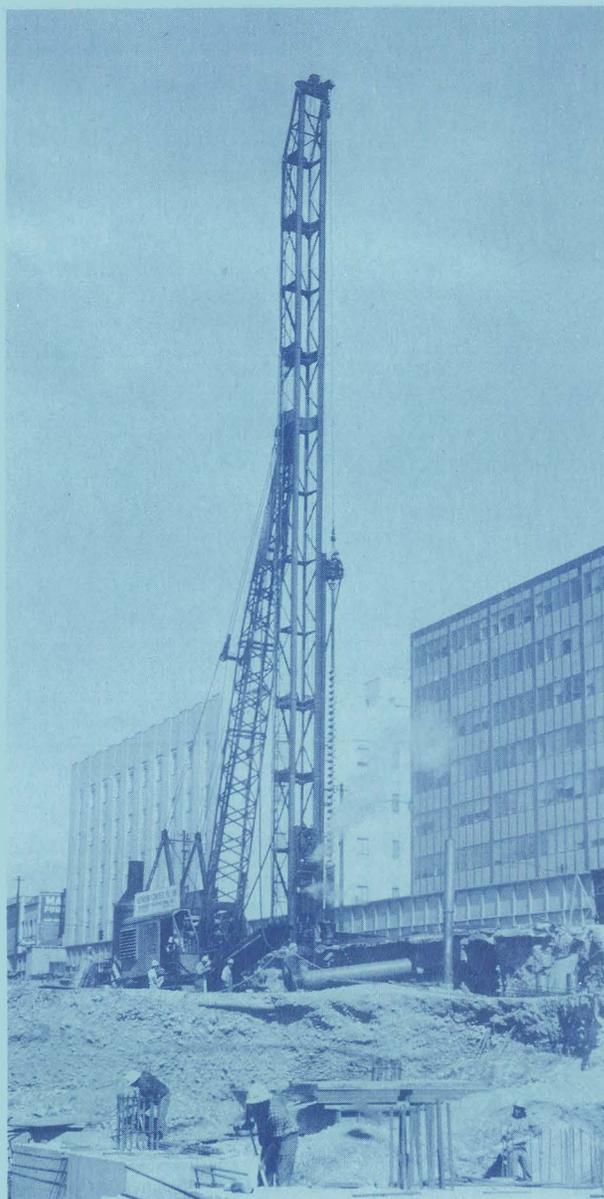


FOUNDATION CHARACTERISTICS
OF SEDIMENTS,
SALT LAKE METROPOLITAN AREA



Utah Geological and Mineralogical Survey

Special Studies 10

UTAH GEOLOGICAL AND MINERALOGICAL SURVEY

103 Civil Engineering Building
University of Utah
Salt Lake City, Utah 84112

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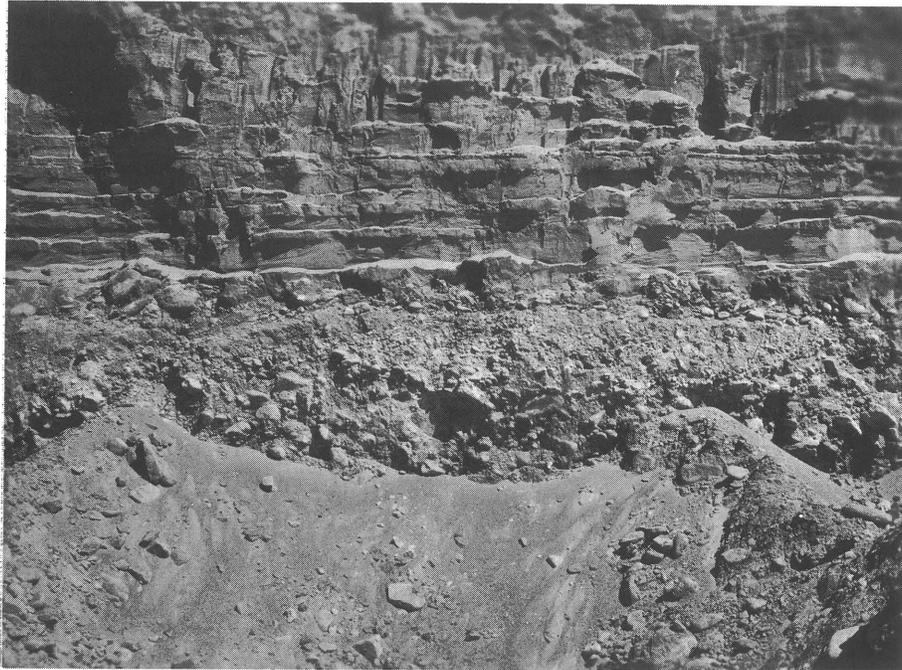
DIRECTORS:

William P. Hewitt, 1961-

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FOUNDATION CHARACTERISTICS OF SEDIMENTS SALT LAKE METROPOLITAN AREA

*by Richard D. Bauman
Graduate Student, University of Utah*



North wall of foundation, University of Utah Law Building. Note interstratified sorted sand and silty clays overlying unsorted boulders, silts, "muds", and gravels.



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FOREWORD

In Utah, and especially in the communities along the Wasatch Front, there are three categories of ownership of larger buildings: (1) Private; (2) Public-State, County, and City; and (3) Church Construction. A canvass by mail was conducted of these sources, and 106 owners controlling 155 buildings in Salt Lake City were contacted. Fifty-one owners controlling 77 buildings responded. Ultimately data were collected on 83 buildings in the study area, of which the foundations of 52 had been tested by bore holes (62%). Therefore it is a privilege to acknowledge the cooperation of the following firms and individuals who willingly supplied data for the preparation of this manuscript.

ARCHITECTS

Edwards & Daniels Architects, 1407 South 22 East
M. E. Harris Jr., Architrave Corporation, 315 East Second South
Cannon & Mullen, Beneficial Life Building
Snedicker & Budd Architects, 12 Post Office Place
Scott & Louie, Architects & Engineers, Dooly Building
G. C. Young, Utah Saving and Trust Building

STRUCTURAL ENGINEERS

J. F. Patrick, 338 East First South
Folsom & Hunt, 1593 South 12th East

SOILS ENGINEERS

Caldwell, Richards, & Sorenson, % M. Montgomery, 118 First Avenue
Dames & Moore, W. L. Curtiss, 823 East Fourth South

OWNERS

Howard Barker, Church Building Committee, L.D.S. Church
I. C. Glaser, 231 East Fourth South
J. Wallace, Wallace McConaughy Corporation, Walker Bank Building
Safeway Stores Inc., Construction & Design Department, Salt Lake City, Ut.
California Oil Company, P.O. Box 117, Salt Lake City, Utah
Dr. R. E. Marsell, % Utah Water & Power Board, State Capital Building

In addition twenty-five owners controlling 31 buildings responded, but stated no foundation investigation had been conducted; and unfortunately it was not possible to obtain foundation reports on a group of buildings for which the following cooperative owners had authorized their release and use:

Owners Authorizing Use of Report	Building
R. P. Makoff	Fashion Center 2nd East & South Temple
H. W. Wilkinson	Executive Building 455 East 4th South
Zions Securities Corp.	8-story Business Bldgs. 57 W. South Temple
	Temple Square Parking Terrace
	Z. C. M. I. Warehouse
State Building Board	Bookstore and Memorial Theatre Bldg. at U. of U.

The Utah Survey likewise acknowledges its indebtedness to the Utah Chapter of the American Society of Civil Engineers, particularly to its President, Mr. George B. Gudgell and to its Review Committee: Mr. E.G. Johnson (chairman), George Lawrence, Warren Curtis, Ed Nordquist, Ralph Rollins, and Mel Montgomery, who carefully and critically reviewed the manuscript.

It is our hope that the geologic data thus presented will prove its usefulness.

William Paxton Hewitt
Director

ABSTRACT

The sediments underlying Salt Lake City exist as the result of repetitive cycles of deposition and erosion which have occurred over many thousands of years. Because they have been shaped by a wide variety of geologic processes, their corresponding foundation characteristics are extremely variable.

As a result of the complexity of the foundation conditions, problems have occurred during and after construction in many locations in the city. This paper is presented to emphasize subsoil problems which may be expected in both the valley and the surrounding bench areas.

Included is a compilation of borehole data and general engineering characteristics of the sediments underlying Salt Lake City. These data were obtained from well log information and foundation investigations conducted on sites located within the area. Isometric cross sections of subsoils beneath specific areas of the city are presented.

An analysis of the data indicates the settlement and bearing characteristics of the sediments are so variable that a foundation investigation is required prior to the construction of any permanent structure, no matter how closely it may be located to a previously tested site; and that neither standard rules nor performance formulas may be applied to either specific sediments or to certain locations within the city.

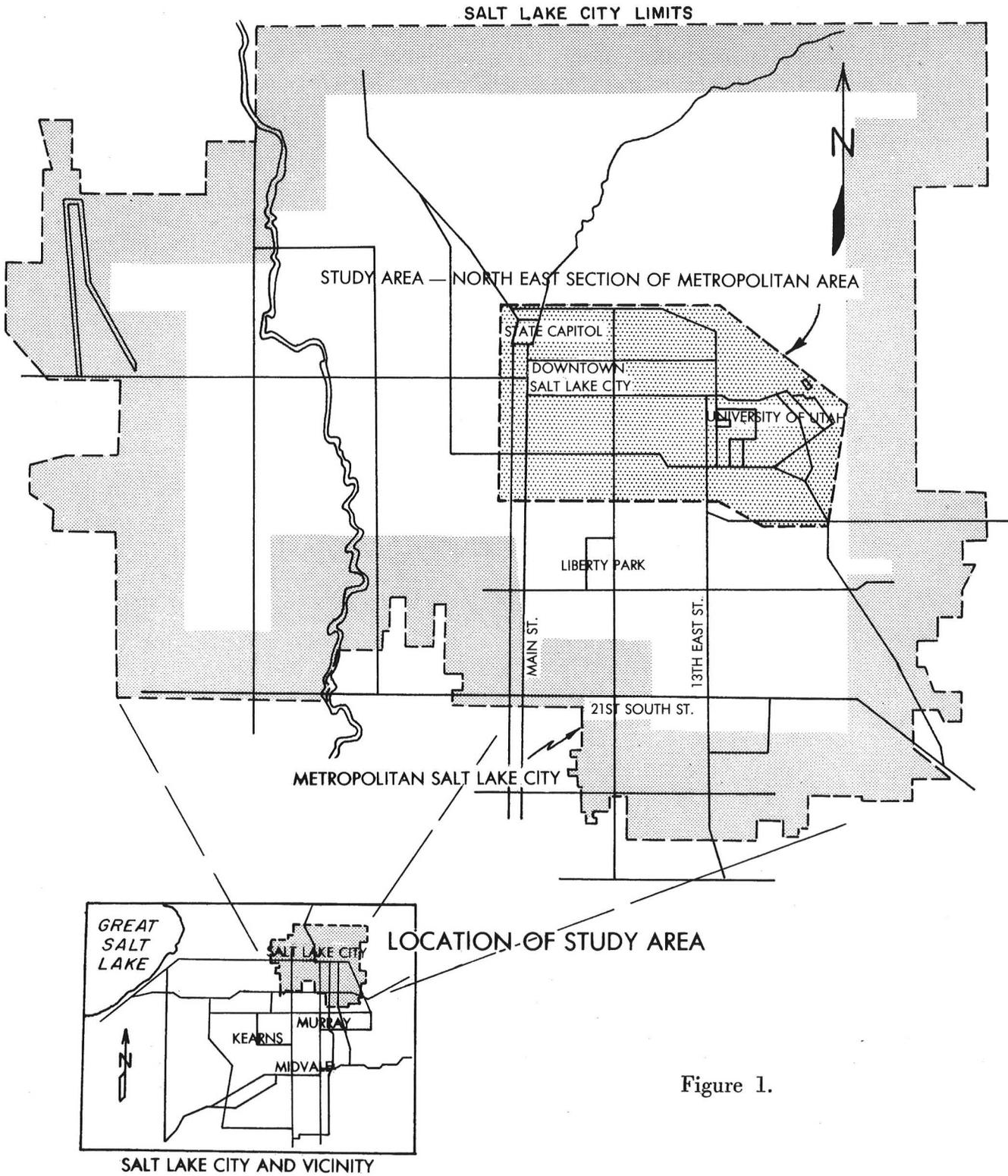


Figure 1.

FOUNDATION CHARACTERISTICS OF SEDIMENTS, SALT LAKE METROPOLITAN AREA

by Richard D. Bauman¹

INTRODUCTION

Structural failure due to foundation conditions is an ever-present problem for buildings in the Salt Lake Valley. Normally, foundation investigations are conducted prior to the construction of most large buildings, but in some instances the lack of an understanding of the complexity of Salt Lake's subsoil formations has resulted in undesirable situations. Thus under a new wing of the Medical Center Building, excessive settlement due to unrecognized rapid facies changes caused extensive revision of the original foundation design. Under the Merrill Engineering Building and the Student Union Building on the University of Utah campus, differential settlement has caused unsightly cracks to form. Furthermore, cracks in walls, floors, and ceilings of public and private buildings throughout the area provide visual evidence that the problem is widespread. In addition to the problem of differential settlement, which occurs after construction, many builders in the downtown area have been plagued by excessive water entering the excavation during construction.

Basically the foundation problems can be attributed to the types of deposits within the area. To an engineer, unconsolidated deposits are known as "soils." As used in this report, "soils" shall be confined to its geologic meaning, i.e., the decayed rock material derived from a weathering process, and the "soils" of the engineer shall be referred to by their geologic definition of unconsolidated deposits of sedimentary material - clays, silts, sands, being the principal members. The valley, to a depth of at least 500 feet, is filled with unconsolidated sediments, and it is to be emphasized that there is no typical deposit. Instead, widely varying engineering characteristics and erratic distribution, both horizontally and vertically, characterize the Salt Lake Valley sediments.

In addition to foundation problems caused by the nature of the sediments, another less evident problem exists -- earthquakes. Although no earthquake of magnitude similar to the recent Alaskan earthquake has occurred in Utah since the area was settled, evidence indicates that a strong earthquake occurred along the Wasatch Fault approximately 250 years ago. A branch of the Wasatch Fault, the East Fault, passes through Salt Lake City (Figure 2). Thirteen earthquakes of intensity III to V on the Modified Mercalli Intensity Scale, have been recorded in Salt Lake City since the area was founded (Marsell, 1964). The Modified Mercalli Scale of I to XII, wherein I repre-

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sents a low intensity felt by very few and XII represents total destruction, depends on such qualitative data as a person's perceptibility to a quake or a visual assessment of the destruction produced.

The purpose of this report, one of a series to deal with urban geology, is to acquaint those unfamiliar to the area with the local problems which should be considered in any foundation design, and to emphasize to those presently engaged in construction and design that subsoil conditions in the valley are extremely complex (in some downtown areas, adjacent buildings have their foundations on entirely different materials with entirely different engineering characteristics). It covers the northeast quarter of Metropolitan Salt Lake City, including the commercial center of Salt Lake City, the campus of the University of Utah, and the large residential area inbetween which contains many apartment dwellings (Figures 1 and 2). In examining Figure 1, a map of Salt Lake City and vicinity, the relationship between the total metropolitan area and the study area may be determined. Figure 2, an aerial photograph of the study area, shows the locations of boreholes, the location of the East Bench Fault, and the various cross section lines used in the isometric diagrams (Figures 4 and 5).

Subsequent sections of this report include a description of the area, earthquake probability and damage, and engineering characteristics of the predominant sediments.

DESCRIPTION OF AREA

Salt Lake City lies in a valley bounded on three sides by mountains and on the fourth side by the Great Salt Lake. When Lake Bonneville existed, the area that is now Salt Lake City was covered by as much as 1,000 feet of water. During this time, bars, spits, and beaches were formed at many elevations, and great thicknesses of silts and clays were deposited in the lake bed. Presently, rapidly downcutting mountain streams empty into the valley at many points. The silts and clays in many parts of the valley exhibit signs of being reworked periodically by ancient streams. Because of this mountain-lake relationship, the valley's sediments have been shaped by many factors.

The area of this report, bounded on the north by Eleventh Avenue, on the west by West Temple Street, on the south by Sixth South, and on the east by the Medical Center, is experiencing a new period of growth and expansion in which much major-building construction is taking place. The lowest elevation in the area, 4,235 feet, occurs in the southwest corner. To the north, northeast, and east the land rises rapidly. The Medical Center on the eastern edge of the area has an elevation of approximately 5,000 feet.

The factors which have been involved in forming the valley's unconsolidated deposits are briefly noted in order that the reader may appreciate the complexity of formations. If more extensive geologic information concerning the area is desired, refer to Utah Geological and Mineralogical Survey Bulletin 69, GEOLOGY OF SALT LAKE COUNTY.

EARTHQUAKE PROBABILITY AND DAMAGE

Salt Lake City is located in a region where earthquake disturbances may be anticipated during the economic life of a structure. There are many types of maps and techniques of presenting seismic data; all are more or less inadequate because the observation periods for different parts of the world have been variable and generally of short duration. However, C.F. Richter (1959), on a seismic regionalization map of the United States, indicates that the Salt Lake City area is in a seismic zone wherein earthquakes may reach an intensity of IX, which according to the Modified Mercalli Scale is: "Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken." It must be understood, however, that within short distances damage may be highly variable because of changes of composition and physical characteristics in the underlying substratum.

During the 117 years since settlers arrived in Utah, 263 earthquakes have been recorded. Forty-four of these originated in Salt Lake County. Several major active fault zones are responsible for most of the recorded earthquakes. However, movements along the Wasatch Fault zone have accounted for more earthquakes than have movements along any of the other zones (Marsell, 1964). A branch of the Wasatch Fault, the East Bench Fault, passes through Salt Lake City (Figure 2).

Earth movements, primarily along faults, are the cause of earthquakes. As the masses of material involved in the movement change position with respect to one another, elastic vibrations are induced within the materials in the crust of the earth. These vibrations, capable of moving great distances through the earth, travel at a high rate of speed. Thus, a localized earth movement can have disastrous effects over a wide area.

The results of an earthquake depend upon local geologic factors. Earthquake-induced vibrations travel through different materials at different speeds, and affect solid rock and unconsolidated materials differently. Because of induced vibrations, unconsolidated material will fracture and be displaced to a greater degree than will solid rock. Also, greater accelerations occur in softer materials. Recognizing this, the National Research Council of Japan (1950) suggested that the relative intensities of earthquake damage on different types of terrain could be compared as follows:

Marshy Land---1.5 Alluvial Ground---1.0 Tertiary Rock---0.4

On this basis the damage to be expected on unconsolidated alluvial ground is 2.5 times that to be expected on consolidated Tertiary formations. Moreover, on marshy land the expected damage is 1.5 times greater than that on alluvial sediments. Using the above scale, the relative intensity in the Salt Lake City area would be slightly greater than 1.

Earthquake shock waves have caused a great deal of destruction in urban areas .

In San Francisco, damage to utility lines (gas , power, and water) were as effectively crippling as the destruction of buildings . Existing springs may cease to flow and new ones may appear. Fill material and unconsolidated, saturated, fine-grained sediments may be severely compacted and landslides and rockfalls may occur on sloping faces , even of consolidated material. Thus within the vicinity of Salt Lake City, in March 1949 a low intensity earthquake fractured a 10-inch water line. Following the Hansel Valley earthquake which occurred in the vicinity of Kosmo, Utah, on March 12, 1934 (Engineering News Record, 1954), the ground settled up to 15 inches. The recurring landslides in consolidated formations at the mouth of Parleys Canyon are an ever-present reminder of the damage which might occur if a severe shock should occur.

There are five principal elements that influence earthquake damage to structures (Iacopi, 1964):

1. Strength of earthquake waves reaching the surface. Generally, an earthquake with Richter magnitude 4.5 or greater will cause substantial damage. On a logarithmic scale of 1 to 10, the Richter scale indicates the release of energy as measured by seismograph records.
2. Length of earthquake motion. The shock wave is usually a fluctuating series of tremors that last from 10 seconds to 1 minute. The cumulative effect of this motion works on structural walls and usually is the cause of collapse.
3. Proximity to the fault. Unless a building is located directly over a fault zone, proximity is much less important than building construction and underlying geologic foundation.
4. Geologic foundation. Earthquake studies show that intensity of a shock is directly related to the type of ground supporting the building. Structures built on solid rock near the epicenter of an earthquake frequently fare better than more distant buildings on soft ground.
5. Building Design. Any building can be designed to be earthquake resistant, provided all other problems are known and evaluated.

Tall buildings in the urban area may still be affected by an earthquake as far as one hundred miles distant. Certain characteristics inherent in tall buildings make them particularly susceptible to damage from slow surface waves generated by an earthquake. The slow surface wave can induce resonance into buildings which are more than five stories high. This induced resonance can result in minor damage within the building. Damage may also occur when two immediately adjacent tall buildings set up different motions and sway against each other.

At the present time earthquake-resistant design is not a mandatory requirement of the Salt Lake City Building Code. However, because of the nature of the area, all architects strongly recommend that an earthquake resistant design be employed in any multi-story building constructed in the Salt Lake Valley.

Multi-storied buildings have been and are being constructed on and near the East Bench Fault. Whereas there is no evidence to support the idea that further movement along the Wasatch Fault and its branches is imminent, evaluation of past fault movements indicates that the Wasatch Fault has experienced recurring periods of movement along the same plane. It is possible that at some unknown time in the future, movement could again occur along the fault. Unfortunately, at the present time, it is impossible to predict earth movements and accompanying earthquakes.

People who have lived in homes located in the vicinity of the East Bench Fault since the early 1930's attribute cracks in their homes to earthquakes, particularly the earthquakes of 1934 and 1962. This could be accepted as evidence of minor fault movement during these periods. However, after examining many homes along the fault, the writer concludes that these cracks might be due to many factors. Differential settlement is a natural occurrence in older homes, especially those homes built on lots containing both naturally deposited and fill materials. Moreover, the elevation of the groundwater table is lowering throughout the bench area, and settlement with accompanying cracks can occur as the water table lowers in the sediments underlying the structure.

Because of the many possible causes for settlement and the lack of accurately measured points on either side of the fault, it was decided that there is not conclusive evidence to support the theory that continuing movement occurs along the fault. Only by accurately locating points on either side of the fault and observing changes, or lack of changes, in location with time can it be determined whether or not the fault is moving. The U. S. Coast and Geodetic Survey, working with the Civil Engineering Department of the University of Utah, has recently undertaken a study to determine by precise measurement if there is movement along the East Bench Fault.

ENGINEERING CHARACTERISTICS OF THE PREDOMINANT VALLEY SEDIMENTS

In the past, City Creek meandered through what is now downtown Salt Lake City. As the stream deposited its materials, it also reworked existing lakebed deposits. During this period the surface elevation of the lake was continually changing. The resulting deposits consist of nearly every imaginable combination of lakebed and stream deposit.

Since the maximum elevation of the ancient lake was 5,135 feet and the elevation of the valley floor is approximately 4,220 feet, sediments deposited on the "benches" (ancient lake beaches) display the effects of many formational factors. Some clays found both in the valley and in the upland areas are typical lakebed deposits. Lying over, under, or beside these lakebed deposits are deposits typical of mudflows, bars, beaches, outwash fans, or deltas. Many deposits of clay have been found more than 600 feet above the valley floor. Conversely, deposits of gravel and cobbles have been found at depth beneath the valley floor.

One goal of this report was the preparation of cross sections which would accurately depict the subsoil conditions throughout the area. At first the task of assembling sufficient borehole data to draw the cross sections seemed impossible. Many parts of the study area contain no reasonable new multi-story buildings, consequently, no foundation investigations have been completed and no borehole data are available.

A total of 189 boreholes are located on Figure 2. Those holes marked with a number only, such as 1, 10, or 36, are boreholes which were drilled in order to complete a foundation investigation. Those holes marked with both a number and the letter W, such as 11W or 137W, were drilled for a well. Logs of all boreholes shown on Figure 2 are listed chronologically in the Appendix.

By examining the area map (Figure 2), one can obtain the numbers of boreholes located near any particular area of interest. Then by turning to the Appendix and finding the corresponding borehole numbers, one can obtain general information concerning the sedimentary deposits in any particular part of the study area. Although certain characteristics of the sediments of an area can be deduced from the borehole data, it is emphasized that any description pertains only to an individual sample obtained from a single borehole. BECAUSE OF THE COMPLEX NATURE OF THE DEPOSITS AND THE WIDE RANGE OF ENGINEERING CHARACTERISTICS WITHIN ANY ONE TYPE, REPORTED DATA PERTAIN ONLY TO THE SAMPLE TESTED.

The logs of boreholes in the Appendix contain an estimate of the relative density of the material, the approximate elevation of the ground surface at the borehole, the approximate elevation of the water table, and a visual or laboratory classification of the material sampled.

The methods of soil classification used are discussed on page 17. However, it should be noted that the logs contain classifications by many field engineers who used many different classification systems.

The Salt Lake City Datum and the U.S. Coast and Geodetic Survey Datum differ in elevation by approximately 26.8 feet; the Salt Lake City Datum is the

higher. All elevations in this report are referenced to the U.S. Coast and Geodetic Survey Datum.

The relative densities of sands and the consistencies of clays were estimated by examining the reported blow count obtained while the hole was being bored. The blow count, sometimes known as "N" value of a sample, is determined by performing the standard penetration test, which involves dropping from a height of 30 inches, a 140-pound hammer onto the drill rods and penetration spoon. Table 1 contains the relationship between relative density, consistency density, consistency, and blow count (Peck, Hanson, and Thornburn, 1953).

TABLE I
PENETRATION RESISTANCE AND SOIL PROPERTIES
ON BASIS OF THE STANDARD PENETRATION TEST

Sands		Clays	
<u>No. of Blows per ft.</u>	<u>Relative Density</u>	<u>No. of Blows per ft.</u>	<u>Consistency</u>
0-4	Very loose	Below 2	Very Soft
4-10	Loose	2-4	Soft
10-30	Medium	4-8	Medium
30-50	Dense	8-15	Stiff
Over 50	Very Dense	15-30	Very Stiff
		Over 30	Hard

The standard penetration test must be used with caution and experience. When silts or clays contain even small amounts of gravel, the test may indicate too high a blow count, due to the interference of occasional gravel particles with the driving of the spoon. The penetration test results do not accurately indicate the bearing characteristics of expansive clays or of highly compressible soils. Penetration values fluctuate as the moisture content of the soil and the depth of the water table fluctuate. For most soils, the data from the penetration test should be correlated with laboratory tests on undisturbed samples.

Figure 3.
GENERALIZED DESCRIPTION OF ENGINEERING PROPERTIES OF MAP UNITS

MAP SYMBOL	LITHOLOGY	SLOPE STABILITY	GENERAL STRENGTH CHARACTERISTICS		UNIT WEIGHT lbs. per cubic ft.
			Relative Density	Shear Strength	
	Black clay, lakebed or lagoon deposit, sometimes contains large quantities of organic material, contains lenses of silt or sand in some areas, when indicated exists as a matrix for sand, gravel or cobbles,	Extremely variable in all layers, within any one type of material stability is dependent upon the density of the material and the degree of saturation of the material. An unstable condition can be caused by sudden changes in the elevation of the water-table. A slope may be stable during certain seasons of the year and unstable during other seasons.	Soft to stiff	Generally low to moderate shearing strength For any one soil type actual values depend upon method of placement, age, thickness, underlying material, and ground-water conditions. When wet and unsupported, soils become soft and plastic	71 to 111
	Blue or green clay, lakebed or lagoon deposit,		Medium to very stiff		93 to 118
	Tan or brown clay, lakebed or lagoon deposit,		Soft to stiff		97 - 102
	Varved clay, lagoon deposit,		Stiff to very stiff		113 - 122
	Sandy clay or clayey sand, lagoon, fan, or delta deposit, When indicated exists as a matrix for gravel or cobbles,		Soft to very stiff		99 - 116
	Clayey silt or silty clay, lakebed, lagoon, fan, or delta deposit; contains lenses of silt or sand in some areas, when indicated exists as a matrix for sand or gravel,		Soft to hard		84 - 110
	Silt; lakebed, lagoon, fan, or delta deposit, sometimes contains lenses of sandy clay;		Loose to medium		108 to 116
	Sandy silt or silty sand, lagoon, fan, or delta deposit; when indicated exists as a matrix for gravel or cobbles,		Very loose to dense		94 to 118
	Sand; bar, beach, fan, or delta deposit;		Loose to dense		99 to 116
	Gravel, bar, beach, mudflow, fan, or delta deposit;		Loose to very dense		116 to 132

Because of the deficiencies in the penetration test, the relative density of a sediment should not be directly related to its compressibility or bearing strength. Only laboratory tests on samples from the site in question, performed and interpreted by "soil" engineers, can properly indicate bearing strength and compressibility. Therefore, in this report, data pertaining to relative density refer only to very general characteristics of the material, and should not be used for engineering design.

Most of the sediments described in the Appendix are classified according to the Unified Classification System. However, some logs gave no indication as to what system of classification was used. As a supplement to the Unified System, when laboratory tests were available, clays were considered to be material smaller than two microns; cobbles, from two to eight inches in diameter; and boulders, greater than eight inches in diameter.

This classification produced reasonably consistent data when different areas were compared. However, since many persons with varied backgrounds and experience classified them, the possibility exists that the identical material has been classified and described differently by different persons. Also, varying moisture contents produce a change in appearance. For example, a clay classified when wet resembles a clay, yet that same clay classified when dry might be termed a silty shale.

In order to provide some description of the engineering properties encountered during various foundation investigations, a chart is included which lists in general terms the engineering properties of the major "soil" types (see Figure 4). Subjects contained in the chart include lithology, slope stability, general strength characteristics, and unit weight. The map symbols shown on the chart are also used on two isometric drawings discussed on page 19. Since similar deposits can be formed under different depositional circumstances, the precise lithology of some is uncertain; therefore, a range of formational possibilities is included in the chart.

Slope stability, extremely variable in unconsolidated sediments, is primarily dependent upon the degree of slope, the compactness and type of material contained in the slope, and the water content and seepage forces. For any one type, the maximum degree of slope which will be stable depends to a large amount upon the relative density of the material in place. Since the relative densities vary, the degree of slope also varies. The general strength characteristics are based upon moisture content, relative density, and type of sediment. As stated previously, the wide range of bearing capacity and compressibility within any one type makes it impossible to pinpoint any specific inherent characteristics.

An attempt was made to divide the study area into regions which contained sediments possessing similar engineering characteristics. But after studying

foundation designs for specific structures located in the vicinity of one another and after studying the engineering characteristics associated with sediments underlying these structures, it was determined that such a division is impossible. Throughout the study area extremely rapid facies changes are the rule rather than the exception. To depths greater than 100 feet, sediments could be totally different at points only 20 feet apart, whereas within a horizontal distance of 100 feet changes from dense, well-graded gravel, to soft, blue clay, to an interlayered mixture of silt and sand have been noted.

In areas located above the valley floor some mudflow deposits have proven troublesome. There are certain slightly cemented sediments, usually silts, which occur in some mudflow deposits and appear stable when field tested. Yet these, when exposed to large amounts of water for relatively short periods of time, lose their cementing materials and become very compressible. During construction of one structure, the footings become wet. As water came in contact with the cemented layers of the deposits, rapid differential settlement began. Within a four month period prior to completion of the construction of the building, a maximum settlement of 6 inches occurred.

The sediments in the Salt Lake Valley form a reservoir which contains a vast amount of ground water. Because of the relatively impermeable clays which can be found in most parts of the valley at depths of less than 100 feet, a perched water table exists 5 to 30 feet below the ground surface. The true water table fed by water coming into the valley from the surrounding mountains and percolating along old gravel deposits which overlie the impermeable clays lies approximately 150 feet below ground surface. In contrast the perched water table receives its recharge from precipitation which falls directly on the permeable sediments of the valley floor. In the region between the bottom of the perched water table and the upper surface of the true water table, sediments are moist but not saturated.

When the surface of the perched water table is near the ground surface, problems occur both during and after construction. During excavation, many sites require continuous drainage. As the water is pumped from the excavation, the perched water table in the surrounding area is lowered and settlement occurs in structures located in the vicinity. Thus the contractor and engineer are faced with the problem of completing the construction of their structure without seriously damaging surrounding structures. Because of the continuing water problem after construction, a structure must be designed to permanently keep out water; or else a drainage system must be provided to drain water out of the structure as it enters, in which case differential settlement in surrounding structures might continue for a long period of time after construction (Osmond, Hewitt, and Van Horn, 1965).

During the early 1920's a maximum settlement of 5 feet was recorded in the business district of San Jose, California (Stohsnet, 1937). This settlement was due to abstraction of water from the formations underlying the area. Houston, Texas, draws all its public water supply from underground sources. By 1954 the maximum subsidence in Houston was 3.5 feet, and a total of 7 feet is expected by 1970 (Lockwood, 1954). In Tucson, Arizona, there has been serious cracking due to water withdrawal (Lacy, 1964).

Salt Lake City presently obtains nearly all of its water from surface supplies. However, as the population continues to increase, surface supplies will not be adequate, and the ground-water supplies will be used more and more. Continued use of ground-water supplies will result in a lowering of both the perched and the true water table. As these water tables lower, settlement could occur in structures located throughout the valley.

Isometric cross sections of both downtown Salt Lake City and of the University of Utah campus are shown in Figures 4 and 5. The cross sections are at best over-simplified representations of the subsoil conditions. It is an impossible task to represent on a drawing all of the subtle color changes and gradual grain size changes which occur within these materials.

The isometric cross section of the downtown area, Figure 4, is bounded on the north by North Temple Street, on the west by Main Street, on the South by Sixth South Street, and on the east by Third East Street. The deepest section shown on the drawing extends approximately 135 feet downward.

The isometric cross section of the University of Utah campus, Figure 5 follows a line drawn from University Village to the Engineering Building (line AA' on Figure 2) and a line drawn from Orson Spencer Hall to the Pharmacy Building (line BB' on Figure 2). Offshoots of lines AA' and BB' are shown at various points along the lines. The deepest section shown on the drawing extends to a depth of 50 feet.

Certain layers shown on the cross sections are separated from other layers by a series of " " marks and dotted lines, indicating that sufficient borehole data were not available in this area and the author was forced to interpret between known points. Although interpretation was accomplished in this report, interpretation for distances greater than 50 feet is not advisable in an engineering report.

In many cases, the sediments encountered are a combination of two distinct groups; for example, some types contained approximately equal amounts of gravel and clay. When this occurred, both symbols are indicated, one over the other, on the cross section.

In a few cases the exact point of junction between two sediments was unknown. When this occurred, the junction was represented by a jagged line.

CONCLUSIONS

For any specific area, information contained in the Appendix to this report can be used only as a supplement to a complete foundation investigation of the sedimentary deposits existing at the site. Because of the complex nature of deposits and the wide range of engineering characteristics within any one type, REPORTED DATA PERTAIN ONLY TO THE SAMPLE TESTED.

The following two fundamental design concepts may be derived from the data contained in this report:

1. Salt Lake City is located in a region where it can be anticipated that earthquake disturbance may cause moderate damage during the economic life of a structure.
2. A foundation investigation should be performed on the exact site of any proposed multi-story structure.

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APPENDIX

LOGS OF BOREHOLES
(location shown on figure 2)

Hole No.	Depth From	To	Location	Hole No.	Depth From	To	Location	
1	0	2	UNIVERSITY VILLAGE Sandy silt, 4736	10	0	6	FOOTHILL BLVD. AND GUARDMAN'S WAY Medium, light brown silty sand and gravel, 4763	
	2	4	Silty sand w/gravel		6	9	Medium, dark brown sandy silt w/gravel, w-99, m-13	
	4	13	Red - brown sandy silt		9	14	Dense, gravel and cobbles, and silty clay	
	13	17	Gray silty clay		14	17	Very dense, gravel and boulders, w-132	
2	0	2	UNIVERSITY VILLAGE Sandy silt, 4719	11	0	1	FOOTHILL BLVD. AND GUARDMAN'S WAY Dark brown silty sand w/gravel, 4750, w-94, m-13	
	2	6	Brown silty sand w/gravel		1	6	Very dense, brown gravel and cobbles, and silty clay, w-110, m-18	
	6	16	Brown to gray silt		6	14	Medium, gravel and boulders, and silty sand, w-119, m-11	
3	0	1	UNIVERSITY VILLAGE Sandy silt w/gravel, 4681	12	14	20	Very dense, gravel, cobbles, and silty clay, w-128, m-10	
	1	4	Silty sand w/gravel		20	21	Red sand	
	4	12	Brown to gray silt		21	24	Very dense, gravel, and boulders, silty sand, w-130, m-16	
	12	13	Brown sand		12	0	2	FOOTHILL BLVD. AND GUARDMAN'S WAY Dark brown silty sand, 4791
	13	16	Red sand w/gravel			2	9	Very dense, gravel and boulders, and sandy clay, w-109, m-8
4	0	1	UNIVERSITY VILLAGE Sandy silt, 4739	13	9	14	Red-brown sand, w-101, m-15	
	1	3	Brown sand w/gravel		14	22	Very dense, gravel, and boulders, and sand, silt, and clay	
	3	4	Gravel, and cobble w/silty sand		22	23	Very dense, gravel and boulders and silty sand	
	4	13	Brown silt		14	0	5	FOOTHILL BLVD. AND GUARDMAN'S WAY Medium, dark brown silty sand w/gravel, w-101, m-9
	13	17	Gray silty clay			5	8	Very dense, red-brown sand, gravel and sandy clay, w-110, m-12
5	0	2	UNIVERSITY VILLAGE Sandy silt, 4699	14	8	10	Brown silty clay, w-103, m-23	
	2	4	Brown silty sand		10	12	Green-brown clay, w-97, m-34	
	4	12	Brown silt		12	20	Very dense, red-brown gravel and boulders, and sand, silt, and clay	
	12	15	Gray silty clay		20	21	Very dense, gravel and boulders, and silty sand	
	15	16	Sand w/gravel and cobbles		15	0	5	FOOTHILL BLVD. AND GUARDMAN'S WAY Dark brown silty sand w/gravel, 4763
6	0	1	UNIVERSITY VILLAGE Sandy silt, 4734	15		5	8	Stiff, gray brown clay, w-102, m-26
	1	2	Brown sand w/gravel		8	15	Very dense, red-brown gravel, boulders, and sand, silt, and clay, w-126, m-22	
	2	4	Gravel and cobble w/silty sand		15	18	Varved clay - gray green and red brown, w-119, m-15	
	4	8	Brown silty sand		18	20	Very dense, red-brown gravel and boulders, and silty sand	
	8	12	Brown sand		9	0	2	FOOTHILL BLVD. AND GUARDMAN'S WAY Dark brown silty sand w/gravel, 4773
12	17	Gray silty clay	2	6		Coarse gravel and cobbles and sandy clay		
7	0	1	UNIVERSITY VILLAGE Sandy silt, 4722	9	6	13	Dense brown clayey silt, w-99, m-19	
	1	3	Silty sand		13	15	Very dense, brown clayey silt w/gravel	
	3	4	Gravel and cobbles w/sand		15	18	Very dense, gravel, and boulders, and clayey sand	
	4	7	Brown sandy silt		18	21	Very dense, gravel and boulders, and silty sand	
	7	14	Brown clayey silt		8	0	2	UNIVERSITY VILLAGE Sandy silt, 4689
14	17	Gray silty clay	2	3		Brown silty sand w/gravel		
8	0	2	UNIVERSITY VILLAGE Sandy silt, 4689	8	3	8	Brown sandy silt	
	2	3	Brown silty sand w/gravel		8	11	Gray silt	
	3	8	Brown sandy silt		11	13	Red silty sand	
	8	11	Gray silt		13	15	Red sand w/gravel, cobbles, and boulders	
	11	13	Red silty sand		7	0	1	UNIVERSITY VILLAGE Sandy silt, 4722
13	15	Red sand w/gravel, cobbles, and boulders	1	3		Silty sand		
9	0	2	FOOTHILL BLVD. AND GUARDMAN'S WAY Dark brown silty sand w/gravel, 4773	7	3	4	Gravel and cobbles w/sand	
	2	6	Coarse gravel and cobbles and sandy clay		4	7	Brown sandy silt	
	6	13	Dense brown clayey silt, w-99, m-19		7	14	Brown clayey silt	
	13	15	Very dense, brown clayey silt w/gravel		14	17	Gray silty clay	
	15	18	Very dense, gravel, and boulders, and clayey sand		6	0	1	UNIVERSITY VILLAGE Sandy silt, 4734
	18	21	Very dense, gravel and boulders, and silty sand			1	2	Brown sand w/gravel

Logs of Boreholes, continued.

Hole No.	Depth From	To	Location	Hole No.	Depth From	To	Location	
16	0	3	FOOTHILL BLVD. AND GUARDMAN'S WAY		14	17	Silty sand	
			Loose, brown silty sand and gravel, 4758				17 19 19 22	Sand Dense gravel and cobbles
	3	6	Very dense, gravel, and boulders, and silty sand		22	25		Medium, gravel and silt
								Stiff, gray brown clay, w-105, m-24
	11	20	Very dense, gravel, boulders, and sand, silt, and clay			0	6	Clayey silt w/gravel, 4927
								Stiff, silt and clay w-105.1, m-16.3
17	0	16	UNIVERSITY OF UTAH PHYSICAL PLANT		18	19	Gravel and cobbles	
			Very dense, sand, gravel, and boulders w/some silt				27	
18	0	2	UNIVERSITY OF UTAH PHYSICAL PLANT		0	6	Clayey silt w/gravel, 4933, w-91.5, m-5.5	
			Brown sandy silt w/some gravel				6 12	Stiff, silt and clay, w-93.3, m-14.8
	2	10	Very dense, sand, gravel, and boulders w/silt		12	14		Silty sand
								14 17
	10	12	Dense, sand, gravel, boulders w/thin layers of silty sand		17	20		Very dense, gravel and cobbles
								20 36
19	0	2	UNIVERSITY OF UTAH PHYSICAL PLANT		0	6	UNIVERSITY OF UTAH PHARMACY BLDG.	
			Very dense, sand, gravel, and boulders w/silt				6 11 11 18 18 20	Stiff, silt and clay Medium, silty sand Gravel and cobbles
20	0	6	UNIVERSITY OF UTAH PHARMACY BLDG.		6	11	Stiff, silt and clay	
			Medium, clayey silt, 4930, w-106.0, m-6.2				11 18 18 20	Medium, silty sand Gravel and cobbles
	6	12	Stiff, silt and clay		29	0	6	UNIVERSITY OF UTAH PHARMACY BLDG.
								Silty sand
	15	17	Sand		6	14		Medium, silty sand and gravel w/layers of silty sand
								Gravel and cobbles
22	35	Medium, gravel and silt or clay, w-105.2, m-18.6		14	17		Medium, brown silty sand	
							UNIVERSITY OF UTAH PHARMACY BLDG.	30
21	0	6	UNIVERSITY OF UTAH PHARMACY BLDG.		0	10	Very loose, clayey silt w/gravel, 4940, w-84.4, m-25.9	
			Medium, clayey silt, 4923				10 12 12 17	Medium, clayey silt w/gravel Medium, silt, w-111.6, m-15.2
	6	13	Medium, silt and clay		17	24		Loose, silty sand, w-100.3, m-23.4
								17 22
	19	20	Medium, sand		24	25		Medium, gravel and cobbles
								24 25
22	0	5	UNIVERSITY OF UTAH PHARMACY BLDG.		31	0	UNIVERSITY OF UTAH MEDICAL CENTER	
			Clayey silt, 4926				0 7	Clayey silt w/gravel, 4940
	5	12	Silt and clay		7	12		Silt
								12 17
	17	18	Medium, silty sand		16	19		Dense, gravel and cobbles, m-8.5
								16 19 19 30
23	0	3	UNIVERSITY OF UTAH PHARMACY BLDG.		32	0	UNIVERSITY OF UTAH MEDICAL CENTER	
			Clayey silt w/gravel, 4932				0 12	Loose clayey silt w/gravel, 4939, w-107.7, m-16.8
	3	9	Silt and clay		12	17		Medium, silt, w-108.1, m-14.3
								12 17
	16	18	Sand		17	22		Gravel and cobbles
								17 22
18	20	Gravel and cobbles		33	0	14	UNIVERSITY OF UTAH MEDICAL CENTER	
							0 14 14 22	Clayey silt w/gravel, 4967 Loose, silt w/gravel, w-114.8, m-14.4
24	0	7	UNIVERSITY OF UTAH PHARMACY BLDG.		22	24	Silty sand, w-103.3, m-18.9	
			Loose, clayey silt, 4922				25 26 26 30	Gravel and cobbles Gravelly clay, m-11.7
	7	13	Stiff, silt and clay, w-116.3, m-8.5		24	41		Gravelly clay
								13 19
	19	20	Sand		33	0	14	UNIVERSITY OF UTAH MEDICAL CENTER
								19 20
20	21	Dense, gravel and cobbles		14	22		Loose, silt w/gravel, w-114.8, m-14.4	
							20 21	Loose, silt w/gravel, w-114.8, m-14.4
21	48	Medium, gravel and silt or clay		14	22		Gravelly clay, m-11.7	
							21 48	Gravelly clay, m-11.7
25	0	5	UNIVERSITY OF UTAH PHARMACY BLDG.		22	25	Silty sand, w-103.3, m-18.9	
			Very loose silty gravel, 4932				25 26 26 30	Gravel and cobbles Gravelly clay, m-11.7
	5	10	Loose clayey silt, w-92.6, m-18.4		26	30		Gravel and cobbles
								5 10 10 14
10	14	Silt and clay		26	30		Gravelly clay, m-11.7	
							10 14	Gravelly clay, m-11.7

Logs of Boreholes, continued.

Hole No.	Depth From	To	Location	Hole No.	Depth From	To	Location
34	0	6	UNIVERSITY OF UTAH MEDICAL CENTER	44	0	10	UNIV. OF UTAH MEN'S DORMETORY
			Clayey silt w/gravel, 4956				Medium, light brown sandy silt, 4807
			Clayey silt				Medium, light brown sandy silt w/gravel
			Clayey silt w/gravel, w-109.2 m-15.4				Dense, gravel
			Loose, silt, w-108.9, m-17.8				
28	29	Silty sand	45	0	12	UNIV. OF UTAH MEN'S DORMETORY	
		Medium, gravel				Medium, light brown sandy silt w/gravel, 4803	
35	0	12	UNIVERSITY OF UTAH MEDICAL CENTER	12	18	Medium, light brown clayey silt w/gravel, w-104, m-6.6	
			Loose clayey silt w/gravel, 4940, m-8.8			Medium, light brown sandy silt w/gravel	
			Medium, silt, w-116.1, m-14.3			Very dense, gravel	
17	20	Loose, silty sand, w-100.1, m-23.7	27	31			
36	0	9	ALONG HEATING CONDUIT NEAR CONNOR RD. Road	47	0	8	UNIV. OF UTAH WOMEN'S DORMETORY
			Dense, brown sandy silt w/gravel, 4852				Dense, brown clayey silt, 4796
			Medium, brown silty sand				Gravel
							Medium, sandy silt
37	0	5	UNIV. OF UTAH MEN'S DORMETORY	48	8	11	UNIV. OF UTAH WOMEN'S DORMETORY
			Gravel w/silty sand, 4838				Stiff, silty clay, 4784
			Brown silty sand w/gravel				Yellow silty clay
8	11	Very dense sand, gravel, and boulders w/silt	49	11	22	25	Medium silty sand
							Silty clay w/gravel and sand
38	0	1	UNIV. OF UTAH MEN'S DORMETORY	50	22	30	UNIV. OF UTAH WOMEN'S DORMETORY
			Brown sandy silt w/gravel, 4823				Medium, silty sand w/gravel, 4774
			Very loose, brown sandy silt				Sandy silt
8	41	Medium to dense, brown sandy silt w/gravel	51	5	10	22	Silty clay
							Medium fine sand
39	0	1	UNIV. OF UTAH MEN'S DORMETORY	52	6	10	UNIV. OF UTAH WOMEN'S DORMETORY
			Brown sandy silt w/gravel, 4812				Very dense gravel w/clayey sand
			Very loose, brown sandy silt				
10	30	Medium to dense, brown sandy silt w/gravel	53	10	22	30	
40	0	4	UNIV. OF UTAH MEN'S DORMETORY	49	0	3	MILTON BENNION HALL
			Brown sandy silt w/gravel, 4804				Tan silty clay and sand
			Loose, brown sandy silt				Rust silty clay and sand
			Medium, red-brown sandy silt w/some gravel				Tan sand
			Red-brown sand				Rust sand, gravel, and cobbles
16	27	Loose, brown sandy silt	50	0	2	6	MILTON BENNION HALL
		Loose, red-brown sandy silt					Brown sandy silt
29	31	Loose, red sand	51	2	6	10	Tan clayey sand
							Tan sand and gravel
41	0	1	UNIV. OF UTAH MEN'S DORMETORY	52	10	16	UNIV. OF UTAH WOMEN'S DORMETORY
			Brown sandy silt w/gravel, 4815				Rust sand, gravel, and cobbles
			Loose, brown sandy silt, w-104.4, m-19.4				
			Very dense, gravel w/brown sandy silt				
			Brown sandy silt, w-106.2, m-20.0				
23	30	Medium, brown sandy silt w/gravel	53	0	3	4	MILTON BENNION HALL
							Gravel and sand
42	0	19	UNIV. OF UTAH MEN'S DORMETORY	54	1	8	MILTON BENNION HALL
			Medium, light brown sandy silt w/gravel, 4812				Tan sand, gravel, and cobbles
			Very dense, gravel				Rust sand, gravel, and boulders
19	32		55	5	10	16	MILTON BENNION HALL
							Tan sand
43	0	19	UNIV. OF UTAH MEN'S DORMETORY	56	3	4	MILTON BENNION HALL
			Loose, light brown sandy silt w/gravel, 4807, w-110, m-17.5				Tan clayey sand
			Dense, fine to coarse gravel				Tan sand
							Tan sand and gravel
							Rust sand, gravel, and cobbles

Logs of Boreholes, continued.

Hole No.	Depth From	To	Location	Hole No.	Depth From	To	Location
53	0	2	MILTON BENNION HALL	62	0	12	UNIV. OF UTAH STUDENT UNION BLDG.
			Organic silt and fine sand				Very stiff, white silty clay w/sand partings, 4713
			Silty sand				Very dense fine and coarse sand
			Sand, gravel, and cobbles				Gravel
			Red clayey sand				Gravel w/sandy silt
54	0	4	ORSON SPENCER HALL	63	0	8	NEAR PARK BUILDING
			Very dense sand, gravel, and boulder w/silt				Loose, brown sandy silt w/gravel
			Medium, red brown silty sand				Medium, sand and gravel w/silt
			Very dense sand, gravel and boulder				Medium, silty sand
55	0	6	ORSON SPENCER HALL	64	0	19	UNIV. OF UTAH ENGINEERING BUILDING
			Silty clay, 4732				Dense, coarse gravel w/silty sand
			Medium, fine brown silty sand				Medium, clayey silt w/gravel
			Medium to loose, brown silty sand w/lenses of sand, gravel, or silt clay				Very dense, coarse gravel w/sand and cobbles
56	0	10	ORSON SPENCER HALL	65	0	15	UNIV. OF UTAH ENGINEERING BUILDING
			Medium, brown silty clay, 4725				Medium, coarse gravel w/silty sand
			Medium, brown silty sand				Medium, coarse gravel w/clayey silt
			Very dense gravel				
57	0	8	ORSON SPENCER HALL	66	0	8	UNIV. OF UTAH ENGINEERING BUILDING
			Dense, brown clayey silt, 4731				Loose, coarse gravel w/silt
			Dense, brown silty sand				Medium, sandy clay w/gravel
			Brown sand				Medium, coarse gravel w/sandy clay
58	0	9	ORSON SPENCER HALL	67-W	0	35	WEST OF MEDICAL CENTER
			Loose, brown sandy silt w/thin layers of gravel				Boulders, 4851
			Loose, gray clayey silt w/some gravel				Clay and gravel
			Loose, red-brown sand				Boulders
59	0	3	UNIV. OF UTAH STUDENT UNION BLDG.	110	113	Boulders	
			Very dense, sand, gravel, and silt, 4726	113	118	Sandy clay	
			Loose, brown silty clay	118	120	Boulders	
			Medium, brown fine sand	120	126	Sandy clay	
			Sand and gravel	126	138	Clay and gravel	
			Dense, brown silty sand	138	142	Cemented sand, gravel and boulders	
			Very stiff, silty clay w/gravel	142	159	Clay and gravel	
				159	171	Boulders	
				171	208	Clay and gravel	
				208	217	Cemented sand, gravel, and boulders	
60	0	9	UNIV. OF UTAH STUDENT UNION BLDG.	217	220	Clay	
			Dense, brown sandy silt, 4728	220	223	Clay and gravel	
			Medium, brown sandy silt	243	260	Boulders	
			Very dense, gravel w/sandy silt and lenses of silt	260	332	Clay and gravel	
				332	343	Cemented sand, gravel, and boulders	
				343	347	Boulders	
				347	351	Cemented sand, gravel, and boulders	
				351	357	Boulders	
				357	361	Cemented sand, gravel, and boulders	
				361	366	Clay and gravel	
61	0	8	UNIV. OF UTAH STUDENT UNION BLDG.	366	444	Clay and gravel	
			Medium, brown sandy silt	444	450	Clay	
			Gray-brown clayey silt	450	531	Clay and gravel	
			Loose, brown sandy silt	531	593	Cemented sand, gravel, and boulders	
			Medium, red-brown sand	593	626	Clay and gravel	
				626	628	Clay	
				628	661	Clay and gravel	
				661	675	Cemented sand, gravel, and boulders	
				675	695	Clay and gravel	
				695	750	Cemented sand, gravel, and boulders	

Logs of Boreholes, continued.

Hole No.	Depth From	To	Location	Hole No.	Depth From	To	Location	
68-W	FIFTH EAST AND FIFTEENTH SOUTH			71	318	336	Clay, gravel, and boulders	
	0	4	Top soil, 4672		336	342	Cemented sand, gravel, and boulders	
	4	45	Coarse sand, gravel, and boulders,		342	354	Clay, gravel, and boulders	
	45	60	Clay and cemented gravel		354	398	Brown clay w/some gravel	
	60	80	Clay, gravel, and boulders		398	427	Loose clay and gravel and cemented sand, gravel, and boulders	
	80	125	Clay and gravel		427	434	Brown clay	
	125	150	Coarse sand, gravel, and boulders		434	500	Clay, gravel, and boulders	
	150	185	Clay and gravel		SEVENTH SOUTH AND ELEVENTH EAST			
	185	195	Clay, gravel, and boulders		0	13	Brown sandy silt w/gravel and cobbles, 4468, 4444, w-105, m-20.0	
	195	220	Red clay, and gravel		13	14	Gray clay w/gravel	
	220	230	Clay and gravel		14	16	Black sandy silt w/gravel	
	230	235	Sand and gravel		16	19	Yellow-brown sandy, clayey, silt w/gravel	
	235	260	Clay and gravel		19	28	Red-brown sandy loam w/gravel and cobbles, w-112, m-18.7	
	260	275	Gravel		28	35	Gray clay	
	275	290	Clay and gravel		35	40	Brown sand w/silt and clay lenses	
	290	315	Gravel		SEVENTH SOUTH AND ELEVENTH EAST			
	315	330	Sand and gravel		0	1	Red-brown sandy silt w/gravel, 4435	
	330	345	Gravel and coarse sand		1	7	Red-brown sandy silt w/gravel and cobbles	
345	360	Clay, red sand, and gravel	7	13	Gray clay, w-95, m-30.0			
360	385	Gravel	13	18	Brown sand w/silt and clay lenses			
69-W	WEST OF UNIV. OF UTAH STADIUM			72	SEVENTH SOUTH AND ELEVENTH EAST			
	0	29	Boulders, 4637		0	9	Medium, red sandy silt w/gravel, 4481	
	29	154	Clay, gravel, and boulders		9	10	Sand	
	154	191	Cemented sand, gravel, and boulders		10	20	Medium, gravel w/red sandy silt	
	191	217	Loose gravel, and cemented sand, gravel, and boulders		20	23	Gray and red sandy silt w/gravel	
	217	229	Loose boulders and cemented sand, gravel, and boulders		23	26	Red sandy silt w/gravel	
	229	255	Clay and gravel		26	27	Sand	
	255	270	Cemented sand, gravel, and boulders		27	28	Varved sandy silt and sandy clay	
	270	280	Clay and gravel		28	31	Fine sand	
	280	295	Loose Boulders		31	33	Dense silty sand w/gravel	
	295	328	Clay and gravel		SEVENTH SOUTH AND ELEVENTH EAST			
	328	340	Cemented gravel		0	6	Medium, red brown silty sand w/gravel, 4486	
	340	389	Cemented sand, gravel, and boulders		6	11	Brown to gray sandy silt w/gravel	
	389	445	Loose gravel and cemented sand, gravel, and boulders		11	12	Fine sand	
70-W	WEST OF UNIV. OF UTAH STADIUM			74	12	17	Gravel and cobble rock w/silt	
	0	8	Clay, 4608		17	21	Gravel w/red sandy silt	
	8	75	Clay, gravel, and large boulders		21	23	Red sandy silt	
	75	79	Brown clay		23	27	Medium, red sandy silt w/gravel	
	79	108	Clay, gravel, and boulders		FIFTH SOUTH AND TENTH EAST			
	108	116	Boulders		0	8	Dense, brown silty sand w/gravel, 4435	
	116	138	Clay, gravel, and boulders		8	12	Dense, brown coarse gravel	
	138	140	Cemented sand, gravel, and boulders		12	14	Brown silty sand w/gravel	
	140	152	Clay, gravel, and boulders		14	45	Very dense, brown gravel w/cobbles and boulders	
	152	160	Brown clay, gravel, and boulders		FIFTH SOUTH AND TENTH EAST			
	160	186	Slightly cemented clay, gravel, and boulders		0	15	Medium, brown silty sand w/gravel, 4441	
	186	210	Brown clay, sand, and boulders		15	47	Very dense, brown coarse gravel w/cobbles and boulders	
	210	230	Cemented sand, gravel, and boulders		FIFTH SOUTH AND TENTH EAST			
	230	236	Yellow clay		0	15	Medium, brown silty sand w/gravel, 4441	
	236	252	Loose gravel and cemented sand, gravel, and boulders		15	47	Very dense, brown coarse gravel w/cobbles and boulders	
	252	268	Clay, gravel, and boulders		FIFTH SOUTH AND TENTH EAST			
	268	278	Cemented sand, gravel, and boulders		0	15	Medium, brown silty sand w/gravel, 4441	
	278	284	Clay w/some gravel		15	47	Very dense, brown coarse gravel w/cobbles and boulders	
284	290	Clay and gravel	FIFTH SOUTH AND TENTH EAST					
290	304	Clay, gravel, and boulders	0	15	Medium, brown silty sand w/gravel, 4441			
304	318	Gravel and boulders	15	47	Very dense, brown coarse gravel w/cobbles and boulders			

Logs of Boreholes, continued.

Hole No	Depth From	To	Location	Hole No.	Depth From	To	Location										
77	0	16	FIFTH SOUTH AND TENTH EAST		187	197	Hard Pan										
			Medium, brown silty sand w/gravel, 4432				197	208	Soft blue clay								
			Very dense, brown gravel w/cobbles				208	211	Coarse sand								
			Medium, brown silty sand w/gravel				211	245	Soft sandy clay								
			Very dense to dense, brown gravel w/cobbles				245	250	Clay and gravel								
78	0	18	FIRST SOUTH AND ELEVENTH EAST		250	254	Coarse sand										
			Medium, brown silty sand w/gravel				254	305	Soft sandy clay								
			Loose, gravel w/silty sand				305	322	Clay								
			Medium, brown gravel w/sand				322	330	Clay and gravel								
			Medium, brown silty sand w/clayey silt lenses				330	366	Sandy clay								
			79				16	18	FIRST SOUTH AND ELEVENTH EAST		366	371	Stiff clay				
													Loose to medium, brown silty sand w/gravel	371	385	Soft blue clay	
													Brown silty sand	385	405	Sandy black clay	
													Medium to loose, brown silty sand and gravel	405	468	Clay	
													Loose, brown silty sand	468	500	Stiff clay	
80	18	29	SECOND SOUTH AND SEVENTH EAST		500	528	Soft clay										
							Medium, brown silty sand, 4378, w-115, m-16	528	550	Coarse sand and gravel							
							Medium, tan silty sand, w-117, m-12	84-W		FIRST SOUTH AND FIFTH EAST							
							Medium, brown sand and gravel w/silt and clay, w-107, m-11	0	20	Brown clay							
							Medium, tan silty sand, w-115, m-23	20	24	Gravel							
							81	29	43	SECOND SOUTH AND SEVENTH EAST		24	40	Brown clay			
														Dense, tan silty sand and gravel w/silt and clay, w-109, m-27	40	45	Gravel, rocks, and sand
														Loose, to dense, brown sand and gravel w/silt and clay, w-101, m-29	45	55	Sand and clay
														Medium, brown silty sand, 4372, w-113, m-14	55	61	Cemented sand, gravel, and boulders
														Loose, to dense, brown sand and gravel w/silt and clay, w-101, m-29	61	127	Clay and sand
82	19	42	SECOND SOUTH AND SEVENTH EAST		127	130	Cemented sand, gravel, and boulders										
							Medium, brown silty sand, 4370, w-118, m-12	130	135	Brown clay							
							Medium to dense, brown sandy gravel w/silt and clay, w-116, m-15	135	150	Blue clay							
							Medium, brown silty sand, 4378, w-115, m-16	150	164	Sand and gravel							
							Medium, tan silty sand, w-117, m-12	164	210	Brown clay							
							83-W	19	42	FIFTH SOUTH AND SIXTH EAST		210	245	Sand and gravel			
														Medium, brown silty sand, 4370, w-118, m-12	245	280	Brown clay
														Medium to dense, brown sandy gravel w/silt and clay, w-116, m-15	280	283	Cemented sand, gravel, and boulders
														Medium, brown silty sand, 4372, w-113, m-14	283	305	Green clay
														Loose, to dense, brown sand and gravel w/silt and clay, w-101, m-29	305	310	Blue clay
84-W	0	19	SECOND SOUTH AND SEVENTH EAST		310	325	Gravel										
							Medium, brown silty sand, 4370, w-118, m-12	310	313	Gravel							
							Medium to dense, brown sandy gravel w/silt and clay, w-116, m-15	313	325	Blue clay							
							Medium, brown silty sand, 4378, w-115, m-16	85-W		SOUTH TEMPLE AND FIFTH EAST							
							Medium, tan silty sand, w-117, m-12	0	42	Cemented sand, gravel, and cobbles							
							85-W	19	42	SECOND SOUTH AND SEVENTH EAST		42	55	Loose rock			
														Medium, brown silty sand, 4370, w-118, m-12	55	60	Clay
														Medium to dense, brown sandy gravel w/silt and clay, w-116, m-15	60	80	Loose rock
														Medium, brown silty sand, 4372, w-113, m-14	80	154	Clay and gravel
														Loose, to dense, brown sand and gravel w/silt and clay, w-101, m-29	154	174	Gravel and sand
86-W	19	42	FIFTH SOUTH AND SIXTH EAST		174	186	Sand and clay										
							Medium, brown silty sand, 4370, w-118, m-12	186	197	Sand and gravel							
							Medium to dense, brown sandy gravel w/silt and clay, w-116, m-15	197	226	Clay							
							Medium, brown silty sand, 4372, w-113, m-14	226	236	Cemented sand, gravel, and cobbles							
							Loose, to dense, brown sand and gravel w/silt and clay, w-101, m-29	236	253	Coarse gravel							
							87-W	0	5	FIFTH SOUTH AND SIXTH EAST		253	259	Clay			
														Top soil	86-W		SOUTH TEMPLE AND FIFTH EAST
														Clay and sand	0	5	Top soil
														Coarse sand and gravel	5	55	Clay and sand
														Sandy clay	55	165	Clay and gravel
88-W	5	25	SECOND SOUTH AND SEVENTH EAST		165	183	Coarse gravel										
							Medium, brown silty sand, 4370, w-118, m-12	165	183	Coarse sand							
							Medium to dense, brown sandy gravel w/silt and clay, w-116, m-15	183	195	Sand and clay							
							Medium, brown silty sand, 4372, w-113, m-14	183	195	Clay							
							Loose, to dense, brown sand and gravel w/silt and clay, w-101, m-29	195	235	Clay							
							89-W	116	124	FIFTH SOUTH AND SIXTH EAST		235	243	Cemented sand, gravel, and boulders			
														Top soil	243	262	Coarse gravel
														Clay and sand	262	268	Clay
														Clay and gravel			
														Coarse sand			
90-W	127	176	SECOND SOUTH AND SEVENTH EAST														
							Clay										
							Clay and gravel										
							Coarse sand										
							Clay										
91-W	176	180	FIFTH SOUTH AND SIXTH EAST														
							Clay and boulders										
							Clay and gravel										
							Coarse sand										
							Clay										
92-W	180	187	SECOND SOUTH AND SEVENTH EAST														
							Clay and gravel										
							Coarse sand										
							Clay										
							Black sandy clay										

Logs of Boreholes, continued.

Hole No.	Depth From	To	Location	Hole No.	Depth From	To	Location
87			SECOND AVENUE AND "D" STREET	92-W			THIRD AVENUE AND MEMORIAL LANE
	0	2	Gravel and clay fill, 4467		0	15	Boulders, and clay, 4374
	2	5	Gravel		15	25	Boulders, gravel, and clay
	5	23	Tan silty sand w/layers of silt and clay		25	35	Boulders, sand, and gravel
	23	32	Tan sand w/some gravel		35	59	Boulders, gravel, and clay
	32	39	Very fine sandy silt		59	63	Sand and fine gravel
	39	44	Fine tan sand		63	65	Gravel and clay
	4	50	Layers of sand, silty sand, and clay		65	70	Boulders and gravel
	50	B-55	Sand and gravel		70	90	Gravel and clay
					90	110	Gravel, sand, and clay
88			SECOND AVENUE AND "D" STREET		110	115	Boulders and gravel
	0	6	Gravel, 4465.5		115	130	Gravel, sand and yellow clay
	6	24	Tan silty sand w/sand, clay, and silt lenses, 4465.5		130	135	Gravel, w/some clay
					135	140	Gravel
	24	26	Gravel		140	145	Gravel and clay
	26	46	Tan fine sand		145	146	Gravel
	46	48	Blue clay		146	148	Coarse sand
	48	52	Fine silty sand		148	152	Coarse gravel
	52	56	Gravel		152	154	Sand and coarse gravel
	56	59	Sandy clay		154	180	Gravel
	59	B-63	Clay and gravel		180	181	Clay
					181	186	Gravel and fine sand
89			SECOND AVENUE AND "D" STREET	93			SECOND SOUTH AND THIRD EAST
	0	7	Gravel, 4460		0	4	Gravel and cobbles, 4294
	7	22	Tan fine sand w/layers of silt and clay		4	5	Red-brown sand
	22	27	Yellow sandy clay and gravel		5	16	Red-brown silty clay w/gravel lens
	27	B-32	Tan silty sand		16	23	Silty clay, w-96, m-27.2
90-W			LATTER-DAY SAINT HOSPITAL		23	25	Dark gray silty clay
	0	18	Sand and gravel, 4612		25	40	Gray silty clay, w-91, m-30.2
	18	45	Sand and gravel		40	41	Gray fine sand
	45	65	Fine sand		41	47	Sand and gravel
	65	80	Gravel and clay		47	56	Layers of gray silty clay w/gravel
	80	84	Sand		56	62	Green-gray silty clay, w-93, m-27.6
	84	100	Gravel and clay		62	66	Gravel w/green-gray silty clay
	100	205	Gravel, and rocks	94			SECOND SOUTH AND THIRD EAST
	205	224	Clay and gravel		0	12	Fill, 4293
	224	255	Clay and gravel		12	23	Silty clay w/gravel lens, w-88, m-33.8
	255	280	Brown clay		23	40	Dark gray silty clay, w-87, m-34.0
	280	325	Sand and clay		40	46	Gray sand and gravel
	325	404	Cemented gravel		46	50	Gray silty clay, w-91, m-28.7
	404	411	Clay		50	51	Gravel
	411	440	Clay and gravel	95			SECOND SOUTH AND THIRD EAST
	440	443	Clay		0	3	Gravel w/silty clay, 4290
	443	465	Gravel		3	11	Multicolored silt
	465	492	Clay and gravel		11	12	Gravel
91-W			FOURTH AVENUE AND MEMORIAL LANE		12	21	Light gray clay
	0	26	Sand and gravel, 4400		21	42	Gray silty clay, w-84, m-36.2
	26	34	Clay, sand, and gravel		42	49	Gray silty clay w/gravel
	34	40	Clay		49	55	Fine sand w/gravel
	40	140	Dense sand and gravel		55	62	Light gray silty clay, w-110, m-16.5
	140	170	Coarse sand and gravel		62	75	Sand and gravel, w-119, m-14.9
	170	176	Cemented sand and gravel		75	86	Brown silt and gravel
	176	216	Coarse sand and gravel		86	90	Silty clay, w-103, m-16.8
	216	231	Clay, sand, and gravel		90	92	Sand and gravel
	231	289	Sand, gravel, and boulders	96			SECOND SOUTH AND THIRD EAST
	289	296	Clay, sand, and gravel		0	2	Brown sandy silt, 4292
	296	310	Clay		2	5	Brown sand
	310	318	Sand, and gravel		5	19	Brown silty clay
	318	324	Clay and gravel		19	21	Silty clay
	324	341	Sand and gravel				
	341	350	Clay, sand, and gravel				
	350	380	Clay				
	380	400	Coarse gravel w/some sand				
	400	408	Clay, sand, gravel				
	408	420	Sand, gravel				
	420	464	Clay, sand, and gravel				

Logs of Boreholes, continued.

Hole No.	Depth From	To	Location	Hole No.	Depth From	To	Location			
97	0	3	STATE STREET AND SIXTH SOUTH	69	91		Stiff gray organic silty clay, w-111, m-31			
			Sandy silt, 4250				Red-brown sandy silt w/gravel, w-99, m-29			
	3	9	Medium redish tan sandy silt, w-108, m-19	102			THIRD EAST AND FIFTH SOUTH			
	9	18	Stiff tan clay w/sand layers, w-97, m-31				0	6	Dark brown top soil, 4260	
	18	33	Soft, gray clay, w-71, m-61				6	30	Very dense, red-brown fine to coarse sand w/gravel, 30	
	33	37	Stiff, brown sandy clay, w-116, m-16				30	32	Gray brown fine sand	
	37	47	Medium, brown sandy gravel, w-103, m-22				32	42	Very dense, fine to coarse gravel w/sand, 60	
47	53	Soft, dark gray clay, w-85, m-35	42				60	Gray sandy silt w/gravel, 22, w-2.21		
60	62		62				67	Coarse to fine gravel		
98	0	3	STATE STREET AND SIXTH SOUTH	62	67		Gray silty clay w/fine gravel, 60, w-2.00			
			Sandy silt, 4248	67	70		Red brown fine and coarse gravel w/sand			
	3	10	Dense to medium, tan sandy silt, w-114, m-14	70	86		Gray organic silty clay, 12, w-2.66			
	10	24	Soft, gray clay w/sand layers, w-91, m-34	86	97		Red brown sandy silt w/gravel, 35			
	24	29	Soft, gray clay, w-90, m-33	103			SECOND EAST AND FIFTH SOUTH			
	29	42	Very dense, sandy gravel, w-117, m-18				0	1		Sand and gravel fill, 4260, 4247
99	0	3	STATE STREET AND SIXTH SOUTH	1	6		Medium, dark brown sandy silt w/sand, w-112, m-11			
			Sandy silt	6	9		Tan clayey silt, w-106, m-16			
	3	8	Dense, tan sandy silt, w-115, m-15	9	12		Dense, brown fine to coarse sand and gravel			
	8	11	Loose, tan clayey sand, w-99, m-27	12	14		Tan clayey silt			
	11	17	Medium, red-tan clay, w-99, m-27	14	40		Red brown fine to coarse sand and gravel, w-127, m-17			
	17	28	Soft, gray clay w/sand layers, w-91, m-33	40	42		Loose, tan clayey silt, w-107, m-25			
	28	34	Stiff, gray clay w/gravel layers, w-113, m-19	42	50		Medium, gray-brown silty sand, w-115, m-18			
	34	38	Medium, fine gravel	104			SECOND EAST AND FIFTH SOUTH			
38	52	Medium, gray clayey gravel, w-126, m-13	0				1		Sand and gravel fill, 4260, 4244	
100	0	3	STATE STREET AND SIXTH SOUTH	1	7		Medium, brown sandy silt, w-112, m-13			
			Sandy silt	7	12		Tan clayey silt, w-105, m-15			
	3	6	Medium, tan sandy silt, w-115, m-20	12	50		Red brown fine to coarse sand and gravel, w-130, m-21			
	6	7	Gravel	105			THIRD EAST AND FIFTH SOUTH			
	7	14	Stiff, tan sandy clay, w-126, m-13				0	4		Medium, dark brown top soil, 4263, 4245, w-97, m-13
	14	17	Stiff, tan clay w/sand layers, w-100, m-25				4	9		Tan silty sand w/fine gravel
	17	28	Soft, gray clay, w-81, m-35				9	19		Red-brown fine to coarse gravel w/fine sand, w-115, m-13
	28	34	Medium, gray clayey gravel, w-113, m-20				19	32		Medium, gray poorly sorted fine gravel, w-127, m-11
34	38	Dense, fine gravel, w-123, m-10	32				37		Medium, fine to coarse gravel w/sand, w-122, m-12	
38	42	Dense, gray clayey sand, w-99, m-30	37	44		Dense, brown sand, silt, and fine to coarse gravel, w-129, m-13				
101	0	5	THIRD EAST AND FIFTH SOUTH	44	65		Medium, tan sandy silt and silty sand, w-108, m-22			
			Dense, tan silty sand w/fine gravel, 4261, 4244, w-104, m-3	65	70		Very dense brown fine to coarse gravel, w-117, m-18			
	5	10	Gray fine gravel w/coarse to fine sand	70	77		Gray sandy silt w/gravel, w-95, m-31			
	10	17	Medium, red-brown fine to coarse gravel w/sand, w-114, m-9	77	88		Very stiff gray-blue clay, w-118, m-22			
	17	30	Dense, gray poorly sorted fine gravel, w-124, m-11	88	100		Red-brown sandy silt, w-112, m-27			
	30	32	Thin gray silty clay layers							
	32	44	Medium, brown sand and silt w/gravel, w-123, m-10							
	44	53	Medium gray sandy silt w/gravel, w-116, m-12							
	53	56	Gray silty clay w/gravel, w-99, m-29							
	56	69	Very dense brown coarse sand w/gravel, w-129, m-12							

Logs of Boreholes, continued.

Hole No.	Depth From	To	Location	Hole No.	Depth From	To	Location
106	0	3	THIRD EAST AND FIFTH SOUTH Dark brown top soil, 4263, 4247	62	64		Gray sandy silt, w-97, m-27
	3	7	Medium, gray fine gravel w/sand, w-95, m-12	64	69		Dense coarse brown sand w/fine gravel, w-119, m-27
	7	16	Dense, brown fine to coarse gravel w/sand, w-111, m-12	69	76		Dense, gray fine gravel and coarse sand, w-121, m-29
	16	32	Medium, gray poorly sorted fine gravel, w-126, m-11	111			THIRD EAST AND FOURTH SOUTH
	32	35	Thin gray silt layers, w-130, m-14	0	10		Medium, brown sandy-silt w/fine gravel, 4263, 4248, w-108, m-15
	35	43	Dense, brown fine to coarse gravel w/sand, w-125, m-12	10	12		Medium, fine to coarse brown sand, w-99, m-22
107			THIRD EAST AND FIFTH SOUTH	12	35		Dense fine gravel and coarse to fine sand, w-119, m-20
	0	2	Dark brown top soil, 4262, 4247	35	36		Gray fine sand
	2	7	Medium, tan silty sand w/fine gravel w-99, m-12	36	40		Stiff gray clay layer
	7	23	Red brown coarse sand w/gravel, w-111, m-13	40	52		Very dense, coarse and fine gravel w/sand, w-116, m-24
	23	32	Medium, gray fine to coarse gravel w/sand, w-122, m-12	112			THIRD EAST AND FOURTH SOUTH
	32	34	Gray silty clay layer, w-102, m-27	0	3		Dark brown top soil, 4296.8, 4250
	34	46	Dense, fine to coarse gravel w/fine sand, w-128, m-12	3	6		Tan hardpan-clayey silt, w-99, m-13
	46	56	Tan sandy silt w/fine gravel, w-106 m-23	6	8		Brown silty sand
	56	66	Dense, gray silty sand w/fine gravel, w-109, m-21	8	13		Soft, gray-brown silty clay, w-96, m-28
	66	68	Red brown sandy clay w/gravel, w-11 m-19	13	16		Loose, light brown silty sand, w-107, m-22
	68	69	Blue-gray clay layer	16	23		Medium, gray poorly sorted fine gravel, w-121, m-12
	69	73	Dense, brown sand w/gravel, w-116, m-18	23	26		Loose, yellow-brown sandy silt, w-96, m-26
	73	80	Loose, gray sandy silt w/gravel, w-96, m-30	26	30		Medium, gray fine sand
80	93	Medium, gray organic clay, w-106, m-36	30	48		Medium, gray brown organic silty sand, w-98, m-23	
93	98	Red brown silty sand w/gravel	48	55		Gray fine to coarse silty sand, w-124, m-18	
108			SECOND EAST AND FIFTH SOUTH	55	66		Dense fine to coarse gravel w/brown sand, w-130, m-14
	0	2	Sand and gravel fill, 4259, 4242	66	78		Medium, gray-brown silty sand w/some fine gravel, w-127, m-16
	2	4	Dark brown sandy silt	78	81		Very dense, coarse gravel w/brown sand, w-129, m-15
	4	9	Tan clayey silt, w-109, m-16	81	98		Stiff, gray-brown clay w/some fine gravel, w-119, m-16
	9	33	Red-brown dense, fine to coarse sand and gravel, w-127, m-18	113			THIRD EAST AND FOURTH SOUTH
	33	34	Light gray sandy silt	0	6		Medium, brown sandy-silt w/fine gravel, 4264, 4244, w-108, m-14
	34	42	Red-brown very dense, sand and gravel, w-139, m-20	6	17		Stiff, silty clay, w-98, m-27
				17	26		Medium, fine gravel and sand, w-120, m-22
109			SECOND EAST AND FIFTH SOUTH	26	31		Gray silty clay, w-94, m-30
	0	1	Sand and gravel fill, 4260, 4243	31	33		Fine to coarse gravel w/sand, w-123, m-32
	1	8	Medium, dark brown sandy silt w/sand, w-105, m-15	33	41		Very stiff, gray silty clay, w-97, m-34
	8	11	Tan clayey silt, w-114, m-17	41	62		Sandy silt, w-106, m-27
	11	45	Red-brown fine to coarse sand and gravel, w-120, m-22	62	66		Gray clay
110			THIRD EAST AND FOURTH SOUTH	66	68		Medium, brown sandy silt, w-87, m-48
	0	7	Brown sandy silt, 4263, 4248, w-109, m-14	68	77		Dense, fine gravel w/sand, w-124, m-25
	7	16	Medium, tan silty clay, w-98, m-27	77	95		Medium, brown silty sand, w-109, m-21
	16	37	Dense, fine gravel and coarse to fine sand, w-120, m-19	95	98		Dense, tan silty sand w/fine gravel, w-117, m-19
	37	38	Gray clay	98	103		Brown silty clay, w-101, m-18
	38	62	Dense, fine to coarse gravel w/sand, w-118, m-26				

Logs of Boreholes, continued.

Hole No.	Depth From To	Location	Hole No.	Depth From To	Location
114		THIRD EAST AND FOURTH SOUTH			w/sand
	0 2	Sand and gravel fill, 4264, 4239		77 91	Tan sandy silt, w-111, m-18
	2 7	Loose, dark brown sandy silt w/fine gravel, w-106, m-12		91 93	Medium gray-brown silty sand w/gravel, w-114, m-19
	7 12	Brown silty clay w/sand seams, w-105, m-22		93 98	Dark gray silty clay, w-98, m-28
	12 22	Soft, layered brown silty clay, w-99, m-27	117		SECOND EAST AND FOURTH SOUTH
	22 31	Red brown fine to coarse gravel w/sand, w-122, m-20		0 15	Stiff brown sandy clay, 4260
	31 41	Medium gray silty clay, w-95, m-31		15 16	Fine gravel
	41 52	Dense, fine to coarse gravel w/sand, w-126, m-29		16 19	Brown fine silty sand
	52 66	Loose gray sandy silt w/fine gravel, w-110, m-26		19 33	Soft gray silt clay
	66 73	Brown sandy silt, w-106, m-28		33 34	Gray sandy silt
	73 75	Gray brown clay		34 35	Loose silty gravel
	75 77	Dense, fine to coarse gravel w/sand, w-119, m-20		35 36	Fine sand
	77 89	Tan sandy silt w/sand, w-108, m-17		36 42	Fine to medium gravel
	89 98	Medium, tan silty sand w/gravel, w-115, m-19	118	42 43	Dense silty sand
				43 45	Fine gravel
				45 49	Medium sand
					SECOND EAST AND FOURTH SOUTH
				0 6	Fine to medium gravel, 4262
				6 8	Gravel and sandy clay
				8 10	Stiff sandy clay
115		THIRD EAST AND FOURTH SOUTH		10 11	Loose fine gravel and sand
	0 8	Brown sandy silt w/gravel, 4265, 4244, w-109, m-13		11 16	Brown clayey silt w/lenses of gravel
	8 15	Medium, brown silty clay w/sand seams, w-96, m-26		16 19	Medium fine brown sand
	15 26	Soft, brown silty clay, w-99, m-27		19 29	Soft gray silty clay w/organic material
	26 32	Medium, fine gravel w/sand, w-124, m-21		29 33	Loose, gray silty sand
	32 37	Very stiff gray silty clay, w-94, m-33		33 38	Medium, brown fine sand
	37 44	Dense, coarse and fine gravel w/sand, w-124, m-32		38 43	Medium, silty sand
	44 62	Sandy silt, w-106, m-28		43 46	Stiff, silty clay
	62 64	Gray stiff clay		46 47	Silty fine gravel
	64 69	Very stiff brown silty clay, w-84, m-56	119	47 48	Fine to coarse gravel
	69 73	Dense, fine gravel and sand, w-119, m-23		48 49	Dense fine silty sand
	73 87	Gray silty clay, w-107, m-21		49 50	Fine to coarse gravel
	87 95	Very dense, tan silty sand w/gravel, w-119, m-12			Second East and Fourth South
	95 102	Brown silty clay w/fine gravel, w-103, m-19		0 7	Fine to medium gravel w/silty sand, 4263
				7 9	Gravel w/gray sandy clay
				9 11	Light brown silty clay
				11 12	Fine gravel w/clay
				12 13	Stiff sandy clay
				13 15	Brown fine silty sand
				15 16	Fine gravel
				16 20	Fine silty sand
				20 38	Very loose sandy silt w/organic material
116		THIRD EAST AND FOURTH SOUTH			Sand and gravel
	0 2	Sand and gravel fill, 4264, 4247		38 39	Stiff gray silty clay w/gravel
	2 7	Stiff, brown silty clay w/sand seams, w-105, m-19		39 44	Fine to medium gravel
	7 18	Soft, brown silty clay w/fine sand and gravel, w-103, m-23		44 48	Stiff gray silty clay w/gravel
	18 22	Loose, tan fine to coarse sand, w-106, m-25	120		SECOND EAST AND FIRST SOUTH
	22 27	Soft, brown silty clay, w-98, m-27		0 5	Dark brown silty sand, 4299
	27 32	Medium, light gray silty clay w/sand, w-101, m-30		5 15	Gravel
	32 38	Stiff, dark gray silty clay, w-95, m-32		15 30	Brown silty clay w/lenses of silt, sand, or gravel
	38 44	Dense, coarse to fine gravel w/sand, w-124, m-27		30 35	Gray sand
	44 46	Brown clayey silt w/gravel		35 51	Dark gray clay, w-99, m-25.8
	46 70	Loose, gray-brown sandy silt, w-106, m-28		51 61	Gray silty clay
	70 77	Very dense, fine to coarse gravel		61 66	Green-gray silt
				66 67	Green-gray silty clay, w-104, m-20.5
				67 72	Gravel

Logs of Boreholes, continued.

Hole No.	Depth From To	Location	Hole No.	Depth From To	Location
121		SECOND EAST AND FIRST SOUTH	126		STATE STREET AND FIRST SOUTH
	0 8	Fill-bricks, wood, gravel, and silt, 4302		0 4	Loose, top soil w/rock, 4302, 4285
	8 11	Gravel w/sand		4 21	Dense, gravel and sand
	11 15	Red-brown silt		21 24	Loose layers of silty sand
	15 30	Brown silty clay w/lenses of gravel and coarse sand, w-92, m-31		24 29	Medium, sand and gravel
	30 36	Gray sand, w-93, m-28.4		29 36	Medium, silty clay
	36 57	Gray clay, w-101, m-24.8		36 46	Layers of sand, pea gravel and blue sand
	57 61	Dark gray sand w/gravel		46 68	Soft, blue clay
	61 68	Red-brown silt		68 70	Stiff sandy clay
	68 69	Gray silty clay	127		STATE STREET AND FIRST SOUTH
	69 71	Brown silt w/gravel		0 8	Loose, top soil, rock and cinder fill, 4303, 4284
122		SECOND EAST AND FIRST SOUTH		8 16	Loose, sandy silt and gravel
	0 5	Fill-brick and sand, 4303		16 23	Dense, gravel w/boulders
	5 14	Gravel w/sand and silt		23 31	Loose, silty sand w/some layers of gravel and coarse sand
	14 25	Brown silty clay		31 34	Loose, gravel and sand
	25 30	Brown silt w/clay, w-93, m-29		34 42	Tan silty clay
	30 34	Brown silt w/gravel		42 53	Layers of sand and clay
	34 37	Gray sand, w-99, m-25.2		53 60	Soft, blue clay
	37 64	Dark gray clay	128		STATE STREET AND FIRST SOUTH
	64 70	Gray sand w/silt lenses		0 9	Loose top soil, and gravel fill, 4304, 4286
	70 73	Gray silt w/gravel		9 29	Medium, sand and gravel w/layers of sand and silty clay
	73 79	Gravel		29 39	Medium, sandy gray clay
123		SECOND EAST AND FIRST SOUTH		39 48	Medium, blue gray sand w/layers of pea gravel
	0 7	Brown silty, clayey, sand, 4304		48 60	Soft, blue clay
	7 14	Gravel w/sand	129		STATE STREET AND FIRST SOUTH
	14 27	Brown silty clay		0 8	Loose, gravel and sand fill, 4304, M.N.
	27 35	Brown silt w/clay streaks		8 37	Layers of fine sand w/some gravel
	35 39	Gray sand		37 43	Soft tan sandy clay
	39 59	Dark gray clay		43 48	Soft, blue clay
	59 65	Gray silty clay		48 53	Layers of medium fine sand
	65 70	Light gray silty clay		53 83	Soft, blue clay
	70 78	Gravel w/silty clay streaks		83 85	Dense, sand and gravel
124		SECOND EAST AND FIRST SOUTH	130		STATE STREET AND FIRST SOUTH
	0 4	Medium, gravel fill, 4302, N.M.		0 11	Loose, gravel and sand fill, 4304, dry
	4 10	Medium, gravel and sand		11 24	Dense, gravel and sand
	10 14	Loose, medium sand w/little gravel		24 29	Loose, layers of sand
	14 25	Medium gravel and sand w/layers of sand		29 32	Medium, gravel and sand
	25 35	Medium, sandy tan clay w/layers of silt		32 44	Soft, silty tan clay
	35 38	Layers of gravelly sand - blue clay		44 82	Soft, blue clay
	38 43	Gravel and gray sand		82 85	Gravel and sand
	43 69	Soft, blue clay	131		STATE STREET AND FIRST SOUTH
	69 71	Medium, sand		0 4	Very loose, clay and gravel fill, 4307, dry
	71 85	Very dense, gravel and sand		4 34	Medium, sand gravel and boulders
125		SECOND EAST AND FIRST SOUTH		34 39	Loose, silty sand w/layers of tan clay
	0 8	Loose, top soil and fill, 4302, 4285		39 47	Medium, sand and pea gravel
	8 18	Loose, gravel plus some layers of sand		47 85	Medium, blue clay w/some sand lenses
	18 32	Medium, layers of silty sand and clay		85 90	Very dense, gravel w/sand lenses
	32 34	Layers of sand and gravel	132		SECOND EAST AND FIRST SOUTH
	34 38	Layers of silty sand and clay		0 10	Dense, light brown silty sandy gravel, 4302, w-106, m-3.4
	38 42	Medium, blue gray fine sand			
	42 65	Soft, blue clay			
	65 68	Layers of fine sand			
	68 72	Stiff, white clay w/some rock			
	72 76	Layers of medium sand and gravel			
	76 86	Very dense, chipped gravel and sand			

Logs of Boreholes, continued.

Hole No.	Depth From	To	Location	Hole No.	Depth From	To	Location
	10	15	Loose tan silty sand, w-99, m-29		54	59	Dense sand gravel and cobbles
	15	26	Medium tan clayey sand, w-89, m-30		59	77	Sand, silt, and clay
	26	34	Stiff tan clay, w-102, m-20		77	83	Very dense, gravelly sand w/some organic material
	34	36	Medium silty sand, w-95, m-28		83	95	Very dense sandy gravel
	36	51	Soft blue clay, w-90, m-34				
	51	56	Gray sand	136			STATE STREET AND SOUTH TEMPLE
	56	61	Coarse gravel and sand		0	6	Medium, sandy gravel and cobbles, 4335
133-W			144 SOCIAL HALL AVENUE		6	10	Silty gravel
	0	3	Top soil, 4320, 4085		10	36	Sandy gravel and cobbles
	3	20	Gray clay		36	49	Medium, red-brown sandy silt w/some clay layers
	20	35	Sandy clay		49	51	Gray blue silty sand
	35	45	Cemented sand, gravel, and cobbles		51	54	Very dense, gravel and cobbles
	45	48	Loose rock		54	57	Dense, sandy blue gray silt
	48	50	Brown clay		57	67	Medium, blue gray clayey silt with gravel layers
	50	55	Cemented sand, gravel, and cobbles		67	78	Blue clay w/some gravel
	55	58	Loose gravel		78	95	Very dense, gravel with cemented layers
	58	60	Brown clay				
	60	70	Cemented sand, gravel, and cobbles	137			STATE STREET AND SOUTH TEMPLE
	70	73	Loose gravel		0	4	Medium, silty sandy gravel and cobbles, 4345
	73	75	Brown clay		4	7	Dark brown gravelly silt
	75	85	Cemented sand, gravel, and cobbles		7	40	Dense, sandy gravel and cobbles
	85	88	Loose rocks		40	43	Sand and cobbles
	88	90	Brown clay		43	50	Medium, sand w/silty clay layers
	90	100	Cemented sand, gravel, and cobbles		50	53	Blue gray sandy silt w/clay layers
	100	103	Loose rocks		53	58	Blue gray sandy silt w/gravel
	103	105	Brown clay		58	76	Medium, blue gray sandy silt
	105	115	Cemented sand, gravel, and cobbles		76	B-80	Gravel and cobbles
	115	120	Loose rocks				
	120	123	Clay	138			STATE STREET AND FIFTH SOUTH
	123	135	Cemented sand, gravel, and cobbles		0	4	Fill-sand, gravel, and cinders, 4254
	135	140	Loose rocks		4	15	Loose, tan silty sand, w-113, m-6
	140	142	Clay		15	16	Clay
	142	150	Cemented sand, gravel, and cobbles		16	20	Loose, gray sand, w-94, m-25
	150	165	Loose gravel		20	21	Silt
	165	167	Sand		21	24	Loose, gray sand
	167	237	Cemented sand, gravel, and cobbles		24	29	Soft, gray clay, w-79, m-45
	237	244	Hard pan		29	32	Stiff, sandy clay
	244	247	Coarse sand		32	37	Stiff, gray clay, w-98, m-24
	247	251	Cemented sand, gravel, and cobbles				
	251	259	Coarse sand	139			STATE STREET AND FIFTH SOUTH
	259	265	Cemented sand, gravel, and cobbles		0	4	Cinder and gravel fill, 4252
	265	277	Coarse gravel		4	9	Medium, tan sand and silt w/gravel, w-131, m-7
	277	280	Brown clay		9	13	Medium, tan silty sand, w-100, m-27
134			STATE STREET AND SOUTH TEMPLE		13	19	Stiff, tan silty clay, w-99, m-27
	0	11	Loose, silty sandy gravel, 4330		19	23	Soft, tan silty clay w/sand, w-92, m-32
	11	14	Medium, dark brown gravelly clay		23	29	Medium, tan clay, w-94, m-26
	14	24	Dense, sandy gravel and cobbles		29	36	Stiff, gray silty clay, w-86, m-32
	24	26	Sand and gravel				
	26	35	Medium, sandy gravel and cobbles				
	35	42	Brown fine silty sand with clay lenses				
	42	52	Blue gray silty clay				
	52	55	Fine gray sand				
	55	77	Silty clay to clayey silt				
	77	80	Very dense sandy gravel and cobbles				
135			STATE STREET AND SOUTH TEMPLE	140			STATE STREET AND FIFTH SOUTH
	0	14	Medium sandy gravel and cobbles, 4342		0	3	Cinder and gravel fill, 4253
	14	19	Very dense sandy gravel and cobbles		3	17	Loose, tan silty sand, w-98, m-27
	19	43	Dense, sandy gravel and cobbles		17	24	Soft, gray silty clay, w-86, m-38
	43	46	Medium, coarse to fine sand		24	27	Loose, tan silty sand, w-98, m-24
	46	54	Medium, sandy brown silt		27	32	Medium, gray silty clay, w-100, m-25
					32	36	Stiff, gray clay w/gravel, w-97, m-41

Logs of Boreholes, continued.

Hole No.	Depth From	To	Location	Hole No.	Depth From	To	Location
141			MAIN STREET AND FOURTH SOUTH		482	532	Blue clay
	0	3	Coarse sand and brick, 4259, 4252		532	589	Brown clay
	3	7	Sandy silt with gravel		589	592	Gravel and clay
	7	10	Gray-brown sandy clay, w-104.2, m-21.0		592	622	Blue clay
	10	13	Brown fine sand		622	641	Gravel
	13	30	Brown to gray clay w/lenses of sand, silt, and gravel, w-91.6, m-32.2		641	642	Clay
	30	36	Green clay, w-92.0, m-30.1		642	660	Gravel w/clay
	36	42	Gray clay w/lenses of sand and silt, w-83.2, m-36.6	146	660	670	Blue clay
	42	50	Sandy clay w/some gravel		0	15	SECOND SOUTH AND MAIN STREET Very dense, silty sand w/gravel, 4294
	142	0	13	Brown sandy silt with gravel, 4261, 4252, w-98.5, m-23.4		15	35
13		19	Brown silty sand w/lenses of clay, w-102.0, m-23.6	147	35	45	Very dense, silty sand and coarse sand w/gravel and cobble
19		24	Brown medium sand w/lenses of clay, w-127.0, m-11.7		0	12	SECOND SOUTH AND MAIN STREET Very dense, silty sand and coarse sand w/gravel, 4293
24		35	Gray clay w/lenses of fine sand and silt, w-94.7, m-27.9		12	25	Very dense, silty sand and coarse sand w/gravel and cobble
35		41	Green clay, w-88.8, m-33.7		25	27	Very dense, sand w/gravel and cobble
143	0	7	Gravel with silty clay, 4258, 4249		27	35	Sand w/gravel and cobble
	7	16	Brown sandy silt, w-98.1, m-24.1	148	35	41	Very dense, silty sand and coarse sand w/gravel and cobble
	16	20	Brown clay w/some organics, w-86.3, m-33.9		0	1	SECOND SOUTH AND MAIN STREET Sand w/gravel, 4298
	20	35	Gray clay w/lenses of silty clay, w-94.3, m-29.8		1	4	Silty sand and coarse sand w/gravel
	35	40	Green clay w/lenses of silty clay		4	10	Silty sand and coarse sand w/gravel
	40	43	Gray clay w/lenses of silty clay, w-85.3, m-34.3		10	18	Very dense, silty sand and coarse sand w/gravel
144	0	3	Sand and gravel, 4262, 4250, w-100.8, m-20.5	149	18	40	Very dense, silty sand and coarse sand w/gravel and cobble
	3	10	Black clay w/sand and gravel		0	1	SECOND SOUTH AND MAIN STREET Sand w/gravel, 4300
	10	12	Sandy silt and clay		1	4	Silty sand and coarse sand w/gravel
	12	16	Gray sandy clay w/lenses of sand and gravel, w-95.3, m-27.7		4	8	Silty sand and coarse sand w/gravel and cobble
	16	20	Silty clay w/some gravel		8	14	Very dense, silty sand and coarse sand w/gravel
	20	25	Gray-green sandy clay w/some gravel, w-103.7, m-24.5		14	31	Very dense, silty sand and coarse sand w/gravel and cobble
	25	35	Gray clay w/lenses of silt		31	41	Very dense, silty sand and coarse sand w/gravel and cobble
	35	40	Green clay, w-89.5, m-32.3		0	26	FIRST SOUTH AND STATE STREET Dense, light brown sand and gravel, 4317.5
	40	59	Gray clay w/lenses of silt and fine sand, w-86.3, m-33.3	150	26	30	Medium, light brown sandy silt w/clayey silt lenses
	145-W			28 EAST BROADWAY		30	46
0		16	Sand and gravel w/clay		46	71	Medium to stiff, black silty clay w/some organics and some black sand lenses
16		99	Green and black clay		71	80	Blue black sand and gravel
99		103	Gravel		0	25	FIRST SOUTH AND STATE STREET Medium to dense to medium, light brown sand and gravel, 4317.5, 4293
103		147	Blue clay		25	30	Stiff, brown silty clay
147		152	Gravel		30	59	Medium, blue gray silty clay w/sand lenses and some organic material
152		195	Brown clay				
195		323	Blue clay				
323		337	Hard Pan				
337		390	Brown clay	151			
390		410	Blue clay and gravel				
410		452	Cemented gravel				
452		455	Cemented sand, gravel, and cobbles				

Logs of Boreholes, continued.

Hole No.	Depth From	To	Location	Hole No.	Depth From	To	Location
	59	63	Loose, blue clayey silt w/organic material		55	60	Dark gray silty clay w/lenses of gray fine sand, w-94.0, m-24.2
	63	72	Loose, blue gray clayey silt		60	92	Dark gray clay w/some lenses of gray fine sand, w-86.0, m-34.6
152			FIRST SOUTH AND STATE STREET				MAIN STREET AND SOUTH TEMPLE
	0	34	Dense to medium, sand, gravel, and cobble, 4322.5	157-W	0	45	Boulders, 4330
	34	50	Loose, varved gray clayey silt and gray sand		45	95	Blue clay
	50	54	Fine blue gray sand		95	120	Sand, gravel, and boulders
	54	64	Medium, blue black silty clay w/alternating layers of loose fine sand		120	135	Clay and gravel
	64	71	Loose, black clayey silt		135	210	Sand, gravel, and boulders
	71	80	Varved gray silty clay and black clayey silt		210	235	Coarse sand, and gravel
					235	261	Clay, gravel, and boulders
					261	279	Coarse sand and gravel
					279	370	Stiff blue clay
					370	440	Layers of clay and gravel
153			FIRST SOUTH AND STATE STREET				MAIN STREET AND SOUTH TEMPLE
	0	8	Brown sandy silt and gravel fill, 4320, 4287	158	0	17	Medium to coarse gravel, 4357
	8	13	Brown sandy silt and gravel		17	65	Fine gravel and sand
	13	37	Partially cemented brown coarse sand and gravel		65	90	Blue silty clay
	37	45	Brown fine sand w/lenses of brown silt	159			MAIN STREET AND SOUTH TEMPLE
	45	47	Gray silty clay		0	15	Medium to coarse gravel, 4353
					15	55	Fine gravel and sand
154			FIRST SOUTH AND STATE STREET		55	63	Clayey silt
	0	10	Loose gravel fill, 4320		63	82	Fine sand
	10	12	Brown sandy loam with gravel and boulders		82	B-90	Blue silty clay
	12	14	Brown sand and gravel	160			MAIN STREET AND SOUTH TEMPLE
	14	32	Partially cemented brown coarse sand and gravel, w-131.1, m-5.6		0	20	Medium to coarse gravel, 4357, 4314
	32	33	Brown silty sand, w-129.2, m-7.2		20	55	Fine gravel and sand
	33	40	Brown coarse sand and gravel, w-136.1, m-5.8		55	60	Tan silt
	40	41	Light brown silt		60	72	Blue silty clay, w-98, m-26
	41	43	Gray and brown coarse sand and gravel		72	77	Medium sand
					77	99	Blue silty clay, w-91, m-32
					99	B-101	Gravel
155			FIRST SOUTH AND STATE STREET				MAIN STREET AND SOUTH TEMPLE
	0	5	Brown sandy silt, gravel, and brick fill, 4322	161	0	40	Graded sandy gravel w/boulders, 4355, 4283
	5	10	Brown sandy silt and gravel fill		40	48	Medium to fine sand w/some gravel
	10	15	Brown medium sand, gravel, and cobbles		48	61	Layers of silt and sand
	15	20	Partially cemented brown medium sand and gravel		61	64	Clay
	20	37	Brown coarse sand and gravel w/some cobbles and boulders		64	72	Fine silty sand
	37	45	Brown sand and gravel		72	87	Blue clay
	45	47	Alternating layers of brown fine sand and dark gray silt	162	87	B-90	Sandy gravel
	47	55	Dark gray silt w/lenses of dark gray fine sand and of dark gray silty clay, w-99.0, m-24.8		0	15	Medium to coarse gravel, 4355, 4290
					15	58	Fine gravel and sand
					58	72	Blue clayey silt
					72	82	Fine silty sand
					82	B-86	Blue clayey silt
156			FIRST SOUTH AND STATE STREET				MAIN STREET AND SOUTH TEMPLE
	0	4	Loose brown sandy silt and gravel fill, 4325, w-119.5, m-7.1	163-W	0	30	Boulders, sand, and gravel, 4330, 4226
	4	32	Brown coarse sand and gravel, w/some sandy silt lenses, w-125.8, m-11.4		30	35	Sand and clay
	32	39	Brown sand and gravel, w-125.5, m-7.0		35	45	Cemented sand, gravel, and cobbles
	39	42	Brown medium sand		45	50	Hard pan
	42	50	Brown fine sand		50	62	Gravel
	50	55	Alternating layers of brown fine sand and silty clay, w-103.8, m-25.2		62	83	Blue clay
					83	104	Clay and boulders
					104	128	Cemented sand, gravel, and cobbles
					128	147	Cemented gravel

Logs of Boreholes, continued.

Hole No.	Depth From	To	Location	Hole No.	Depth From	To	Location
	147	178	Gravel	170			MAIN STREET AND SOUTH TEMPLE
	178	190	Cemented sand, gravel, and cobbles		0	13	Dense sand, silt, and gravel, 4335
	190	220	Gravel		13	20	Sandy gravel
	220	235	Hard pan		20	32	Dense sandy gravel w/cobbles
	235	240	Gravel		32	43	Sandy gravel
	240	252	Cemented, sand, gravel, and cobbles		43	50	Fine sand
	252	264	Red clay		50	59	Sandy gravel
	264	287	Blue clay		59	61	Clay
	287	305	Cemented sand, gravel, and cobbles		61	90	Dense sand and gravel
	305	314	Hard pan				
	314	344	Gravel	171			STATE STREET AND NORTH TEMPLE
	344	350	Gravel		0	5	Cobble, 4345
	350	351	Hard pan		5	22	Sand, gravel and cobble
164			STATE STREET AND SOUTH TEMPLE		22	27	Gravel
	0	28	Silt, sand, gravel, and cobbles, 4344		27	44	Silty sand
	28	32	Fine sand		44	51	Sandy clay
	32	50	Thin sand and clay layers		51	79	Dense sand, gravel, and cobble
	50	62	Clay		79	83	Sandy gravel
	62	86	Dense sand and gravel		83	94	Silty sand
	86	102	Fine sand		94	99	Clayey sand
				172			STATE STREET AND NORTH TEMPLE
165			STATE STREET AND SOUTH TEMPLE		0	3	Gravel, 4346
	0	6	Silt, sand, and gravel, 4341		3	15	Sand, gravel, cobble
	6	27	Silt, sand, gravel, and cobbles		15	32	Sand and gravel
	27	31	Clayey gravel		32	40	Silty sand
	31	33	Fine gravel		40	44	Clay
	33	46	Fine sand		44	48	Silty sand
	46	57	Fine silt and sand		48	59	Clay
	57	61	Sandy silt		59	81	Dense sand and gravel
	61	68	Clay w/thin sand layers		81	90	Clayey gravel
	68	90	Dense sand and gravel		90	95	Gravel and sand
					95	101	Silt and sand
166			MAIN STREET AND SOUTH TEMPLE		101	111	Sand
	0	35	Silt, sand, gravel, and cobble, 4334	173			MAIN STREET AND NORTH TEMPLE
	35	45	Fine sand w/silt layers		0	12	Gravel and cobble, 4340
	45	71	Dense sandy gravel		12	17	Silty sand
	71	76	Layers of sand, silt, and gravel		17	38	Sand and gravel
	76	87	Sandy gravel		38	41	Cobble
	87	89	Sand		41	44	Sand
	89	108	Dense sand and gravel		44	51	Silty sand
					51	63	Clay
167			STATE STREET AND SOUTH TEMPLE		63	B-100	Sand and gravel
	0	19	Silt, sand, gravel, and cobbles, 4345	174			STATE STREET AND NORTH TEMPLE
	19	22	Sand		0	19	Sand, gravel and cobble, 4348
	22	33	Loose sand and gravel		19	39	Silty sand
	33	41	Layers of sand and silt		39	54	Clay
	41	51	Clay		54	65	Sandy gravel
	51	53	Sandy silt		65	70	Clayey, gravel
	53	64	Clay		70	87	Sand and gravel
	64	93	Dense sandy gravel		87	100	Silty sand
168			MAIN STREET AND SOUTH TEMPLE		100	117	Sand and gravel
	0	25	Silt, sand, gravel, and cobbles, 4338		117	B-145	Clayey sand and gravel
	25	29	Gravel	175			STATE STREET AND NORTH TEMPLE
	29	48	Sandy gravel and cobble		0	6	Silty sand, 4346
	48	62	Clayey silt w/thin sand layers		6	15	Sand, gravel and cobbles
	62	90	Dense sand and gravel		15	18	Sand
169			MAIN STREET AND SOUTH TEMPLE		18	29	Gravel, sand, and cobbles
	0	25	Silt, sand, gravel and cobbles, 4333		29	48	Silty sand
	25	34	Dense sand and gravel		48	57	Clay
	34	37	Sand		57	90	Sand and gravel
	37	70	Sand, gravel, and cobbles		90	95	Sand
	70	73	Sandy clay		95	102	Sand and gravel
	73	90	Dense sand and gravel		102	B-145	Clayey sand and gravel

Logs of Boreholes, continued.

Hole No.	Depth From To	Location	Hole No.	Depth From To	Location
176		STATE STREET AND NORTH TEMPLE		21 27	Light brown clayey silt
	0 10	Cobble, 4350		27 31	Medium, brown sandy silt w/fine gravel
	10 19	Sand and gravel			
	19 23	Silty gravel		31 33	Dense, medium to coarse gravel w/some fine sand
	23 40	Silty sand			
	40 50	Clay	181		STATE OFFICE BUILDING
	50 69	Sand and gravel		0 10	Brown coarse sand, coarse gravel, and cobbles, 4549.0
	69 72	Silty sand		10 13	Brown medium sand
	72 75	Clayey sand		13 18	Loose, red-brown sandy silt
	75 89	Sand and gravel		18 27	Very dense to medium, gravel w/brown coarse sand
89 93	Sand				
93 B-110	Sand and gravel				
177		STATE STREET AND NORTH TEMPLE		27 32	Very dense, gravel and coarse sand
	0 10	Cobble, 4341		32 35	Dense gray-brown, fine to medium sand
	10 29	Sand and gravel			
	29 32	Sand	182-W		MAIN STREET AND SOUTH TEMPLE
	32 37	Silty sand		0 39	Clay and boulders, 4335
	37 45	Clayey sand		39 70	Blue clay
	45 47	Sand		70 89	Brown clay
	47 58	Clay		89 105	Brown sandy clay
	58 78	Sand and gravel		105 114	Clay and gravel
	78 83	Clayey gravel		114 146	Cemented sand, gravel, and boulders
83 B-100	Sand and gravel	146 162		Boulders and gravel	
		162 170		Cemented sand, gravel, and boulders	
		170 230		Boulders and gravel	
178		STATE STREET AND NORTH TEMPLE		230 238	Brown clay
	0 3	Gravel, 4347		238 242	Cemented sand, gravel, and boulders
	3 17	Sand, gravel and cobble		242 250	Brown clay
	17 22	Sand		250 260	Cemented sand, gravel, and boulders
	22 37	Silty sand		260 276	Blue clay
	37 47	Silty gravel		276 298	Cemented gravel
	47 51	Clay		298 355	Cemented sand, gravel, and boulders
	51 69	Dense sand and gravel	183		MAIN STREET AND FIRST NORTH
	69 80	Clayey gravel		0 16	Loose fill, 4386
	80 83	Sandy gravel		16 20	Gravel and sand
83 94	Sand	20 37		Medium, tan clay, w-96, m-26	
94 B-99	Clayey sand	37 45		Blue clay	
		45 48		Sand w/gravel	
		48 60		Soft, blue clay w/sand lenses, m-42	
		60 68		Medium, gravel, sand, and clay	
179		STATE OFFICE BUILDING			MAIN STREET AND FIRST NORTH
	0 6	Medium, brown silty sand, 4558.5	184	0 2	Top soil, 4388
	6 9	Light brown sandy silt w/some fine gravel		2 15	Dense, gravel and sand
	9 14	Soft blue-gray silty clay		15 17	Medium, gravel w/sand
	14 20	Very dense, gravel w/some brown sand		17 21	Silty sand
	20 37	Dense, cemented gravel and fine to medium brown sand		21 36	Loose, clayey silt w/sand lenses
	37 40	Very dense, gravel and brown coarse sand		36 52	Medium, silty sand
	40 44	Brown fine and coarse sand and gravel w/thin layers of light brown silty clay		52 54	Clayey sand
	44 47	Fine gravel w/brown coarse sand		54 61	Medium, silty sand
	47 49	Dense, light brown sandy silt			
49 50	Very dense, fine and medium gravel				
180		STATE OFFICE BUILDING	185		MAIN STREET AND FIRST NORTH
	0 3	Light brown fine sand, 4549.6		0 3	Fill, 4375
	3 10	Loose, brown silty sand w/thin seams of blue-gray silty clay		3 8	Medium, gravel and sand
	10 16	Dense, medium to coarse light brown sand		8 25	Stiff, tan clay w/sand lenses, w-91, m-31
	16 18	Thin alternating layers of gravel and brown sandy clay		25 29	Gravel w/sand
	18 21	Very dense, medium sand w/some fine gravel		29 34	Soft blue clay, m-42
		34 36	Gravel w/sand		
		36 48	Medium, blue clay, m-37		
		48 60	Very dense, gravel and sand		

Logs of Boreholes, continued.

Hole No.	Depth From	To	Location	Hole No.	Depth From	To	Location
186			MAIN STREET AND FIRST NORTH	191			FIRST SOUTH AND MAIN STREET
	0	3	Fill, 4353		0	1	Bricks, mortar and gravel, 4298
	3	10	Dense, gravel and sand and clay		1	13	Brown, coarse sand, gravel, and cobbles
	10	23	Medium, tan sandy clay, m-24		13	14	Brown, fine to coarse sand
	23	31	Very dense, gravel and sand		14	20	Brown, coarse sand, gravel, and cobbles
	31	33	Silty clay		20	24	Very dense, brown, medium to coarse sand
	33	46	Gravel and sand		24	36	Brown, medium to coarse sand and gravel
187			MAIN STREET AND FIRST NORTH		24	36	Brown, fine to coarse sand
	0	10	Fill, 4400		36	47	Very dense, blue-gray, silty clay w/alternating layers of fine sand
	10	20	Medium, gravel and sand		47	55	Hard, blue-gray silty clay w/some lenses of fine sand and gravel, w-81, m-37
	20	26	Layers of tan clay and gravelly sand, m-24		55	99	Very dense, brown, fine to coarse sand and gravel
	26	29	Medium, tan clay		99	100	
	29	30	Gravelly sand	192			FIRST SOUTH AND MAIN STREET
	30	33	Medium, brown clay		0	47	Very dense, brown, coarse sand, gravel, and cobbles w/some lenses of brown, sand, 4304
	33	37	Layers of sandy gravel and clay		47	56	Brown, fine to coarse sand w/gravel, w-131, m-7
	37	42	Very dense, sandy gravel, m-38		56	60	Blue-gray, silty clay w/lenses of fine sand
	42	44	Clay				
	44	45	Sandy gravel				
	45	49	Medium clay, m-26				
	49	60	Medium, gray brown gravelly sand				
	60	65	Dense sandy gravel, m-20				
188			MAIN STREET AND FIRST NORTH				
	0	12	Very dense, sand w/gravel, 4382				
	12	24	Loose, tan silty sand				
	24	27	Very soft, tan clay				
	27	35	Soft, blue sandy clay				
	35	37	Medium, sandy clay				
	37	46	Very dense, sand w/gravel				
	46	49	Blue clay				
	49	57	Dense, sand w/gravel				
189			MAIN STREET AND FIRST NORTH				
	0	1	Silty sand, 4359				
	1	2	Clayey silt				
	2	3	Silty sand				
	3	4	Clayey silt				
	4	6	Medium, sand w/gravel, m-23				
	6	10	Sand and silt				
	10	12	Gravel and sand, m-23				
	12	15	Tan sandy clay				
	15	22	Medium, sand w/gravel				
	22	25	Stiff, tan sandy clay, m-37				
	25	37	Dense, gravel w/sand				
	37	38	Gravel and sand and clay				
	38	40	Gravel w/sand				
190			FIRST SOUTH AND MAIN STREET				
	0	1	Brown, medium to coarse sand and gravel, 4306				
	1	4	Dark brown, silty sand				
	4	17	Very dense, brown coarse sand, gravel, and cobbles				
	17	25	Medium, brown, fine to medium sand w/gravel				
	25	44	Very dense, brown coarse sand and gravel, w-139, m-12				
	44	54	Brown, medium to coarse sand w/gravel				
	54	60	Blue-gray, silty clay w/lenses of fine sand				

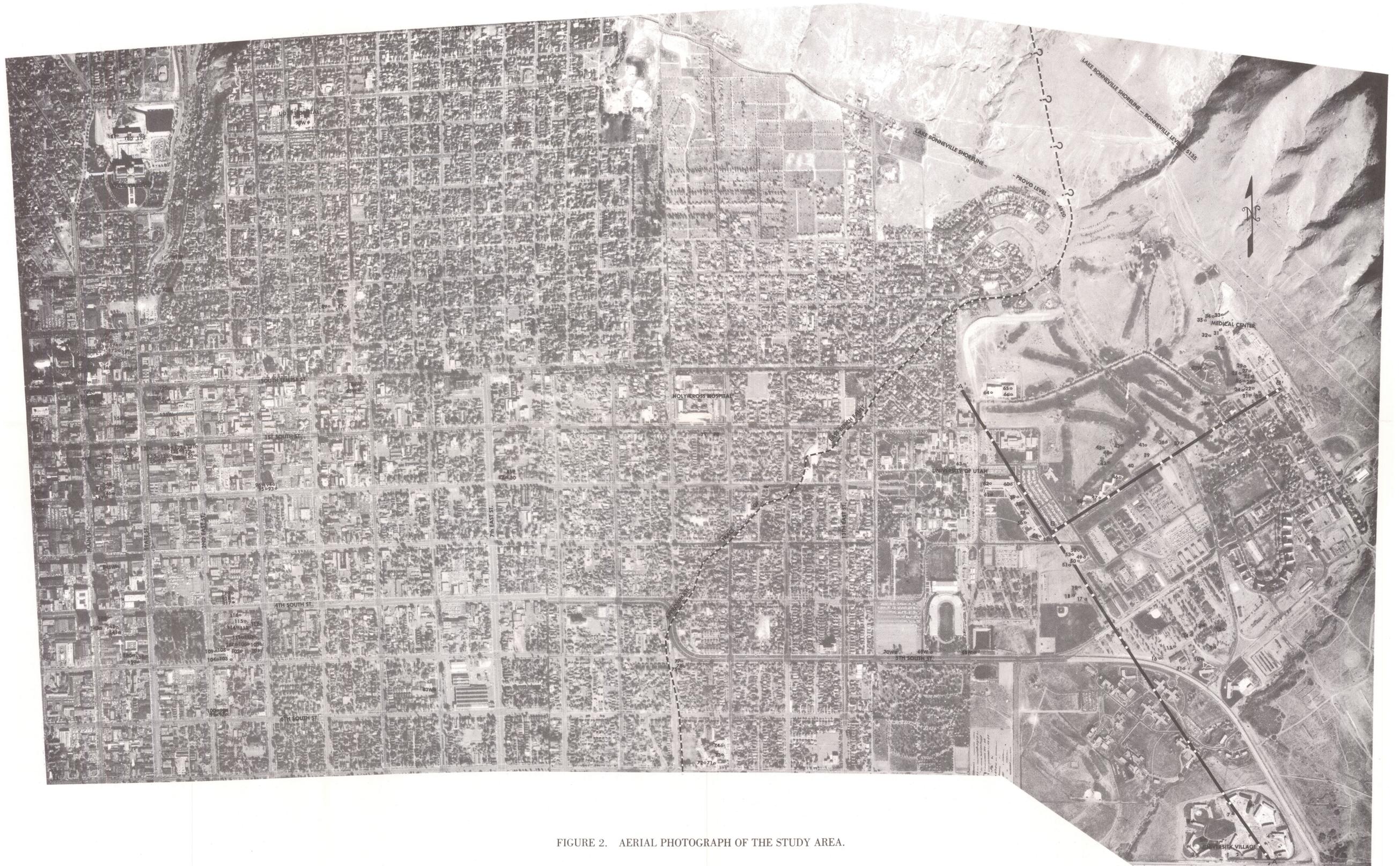


FIGURE 2. AERIAL PHOTOGRAPH OF THE STUDY AREA.

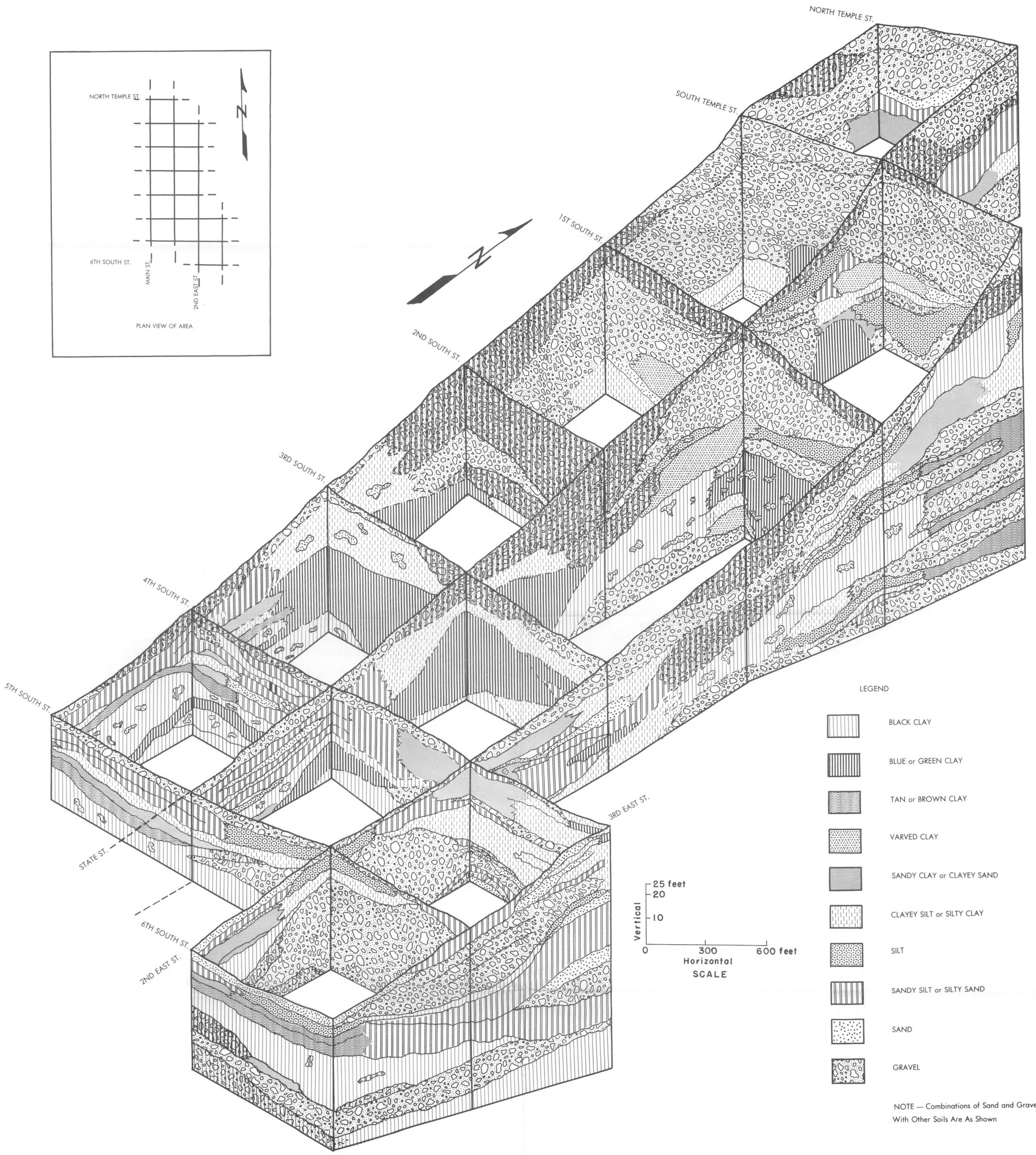


FIGURE 4. ISOMETRIC CROSS SECTIONS THROUGH PORTIONS OF DOWNTOWN SALT LAKE CITY.

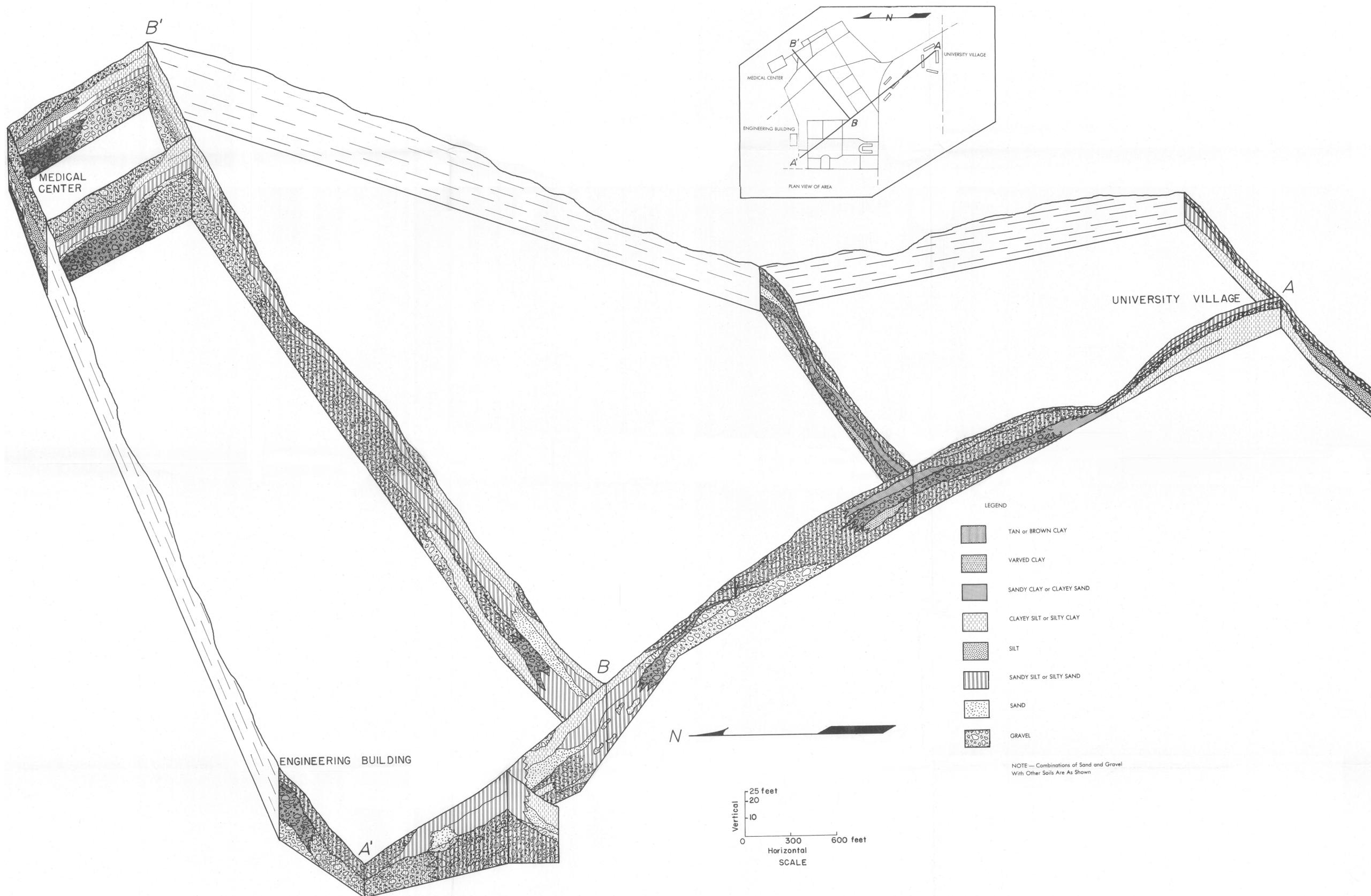


FIGURE 5. ISOMETRIC CROSS SECTIONS THROUGH PORTIONS OF UNIVERSITY OF UTAH CAMPUS.