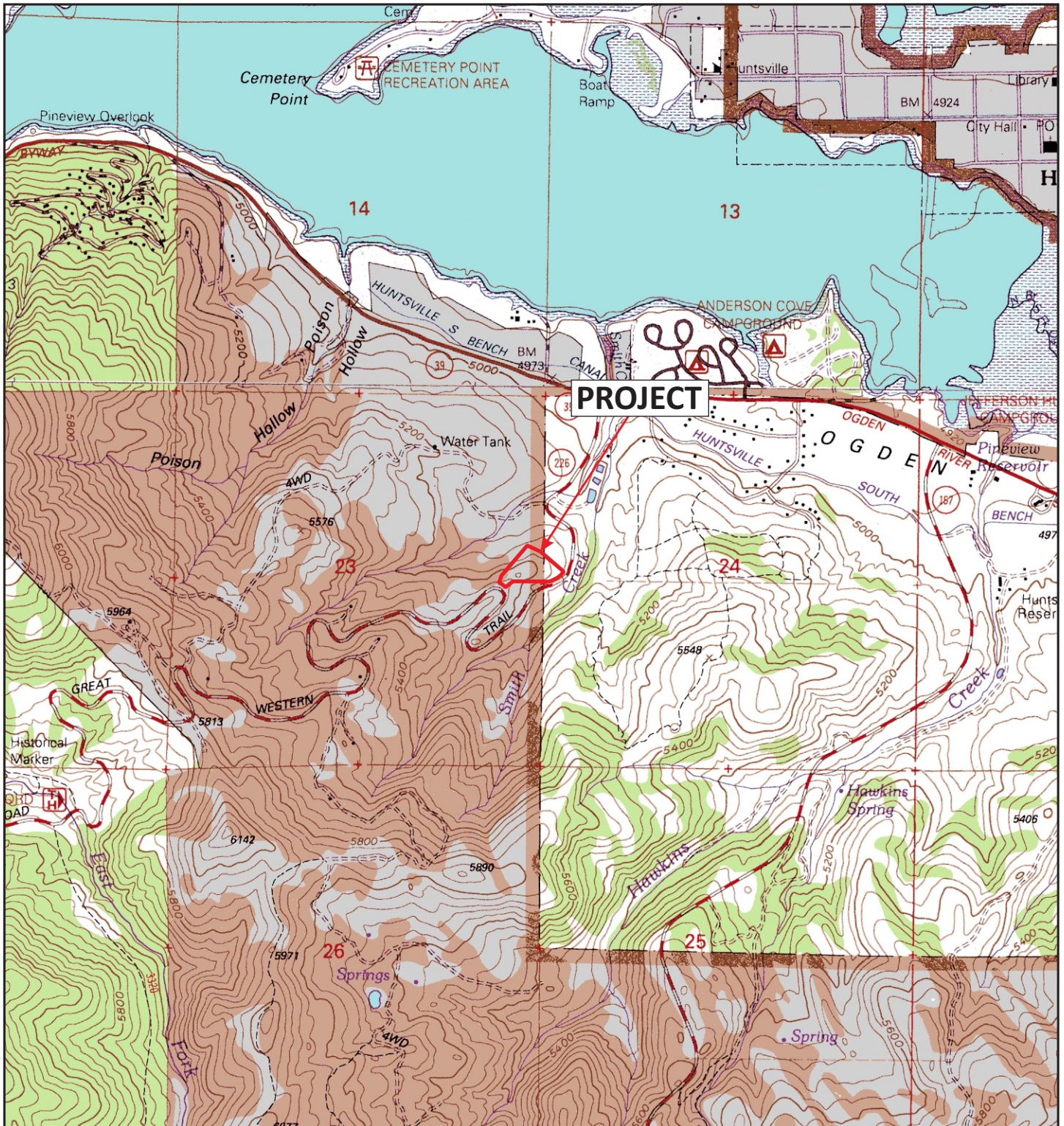
- Figure 1. Location Map (8.5” x 11” portrait)
- Figure 2. Geologic Map (8.5” x 11” portrait)
- Figure 3A. 2012 Air Photo (8.5” x 11” portrait)
- Figure 3B. LIDAR Analysis (8.5” x 11” portrait)
- Figure 3C. Site-Specific Geology (8.5” x 11” portrait)
- Appendix. Photographic Record of Site Reconnaissance

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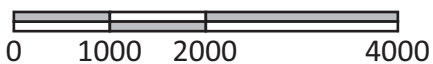
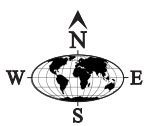
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FIGURES



Source: U.S. Geological Survey 7.5 Minute Series Topographic Maps, Utah - Huntsville, 1998; Project location Sections 23 and 24, T6N, R1E (SLBM).



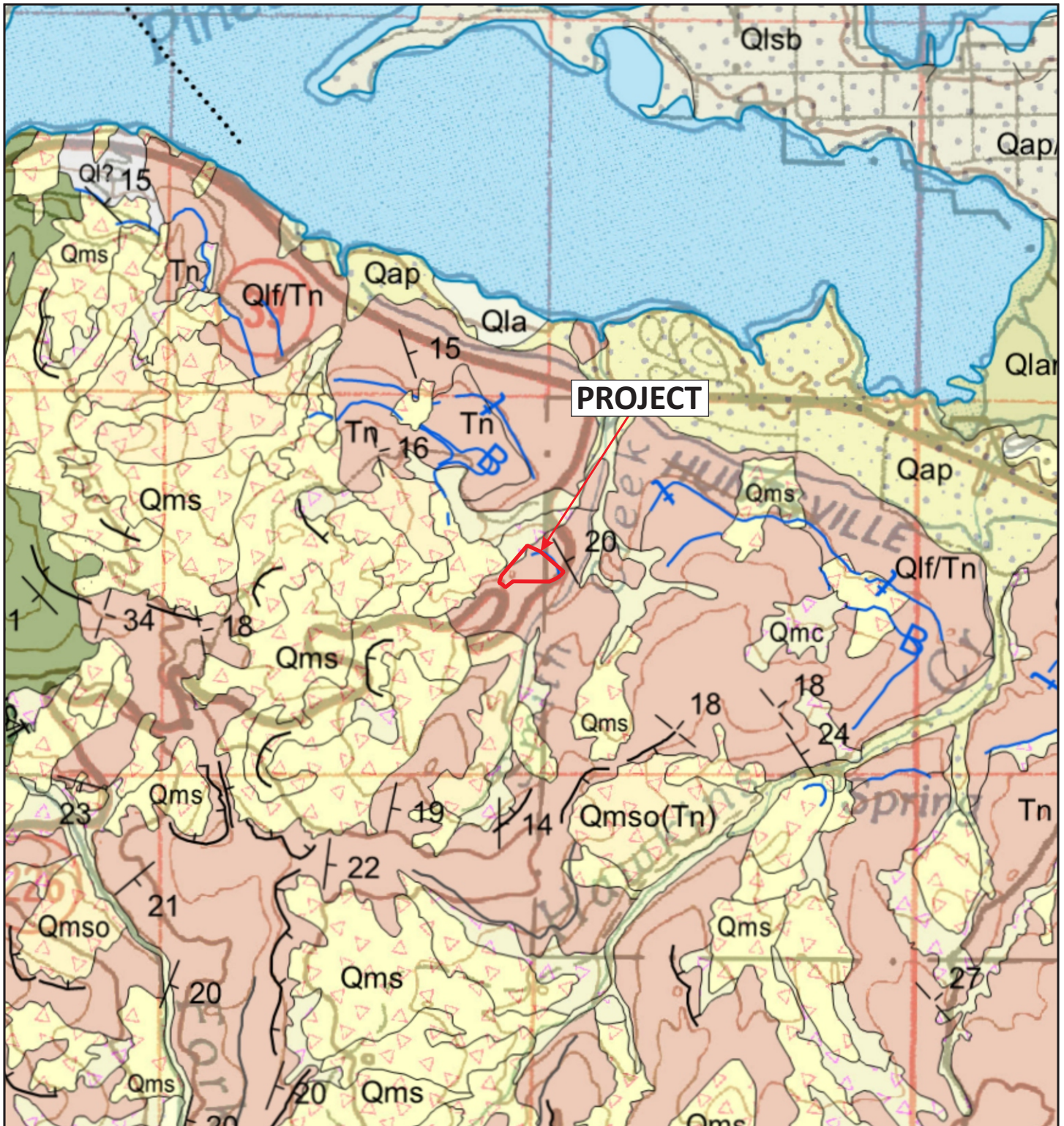
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(1 inch equals 2,000 feet)

LOCATION MAP

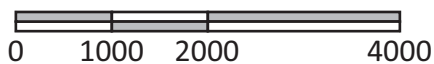
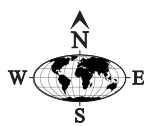
GEOLOGIC HAZARDS RECONNAISSANCE

Proposed Samarel Subdivision
About 6200 East Old Snowbasin Road
Huntsville, Weber County, Utah

FIGURE 1



Source: Coogan and King (2016), original map scale 1:100,000. See text for explanation of nearby surficial geologic units.



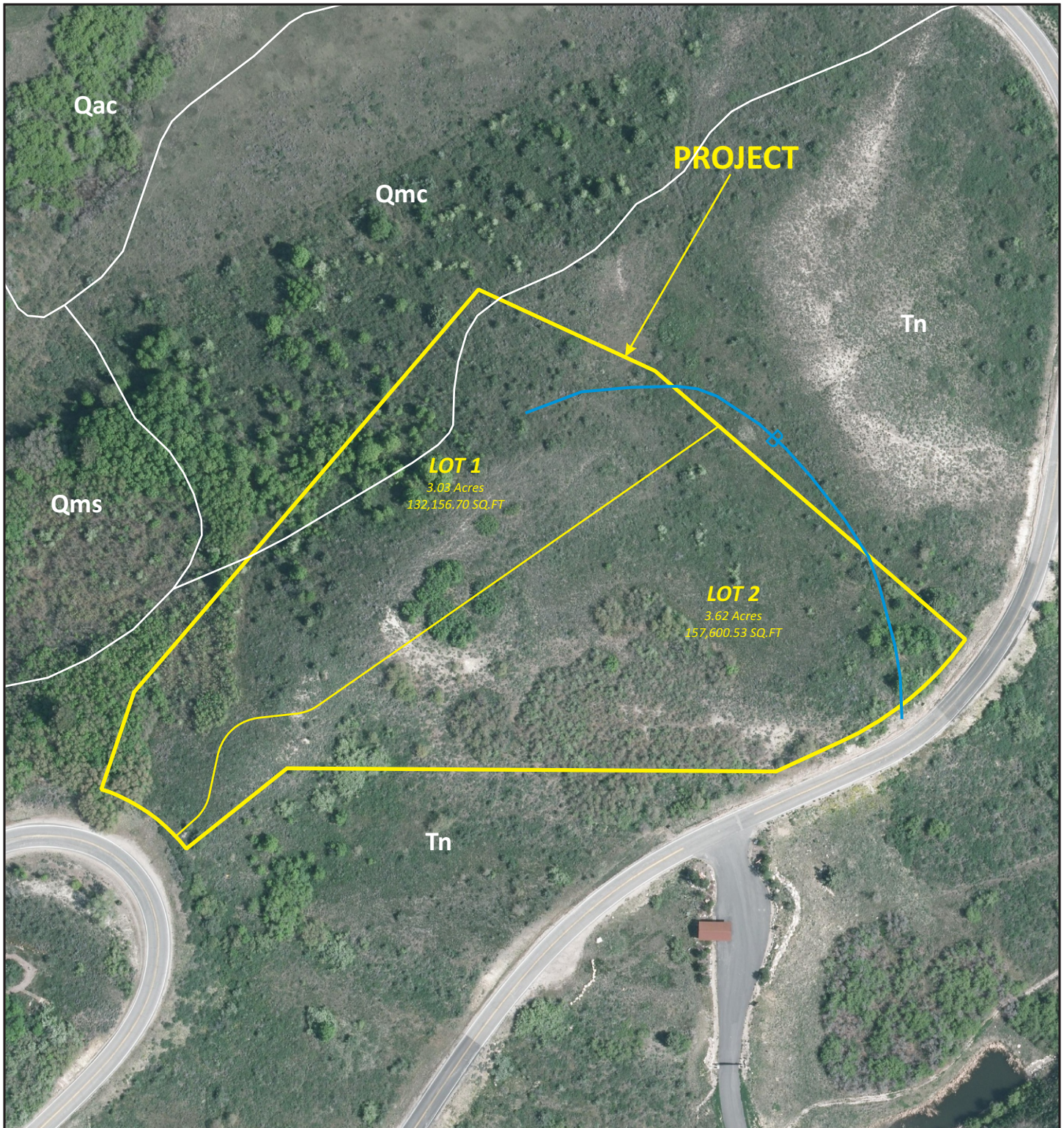
Scale 1:24,000
(1 inch equals 2,000 feet)

GEOLOGIC MAP

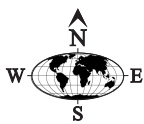
GEOLOGIC HAZARDS RECONNAISSANCE

Proposed Samarel Subdivision
About 6200 East Old Snowbasin Road
Huntsville, Weber County, Utah

FIGURE 2



Source: Utah Geographic Resource Center, 2012 High Resolution Orthophoto, 12.5 centimeter resolution.



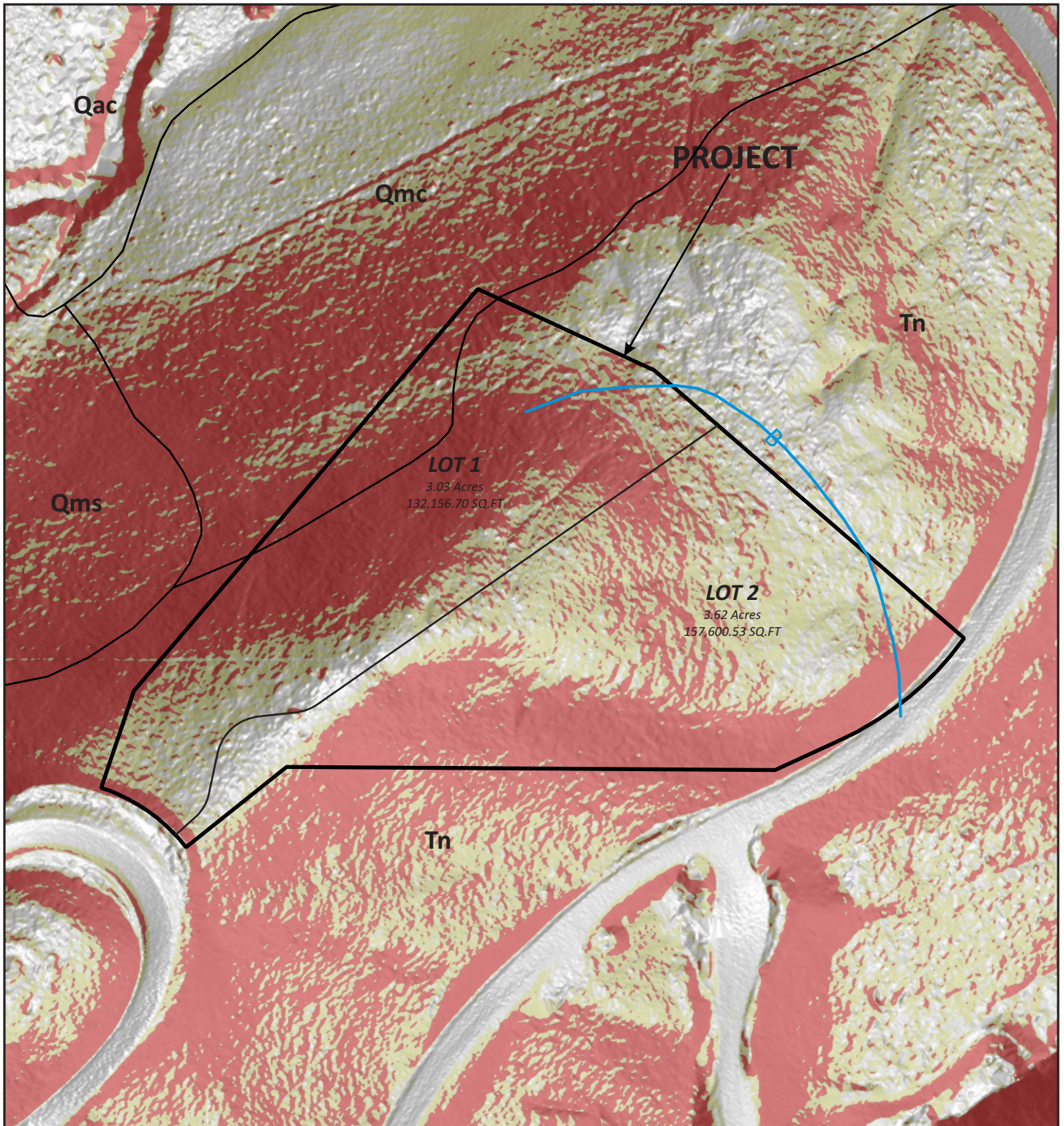
0 50 100 200
 Scale 1:1,800
 (1 inch equals 150 feet)

2012 AIR PHOTO

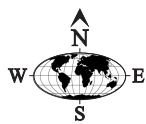
GEOLOGIC HAZARDS RECONNAISSANCE

Proposed Samarel Subdivision
 About 6200 East Old Snowbasin Road
 Huntsville, Weber County, Utah

FIGURE 3A



Source: Utah Geographic Resource Center, 2016 LIDAR Bare Earth DEM, 50 centimeter resolution; slope gradients <15% unshaded, 15-25% in yellow, and >25% in red.



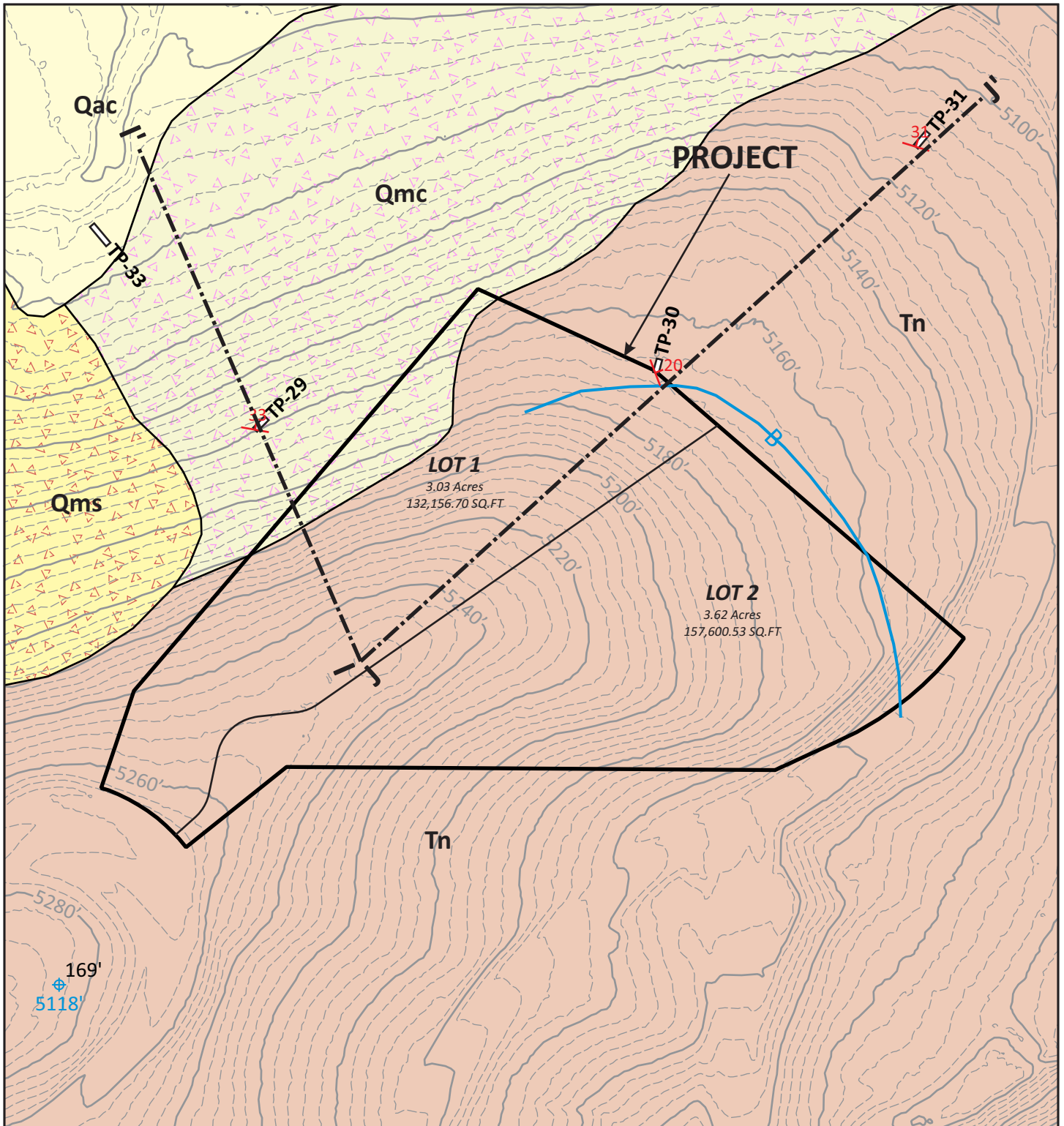
0 50 100 200
 Scale 1:1,800
 (1 inch equals 150 feet)

LIDAR ANALYSIS

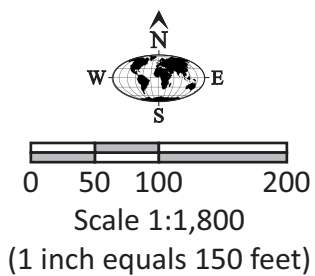
GEOLOGIC HAZARDS RECONNAISSANCE

Proposed Samarel Subdivision
 About 6200 East Old Snowbasin Road
 Huntsville, Weber County, Utah

FIGURE 3B



Source: Coogan and King (2016) and Western Geologic (2021).
 Contours generated by Global mapper from 2016 LIDAR data, 4 foot interval.



SITE-SPECIFIC GEOLOGY

GEOLOGIC HAZARDS RECONNAISSANCE

Proposed Samarel Subdivision
 About 6200 East Old Snowbasin Road
 Huntsville, Weber County, Utah

FIGURE 3C

APPENDIX

Photographic Record of Site Reconnaissance

Proposed Samarel Subdivision

About 6200 East Old Snowbasin Road - Huntsville, Weber County, Utah

Photo 1. View north across property



Photo 2. View east across property



Photographic Record of Site Reconnaissance

Proposed Samarel Subdivision

About 6200 East Old Snowbasin Road - Huntsville, Weber County, Utah

Photo 3. View south across property



Photo 4. View west across property toward Legacy Mountain Development



Photographic Record of Site Reconnaissance

Proposed Samarel Subdivision

About 6200 East Old Snowbasin Road - Huntsville, Weber County, Utah

Photo 5. Typical weathered Norwood Formation sandstone bedrock at surface



Photo 6. Typical weathered Norwood Formation sandstone bedrock at surface

