# REPORT

## FAULT HAZARD EXCAVATION INSPECTION

PROPOSED MOELLER RESIDENCE ADDITION
2932 EDGEROCK CIRCLE
HOLLADAY, UTAH

*Prepared for*

Shere Moeller
2932 Edgerock Circle
Holladay, Utah 84117

- bring McD's Moeller letters

plu Clint Blacks faultstudy report

July 22, 2008

*Prepared by*


Western GeoLogic, LLC
74 North "N" Street
Salt Lake City, UT 84103

Voice: 801.359.7222
Fax: 801.359.2730
Web: www.western-geologic.com

**WESTERN GEOLOGIC, LLC**
74 NORTH N STREET
SALT LAKE CITY, UTAH 84103 USA

Phone: 801.359.7222 Fax: 801.359.2730 Email: craig_nelson@western-geologic.com

August 19, 2008

Shere Moeller
2932 Edgerock Circle
Holladay, Utah 84117

**SUBJECT:** Fault Hazard Excavation Inspection
Proposed Moeller Residence Addition
2932 Edgerock Circle
Holladay, Utah

Dear Ms. Moeller,

This report presents results of a fault hazard excavation inspection evaluation conducted by Western GeoLogic, LLC (Western GeoLogic) for the proposed addition to the existing home at 2932 Edgerock Circle in Holladay, Utah (Figure 1 – Project Location). The site is in the north-central part of Salt Lake Valley in the NW¼ Section 14, Township 2 South, Range 1 East (Salt Lake Base Line and Meridian). Elevation of the site is about 4,580 feet above sea level.

## PURPOSE AND SCOPE

The purpose of this investigation was to evaluate the hazard from surface faulting to the proposed home addition. Other geologic hazards possibly present at the site, as well as risk from surface faulting to the existing home, were not evaluated and are beyond the scope of this study. The following scope of services was performed in accordance with the above purpose:

- Examination and logging of the southeast excavation wall and one exploratory trench along the southwestern edge of the proposed addition footprint to: (1) identify the presence and location of any active faults that may pass beneath the proposed structure, (2) assess zones of fault-related deformation should faults be discovered, and (3) recommend appropriate fault set-back distances and safe "buildable" areas for any faults found;

- Review of available geologic maps and reports; and

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

With regard to our evaluation and within the above stated purpose and scope, this report generally follows the Guidelines for Evaluating Surface Fault Rupture Hazards in Utah

(Christenson and others, 2003).

## GEOLOGY

### Seismotectonic Setting

The property is located in Salt Lake Valley about 0.7 miles northwest of the mouth of Tolcats Canyon at the western base of the Wasatch Range (Figure 1). Salt Lake Valley is a deep, sediment-filled structural basin of Cenozoic age that is bounded by two uplifted range blocks, the Oquirrh Mountains and the Wasatch Range (to the west and east, respectively). The valley lies at the eastern edge of the Basin and Range physiographic province (Stokes, 1977, 1986). The Basin and Range province 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 the prominent, west-facing escarpment along the Wasatch fault zone at the western base of the Wasatch Range. Late Cenozoic normal faulting, a characteristic of the Basin and Range, began between about 17 and 10 Ma (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 Wasatch fault zone is one of the longest and most active normal-slip faults in the world, and extends for 213 miles along the western base of the Wasatch Range from southeastern Idaho to north-central Utah (Machette and others, 1992). The fault zone generally trends north-south and, at the surface, can form a zone of deformation up to several hundred feet wide containing many subparallel west-dipping main faults and east-dipping antithetic faults. Previous studies divided the fault zone into 10 sections, each of which rupture independently and are capable of generating large-magnitude surface-faulting earthquakes (Machette and others, 1992). The central five sections of the fault (Brigham City, Weber, Salt Lake, Provo, and Nephi) have each produced two or more surface-faulting earthquakes in the past 6,000 years (Black and others, 2003).

The site is in Salt Lake County's Surface Fault Rupture Special Study Zone in a zone of faulting on the Cottonwood subsection of the active Salt Lake City segment of the Wasatch fault zone. The Salt Lake City segment consists of three subsections (Warm Springs fault, East Bench fault, and Cottonwood section; from north to south) that trend across the heavily populated east side of Salt Lake Valley. The Cottonwood section is the southernmost subsection, and forms a complex fault zone along the Wasatch Range front between Olympus Cove and Corner Canyon in the Traverse Range.

Personius and Scott (1992) and Salt Lake County Planning Division maps show a main west-dipping trace of the Salt Lake City segment trending northward across the site, although their locations differ slightly (likely due to mapping scales). The Salt Lake County maps show the fault in the western part of the property, whereas Personius and Scott (1992) locate it in the eastern part. Lund (2005) indicates preferred earthquake timing for the last four surface-faulting earthquakes on the Salt Lake City segment, mainly based on trenching data from sites on the Cottonwood section, is: (1) about 1,300 years ago, (2) a about 2,450 years ago, (3) about 3,950 years ago, and (4) about 5,300 years ago. The consensus preferred recurrence interval for the Salt Lake City segment, as determined by the Utah Quaternary Fault Working Group, is 1,300 years for the past four surface-faulting earthquakes (Lund, 2005).

The site 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 $M_S$ 7.5 event in 1959 near Hebgen Lake, Montana. However, none of these earthquakes occurred along the Wasatch fault or other known late Quaternary faults (Arabasz and others, 1992; Smith and Arabasz, 1991). The closest of these events was the 1934 Hansel Valley ($M_S$ 6.6) event north of the Great Salt Lake.

**Unconsolidated Deposits**

Personius and Scott (1992) map the site at a fault contact between Holocene to Pleistocene alluvium and Pleistocene Lake Bonneville gravels (units al2 and lpg, respectively; Figure 2). Unit al2 is on the downthrown (western side) of the fault, whereas unit lpg is on the upthrown (eastern) fault side. Given the relatively simple geology of the site and surrounding area, Figure 2 was enlarged to a scale of 1:24,000 from the original map scale of 1:50,000. The main fault trace discussed above is shown by the heavy black line on Figure 2.

Personius and Scott (1992) describe surficial geologic units in the site vicinity, from youngest to oldest in age, as follows:

> ***al1 – Stream alluvium 1 (upper Holocene).*** *Sand, silt, and minor clay and gravel along Jordan River and lower reaches of its tributaries; deposits along upper reaches of tributaries consist of pebble and cobble gravel, and minor sand and silt. Poorly to moderately sorted; parallel bedding and crossbedding. Forms modern flood plain and terraces less than 5 m above modern stream level. Subject to flooding and high water table. Exposed thickness 1-3 m.*

> ***chs – Hillslope colluvium (Holocene to upper Pleistocene).*** *Pebble, cobble, and boulder gravel, usually clast supported, in a matrix of sand and silt; clasts usually angular to subangular, but unit contains some recycled lacustrine gravel of the Bonneville lake cycle. Very poorly sorted; massive to crude parallel bedding. Forms small fans, cones, and debris aprons at the mouths of small canyons and at the bases of bedrock slopes. Deposited by mass-wasting*

*processes, sheetwash, and small debris flows. Thickness 1 to >10 m.*

***al2 – Stream alluvium 2 (middle Holocene to uppermost Pleistocene).*** *Sand, silt, clay, and local gravel along Jordan River and lower reaches of its tributaries; deposits along upper reaches of tributaries consist of pebble and cobble gravel, and minor sand and silt. Poorly to moderately sorted; parallel bedding and crossbedding. Deposited by streams graded to recessional stands of Lake Bonneville and to lakes of early Holocene age; forms terraces more than 5 m above modern stream level, usually inset into deposits of the Bonneville lake cycle. Exposed thickness 1-5 m.*

***af2 – Fan alluvium 2 (middle Holocene to uppermost Pleistocene).*** *Clast-supported pebble and cobble gravel, locally bouldery, in a matrix of sand and silty sand; poorly sorted; casts subangular to round. Thin to thick, parallel bedding and crossbedding; locally massive. Deposited by perennial and intermittent streams, debris flows, and debris floods (hyperconcentrated floods) graded approximately to modern stream level. May contain small deposits of units af1 and cd1, especially near fan heads and along active stream channels. No shorelines present on surfaces. Typical soil profiles range from A-Bw-Cox-Cn to A-Bt(weak)-Cox-Cn. Thickness 1 to >10 m.*

***lpd – Deltaic deposits related to regressive phase (uppermost Pleistocene).*** *Clast-supported pebble and cobble gravel, in a matrix of sand and minor silt; locally includes thin beds of silt and sandy silt. Moderately to well sorted within beds; clasts subround to round. Deposited as thin to thick, parallel and crossbedded foreset beds having original dips of 5-10°; locally deposited as topset beds. More commonly capped with topset beds of poorly sorted, silty to sandy, pebble and cobble alluvial gravel (alp). Forms large delta complexes graded to Provo shoreline at the mouths of Big and Little Cottonwood Canyons. Thickness 1-25 m.*

***lpg – Lacustrine sand and gravel related to regressive phase (uppermost Pleistocene).*** *Clast-supported pebble and cobble gravel, in a matrix of sand and pebbly sand; locally interbedded with beds and lenses of silt and sandy silt. Good sorting within beds; clasts subround to round. Deposited in parallel and crossbedded, thin to thick beds dipping from horizontal to as much as 15°. Deposited in beaches, bars, and spits, as well as small deltas that no longer retain distinctive morphology. Mapped at Provo shoreline (1,463-1,469 m (4,800-4,820 ft) in map area) and below. Contact with unit lbpg is mapped where lpg deposits can no longer be correlated with other regressive-phase deposits or shorelines. Thickness 1-25 m.*

**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). Sediments from Lake Bonneville comprise some of the unconsolidated deposits in the site vicinity.

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 (Donald Currey, University of Utah; written communication to the Utah Geological Survey, 1996; and verbal communication to the Utah Quaternary Fault Parameters Working Group, 2004). Approximately 32,500 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, after about 18,000 years ago. The lake remained at this level until 16,500 years ago, when headward erosion of the Snake River-Bonneville basin drainage divide 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. 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. Oviatt and others (1992) deem this low stage the end of the Bonneville lake cycle. Great Salt Lake then experienced a brief transgression between 12,800 and 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). The site is located below both the Bonneville and Provo shorelines.

## SUBSURFACE INVESTIGATION

To assess the potential hazard from surface faulting to the proposed addition, a field exploration plan was developed to inspect and log the southeast wall of the footing excavation for the addition, and excavate and log one generally west-trending trench along the southwest side of the addition footprint. Location of the excavation wall and trench (in yellow), approximate addition location, nearby faults from the Salt Lake County maps (in pink), and site boundaries (in blue) are shown on Figure 3. Figures 4 and 5 are detailed logs of the excavation wall and trench at a scale of 1 inch equals 5 feet (1:60).

The excavation and trench walls at the site exposed a sequence of interbedded lacustrine gravel, sand, and silt correlating well with Personius and Scott's (1992) unit lpg mapped on Figure 2 and described above. A thin veneer of Holocene alluvium in which the modern A-horizon soil was forming was evident in the excavation wall overlying the Lake Bonneville deposits. This unit appears to correspond to Personius and Scott's (1992) unit al2. We note that the trench did not expose alluvium because it was below grade and they would have been removed by prior grading for the existing home. The above depositional sequence was comprised of: (1) a lower poorly bedded sand in the trench, a middle interbedded silt and sand in both the trench and excavation wall, and an upper interbedded gravel and sand in the excavation wall; and (2) alluvium comprised of organic-rich silty sand with gravel, cobbles, and boulders in the excavation wall. Detailed unit descriptions are provided on Figures 4 and 5. Pedogenic carbonate on clasts in the exposure appeared to correspond well with Personius and Scott's (1992) presumed sediment ages.

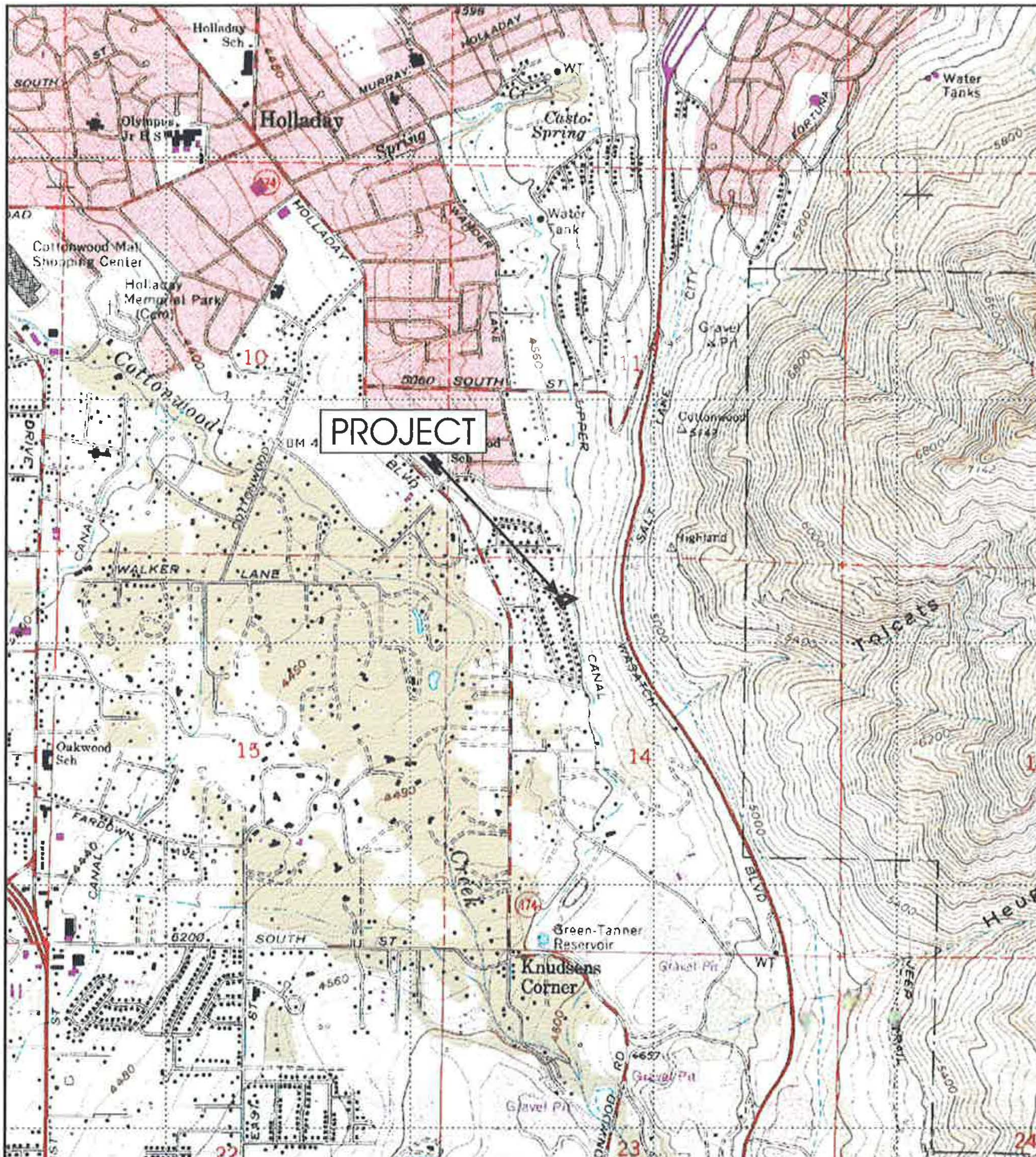
No evidence for faulting such as vertical terminations, backtilting, aligned clasts, or fault-zone colluvium was exposed in the excavation wall or trench exposure. However, the exposed sediments suggest the fault is to the west. The lacustrine gravels should not have been evident at their observed depth if they were on the downthrown (western) side of a main fault trace; conversely, the exposed alluvium should have been considerably thicker. Our surficial site observations suggest the fault may be located about 10-15 feet west of the existing home northwest corner, corresponding roughly to a low west-facing scarp trending through the brush (Figure 3 – Estimated Fault Location in red). We note that fills from prior site grading could be responsible for this surficial feature and the fault location could vary. However, given the lack of evidence for faulting in the excavation wall and trench, risk to the proposed addition should be low.

## CONCLUSIONS AND RECOMMENDATIONS

A main west-dipping trace of the active Salt Lake City segment of the Wasatch fault zone is mapped crossing the property, and may be a few tens of feet west of the existing home. The site is also in the Surface Fault Rupture Special Study Area on Salt Lake County hazard maps. Geology of the site is comprised of alluvium and near-shore lacustrine sediments related to Pleistocene Lake Bonneville.

The southeast foundation excavation wall and one trench along the southwestern addition footprint were inspected and logged to evaluate the hazard from surface faulting to the proposed home addition. No evidence for faulting was exposed in the excavation wall or trench. Sediments exposed in the excavation wall and trench appeared to correlate well with the mapped surficial geology and suggest the main fault trace is located west of the proposed addition.

Given all the above evidence, the existing hazard from surface faulting to the proposed addition appears low. However, location of the main fault trace is still uncertain and risk may be higher to the existing home. Given that the addition may be structurally connected to the existing home, and location of the fault is uncertain, we recommend disclosing an inherent risk from surface fault rupture may exist at the site to future buyers and real estate agents in any impending real estate transaction so that they may understand and be willing to accept this risk.




Source: U.S. Geological Survey 7.5 Minute Series Topographic Map - SUGARHOUSE, UT; 1963, photorevised 1969 and 1975.

## LOCATION MAP

**FAULT HAZARD EXCAVATION INSPECTION**

Moeller Residence Proposed Addition
2932 Edgerock Circle
Holladay, Utah

**FIGURE 1**

WESTERN GEOLOGIC

N W E S

0 1000 2000 feet

Scale 1:24,000
(1 inch = 2000 feet)


Sources: air photo base from Utah AGRC, 2006; fault mapping from Salt Lake County Planning and Development Services zoning map, accessed August 15, 2008.

WESTERN GEOLOGIC

N W E S

0 25 50 feet

Scale 1:600
(1 inch = 50 feet)

## SITE PLAN AND AIR PHOTO

**FAULT HAZARD EXCAVATION INSPECTION**

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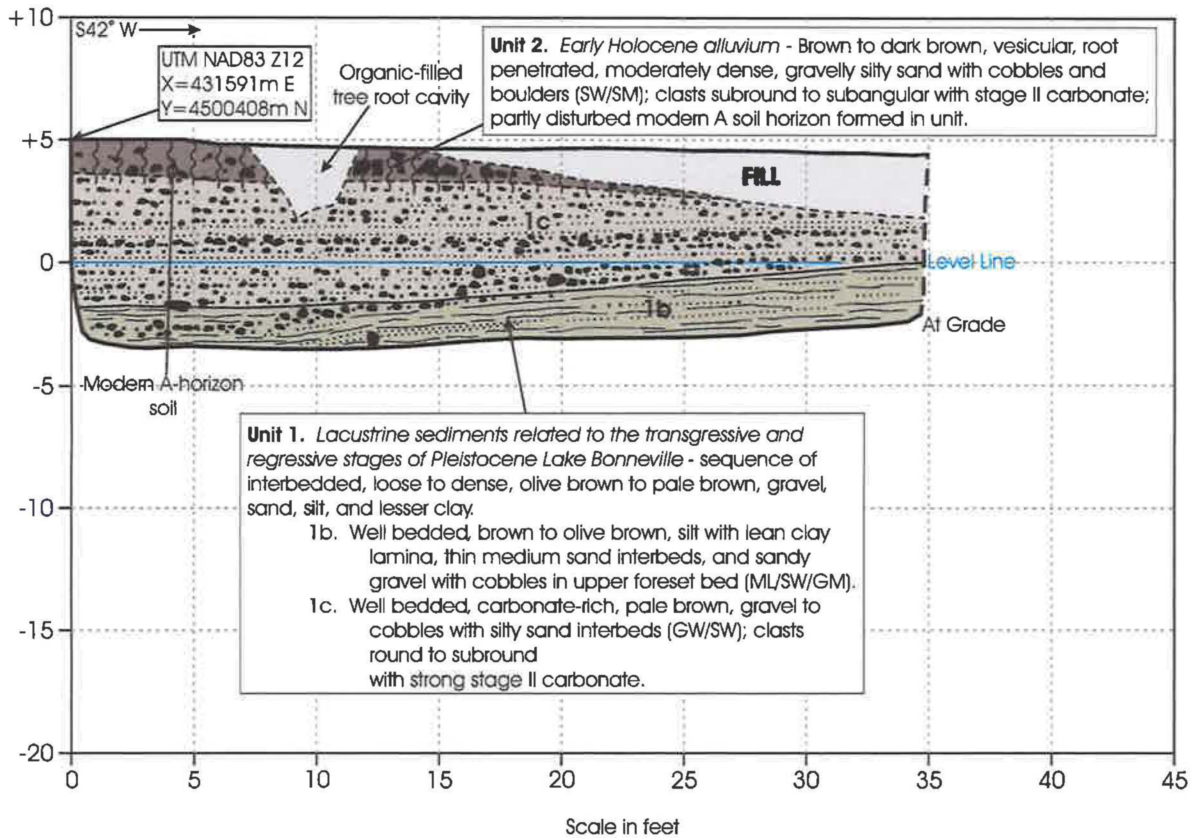
Holladay, Utah

**FIGURE 3**




WESTERN GEOLOGIC

LICENSED PROFESSIONAL GEOLOGIST
BILL DUANE BLACK
NO. 5224898-2250
STATE OF UTAH

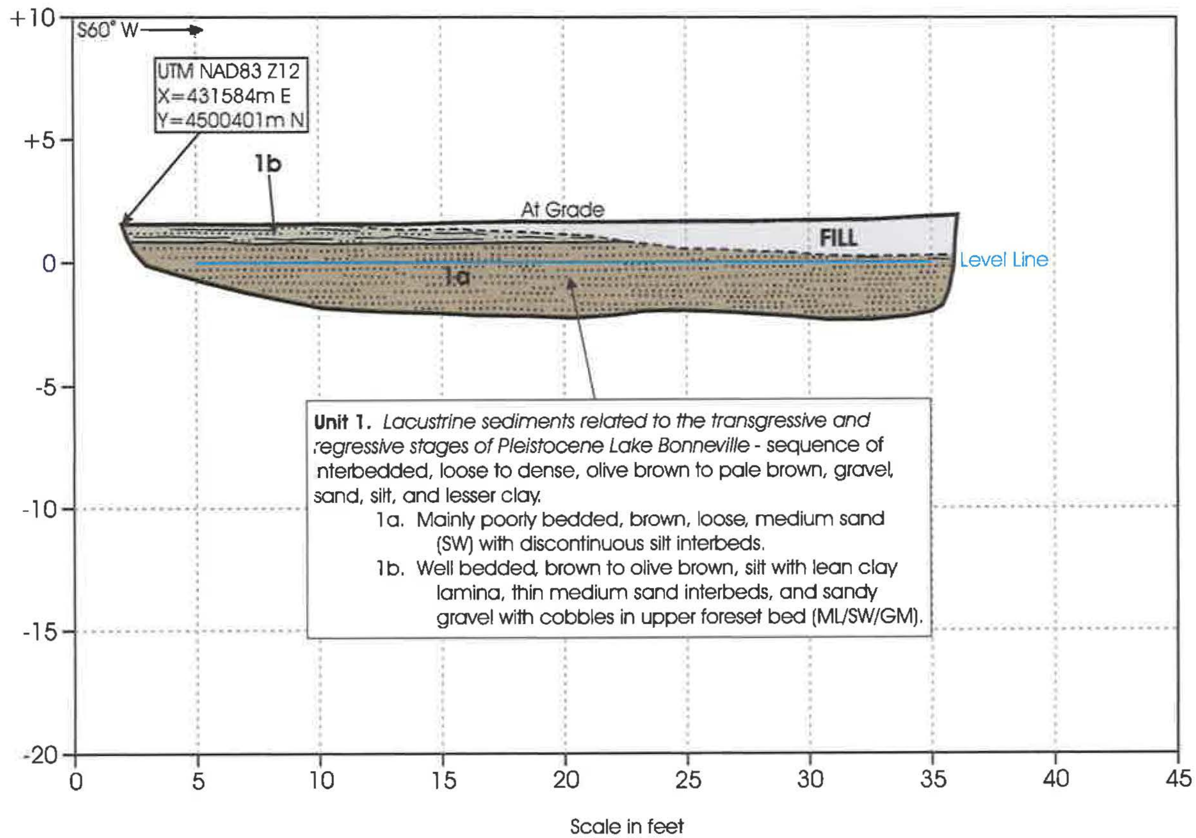
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Wall Logged, East to West

Excavation wall logged by Bill Black, P.G. on August 18, 2008

## SOUTHEAST EXCAVATION WALL LOG

**FAULT HAZARD EXCAVATION INSPECTION**
Moeller Residence Proposed Addition
2932 Edgerock Circle
Holladay, Utah

**FIGURE 4**




WESTERN GEOLOGIC

LICENSED PROFESSIONAL GEOLOGIST
BILL DUANE BLACK
NO. 5224898-2250
STATE OF UTAH

SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Wall Logged, East to West

Trench logged by Bill Black, P.G. on August 18, 2008

## SOUTHWEST TRENCH LOG

**FAULT HAZARD EXCAVATION INSPECTION**
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Holladay, Utah

**FIGURE 5**