SURFACE GEOLOGIC HAZARD STUDY

PROPOSED PAS DE CALAIS SUBDIVISION

S.W. ¼ OF SECTION 24, T. 5 N., R. 1 W.

WEBER COUNTY, UTAH

PREPARED FOR:

MATT RASMUSSEN AND JEAN ROBERT BABILIS
2975 MELANIE LANE
OGDEN, UTAH 84403

PROJECT NO. 02-17

JUNE 20, 2017

Matt Rasmussen and Jean Robert Babilis
Property Owners
2975 Melanie Lane
Ogden, Utah 84403

Gentlemen:

Re: Report
Surface Fault Rupture Hazard Study
Pas De Calais Subdivision
Between Melanie Lane and 2900 East
Ogden, Utah

1. INTRODUCTION

1.1 GENERAL

Presented in this report are the results of a surface fault rupture hazard study which includes other potential geologic hazards as well. The site is located within the location of what was once known as the Bybee Pond. The general location of the site with respect to major topographic features and general conditions, as of 1998, is shown on Figure 1, Vicinity Map. A more detailed layout of the site showing overall property boundaries and locations of the exploration trenches excavated in conjunction with this study are presented on Figure 3, Site Plan, including property boundaries and trench locations.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of this study were planned during telephone discussions between Mr. Matt Rasmussen and C. Charles Payton of Payton Geological Services, LLC.

The objectives of this study were to:

1. Determine if faults that represent a potential surface fault rupture hazard exist within the proposed subdivision.

2. If such faults are encountered, determine the extent of faulting and deformation.

3. Determine setbacks from any active fault for planned structures.

In accomplishing these objectives the scope included the following:

1. An initial review of geologic maps and a report prepared by GeoStrata of adjoining property.

2. A field program consisting of general reconnaissance and the logging of 3 exploratory trenches.

3. Preparation of this summary report.

2. SITE DESCRIPTION

This report presents the results of a surface geologic hazard study for the development of a subdivision within the area that was at one time the area of Bybee Pond. The subdivision is called the Pas De Calais Subdivision which consists of three lots with a total area of approximately 4 acres. The property is between Melanie Lane and 2900 East and about 6100 South in Ogden, Utah. The approximate elevation of the site is 5,060 feet above sea level.

Most of the subdivision is covered with grass and weeds. On the eastern side of the subdivision near the toe of the slope extending up to Melanie Lane are groups of scrub oak. A tributary of Spring Creek runs down the slope about 20 feet southeast of the subdivision. No surface water is present within the area of Bybee Pond.

This study was conducted to primarily determine if any active faults were present within the subdivision. The evaluation of the site for potential active faulting was performed by a review of geological literature and also of the 0.5 meter LiDAR elevation data provided in the GeoStrata report.

Bybee Pond was present within the site area from approximately 1913 until in the 1980's. Since 1956 the pond was operated by the Mountain Streams Irrigation Company. The dikes forming the pond area were constructed using horses and scrappers and lots of hand shovels. The soil used in the embankments was that present on the ground surface at that time. Water was diverted from Spring Creek along a stone lined ditch. The pond has always leaked and the water depth ranged from a few feet in the north end to up to 15 feet in the southern end. The pond was decommissioned in the 1980's.

This study was conducted primarily to identify active faults which may be present within the proposed subdivision. A review of geologic maps indicates that the Wasatch fault is present crossing the eastern portion of the proposed subdivision. Three exploratory trenches were excavated to identify the potential of active faults within the area and to determine soil conditions at depth. Logs of the trenches were prepared.

3. GEOLOGIC AND SEISMOTECTONIC SETTING

The subdivision site is located within the southeastern portion of Ogden, Utah at an approximated elevation of 5,060 feet above mean sea level and along the foothills of the Wasatch Range and just north of Weber Canyon (Figure 1). The site is also on the eastern margin of the Great Salt Lake Basin which represents a deep, sediment filled structural basin of Cenozoic age between the Wasatch Range on the east and the Lakeside Mountains to the west (Hintze, 1980). The Wasatch range is the eastern side of the Basin and Range Province which extends westward to the Sierra Mountains in California.

The surface soils are primarily sediments which were deposited by Lake Bonneville within the last 30,000 years (Yonkee and Lowe, 2004). The lacustrine sediments near the mountain front consist of mostly sand and rounded gravels and cobbles. Surface soils mapped by Yonkee and Lowe (2004) within the subdivision area are either colluvium (Qc) or lacustrine sand and gravel deposited during the transgressing of Lake Bonneville (Qlg4). A more complete description of these deposits is given on Figure 2a.

The site is located on a near horizontal bench on the foothills of the Wasatch Range and just north of Weber Canyon in the southeastern portion of Ogden, Utah. The Weber segment of the Wasatch Fault Zone is mapped trending northwest through the subdivision (Figure 2). The Wasatch Fault is considered to be made up of several segments, each segment acting relatively independently (Machette and Others, 1987). The Weber segment is one of the longest and most active segments within the Wasatch fault zone. The segment extends from north of Ogden to the north end of Salt Lake City, Utah. Nelson and others (2006) report four surface rupturing seismic events since the middle Holocene (about 5000 years ago) with the most recent event being about 500 years ago with a surface rupture of 1.6 feet. The Weber Segment of the Wasatch Fault may be capable of producing earthquakes with a magnitude as large as 7.5 (Ms). Vertical displacements of 3 to 15 feet have been considered possible during a major earthquake on the Weber segment of the Wasatch Fault (Hecker, 1993).

Consensus by the Utah Quaternary Fault Working Group is that the recurrence interval for large earthquakes within the Weber segment of the Wasatch Fault is approximately 1,400 years for the past four surface fault rupture events (Lund, 2005).

4. FIELD INVESTIGATION

At the time of the field investigation, there were no permanent structures or pavement on the property. There is a short dirt road extending southeast from the intersection of Melanie Lane and 2900 East. On June 5, 2017 three exploratory trenches where completed. The trenches had been excavated using a tracked backhoe. A total of 586 feet of trench excavation was completed with depths of the trenches ranging from 6 to 12 feet. No groundwater was encountered in any of the trenches. In Trench 3 (T-3) surface water from the diversion of Spring Creek did enter the trench for a short period of time. On June 7, 2017 logging of the trenches began. A level line and stationing were established on the southeastern wall of each trench. The approximate location of each trench is shown on the current study site plan which is shown on Figure 3. The approximate locations shown are based on distance and direction from the property boundaries surveyed by Landmark Surveying Inc.

The soils expected to be encountered in the trenches generally consist of colluvium overlying Lake Bonneville deposits of silt, sand and gravel with some cobbles and boulders. The geologic units exposed in the trenches were logged to determine if there was evidence of active faults extending through the three trench excavated within the Bybee Pond area. Based upon the geologic map shown on Figure 2 the active Wasatch Fault extends through the eastern portion of the planned subdivision.

4.1 Trench 1 (T-1)

Trench 1 was excavated across the northern third of Lot 3 as shown on Figure 3. Debris flow and lacustrine deposits are exposed in the trench and are partly covered by some disturbed surface soil most likely disturbed during the construction of Bybee Pond. The soil units that are debris flow deposits are designated SU-1 and SU-2. They consist of light brown to light silver gray, fine sand, silt and rounded very hard gravel and cobbles. The soils are massive, dense, and dry. The gravel and cobbles make up between 10 % and 20% of the deposit. The remainder is fine sand with some silt, which is friable and non-plastic. SU-3 and SU-4 soil units are lacustrine sand and silt, which is interpreted as transgressive

Lake Bonneville sediments deposited in relatively shallow water on beaches. These sediments occasionally show slight layering as alternating sand and poorly sorted sand and clay deposits. The bedding ranges from near horizontal to a very shallow dip to the east. Soil Unit 3 has abundant roots which decrease westward to about Station 1+ 20.

In the disturbed soil area at Station 0+94 at a depth of approximately 2 feet is a white golf ball. The log of this trench is shown on three figures (Figures 4, 4a, and 4b) due to the length of the trench.

4.2 Trench 2 (T-2)

Trench 2 was excavated about 7 feet southeast of a property corner at the north side of Lot 2 as shown on Figure 3. The log of this trench is shown on Figure 5. Four soil units were identified in this trench which are interpreted to be transgressive Lake Bonneville sediments. The lacustrine soil units range from light orange brown fine sand which is massive to a dark gray moist massive sand and silt with some rounded hard gravel which is locally bedded in the eastern portion of the trench. These two soil units overlay SU-3, which is light yellowish orange, dense clay, fine sand and some small rounded gravel. This unit is massive and at Station 0+54 there is a near vertical filled fracture extending through SU-3 as exposed in the trench wall. The fracture is filled with dark gray clay, and fine sand and does not extend to the overlying SU-2 soil unit. At Station 1+24 there is a contact with another lacustrine soil unit which is designated SU-4. This unit is composed of light gray to orange brown thin beds of clay, fine sand and silt which are dense and are 1inch to 2 inches thick. They have an apparent dip of 5 degrees to 25 degrees to the northeast. At Station 1+41 is a fracture which also shows that there may have been some movement along the fracture surface. The fracture has a north-south strike and a dip of 70 to 75 degrees to the east. At the base of SU-4 is a contact with a medium gray to silver gray loose sand and fine rounded gravel. This sand and gravel is loose, dry and has no to very few fines associated with it. This soil unit is designated SU-5. Along the fracture surface the contract between SU-4 and SU-5 has an apparent offset of approximately 6 inches. This suggests that there has been a small movement in the past along this fracture. Also the dip of the beds within SU-4 suggest that this soil unit has moved in the past as a large block during an earthquake. Lacustrine beds are usually nearly flat or have a gently dip to the west when they are deposited during the transgression of Lake Bonneville.

4.3 Trench 3A (T-2A)

Some difficulty with the excavator resulted in the excavation of a short trench northeast of T-2. This short trench has been designated Trench 2A (T-2A). The southeast wall of the trench was logged as has been done in all the trenches within this proposed subdivision. Two soil units were logged both of them being debris flows. SU-1 is a light brown massive mixture of sand and gravel with some very hard rounded cobbles. It is dry and excavates easily. SU-2 appears to be younger and to be deposited on top and to the west of SU-1. SU-2 is also a debris flow which is dark gray, massive and a mixture of fine sand, gravel and cobbles. It is generally dry but becomes slightly damp at depth. The gravel is all rounded and very hard. No top soil was present at the top of the trench. No groundwater was encountered during the excavation of this trench. The log of this trench is shown on Figure 6.

4.4 Trench 3 (T-3)

Trench 3 was excavated near the southeast corner of Lot 2 as shown on Figure 3. Trench 3 was approximately 100 feet long and the east end of it was in a debris flow soil unit SU-1 on the log which is shown on Figure 7. The debris flow was dark brown to nearly black and a mixture of silt, fine sand, gravel and cobbles. The gravel and cobbles were very hard and round. The soil unit was massive and dry. Above the debris flow deposit was a lacustrine deposit of brown fine sand and silt which was massive and damp to moist. The fine sand was friable and non-plastic. No groundwater was encountered however, surface water from the diversion of Spring Creek was seeping into the trench at about Station 0+42. This flow of water was accumulated in the bottom of the trench at about Station 0+65. After two days this seepage water stopped flowing and logging of the trench was possible. No evidence of faulting as identified in this area.

The exploratory trenches were backfilled using a large tracked backhoe with the excavated material being used as backfill and compacted with the backhoe bucket.

Groundwater was not encountered in the exploration trenches to the depth excavated.

5. CONCLUSIONS AND RECOMMENDATIONS

Based on field observations, a review of available geologic literature and the subsurface conditions encountered in the exploratory trenches, there is little evidence of active faulting in the area of this subsurface investigation. However, a geologic hazard assessment was made in October 2016 of the building lot located at 6116 South 2900 East which is just west of this proposed subdivision. The location of this lot is shown on Figure 3. The geologic hazard study for this lot was accomplished by GeoStrata. A single trench was excavated on the lot and three faults were encountered. Two faults, F2 and F3, dip eastward and fault F1 dips westward. GeoStrata concluded that Fault 1 and Fault 2 are inactive minor faults or minor lateral spread related offsets. Fault 3 is considered an active antithetic fault within the Weber Segment of the Wasatch Fault Zone.

The large fracture or fault observed in Trench 2 with a possible maximum displacement of 6 inches is concluded to be an inactive minor fault or a minor lateral spread feature which resulted in the tilting of the thin clay beds to the east during a large soil block movement related to a pre-Holocene earthquake more than 10,000 years ago.

Active surface traces of the main Wasatch fault could not be seen during this geologic hazard study. The Yonkee & Lowe geologic map of the Ogden Quadrangle does show the Wasatch fault passing through Bybee Pond. It is concluded, based upon the current study, that the Wasatch fault is east of the site.

Other geologic hazards considered during this study included landslide, slope stability, alluvial fan flooding / debris flow, stream flooding, and rock fall. The landslide hazard within the subject site is considered low. Slope stability was not assessed as part of this geological hazard assessment. Alluvial

fan flooding or a debris flood consisting of organic material and rock debris transported by fast-moving flood water would be possible along the diversion channel of Spring Creek which had been used to divert water into Bybee Pond. Debris flow or alluvial fan flooding hazards are considered to be low. Stream flooding from the Spring Creek channel is also considered to be low. While there are rock source areas up the mountain slopes east of the site there is no evidence of rock falls on the site. Therefore, rock fall hazards are considered to be low.

6. LIMITATIONS

The analysis and report findings are based on published geologic maps and report, a reconnaissance of the site, and the excavations at the approximate locations shown on Figure 3. The conclusions are based on currently accepted geologic interpretation of this information. Geologic logs of the exploratory excavations presented in this report depict geologic conditions only along the specific corridors and to the depth excavated. They do not necessarily reflect geologic conditions at other locations or at greater depth. It is recommended that because during construction that geologic conditions may change at depth that a geologic review be made of the excavation to be certain that geologic features are not detrimental to home construction. No attempt has been made to predict earthquake ground motions or determine potential magnitude for earthquakes associated with faults in the project area.

I appreciate the opportunity to be of service on this project. Should you have any questions regarding the report or wish to discuss additional services, please do not hesitate to contact me at your convenience at (801) 631-1613.

Respectfully submitted,

C. Charles

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10-21-2017
STATE OF UTAH

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Enclosures:

Figure 1,	Project Site
Figure 2,	Geologic Map of Subdivision Area
Figure 2a,	Description of Map Units in Area of Site
Figure 3,	Property Boundaries and Trench Locations
Figure 4,	Log of Trench 1
Figure 4a,	Log of Trench 1
Figure 4b,	Log of Trench 1
Figure 5	Log of Trench 2
Figure 6	Log of Trench 2
Figure 7	Log of Trench 3

REFERENCES CITED

Hecker, S., 1993; Quaternary Tectonics of Utah with Emphasis on Earthquake-Hazard Characterization, Utah Geological Survey, Bulletin 127.

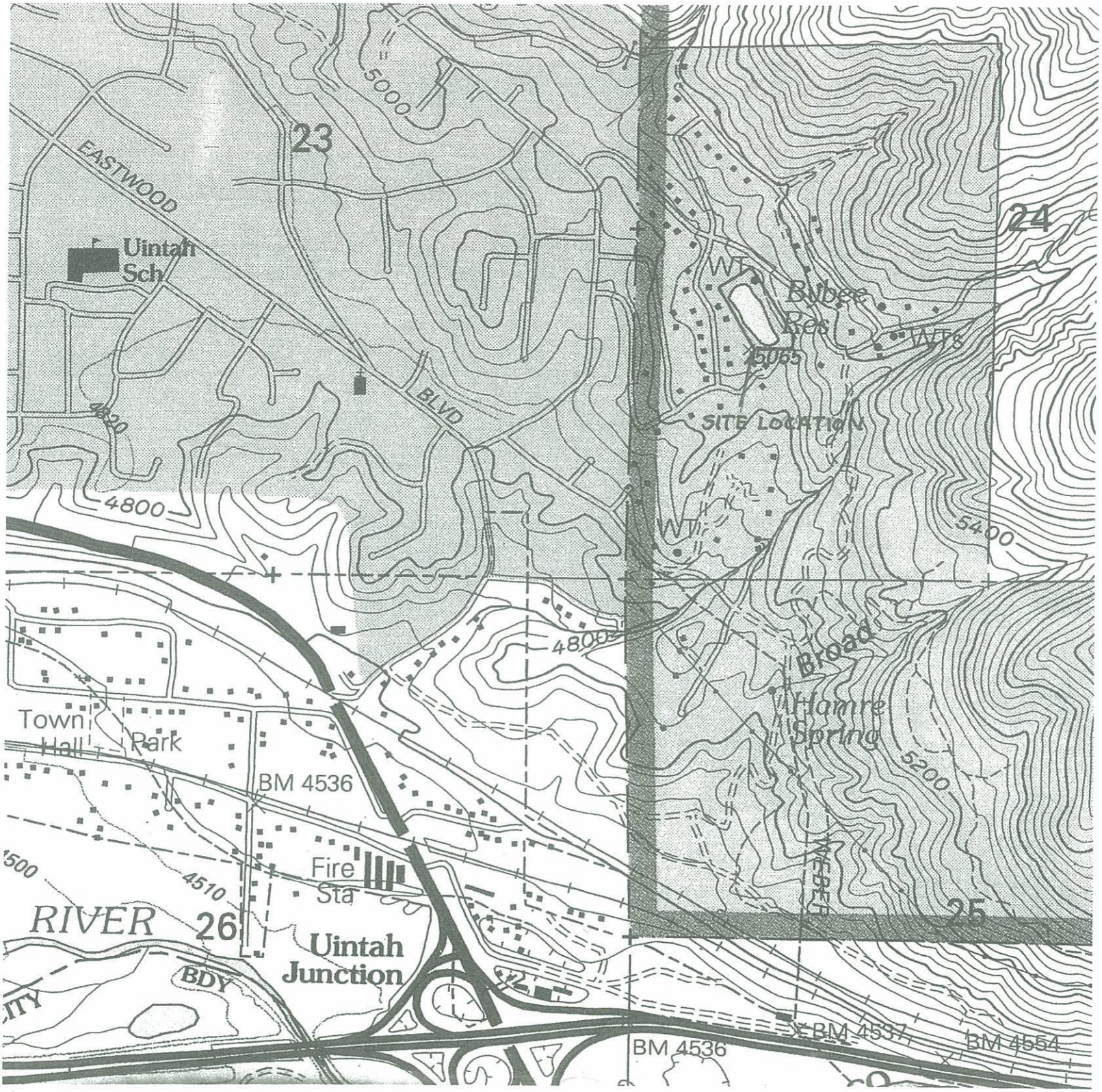
Hintze, L.F. , 1980; Geologic Map of Utah: Utah Geological and Mineral Survey Map-A-1, scale 1:500,000.

Lund, W.R., 2005; Consensus preferred recurrence-interval and vertical slip-rate estimates: review of Utah paleoseismic-trenching data by the Utah Quaternary Fault Parameters Working Group: Utah Geological Survey Bulletin 134.

Macheette, M.N. and Personius, S.F. and Nelson, A.R., 1987; Quaternary geology along the Wasatch Fault zone; segmentation, recent investigations and preliminary conclusions; U.S. Geological Survey open file report 87-585 p. B-1 – B 124.

Nelson, A.R, Lowe, M., Personius, S., Bradley, L, Forman, S.L., Izlask, R., and Garr, J., 2006; Holocene earthquake history of the northern Weber segment of the Wasatch fault zone, Utah, Paleoseismology of Utah, Volume 13: Utah Geological Survey Miscellaneous Publication 05-8, 39p.

Yonkee, A., Lowe, M., 2004; Geologic Map of the Ogden 7.5' Quadrangle, Weber and Davis Counties, Utah: Utah Geological Survey Map 200.



Modified from USGS
Ogden Quadrangle 1998
contour Interval 40 feet

1000 0 1000 2000 3000 4000

Scale 1" = 1000'

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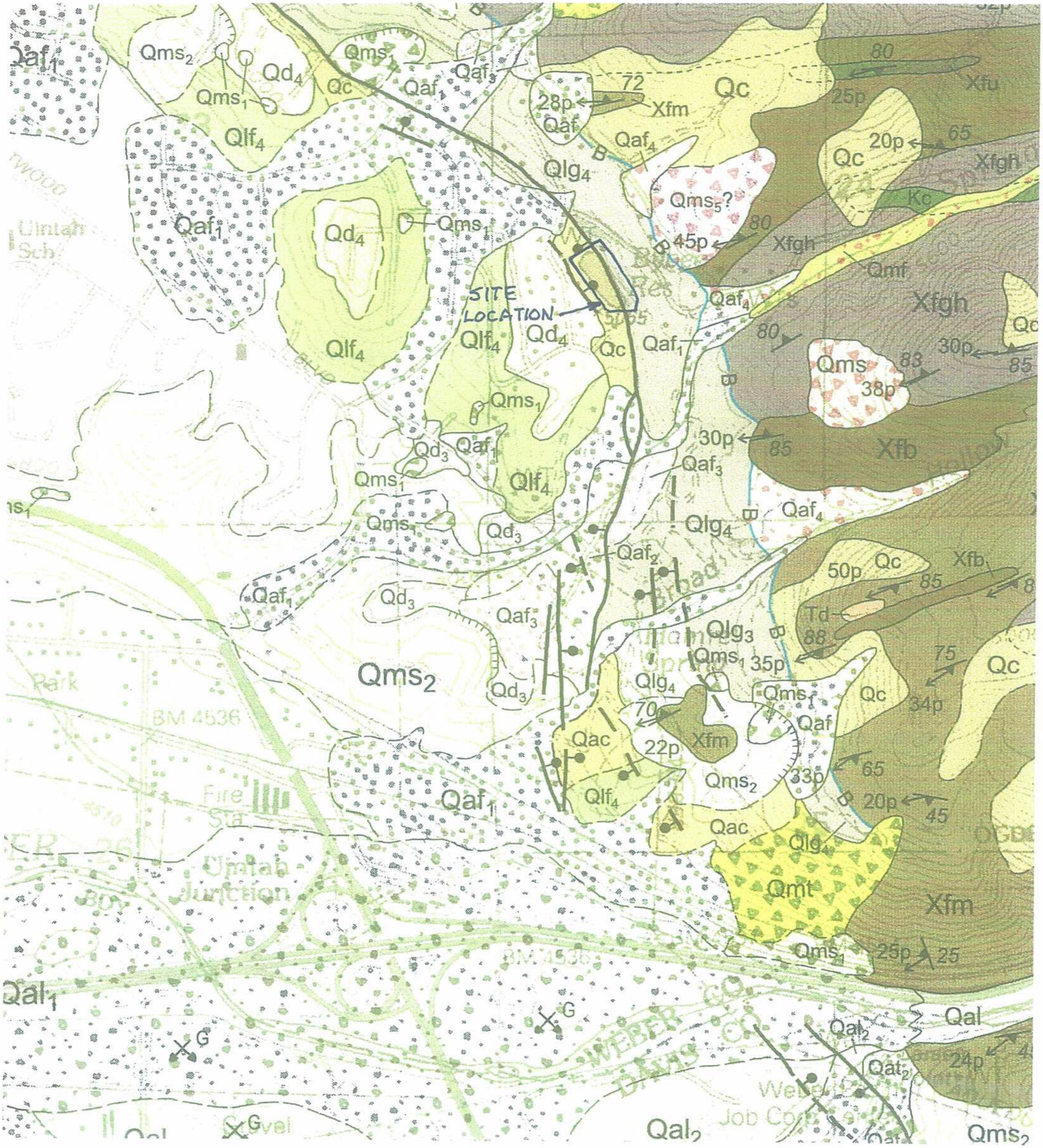
PROPOSED PAS DE CALAIS SUBDIVISION
SW ¼ OF SECTION 24, T.5N. R.1W.
WEBER COUNTY, UTAH

PROJECT SITE

FIGURE 1



Qaf_1
Qms_2
Qms_1
Qd_4
Qc
Qaf_1
Qaf_3
72
28p
Xfm
Qaf
Qc
80
Xfu
25p
Qlf_4
Qaf_4
Qlg_4
20p
65
Xfgh
Qms_5?
Kc
Uintah Sch.
Qaf_1
Qd_4
Qms_1
45p
80
Xfgh
Qmf
SITE LOCATION
Xfgh
Qaf_4
Qlf_4
Qlf_4
Qd_4
Qc
Qaf_1
80
Qms
83
30p
85
38p
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Qd_3
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30p
85
Xfb
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Qlf_4
Qaf_3
Qms_1
Qd_3
Qlg_4
Qaf_4
Qaf_2
Qaf_1
Qd_3
Qaf_3
50p
Qc
Xfb
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Td
Qlg_3
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Qms_1
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Qlg_4
Qms_1
Qc
34p
70
Qaf
BM 4536
Qac
22p
Xfm
65
Qms_2
33p
20p
45
Fire Sta
Qaf_1
Qlf_4
Qac
Qlg_4
Uintah Junction
Qmt
Xfm
Qms_1
25p
25
BM 4536
Qal_1
G
G
Qal
Qal_2
WEBER CO
DAVIS CO
Qat_2
24p
G
Qal_2
Qms_2

Modified from Yonkee & Lowe (2004)

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GEOLOGIC MAP OF SUBDIVISION AREA

FIGURE 2

DESCRIPTION OF MAP UNITS IN AREA OF SITE

Qc Colluvium- Weakly to non-layered, variably sorted, matrix- to clast-supported, pebble to boulder gravel and diamicton of local origin; contains angular to subangular clasts in variable amounts of clay, silt, and sand matrix; deposits formed mostly by creep and slope wash, also includes small landslides, talus, debris cones, minor alluvium, and small bedrock exposures; found mostly along vegetated slopes in the Wasatch Range, and locally covering scarps along the Wasatch fault zone; thickness probably less than 50 feet in most areas.

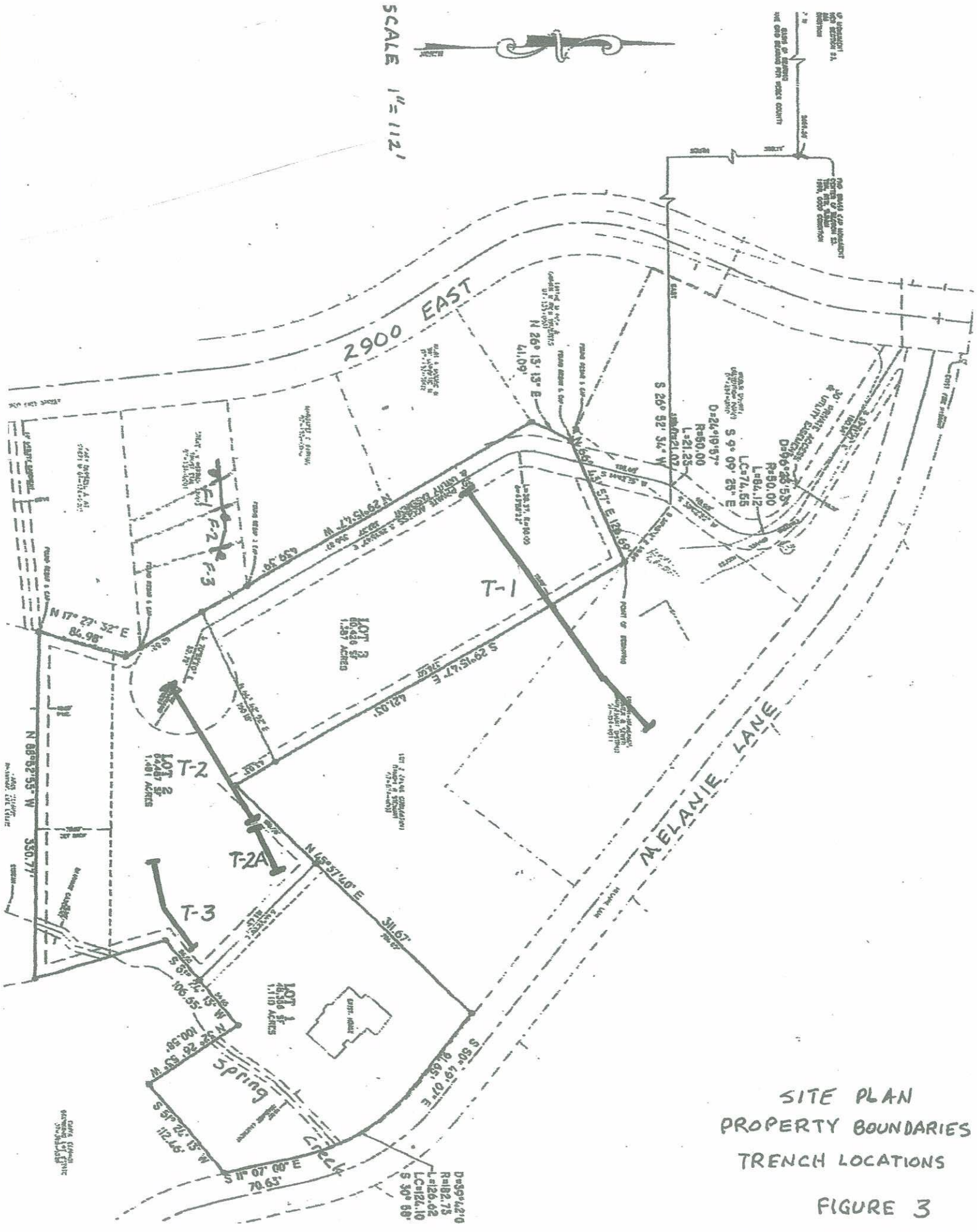
Qlg4 Lacustrine gravel-bearing deposits, Bonneville transgressive – Clast-supported, moderately to well-sorted, pebble to cobble gravel, with some silt to sand in interfluve areas and away from mountain front; gravels contain rounded to subrounded clasts, and some subangular clasts derived from reworking of mass-wasting and alluvial-fan deposits; deposited in higher energy environments along shorelines and small fan deltas as Lake Bonneville was transgressing; grades westward away form shorelines into fine-grained lacustrine deposits (Qlf4); total thickness locally as much as 200 feet

MAP SYMBOLS

Normal Fault – Dashed where location approximate; dotted where concealed; solid bar and ball on downthrown side.

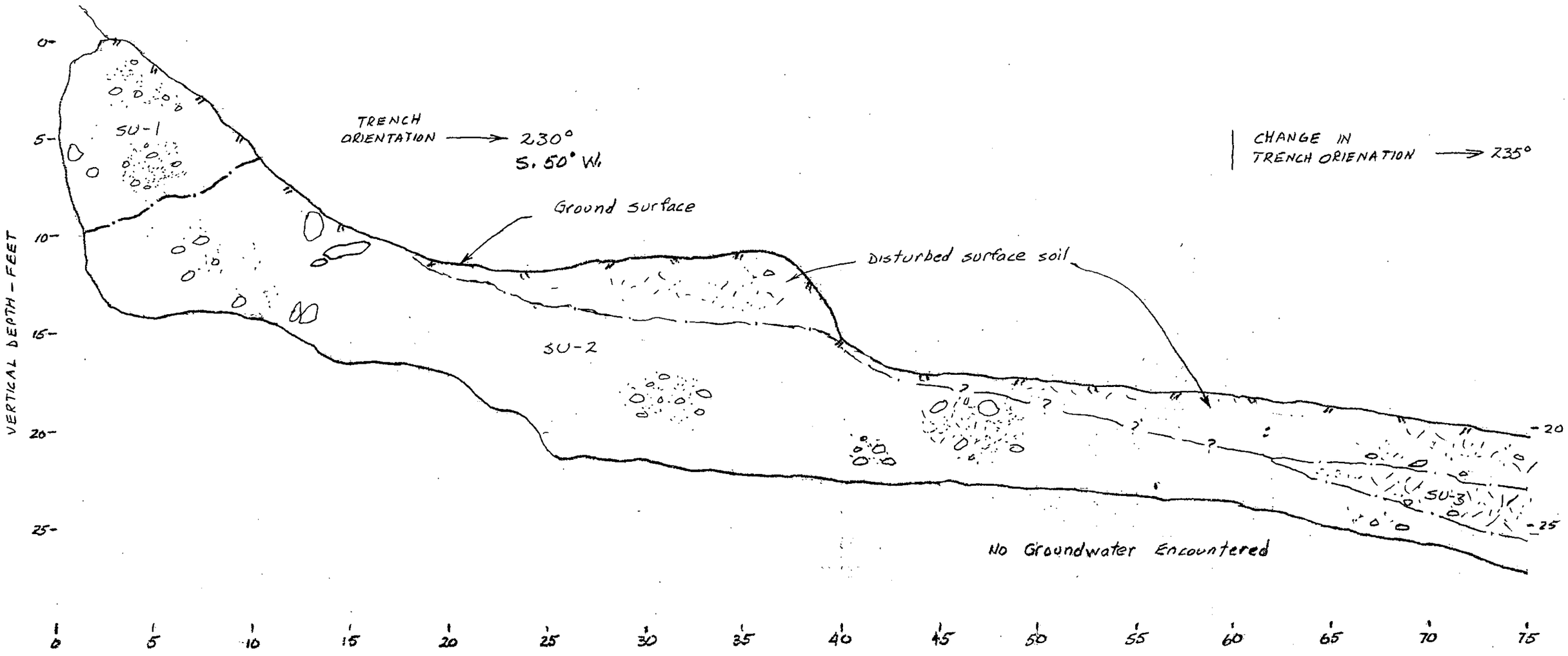
B Bonneville shoreline of Lake Bonneville

FIGURE 2a



SITE PLAN
PROPERTY BOUNDARIES
TRENCH LOCATIONS

FIGURE 3



SOIL UNITS

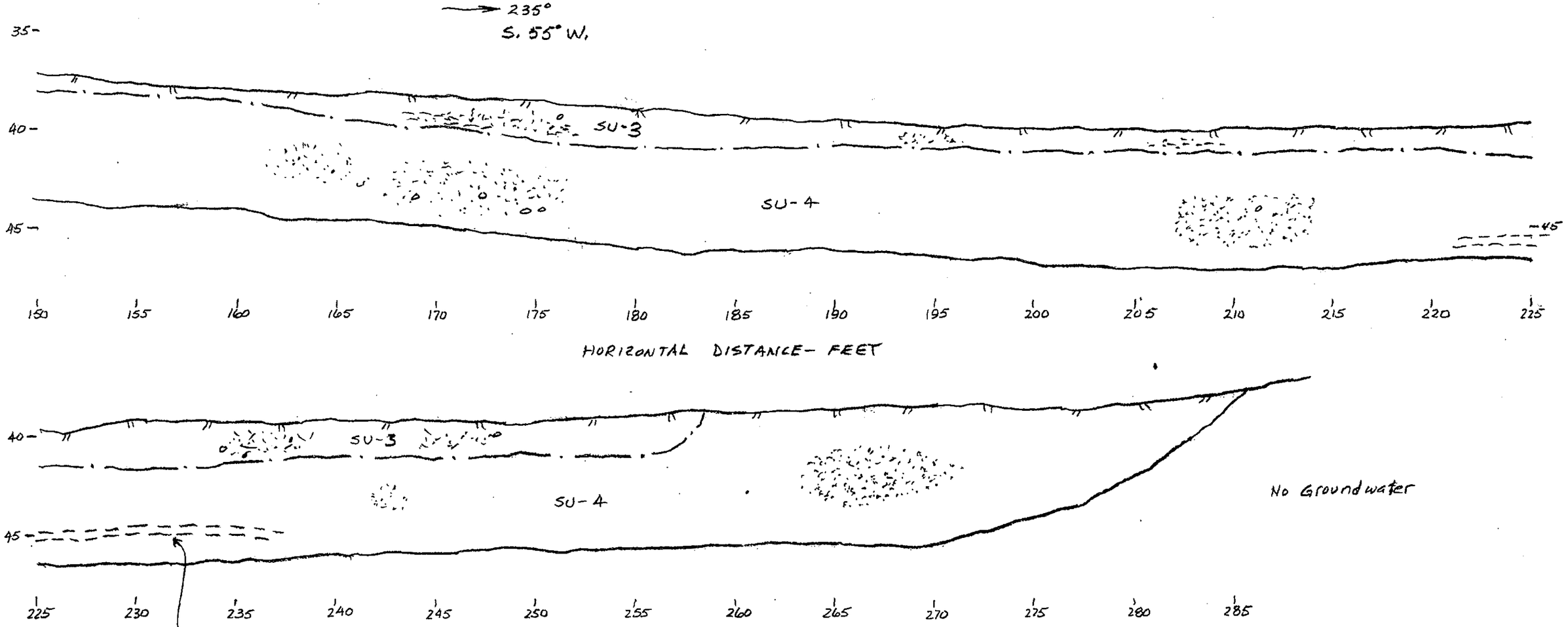
SU-1 Light brown to light silver gray, fine sand, silt and rounded very hard gravel and cobbles. GM, damp, non plastic, Debris Flow

SU-2 Light gray, sand and gravel, rounded very hard gravel, dense, dry. GM, Debris Flow

SU-3 Dark gray, fine sand and silt, with some rounded very hard gravels, abundand roots, Lacustrine Deposits massive

EXPLORATION TRENCH NO. 1
SOUTHEAST WALL LOG

FIGURE 4

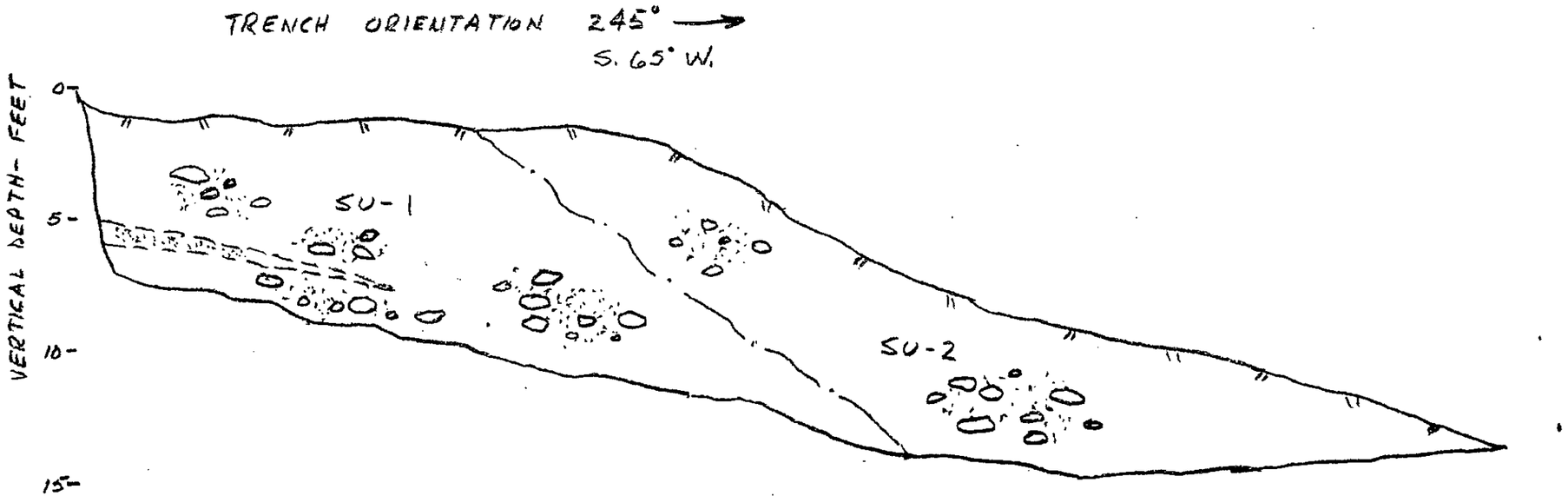


SU-3 Dark gray, fine sand and silt, some hard rounded gravel, massive - some local thin bedded areas, friable - slightly plastic with added water; scattered small roots.

SU-4 Light orange brown, massive fine sand and silt, dry to damp, non plastic, SM sharp contact with SU-3 in this area. Lacustrine Deposit.

EXPLORATION TRENCH No. 1
SOUTHEAST WALL LOG

FIGURE 4b

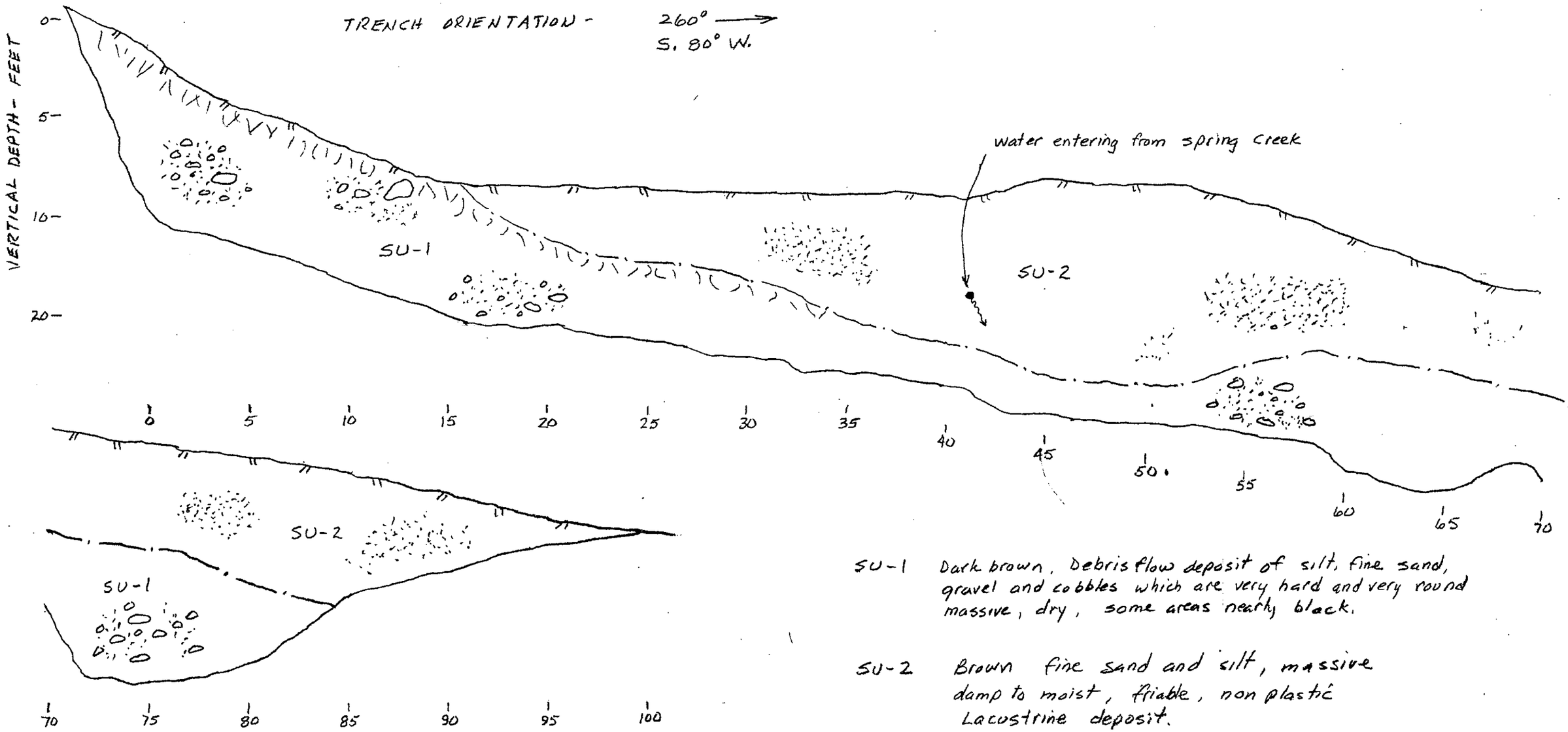


SU-1 Debris Flow, sand, gravel and cobbles dry. excavates easily, light brown, massive Gravel and cobbles rounded, very hard.

SU-2 Dark gray, Debris Flow, massive, sand, gravel and cobbles, dry to damp at depth. gravel rounded, very hard.

EXPLORATION TRENCH T-2A
SOUTH EAST WALL LOG

FIGURE 6



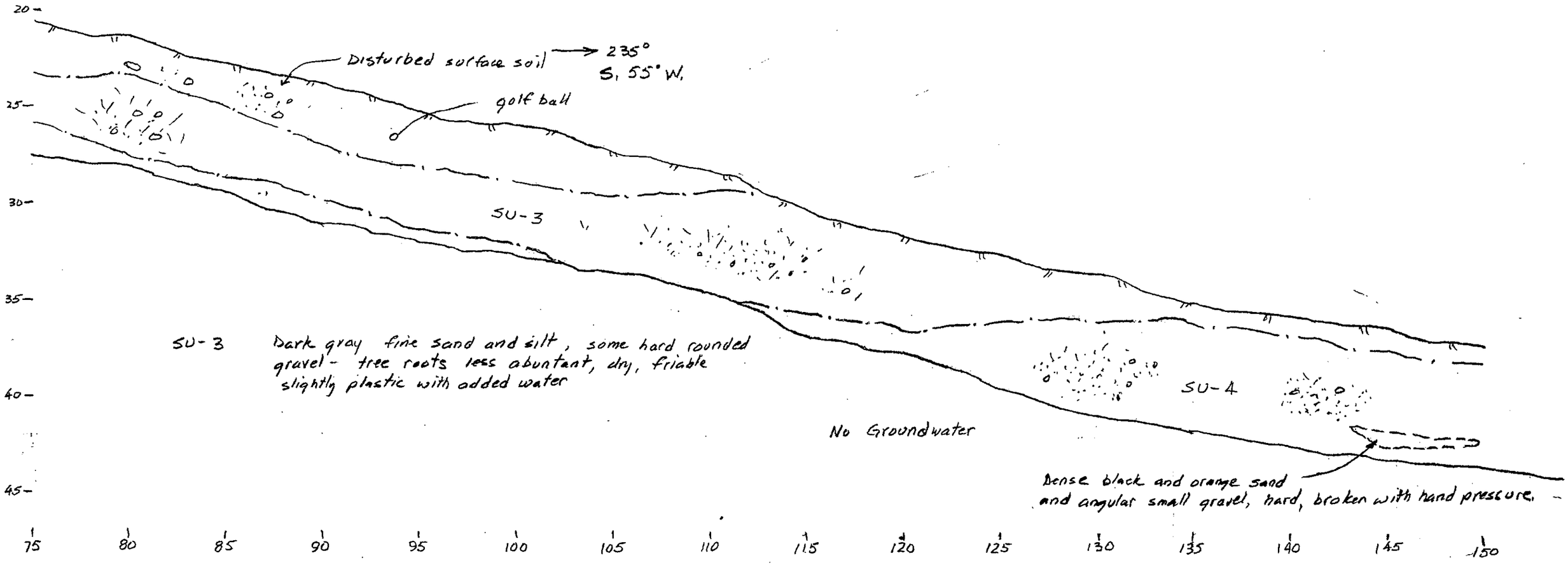
SU-1 Dark brown, Debris flow deposit of silt, fine sand, gravel and cobbles which are very hard and very round massive, dry, some areas nearly black.

SU-2 Brown fine sand and silt, massive damp to moist, friable, non plastic Lacustrine deposit.

No Groundwater Encountered

EXPLORATION TRENCH T-3
SOUTH EAST WALL LOG

FIGURE 7

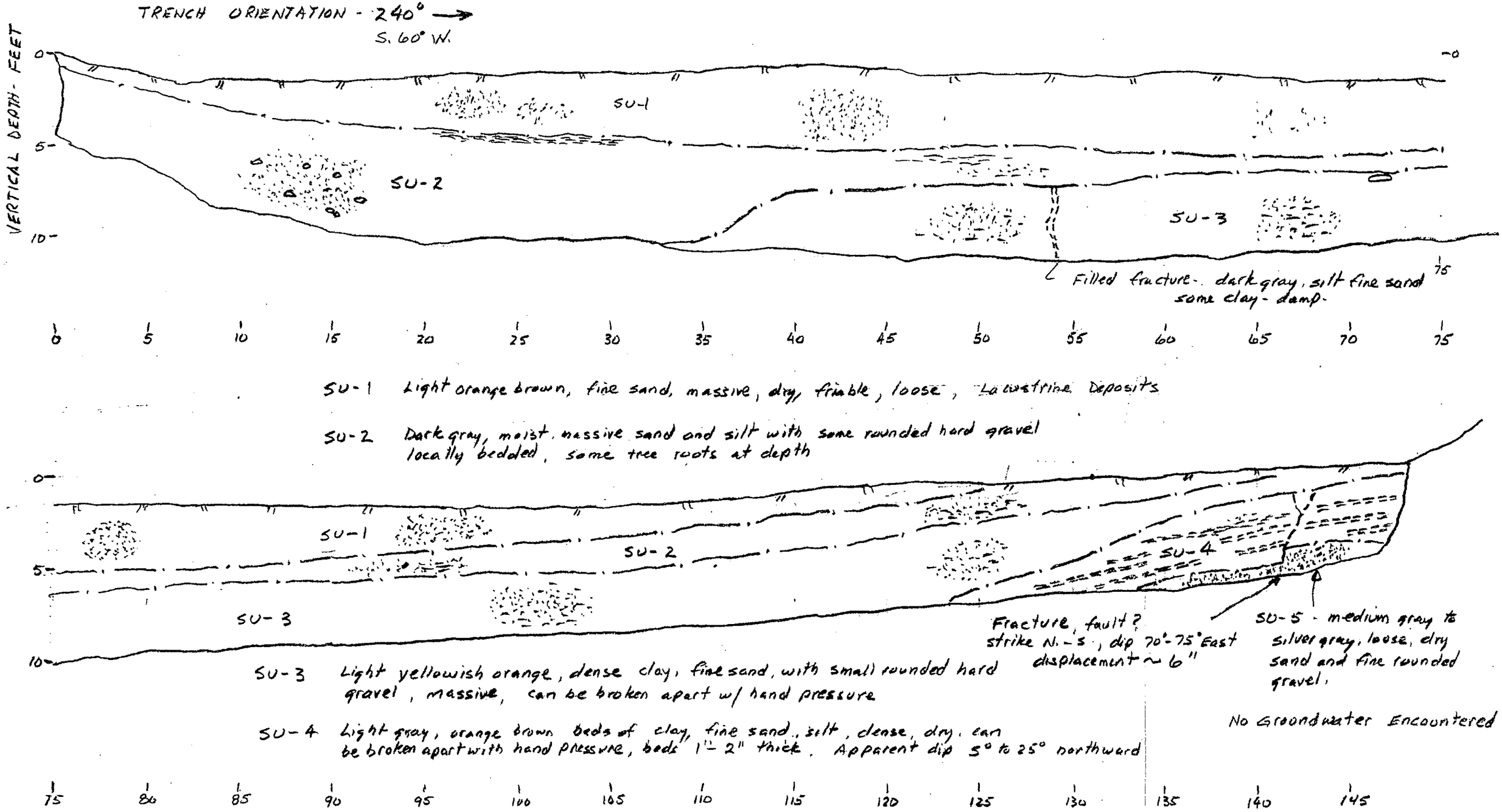


SU-3 Dark gray fine sand and silt, some hard rounded gravel - tree roots less abuntant, dry, friable slightly plastic with added water

SU-4 Light brown, massive fine sand and silt with scattered rounded very hard gravel; dry to damp, non plastic gradational contact with SU-3.

EXPLORATION TRENCH NO.1
SOUTH EAST WALL LOG

FIGURE 4a



SU-1 Light orange brown, fine sand, massive, dry, friable, loose, Lacustrine Deposits

SU-2 Dark gray, moist, massive sand and silt with some rounded hard gravel locally bedded, some tree roots at depth

SU-3 Light yellowish orange, dense clay, fine sand, with small rounded hard gravel, massive, can be broken apart w/ hand pressure

SU-4 Light gray, orange brown beds of clay, fine sand, silt, dense, dry, can be broken apart with hand pressure, beds 1" - 2" thick. Apparent dip 5° to 25° northward

No Groundwater Encountered

EXPLORATION TRENCH No. 2
SOUTH EAST WALL LOG

FIGURE 5