KLEINFELDER

Geotechnical Investigation
Riverton Library
12860 South 1830 West
Riverton, Utah

For: Salt Lake County
c/o Beneco Enterprises

Kleinfelder File No. 35-8108-34.001

July 25, 1997

Prepared for:

Salt Lake County
c/o Beneco Enterprises
2120 South 1300 East
Salt Lake City, UT 84106

Kleinfelder Job No. 35-8108-34.001

GEOTECHNICAL INVESTIGATION
Riverton Library
12860 South 1830 West
Murray, Utah

Prepared by:

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STATE OF UTAH

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July 25, 1997

TABLE OF CONTENTS

3.0 GENERAL SITE CONDITIONS

3.1 Surface Conditions

At the time of our investigation, the site was being used as a soccer field. The site is relatively flat with a slight slope toward the east and is covered with grass. The site is bordered to the north and west by 12860 South and 1830 West, respectively. The south side of the site is bordered by an agriculture field and an LDS chapel is located to the east. There is a white brick building located on the southwest corner of the property. The property is fenced along the south and west borders and a small irrigation ditch runs along the east border.

3.2 Subsurface Conditions

3.2.1 Soils

Based on the 5 borings completed for this investigation, the near surface native soils generally consisted of 2 to 3 feet of soft to medium stiff SILT (ML) overlying medium stiff to stiff Lean CLAY (CL), which extended to the full depth explored.

The upper silts were generally slightly moist and brown in color and the deeper clays were generally olive-brown to gray-brown. Soil consistency within the clay soils varied throughout the site with no observable trend. Blow counts ranged from approximately 3 to 20 blows per foot.

Consolidation test results on the silt and clay material indicate the near surface soil is highly overconsolidated and slightly compressible with slight collapse or swell potential when saturated. Shear strength test results on the clay soils ranged from 700 to 2000 pounds per square foot (psf)..

3.2.2 *Groundwater*

Groundwater was not encountered at the site within the depths explored at the time of our investigation. It should be noted that groundwater levels will likely fluctuate at this site in response to seasonal changes, precipitation, and groundwater recharge and withdrawal. However, given the location of the project site and our present understanding of development plans, we do not anticipate that groundwater will adversely affect the development.

4.0 GEOLOGIC CONDITIONS

4.1 Geologic Setting

The site is located within the south-central portion of the Salt Lake Valley which lies within a deep, sediment-filled structural basin of Cenozoic age that is flanked by two uplifted range blocks, the Wasatch Range and the Oquirrh Mountains. The Wasatch Range is the easternmost expression of pronounced Basin and Range extension in north-central Utah.

The near-surface geology of the Salt Lake Valley is characterized by Quaternary materials deposited within the last 30,000 years by Lake Bonneville. As the lake receded, streams began to regrade through large deltas formed at the mouths of major Wasatch Range canyons and the eroded material was deposited in the basin as a series of recessional deltas and alluvial fans. Toward the center of the valley, deep-water deposits of clay, silt, and fine sand predominate. (William R. Lund, 1990).

4.2 Seismicity and Faulting

Review of available literature indicated there are no known active faults that pass under or immediately adjacent to the site. The nearest mapped fault is the Salt Lake Segment of the Wasatch Fault located approximately five miles east of the site, which is part of the Wasatch Fault zone. Analyses of ground shaking hazard along the Wasatch Front suggests that the Wasatch Fault zone is the single greatest contributor to the mean seismic hazard in the Salt Lake City region.

Expected maximum ground accelerations from a large earthquake at this site with a ten (10) percent probability of exceedance in 50 years is 0.3g (R.R. Youngs et al., 1987). Ground accelerations greater that 0.3g are possible but will have a lower probability of occurrence. The site is situated within the Uniform Building Code (UBC) Seismic Zone 3 and based on the borings, the soils best fit within soil type S_3 having a site coefficient of 1.5

4.3 Geologic Hazards

In conjunction with the ground shaking potential of large magnitude seismic events as discussed previously, certain areas within the Salt Lake Valley also possess a potential for liquefaction during such events. Liquefaction is a phenomenon whereby loose, saturated, granular soil deposits lose a significant portion of their shear strength due to excess pore water pressure buildup resulting from dynamic loading, such as that caused by an earthquake. Among other effects, liquefaction can result in densification of such deposits (and hence settlements of overlying deposits) after an earthquake as excess pore water pressures are dissipated. The primary factors affecting liquefaction potential of a soil deposit are: (1) level and duration of seismic ground motions; (2) soil type and consistency; and (3) depth to groundwater.

Based on review of the "Surface Fault Rupture and Liquefaction Potential Special Study Areas" map dated March 31, 1989 by Salt Lake County Public Works - Planning Division, the subject site is located within a broad area designated as "very low" for liquefaction potential. Based on the fine grained nature of the soils at the site and the apparent depth to groundwater at this site, it is our opinion that the potential for liquefaction is relatively low.

5.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS

5.1 General Conclusions

Based on the results of our field and laboratory investigations, it is our opinion that the site is suitable for the proposed construction provided that the recommendations contained in this report are complied with. The planned structures and pavement section may be supported on competent native soils or approved structural fill.

Specific recommendations regarding site grading, structural fill and compaction, foundation design and lateral pressures are presented in Sections 5.2, 5.3 and 5.4 of this report. Pavement areas may be supported on competent, prepared native soils or structural fill. Specific recommendations regarding pavement design and construction are presented in Section 5.6 of this report. Additional sections of this report present our recommendations for floor slab design and construction, soil corrosion, moisture protection and construction observation and testing.

5.2 Earthwork

5.2.1 General Site Preparation and Grading

Prior to commencing site grading operations the site should be stripped of all fill soils, vegetation, organic-laden soils and debris. Topsoil material removed during stripping may be used in landscaping areas, but should not be used as structural fill beneath building and pavement areas. Based on our field investigation, we anticipate that required stripping depths will range from 6 to 12 inches across the site. Excavated soils other than topsoil may be used as structural fill provided the recommendations contained in Section 5.2.2 of this report are complied with and upon approval of the Geotechnical Engineer.

Following stripping and any additional excavation required to achieve design grades, and prior to structural fill placement, the exposed native soils should be observed by the Geotechnical Engineer to observe that all unsuitable soils are removed and that competent soils are exposed. Prior to structural fill or concrete placement, the exposed soils within the building and pavement areas should be scarified to a depth of 8 inches, brought to slightly above optimum moisture content (0 to +3%) and compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557. The site may then be brought to grade, as necessary with structural fill as recommended in Section 5.2.2.

5.2.2 Structural Fill and Compaction

All fill placed within the proposed building and pavement areas should be structural fill. Structural fill may consist of the onsite silt soils upon approval from the Geotechnical Engineer. Low plasticity clay soils (PI<15) may also be used, if necessary, however it should be noted that these soils are moisture-sensitive and require greater care and effort during moisture conditioning and compaction. Where imported fill is required, we recommend that the material consist of well graded granular soils with a maximum of 50 percent passing the No. 4 mesh sieve and a maximum of 20 percent passing the No. 200 mesh sieve with no material greater than 4 inches in effective diameter. All structural fill should be placed at near optimum moisture content (+1 to +3 percent above optimum for clay soils) in maximum ten-inch loose lifts and compacted to at least 90 percent of the maximum dry density as determined by ASTM D-1557. Where fill heights exceed five feet, the level of compaction should be increased to a minimum of 95 percent. All imported fill materials should be approved by the Geotechnical Engineer prior to importing.

Prior to placing any fill, the excavations should be observed by the Geotechnical Engineer to verify that all unsuitable materials have been removed and that the exposed soils are in a firm, unyielding condition.

5.3 Foundations

The structure may be supported by conventional spread footings established on undisturbed native soils or structural fill. Perimeter footings should be a minimum of 18 inches wide and should be established a minimum of 30 inches below the lowest adjacent final grade for frost protection and confinement.

Footings bearing on competent natural soils or structural fill may be proportioned for a maximum net allowable bearing pressure of 2,000 psf. A one-third increase may be used for transient wind or seismic loads. Total post-construction settlement of footings founded as recommended should be on the order of ¾ of an inch with differential settlements ½ of an inch or less.

Prior to placement of structural fill and constructing the foundations, the footing excavations should be observed by the Geotechnical Engineer to determine whether suitable bearing soils have been exposed and whether the excavation bottoms are free of loose or disturbed soils.

Horizontal loads acting on foundations formed in open excavations will be resisted by friction acting at the base of foundations and by passive earth pressures. If design makes use of passive earth pressures, it is important that the Geotechnical Engineer be present during any footing backfill placement.

The friction acting along the base of footings founded on the structural fill pad or competent natural soils may be computed by using a coefficient of friction of 0.30 with the normal dead load. Ultimate lateral passive earth pressures may be computed by using an equivalent fluid weighing 340 pcf for the sides of footings placed against natural soils or properly placed and compacted backfill. The value given above may be increased by one-third for transient wind or seismic loads. An appropriate factor of safety should be applied.

5.4 Lateral Earth Pressures

Ultimate lateral earth pressures acting against subgrade walls may be computed from the equivalent fluid densities presented below.

Condition	Lateral Pressure Coefficient	Equivalent Fluid Density, pcf
Active	0.35	40
At-rest	0.60	70
Passive	2.88	340

The coefficients and densities presented assume level backfill behind walls and that no buildup of hydrostatic pressure will develop. Lateral pressures from surcharge loads may be computed by multiplying the surcharge load by the appropriate lateral pressure coefficient. Retaining walls that are allowed to rotate slightly should use the active coefficient. Basement walls, buried structures, or retaining walls not allowed to rotate should use the at-rest coefficient. An appropriate factor of safety should be applied to the above values.

Where the potential of water accumulation behind walls exists, we recommend retaining walls be properly drained to prevent hydrostatic pressures from developing. This may be accomplished by placing free-draining gravel against the wall with a geotextile filter fabric placed against the gravel to prevent the infiltration of fines into the gravel. Alternately, a geotextile drainage fabric, such as Miradrain 6000 or equivalent may be placed against the wall. Any water collected at the base of the wall should be removed by means of weep holes or collection pipes which discharge to suitable drainage structures.

5.5 Concrete Slab-on-Grade Construction

Direct support for the concrete floor slabs may be provided by a minimum six-inch blanket of pea gravel or clean gravel (less than 10 percent passing No. 4 mesh sieve and less than 2 percent passing No. 200 mesh sieve). Prior to placement of the gravel, the natural soils and/or structural fill should have been prepared as recommended in sections 5.2.1 and 5.2.2 of this report. As a basis for designing concrete slab thickness, the native soils may be considered to possess a subgrade modulus of 170 pounds per cubic inch (pci), and compacted granular structural fill may be considered to possess a subgrade modulus of 250 pci. The actual floor slab thickness and reinforcement design should be provided by the structural Engineer.

Special precautions must be taken during the placement and curing of all concrete slabs. Excessive slump caused by high water-cement ratio of the concrete and/or improper curing procedures used during either hot or cold weather conditions could lead to excessive shrinkage, cracking or curling in the slabs. We recommend that all concrete placement and curing operations be performed in accordance with the American Concrete Institute (ACI) Manual.

5.6 Pavement Section Design and Construction

Support for the asphalt pavement sections may be provided by properly conditioned native soils or compacted structural fill. Prior to placing pavement base course materials, all unsuitable soils should be excavated to expose competent natural soils and the subgrade should be prepared by scarifying to at least 8-inches, moisture conditioning to near optimum and compacting to a minimum of 90 percent of the maximum dry density as determined by ASTM D-1557. Any required structural fill should be compacted as outlined in Section 5.2.2.

Recommendations for pavement structural sections are based upon classifications and strength data of the soils. A California Bearing Ratio (CBR) Test was performed on a representative sample of the near surface native soils to evaluate pavement subgrade strength. A value of 7.5 percent was obtained and used for design of a pavement section placed on prepared native soils. No traffic loading information was provided, therefore, we have assumed traffic loading values of 300 passenger vehicles, 2 light trucks and 1 heavy truck per day for a 20-year design. Based on this information we recommend the following minimum pavement sections:

For Pavement Sections Placed on Prepared Native Soils

Pavement Area	Asphalt Thickness (inches)	Aggregate Base Thickness (inches)
Passenger Vehicle Parking	3	6
Entrance, Roadway and Truck Delivery Lanes	4	6

Asphalt and aggregate base material should conform with local requirements. All aggregate base material should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D-1557. Asphalt should be compacted to a minimum of 95 percent of the Marshall (50 blow) maximum density. Field and laboratory testing should be performed to determine whether these requirements have been met.

It is important that parking area grades be set to provide positive drainage to suitable drainage structures. A desirable slope for drainage in paved areas is two percent.

5.7 Moisture Protection and Surface Drainage

Precautions should be taken during and after construction to eliminate, or at least minimize, saturation of soils beneath foundations or pavements. Over-wetting of the fine-grained soils prior to or during construction may result in softening and pumping, causing equipment mobility problems and difficulty in achieving compaction. Positive drainage should be established away from all structures and pavements. Landscape watering adjacent to structures should be minimized. All utility trenches leading into structures should be backfilled with compacted structural fill. Special care should be taken during installation of subfloor sewer and water lines to reduce the possibility of future subsurface saturation.

5.8 Soil Corrosion and Reactivity

Based on the soil conditions encountered during our field investigation, soils on this site do not appear to contain significant concentrations of water-soluble sulfates which can be detrimental to concrete placed against the soil. Therefore, all concrete in contact with the onsite soils may contain conventional Type I or II cements.

6.0 CLOSURE

6.1 Limitations

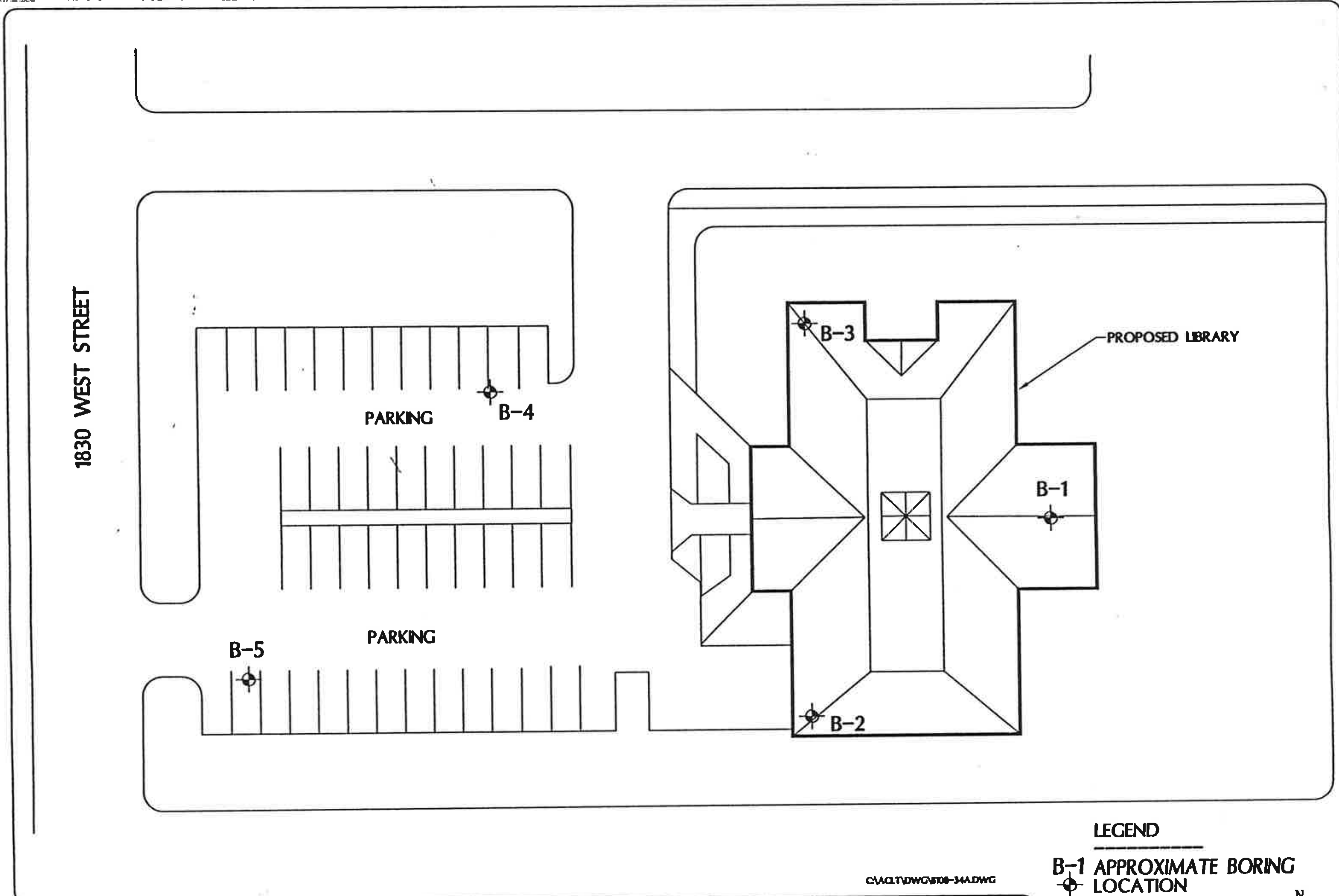
The recommendations contained in this report are based on our field explorations, laboratory tests, and our understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the 5 borings completed for this investigation. It is possible that variations in the soil and groundwater conditions could exist between the points explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site which are different from those described in this report, our firm should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, our firm should also be notified. The recommendations presented herein should be considered as preliminary and subject to modification once project development plans are finalized.

This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, express or implied, is made.

It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

6.2 Additional Services

The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be made during the construction to verity compliance with these recommendations. These tests and observations should include, but not necessarily be limited to, the following:



KLEINFELDER

Project Number 35-8108-34.001

Riverton Library
12860 South 1830 West
Riverton, Utah

SITE PLAN

PLATE

A-2

Depth (ft)	Percent Passing #200	Dry Density (lb/ft^3)	Moisture Content (%)	Other Tests	Blows/Ft.	USCS	SOIL DESCRIPTION
0						ML	SILT with sand - brown, slightly moist, soft, major roots to 8 inches
3					7	CL	SILT - olive-brown, slightly moist, medium stiff
6		97	25.7	PI C			- stiff
7						CL	Lean CLAY - olive-brown, slightly moist to moist, medium stiff
9					14		
10							- stiff
14				PI			
16						CH	Fat CLAY - gray-brown, moist, stiff to very stiff
18						CL	Lean CLAY - olive brown, moist, soft
19					3		

DEPTH IN FEET: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22

DATE DRILLED: 6-26-97
TOTAL DEPTH: 21.0 feet
DIAMETER OF BORING: 6 inches

LOGGED BY: D. Salter
EQUIPMENT: BK-66
ELEVATION: Not Meas.

KLEINFELDER

PROJECT NO. 35-8108-34.001

LOG OF BORING B- 1

Riverton Library
12860 South 1830 West
Riverton, Utah

PLATE **A-3**

Depth (feet)	Percent Passing #200	Dry Density (lb/ft^3)	Moisture Content (%)	Other Tests	Blows/Ft.	USCS	SOIL DESCRIPTION
0						ML	SILT with sand - brown, slightly moist, soft, major roots to ~8 inches
~3						ML	SILT - olive-brown, slightly moist, very stiff
4				PI	20		
~5.3						CL	Lean CLAY - olive brown, slightly moist, very stiff
8					6		- gray-brown, medium stiff, molted with rust
12							- medium stiff to stiff
17					3		- olive-brown, soft

DEPTH IN FEET

DATE DRILLED: 6-26-97
TOTAL DEPTH: 19.0 feet
DIAMETER OF BORING: 6 inches

LOGGED BY: D. Salter
EQUIPMENT: BK-66
ELEVATION: Not Meas.

KLEINFELDER

PROJECT NO. 35-8108-34.001

LOG OF BORING B- 2

Riverton Library
12860 South 1830 West
Riverton, Utah

PLATE
A-4

Depth (feet)	Percent Passing #200	Dry Density (lb/ft^3)	Moisture Content (%)	Other Tests	Blows/Ft.	USCS	SOIL DESCRIPTION
0						ML	SILT with sand - brown, slightly moist, to soft, major roots to ~8 inches
2						CL	Lean CLAY - gray-brown, slightly moist, medium stiff to stiff
3.2		100	22.2	PI C UC			
6					5		- medium stiff
9		81	26.0	C			- stiff
14					10		
19					11		- olive gray, molted with rust

DEPTH IN FEET

DATE DRILLED: 6-26-97
TOTAL DEPTH: 21.0 feet
DIAMETER OF BORING: 6 inches

LOGGED BY: D. Salter
EQUIPMENT: BK-66
ELEVATION: Not Meas.

KLEINFELDER

PROJECT NO. 35-8108-34.001

LOG OF BORING B- 3

Riverton Library
12860 South 1830 West
Riverton, Utah

PLATE **A-5**

Depth in Feet	Percent Passing #200	Dry Density (lb/ft^3)	Moisture Content (%)	Other Tests	Blows/Ft.	Sample	USCS	SOIL DESCRIPTION
0							ML	SILT with sand - brown, slightly moist, soft, major roots to ~8 inches
2.5							CL	Lean CLAY - olive brown, slightly moist, stiff
3				PI	13			
6					11			- gray-brown
11								

DATE DRILLED: 6-26-97
TOTAL DEPTH: 11.0 feet
DIAMETER OF BORING: 6 inches

LOGGED BY: D. Salter
EQUIPMENT: BK-66
ELEVATION: Not Meas.

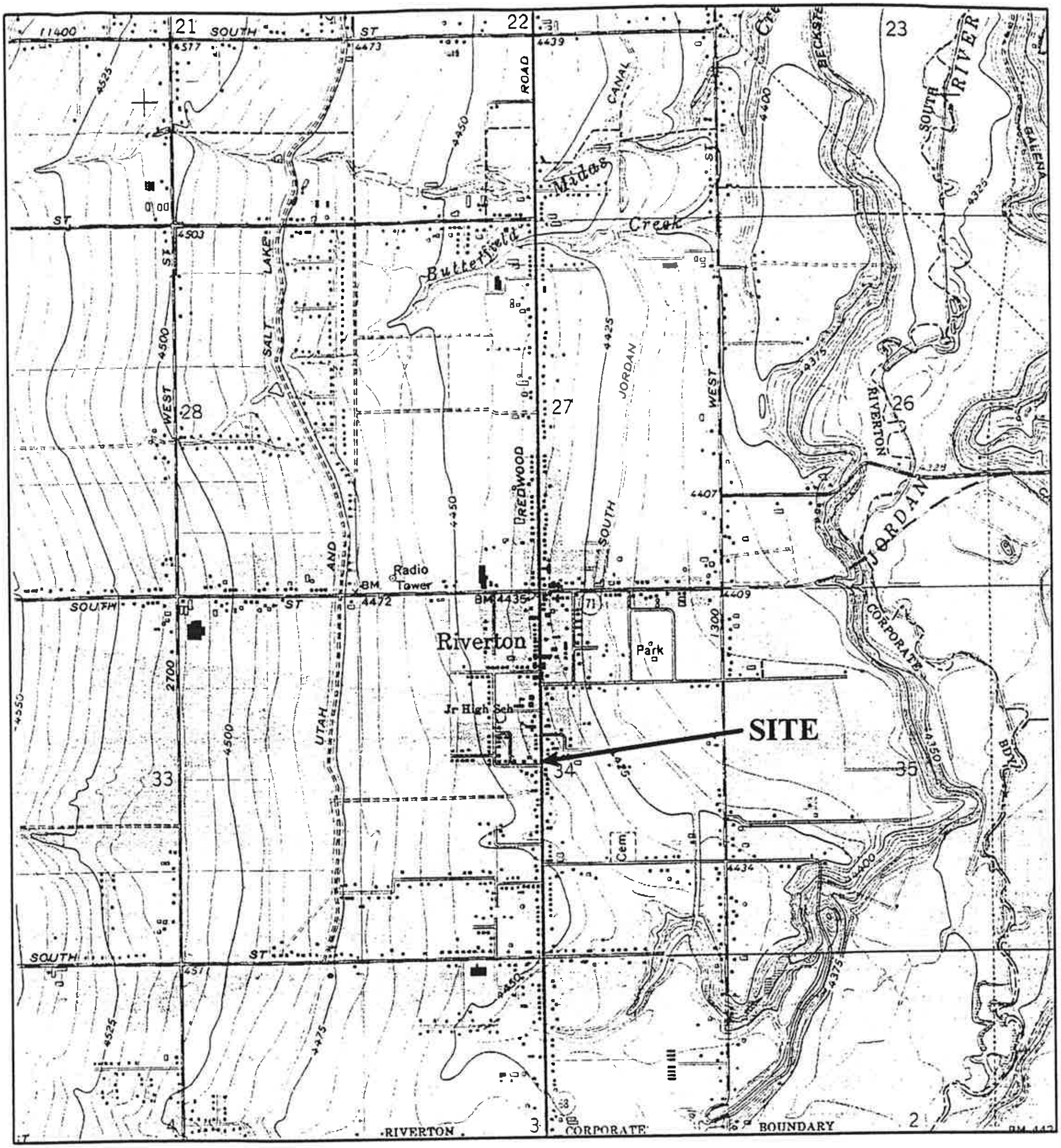
KLEINFELDER

PROJECT NO. 35-8108-34.001

LOG OF BORING B- 5

Riverton Library
12860 South 1830 West
Riverton, Utah

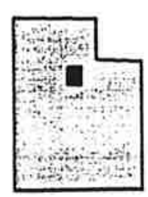
PLATE A-7



BASE MAP:
MIDVALE, UTAH
U.S.G.S. 7.5 MINUTE QUADRANGLE
PHOTOREVISED 1975

0' 1000' 2000'

SCALE 1:24,000
1" = 2000'
CONTOUR INTERVAL 40 FEET



MAP LOCATION

8108-34A.ppt

KLEINFELDER

Project Number 35-8108-34.001

Riverton Library
12860 South 1830 West
Riverton, Utah

SITE LOCATION MAP

PLATE

A-1

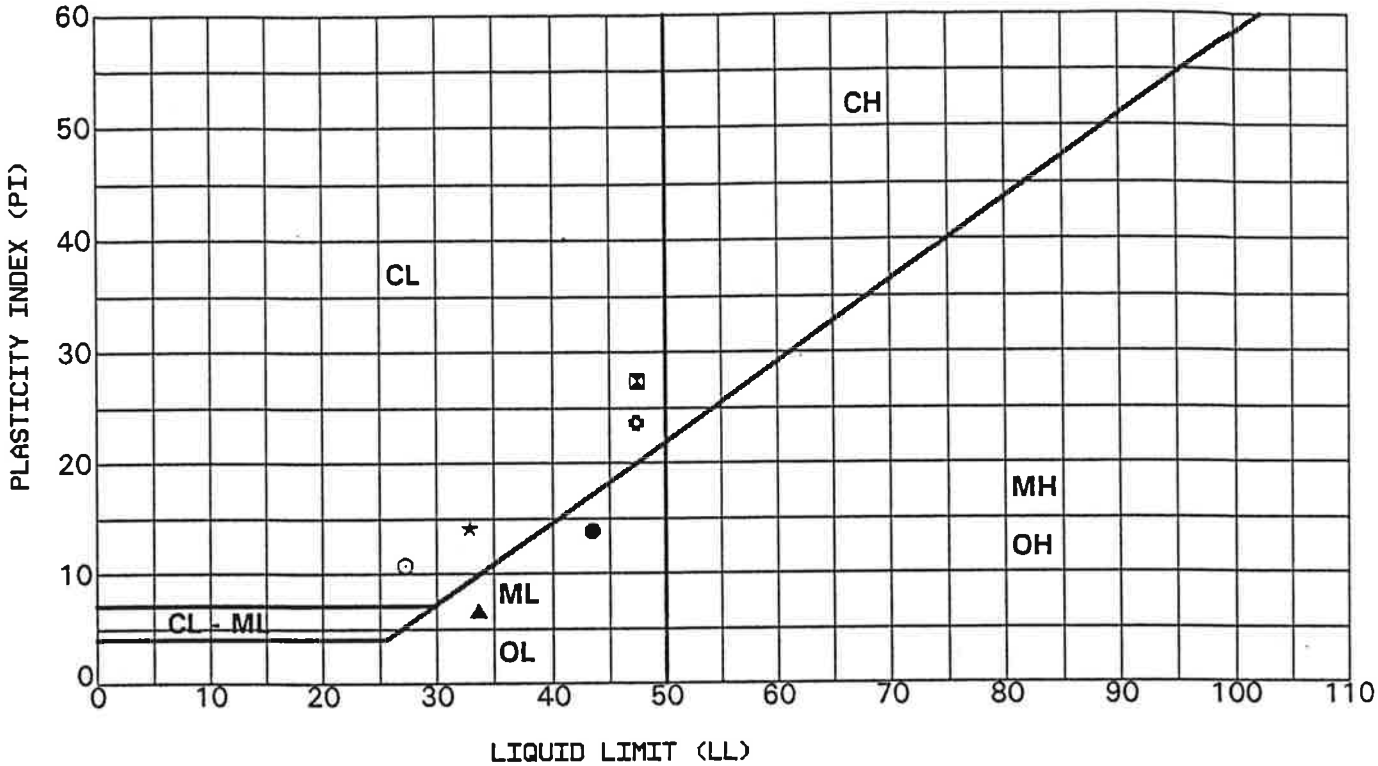
Table 1
SUMMARY OF LABORATORY TEST RESULTS

Project: Riverton Library

Project No. 35-8108-34.001

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (kN/m³)	GRADATION			ATTERBERG LIMITS		CALIFORNIA BEARING RATIO (%)	UNIFIED SOIL CLASSIFICATION
BORING NO.	DEPTH (ft)			GRAVEL (%)	SAND (%)	SILT AND CLAY (%)	LIQUID LIMIT	PLASTICITY INDEX		
B-1	6						44	14		SILT (ML)
B-1	14						48	27		LEAN CLAY (CL)
B-2	4						34	7		SILT (ML)
B-3	3						33	14	UC=3477	LEAN CLAY (CL)
B-4	1					56.8	27	11	CBR=7.5	SANDY LEAN CLAY (CL)
B-4	5								RS=2.5	LEAN CLAY (CL)
B-5	3						47	24		LEAN CLAY (CL)

Notes: UC = Unconfined Compressive strength, psf; CBR = California Bearing Ratio, %; RS = Remolded Swell, %



	Sample	Depth (ft)	LL (%)	PL (%)	PI (%)	Description
●	B- 1	6.0	44	30	14	SILT (ML)
⊠	B- 1	14.0	48	20	27	Lean CLAY (CL)
▲	B- 2	4.0	34	27	7	SILT (ML)
★	B- 3	3.0	33	19	14	Lean CLAY (CL)
⊙	B- 4	1.0	27	17	11	Lean CLAY (CL)
✿	B- 5	3.0	47	24	24	Lean CLAY (CL)

LL - Liquid Limit
PL - Plasticity Limit
PI - Plasticity Index

Unified Soil Classification
Fine Grained Soil Groups

	LL < 50
ML	Inorganic clayey silts to very fine sands of slight plasticity
CL	Inorganic clays of low to medium plasticity
OL	Organic silts and organic silty clays of low plasticity

	LL > 50
MH	Inorganic silts and clayey silts of high plasticity
CH	Inorganic clays of high plasticity
OH	Organic clays of medium to high plasticity, organic silts

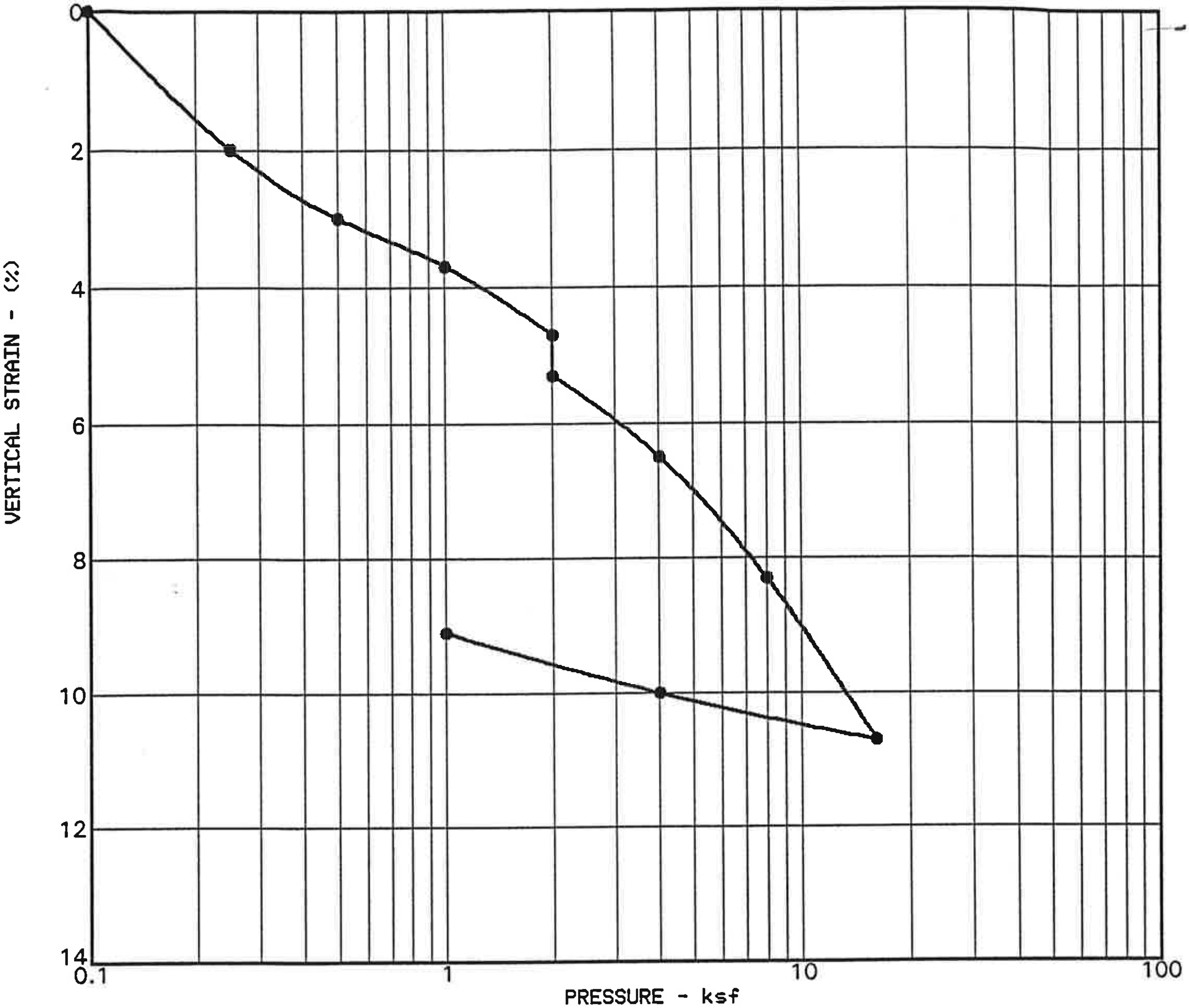
KLEINFELDER

PROJECT NO. 35-8108-34.001

Riverton Library
12860 South 1830 West

PLASTICITY CHART

PLATE
B-2



Sample	B- 1
Depth	6.0 ft
Description	SILT
Classification	ML
Overburden Pressure	0.70 ksf
Preconsolidation Pressure	5.00 ksf
Compression Index	0.079
Recompression Index	0.013
Overconsolidation Ratio	7.1

	Initial	Final
Dry density, pcf	97.5	107.2
Water content, %	25.7	21.1
Sample height, in.	1.000	0.909

KLEINFELDER

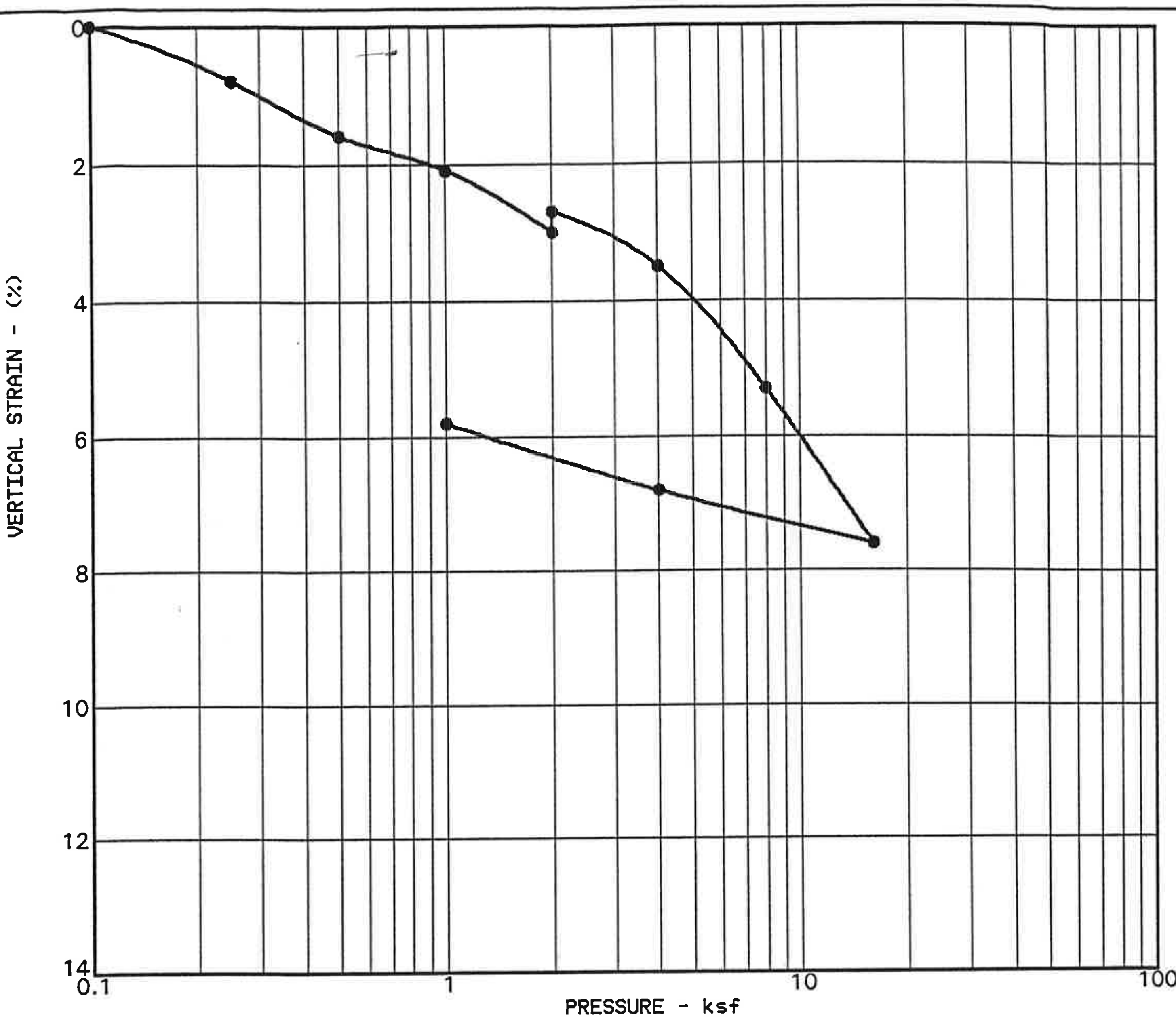
PROJECT NO. 35-8108-34.001

Riverton Library
12860 South 1830 West

CONSOLIDATION TEST RESULTS

PLATE

B-3



Sample	B- 3
Depth	3.0 ft
Description	Lean CLAY
Classification	CL
Overburden Pressure	0.40 ksf
Preconsolidation Pressure	4.20 ksf
Compression Index	0.077
Recompression Index	0.015
Overconsolidation Ratio	10.5

	Initial	Final
Dry density, pcf	107.9	114.5
Water content, %	17.5	17.9
Sample height, in.	1.000	0.942

KLEINFELDER

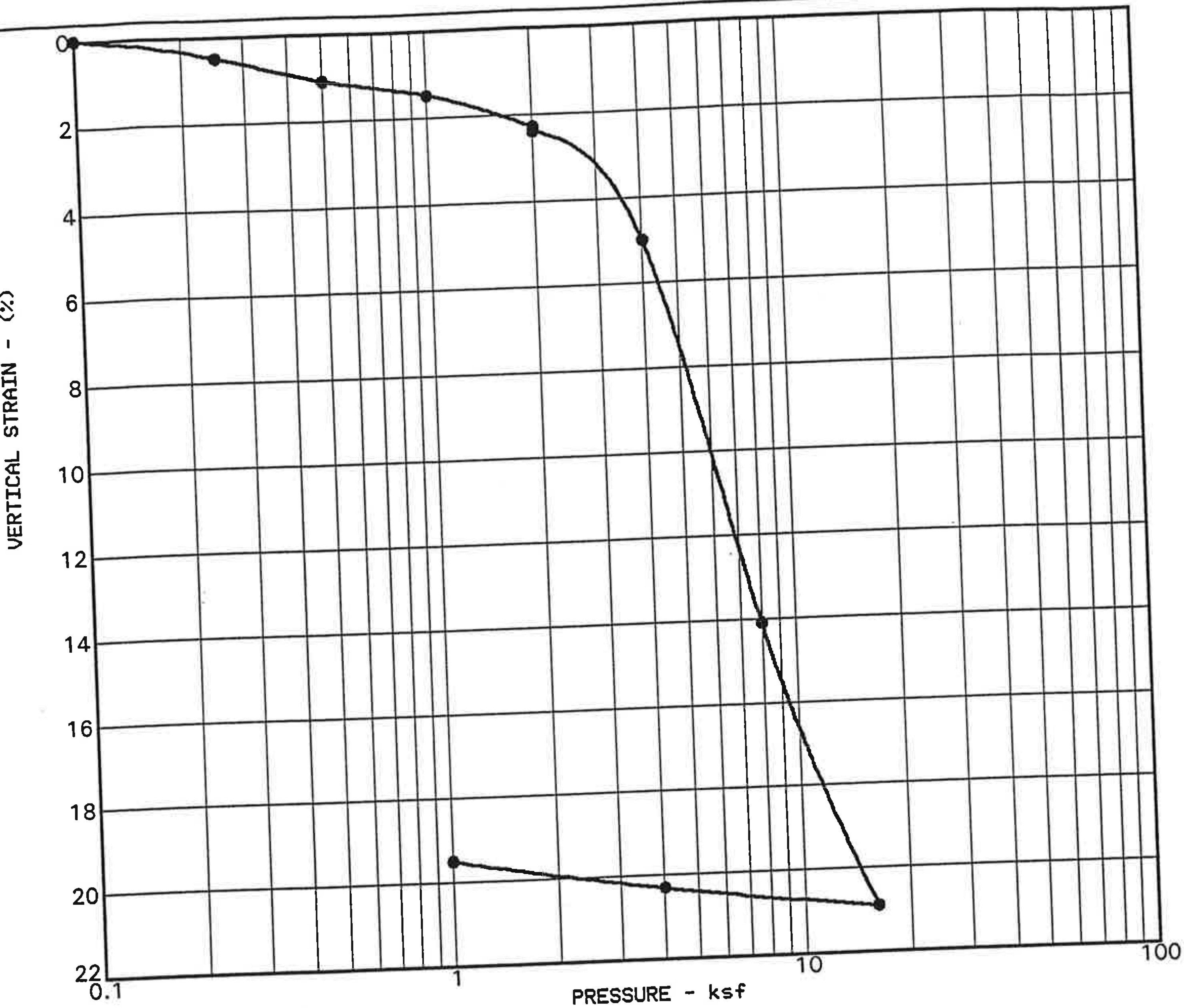
PROJECT NO. 35-8108-34.001

Riverton Library
12860 South 1830 West

CONSOLIDATION TEST RESULTS

PLATE

B-4



Sample	B- 3
Depth	9.0 ft
Description	Lean CLAY
Classification	CL
Overburden Pressure	1.00 ksf
Preconsolidation Pressure	3.50 ksf
Compression Index	0.264
Recompression Index	0.013
Overconsolidation Ratio	3.5

	Initial	Final
Dry density, pcf	81.4	101.1
Water content, %	26.0	25.6
Sample height, in.	1.000	0.805

KLEINFELDER

Riverton Library
12860 South 1830 West

CONSOLIDATION TEST RESULTS

PLATE

B-5

PROJECT NO. 35-8108-34.001