

FORT LEAVENWORTH HOUSING PHASE 1A LEAVENWORTH, KANSAS  
ALLIED LABORATORIES REPORT NO: 74-00555-3B-147



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LABORATORIES**

A DEPARTMENT OF PROFESSIONAL  
ENGINEERING CONSULTANTS, P.A.



# PRELIMINARY GEOTECHNICAL REPORT

***FORT LEAVENWORTH HOUSING***

***PHASE 1A***

***LEAVENWORTH, KANSAS***

2	EXISTING FILL
3	NATURAL SOILS
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PREPARED FOR

***GOSSEN LIVINGSTON ASSOCIATES***

JANUARY 2002

PROJECT NO: 74-00555-3B-147

## ALLIED LABORATORIES

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## APPENDIX A

### FIELD EXPLORATION RESULTS

***FORT LEAVENWORTH HOUSING  
PHASE 1A  
LEAVENWORTH, KANSAS***

Allied Project No: 74-00555-3B-147

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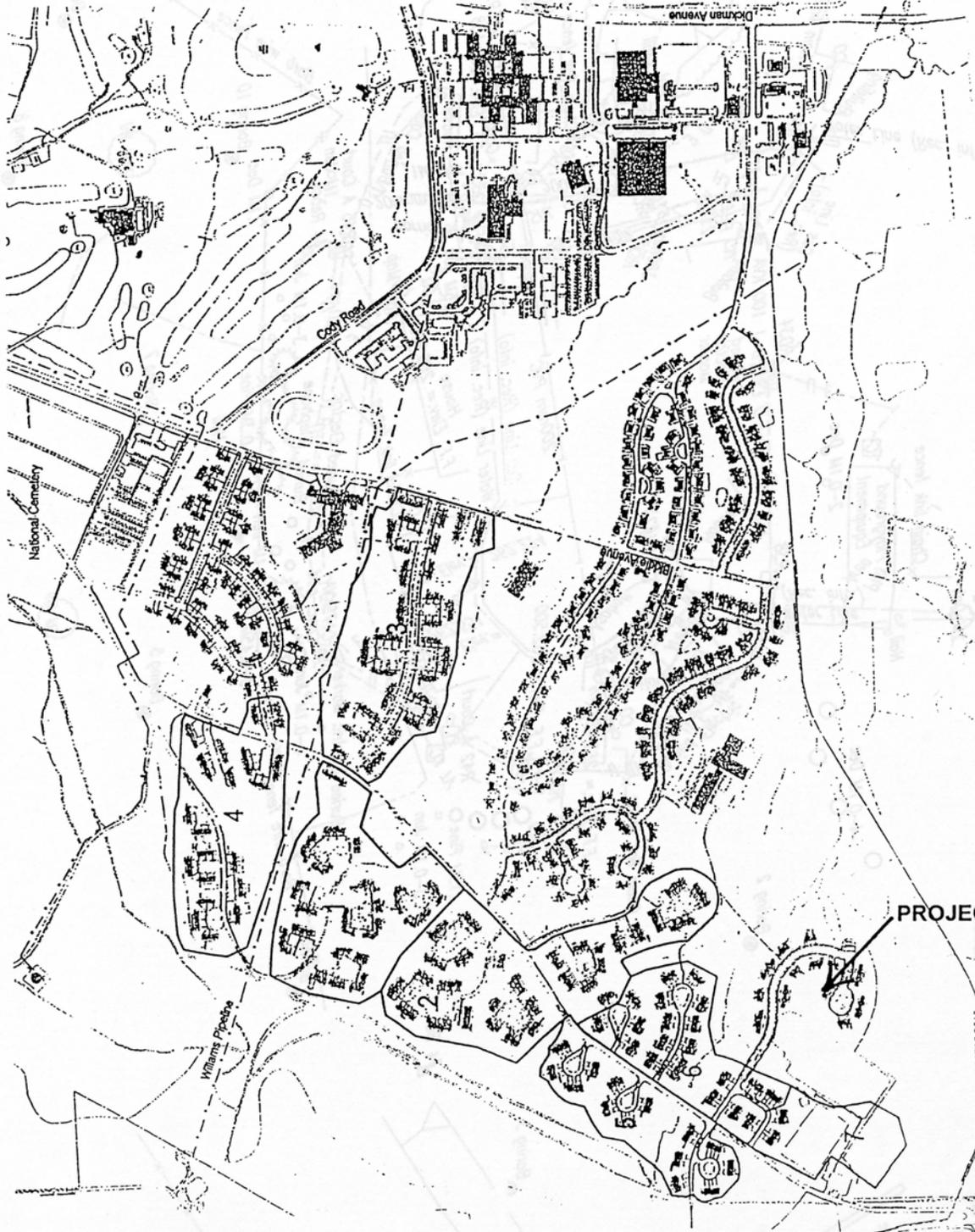
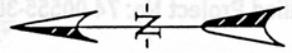


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# SITE LOCATION MAP

## FORT LEAVENWORTH HOUSING PHASE 1A - LEAVENWORTH, KANSAS

Allied Project No: 74-00555-3B-147



Prepared By: smh

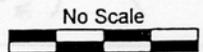


Figure A-1



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# BORING LOCATION SKETCH

FORT LEAVENWORTH HOUSING PHASE 1A - LEAVENWORTH, KANSAS

Allied Project No: 74-00555-3B-147



Prepared By: smh

No Scale

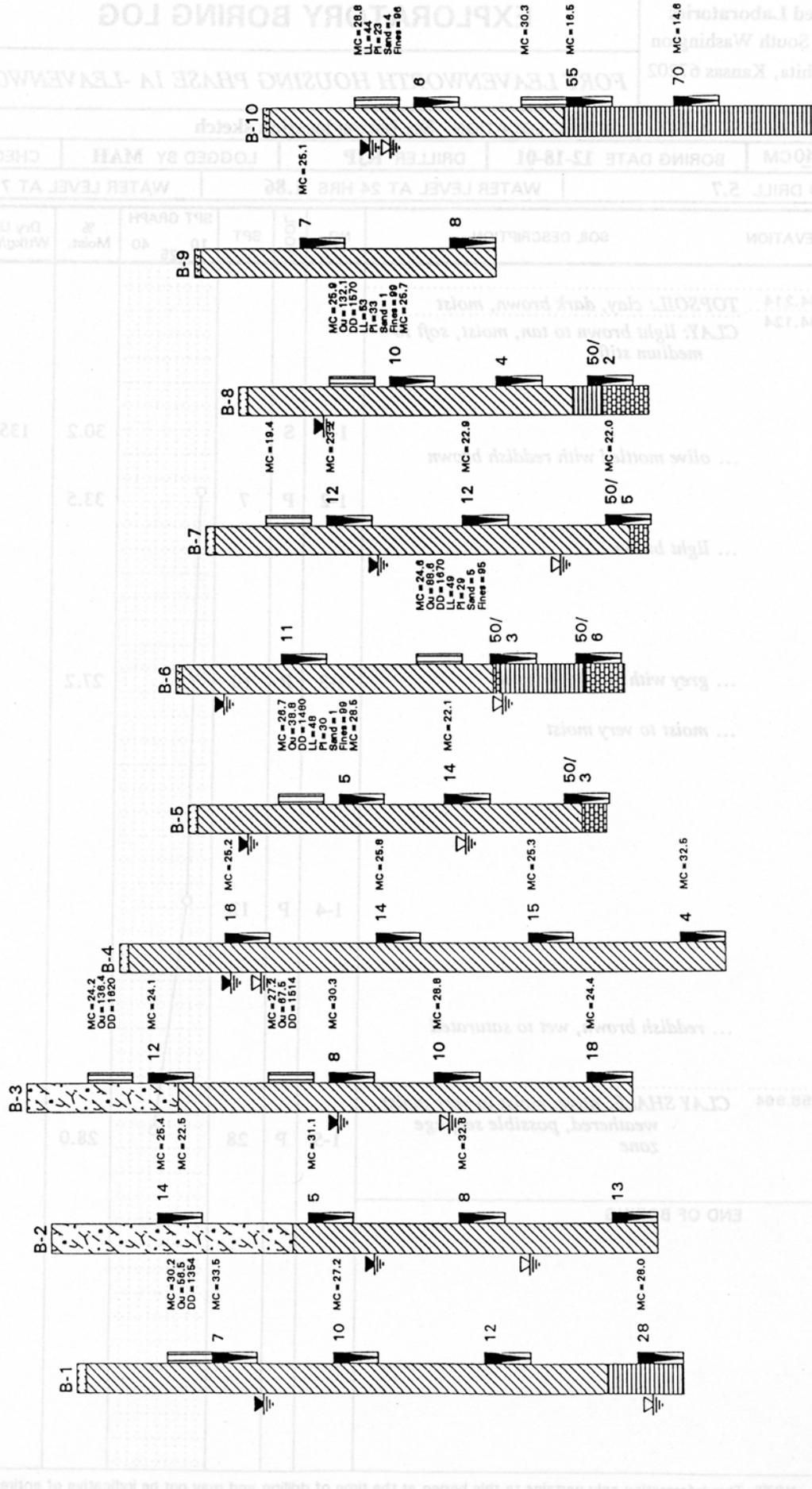


Figure A-2

# SUMMARY OF EXPLORATORY BORINGS

## FORT LEAVENWORTH HOUSING PHASE 1A - LEAVENWORTH, KANSAS

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STRATA SYMBOLS	Misc. Symbols	Soil Samplers
Topsoil	Water level 24 hours after drilling	Undisturbed Sample (7.8 cm Shelby Tube)
Clay: medium to high plasticity	Water level during drilling	Standard Penetration Sampler (5 cm OD Split spoon)
Clay Shale	Limestone	
Existing Fill		

Note: Profiles present summary of data. They are not proportional and do not present a cross section of the site.

Figure A-3



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# EXPLORATORY BORING LOG

B-1

FORT LEAVENWORTH HOUSING PHASE 1A -LEAVENWORTH, KANSAS

PROJECT NO: 74-00555-3A-147

BORING LOCATION: See boring location sketch

SCALE: 1 CM = 40 CM

BORING DATE 12-18-01

DRILLER KJP

LOGGED BY MAH

CHECKED BY SMH

WATER LEVEL @ DRILL 5.7

WATER LEVEL AT 24 HRS 1.86

WATER LEVEL AT 72 HRS

LOG	ELEVATION	SOIL DESCRIPTION	NO.	TOOL	SPT	SPT GRAPH			% Moist.	Dry Unit Wt(kg/m3)	Qu (kPa)	% Fines	PI
						10	25	40					
	264.214	TOPSOIL: clay, dark brown, moist											
	264.124	CLAY: light brown to tan, moist, soft to medium stiff											
	0.8	... olive mottled with reddish brown	1-1	S				30.2	1354	56.5			
	1.6	... light brown	1-2	P	7			33.5					
	2.4	... grey with reddish brown ... moist to very moist	1-3	P	10			27.2					
4.0	... reddish brown, wet to saturated	1-4	P	12									
5.6	258.964 CLAY SHALE: olive, moist to very moist, weathered, possible seepage zone	1-5	P	28			28.0						
6.4	END OF BORING												
7.2													

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

Figure A-4



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# EXPLORATORY BORING LOG

B-2

FORT LEAVENWORTH HOUSING PHASE 1A - LEAVENWORTH, KANSAS

PROJECT NO: 74-00555-3A-147

BORING LOCATION: See boring location sketch

SCALE: 1 CM = 40 CM

BORING DATE 12-18-01

DRILLER KJP

LOGGED BY MAH

CHECKED BY SMH

WATER LEVEL @ DRILL 4.74

WATER LEVEL AT 24 HRS 3.21

WATER LEVEL AT 72 HRS

LOG	ELEVATION	SOIL DESCRIPTION	NO.	TOOL	SPT	SPT GRAPH			% Moist.	Dry Unit Wt(kg/m3)	Qu (kPa)	% Fines	PI
						10	25	40					
	0 265.03	FILL: clay, brown, lightly moist, firm, mixed gravel											
	0.8												
	1.6	... silty clay, dark brown, firm	2-1A	P	14				25.4				
	2.4		2-1B						22.5				
	2.4 262.63	CLAY: dark brown to black mottled with reddish brown, very moist, soft	2-2	P	5				31.1				
	3.2												
	4	... grey mottled with reddish brown, wet to saturated, soft to medium stiff, possible seepage zone	2-3	P	8				32.6				
	4.8												
	5.6		2-4	P	13								
	6.4	END OF BORING											
	7.2												

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

Figure A-5



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# EXPLORATORY BORING LOG

B-3

FORT LEAVENWORTH HOUSING PHASE 1A -LEAVENWORTH, KANSAS

PROJECT NO: 74-00555-3A-147

BORING LOCATION: See boring location sketch

SCALE: 1 CM = 40 CM

BORING DATE 12-18-01

DRILLER KJP

LOGGED BY MAH

CHECKED BY SMH

WATER LEVEL @ DRILL 4.2

WATER LEVEL AT 24 HRS 3.09

WATER LEVEL AT 72 HRS

LOG	ELEVATION	SOIL DESCRIPTION	NO.	TOOL	SPT	SPT GRAPH			% Moist.	Dry Unit Wt(kg/m3)	Qu (kPa)	% Fines	PI
						10	25	40					
	265.819	FILL: clay, brown, lightly moist, firm mixed gravel											
	0.8	... reddish brown, moist, stiff	3-1	S				24.2	1620	136.4			
	1.6	CLAY: dark brown, moist, medium stiff	3-2	P	12			24.1					
	2.4	... reddish brown mottled with grey, moist, stiff	3-3	S				27.2	1514	67.5			
	3.2	... grey, soft to medium stiff, wet	3-4	P	8			30.3					
	4.0	... mottled with reddish brown ... possible seepage zone	3-5	P	10			28.8					
4.8	... medium stiff to stiff ... reddish brown with grey												
5.6			3-6	P	18			24.4					
	6.4	END OF BORING											
	7.2												

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

Figure A-6



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# EXPLORATORY BORING LOG

B-4

FORT LEAVENWORTH HOUSING PHASE 1A -LEAVENWORTH, KANSAS

PROJECT NO: 74-00555-3A-147

BORING LOCATION: See boring location sketch

SCALE: 1 CM = 40 CM

BORING DATE 12-19-01

DRILLER KJP

LOGGED BY MAH

CHECKED BY SMH

WATER LEVEL @ DRILL 1.41

WATER LEVEL AT 24 HRS 1.11

WATER LEVEL AT 72 HRS

LOG	ELEVATION	SOIL DESCRIPTION	NO.	TOOL	SPT	SPT GRAPH			% Moist.	Dry Unit Wt(kg/m3)	Qu (kPa)	% Fines	PI	
						10	25	40						
	0	262.735												
		262.645	TOPSOIL: clay, dark brown, moist											
			CLAY: grey mottled with reddish brown, moist, medium stiff to stiff											
		1.6	... possible seepage zone, free water present	4-1	P	16				25.2				
		2.4		4-2	P	14				25.8				
	4.0		4-3	P	15				25.3					
	5.6	... reddish brown, soft, wet to saturated	4-4	P	4				32.5					
	6.4	END OF BORING												
	7.2													

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

Figure A-7



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# EXPLORATORY BORING LOG

B-5

FORT LEAVENWORTH HOUSING PHASE 1A -LEAVENWORTH, KANSAS

PROJECT NO: 74-00555-3A-147

BORING LOCATION: See boring location sketch

SCALE: 1 CM = 40 CM

BORING DATE 12-19-01

DRILLER KJP

LOGGED BY MAH

CHECKED BY SMH

WATER LEVEL @ DRILL 2.76

WATER LEVEL AT 24 HRS 0.6

WATER LEVEL AT 72 HRS

LOG	ELEVATION	SOIL DESCRIPTION	NO.	TOOL	SPT	SPT GRAPH			% Moist.	Dry Unit Wt(kg/m <sup>3</sup> )	Qu (kPa)	% Fines	PI
						10	25	40					
	260.428	TOPSOIL: clay, dark brown, moist											
	260.338	CLAY: brown, moist, soft to medium stiff											
	0.8	... grey with reddish brown, moist to very moist, soft	5-1	S					26.7	1480	38.8	99	30
	1.6	... grey, wet, soft, possible seepage zone, free water present	5-2	P	5				28.5				
	2.4	... medium stiff ... grey with reddish brown, moist, medium stiff	5-3	P	14				22.1				
4.0	256.528	LIMESTONE: tan, hard	5-4	P	50/3								
		END OF BORING											

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

Figure A-8



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# EXPLORATORY BORING LOG

B-6

FORT LEAVENWORTH HOUSING PHASE 1A -LEAVENWORTH, KANSAS

PROJECT NO: 74-00555-3A-147

BORING LOCATION: See boring location sketch

SCALE: 1 CM = 40 CM

BORING DATE 12-19-01

DRILLER KJP

LOGGED BY MAH

CHECKED BY SMH

WATER LEVEL @ DRILL 3.24

WATER LEVEL AT 24 HRS 0.48

WATER LEVEL AT 72 HRS

LOG	ELEVATION	SOIL DESCRIPTION	NO.	TOOL	SPT	SPT GRAPH			% Moist.	Dry Unit Wt(kg/m3)	Qu (kPa)	% Fines	PI
						10	25	40					
	260.813	TOPSOIL: clay, dark brown, moist											
	260.753	CLAY: light brown, moist, soft to medium stiff											
		... reddish brown mottled with grey, moist to very moist, medium stiff	6-1	P	11								
			6-2	S				24.6	1670	88.6	95	29	
	257.663	LIMESTONE: approx. 4" thick	6-3	P	50/3								
	257.603	CLAY SHALE: light brown, very moist, firm, with limestone fragments											
		... wet zone, free water present											
	256.763	LIMESTONE: tan, hard	6-4	P	50/6								
		... practical drilling refusal											
		END OF BORING											

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

Figure A-9



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# EXPLORATORY BORING LOG

B-7

FORT LEAVENWORTH HOUSING PHASE 1A -LEAVENWORTH, KANSAS

PROJECT NO: 74-00555-3A-147

BORING LOCATION: See boring location sketch

SCALE: 1 CM = 40 CM

BORING DATE 12-19-01

DRILLER KJP

LOGGED BY MAH

CHECKED BY SMH

WATER LEVEL @ DRILL 3.51

WATER LEVEL AT 24 HRS 1.71

WATER LEVEL AT 72 HRS

LOG	ELEVATION	SOIL DESCRIPTION	NO.	TOOL	SPT	SPT GRAPH		% Moist.	Dry Unit Wt(kg/m3)	Qu (kPa)	% Fines	PI
						10	25 40					
	0	<i>TOPSOIL: clay, dark brown, moist</i>										
	259.801	<i>CLAY: light brown, moist, medium stiff</i>										
	259.711	<i>... mottled with reddish brown</i>	7-1	S				19.4				
	0.8											
	1.6		7-2	P	12			23.2				
	2.4	<i>... grey mottled with reddish brown</i>										
	3.2		7-3	P	12			22.9				
	4.0	<i>... wet, possible seepage zone</i>										
	4.0	<i>... brown to reddish brown, with limestone fragments</i>	7-4	P	50/5			22.0				
	255.601	<i>LIMESTONE: tan, hard</i>										
		<i>... practical drilling refusal</i>										
		END OF BORING										
	4.8											
	5.6											
	6.4											
	7.2											

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

Figure A-10



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# EXPLORATORY BORING LOG

B-8

FORT LEAVENWORTH HOUSING PHASE 1A -LEAVENWORTH, KANSAS

PROJECT NO: 74-00555-3A-147

BORING LOCATION: See boring location sketch

SCALE: 1 CM = 40 CM

BORING DATE 12-19-01

DRILLER KJP

LOGGED BY MAH

CHECKED BY SMH

WATER LEVEL @ DRILL 0.84

WATER LEVEL AT 24 HRS 0.84

WATER LEVEL AT 72 HRS

LOG	ELEVATION	SOIL DESCRIPTION	NO.	TOOL	SPT	SPT GRAPH			% Moist.	Dry Unit Wt(kg/m3)	Qu (kPa)	% Fines	PI
						10	25	40					
	0												
	258.68	TOPSOIL: clay, dark brown, moist											
	258.59	CLAY: light brown to brown, moist, soft											
	0.8	... tan to grey, mottled with reddish brown, moist, medium stiff	8-1	S					25.9	1570	132.1	99	33
	1.6	... grey, soft to medium stiff	8-2	P	10				25.7				
	2.4	... brown to grey, wet to saturated, soft	8-3	P	4								
	3.2												
	255.38	CLAY SHALE: grey, lightly moist, medium hard, weathered	8-4	P	50/2								
	255.08	LIMESTONE: tan, hard											
	4	...practical drilling refusal											
		END OF BORING											
	4.8												
	5.6												
	6.4												
	7.2												

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

Figure A-11



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# EXPLORATORY BORING LOG

B-9

FORT LEAVENWORTH HOUSING PHASE 1A -LEAVENWORTH, KANSAS

PROJECT NO: 74-00555-3A-147

BORING LOCATION: See boring location sketch

SCALE: 1 CM = 40 CM

BORING DATE 12-19-01

DRILLER KJP

LOGGED BY MAH

CHECKED BY SMH

WATER LEVEL @ DRILL

WATER LEVEL AT 24 HRS

WATER LEVEL AT 72 HRS

LOG	ELEVATION	SOIL DESCRIPTION	NO.	TOOL	SPT	SPT GRAPH			% Moist.	Dry Unit Wt(kg/m3)	Qu (kPa)	% Fines	PI
						10	25	40					
	0	260.138											
	0.138	260.078	TOPSOIL: clay, dark brown, moist										
	0.8	CLAY: brown to dark brown, moist, soft to medium stiff											
	1.6	... brown, medium stiff, very moist	9-1	P	7				25.1				
	2.4		9-2	P	8								
	3.2	END OF BORING											
	4												
	4.8												
	5.6												
	6.4												
	7.2												

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

Figure A-12



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# EXPLORATORY BORING LOG

**B-10**

**FORT LEAVENWORTH HOUSING PHASE 1A -LEAVENWORTH, KANSAS**

PROJECT NO: **74-00555-3A-147**

BORING LOCATION: **See boring location sketch**

SCALE: 1 CM = 40 CM

BORING DATE **12-19-01**

DRILLER **KJP**

LOGGED BY **MAH**

CHECKED BY **SMH**

WATER LEVEL @ DRILL **1.26**

WATER LEVEL AT 24 HRS **1.05**

WATER LEVEL AT 72 HRS

LOG	ELEVATION	SOIL DESCRIPTION	NO.	TOOL	SPT	SPT GRAPH			% Moist.	Dry Unit Wt(kg/m <sup>3</sup> )	Qu (kPa)	% Fines	PI	
						10	25	40						
	0	257.814												
		257.754	TOPSOIL: clay, dark brown, moist											
			CLAY: brown mottled with reddish brown, moist to very moist, soft to medium stiff											
		0.8	... wet zone	10-1	S				28.8			96	23	
		1.6	... very moist to wet	10-2	P	6								
		2.4		10-3	S				30.3					
	3.2	254.844	CLAY SHALE: grey, lightly moist, firm to medium hard	10-4	P	55		16.5						
	4.0		10-5	P	70		14.6							
	4.8	... medium hard to hard												
	5.6		10-6	P	50/5									
	6.4	END OF BORING												
	7.2													

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

Figure A-13



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## EXPLORATORY BORING LEGEND

FORT LEAVENWORTH HOUSING PHASE 1A -LEAVENWORTH, KANSAS

### STRATA SYMBOLS



Topsoil



Clay: medium to high plasticity



Clay Shale



Existing Fill



Limestone

### Misc. Symbols



Water level 24 hours after drilling



Water level during drilling



Standard Penetration (N)  
(blows/30 cm)

### Soil Samplers



Undisturbed Sample  
(7.6 cm Shelby Tube)



Standard Penetration Sampler  
(5 cm OD Splitspoon)

### Notes:

1. Exploratory borings were drilled with a Mobile Drill B-31 rotary drill rig using 15 cm diameter continuous flight auger and a rock bit. The borings were drilled at the dates indicated on the boring logs.
2. Groundwater encountered during drilling is presented on the boring logs. The water level presented is for the time indicated on the boring logs. The water level should be considered as approximate. Water levels may fluctuate several feet due to various factors beyond the scope of this geotechnical study.
3. Borings were located by Allied Laboratories Survey Division. Approximate locations are shown on the boring location sketch.
4. Ground surface elevations were determined by Allied Laboratories Survey Division.
5. The subsurface soils presented on the boring logs should be considered as approximate. The exploratory boring logs represent average subsurface conditions based on visual observation of auger cuttings and periodic sampling. Other soil types may be present at the site which could not be identified by this type of study. The boring logs present sharp transitions between soil types. However, these transitions will occur more gradually in most instances.
6. The data presented on the exploratory boring logs is subject to the conclusions, recommendations and limitations discussed in the Geotechnical Report. Additional information on the subsurface soils and data may be included in the report which is not presented on the exploratory boring logs.



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## GENERAL GEOTECHNICAL NOTES

### SOIL CLASSIFICATION TERMINOLOGY

Soil classification is based on ASTM D-2487 "Soil Classification for Engineering Purposes" which is based on the Unified Soil Classification System. Fine grained soils have less than 50 percent of their particles retained on the No. 200 sieve. These soils are classified as silts if they are nonplastic to slightly plastic and as clays if they classify as plastic. Coarse grained soils have more than 50 percent of their particles retained on the No. 200 sieve and are classified as sands, gravels, cobbles and boulders depending on the grain size. Minor and major constituents may be added as modifiers depending on the proportions of the soil types. Additionally, fine grained soils are described based on their consistency and coarse grained soils are delineated by their relative density. Examples: Fat clay with sand (CH) and Silty sand (SM).

### WATER LEVEL MEASUREMENTS

Water level measurements presented on the test boring logs are for the times indicated. These measurements may not necessarily represent the actual groundwater levels at the site. Fine grained soils of low permeability may require measurements for extended periods to accurately reflect free water levels. Coarse grained soils will generally reflect true groundwater levels after short periods. Groundwater levels and seepage water can vary depending on time of year, climatic conditions and other factors beyond the scope of normal geotechnical explorations. Typical water level abbreviations follows:

- |                                           |                                           |
|-------------------------------------------|-------------------------------------------|
| WD - Water level during drilling          | WA - Water level after drilling           |
| W24 - Water level 24 hours after drilling | W48 - Water level 48 hours after drilling |
| CW - Depth to wet cave of boring          | CD - Depth to dry cave of boring          |

### SAMPLING AND DRILLING ABBREVIATIONS

Drilling and sampling procedures are typically performed in accordance with ASTM standards unless otherwise noted. Typical sampling and drilling abbreviations follows:

- |                                                              |                                                |
|--------------------------------------------------------------|------------------------------------------------|
| P - Standard Penetration sampler<br>(3.5 cm. ID split-spoon) | SB - Sawtooth bit barrel sampler               |
| S - 7.6 cm diameter thin walled Shelby Tube                  | CF10 - 10 cm. diameter continuous flight auger |
| D - Denison Barrel Sampler                                   | CF15 - 15 cm. diameter continuous flight auger |
| B - Bulk/grab sample                                         | HS - 18.4 cm. diameter hollow stem auger       |
|                                                              | NX - Diamond bit coring                        |

#### CONSISTENCY OF COARSE GRAINED SOILS

#### CONSISTENCY OF FINE GRAINED SOILS

Relative Density ( $D_R$ )	Percent $D_R$	Approximate N - Value (blows/30 cm)	Consistency	Unconfined Compressive Strength ( $Q_u$ ) kPa	Approximate N - Value (blows/30 cm)
Very Loose	less than 15	0 to 4	Very Soft	Less than 25	0 to 2
Loose	15 to 35	4 to 10	Soft	25 to 50	2 to 4
Medium Dense	35 to 65	10 to 30	Medium Stiff	50 to 95	4 to 8
Dense	65 to 85	30 to 50	Stiff	95 to 190	8 to 16
Very Dense	85 to 100	over 50	Very Stiff	190 to 380	16 to 30
			Hard	Over 380	Over 30

#### BEDROCK HARDNESS DESCRIPTIONS

#### GRAIN SIZE DESCRIPTIONS

Hardness	Approximate N - Value (blows/30 cm)	Constituent Description	Particle Size
Weathered (Soft)	Less than 20	Silt or Clay  Sand  Gravel  Cobbles  Boulders	Passing No. 200 Sieve (0.075 mm)  No. 200 to No. 4 Sieve (0.075 to 4.75 mm)  No. 4 (4.75 mm) to 75 mm  75 mm to 300 mm  Over 300 mm
Firm	20 to 30		
Medium Hard	30 to 50		
Hard	50 to 80		
Very Hard	Over 80		
PROPORTIONING OF CONSTITUENTS			
Constituent Description	Percent		
Trace	Less than 5		
With	5 to 12		
Modifier	More than 12		

Figure A-15



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## APPENDIX B

### LABORATORY TEST RESULTS



**FORT LEAVENWORTH HOUSING  
 PHASE 1A  
 LEAVENWORTH, KANSAS**

Allied Project No: 74-00555-3B-147

SUMMARY OF LABORATORY TESTS

Figure B-1

REPORT OF LIQUID AND PLASTIC LIMITS

Figure B-2

UNCONFINED COMPRESSION GRAPHS

Figure B-3 & B-4

SOIL CLASSIFICATION CHART

Figure B-5



# LABORATORY TEST SUMMARY

PROJECT NUMBER: 74-00555-3A-147

LOCATION: FORT LEAVENWORTH HOUSING PHASE 1A -LEAVENWORTH, KANSAS

BORING	SAMP. NO.	SPT	MOIST %	DRY DEN (kg/m <sup>3</sup> )	Qu (kPa)	LL	PI	% Gravel	% Sand	% Fines
B-1	1-1		30.2	1354	56.5					
	1-2	7	33.5							
	1-3	10	27.2							
	1-4	12								
	1-5	28	28.0							
B-2	2-1A	14	25.4							
	2-1B		22.5							
	2-2	5	31.1							
	2-3	8	32.6							
	2-4	13								
B-3	3-1		24.2	1620	136.4					
	3-2	12	24.1							
	3-3		27.2	1514	67.5					
	3-4	8	30.3							
	3-5	10	28.8							
	3-6	18	24.4							
B-4	4-1	16	25.2							
	4-2	14	25.8							
	4-3	15	25.3							
	4-4	4	32.5							
B-5	5-1		26.7	1480	38.8	48	30		1	99
	5-2	5	28.5							
	5-3	14	22.1							
	5-4	50/3								
B-6	6-1	11		1670	88.6	49	29		5	95
	6-2		24.6							
	6-3	50/3								
	6-4	50/6								
B-7	7-1		19.4							
	7-2	12	23.2							
	7-3	12	22.9							
	7-4	50/5	22.0							
B-8	8-1		25.9	1570	132.1	53	33		1	99
	8-2	10	25.7							
	8-3	4								
	8-4	50/2								
B-9	9-1	7	25.1							
	9-2	8								

Figure No. B-1



# LABORATORY TEST SUMMARY

PROJECT NUMBER: 74-00555-3A-147

LOCATION: FORT LEAVENWORTH HOUSING PHASE 1A -LEAVENWORTH, KANSAS

BORING	SAMP. NO.	SPT	MOIST %	DRY DEN (kg/m <sup>3</sup> )	Qu (kPa)	LL	PI	% Gravel	% Sand	% Fines
B-10	10-1	6	28.8			44	23		4	96
	10-2		30.3							
	10-3	55	16.5			70				
	10-4		14.6							
	10-5	50/5								
	10-6									

Figure No. B-1



ALLIED LABORATORIES  
 350 South Washington  
 Wichita, KS 67202  
 (316) 262-6457

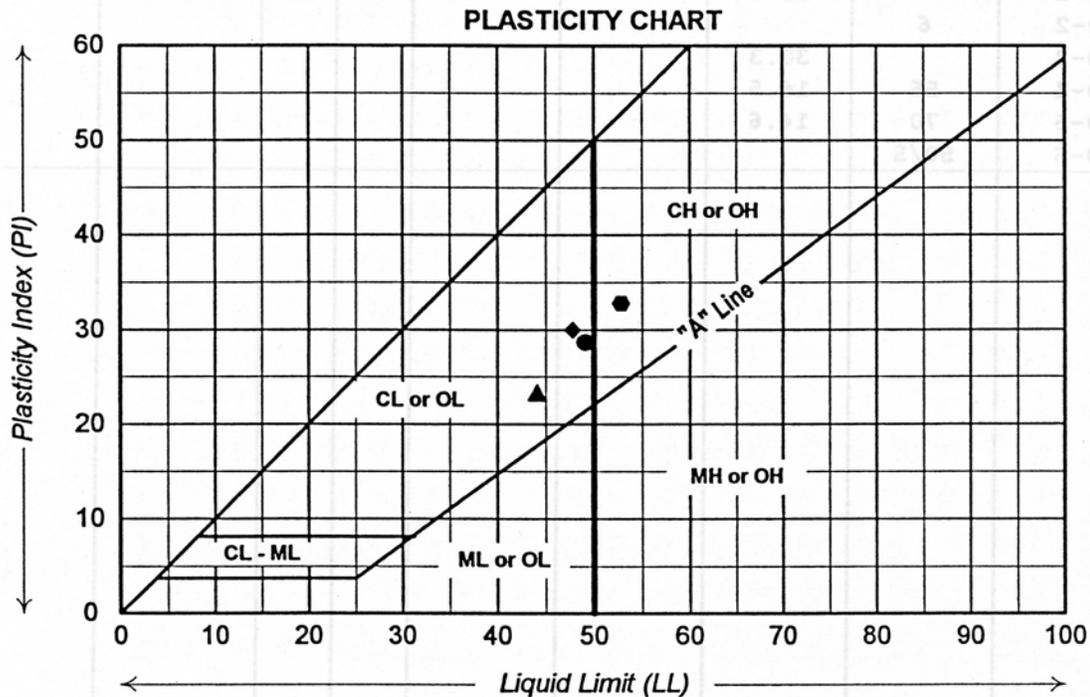
# LIQUID AND PLASTIC LIMITS TEST REPORT

ASTM D-4318



PROJECT NO: 74-00555-3B-147

FORT LEAVENWORTH HOUSING PHASE 1A - LEAVENWORTH, KS



## TEST RESULTS

SYMBOL	SAMPLE NUMBER	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PERCENT FINES	ASTM D - 2487 CLASSIFICATION	
◆	5-1	48	18	30	99	LEAN CLAY	CL
●	6-2	49	20	29	95	LEAN CLAY	CL
⬠	8-1	53	20	33	99	FAT CLAY	CH
▲	10-1	44	21	23	96	LEAN CLAY	CL
■							
○							
×							
+							
◇							
□							

Figure B-2



**Allied Laboratories**  
 350 South Washington  
 Wichita, KS 67202  
 (316) 262-6457

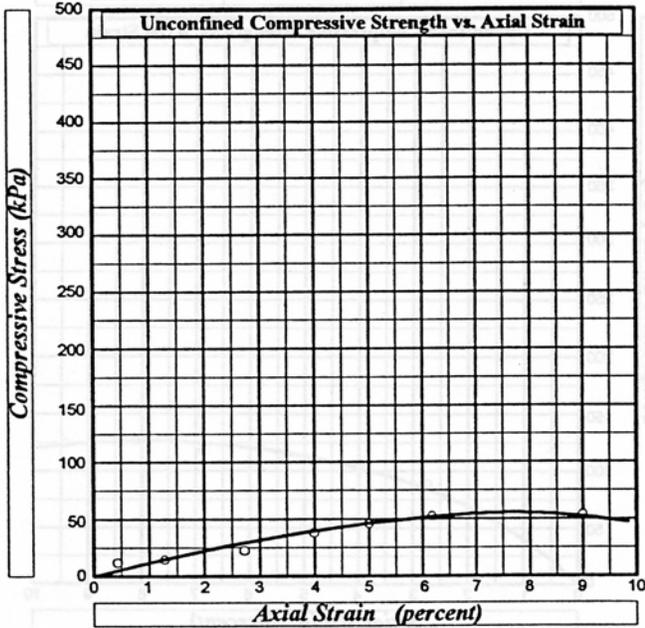
# UNCONFINED COMPRESSION TEST RESULTS

ASTM D-2166

Project No. 74-00555-3B-147

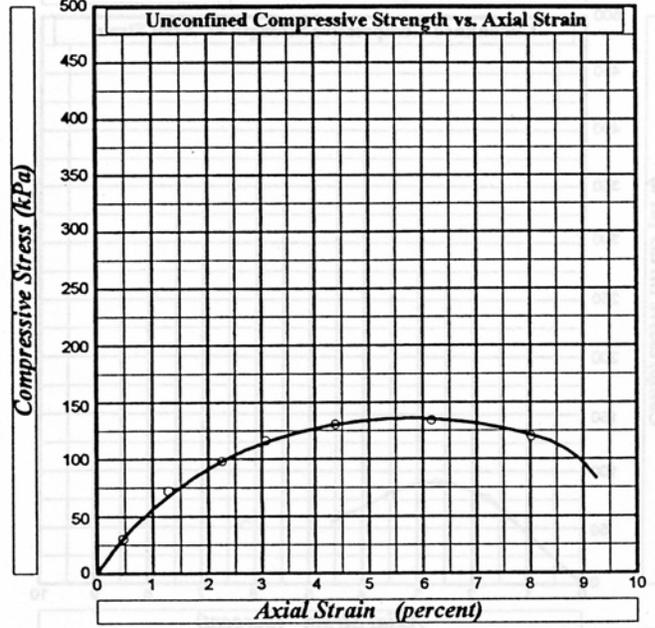
Project Name: Fort Leavenworth Housing Phase 1A - Leavenworth, Kansas

Boring: B-1	Sample: 1-1	Depth: 1.0 m
Moisture: 30.2	Density: 1354 kg/m <sup>3</sup>	Length/Dia. 1.96



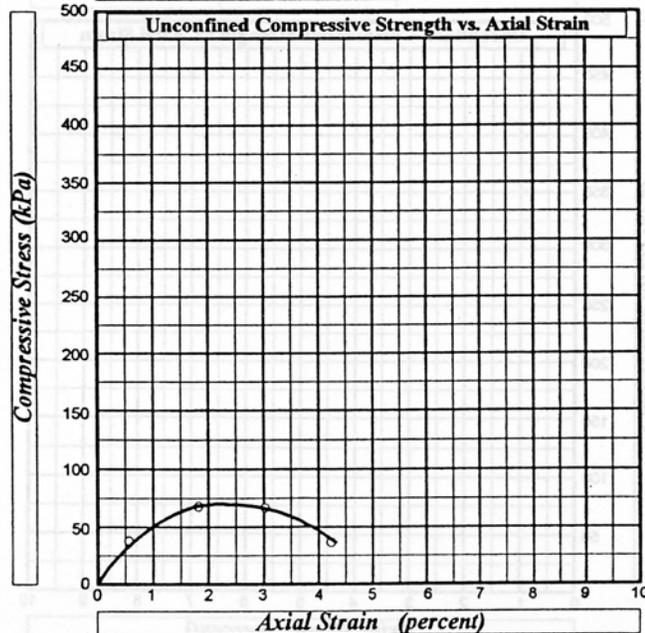
Compressive Strength: 56.5 kPa      Axial Strain: 8.0 %

Boring: B-3	Sample: 3-1	Depth: 1.0 m
Moisture: 24.2	Density: 1620 kg/m <sup>3</sup>	Length/Dia. 1.95



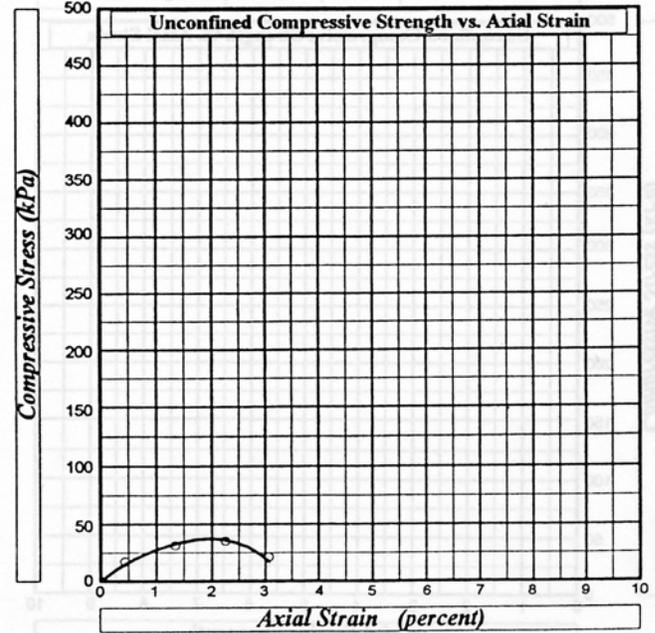
Compressive Strength: 136.4 kPa      Axial Strain: 6.3 %

Boring: B-3	Sample: 3-3	Depth: 2.5 m
Moisture: 27.2	Density: 1514 kg/m <sup>3</sup>	Length/Dia. 1.45



Compressive Strength: 67.5 kPa      Axial Strain: 2.3 %

Boring: B-5	Sample: 5-1	Depth: 1.0 m
Moisture: 26.7	Density: 1480 kg/m <sup>3</sup>	Length/Dia. 1.93



Compressive Strength: 38.8 kPa      Axial Strain: 2.1 %

Figure B-3



**Allied Laboratories**  
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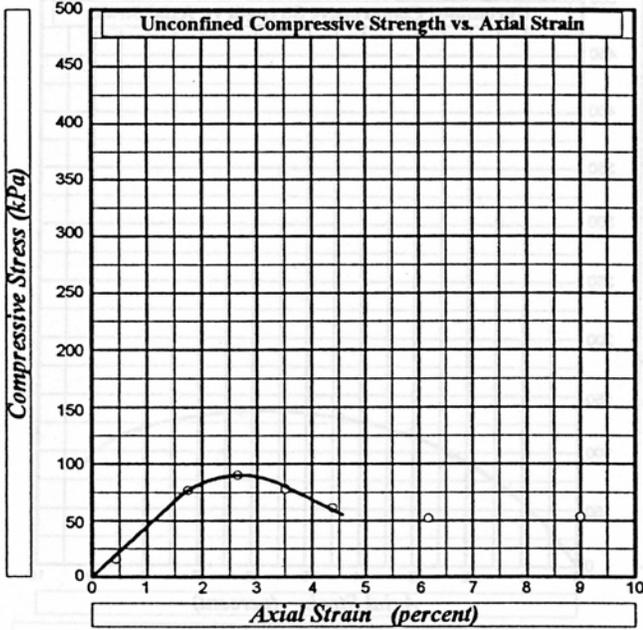
# UNCONFINED COMPRESSION TEST RESULTS

ASTM D-2166

Project No. 74-00555-3B-147

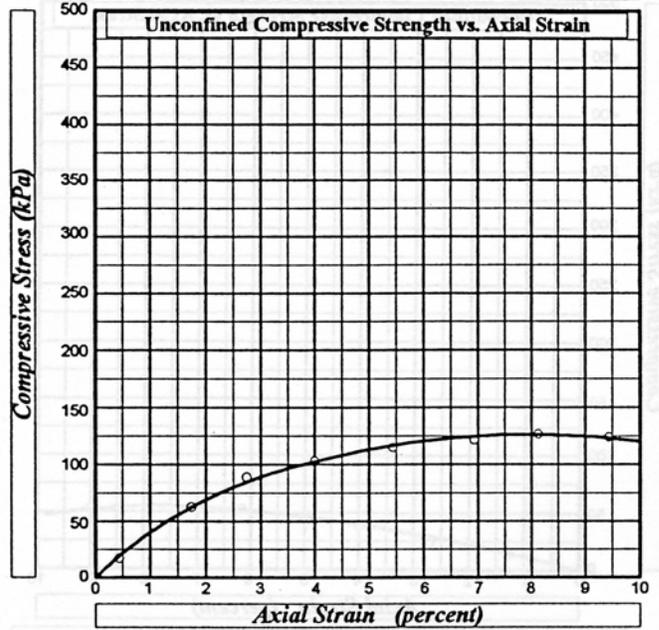
Project Name: Fort Leavenworth Housing Phase 1A - Leavenworth, Kansas

Boring: B-6	Sample: 6-2	Depth: 2.5 m
Moisture: 24.6	Density: 1670 kg/m <sup>3</sup>	Length/Dia. 1.99



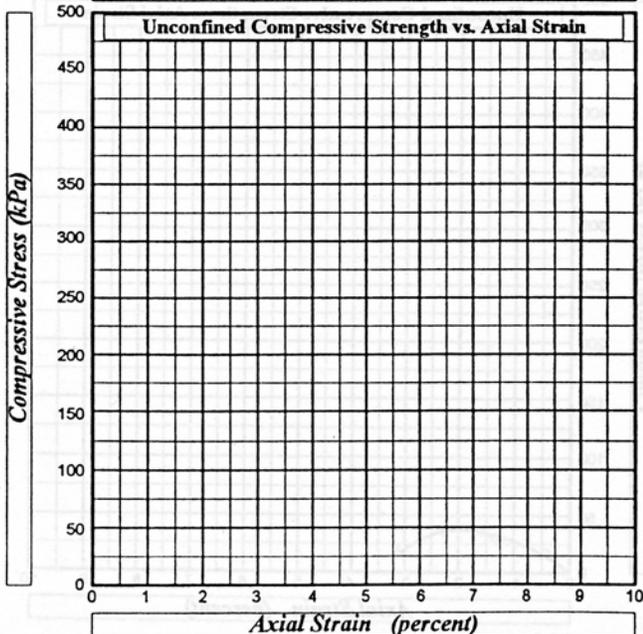
Compressive Strength: 88.6 kPa      Axial Strain: 2.6 %

Boring: B-8	Sample: 8-1	Depth: 1.0 m
Moisture: 25.9	Density: 1570 kg/m <sup>3</sup>	Length/Dia. 1.95



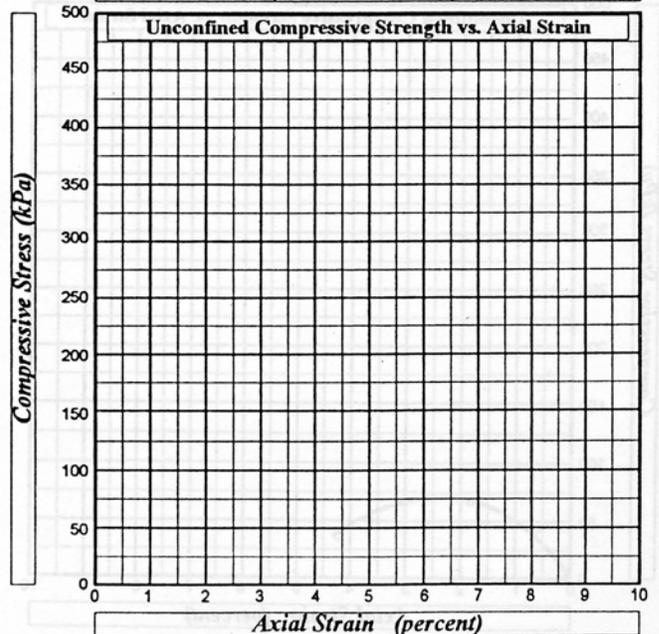
Compressive Strength: 132.1 kPa      Axial Strain: 8.2 %

Boring:	Sample:	Depth:
Moisture:	Density:	Length/Dia.



Compressive Strength:      Axial Strain:

Boring:	Sample:	Depth:
Moisture:	Density:	Length/Dia.



Compressive Strength:      Axial Strain:

Figure B-4



ALLIED LABORATORIES  
350 South Washington  
Wichita, KS 67202  
(316) 262-6457

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487  
(Based on Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests <sup>A</sup>				Soil Classification	
				Group Symbol	Group Name <sup>B</sup>
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines <sup>C</sup>	$Cu \geq 4$ and $1 \leq Cc \leq 3$ <sup>E</sup>	GW	Well graded gravel <sup>F</sup>
			$Cu < 4$ and/or $1 > Cc > 3$ <sup>E</sup>	GP	Poorly graded gravel <sup>F</sup>
		Gravels with fines More than 12% fines <sup>C</sup>	Fines Classify as ML or MH	GM	Silty gravel <sup>F,G,H</sup>
			Fines Classify as CL or CH	GC	Clayey gravel <sup>F,G,H</sup>
	Sands 50% or more passes No. 4 sieve	Clean Sands Less than 5% fines <sup>D</sup>	$Cu \geq 6$ and $1 \leq Cc \leq 3$ <sup>E</sup>	SW	Well graded sand <sup>I</sup>
			$Cu < 6$ and/or $1 > Cc > 3$ <sup>E</sup>	SP	Poorly graded sand <sup>I</sup>
		Sands with Fines More than 12% fines <sup>D</sup>	Fines Classify as ML and MH	SM	Silty sand <sup>G,H,I</sup>
			Fines Classify as CL and CH	SC	Clayey sand <sup>G,H,I</sup>
Fine Grained Soils 50% or more passes the No. 200 Sieve	Silts and Clays Liquid limit less than 50.	Inorganic	PI > 7 and plots on or above "A" line <sup>J</sup>	CL	Lean clay <sup>K,L,M</sup>
			PI < 4 and plots on or below "A" line <sup>J</sup>	ML	Silt <sup>K,L,M</sup>
		Organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} \leq 0.75$	OL	Organic clay <sup>K,L,M,N</sup>
				Organic silt <sup>K,L,M</sup>	
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" Line	CH	Fat clay <sup>K,L,M</sup>
			PI plots below "A" Line	MH	Elastic silt <sup>K,L,M</sup>
		Organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} \leq 0.75$	OH	Organic clay <sup>K,L,M,P</sup>
				Organic silt <sup>K,L,M,Q</sup>	
Highly organic soils	Primarily organic matter, dark in color, and organic odor			Pt	Peat

- <sup>A</sup> Based on the material passing the 3-in. (75-mm) sieve.
- <sup>B</sup> If field sample contained cobbles or boulders, or both add "with cobbles or boulders, or both" to group name.
- <sup>C</sup> Gravels with 5 to 12% fines require dual symbols:  
GW-GM Well graded gravel with silt.  
GW-GC Well graded gravel with clay.  
GP-GM Poorly graded gravel with silt.  
GP-GC Poorly graded gravel with clay.
- <sup>D</sup> Sands with 5 to 12% fines require dual symbols:  
SW-SM Well graded sand with silt.  
SW-SC Well graded sand with clay.  
SP-SM Poorly graded sand with silt.  
SP-SC Poorly graded sand with clay.

- <sup>E</sup>  $Cu = D_{60}/D_{10}$ ;  $Cc = (D_{30})^2 / (D_{10} \times D_{60})$ .
- <sup>F</sup> If soil contains  $\geq 15\%$  sand, add "with sand" to group name.
- <sup>G</sup> If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
- <sup>H</sup> If fines are organic, add "with organic fines" to group name.
- <sup>I</sup> If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.
- <sup>J</sup> If Atterberg limits plot in hatched area, soil is a CL-ML silty clay.
- <sup>K</sup> If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel" to group name.
- <sup>L</sup> If soil contains  $\geq 30\%$  plus No. 200, predominately sand, add "sandy" to group name.
- <sup>M</sup> If soil contains  $\geq 30\%$  plus No. 4, predominately gravel, add "gravelly" to group name.
- <sup>N</sup> PI  $\geq 4$  and plots on or above "A" line.
- <sup>O</sup> PI < 4 or plots below "A" line.
- <sup>P</sup> PI plots on or above "A" line.
- <sup>Q</sup> PI plots below "A" line.

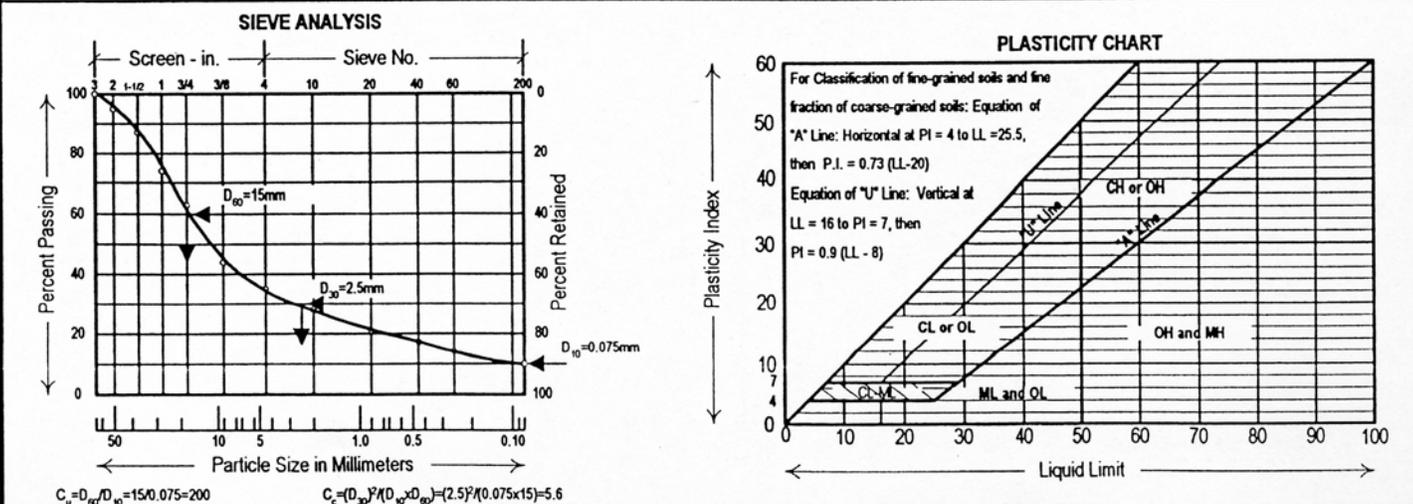


Figure B-5