

June 23, 2016  
File No: GCS 20146.4

Camp UTABA  
7005 N Fork Road  
Eden, UT 84310

ATTN: Scott & Tracye Blank  
Camp UTABA Managers

**Subject: Professional Geologist Site Reconnaissance and Review  
Camp UTABA Caretakers Home  
Weber County Parcel #17-092-0015  
7005 N Fork Road, (Liberty Area)  
Eden, Weber County, Utah**

Dear Mr. & Mrs. Blank,

In response to your request, GCS Geoscience (GCS) has prepared this Professional Geologist site reconnaissance review report for the above referenced site.

**Introduction**

The Camp UTABA property consists of approximately 40-acres located in the "North Fork Area" of northern Ogden Valley, in Weber County, Utah. The site location relative topographic and improved features as of 1991 is shown on Figure 1, Vicinity Map. The property is operated as a religious retreat and includes meeting/dining hall, bunk houses and shower facilities which support these purposes. A larger scale rendering of the Camp UTABA property is presented on Figure 2, Aerial Coverage.

It is our understanding the owner (Utah Association Of American Baptist Churches Inc.) intends to construct a "Caretaker House" single family residence on part of this site, at the location shown on Figure 2. We understand that the proposed construction is to be of light weight modular-unit installation and will occupy a building pad of approximately 6,000 square feet in plan area, and be located near the eastern entry to the property. The location of the property parcel, including the proposed Caretakers House is within the Weber County Forest Zone F-5 of which promotes...*"to protect and preserve the natural environment of those areas of the County that are characterized by mountainous, forest or naturalistic land, and to permit development compatible to...provide areas for private and public recreation and recreation resorts, and...to provide areas for homes, summer homes, and summer camp sites."*

Because the proposed construction appears to be located in part on a hill slope area in the vicinity of mapped landslide hazards, and natural floodplain areas, Weber County is requesting that this geological site reconnaissance be performed to assess whether all or parts of the site are exposed to the hazards that are included in the [Weber County Code, Chapter 38, Natural Hazards Overlay District](#). These hazards include, but are not limited to: Surface-Fault Ruptures, Landslide, Tectonic Subsidence, Rock Fall, Debris Flows, Liquefaction Areas, Flood, or other Hazardous Areas.

The purpose of this proposed **Professional Geologist Site Reconnaissance Review** is to evaluate if the proposed development is outside or within areas identified as Natural Hazards Overlay District, and if within a hazard area, to recommend appropriate additional studies that comply with the purpose and intent of the [Weber County Hillside Development Review Procedures and Standards](#) to evaluate and/or mitigate the hazard exposure. Because the Camp UTABA parcel is a large property, mitigations may simply include recommendations for on-site hazard avoidance, or be more complex involving site specific engineering measures.

## Literature and Resource Review

To evaluate the potential exposure of sites to geological hazards that impact sites or site improvements, Weber County has compiled a series of Geographic Information Systems (GIS) data mapping layers of geological hazard related information. These data may be queried on-line using the Weber County Geo-Gizmo application at <http://www.co.weber.ut.us/gis/maps/gizmo/>. Using the Geo-Gizmo application, under the Engineering Layers category is listed geological hazard related layers that may be toggled on and off to determine potential hazards exposure to sites in the county. These mapping layers include the following categories; *Quake Epicenters, FEMA Flood Zone Line, FEMA Base Flood Elevation, Wasatch Faults, Landslide Scarps, Geologic Faults, Faults, Quaternary Faults, FEMA Flood Zone, FEMA LOMR, Engineering Problems; Liquefaction Potential, Landslide, FEMA Letters of Map Change, and FEMA Flood Zones*. These layers have been compiled from the respective agencies including the Federal Emergency Management Agency (FEMA), the Utah Geological Survey (UGS), and the U.S. Geological Survey (USGS). These mapping layers consist of regional compilation hazards data, but are not compiled at scales that are necessarily relevant for site specific usage. When hazard layer data on the Geo-Gizmo are found to interact with Applicant site improvement locations, Weber County Engineers and Planners will request that the Applicant have a Professional Geologist Site Reconnaissance Review, such as presented herein, conducted for the site.

Our preliminary review of the Geo-Gizmo indicated that parts of the Camp UTABA property interact with the *Landslide* and *FEMA* layers, however the proposed Caretaker House location showed no exposure to either of those hazard layer areas.

Our review consisted of a GIS data integration effort that included reviews of previous mapping and literature pertaining to site geology including King (2015), Coogan and King (2016) and Crittenden and Sorensen (1985); an analysis of vertical and

stereoscopic aerial photography for the site including a 1946 1:20,000 stereoscopic sequence, a 2014 1.0 meter digital NAIP coverage, and a 2012 5.0 inch digital HRO coverage of the site; and a GIS analysis using the QGIS<sup>®</sup> GIS platform to geoprocess and analyze 2011 1.0 meter LiDAR digital elevation data made available for the site by the Utah Automated Geographic Reference Center (AGRC). The GIS analysis included using the QGIS<sup>®</sup> platform Geospatial Data Abstraction Library (GDAL, 2013) Contour; the GRASS<sup>®</sup> (Geographic Resources Analysis Support System, 2013) r.slope and r.shaded.relief modules.

For the best site specific scale for this review we used mapping by King (2015), which provided the most up-to-date and best scale (1:24,000) rendering of geological mapping for the site location. Supporting documentation by Coogan and King (2016), Crittenden and Sorensen (1985) and FEMA (2015) was also used for conducting this review. The geological and flood hazard mapping for this review is provided on Figure 3, Geologic and Flood Hazard Map. Topographic, slope, and elevation data for this review was supported through the aforementioned LiDAR analysis which is presented on Figure 4, Shaded Relief and Slope Map.

## Review Findings

Topographically the site is located on the upper reaches of the North Fork of the Ogden River, on the east side of Ben Lomond Peak, in an area that includes the confluence of Cutler Creek and the North Fork River. The site and surrounding area consists of bedrock-controlled sloping areas that are dissected by alluvial stream and floodplain areas, that have been eroded by Cutler Creek and the North Fork River.

Figure 3 shows the location of the Camp and the Proposed Caretakers House location relative to GIS overlays including geological mapping prepared by King (2016) and floodplain risks by FEMA (2015) and Weber County (1994). A summary of the geological mapping of the site found at the Camp is provided as follows:

The lower-lying alluvial floodplain areas of the site include geological units classified as **Qal**, **Qap?**, and **Qab?**. The **Qal** deposits consist of stream alluvium and floodplain deposits, Holocene and uppermost Pleistocene in age (0 to 15,000 ybp), comprised of sand, silt, clay, and gravel. The **Qal** areas should be considered exposed to potential flood hazards, and liquefaction potential hazards. The **Qap?** and **Qab?** deposits are Lake Bonneville-age alluvium, upper Pleistocene in age (10,000 to 30,000 ybp). These are older, no longer active, alluvial deposits related to shorelines of ancient Lake Bonneville which inundated parts of Ogden Valley 15,000 to 19,000 years ago (Currey and Oviatt, 1985). The proposed Caretakers House is to be located on **Qap?** deposits, and no exposure to active geological processes are associated with these deposits.

**Qmc?** and **Qms?** deposits include landslide and colluvial deposits associated with failed or moving slopes, Holocene and Pleistocene in age (0 to 30,000 ybp), consisting of poorly sorted to unsorted clay- to boulder-sized material. The **Qmc?**

and **Qms?** classified areas should be considered exposed to landslide and slope-creep hazards. On Figure 3 these deposits are shown to occur on two areas on the Camp site, with a **Qmc?** area of approximately 1.7 acres on the north part of the Camp site, where the North Fork River has apparently over-steepened slopes it's left flank. The **Qms?** area includes a steep slope on the east boundary of the Camp property, comprising an area of approximately 6.0 acres, of which 1.3 acres occurs on the Camp property.

The **Qgo?** deposit lobe on the southwest side of the Camp site consist of older glacial till and outwash, upper and middle? Pleistocene in age (15,000 to 130,000 ybp). The till consists of non-stratified, poorly sorted clay, silt, sand, and gravel, to boulder size materials.

Bedrock controlled slopes on the northeast side of the Camp site are classified as **Zm** - Mutual Formation, which is Proterozoic in age (750 ma), consisting of grayish-red to purple coarse-grained quartzite. These rocks are shown on Figure 3 to dip 35 and 40 degrees towards the northeast, away from the site.

UTABA Retarding Dam (No. UT00541) and reservoir is in part located on the northwest corner of the Camp property as shown on Figure 2, Figure 3 and Figure 4. The dam is an earthen zone-filled structure built for flood control purposes, and is classed as controlling greater than 20 Acre feet of water, and was constructed in 1962. The dam has structural height of 71 Feet, with a crest length of 369 Feet. The dam crest elevation is 5770 feet (msl), and the spillway elevation is appears to be approximately 10.0 feet lower then the crest. Peak spillway discharge is estimated to be 5401 cfs. The control outlet works consist of a 24-inch reinforced concrete pipe, and has a peak discharge of 161 cfs.

The reservoir storage capacity at the spillway crest height is 91 Acre feet, . The Hazard Rating for the dam is "Moderate" as assigned by the Utah State Engineer. A Moderate hazard rating indicates that failure has a low probability of causing loss of human life, but would cause appreciable property damage, including damage to public utilities. The dam is managed by the Weber County Engineering Department. The last Utah State inspection of the dam was conducted July 2, 2013, and a Emergency Action Plan (EAP) for the dam has been prepared, and copies of this plan are on file with Weber County and Utah Division of Water Rights, Dam Safety, <http://waterrights.utah.gov/docImport/0538/05383579.pdf>. (Bridges, 1977; Utah Division of Water Rights, 2016). We understand that Mr. Scott Blank, Camp UTABA Manager, has a copy of this Emergency Action Plan.

In addition to the review and location query we searched for nearby or proximal classifications or conditions that could possibly present hazardous conditions to the site. A summary of this search is provided as follows:

1. **Landsliding:** The nearest landslide units mapped as **Qmc?** and **Qms?** deposits are located on the north and east parts of the Camp site. The nearest



landslide deposits to the proposed Caretakers House are the Qms? deposits located approximately 100 feet to the northeast of the proposed location, and do not appear to potentially impact the proposed Caretakers House.

2. **Alluvial fan debris flow processes** including flash flooding and debris flow hazard: The nearest fan debris flow process deposits to the Camp site are mapped as **Qac**, and occur approximately 280 feet south of the property boundary, and are located approximately 960 feet southwest of the proposed Caretakers House. These deposits and processes do not appear to be a potential impact to the site.
- 3 **Surface fault rupture hazards, strong earthquake ground motion, and liquefaction:** The nearest active (Holocene) earthquake fault to the site is the Brigham City segment of the Wasatch fault zone (UT2351C) which is located 4.3 miles southwest of the site, thus fault rupture hazards are not considered present on the site (Black et al., 2004). The Ogden Valley North Fork fault (UT2376) is located much closer to the site, approximately 865 feet to the southwest, however the most recent movement along this fault is estimated to be pre-Holocene (>15,000 ybp), and presently is not considered an active risk (Black, et al., 1999).

**Strong earthquake ground motion** originating from the Wasatch fault or other near-by seismic sources is capable of impacting the Camp site. The Wasatch fault zone is considered active and capable of generating earthquakes as large as magnitude 7.3 (Arabasz et al., 1992). Based on probabilistic estimates (Peterson, et al., 2008) queried for the site, the expected peak horizontal ground acceleration on rock from a large earthquake with a ten-percent probability of exceedance in 50 years is as high as 0.19g, and for a two-percent probability of exceedance in 50 years is as high as 0.43g for the site. Ground accelerations greater than these are possible but will have a lower probability of occurrence.

**Liquefaction Potential Hazards:** In conjunction with Strong earthquake ground motion potential of large magnitude seismic events as discussed previously, certain soil units may also possess a potential for liquefaction during a large magnitude event. Liquefaction is a phenomenon whereby loose, saturated, granular soil units lose a significant portion of their shear strength due to excess pore water pressure buildup resulting from dynamic loading, such as that caused by an earthquake. Among other effects, liquefaction can result in densification of such deposits causing settlements of overlying layers after an earthquake as excess pore water pressures are dissipated. Horizontally continuous liquefied layers may also have a potential to spread laterally where sufficient slope or free-face conditions exist. The primary factors affecting liquefaction potential of a soil deposit are: (1) magnitude and duration of seismic ground motions; (2) soil type and consistency; and (3) occurrence and depth to groundwater.

Liquefaction potential hazards have not been studied or mapped for the Ogden Valley area, as has occurred in other parts of northern Utah (Anderson, et al., 1994). Because this phenomena is known to occur in susceptible alluvial sediments in conjunction with shallow groundwater conditions, we consider areas mapped as **Qal** on Figure 3 as potentially susceptible to liquefaction during a future earthquake event. We recommend that liquefaction hazard studies be considered for future improvements that may occur on the areas mapped as **Qal** on Figure 3.

5. **Rockfall and Avalanche hazards:** The site is over one mile from steep slope areas where such hazards may originate.
6. **Flooding:** Mapping by Federal Emergency Management Agency (FEMA, 2015) is shown on Figure 3. The Zone A shown on Figure 3, includes the 100-year flood hazard zone as delimited by recent FEMA studies conducted in the Ogden Valley area. On the basis of the FEMA determination *...mandatory flood insurance purchase requirements and floodplain management standards apply...* for improvements made in the Zone A area shown on Figure 3.

UTABA Dam Failure inundation mapping has been prepared by Weber county to evaluate the area of inundation should dam failure occur, and is also presented on Figure 3. The estimated inundation area shown on Figure 3 is presumed to be the worst-case scenario calculated by the County Engineers (Weber County Engineering, 1994).

7. **Sloping Surfaces:** The surface of site slopes developed from our LiDAR analysis range from level to well over 50-percent as shown on Figure 4, Shaded Relief and Slope Map.-Slope Analysis. For the proposed Caretakers House site area the slope gradients averaged 22-percent, for the over all Camp site area the slope gradients averaged 32-percent. The threshold gradient for slope development considerations according to the Weber County Section 108-14-3. (Weber County Code, 2016), includes slopes greater that 25-percent.
8. **Radon Exposure:** Radon is a naturally occurring radioactive gas that has no smell, taste, or color, and comes from the natural decay of uranium that is found in nearly all rock and soil. Radon and has been found occur in the Ogden Valley area, and can be a hazard in buildings because the gas collects in enclosed spaces. Indoor testing following construction to detect and determine radon hazard exposure should be conducted to determine if radon reduction measures are necessary for new construction. The radon-hazard potential mapping has been prepared for most of Ogden Valley by the Utah Geological Survey (Solomon, 1996), however that mapping does not extend far enough to the north to include the Camp UTABA site.

## **Site Reconnaissance**

The site was reconnoitered on June 22, 2016. During the reconnaissance the graded pad for the proposed Caretakers House was observed, as well as the UTABA Dam, and the guest facilities area including the dining hall, bunk houses and shower house locations. During the reconnaissance no conditions of imminent geologic hazards were observed.

## **Conclusions**

Based upon the findings of this review we believe that the proposed Caretakers house location is not adversely exposed to the geological hazards specified by the Weber County Hillside Ordinance. Based on this review, specific areas within the Camp UTABA boundaries may be exposed to landslide hazards, liquefaction potential hazards, and flood hazards, and these areas may require additional geological studies for approvals in the future, should improvements be proposed in these areas. We also advise that geotechnical soil and groundwater studies for foundations, earthwork, and geoseismic design should be conducted for future improvements proposed on the Camp site.

## **Limitations**

Our services were limited to the scope of work discussed in the introduction section of this report. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. The recommendations contained in this report are based on our site observations, available data, probabilities, and our understanding of the facilities investigated. This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, express or implied, is made.

This report may be used only by the client and only for the purposes stated within a reasonable time from its issuance. The regulatory requirements and the "state of practice" can and do change from time to time, and the conclusions presented herein may not remain current. Based on the intended use of the report, or future changes to design, GCS Geoscience may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else, unless specifically agreed to in advance by GCS Geoscience in writing will release GCS Geoscience from any liability resulting from the use of this report by any unauthorized party.

## References

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Weber County Engineering, 1994, Weber County, Utah UTABA Dam Failure Inundation  
Map: Weber County Engineering unpublished mapping, scale 1:24,000

We appreciate the opportunity to work with you on this project and look forward to assisting with you in the future. If you have any questions or need additional information on this or other reporting, please contact the undersigned at (801) 745-0262 or (801) 458-0207.

Respectfully submitted,

**GCS Geoscience**

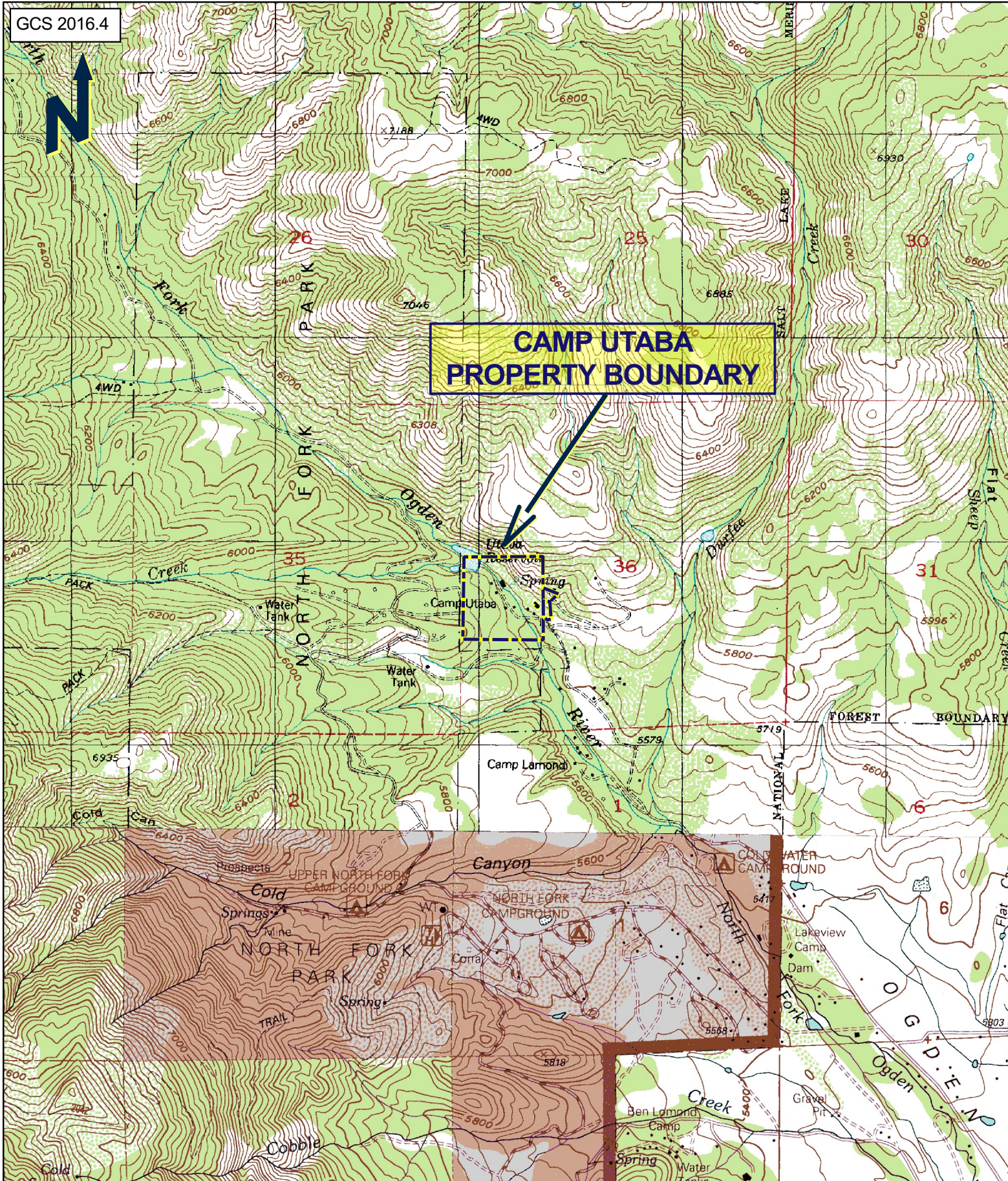

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Encl. Figure 1, Site Vicinity Map  
Figure 2, Aerial Coverage  
Figure 3, Geologic and Flood Hazard Map  
Figure 4, Shaded Relief and Slope Map



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**CAMP UTABA  
PROPERTY BOUNDARY**

Base:  
1991 USGS 7.5 Minute topographic map titled  
"Mantua, Utah" from Utah AGRC;  
<http://gis.utah.gov/>

0 1000 2000 3000 ft



1:24,000

**FIGURE 1  
SITE VICINITY MAP**

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**UTABA  
DAM**

**Property  
Boundary**

**Proposed  
Caretaker  
House**



Base:  
2014 1.0m NAIP Color Orthoimagery,  
from Utah AGRC; <http://gis.utah.gov/>

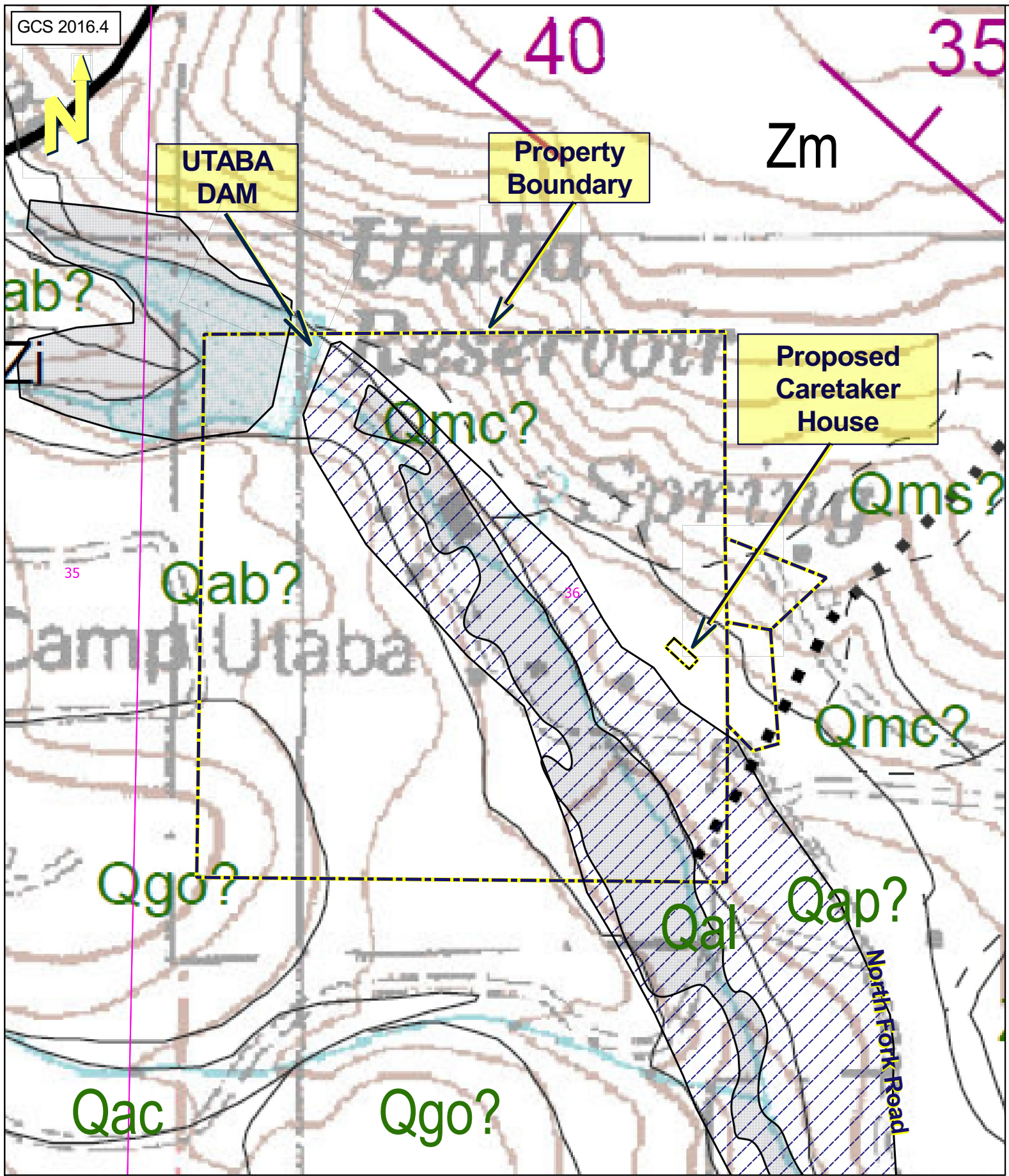
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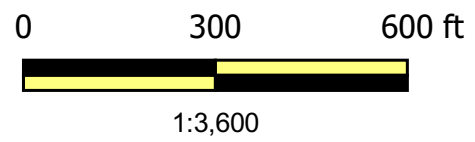
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**FIGURE 2**  
**AERIAL COVERAGE**  
**GCS Geoscience**





Base:  
King, 2015



### Geologic Classification

#### Geology after Coogan and King, 2016; and King, 2015

- Qal - Stream alluvium and flood-plain deposits (Holocene and uppermost Pleistocene) – Sand, silt, clay, and gravel in channels, flood plains, and terraces...  
 -Qal classified areas should be considered exposed to potential flood hazards, and liquefaction potential hazards.
- 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...  
 -Qac classified areas should be considered exposed to flooding and debris-flow hazards.
- Qap? & Qab?- 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...
- 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...  
 -Qmc classified areas should be considered exposed to landslide and slope-creep hazards.
- Qms?- Landslide deposits (Holocene and upper and middle? Pleistocene) – Poorly sorted clay- to boulder sized material; includes slides, slumps, and locally flows and floods...  
 -Qmc classified areas should be considered exposed to landslide and debris-flow hazards.
- Qgo? - Older glacial till and outwash (upper and middle? Pleistocene) – Mapped down-drainage from and locally laterally above Pinedale deposits as undivided...
- Zi - Inkorn Formation (upper Proterozoic) -- Argillite to psammite...meta-sandstone over meta-siltstone...
- Zm - Mutual Formation (upper Proterozoic) - Grayish-red to purple coarse-grained quartzite...

### Flood Hazards

#### FEMA - Flood Insurance Rating Zones (2015)

- Zone A - Areas subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.

#### Weber County Engineering UTABA Dam Failure Inundation Mapping (1994)

- Rainy Day Inundation Zone

**FIGURE 3**  
**GEOLOGIC AND**  
**FLOOD HAZARD MAP**  
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**UTABA  
DAM**

**Property  
Boundary**

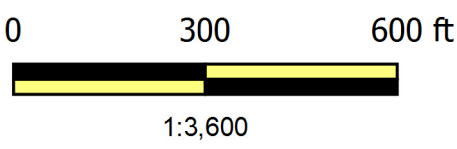
**Proposed  
Caretaker  
House**

**Explanation**

**Slope Percentage**

-  0 to 25 Percent Slope
-  25 Percent or Greater Slopes
-  Index Contour 10ft

Base:  
2011 1.0-Meter LiDAR Imagery  
from Utah AGRC; <http://gis.utah.gov/>



**FIGURE 4**  
**SHADED RELIEF**  
**AND SLOPE MAP**  
**GCS Geoscience**