LAW ENGINEERING

SUBSURFACE EXPLORATION DATA

TVA BORINGS AT JOHNSONVILLE FOSSIL PLANT

JOHNSONVILLE, TENNESSEE

Prepared for:

MR. DAVID R. ERALI

GILBERT COMMONWEALTH

READING, PENNSYLVANIA

(14)

October 11, 1994

October 11, 1994

LAW
ENGINEERING AND ENVIRONMENTAL SERVICES

Mr. David R. Erali
Gilbert Commonwealth
P.O. Box 1498
Reading, Pennsylvania 19603-1498

Subject: **Subsurface Exploration Data**
TVA Borings at Johnsonville Fossil Plant
Johnsonville, Tennessee
Law Engineering Project 382 94469 01

Dear Mr. Erali:

We are pleased to submit the data obtained from our subsurface exploration. The proposed scope of our services was described in our August 18, 1994 proposal 94445 382 and in our revision to that proposal dated September 2, 1994.

Tasks were defined in the proposals for three areas:

1. Proposed ash disposal site (located in a gravel pit approximately 5 miles from the plant).
2. Top of the dike around existing ash pond.
3. Top of causeway from plant to ash pond.

Additional services requested on August 31, 1994 were:

1. Provide a drawing of the boring locations along the crest of the causeway.
2. Evaluate the laboratory testing data and provide recommended soil design parameters for use in TVA's stability analysis.
3. Review the requirements for NEPA and insure that the data required is obtained during our drilling of the gravel pit area.
4. Review the State of Tennessee Regulations for Solid Waste Disposal Class II and prepare a statement discussing the conformance of the gravel pit site to those requirements.

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The results of our work are presented in the attached document. Task 1 has been separated from tasks 2 and 3 to facilitate access to the data.

Mr. Erali, we appreciate your consideration of Law Engineering for these services and are looking forward to working as your geotechnical consultant on this and future projects. If we can be of further assistance on this project, please contact us at (615) 482-5099.

Sincerely,

LAW ENGINEERING, INC.

Daniel R. Boles, E.I.T.
Staff Professional

Carl D. Tockstein, P.E.
Principal

CARL D. TOCKSTEIN
REGISTERED ENGINEER
AGRICULTURE
COMMERCE
No. 020094
STATE OF TENNESSEE

DRB/CDT:ru

Enclosures

SUBSURFACE EXPLORATION DATA

TVA BORINGS AT JOHNSONVILLE FOSSIL PLANT

JOHNSONVILLE, TENNESSEE

Prepared for:

MR. DAVID R. ERALI

GILBERT COMMONWEALTH

READING, PENNSYLVANIA

by:

Law Engineering, Inc.

Oak Ridge, Tennessee

October 11, 1994

Project 382 94469 01

TASK 1

PROPOSED ASH DISPOSAL SITE

- Objective of Exploration
- Scope of Exploration
- Discussion
- Table 1

Appendix A-1 - Field Procedures
Appendix B-1 - Test Boring Records
Appendix C-1 - Laboratory Data
- Table C-1
- Test Results

OBJECTIVE OF EXPLORATION

The objectives of our exploration were to determine general subsurface conditions and obtain initial data to evaluate the site for potential use for placement of ash. An assessment of site environmental conditions or of the presence of pollutants in the soil, rock, surface water, or ground water of the site was beyond the proposed scope of our exploration.

SCOPE OF EXPLORATION

The scope of services for this exploration has included a site reconnaissance, assisting TVA personnel with layout of the borings, drilling 8 test borings in the gravel pit area and visually classifying the soil samples obtained from standard penetration testing. Piezometers were installed in four of the borings.

Attempts at obtaining undisturbed samples in this material were not successful because of the high chert content of the material. Natural moisture and grain size laboratory tests were conducted on selected samples obtained during standard penetration testing to aid in classification and characterization. The material is non plastic therefore Atterberg limits testing was not performed. Results of laboratory testing are attached in Appendix C-1.

DISCUSSION

Subsurface conditions were explored with widely spaced borings drilled in general accordance with the procedures presented in Appendix A-1. Boring locations and depths were selected by TVA. The actual boring locations were established in the field by representatives of TVA, Gilbert Commonwealth and LAW. Boring elevations are not yet available to us.

Subsurface conditions encountered at the boring locations are shown on the Test Boring Records in Appendix B-1. These Test Boring Records represent our interpretation of the subsurface conditions based on the field logs and visual examination of the field samples by one of our engineers. The lines designating the interface between various strata on the Test Boring Records represent the approximate interface location.

Piezometers installed in borings B-1A, B-4, B-6, and B-8 were read following installation and a minimum of seven days later. The results are presented in Table 1.

The results of laboratory testing are shown in Appendix C-1.

Based on the grain size distribution curve, the non-plastic nature of the soil and visual observation the material encountered is not indicative of soil that exhibits a hydraulic conductivity of 1×10^{-6} cm/sec, such as is required by the State of Tennessee. Policy Memorandum: SW-91-2 (Variance Agreement for Fossil Fuel Fly Ash and Bottom Ash Disposal Within a Class II Facility) from the Tennessee Department of Health and Environment states:

> "The liner and geologic buffer required will be 3 feet in total thickness with a maximum hydraulic conductivity of 1×10^{-6} cm/sec. The thickness will be measured from the base of the fill to the seasonal high water table of the uppermost unconfined aquifer, or the top of the formation aquifer."

Two monitoring wells within the gravel pit had water levels less than 3 feet which would disqualify the gravel pit area as a suitable buffer. However, pursuing the possibility of constructing an engineered liner may be desirable.

TABLE 1

MONITORING WELL WATER LEVEL MEASUREMENTS PROPOSED ASH DISPOSAL AREA TVA WELLS - JOHNSONVILLE FOSSIL PLANT CAMDEN, TENNESSEE LAW ENGINEERING PROJECT 382 94469 01			
MONITORING WELL	PIPE HEIGHT ABOVE GROUND LEVEL (FT)	DATE	WATER DEPTH FROM TOP OF PIPE (FT.)
B-1A	0.7	9/7/94 9/8/94 9/15/94 9/26/94	16.6 3.2 2.5 2.5
B-4	2.0	9/8/94 9/10/94 9/15/94 9/26/94	22.6 11.2 12.1 11.1
B-6	1.4	9/8/94 9/10/94 9/15/94 9/26/94	22.3 5.5 5.5 6.4
B-8	1.2	9/8/94 9/10/94 9/15/94 9/26/94	28.0 2.5 2.5 2.9

APPENDIX A-1

FIELD PROCEDURES

FIELD EXPLORATORY PROCEDURES

Soil Test Boring (Hollow Stem)

All boring and sampling operations were conducted in general accordance with ASTM D-1586. The borings were advanced by mechanically twisting continuous steel hollow-stem auger flights into the ground. At regular intervals, soil samples were obtained with a standard 1.4-inch I.D., 2-inch O.D., split-tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot of penetration was recorded and is designated the "standard penetration resistance." (SPT) The penetration resistance, when properly evaluated, is an index to the soil's strength, density, and ability to support foundations.

Representative portions of the soil samples obtained from the split-tube sampler were sealed in glass jars and transported to our laboratory, where they were examined by our engineer to verify the driller's field classifications. Test Boring Records are attached, graphically showing the soil descriptions and penetration resistances.

Undisturbed Sampling

The relatively undisturbed samples were obtained by pushing a section of 3-inch O.D., 16 gauge, steel tubing into the soil at the desired sampling level. The sampling procedure is described by ASTM D-1587. The tube, together with the encased soils, was carefully removed from the ground, made airtight, and transported to our laboratory.

APPENDIX B-1

TEST BORING RECORDS

CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	NO. OF BLOWS, N	RELATIVE DENSITY
SANDS:	0-4	Very Loose
	5-10	Loose
	11-30	Firm
	31-50	Dense
	OVER 50	Very Dense

		CONSISTENCY
SILTS & CLAYS:	0-2	Very Soft
	3-4	Soft
	5-8	Firm
	9-15	Stiff
	16-30	Very stiff
	31-50	Hard
	OVER 50	Very Hard

PARTICLE SIZE IDENTIFICATION

BOULDERS:		Greater than 300 mm
COBBLES:		75 mm to 300 mm
GRAVEL:	Coarse -	19.0 mm to 75 mm
	Fine -	4.75 mm to 19.0 mm
SANDS:	Coarse -	2.00 mm to 4.75 mm
	Medium -	0.425 mm to 2.00 mm
	Fine -	0.075 mm to 0.425 mm
SILTS & CLAYS:		Less than 0.075 mm

KEY TO DRILLING SYMBOLS

- Undisturbed Sample
- Split Spoon Sample
- Water Table 24 Hr.
- Water Table at Time of Drilling
- 45/83 = RQD/Recovery
- Rock Coring

KEY TO SOIL CLASSIFICATIONS

- **TOPSOIL**
- **SAND**
- **GRAVEL**
- **ASPHALT, OR ASPHALT AND GRAVEL**
- **FILL**
- **ALLUVIUM**
- **COLLUVIUM**
- **RESIDUUM** - Very soft, soft, or firm
- **RESIDUUM** - Stiff, very stiff, hard, or very hard
- **PARTIALLY WEATHERED ROCK** - A transitional material between soil and rock, retaining relic structure of the parent rock
- **LIMESTONE**
- **DOLOMITE**
- **LIMESTONE / SHALE** - Limestone with shale interbeds
- **SHALE**
- **SANDSTONE**
- **VOID IN ROCK MASS**
- **AUGER BORING**
- **UNDISTURBED SAMPLE ATTEMPT**

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)
0.0	HARD TO VERY HARD BROWN SILTY SAND WITH CHERT - RESIDUUM		38
			48
			50/0.4
16.5	AUGER REFUSAL		

REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	B- 1
DATE DRILLED	September 7, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 1	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	HOLLOW-STEM AUGER BORING			
19.0	VERY HARD BROWN SILTY SAND, PRIMARILY CHERT - RESIDUUM			57
22.5	DENSE WHITE SAND WITH CHERT - RESIDUUM			38
27.5	DENSE BROWN SILT MIXED WITH FINE WHITE SAND AND CHERT - RESIDUUM			81/0.8
30.3	AUGER REFUSAL			

REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	B- 1A
DATE DRILLED	September 7, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 1	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)
0.0	VERY HARD BROWN SILTY SAND MIXED WITH DENSE WHITE SAND AND CHERT - RESIDUUM		52
7.5	DENSE TO VERY DENSE WHITE SAND MIXED WITH BROWN SILT AND CHERT - RESIDUUM		42
			47
			47
22.5	DENSE TO VERY DENSE COARSE GRAY SAND WITH BROWN SILT AND CHERT - RESIDUUM		46
30.5	BORING TERMINATED		55

REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	B- 2
DATE DRILLED	September 7, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 1	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)
0.0	HARD BROWN SANDY SILT WITH CHERT - RESIDUUM		38
7.5	DENSE TO VERY DENSE COARSE GRAY SAND WITH BROWN SILT AND CHERT - RESIDUUM		68
			57
			47
			50/0.2
30.5	BORING TERMINATED		50/0.4

REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	B- 3
DATE DRILLED	September 7, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 1	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)
0.0	DENSE TO VERY DENSE GRAY CHERT WITH BROWN SILT - RESIDUUM		63
			44
12.5	DENSE TO VERY DENSE GRAY CHERT WITH BROWN SILT AND WHITE SAND - RESIDUUM		47
			76
			99/0.8
30.5	BORING TERMINATED		50/0.4

REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	B- 4
DATE DRILLED	September 8, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 1	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)
0.0	DENSE GRAY CHERT WITH BROWN SILT - RESIDUUM		36
			36
			32
17.5	FIRM WHITE SAND WITH BROWN SILT AND CHERT - RESIDUUM		24
22.5	DENSE GRAY CHERT WITH BROWN SILT AND WHITE SAND - RESIDUUM		34
27.5	DENSE WHITE SAND WITH BROWN SILT AND CHERT - RESIDUUM		40
30.5	BORING TERMINATED		

REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	B- 5
DATE DRILLED	September 8, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 1	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)
0.0	VERY DENSE CHERT WITH BROWN SILT - RESIDUUM		57; 0/0.2
7.5	DENSE WHITE SAND WITH CHERT AND BROWN SILT - RESIDUUM		44
12.5	DENSE TO VERY DENSE CHERT WITH BROWN SILT AND WHITE SAND - RESIDUUM		89/0.7; 44; 57
27.5	VERY DENSE GRAY CHERT WITH BROWN SILT - RESIDUUM		73
30.5	BORING TERMINATED		

REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	B- 6
DATE DRILLED	September 8, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 1	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)
0.0	FIRM WHITE SAND WITH BROWN SILT AND CHERT - RESIDUUM		23
7.5	DENSE GRAY CHERT WITH BROWN SILT AND WHITE SAND - RESIDUUM		41
12.5	VERY DENSE TO DENSE WHITE SILTY SAND WITH BROWN SILT AND CHERT - RESIDUUM		42
			46
			86/0.9
27.5	VERY DENSE CHERT WITH BROWN SILT - RESIDUUM		
30.5	BORING TERMINATED		98

REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	B- 7
DATE DRILLED	September 9, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 1	

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DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)
0.0	DENSE TO VERY DENSE CHERT WITH BROWN SILT AND WHITE SAND - RESIDUUM		36; 0/0.3; 44; 51
17.5	STIFF TO VERY HARD WHITE CLAYEY SILT WITH CHERT AND WHITE SAND - RESIDUUM		28; 30; 62
30.5	BORING TERMINATED		

REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	B- 8
DATE DRILLED	September 8, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 1	

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APPENDIX C-1

LABORATORY DATA

TABLE C-1

SUMMARY OF LABORATORY TEST RESULTS

Task 1 - Proposed Ash Disposal Area
TVA Wells - Johnsonville Fossil Plant
Camden, Tennessee
Law Engineering Project 382 94469 01

BORING NUMBER	SAMPLE TYPE	SAMPLE DEPTH (ft)	INDEX PROPERTIES					USCS
			SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MINUS NO. 200 SIEVE (%)	
B-1	SS	4.0-5.5		16.6		NP		
B-1A	SS	24.0-25.5	2.67	18.7		NP	47	SM
B-1A	SS	29.0-30.5		16.5		NP		
B-2	SS	9.0-10.5		17.7		NP		
B-2	SS	24.0-25.5		19.8		NP		
B-3	SS	9.0-10.5		14.4		NP		
B-3	SS	14.0-15.5	2.68			NP	25	SM
B-3	SS	19.0-20.5				NP		
B-3	SS	24.0-25.5				NP		
B-3	SS	29.0-30.5				NP		
B-4	SS	9.0-10.5		15.6		NP		
B-4	SS	24.0-25.5		12.2		NP		
B-5	SS	9.0-10.5		14.6		NP		
B-5	SS	24.0-25.5		12.4		NP		
B-5	SS	29.0-30.5		20.1		NP		
B-6	SS	9.0-10.5		15.0		NP		

NOTE: SS - Split Spoon sample
USCS - Unified Soil Classification System
NP - Non Plastic

TABLE C-1

SUMMARY OF LABORATORY TEST RESULTS

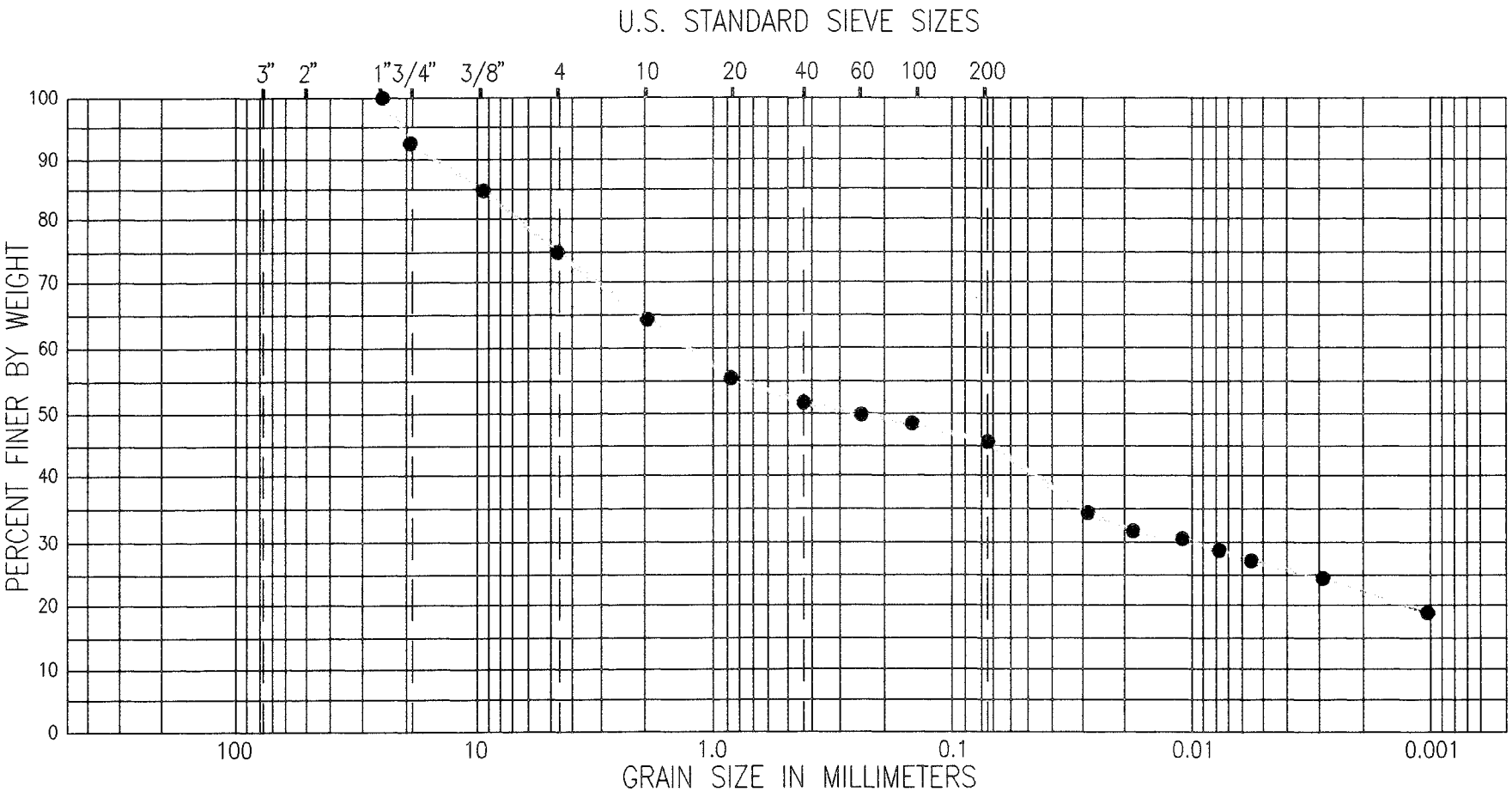
Task 1 - Proposed Ash Disposal Area
TVA Wells - Johnsonville Fossil Plant
Camden, Tennessee
Law Engineering Project 382 94469 01

BORING NUMBER	SAMPLE TYPE	SAMPLE DEPTH (ft)	INDEX PROPERTIES					USCS
			SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MINUS NO. 200 SIEVE (%)	
B-6	SS	14.0-15.5	2.64			NP	17	SM
B-6	SS	19.0-20.5				NP		
B-6	SS	24.0-25.5				NP		
B-6	SS	29.0-30.5		17.0		NP		
B-7	SS	14.0-15.5	2.70			NP	32	SM
B-7	SS	19.0-20.5		17.3		NP		
B-7	SS	24.0-25.5				NP		
B-7	SS	29.0-30.5		18.2		NP		
B-8	SS	9.0-10.5		16.5		NP		
B-8	SS	14.0-15.5	2.65			NP	39	SM
B-8	SS	19.0-20.5				NP		
B-8	SS	24.0-25.5				NP		

NOTE: SS - Split Spoon sample
USCS - Unified Soil Classification System
NP - Non Plastic

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	7% GRAVEL 18%		10%	13% SAND	5%	24% FINES	23%
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



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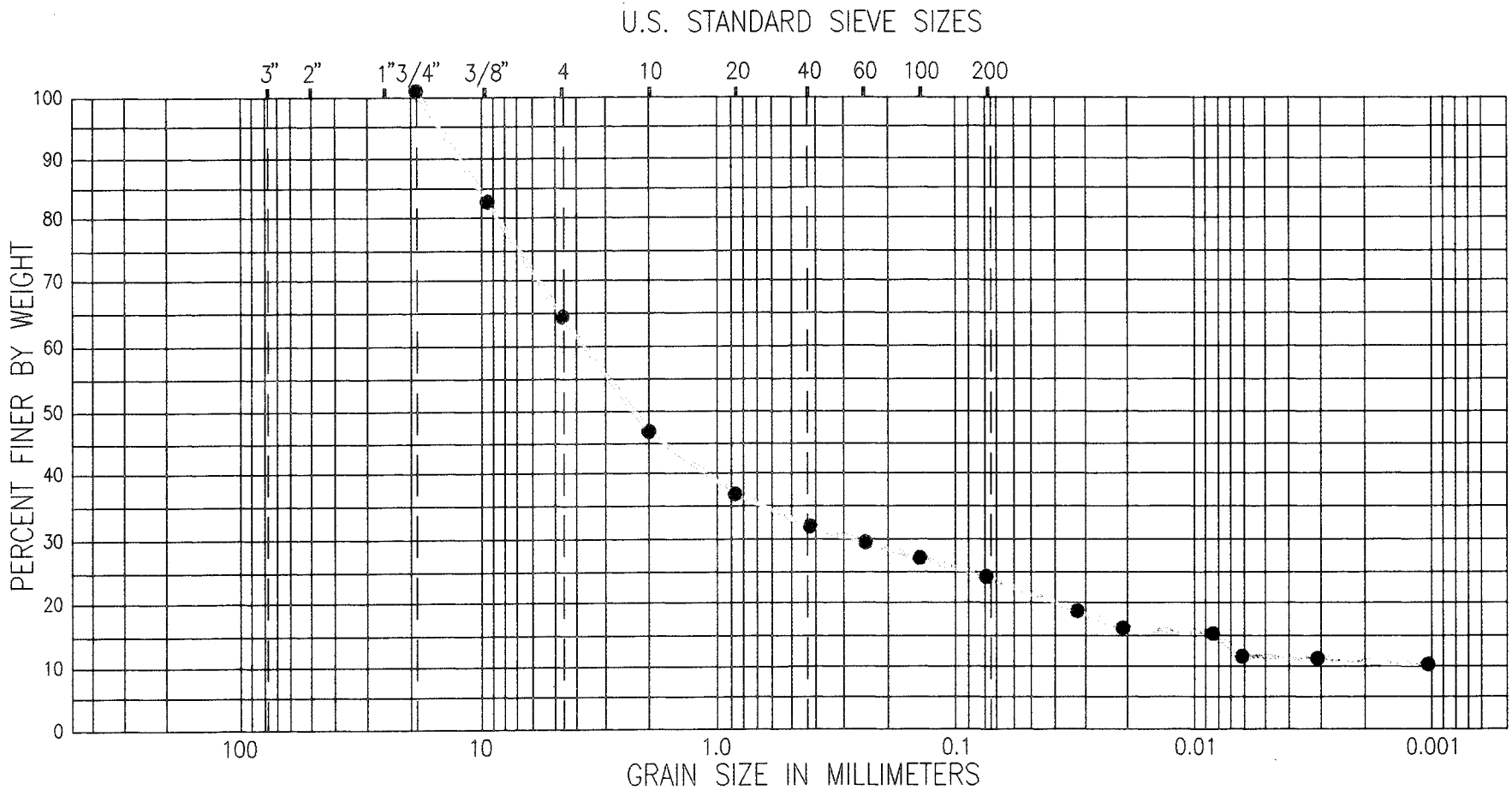
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
B1A	S2 = 24'-25.5'	18.7				SM
	S3 = 29'-30.5'	16.5				

JOB NUMBER: 382 94469 01

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	0% GRAVEL 35%		19% SAND 13%		8%	14% FINES	11%
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



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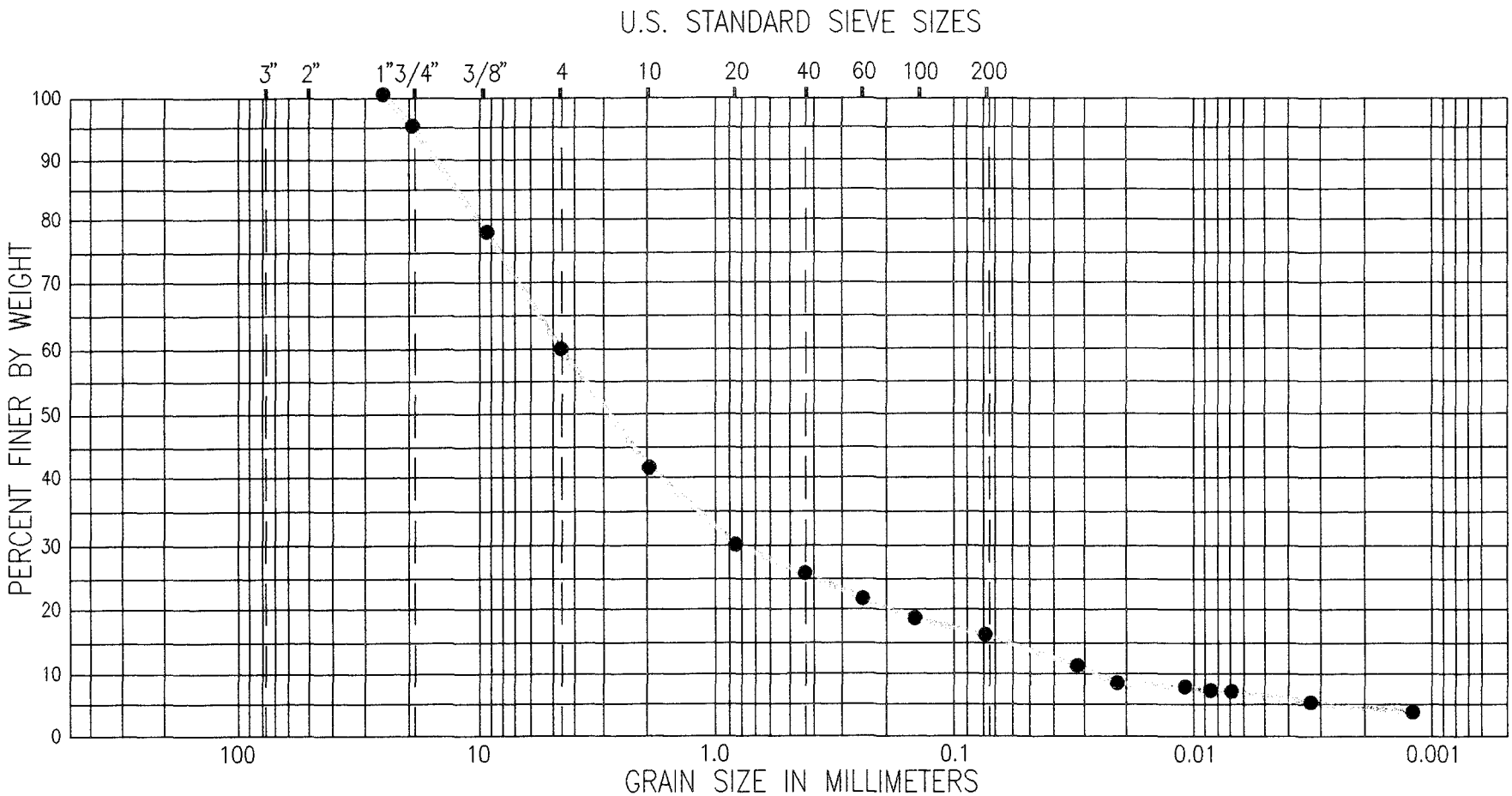
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
B-3	S3 = 14'-15.5'					SM
	S4 = 19'-20.5'					
	S5 = 24'-25.5'					
JOB NUMBER: 382 94469 01	S6 = 29'-30.5'					

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	5% GRAVEL 34%		19% SAND 16%		10%	11% FINES	5%
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
B-6	S3 = 14'-15.5' S4 = 19'-20.5' S5 = 24'-25.5'					SM
JOB NUMBER: 382 94469 01						

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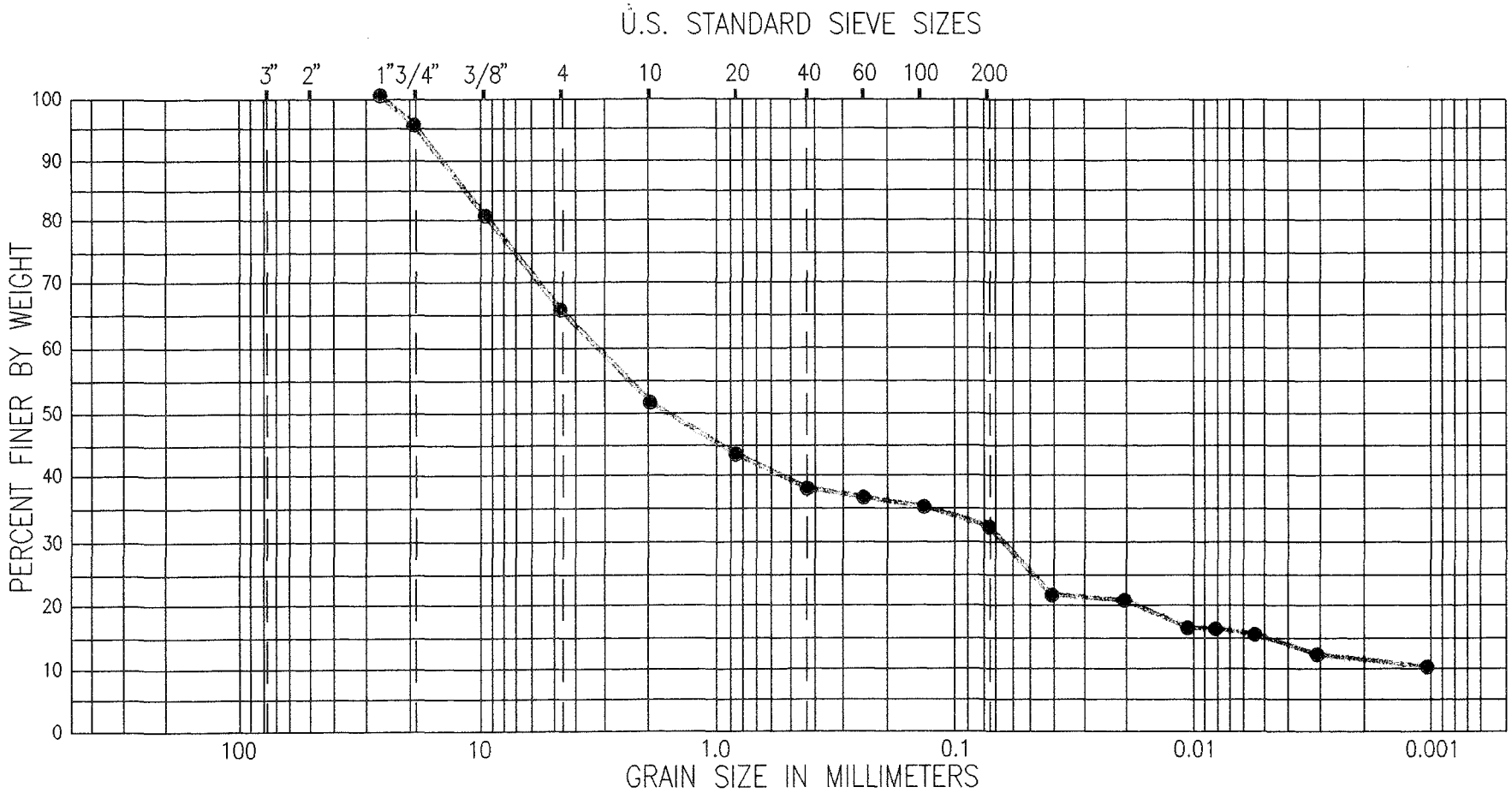
GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	4% GRAVEL 30%		14% SAND 13%		7%	20% FINES	12%
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



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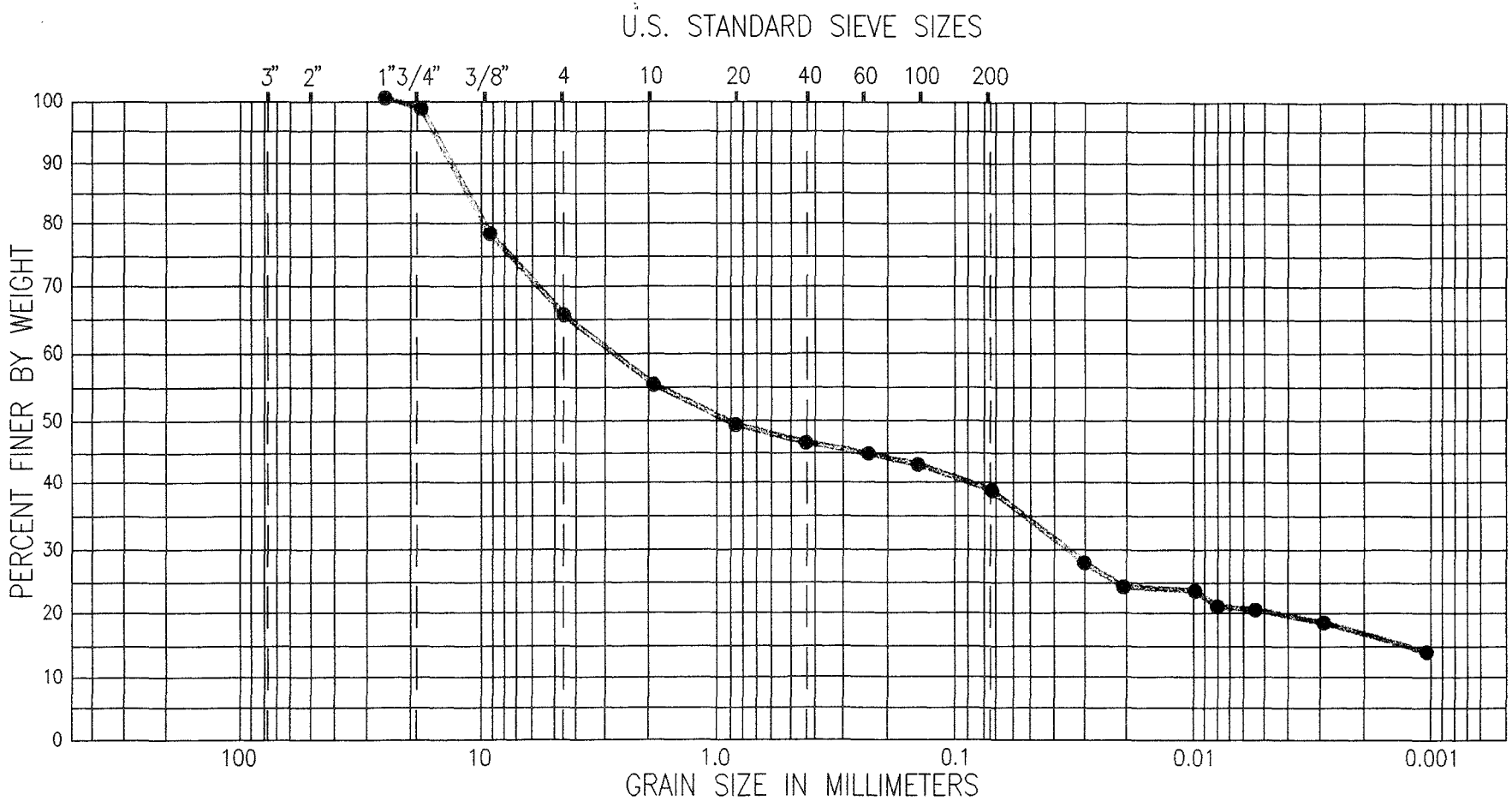
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
B-7	S3 = 14'-15.5' S4 = 19'-20.5' S5 = 24'-25.5'	17.3				SM

JOB NUMBER:
382 94469 01

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	2% GRAVEL 32%		10%	10% SAND	7%	22% FINES	17%
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



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& CONSTRUCTION MATERIALS
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BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
B-8	S3 = 14'-15.5' S4 = 19'-20.5' S5 = 24'-25.5'					SM
JOB NUMBER: 382 94469 01						

TASKS 2 & 3

DIKE AROUND EXISTING ASH POND AND CAUSEWAY LEADING TO DIKE

- Objective of Exploration
- Scope of Exploration
- Discussion
- Table 2 - Table of Well Data

Appendix A-2 - Boring Location Plan and Field Exploratory Procedures

Appendix B-2 - Test Boring Records

Appendix C-2 - Laboratory Testing Procedures and Test Results

- Table of Lab Data
- Lab Procedures
- Section Drawing
- Test Results

OBJECTIVE OF EXPLORATION

The objectives of our exploration were to determine general subsurface conditions along the centerline of the dike and causeway and obtain initial data to provide soil strength parameters for use in analysis. An assessment of site environmental conditions or of the presence of pollutants in the soil, rock, surface water, or ground water of the site was beyond the proposed scope of our exploration.

SCOPE OF EXPLORATION

The scope of services for this exploration has included a site reconnaissance, assisting TVA personnel with layout of the borings, drilling 4 test borings in the causeway area and 10 test borings in the dike area, and visually classifying the soil samples obtained from standard penetration testing. Piezometers were installed in five of the borings.

We collected 14 undisturbed samples in conjunction with the drilling for laboratory testing. Triaxial shear strength laboratory tests were conducted on the undisturbed samples to determine soil strength parameters. Natural moisture, grain size, and Atterberg limits laboratory tests were conducted and selected samples obtained during standard penetration testing to assist in classification and characterization of the soils. Results of the laboratory testing are attached in Appendix C-2.

DISCUSSION

Subsurface conditions were explored with widely spaced borings drilled in general accordance with the procedures presented in Appendix A-2. Boring locations and depths were selected by TVA and depths were suggested by Gilbert Commonwealth. The actual boring locations were established in the field by TVA, Gilbert Commonwealth and LAW personnel. Boring elevations were obtained by superimposing boring locations onto the provided topographic site plan and interpolating between contours. The boring locations shown on the Boring Location Plan and the elevations shown on the Test Boring Records in Appendix B-2 should be considered approximate.

Subsurface conditions encountered at the boring locations are shown on the Test Boring Records in Appendix B-2. These Test Boring Records represent our interpretation of the subsurface conditions based on the field logs and visual examination of the field samples by one of our engineers. The lines designating the interface between various strata on the Test Boring Records represent the approximate interface location.

Piezometers installed in borings 94-5, 94-7, 94-9, 94-11, and 94-13 were read immediately following installation and twice thereafter. Readings are shown in Table 2.

Laboratory procedures and results are presented in Appendix C-2. Selection of the samples for strength testing and the amount of testing performed was made based on two criteria:

- Obtaining parameters for each typical soil type identified
- The number and location of undisturbed samples obtainable from our drilling.

Usable samples could not be retrieved from the loose non-plastic sands and the bottom ash layers. A range of typical values for these materials is available within the TVA data base or we can provide typical values if requested to do so.

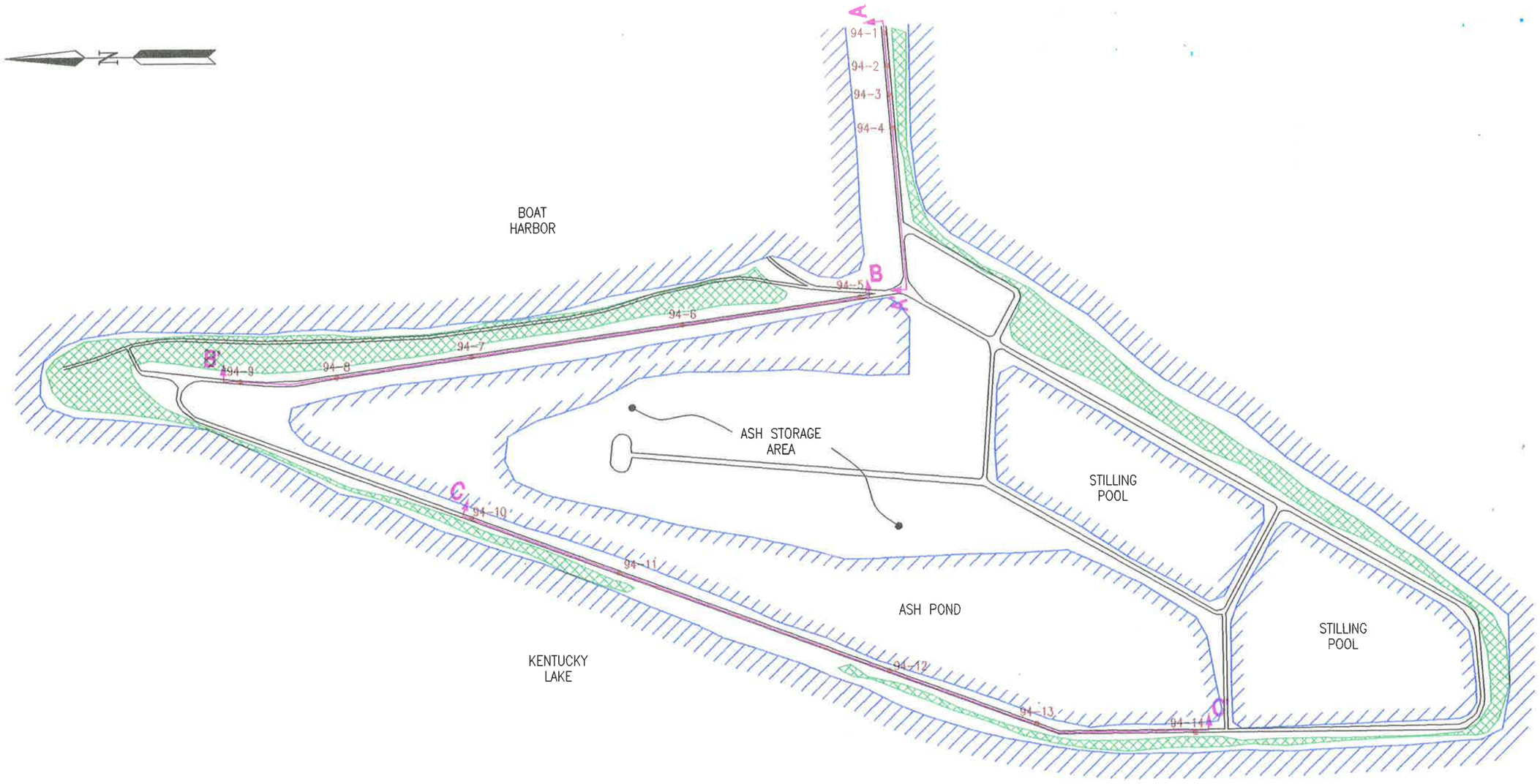
TABLE 2

MONITORING WELL WATER LEVEL MEASUREMENTS TASK 2 - EXISTING ASH POND TVA WELLS - JOHNSONVILLE FOSSIL PLANT CAMDEN, TENNESSEE LAW ENGINEERING PROJECT 382 94469 01			
MONITORING WELL	PIPE HEIGHT ABOVE GROUND LEVEL (FT.)	DATE	WATER DEPTH FROM TOP OF PIPE (FT.)
94-5	1.4	9/9/94 9/10/94 9/26/94	23.4 13.1 14.1
94-7	1.0	9/10/94 9/11/94 9/26/94	15.7 32.9 35.3
94-9	1.0	9/12/94 9/13/94 9/26/94	23.8 32.9 34.0
94-11	1.3	9/13/94 9/14/94 9/26/94	2.2 33.0 34.5
94-13	1.2	9/14/94 9/15/94 9/26/94	32.8 33.1 35.3

APPENDIX A-2

BORING LOCATION PLAN

FIELD EXPLORATORY PROCEDURES



LEGEND

- BORING LOCATION
- 94-3 BORING IDENTIFICATION
- TREES
- A SECTION LIMITS AND IDENTIFIER

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& CONSTRUCTION MATERIALS
CONSULTANTS

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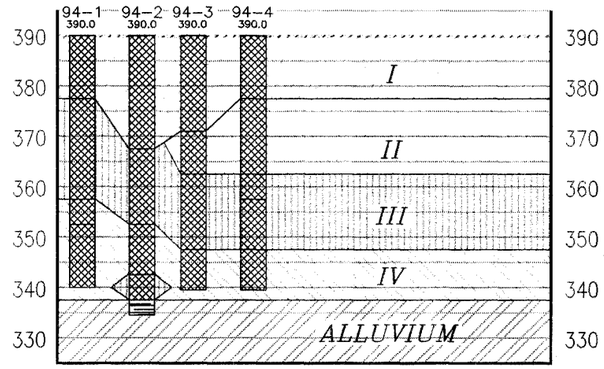
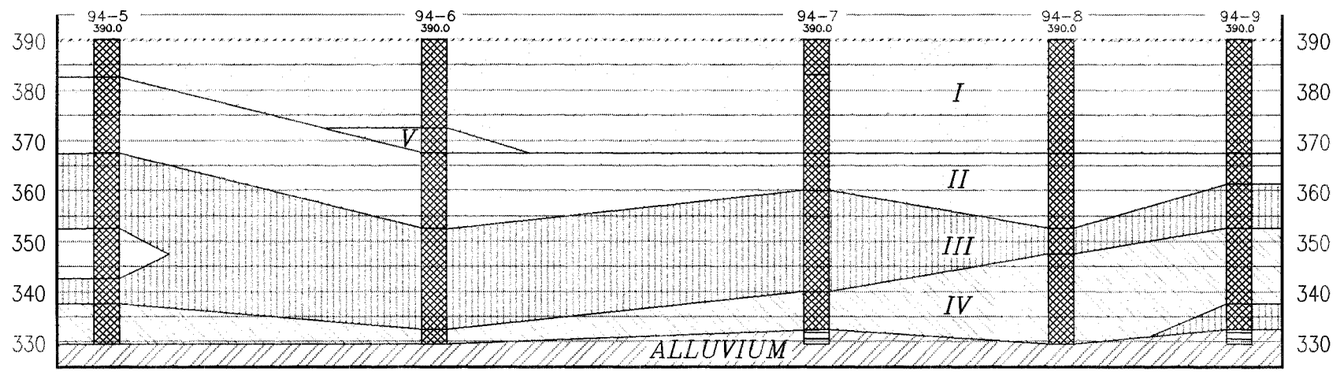
BORING/MASTER SECTION PLAN
TVA WELLS – ASH DISPOSAL AREA.
JOHNSONVILLE, TENNESSEE

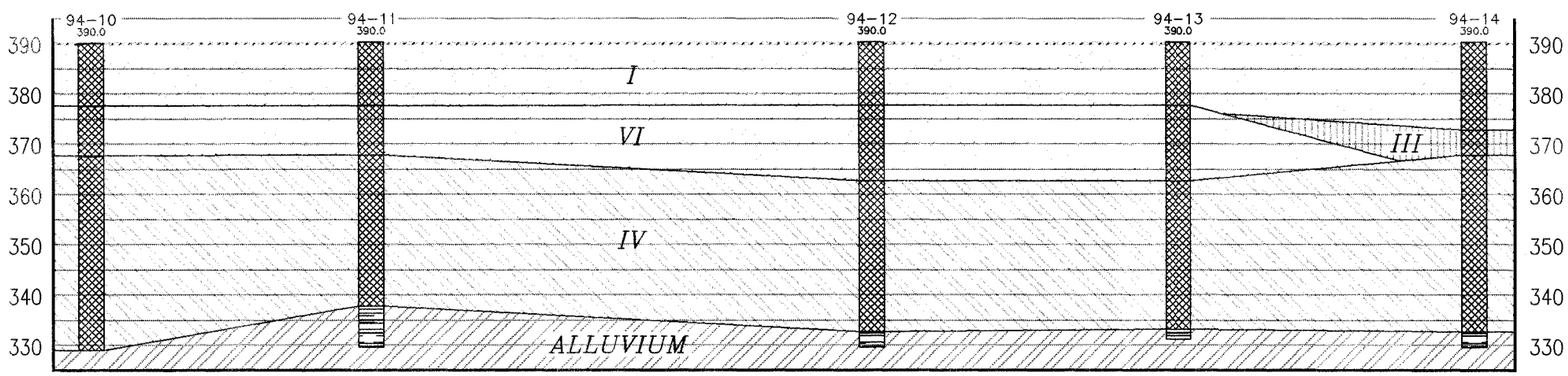
JOB NUMBER:	DATE:	SCALE:
382 94469 01	OCTOBER 5, 1994	0 — 400'



SECTION A–A'



SECTION B–B'



SECTION C–C'

TYPICAL SOIL DESCRIPTION AND STRENGTH PARAMETER

SOIL TYPE	DESCRIPTION	UNIT WEIGHT (γ)	Q		R			
					TOTAL		EFFECTIVE	
			c (psf.)	ø (degree)	c (psf.)	ø (degree)	c (psf.)	ø (degree)
I	FIRM TO STIFF BROWN TO GRAY SILTY CLAY	125 pcf	1500	7	650	15	0	38
II	SOFT TO FIRM BROWN TO GRAY SILTY CLAY	126 pcf	200	5	200	24	0	33
III	FLY ASH	123 pcf	0	5	0	10	0	33
IV	STIFF TO VERY STIFF BROWN SILTY CLAY	125 pcf	1500	7	750	15	0	30
V*	LOOSE BROWN SILTY SAND							
IV*	BOTTOM ASH							

* NO USABLE UNDISTURBED SAMPLES WERE OBTAINABLE IN THESE SOIL TYPES.

NOTES:

1. THE SOIL PARAMETERS GIVEN IN THE ABOVE TABLE ARE RECOMMENDED FOR USE IN ANALYSIS. THEY HAVE BEEN ADJUSTED FROM ACTUAL TEST RESULTS BASED ON EVALUATION OF ALL DATA AVAILABLE AND APPLICATION OF PREVIOUS EXPERIENCE AND ENGINEERING JUDGEMENT.
2. THE SOIL TYPE HORIZONS SHOWN RESULT FROM CONNECTING LIKE SOILS IN ADJACENT BORINGS. ACTUAL CONDITIONS MAY VARY SIGNIFICANTLY BETWEEN BORINGS.

NOTES

1. FOR BORING SYMBOLS, SEE KEY SHEET.
2. FOR BORING AND SECTION LOCATION, SEE BORING/SECTION LOCATION PLAN.

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SECTIONS
TVA WELLS
NEW JOHNSONVILLE, TENNESSEE

JOB NUMBER:	DATE:	
382 94469 01	10-7-94	VERT.= 0 30' HORIZ.= 0 300'

FIELD EXPLORATORY PROCEDURES

Soil Test Boring (Hollow Stem)

All boring and sampling operations were conducted in general accordance with ASTM D-1586. The borings were advanced by mechanically twisting continuous steel hollow-stem auger flights into the ground. At regular intervals, soil samples were obtained with a standard 1.4-inch I.D., 2-inch O.D., split-tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot of penetration was recorded and is designated the "standard penetration resistance." (SPT) The penetration resistance, when properly evaluated, is an index to the soil's strength, density, and ability to support foundations.

Representative portions of the soil samples obtained from the split-tube sampler were sealed in glass jars and transported to our laboratory, where they were examined by our engineer to verify the driller's field classifications. Test Boring Records are attached, graphically showing the soil descriptions and penetration resistances.

Undisturbed Sampling

The relatively undisturbed samples were obtained by pushing a section of 3-inch O.D., 16 gauge, steel tubing into the soil at the desired sampling level. The sampling procedure is described by ASTM D-1587. The tube, together with the encased soils, was carefully removed from the ground, made airtight, and transported to our laboratory.

APPENDIX B-2

TEST BORING RECORDS

CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	NO. OF BLOWS, N	RELATIVE DENSITY
SANDS:	0-4	Very Loose
	5-10	Loose
	11-30	Firm
	31-50	Dense
	OVER 50	Very Dense

		CONSISTENCY
SILTS & CLAYS:	0-2	Very Soft
	3-4	Soft
	5-8	Firm
	9-15	Stiff
	16-30	Very stiff
	31-50	Hard
	OVER 50	Very Hard

PARTICLE SIZE IDENTIFICATION

BOULDERS:		Greater than 300 mm
COBBLES:		75 mm to 300 mm
GRAVEL:	Coarse -	19.0 mm to 75 mm
	Fine -	4.75 mm to 19.0 mm
SANDS:	Coarse -	2.00 mm to 4.75 mm
	Medium -	0.425 mm to 2.00 mm
	Fine -	0.075 mm to 0.425 mm
SILTS & CLAYS:		Less than 0.075 mm

KEY TO DRILLING SYMBOLS

- Undisturbed Sample
- Split Spoon Sample
- Water Table 24 Hr.
- Water Table at Time of Drilling
- 45/83 = RQD/Recovery
- Rock Coring

KEY TO SOIL CLASSIFICATIONS

- **TOPSOIL**
- **SAND**
- **GRAVEL**
- **ASPHALT, OR ASPHALT AND GRAVEL**
- **FILL**
- **ALLUVIUM**
- **COLLUVIUM**
- **RESIDUUM** - Very soft, soft, or firm
- **RESIDUUM** - Stiff, very stiff, hard, or very hard
- **PARTIALLY WEATHERED ROCK** - A transitional material between soil and rock, retaining relic structure of the parent rock
- **LIMESTONE**
- **DOLOMITE**
- **LIMESTONE / SHALE** - Limestone with shale interbeds
- **SHALE**
- **SANDSTONE**
- **VOID IN ROCK MASS**
- **AUGER BORING**
- **UNDISTURBED SAMPLE ATTEMPT**

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)
0.0	STIFF BROWN SILTY CLAY MIXED WITH BLACK ASH - FILL	390.0	
		385.0	11
		380.0	14
12.5	SOFT TO STIFF BLACK ASH - FILL		
		375.0	13
		370.0	4
		365.0	4
		360.0	5
32.5	FIRM BROWN SILTY CLAY - FILL		
		355.0	9
37.5	FIRM TO VERY STIFF BROWN AND GRAY SILTY CLAY - FILL		
40.0			

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94- 1
DATE DRILLED	September 11, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	FIRM TO VERY STIFF BROWN AND GRAY SILTY CLAY - FILL			11
		345.0		17
				2.0/2.0
50.0	BORING TERMINATED	340.0		
		335.0		
		330.0		
		325.0		
		320.0		
		315.0		

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94- 1
DATE DRILLED	September 11, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	FIRM TO STIFF BROWN SILTY CLAY WITH CHERT - FILL	390.0		
		385.0		15
		380.0		8
				1.5/2.0
		375.0		10
		370.0		9
22.5	VERY SOFT TO SOFT BLACK AND GRAY ASH - FILL			
		365.0		3
		360.0		4
		355.0		0
37.5	STIFF TO VERY STIFF BROWN AND GRAY SILTY CLAY - FILL			
40.0				

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94- 2
DATE DRILLED	September 11, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	STIFF TO VERY STIFF BROWN AND GRAY SILTY CLAY - FILL			16
		345.0		17
47.5	VERY SOFT GRAY ASH - FILL			
		340.0		3
52.5	DENSE RIVER STONE WITH BROWN SILT - ALLUVIUM			
55.5	BORING TERMINATED	335.0		22
		330.0		
		325.0		
		320.0		
		315.0		

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94- 2
DATE DRILLED	September 11, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	FIRM TO VERY HARD BROWN SILTY CLAY WITH CHERT - FILL	390.0		
		385.0		57
		380.0		15
		375.0		8
19.0	SOFT BROWN SILTY CLAY - FILL	370.0		9
		365.0		4
27.5	VERY SOFT TO SOFT GRAY ASH - FILL			
		360.0		2
				2.0/2.0
		355.0		1
40.0				

REMARKS:

NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94- 3
DATE DRILLED	September 11, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	VERY SOFT TO SOFT GRAY ASH - FILL			3
42.5	STIFF BROWN AND GRAY SILTY CLAY - FILL	345.0		14
50.5	BORING TERMINATED	340.0		19
		335.0		
		330.0		
		325.0		
		320.0		
		315.0		

REMARKS:

NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94- 3
DATE DRILLED	September 11, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	STIFF TO VERY STIFF BROWN SILTY CLAY WITH CHERT - FILL	390.0		
		385.0		15
		380.0		18
12.5	SOFT TO FIRM BROWN SILTY CLAY MIXED WITH GRAY ASH - FILL			
		375.0		4
		370.0		6
		365.0		1.5/2.0
		360.0		4
32.5	SOFT TO FIRM GRAY ASH - FILL			
		355.0		9
40.0				

REMARKS:

TEST BORING RECORD

BORING NUMBER	94- 4
DATE DRILLED	September 12, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	SOFT TO FIRM GRAY ASH - FILL			3
42.5	STIFF TO VERY STIFF BROWN AND GRAY SILTY CLAY - FILL	345.0		16
50.5	BORING TERMINATED	340.0		10
		335.0		
		330.0		
		325.0		
		320.0		
		315.0		

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94- 4
DATE DRILLED	September 12, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	STIFF GRAY SILTY CLAY - FILL	390.0		
		385.0		15
				1.2/1.2
7.5	SOFT TO STIFF BROWN SILTY CLAY MIXED WITH GRAY ASH - FILL			
		380.0		15
		375.0		9
		370.0		3
22.5	SOFT TO FIRM GRAY ASH - FILL			
		365.0		3
		360.0		6
		355.0		5
37.5	SOFT TO FIRM BROWN AND GRAY SILTY CLAY - FILL			
40.0				

REMARKS:

TEST BORING RECORD

BORING NUMBER	94- 5
DATE DRILLED	September 9, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	SOFT TO FIRM BROWN AND GRAY SILTY CLAY - FILL			3
		345.0		4
47.5	FIRM BLACK ASH - FILL			
		340.0		6
52.5	STIFF BROWN AND GRAY SILTY CLAY - FILL			
		335.0		10
60.5	BORING TERMINATED	330.0		14
		325.0		
		320.0		
		315.0		

REMARKS:

TEST BORING RECORD

BORING NUMBER	94- 5
DATE DRILLED	September 9, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	STIFF BROWN AND GRAY SILTY CLAY - FILL	390.0		
		385.0		14
		380.0		15
		375.0		10
17.5	LOOSE FINE BROWN SILTY SAND - FILL			2.0/2.0
		370.0		9
22.5	SOFT TO FIRM BROWN SILTY CLAY - FILL			
		365.0		8
		360.0		15
		355.0		4
37.5	VERY SOFT TO FIRM GRAY ASH - FILL			
40.0				

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94- 6
DATE DRILLED	September 9, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	VERY SOFT TO FIRM GRAY ASH - FILL			2
		345.0		4
		340.0		5
		335.0		2
57.5	STIFF BROWN AND GRAY SILTY CLAY - FILL			
60.5	BORING TERMINATED	330.0		14
		325.0		
		320.0		
		315.0		

REMARKS:

TEST BORING RECORD

BORING NUMBER	94- 6
DATE DRILLED	September 9, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	STIFF BROWN CLAYEY SILT - FILL	390.0		
		385.0		15
7.0	FIRM TO STIFF BROWN AND GRAY SILTY CLAY - FILL			
		380.0		13
		375.0		12
		370.0		3
				2.0/2.0
		365.0		
30.0	SOFT TO FIRM GRAY ASH - FILL	360.0		6
		355.0		5
40.0				

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94- 7
DATE DRILLED	September 10, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	SOFT TO FIRM GRAY ASH - FILL			3
		345.0		4
50.0		340.0		10
	STIFF BROWN AND GRAY SILTY CLAY - FILL			
		335.0		14
57.5				
	DENSE COARSE SILTY SAND WITH BROWN CLAY - ALLUVIUM			
60.5		330.0		44
	BORING TERMINATED			
		325.0		
		320.0		
		315.0		

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94- 7
DATE DRILLED	September 10, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	FIRM TO VERY STIFF BROWN SILTY CLAY - FILL	390.0		
		385.0		11
		380.0		10
		375.0		11
		370.0		11
		365.0		16
		360.0		1.5/2.0
		355.0		7
37.5	FIRM GRAY ASH - FILL			
40.0				

REMARKS:

TEST BORING RECORD

BORING NUMBER	94- 8
DATE DRILLED	September 10, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	FIRM GRAY ASH - FILL			6
42.5				
	FIRM TO STIFF BROWN AND GRAY SILTY CLAY - FILL	345.0		10
		340.0		15
		335.0		9
60.5		330.0		8
	BORING TERMINATED			
		325.0		
		320.0		
		315.0		

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94- 8
DATE DRILLED	September 10, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	STIFF TO VERY STIFF BROWN AND GRAY SILTY CLAY - FILL	390.0		
		385.0		18
		380.0		13
		375.0		13
		370.0		8
22.5	FIRM GRAY ASH MIXED WITH BROWN SILTY CLAY - FILL			
		365.0		8
		360.0		7
		355.0		2.0/2.0
37.5	FIRM TO VERY STIFF BROWN SILTY CLAY - FILL			
40.0				

REMARKS:

TEST BORING RECORD

BORING NUMBER	94- 9
DATE DRILLED	September 12, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	FIRM TO VERY STIFF BROWN SILTY CLAY - FILL			16
		345.0		19
		340.0		8
52.5				
	FIRM BLACK ASH - FILL	335.0		5
57.5				
	DENSE BROWN SILTY SAND - ALLUVIUM			
60.5		330.0		36
	BORING TERMINATED			
		325.0		
		320.0		
		315.0		

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94- 9
DATE DRILLED	September 12, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	FIRM TO STIFF BROWN SILTY CLAY - FILL	390.0		
		385.0		15
		380.0		9
12.5	HARD TO VERY HARD BLACK ASH - FILL			
		375.0		54
		370.0		74
22.5	FIRM TO VERY STIFF BROWN AND GRAY SILTY CLAY - FILL			
		365.0		5
		360.0		13
		355.0		6
40.0				

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94-10
DATE DRILLED	September 13, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	FIRM TO VERY STIFF BROWN AND GRAY SILTY CLAY - FILL			8
		345.0		18
		340.0		9
		335.0		6
		330.0		1.5/2.0
61.0	BORING TERMINATED			
		325.0		
		320.0		
		315.0		

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94-10
DATE DRILLED	September 13, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	FIRM TO STIFF BROWN AND GRAY SILTY CLAY - FILL	390.0		
		385.0		14
		380.0		9
12.5	HARD BLACK ASH - FILL			
		375.0		47
		370.0		52
22.5	FIRM TO VERY STIFF BROWN AND GRAY SILTY CLAY - FILL			
		365.0		9
		360.0		15
		355.0		18
40.0				

REMARKS:

TEST BORING RECORD

BORING NUMBER	94-11
DATE DRILLED	September 13, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	FIRM TO VERY STIFF BROWN AND GRAY SILTY CLAY - FILL			14
				2.0/2.0
		345.0		15
		340.0		11
52.5	FIRM BROWN CLAYEY SANDY SILT - ALLUVIUM			
		335.0		8
60.5	BORING TERMINATED	330.0		
		325.0		
		320.0		
		315.0		

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94-11
DATE DRILLED	September 13, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	STIFF BROWN AND GRAY SILTY CLAY - FILL	390.0		
		385.0		14
		380.0		11
12.5	SOFT TO VERY HARD BLACK ASH - FILL			
		375.0		55
		370.0		23
		365.0		3
27.5	FIRM TO VERY STIFF BROWN SILTY CLAY - FILL			
		360.0		17
		355.0		18
40.0				

REMARKS:

TEST BORING RECORD

BORING NUMBER	94-12
DATE DRILLED	September 14, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

LAW ENGINEERING

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	FIRM TO VERY STIFF BROWN SILTY CLAY - FILL			14
		345.0		9
		340.0		
		335.0		2
57.5	VERY STIFF BROWN SILTY CLAY WITH RIVERSTONE - ALLUVIUM			
60.5		330.0		29
	BORING TERMINATED			
		325.0		
		320.0		
		315.0		

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94-12
DATE DRILLED	September 14, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	STIFF TO VERY STIFF BROWN SILTY CLAY - FILL	390.0		
		385.0		18
		380.0		11
12.5	FIRM TO HARD BLACK ASH - FILL			
		375.0		28
		370.0		6
		365.0		11
27.5	FIRM TO STIFF BROWN SILTY CLAY - FILL			
		360.0		9
		355.0		12
40.0				

REMARKS:

TEST BORING RECORD

BORING NUMBER	94-13
DATE DRILLED	September 14, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	FIRM TO STIFF BROWN SILTY CLAY - FILL			12
		345.0		9
		340.0		9
		335.0		1.5/1.7
57.0				
	RIVERSTONE - ALLUVIUM			
59.0				
	BORING TERMINATED	330.0		
		325.0		
		320.0		
		315.0		

REMARKS:

TEST BORING RECORD

BORING NUMBER	94-13
DATE DRILLED	September 14, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
0.0	FIRM TO VERY STIFF BROWN AND GRAY SILTY CLAY - FILL	390.0		
		385.0		16
		380.0		13
				1.5/2.0
		375.0		5
17.5	VERY SOFT BLACK ASH - FILL			
		370.0		1
22.5	FIRM TO VERY STIFF BROWN SILTY CLAY - FILL			
		365.0		13
		360.0		17
		355.0		18
40.0				

REMARKS:

TEST BORING RECORD

BORING NUMBER	94-14
DATE DRILLED	September 15, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 1 OF 2	

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)	
	FIRM TO VERY STIFF BROWN SILTY CLAY - FILL			13
		345.0		7
		340.0		12
		335.0		0
57.5	STIFF GRAY SANDY SILT - ALLUVIUM			
60.5	BORING TERMINATED	330.0		11
		325.0		
		320.0		
		315.0		

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94-14
DATE DRILLED	September 15, 1994
PROJECT NUMBER	382 94469 01
PROJECT	TVA WELLS - New Johnsonville
PAGE 2 OF 2	

LAW ENGINEERING

APPENDIX C-2

LABORATORY TESTING PROCEDURES

TEST RESULTS

SUMMARY OF LABORATORY TEST RESULTS

Task 2 and 3 - Existing Ash Pond and Causeway
TVA Wells - Johnsonville Steam Plant
Camden, Tennessee
Law Engineering Project 382 94469 01

BORING NUMBER	SAMPLE TYPE	SAMPLE DEPTH (ft)	INDEX PROPERTIES					USCS	STRENGTH PARAMETERS					
									CONSOLIDATED UNDRAINED TRIAXIAL				UNCONSOLIDATED UNDRAINED TRIAXIAL	
									TOTAL		EFFECTIVE			
			SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MINUS NO. 200 SIEVE (%)		c (psf)	ϕ (degree)	c (psf)	ϕ (degree)	c (psf)	ϕ (degree)
94-1	SS	4.0-5.5		17.4										
94-1	SS	14.0-15.5		13.5										
94-1	SS	19.0-20.5	2.69		40	18	41	SC						
94-1	SS	24.0-25.5		14.5										
94-1	SS	34.0-35.5		26.2										
94-1	SS	44.0-45.5		17.4										
94-1	UD	48.0-50.0	2.63		31	11	76	CL	1260	7.0	340	30		
94-2	SS	9.0-10.5		22.3										
94-2	SS	19.0-20.5		17.5										
94-2	SS	29.0-30.5		18.3										
94-2	SS	39.0-40.5		23.4										
94-2	SS	44.0-45.5												
94-2	SS	49.0-50.5	2.67	25.6	32	13	59	CL						
94-2	SS	54.0-55.5												
94-4	UD	24.0-26.0	2.70		46	28	61	CL/CH					210	5
94-5	SS	9.0-10.5												
94-5	SS	14.0-15.5	2.71		41	23	94	CL						
94-5	SS	19.0-20.5												
94-6	SS	9.0-10.5		17.9										

NOTE: SS - Split Spoon sample
UD - Undisturbed sample
USCS - Unified Soil Classification System

SUMMARY OF LABORATORY TEST RESULTS

Task 2 and 3 - Existing Ash Pond and Causeway
TVA Wells - Johnsonville Steam Plant
Camden, Tennessee
Law Engineering Project 382 94469 01

BORING NUMBER	SAMPLE TYPE	SAMPLE DEPTH (ft)	INDEX PROPERTIES					USCS	STRENGTH PARAMETERS					
									CONSOLIDATED UNDRAINED TRIAXIAL				UNCONSOLIDATED UNDRAINED TRIAXIAL	
									TOTAL		EFFECTIVE			
			SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MINUS NO. 200 SIEVE (%)		c (psf)	ϕ (degree)	c (psf)	ϕ (degree)	c (psf)	ϕ (degree)
94-6	SS	19.0-20.5		14.5										
94-6	SS	34.0-35.5		27.3										
94-6	SS	39.0-40.5		29.7										
94-6	SS	44.0-45.5	2.68		33	16	87	CL AND FLY ASH						
94-6	SS	49.0-50.5		26.2										
94-6	SS	59.0-60.5		24.5										
94-7	SS	29.0-30.5												
94-7	SS	34.0-35.5	2.68		34	16	85	CL AND FLY ASH						
94-7	SS	39.0-40.5												
94-7	UD	23.0-24.0	2.70						170	25	220	33		
94-8	UD	29.0-30.5			46	28	61	CL/CH						
94-8	SS	14.0-15.5												
94-8	SS	19.0-20.5	2.67		47	30	82	CL/CH						
94-8	SS	24.0-25.5												
94-9	SS	4.0-5.5		18.9										
94-9	SS	14.0-15.5		18.1										
94-9	SS	24.0-25.5		19.8										
94-9	UD	35.0-37.0	2.70		44	24	92	CL	0	18	0	33	240	0
94-9	SS	39.0-40.5		21.9										

NOTE: SS - Split Spoon sample
UD - Undisturbed sample
USCS - Unified Soil Classification System

SUMMARY OF LABORATORY TEST RESULTS

Task 2 and 3 - Existing Ash Pond and Causeway
TVA Wells - Johnsonville Steam Plant
Camden, Tennessee
Law Engineering Project 382 94469 01

BORING NUMBER	SAMPLE TYPE	SAMPLE DEPTH (ft)	INDEX PROPERTIES					USCS	STRENGTH PARAMETERS					
									CONSOLIDATED UNDRAINED TRIAXIAL				UNCONSOLIDATED UNDRAINED TRIAXIAL	
									TOTAL		EFFECTIVE			
			SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MINUS NO. 200 SIEVE (%)		c (psf)	ϕ (degree)	c (psf)	ϕ (degree)	c (psf)	ϕ (degree)
94-9	SS	49.0-50.5		25.2										
94-9	SS	59.0-60.5		20.4										
94-10	SS	34.0-35.5			41	21	97	CL						
94-10	SS	39.0-40.5												
94-10	UD	59.0-60.5	2.70		31	11	76	CL					770	0
94-11	SS	14.0-15.5	2.76				22	BOTTOM ASH						
94-11	SS	19.0-20.5												
94-11	SS	34.0-35.5		19.0	39	17		CL						
94-11	SS	39.0-40.5		24.4										
94-11	SS	44.0-45.5		23.3										
94-11	SS	49.0-50.5		24.6										
94-11	UD	42.0-44.0	2.70		43	21	97	CL					1930	7
94-13	SS	24.0-25.5	2.70		38	18	91	CL						
94-13	SS	29.0-30.5												
94-13	SS	34.0-35.5												
94-14	SS	4.0-5.5		19.7										
94-14	SS	14.0-15.5		18.8										
94-14	SS	24.0-25.5		23.3										
94-14	SS	34.0-35.5		22.8										

NOTE: SS - Split Spoon sample
UD - Undisturbed sample
USCS - Unified Soil Classification System

SUMMARY OF LABORATORY TEST RESULTS

Task 2 and 3 - Existing Ash Pond and Causeway
TVA Wells - Johnsonville Steam Plant
Camden, Tennessee
Law Engineering Project 382 94469 01

BORING NUMBER	SAMPLE TYPE	SAMPLE DEPTH (ft)	INDEX PROPERTIES					USCS	STRENGTH PARAMETERS					
									CONSOLIDATED UNDRAINED TRIAXIAL				UNCONSOLIDATED UNDRAINED TRIAXIAL	
									TOTAL		EFFECTIVE			
			SPECIFIC GRAVITY	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MINUS NO. 200 SIEVE (%)		c (psf)	ϕ (degree)	c (psf)	ϕ (degree)	c (psf)	ϕ (degree)
94-14	SS	44.0-45.5		26.7										
94-14	SS	54.0-55.5		28.9										
94-14	SS	59.0-60.5		24.0										
94-2	UD	12.0-13.5	2.65		38	21	73	CL	680	15	130	38		
94-14	UD	12.0-14.0											2410	5
94-5	UD	6.0-7.5												

NOTE: SS - Split Spoon sample
UD - Undisturbed sample
USCS - Unified Soil Classification System

LABORATORY TESTING PROCEDURES

Moisture Content

The moisture content in a given mass of soil is the ratio, expressed as a percentage, of the weight of water to the weight of the solid particles. This test was conducted in accordance with ASTM D 2216.

Atterberg Limits (Plasticity Index)

Originally, the Atterberg Limits consisted of seven "limits of consistency" of fine-grained soils. In current engineering usage, the term usually refers only to the liquid limit (LL) and plastic limit (PL). The LL (between the liquid and plastic states) is the water content at which a trapezoidal groove of specified shape, cut in moist soil held in a special cup, is closed after 25 taps on a hard rubber plate. The PL (between plastic and semi-solid states) is the water content at which the soil crumbles when rolled into threads of 1/8 inch in diameter.

The LL has been found to be proportional to the compressibility of the normally consolidated soil. The Plasticity Index (PI) is the calculated difference in water contents between the LL and PL. Together the LL and PI are used to classify silts and clays according to the Unified Soils Classification System (ASTM D 2487). The PI is used to predict the potential for volume changes in confined soils beneath foundations or grade slabs. The LL, PL, and PI are determined in accordance with ASTM D 4318.

Grain Size Distribution

Grain Size Tests are performed to aid in determining the soil classification and the grain size distribution. The soil samples are prepared for testing according to ASTM D-421 (dry preparation) or ASTM D-2217 (wet preparation). If only the grain size distribution of soils coarser than a number 200 sieve (0.074 mm opening) is desired, the grain size distribution is determined by washing the sample over a #200 sieve and, after drying, passing the samples through a standard set of nested sieves. If the grain size distribution of the soils finer than the #200 sieve is also desired, the grain size distribution of the soils coarser than the #10 sieve is determined by passing the sample through a set of nested sieves. Materials passing the number 10 sieve are dispersed

with a dispersing agent and suspended in water, and the grain size distribution calculated from the measured settlement rate of the particles. These tests are conducted in accordance with ASTM D 422.

Triaxial Shear Tests

Triaxial shear tests are used to determine the strength characteristics and friction angle of a given soil sample. Triaxial tests are also used to determine the elastic properties of the soil specimen.

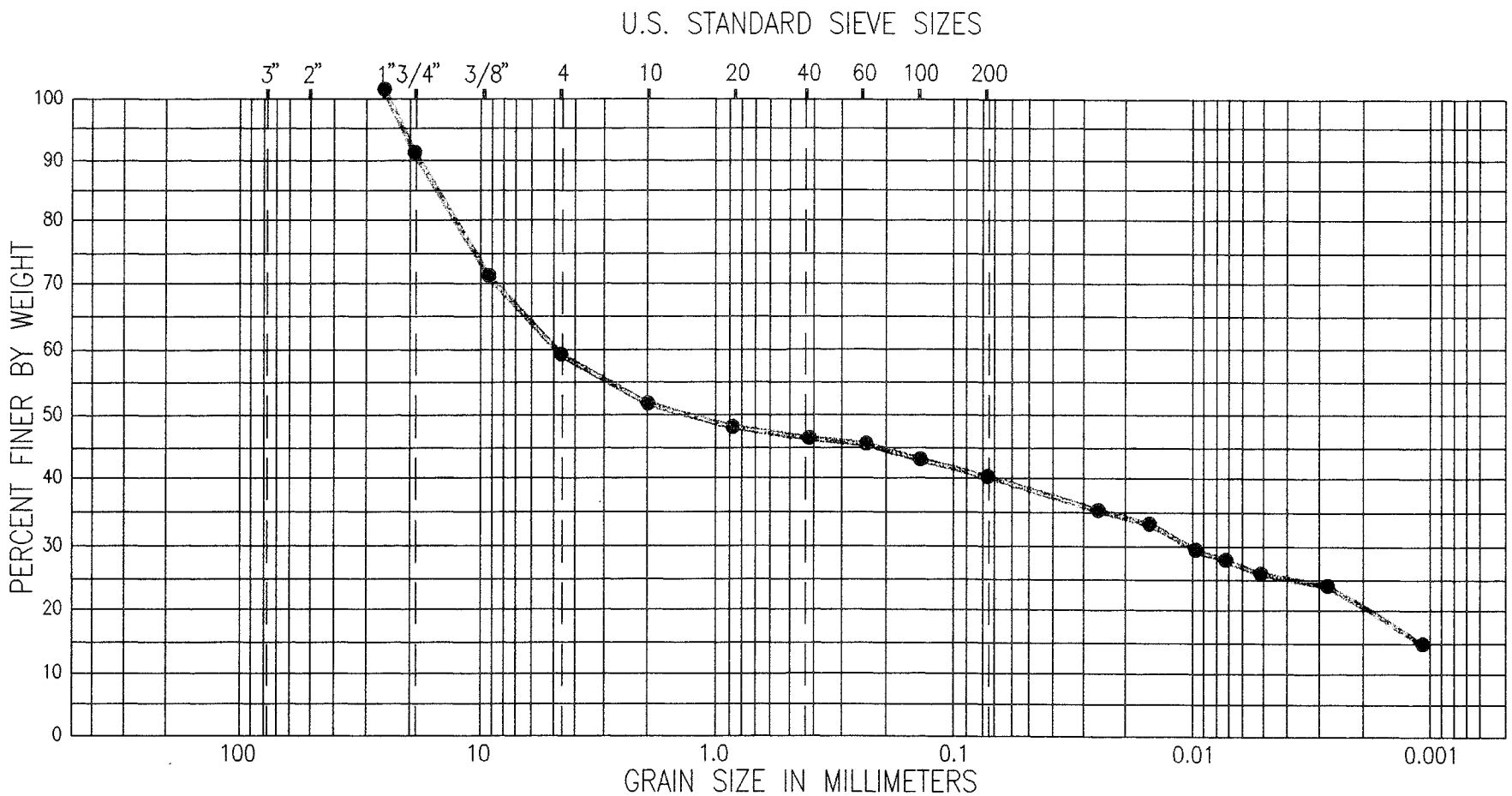
Triaxial shear tests are performed on several sections of a relatively undisturbed sample extruded from the sampling tube. The samples are then trimmed into cylinders 1.4 to 2.8 inches in diameter and encased in rubber membranes. Each is then placed in a compression chamber and confined by all around air pressure. The test results are presented in the form of stress-strain curves and Mohr envelopes or p-q plots on the accompanying Triaxial Shear Test Sheets.

Three types of triaxial tests are normally performed. The most suitable type of triaxial test is determined by the loading conditions imposed on the soil in the field and the soil characteristics.

1. Consolidated-Undrained (Designated as a CU or R Test)
2. Consolidated-Drained (designated as a CD or S Test)
3. Unconsolidated-Undrained (designated as a UU or Q Test)

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	10% GRAVEL 30%		7%	6% SAND 6%		20% FINES 21%	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



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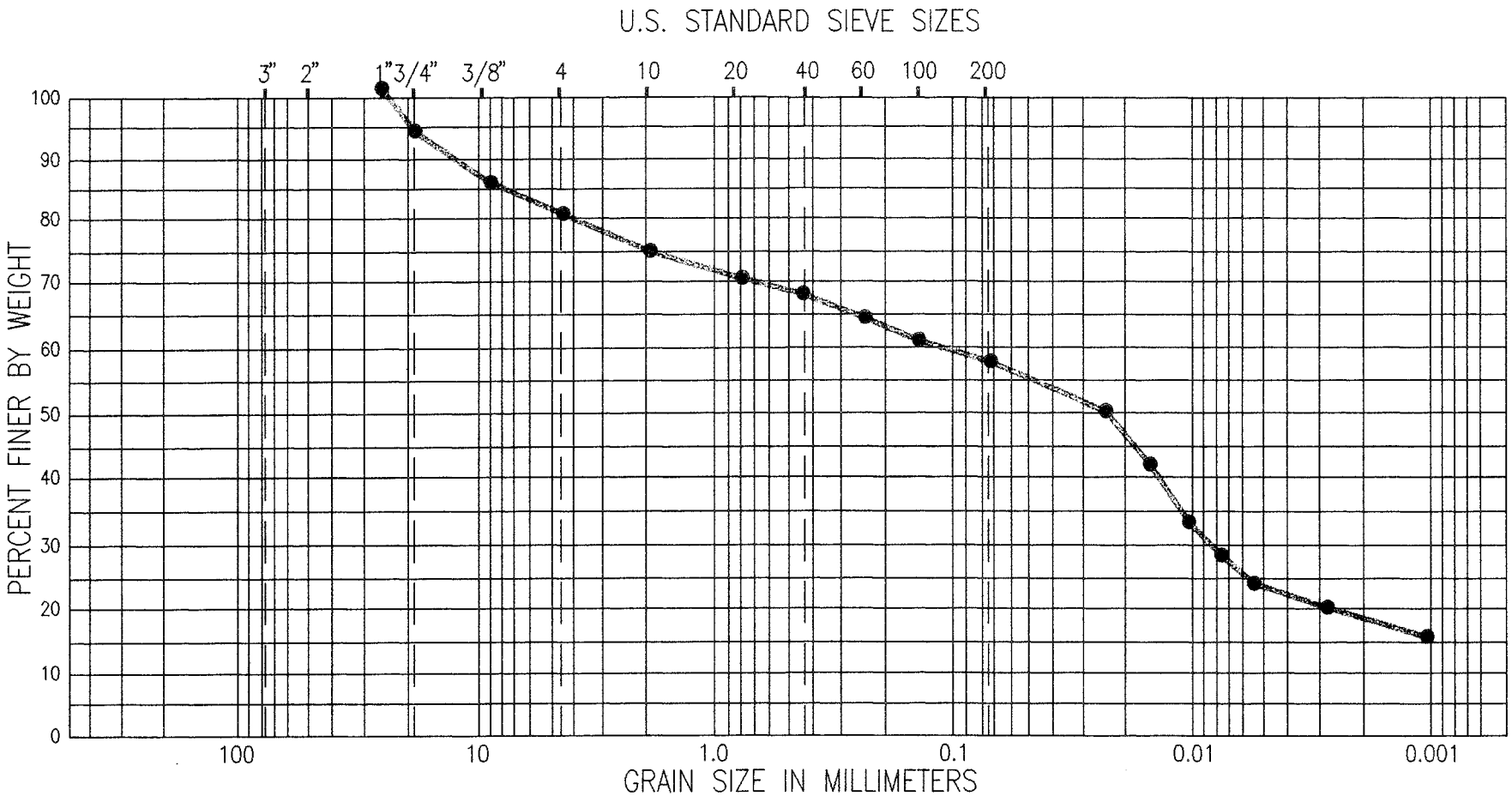
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
94-1	S3 = 14'-15.5'	13.5%	40	22	18	SC
	S4 = 19'-20.5'					
JOB NUMBER: 382 94469 01	S5 = 24'-25.5'	14.5%				

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	6% GRAVEL 13%		5%	7% SAND 10%		40% FINES 19%	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



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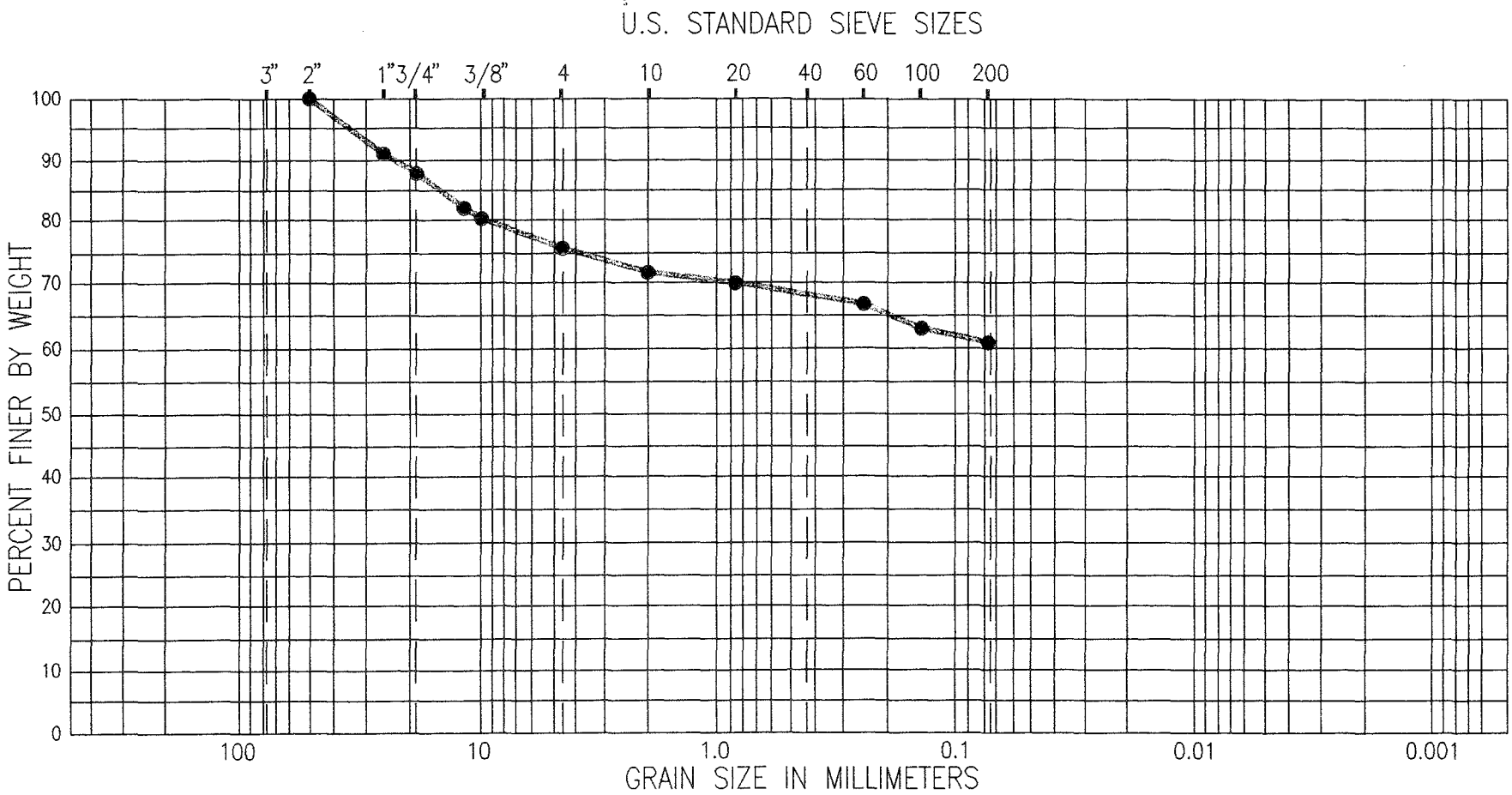
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
94-2	S9 = 39'-40.5'	23.4%	32	19	13	CL
	S10 = 44'-45.5'					
JOB NUMBER: 382 94469 01	S11 = 49'-50.5'	25.6%				
	S12 = 54'-55.5'					

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	12% GRAVEL 12%		4%	3% SAND	8%	61% FINES
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES



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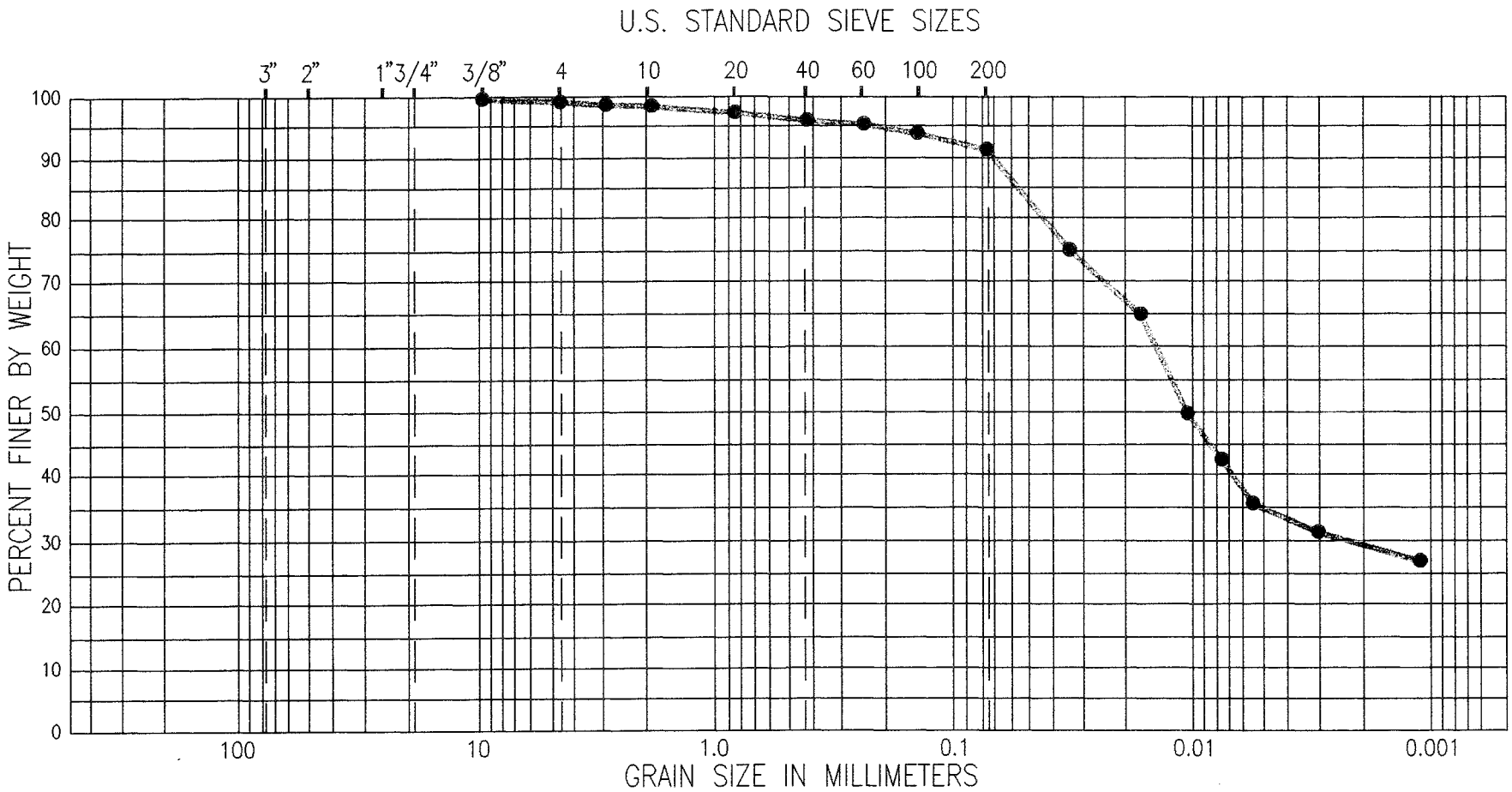
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
94-4 & 94-8	24'-26'		46	18	28	CL/CH
	29'-30.5'					SIMILAR UD SAMPLES COMBINED

JOB NUMBER: 382 94469 01

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	0% GRAVEL 18%		0%	2% SAND 5%		64% FINES 30%	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



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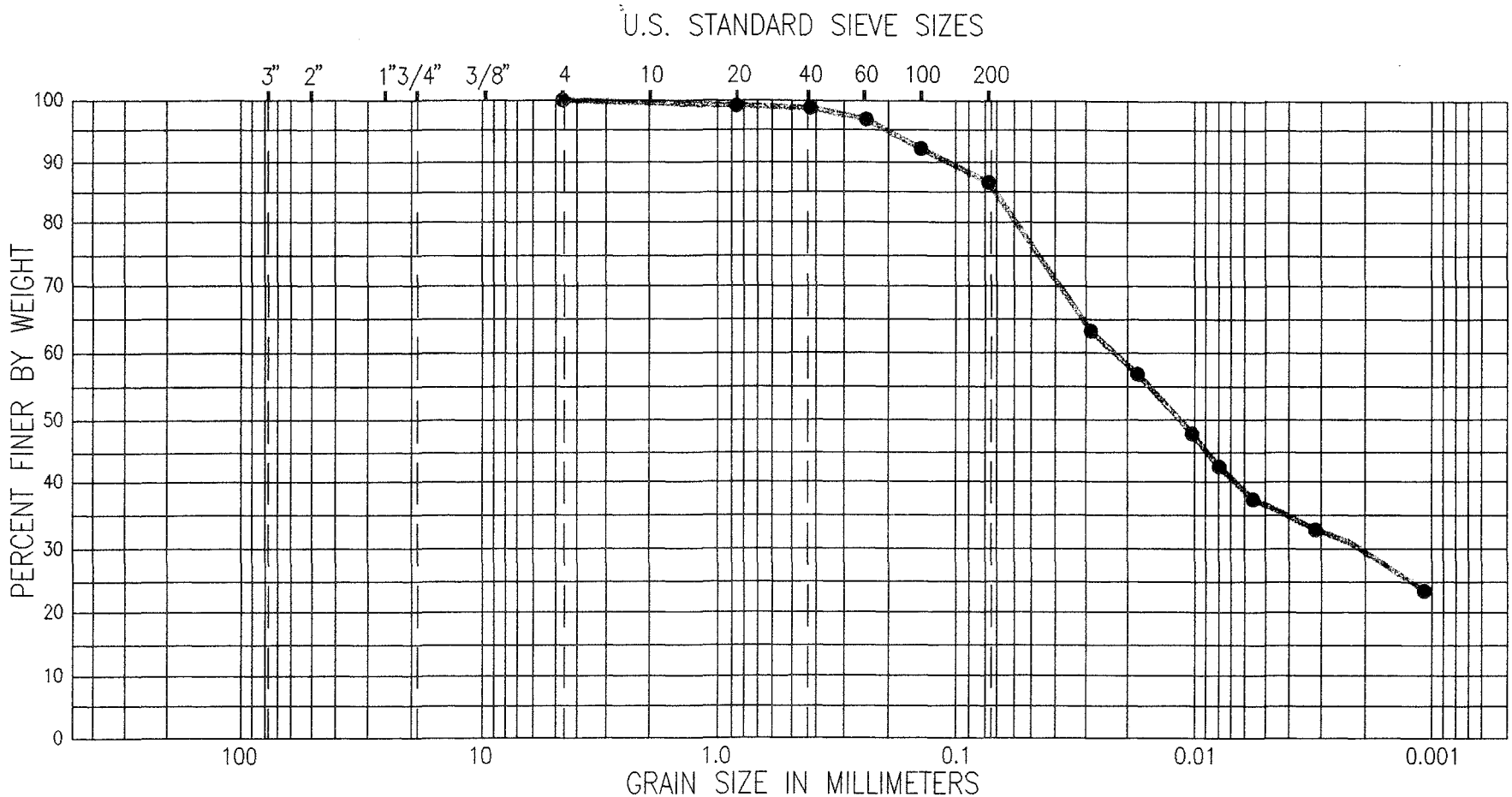
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
94-5	S3 = 9'-10.5' S4 = 14'-15.5' S5 = 19'-20.5'		41	18	23	CL
JOB NUMBER: 382 94469 01						

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	0% GRAVEL 0%		1%	1% SAND	11%	58% FINES	29%
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



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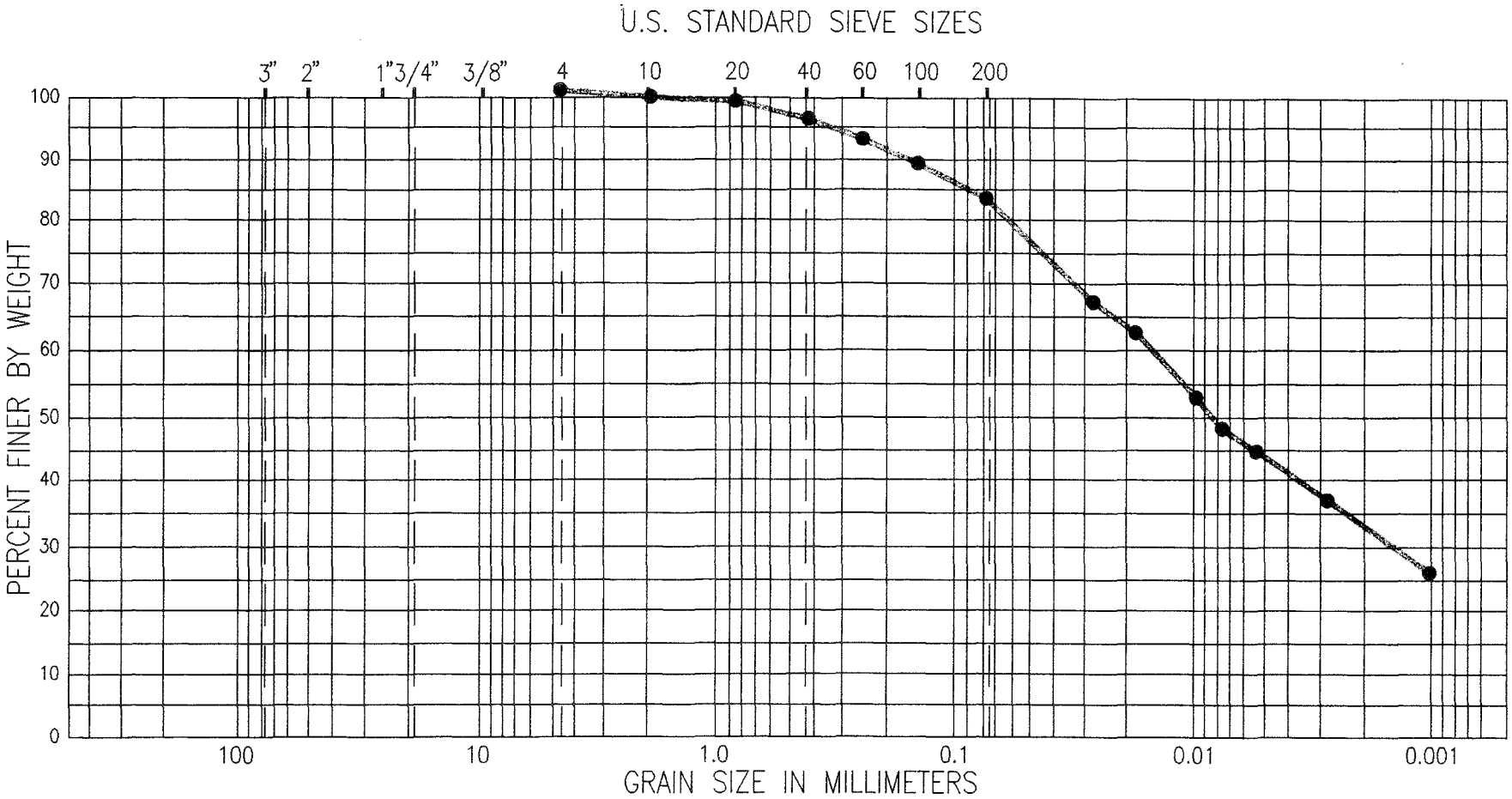
BORING NUMBER: 94-6

JOB NUMBER: 382 94469 01

DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
S9 = 39'-40.5'	29.7%	33	17	16	CL AND FLY ASH
S10 = 44'-45.5'					
S11 = 49'=50.5'	26.2%				

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	0% GRAVEL 0%		1%	2% SAND	12%	52% FINES	33%
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



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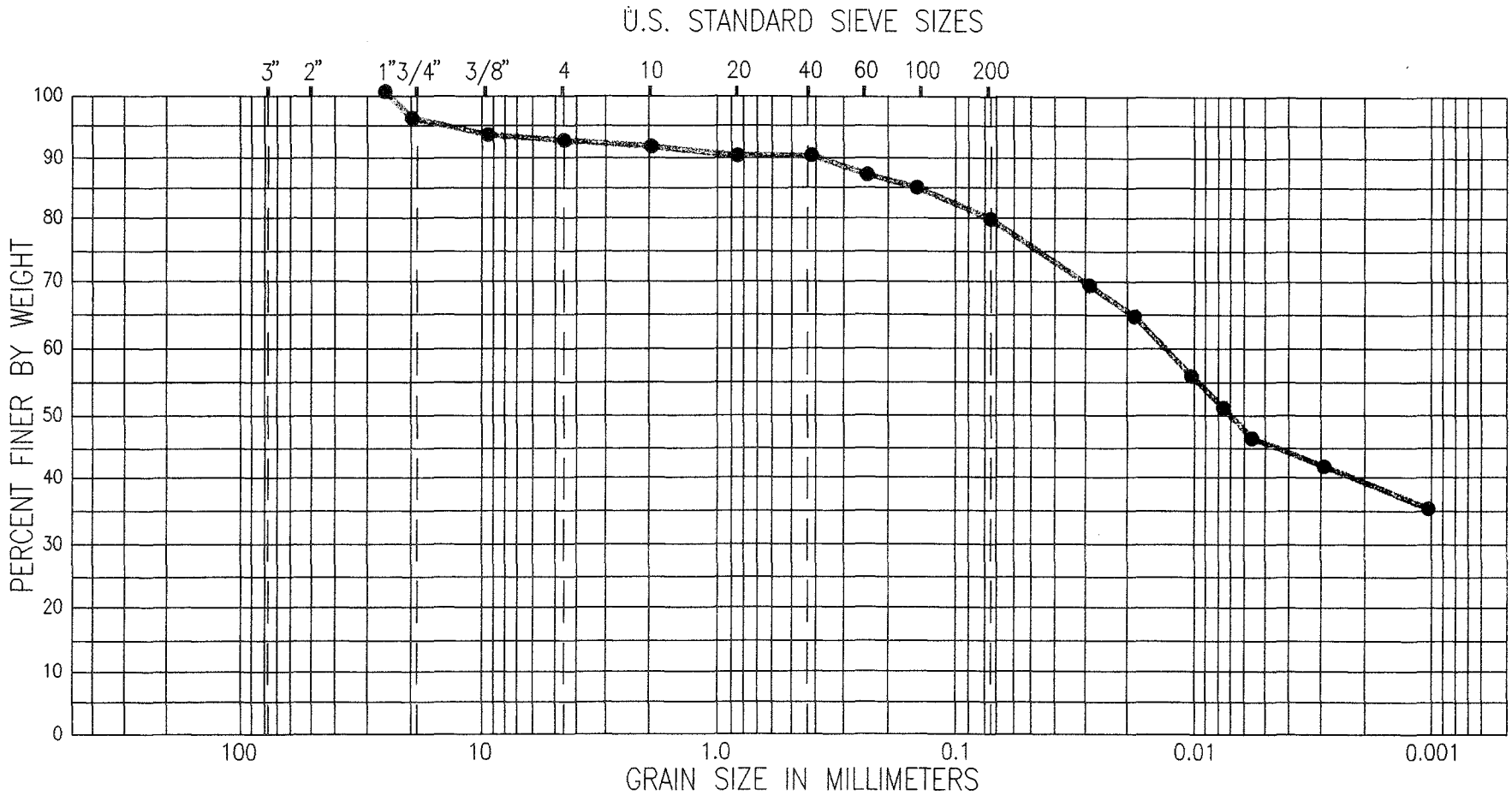
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
94-7	S6 = 29'-30.5' S7 = 34'-35.5' S8 = 39'-40.5'		34	18	16	CL AND FLY ASH

JOB NUMBER: 382 94469 01

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	4% GRAVEL 3%		1% SAND 2%		8%	47% FINES	40%
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



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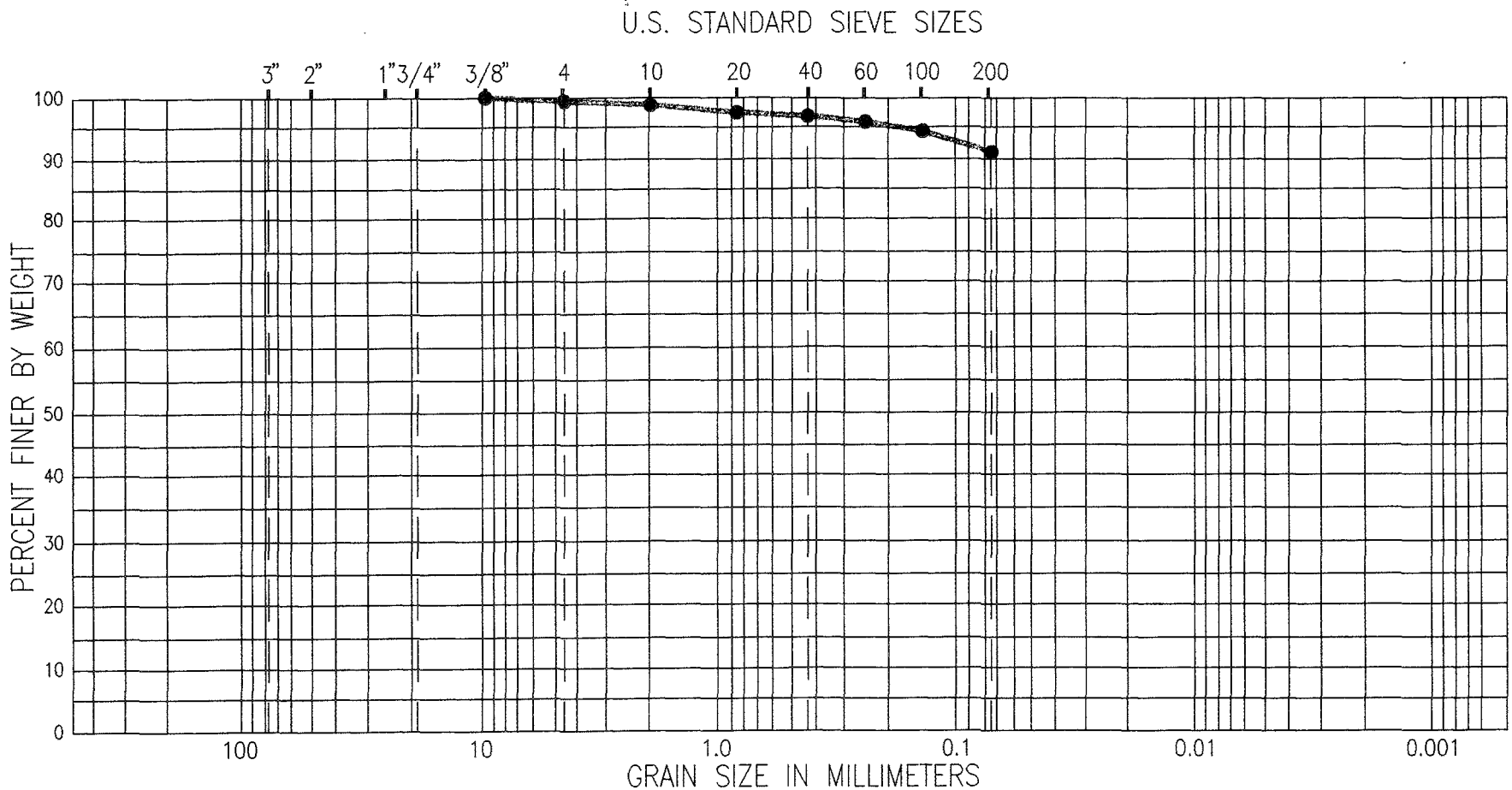
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
94-8	S3 = 14'-15.5' S4 = 19'-20.5' S5 = 24'-25.5'		47	17	30	CL/CH

JOB NUMBER: 382 94469 01

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	0% GRAVEL 0%		1%	2% SAND	5%	92% FINES
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES



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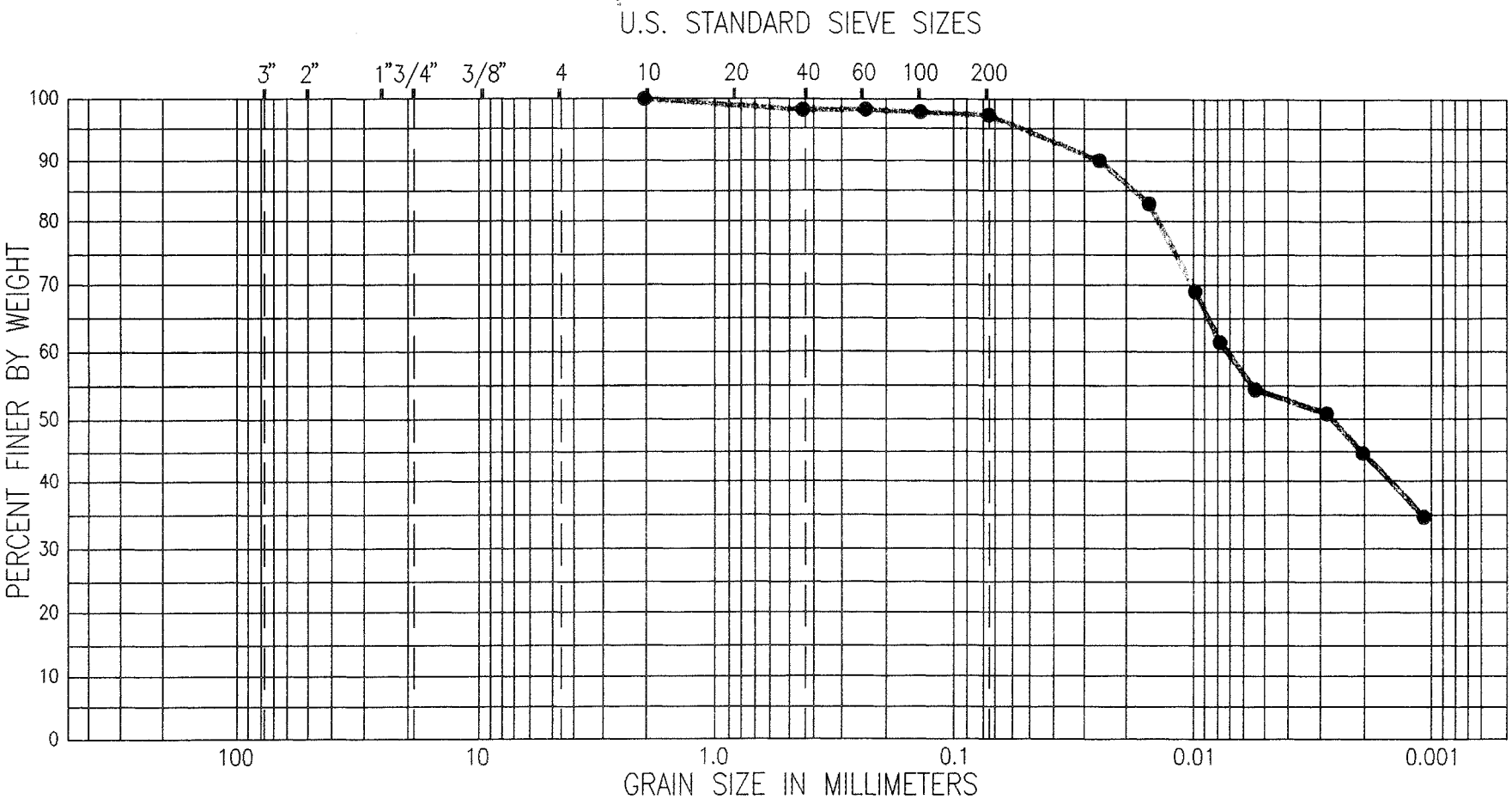
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
94-9	35'-37'		44	20	24	CL

JOB NUMBER: 382 94469 01

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	0% GRAVEL 0%		0%	1% SAND 2%		53% FINES 44%	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



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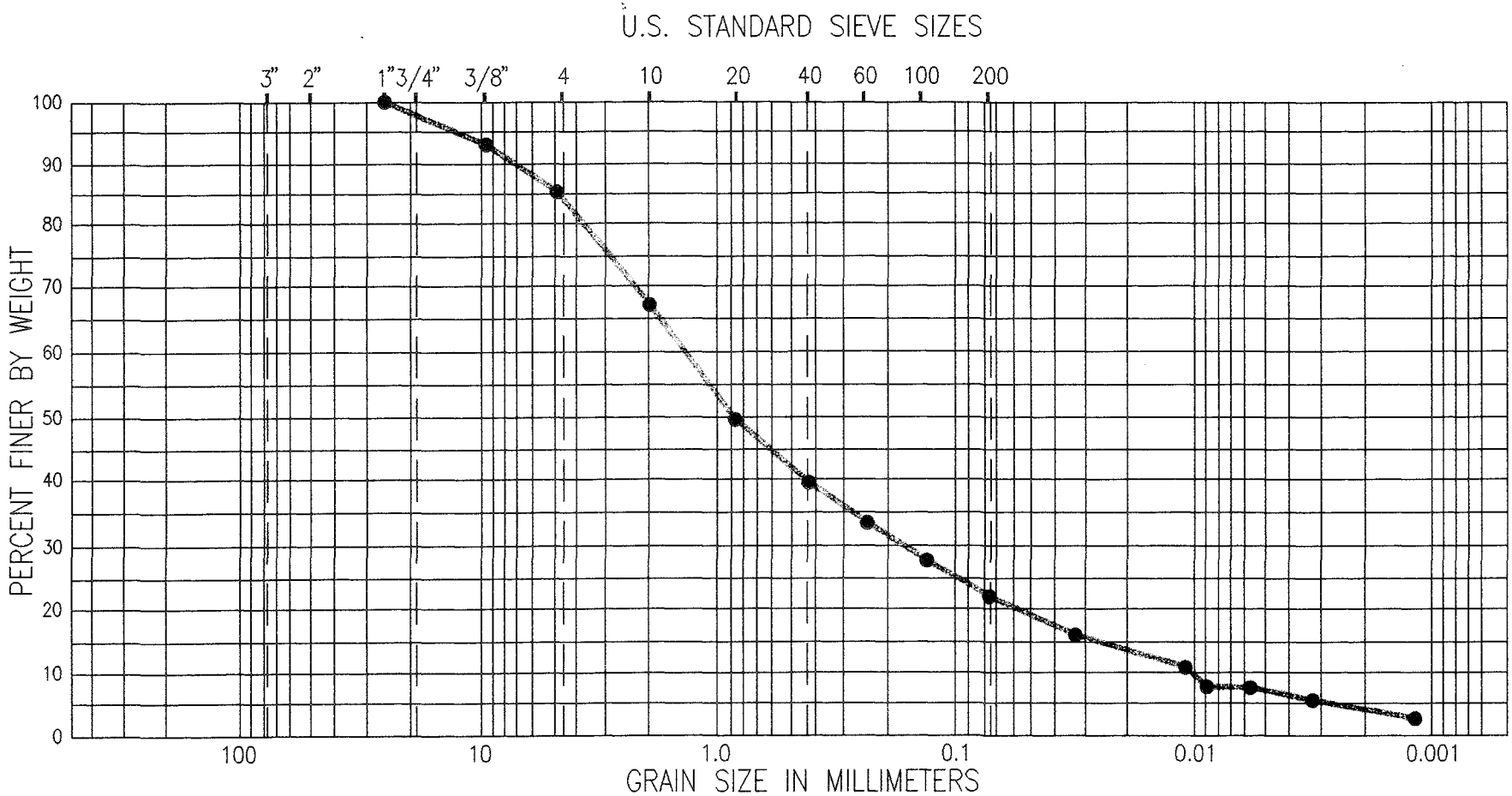
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
94-10	S7 = 34'-35.5' S8 = 39'-40.5'		41	20	21	CL

JOB NUMBER:
382 94469 01

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	1% GRAVEL 14%		17% SAND 29%		17%	17% FINES	5%
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



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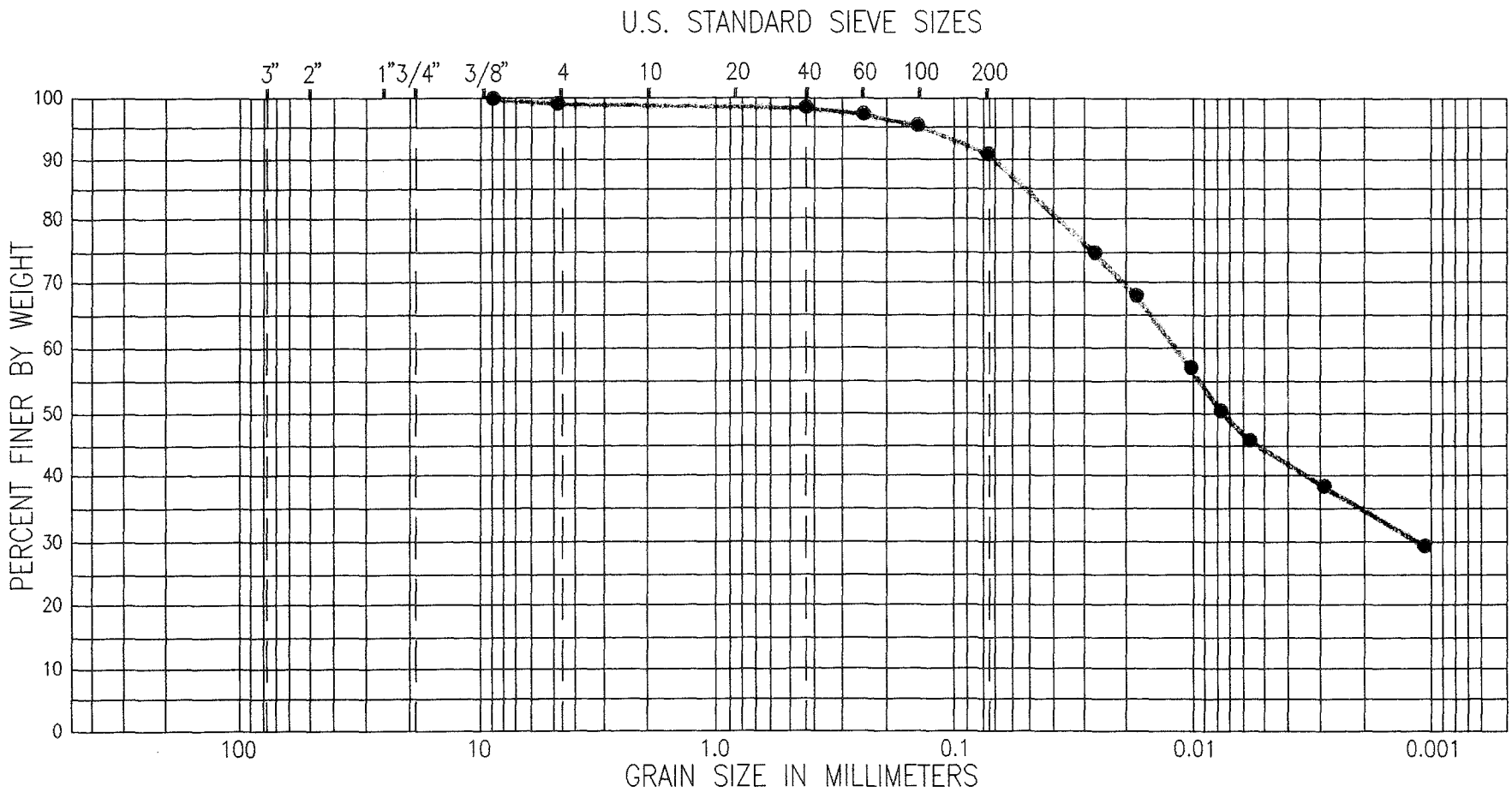
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
94-11	S3 = 14'-15.5' S4 = 19'-20.5'					BOTTOM ASH
JOB NUMBER: 382 94469 01						

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	0% GRAVEL 1%		1%	1% SAND 6%		56% FINES 35%	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES



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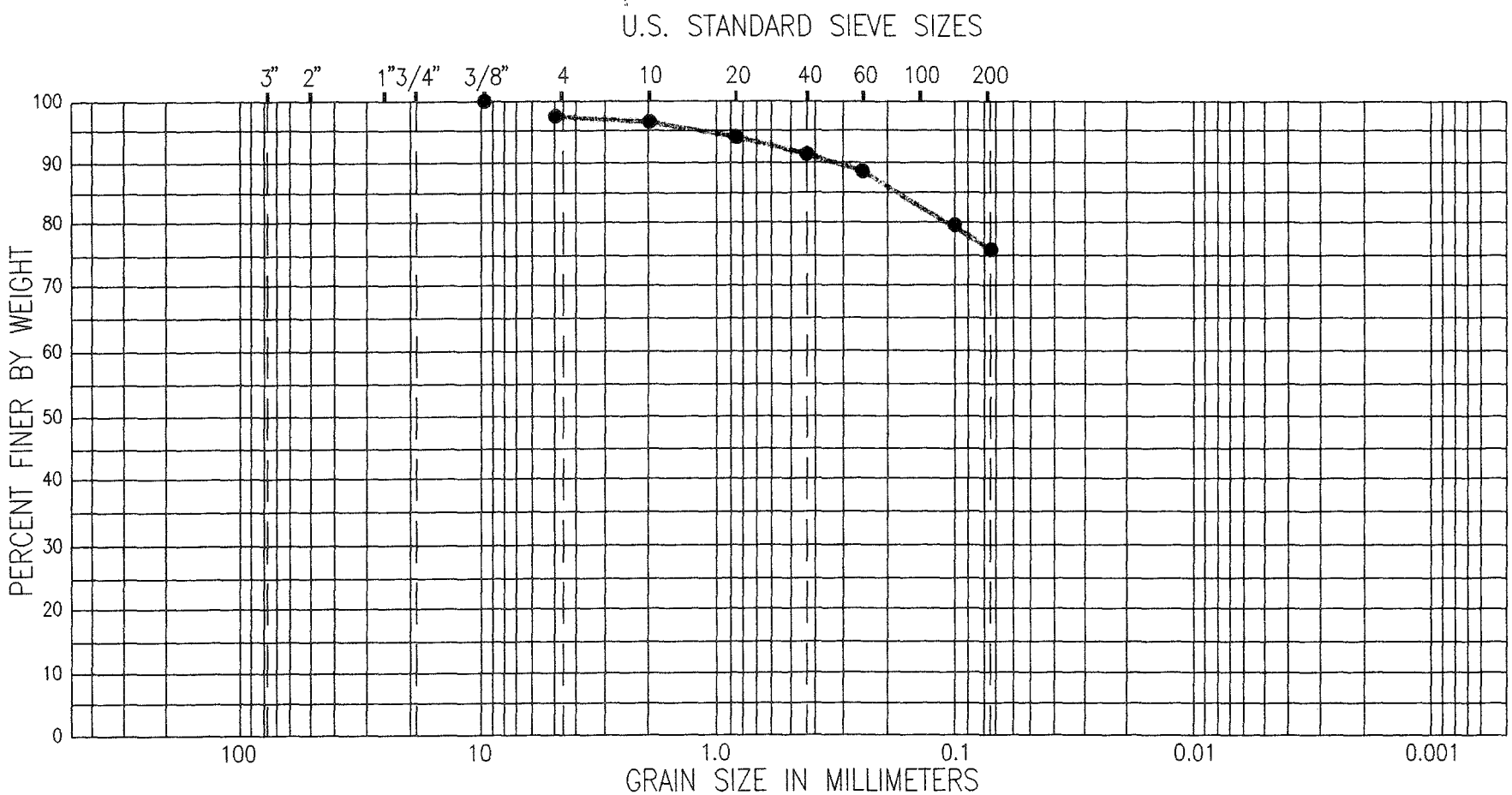
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
94-13	S5 = 24'-25.5' S6 = 29'-30.5' S7 = 34'-35.5'		38	20	18	CL

JOB NUMBER: 382 94469 01

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	0% GRAVEL 2%		2% SAND 16%			76% FINES
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES



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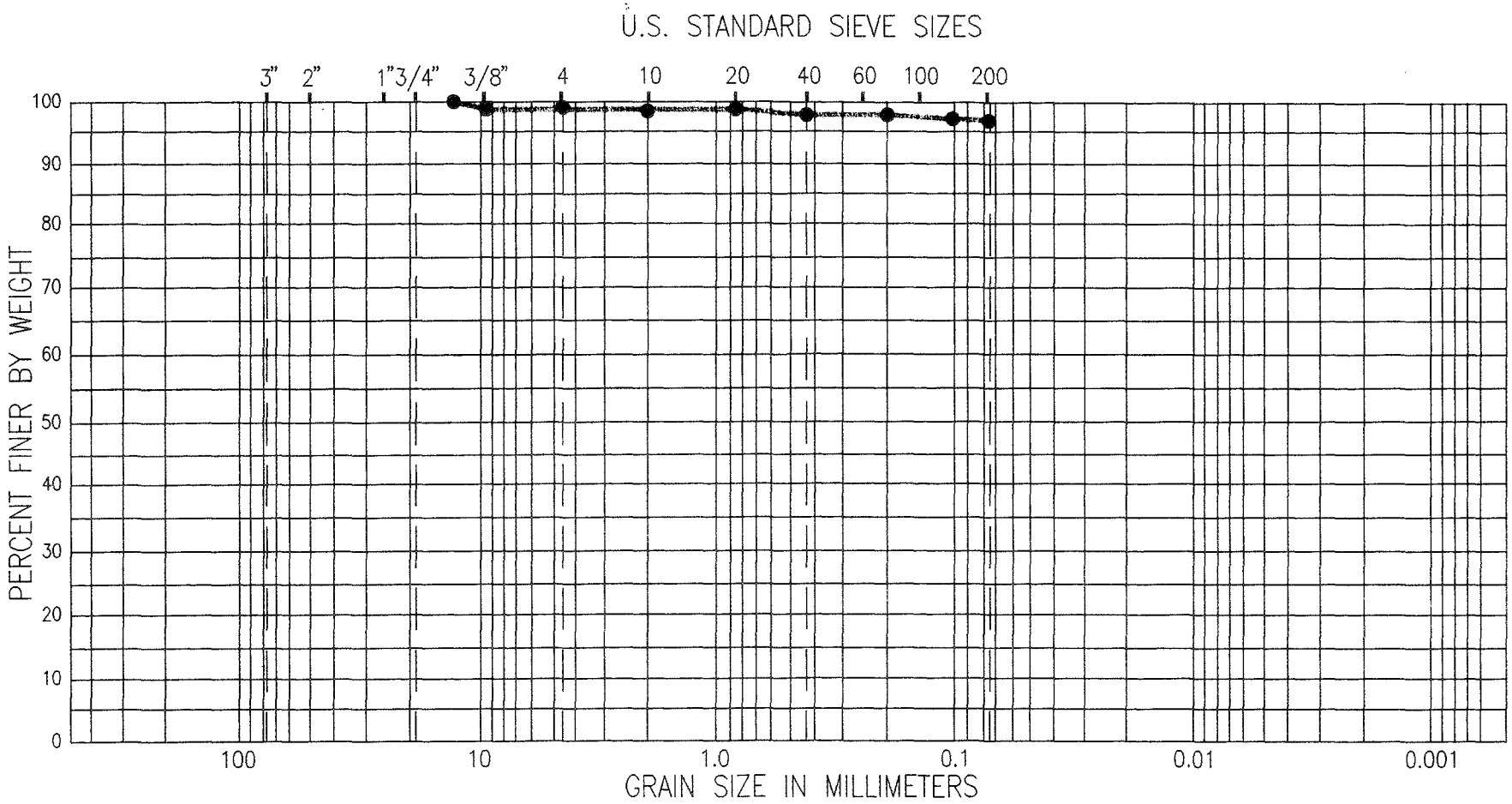
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
94-1 & 94-10	48'-50' 59'-61'		31	20	11	CL SIMILAR UD SAMPLES COMBINED

JOB NUMBER: 382 94469 01

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	0% GRAVEL 1%		0%	1% SAND	1%	97% FINES
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES



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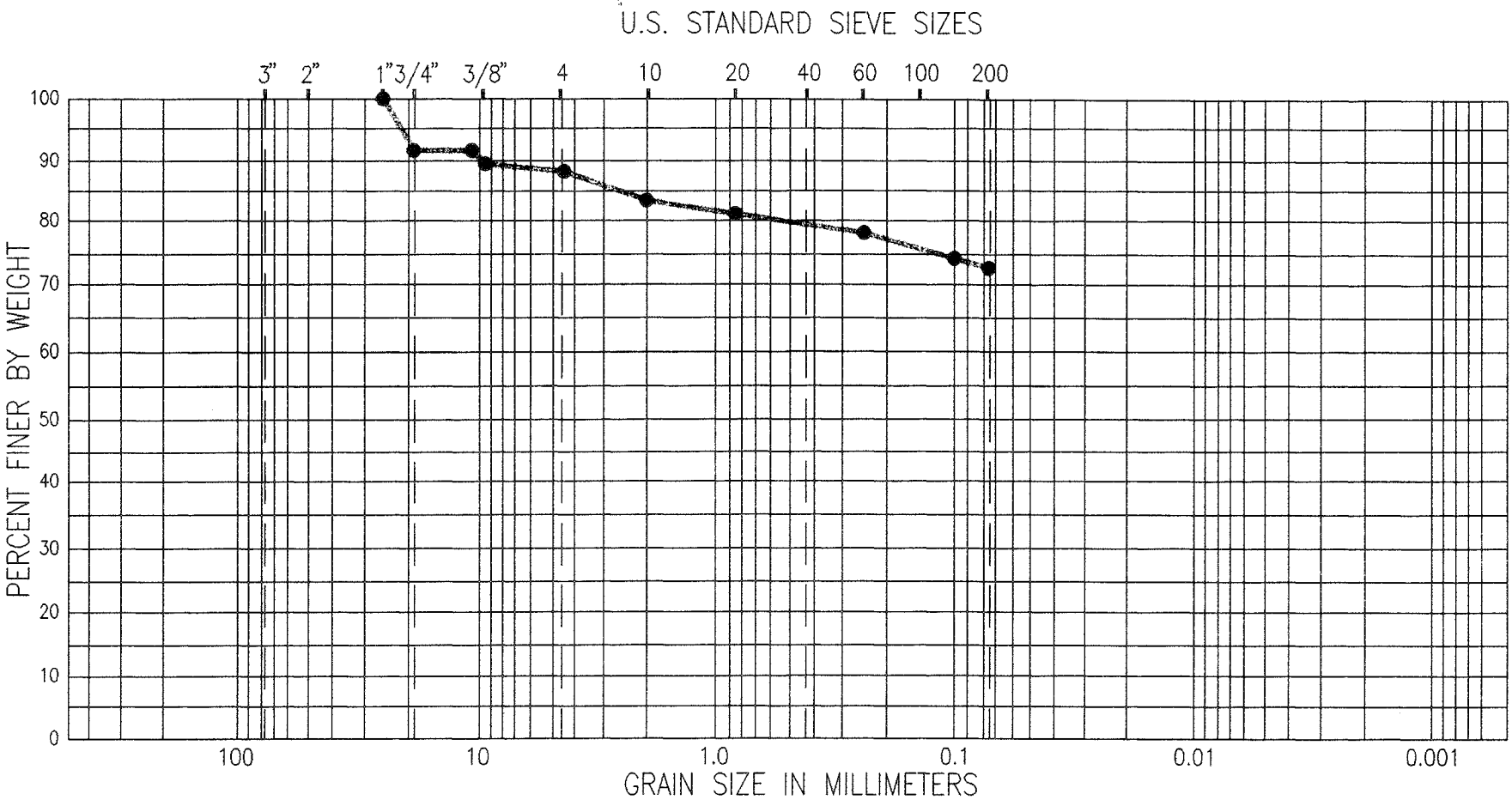
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
94-11	42'-44'		43	22	21	CL

JOB NUMBER: 382 94469 01

GRAIN SIZE DISTRIBUTION

BOUL-DERS	COBBLES	8% GRAVEL 4%		4% SAND 4% 7%			73% FINES
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES



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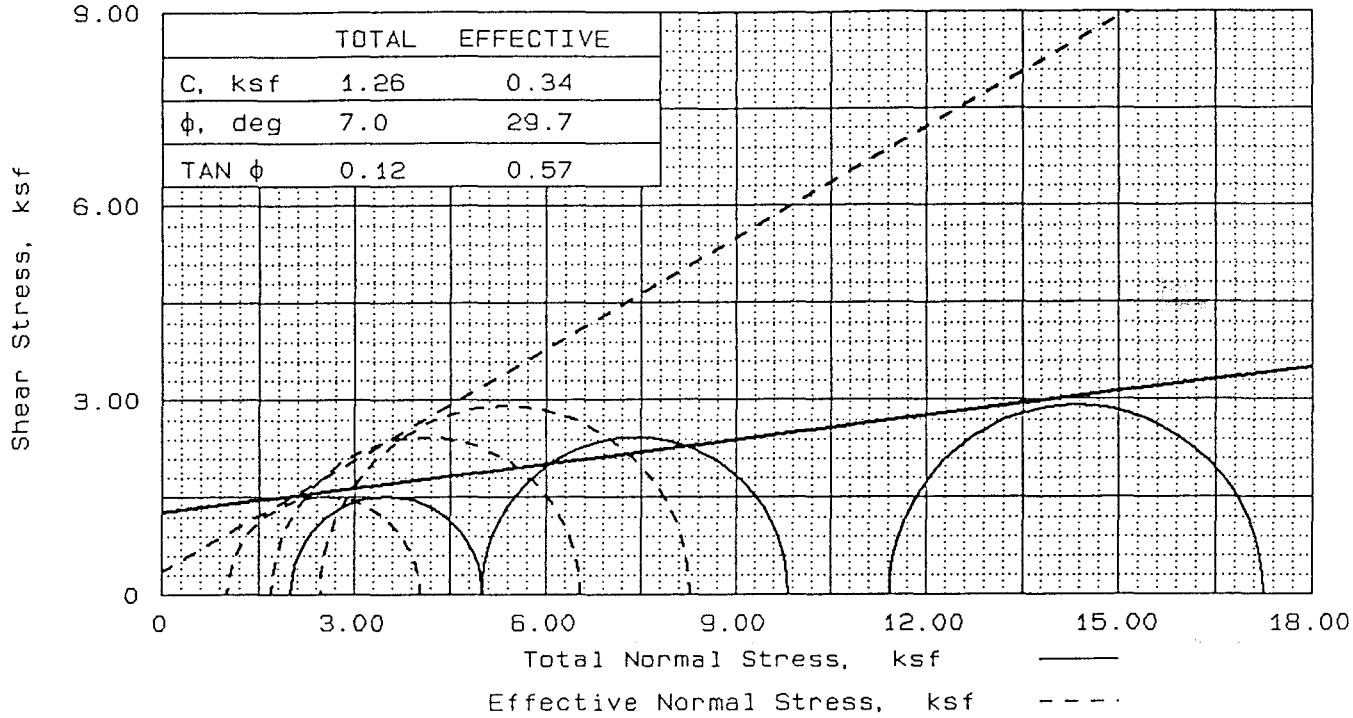
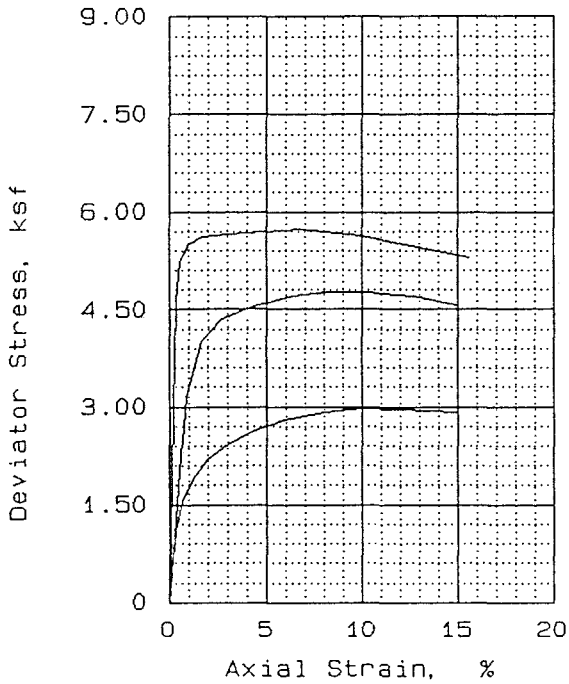
BORING NUMBER:	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
94-14, 94-2 & 94-5	12'-14'		38	17	21	CL
	12'-13.5'					SIMILAR UD SAMPLES COMBINED
JOB NUMBER: 382 94469 01	6'-7.5'					



	TOTAL	EFFECTIVE
C, ksf	1.26	0.34
ϕ, deg	7.0	29.7
TAN ϕ	0.12	0.57



	SAMPLE NO.	1	2	3
INITIAL	WATER CONTENT, %	28.8	30.3	32.2
	DRY DENSITY, pcf	94.0	93.5	88.4
	SATURATION, %	101.5	105.5	98.8
	VOID RATIO	0.747	0.756	0.858
	DIAMETER, in	2.87	2.84	2.87
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	26.8	25.2	35.2
	DRY DENSITY, pcf	96.3	98.7	85.2
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.704	0.663	0.927
	DIAMETER, in	2.83	2.76	2.91
	HEIGHT, in	6.01	6.02	6.03
BACK PRESSURE, ksf		2.59	2.61	2.84
CELL PRESSURE, ksf		4.59	7.61	14.28
FAILURE STRESS, ksf		3.01	4.85	5.81
PORE PRESSURE, ksf		3.57	5.90	11.81
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		4.04	6.55	8.28
$\bar{\sigma}_3$ FAILURE, ksf		1.02	1.7	2.47

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Undisturbed
DESCRIPTION: Grey Lean Clay with Sand
LL= 31 PL= 20 PI= 11.0
SPECIFIC GRAVITY= 2.63
REMARKS: Tested by: HD

Reviewed by: RLB

FIG. NO.

CLIENT:

PROJECT: New Johnsonville

SAMPLE LOCATION: 94-1 Ud @ 48-50 Ft.

PROJ. NO.: 5810763701 DATE: Oct. 4, 1994

TRIAXIAL COMPRESSION TEST

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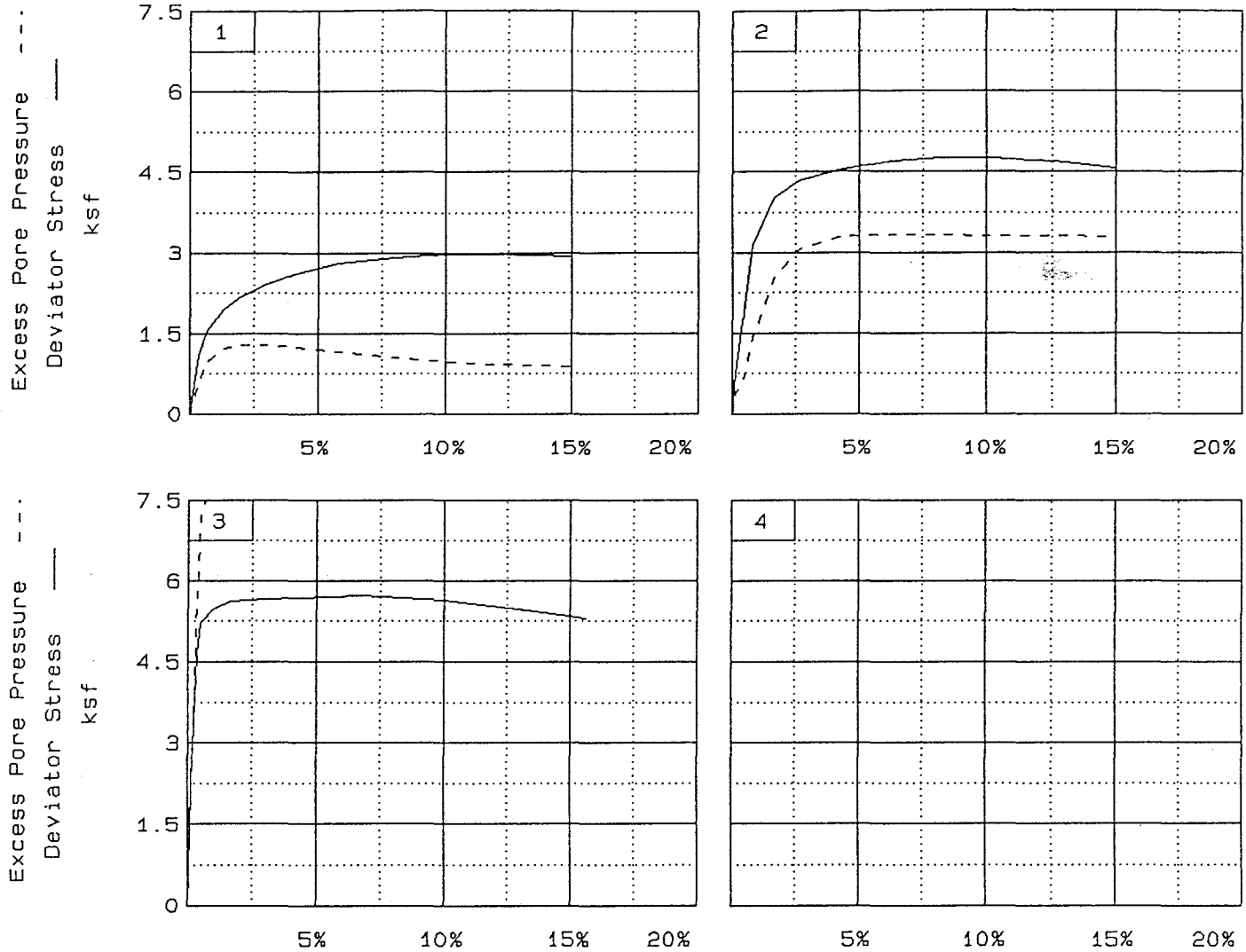
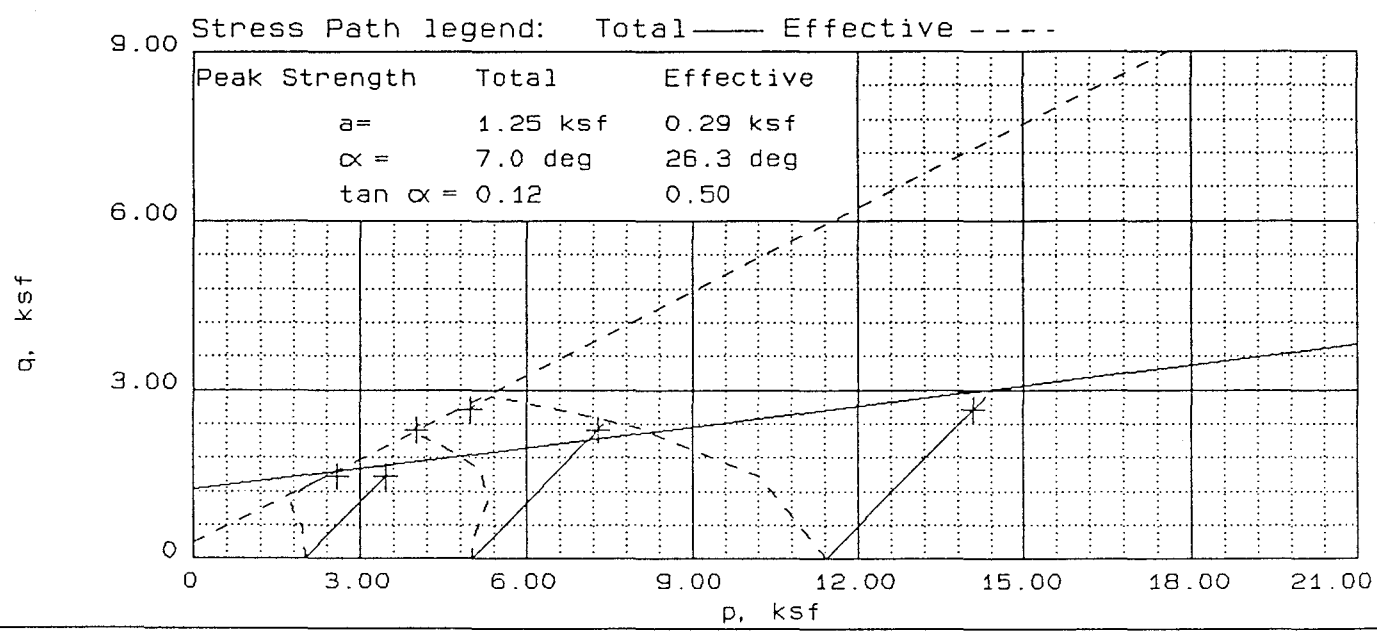


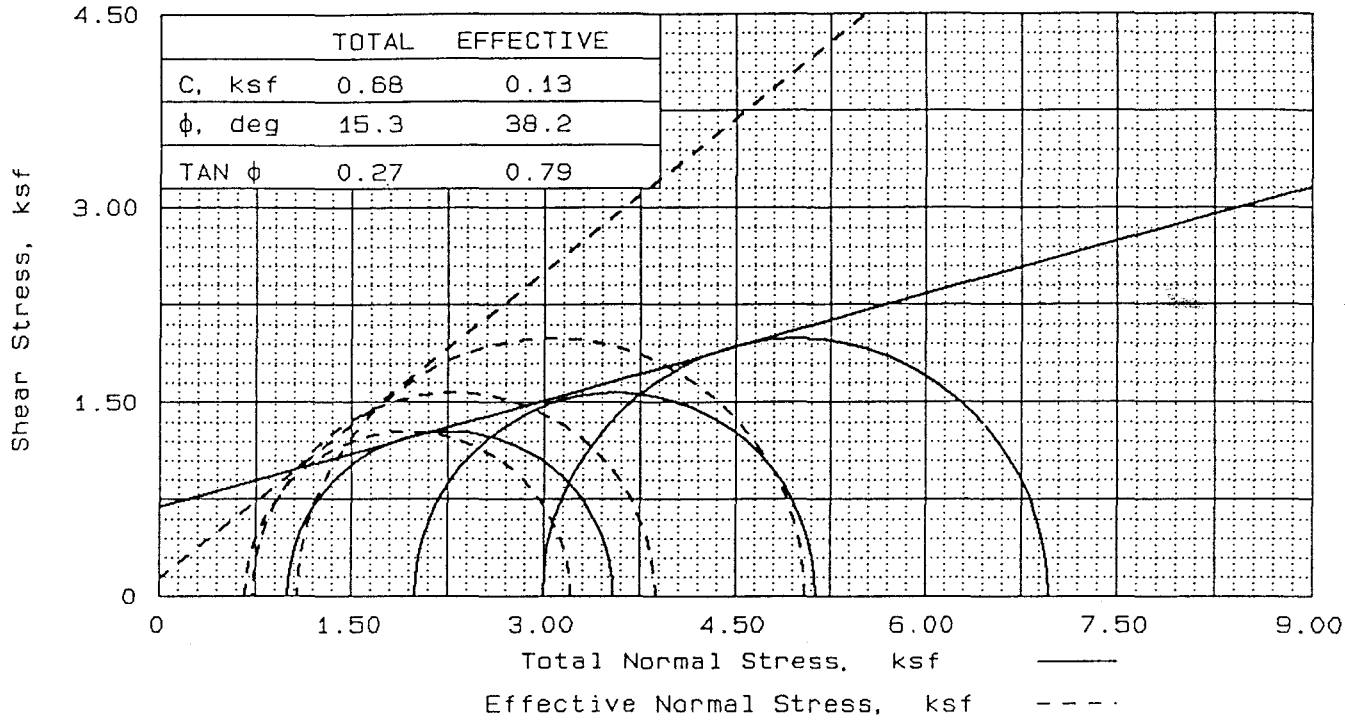


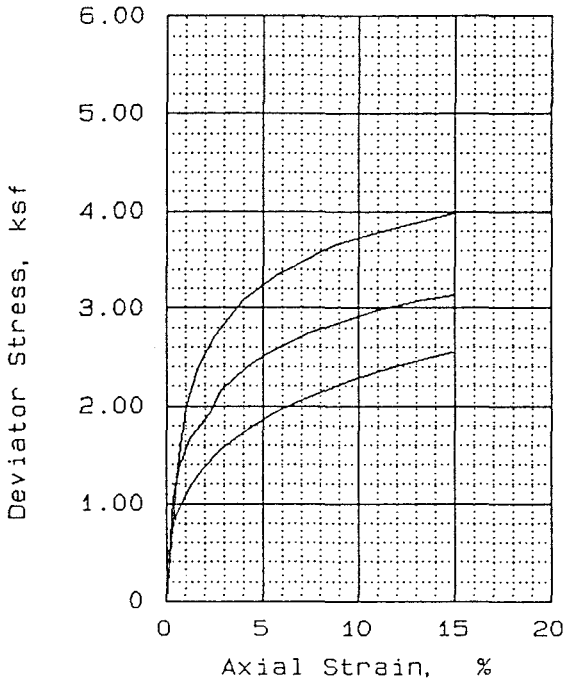
Client:

Project: New Johnsonville

Location: 94-1 Ud @ 48-50 Ft.

File: 763701F Project No.: 5810763701 Page 2/2 Fig. No. ____





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	23.2	22.2	21.6
	DRY DENSITY, pcf	102.1	102.5	106.7
	SATURATION, %	99.4	95.8	103.8
	VOID RATIO	0.620	0.613	0.551
	DIAMETER, in	2.82	2.85	2.84
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	23.0	22.3	19.5
	DRY DENSITY, pcf	102.8	104.0	109.0
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.609	0.591	0.518
	DIAMETER, in	2.81	2.82	2.81
	HEIGHT, in	6.00	6.01	6.02
BACK PRESSURE, ksf		3.30	3.27	3.23
CELL PRESSURE, ksf		4.30	5.27	6.23
FAILURE STRESS, ksf		2.54	3.15	3.98
PORE PRESSURE, ksf		3.63	4.54	5.14
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		3.21	3.88	5.06
$\bar{\sigma}_3$ FAILURE, ksf		0.67	0.73	1.08

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Undisturbed
DESCRIPTION: Brown Lean Clay with Gravel
LL= 38 PL= 17 PI= 21.0
SPECIFIC GRAVITY= 2.65
REMARKS: Tested by: HB

Reviewed by: RLB

FIG. NO.

CLIENT:

PROJECT: New Johnsonville

SAMPLE LOCATION: 94-2 Ud @ 10-12 Ft.
94-14 Ud @ 12-14 Ft

PROJ. NO.: 5810763701 DATE: Oct 4, 1994

TRIAXIAL COMPRESSION TEST

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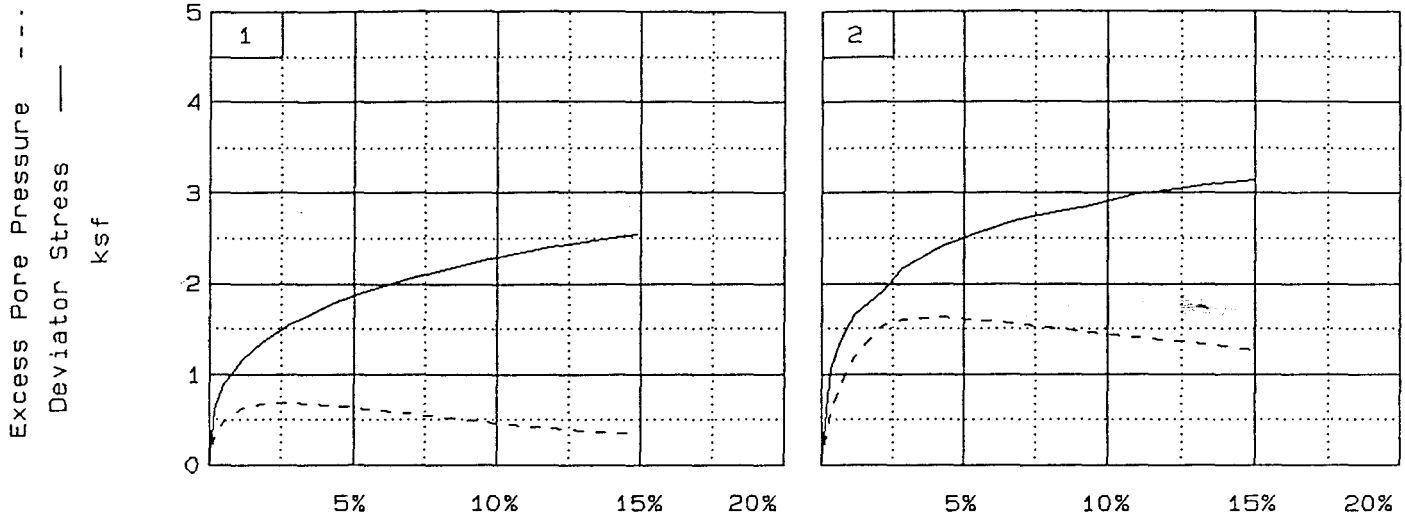
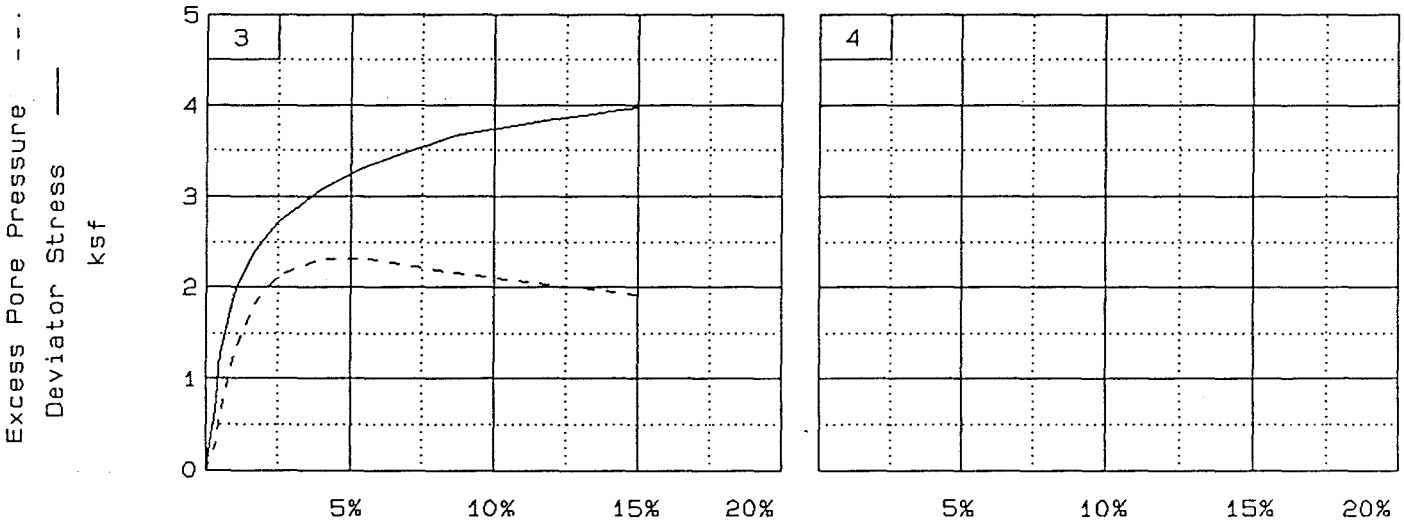
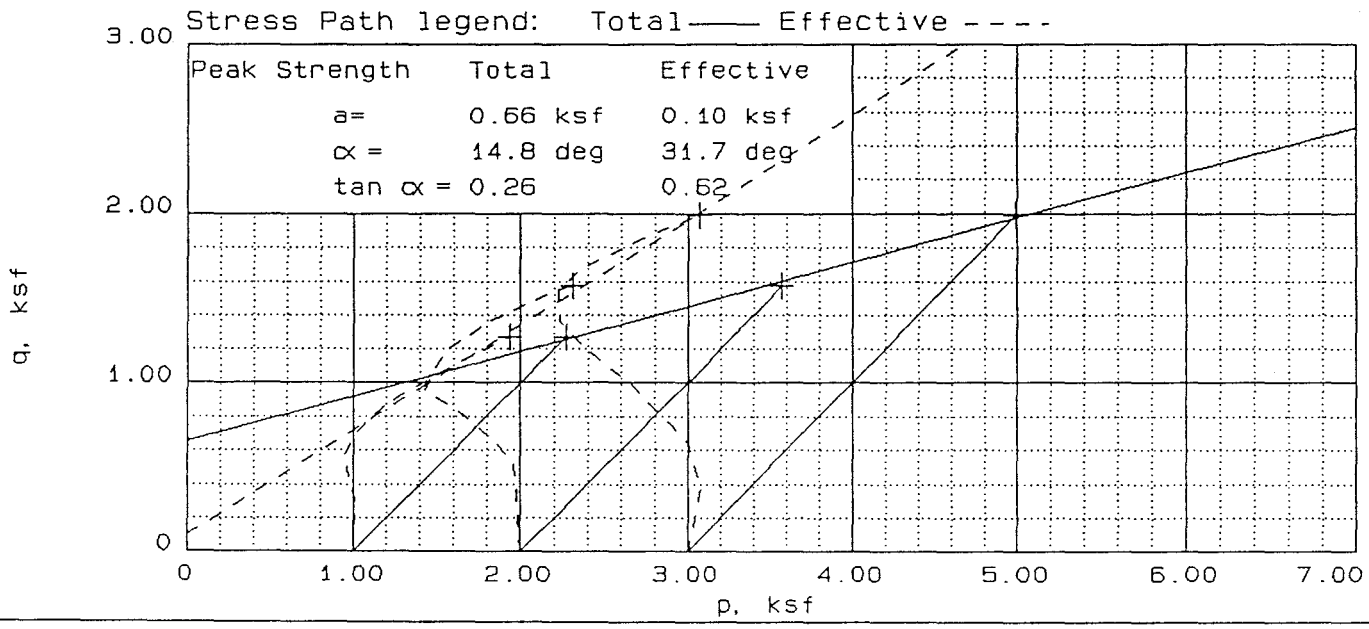




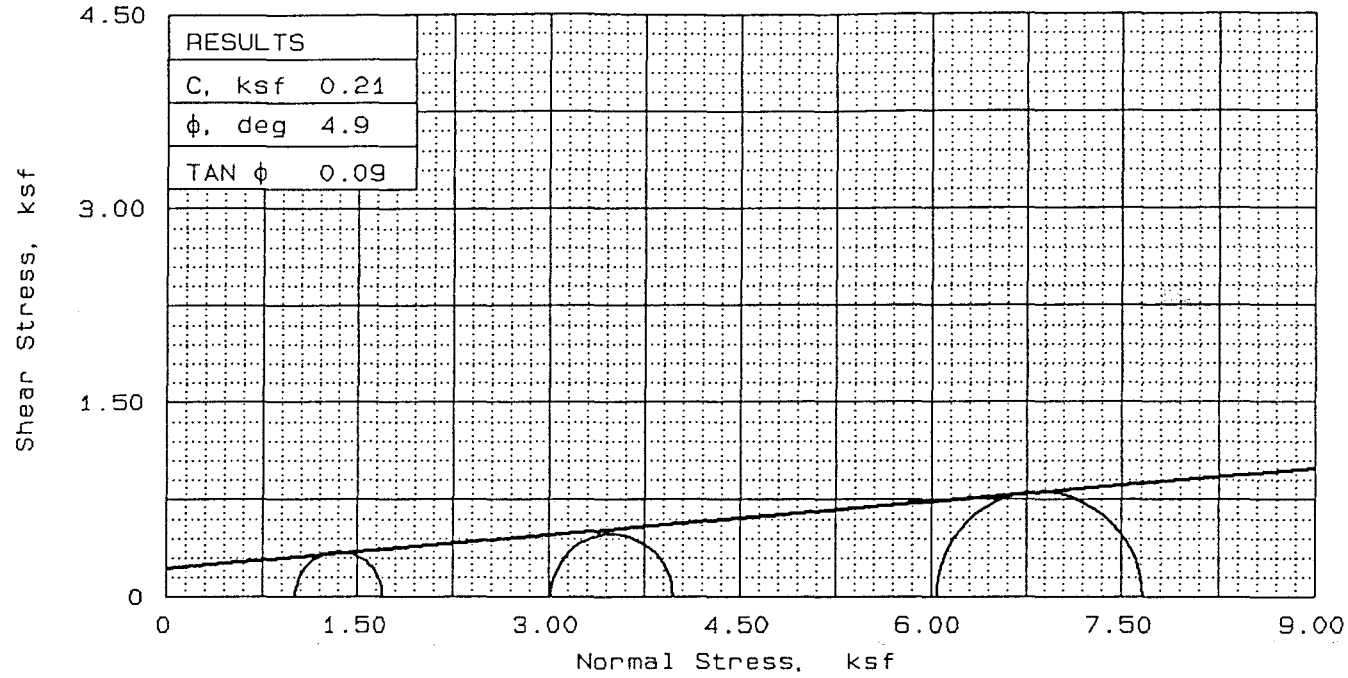


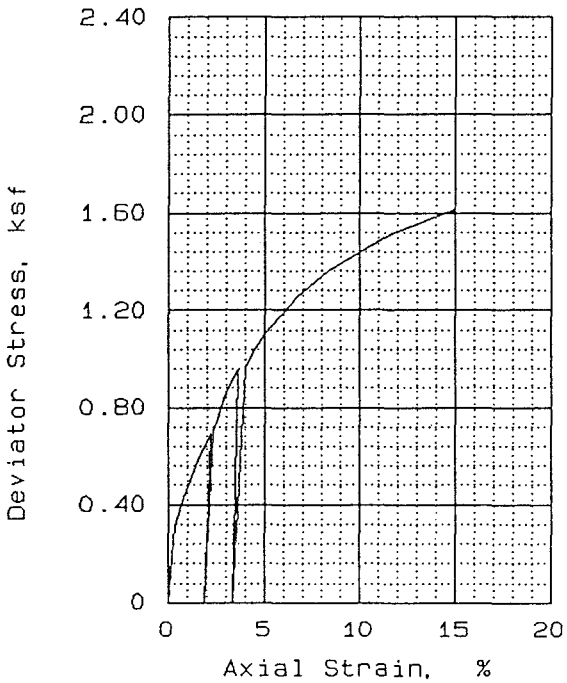
Client:

Project: New Johnsonville

Location: 94-2 Ud @ 10-12 Ft. 94-14 Ud @ 12-14 Ft

File: 763701H Project No.: 5810763701 Page 2/2 Fig. No. ____





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	24.5	24.5	24.5
	DRY DENSITY, pcf	100.3	100.3	100.3
	SATURATION, %	98.3	98.3	98.3
	VOID RATIO	0.668	0.668	0.668
	DIAMETER, in	2.83	2.83	2.83
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	24.5	24.5	24.5
	DRY DENSITY, pcf	100.3	100.3	100.3
	SATURATION, %	98.3	98.3	98.3
	VOID RATIO	0.668	0.668	0.668
	DIAMETER, in	2.83	2.83	2.83
	HEIGHT, in	6.00	6.00	6.00
BACK PRESSURE, ksf		0.00	0.00	0.00
CELL PRESSURE, ksf		1.01	3.02	6.05
FAILURE STRESS, ksf		0.69	0.96	1.61
PORE PRESSURE, ksf				
STRAIN RATE, %/min.		1.000	1.000	1.000
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
σ_1 FAILURE, ksf		1.70	3.98	7.66
σ_3 FAILURE, ksf		1.01	3.02	6.05

TYPE OF TEST:
Unconsolidated undrained

SAMPLE TYPE: Undisturbed

DESCRIPTION: Brown Lean Clay with Gravel

LL= 46 PL= 18 PI= 28.0

SPECIFIC GRAVITY= 2.68

REMARKS: Tested by: HEJ

Reviewed by: RLB

FIG. NO.

CLIENT:

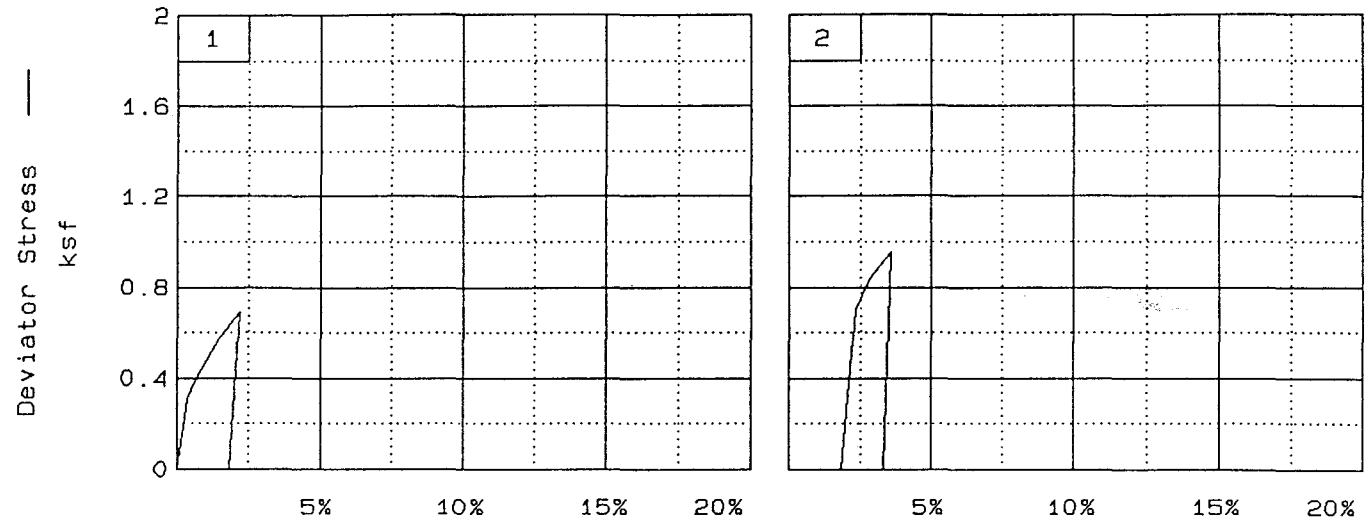
PROJECT: New Johnsonville

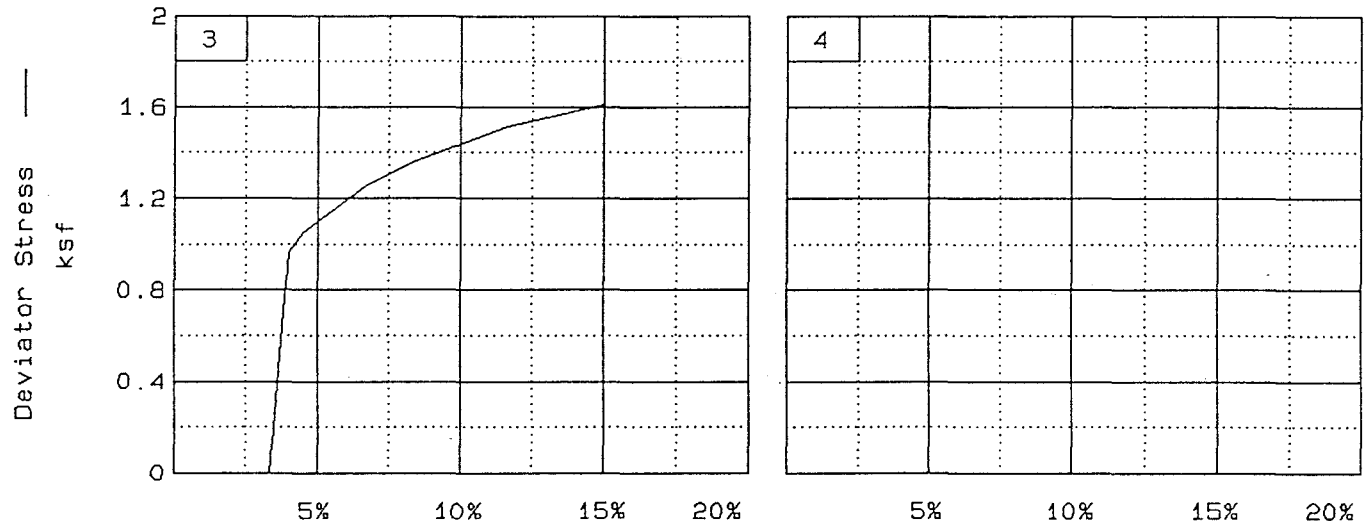
SAMPLE LOCATION: 94-4 UD @ 24-26 Ft.

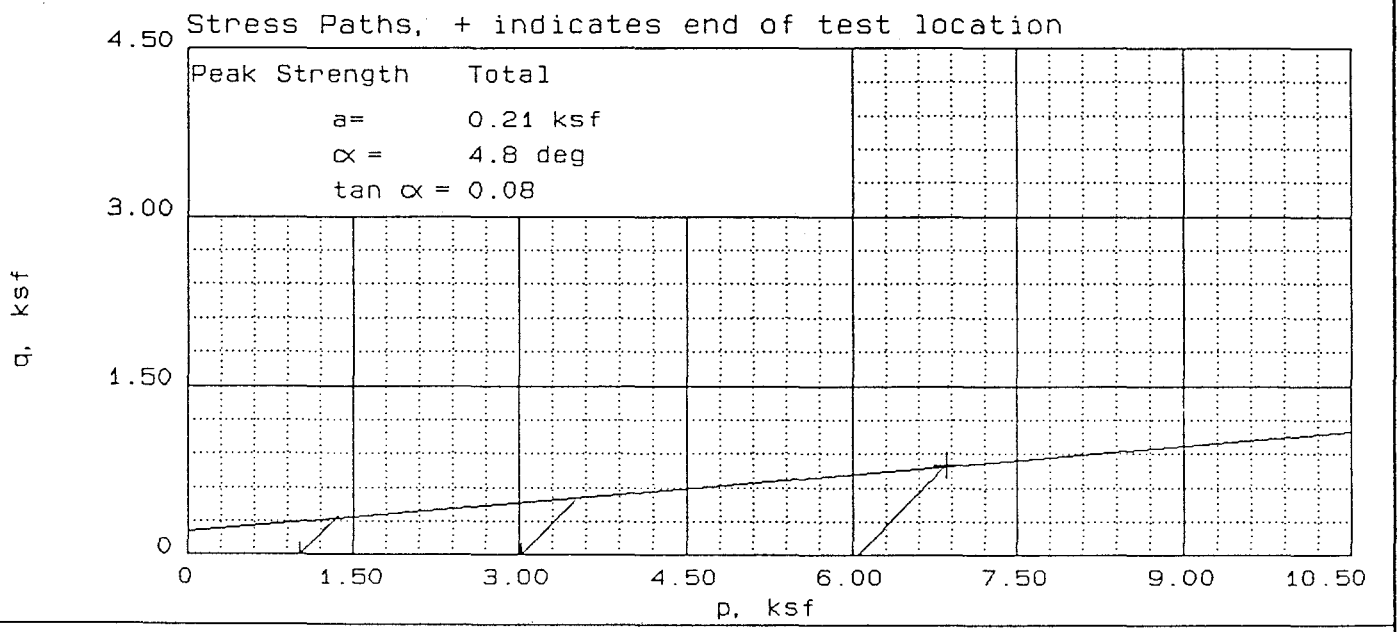
PROJ. NO.: 5810763701 DATE: Oct.4, 1994

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.





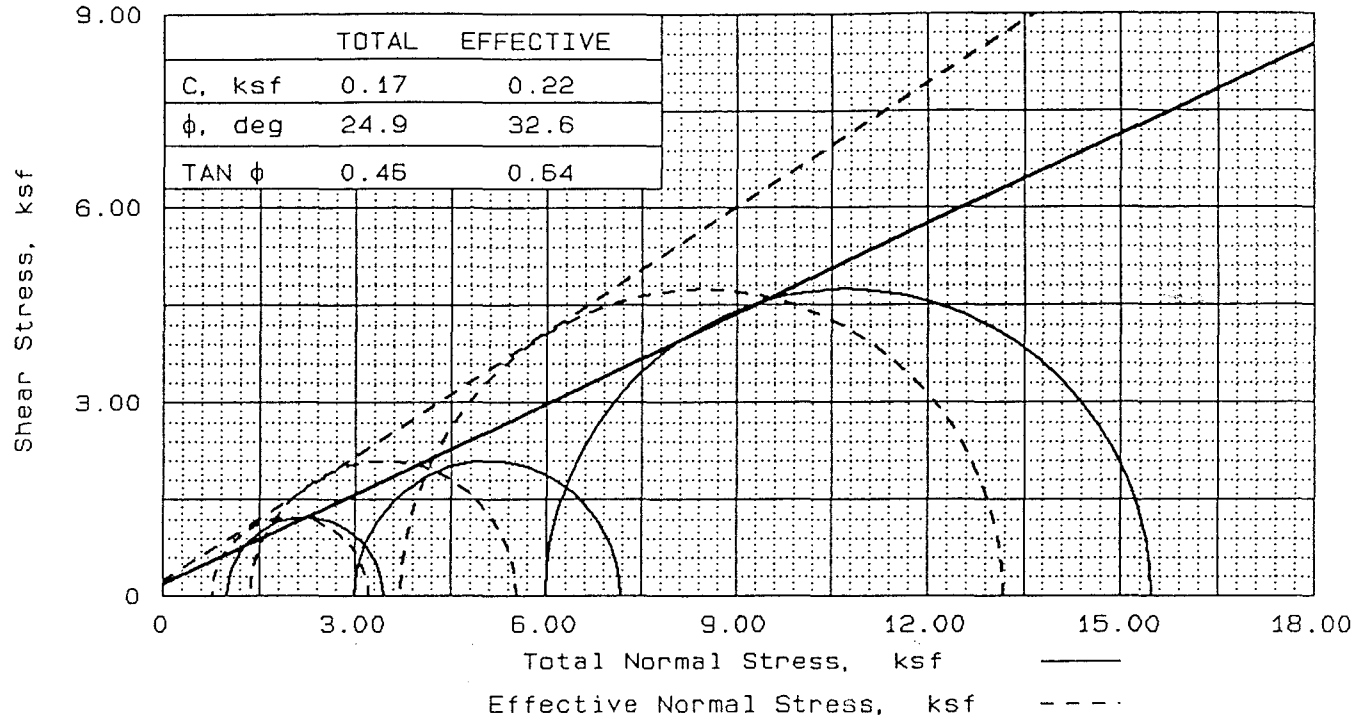


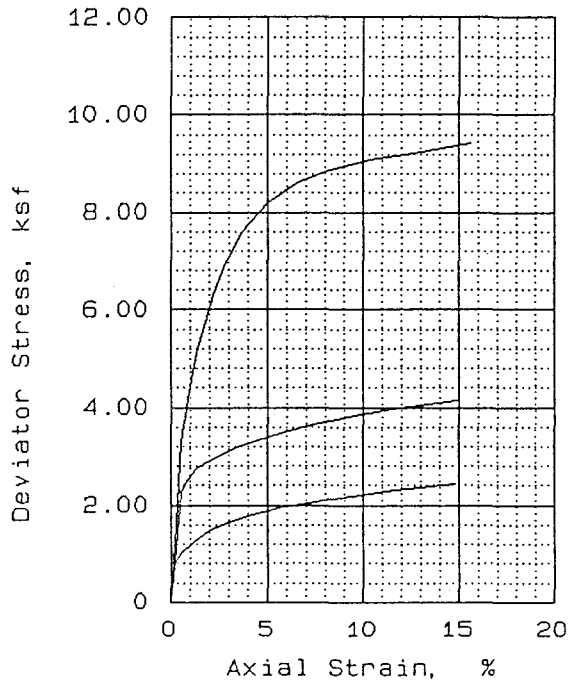
Client:

Project: New Johnsonville

Location: 94-4 UD @ 24-26 Ft.

File: 763701A Project No.: 5810763701 Page 2/2 Fig. No. _____





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	23.1	22.3	21.8
	DRY DENSITY, pcf	102.2	101.9	103.9
	SATURATION, %	97.3	93.2	95.8
	VOID RATIO	0.637	0.642	0.610
	DIAMETER, in	2.84	2.84	2.84
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	23.7	23.0	21.2
	DRY DENSITY, pcf	102.3	103.5	106.8
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.635	0.617	0.567
	DIAMETER, in	2.83	2.82	2.79
	HEIGHT, in	6.01	6.01	6.02
BACK PRESSURE, ksf		3.28	3.28	3.33
CELL PRESSURE, ksf		4.28	6.28	9.33
FAILURE STRESS, ksf		2.45	4.17	9.48
PORE PRESSURE, ksf		3.51	4.92	5.60
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		3.22	5.53	13.20
$\bar{\sigma}_3$ FAILURE, ksf		0.77	1.36	3.72

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Undisturbed
DESCRIPTION: Brown Lean Clay with Gravel
LL= 46 PL= 18 PI= 28.0
SPECIFIC GRAVITY= 2.68
REMARKS: Tested by: HD

Reviewed by: RLB

FIG. NO.

CLIENT:

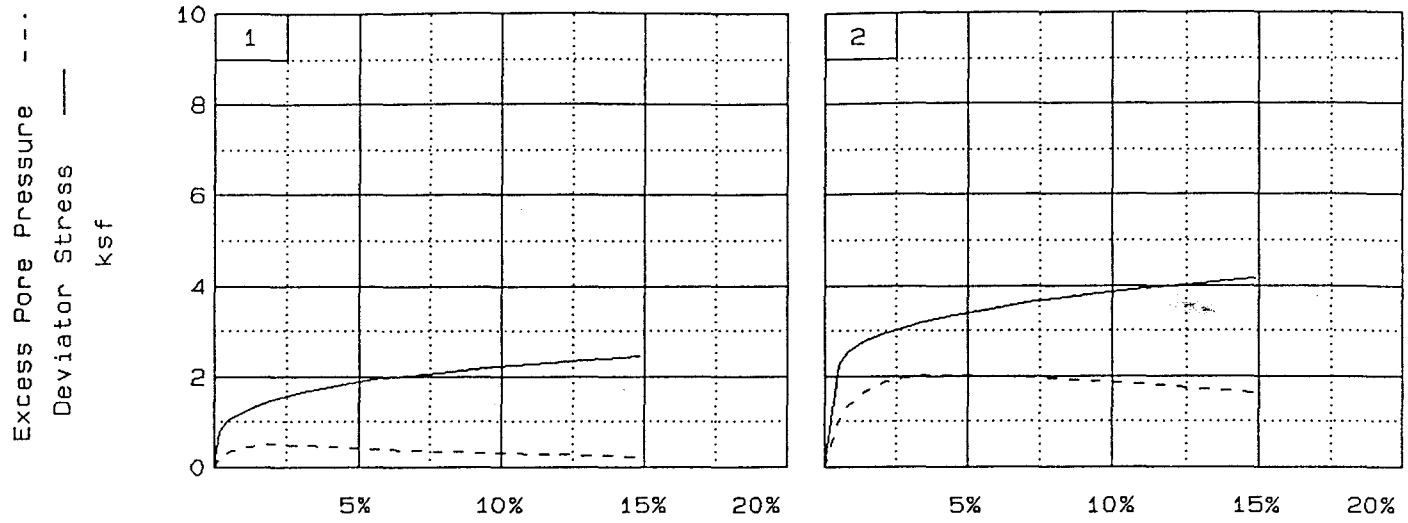
PROJECT: New Johnsonville

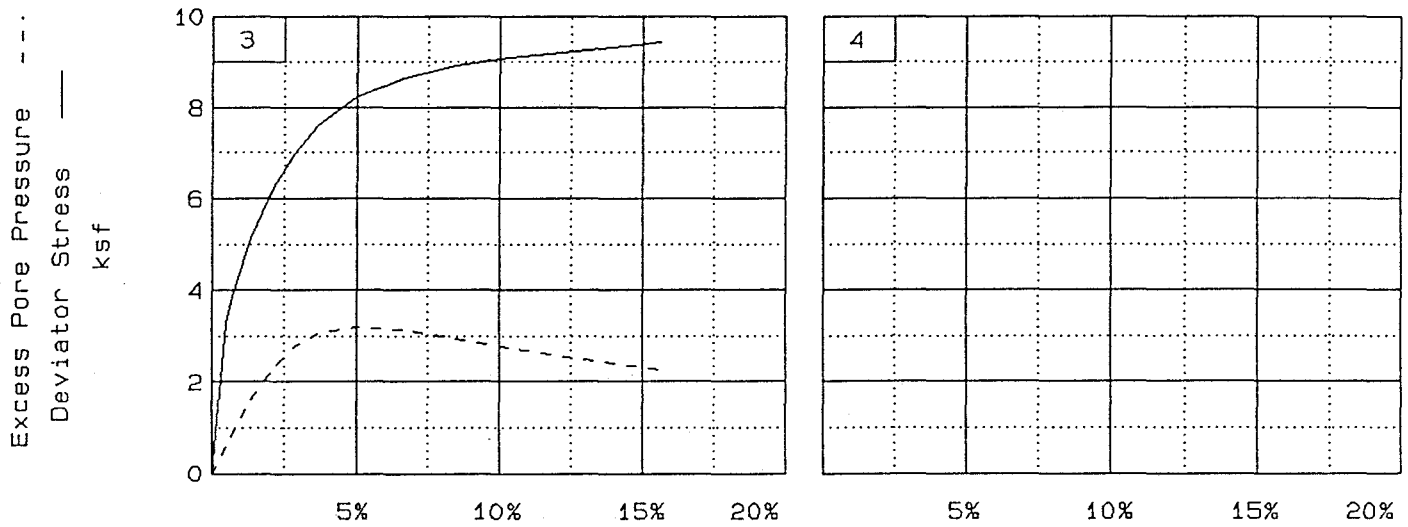
SAMPLE LOCATION: 94-7 Ud @ 23-24 Ft.
94-8 Ud @ 29-30.5 Ft.

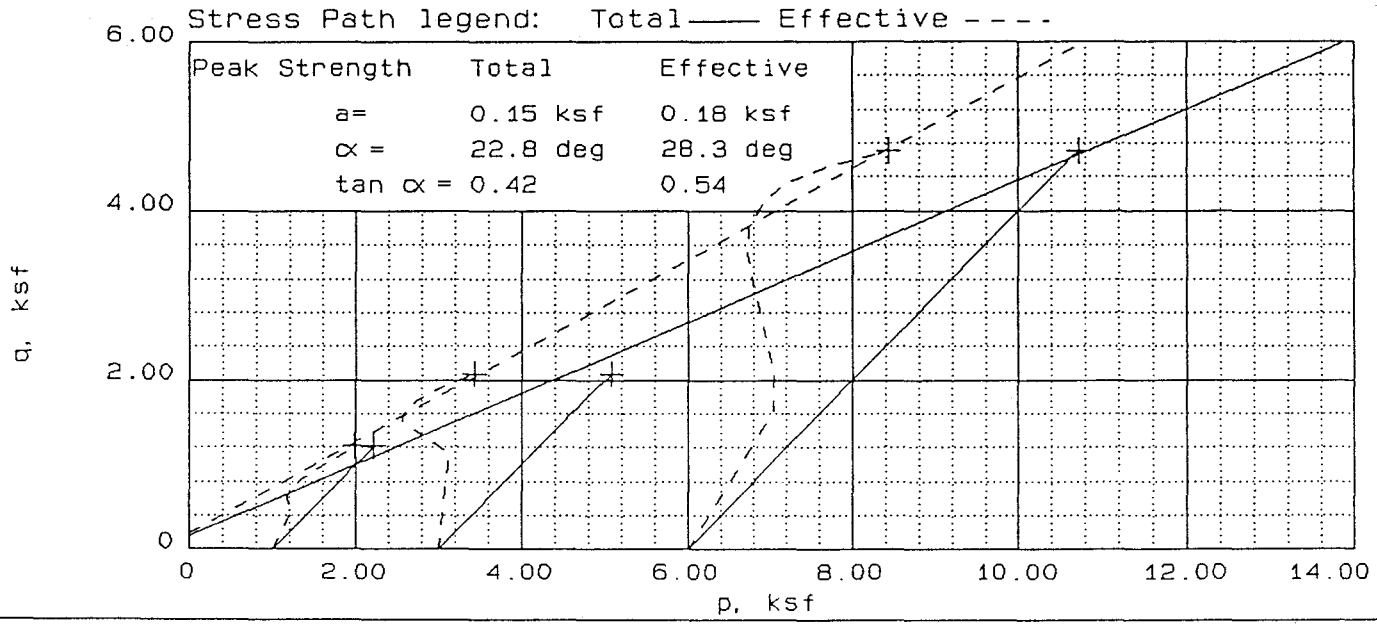
PROJ. NO.: 5810763701 DATE: Oct 4, 1994

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.





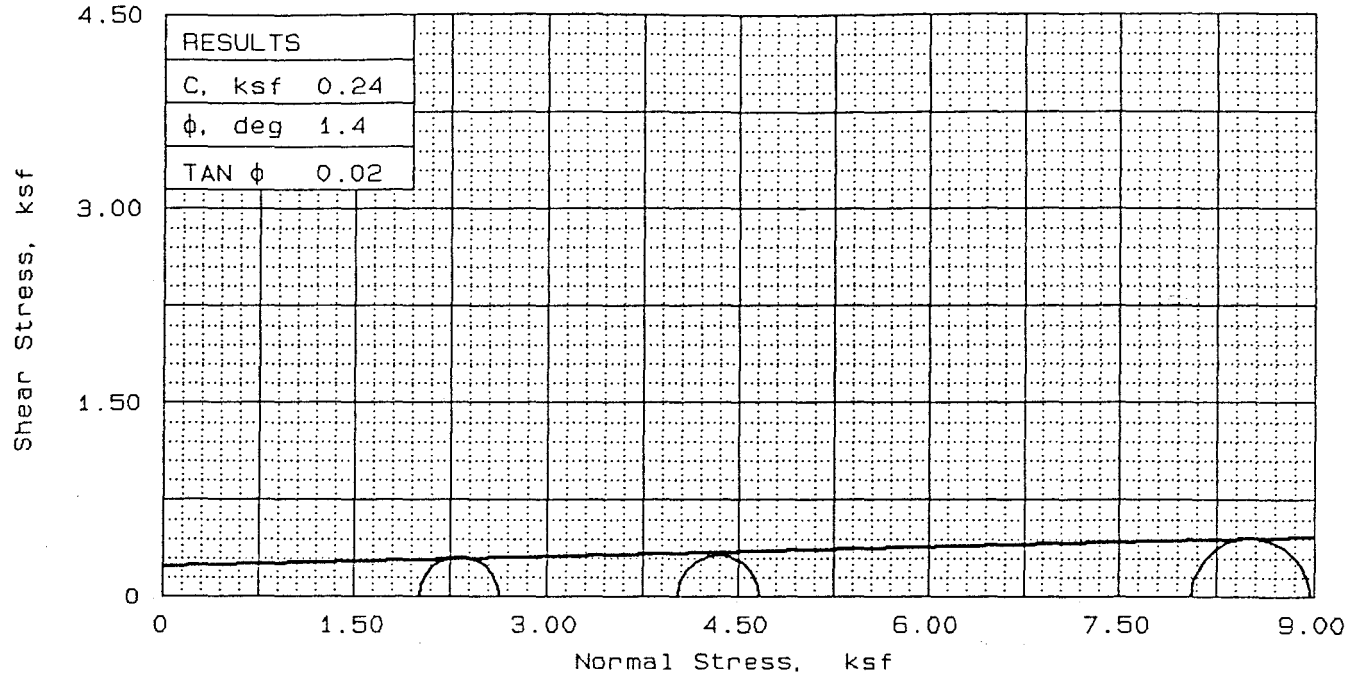


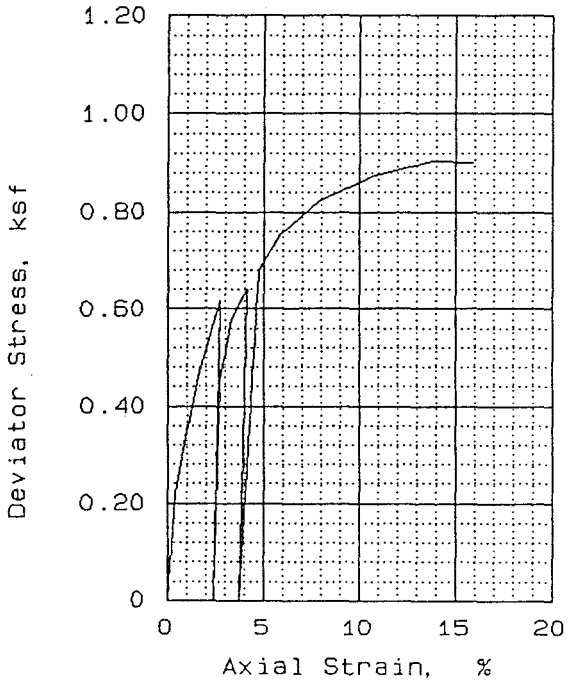
Client:

Project: New Johnsonville

Location: 94-7 Ud @ 23-24 Ft. 94-8 Ud @ 29-30.5 Ft.

File: 763701B Project No.: 5810763701 Page 2/2 Fig. No. ____





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	29.6	29.6	29.6
	DRY DENSITY, pcf	93.2	93.2	93.2
	SATURATION, %	97.0	97.0	97.0
	VOID RATIO	0.836	0.836	0.836
	DIAMETER, in	2.87	2.87	2.87
	HEIGHT, in	5.11	5.11	5.11
AT TEST	WATER CONTENT, %	29.6	29.6	29.6
	DRY DENSITY, pcf	93.2	93.2	93.2
	SATURATION, %	97.0	97.0	97.0
	VOID RATIO	0.836	0.836	0.836
	DIAMETER, in	2.87	2.87	2.87
	HEIGHT, in	5.11	5.11	5.11
BACK PRESSURE, ksf		0.00	0.00	0.00
CELL PRESSURE, ksf		2.02	4.03	8.06
FAILURE STRESS, ksf		0.62	0.64	0.90
PORE PRESSURE, ksf				
STRAIN RATE, %/min.		1.000	1.000	1.000
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
σ_1 FAILURE, ksf		2.63	4.67	8.97
σ_3 FAILURE, ksf		2.02	4.03	8.06

TYPE OF TEST:
Unconsolidated undrained
SAMPLE TYPE: Undisturbed
DESCRIPTION: Brown Lean Clay

LL= 44 PL= 20 PI= 24.0
SPECIFIC GRAVITY= 2.74
REMARKS: Tested by: HJ

Reviewed by: RLB

FIG. NO.

CLIENT:

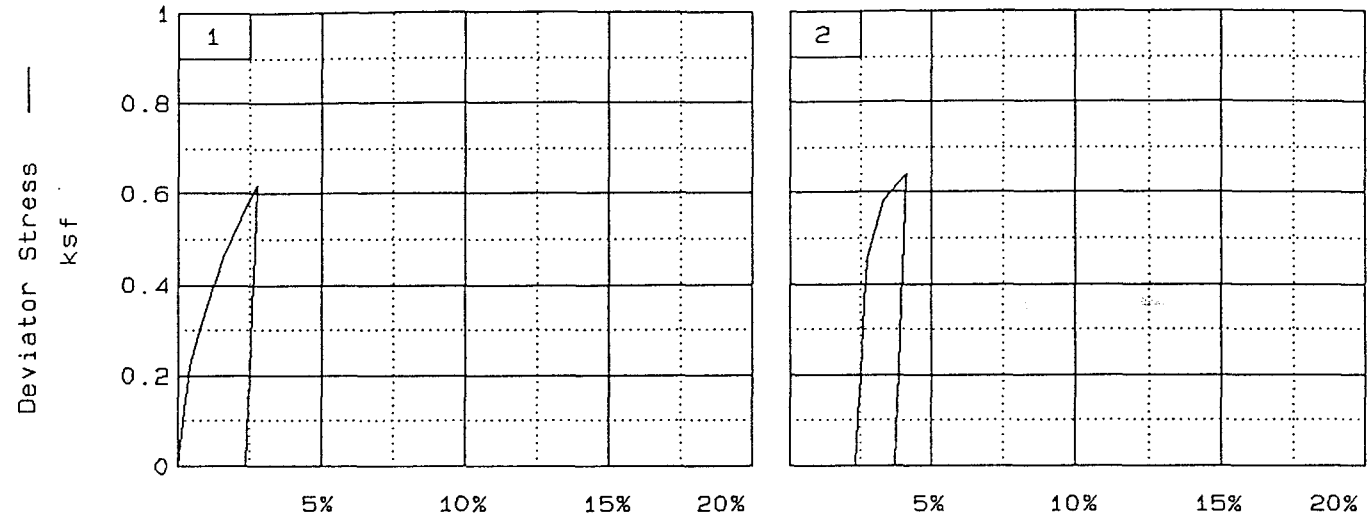
PROJECT: New Johnsonville

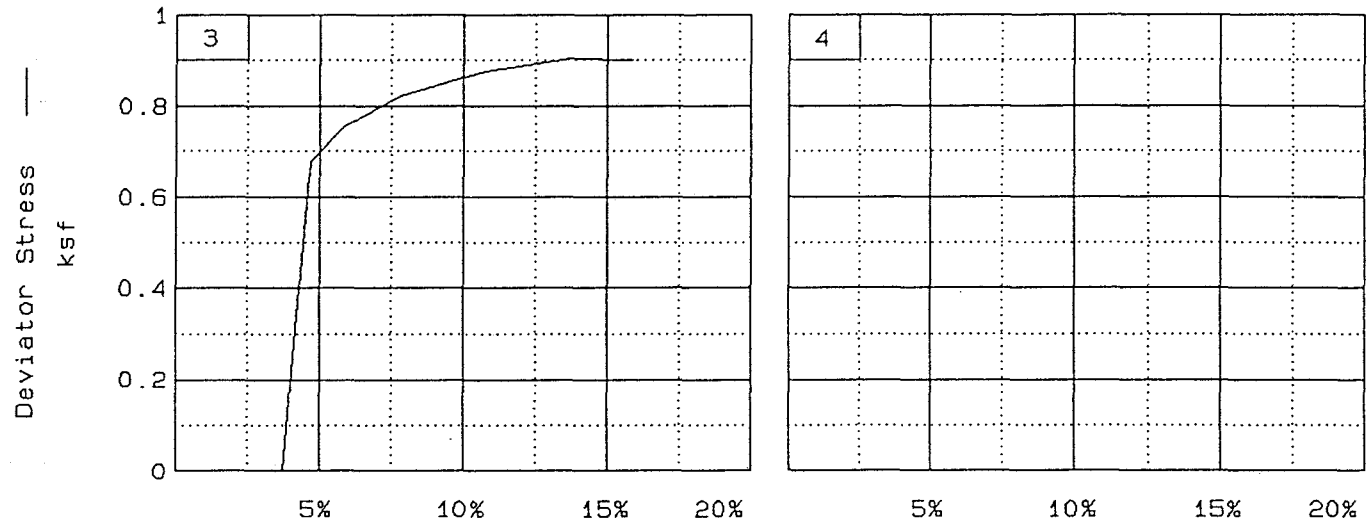
SAMPLE LOCATION: 94-9 Ud @ 35-37 Ft.

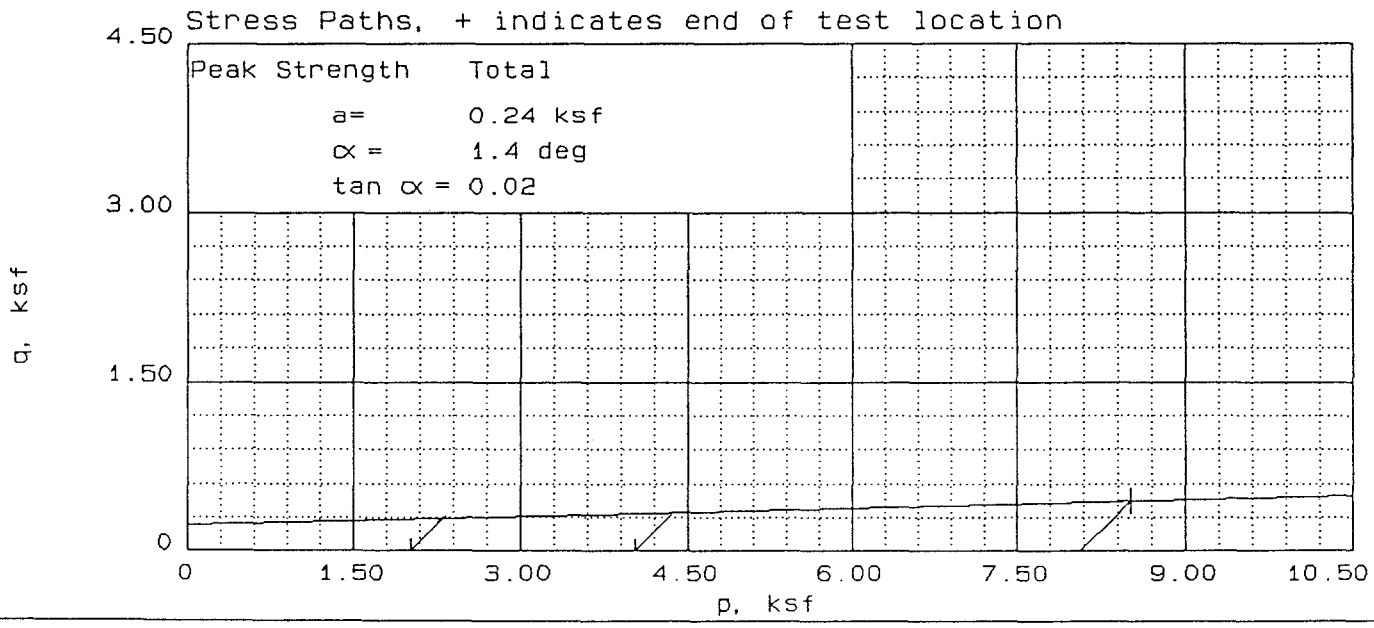
PROJ. NO.: 5810763701 DATE: Oct. 4, 1994

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.





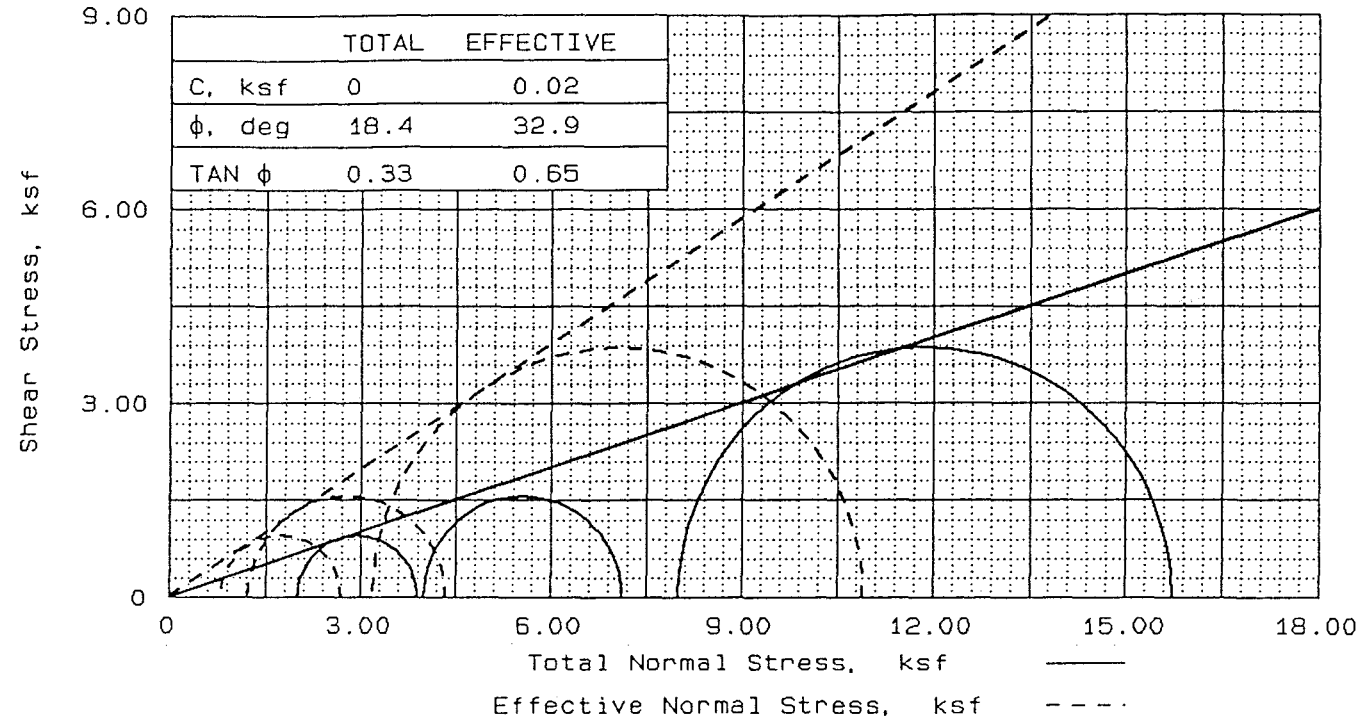


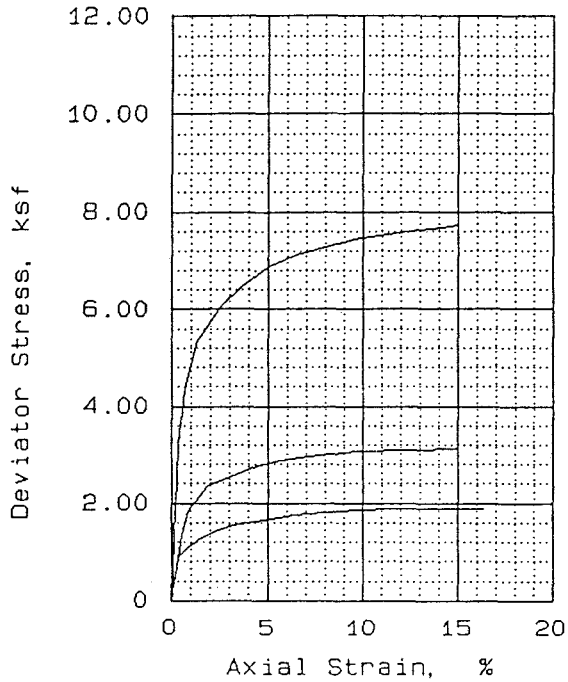
Client:

Project: New Johnsonville

Location: 94-9 Ud @ 35-37 Ft.

File: 763701C Project No.: 5810763701 Page 2/2 Fig. No. ____





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	33.0	29.7	27.9
	DRY DENSITY, pcf	93.8	93.4	96.8
	SATURATION, %	109.8	98.0	99.8
	VOID RATIO	0.824	0.831	0.767
	DIAMETER, in	2.85	2.84	2.85
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	27.9	27.6	23.3
	DRY DENSITY, pcf	96.9	97.4	104.3
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.766	0.757	0.640
	DIAMETER, in	2.81	2.78	2.74
	HEIGHT, in	6.00	6.01	6.02
BACK PRESSURE, ksf		2.59	2.58	2.52
CELL PRESSURE, ksf		4.59	6.58	10.52
FAILURE STRESS, ksf		1.90	3.13	7.72
PORE PRESSURE, ksf		3.80	5.36	7.33
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		2.69	4.35	10.91
$\bar{\sigma}_3$ FAILURE, ksf		0.79	1.22	3.19

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Undisturbed
DESCRIPTION: Brown Lean Clay

LL= 44 PL= 20 PI= 24.0
SPECIFIC GRAVITY= 2.74
REMARKS: Tested by: HS

Reviewed by: RLB

FIG. NO.

CLIENT:

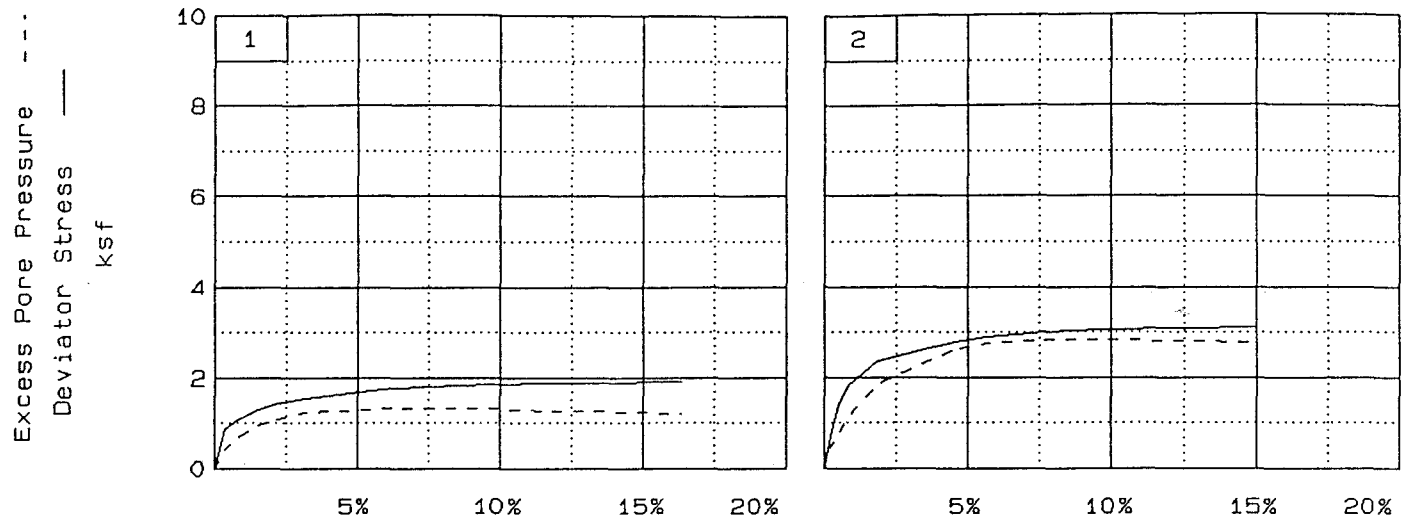
PROJECT: New Johnsonville

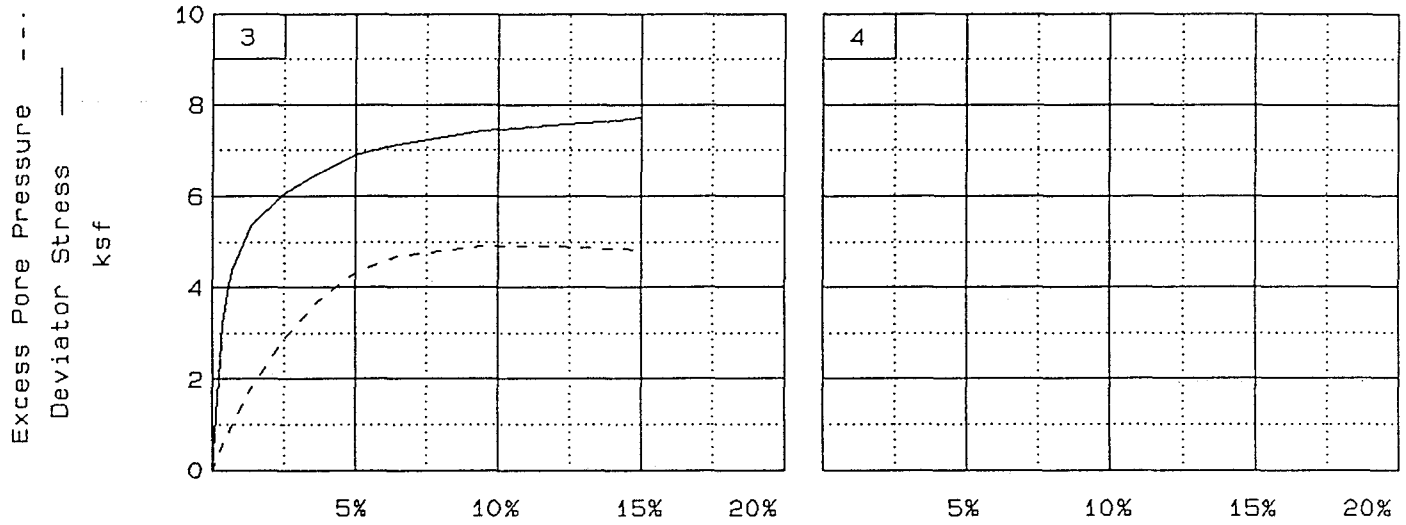
SAMPLE LOCATION: 94-9 Ud @ 35-37 Ft.

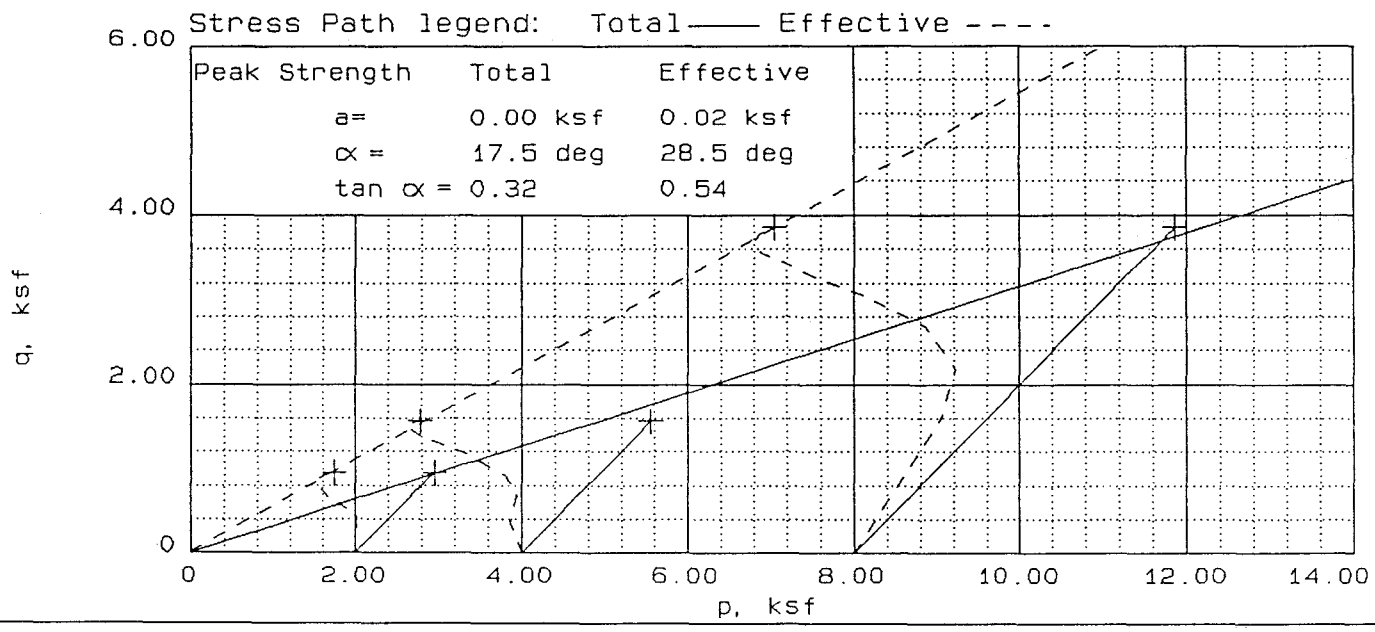
PROJ. NO.: 5810763701 DATE: Oct. 4, 1994

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.





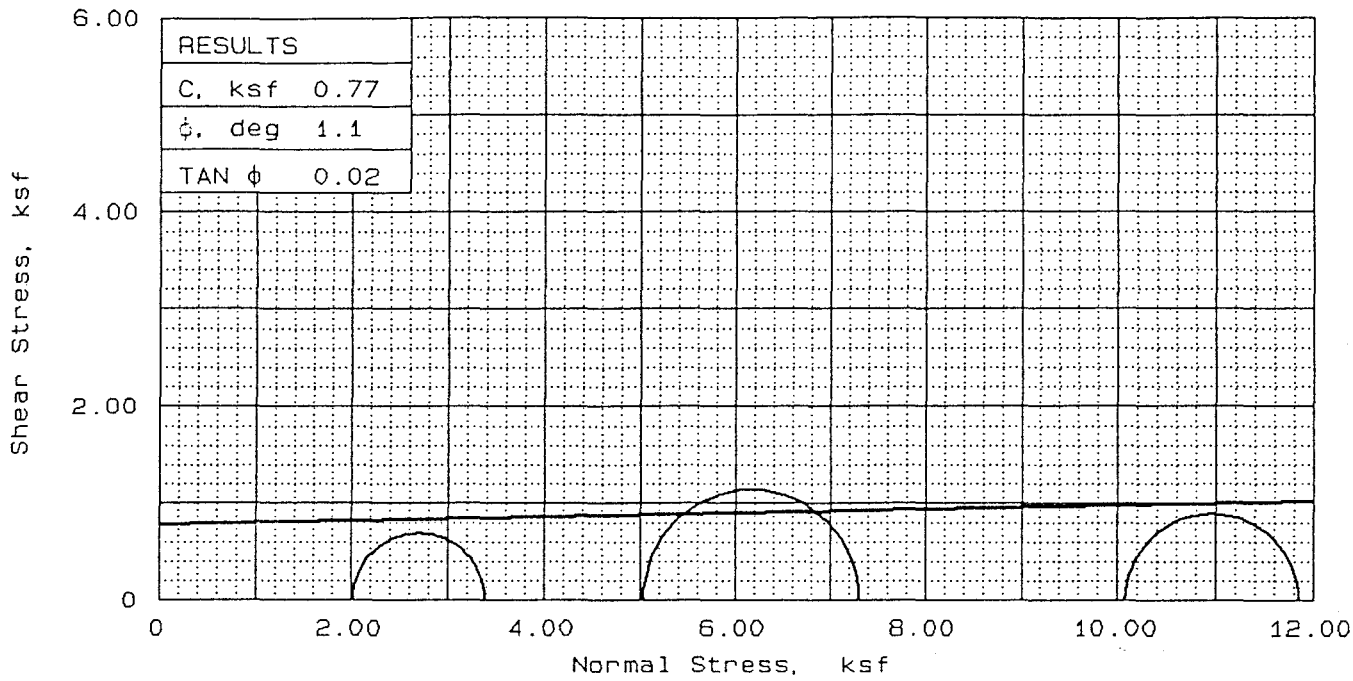


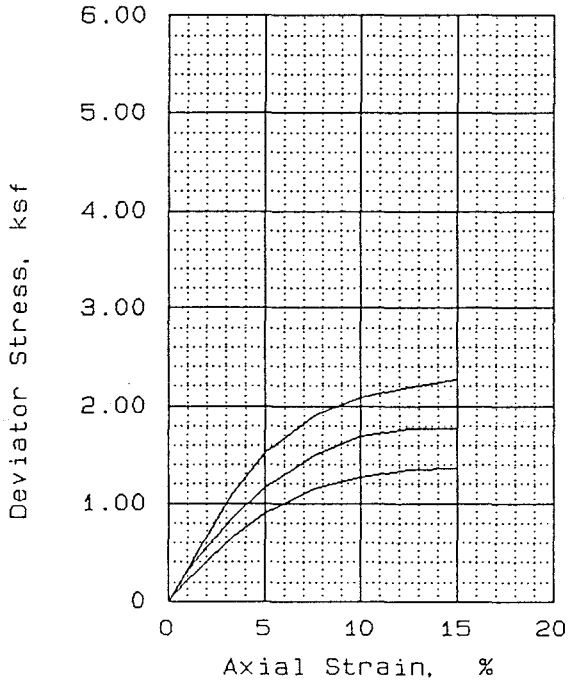
Client:

Project: New Johnsonville

Location: 94-9 Ud @ 35-37 Ft.

File: 763701D Project No.: 5810763701 Page 2/2 Fig. No. ____





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	25.7	21.0	25.4
	DRY DENSITY, pcf	102.4	106.6	99.6
	SATURATION, %	112.1	102.3	103.1
	VOID RATIO	0.604	0.541	0.649
	DIAMETER, in	2.84	2.84	2.86
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	25.7	21.0	25.4
	DRY DENSITY, pcf	102.4	106.6	99.6
	SATURATION, %	112.1	102.3	103.1
	VOID RATIO	0.604	0.541	0.649
	DIAMETER, in	2.84	2.84	2.86
	HEIGHT, in	6.00	6.00	6.00
BACK PRESSURE, ksf		0.00	0.00	0.00
CELL PRESSURE, ksf		2.02	5.04	10.08
FAILURE STRESS, ksf		1.37	2.28	1.77
PORE PRESSURE, ksf				
STRAIN RATE, %/min.		1.000	1.000	1.000
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
σ_1 FAILURE, ksf		3.39	7.32	11.85
σ_3 FAILURE, ksf		2.02	5.04	10.08

TYPE OF TEST:
Unconsolidated undrained
SAMPLE TYPE: Undisturbed
DESCRIPTION: Grey Lean Clay with Sand
LL= 31 PL= 20 PI= 11.0
SPECIFIC GRAVITY= 2.63
REMARKS: Tested by: HD

Reviewed by: RLB

FIG. NO.

CLIENT:

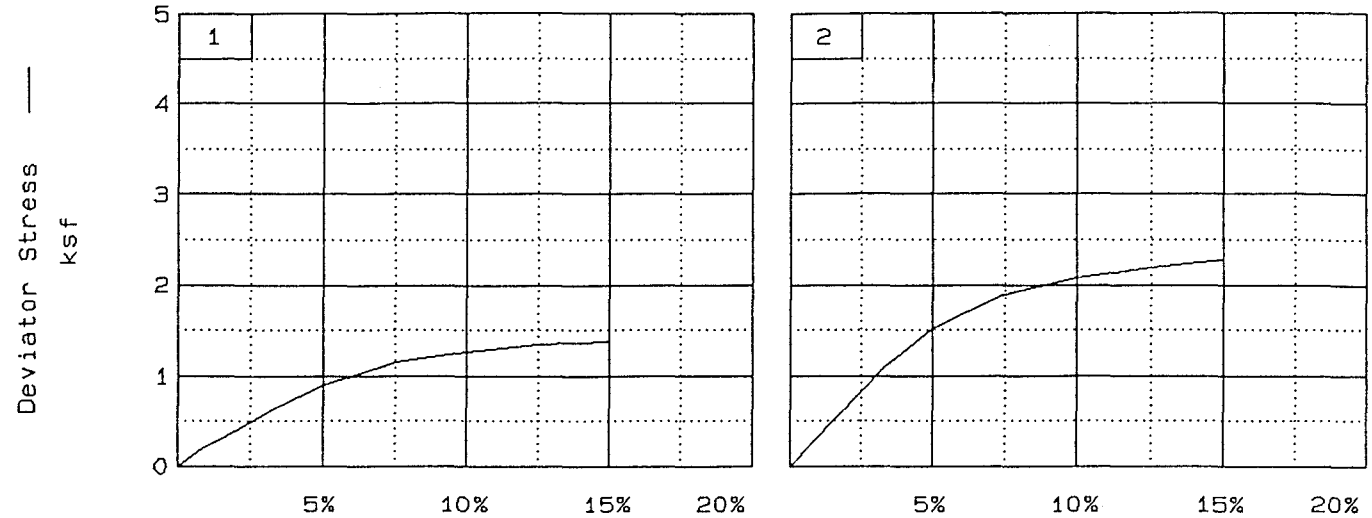
PROJECT: New Johnsonville

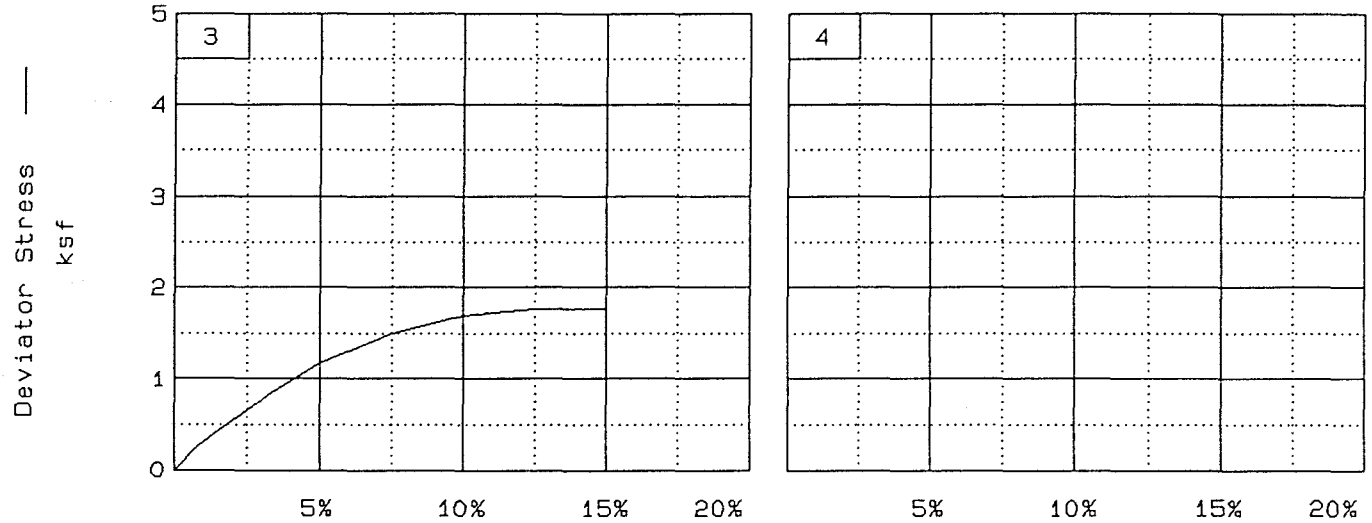
SAMPLE LOCATION: 94-10 Ud @ 59-61 Ft.

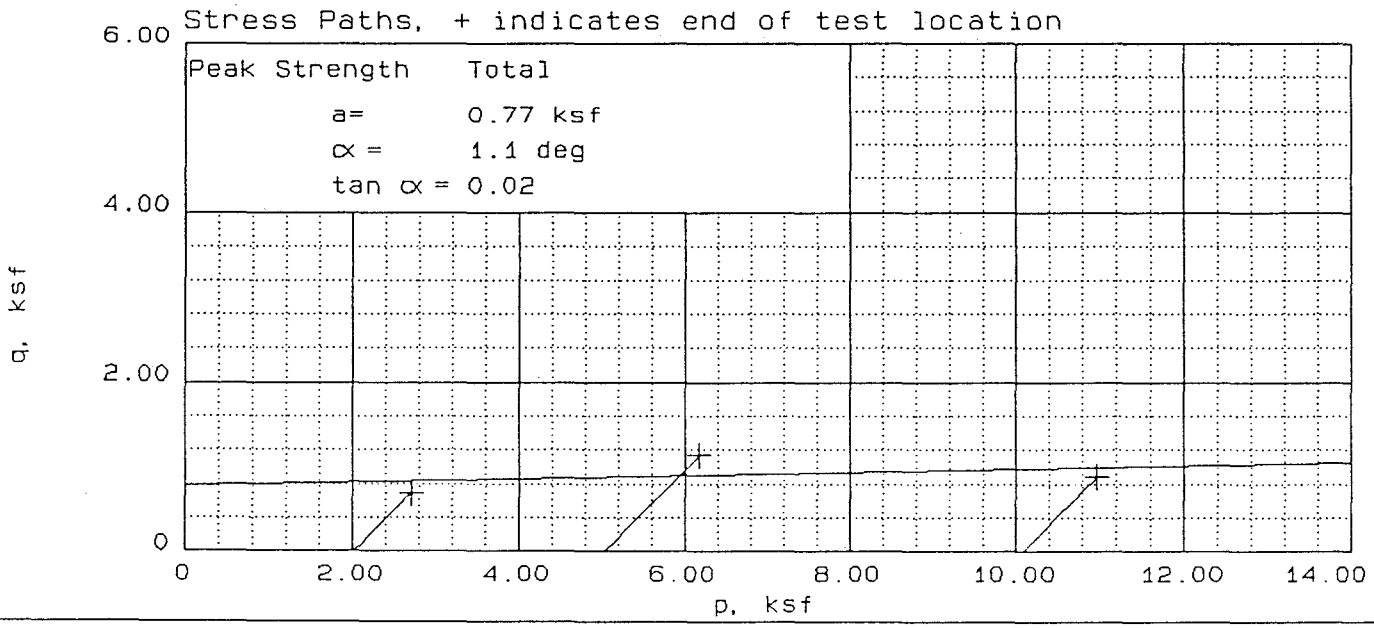
PROJ. NO.: 5810763701 DATE: Oct. 4, 1994

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.





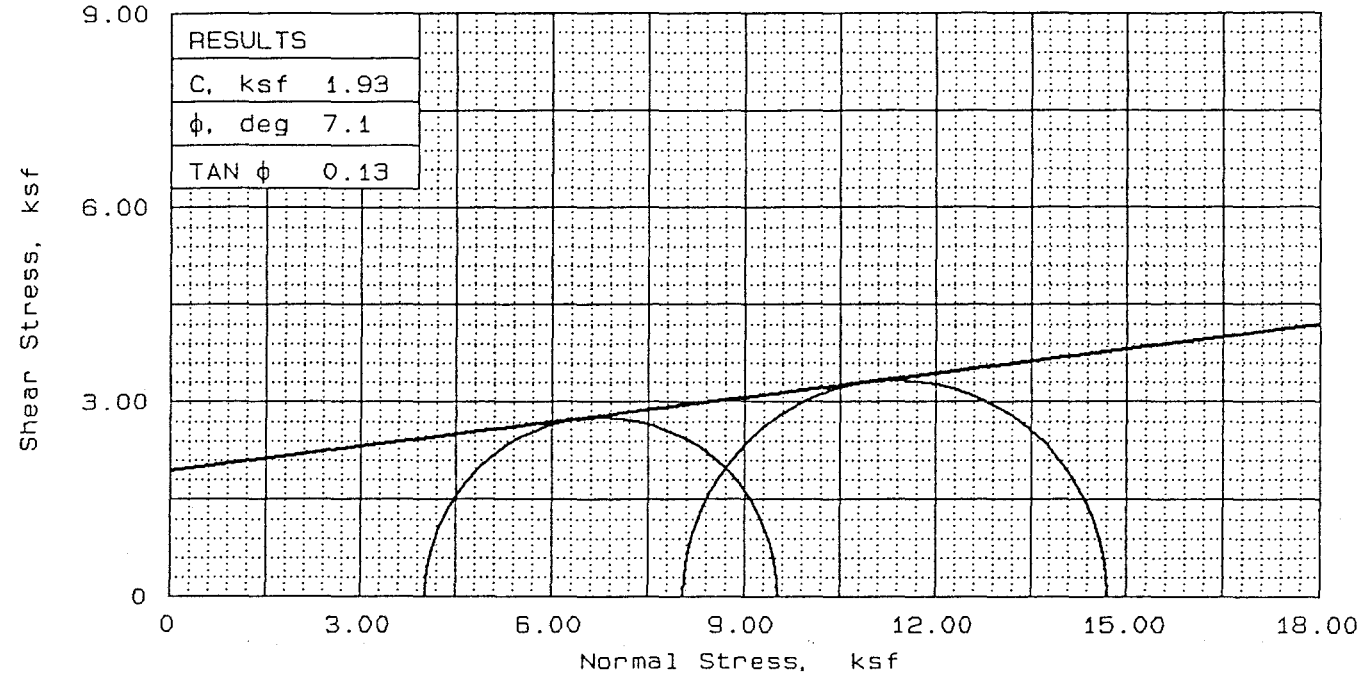


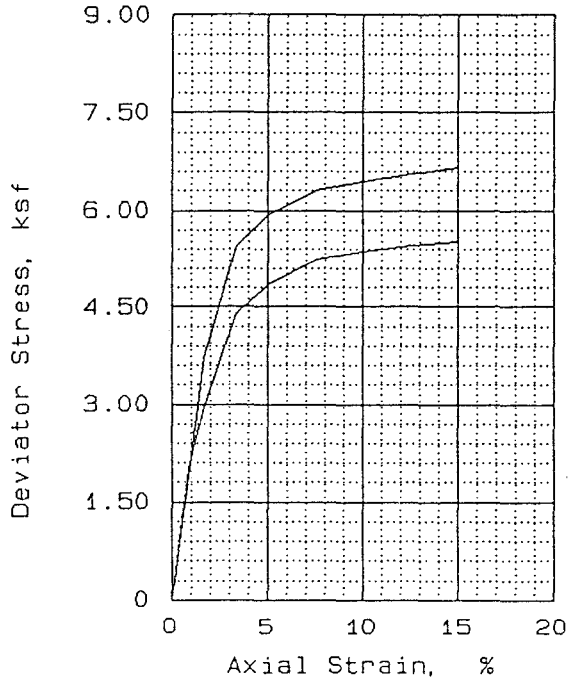
Client:

Project: New Johnsonville

Location: 94-10 Ud @ 59-61 Ft.

File: 763701E Project No.: 5810763701 Page 2/2 Fig. No. _____





SAMPLE NO.		1	2
INITIAL	WATER CONTENT, %	23.8	23.6
	DRY DENSITY, pcf	101.0	100.5
	SATURATION, %	97.9	95.7
	VOID RATIO	0.650	0.658
	DIAMETER, in	2.85	2.85
	HEIGHT, in	6.00	6.00
AT TEST	WATER CONTENT, %	23.8	23.6
	DRY DENSITY, pcf	101.0	100.5
	SATURATION, %	97.9	95.7
	VOID RATIO	0.650	0.658
	DIAMETER, in	2.85	2.85
	HEIGHT, in	6.00	6.00
BACK PRESSURE, ksf		0.00	0.00
CELL PRESSURE, ksf		4.03	8.06
FAILURE STRESS, ksf		5.51	6.65
PORE PRESSURE, ksf			
STRAIN RATE, %/min.		1.000	1.000
ULTIMATE STRESS, ksf			
PORE PRESSURE, ksf			
σ_1 FAILURE, ksf		9.54	14.72
σ_3 FAILURE, ksf		4.03	8.06

TYPE OF TEST:
Unconsolidated undrained
SAMPLE TYPE: Undisturbed
DESCRIPTION: Brown Lean Clay

LL= 43 PL= 22 PI= 21.0
SPECIFIC GRAVITY= 2.67
REMARKS: Tested by: HD

Reviewed by: RLB

FIG. NO.

CLIENT:

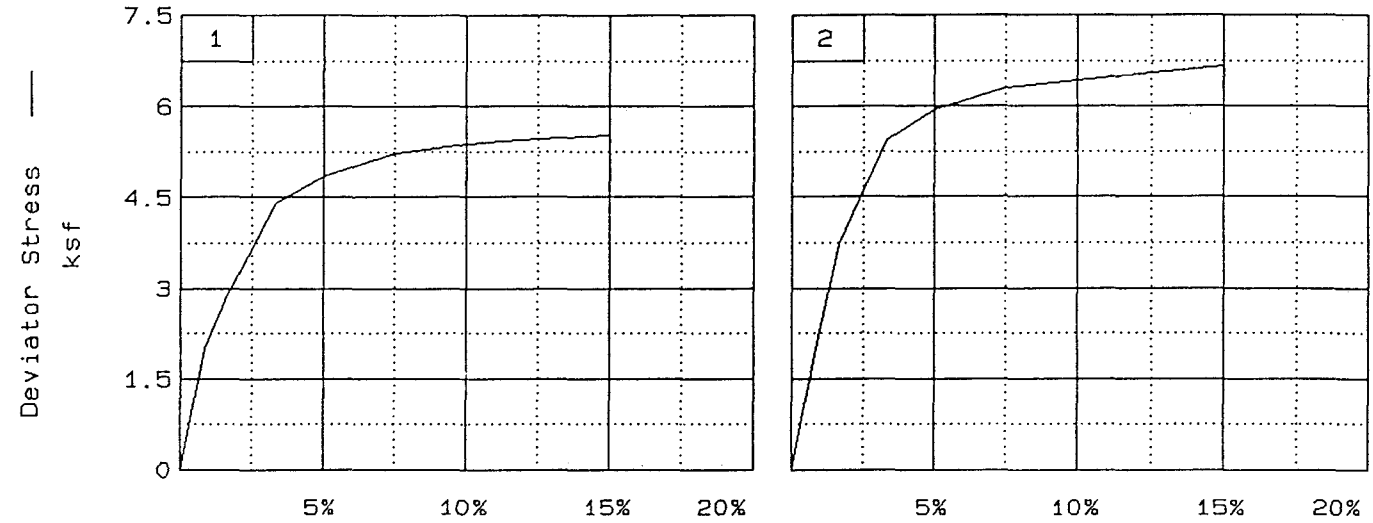
PROJECT: New Johnsonville

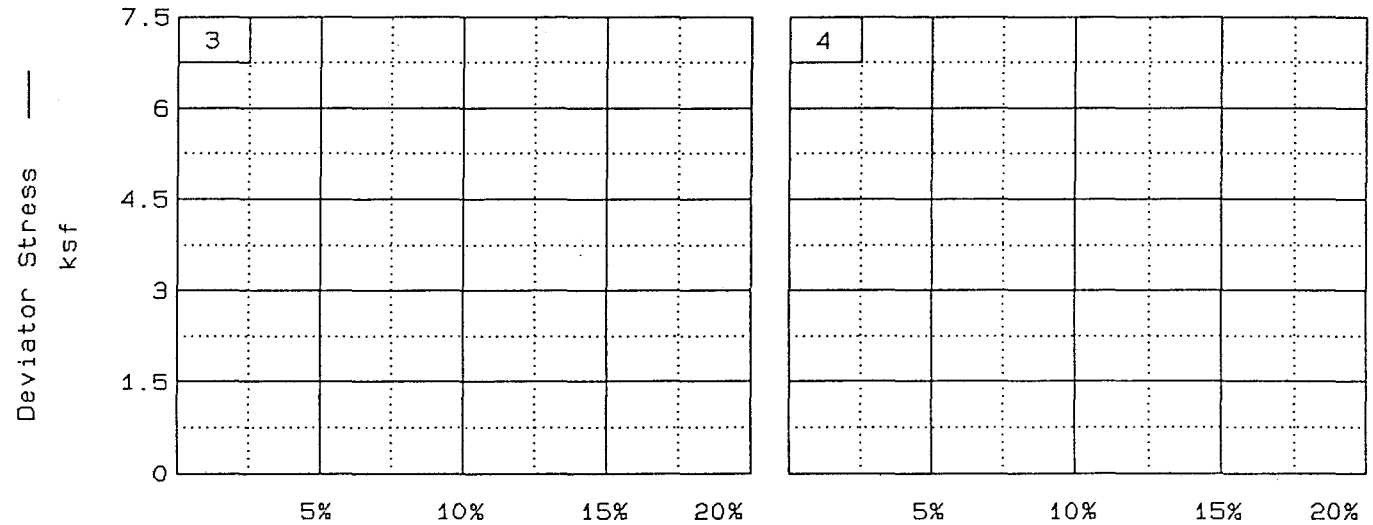
SAMPLE LOCATION: 94-11 UD @ 42-44 Ft.

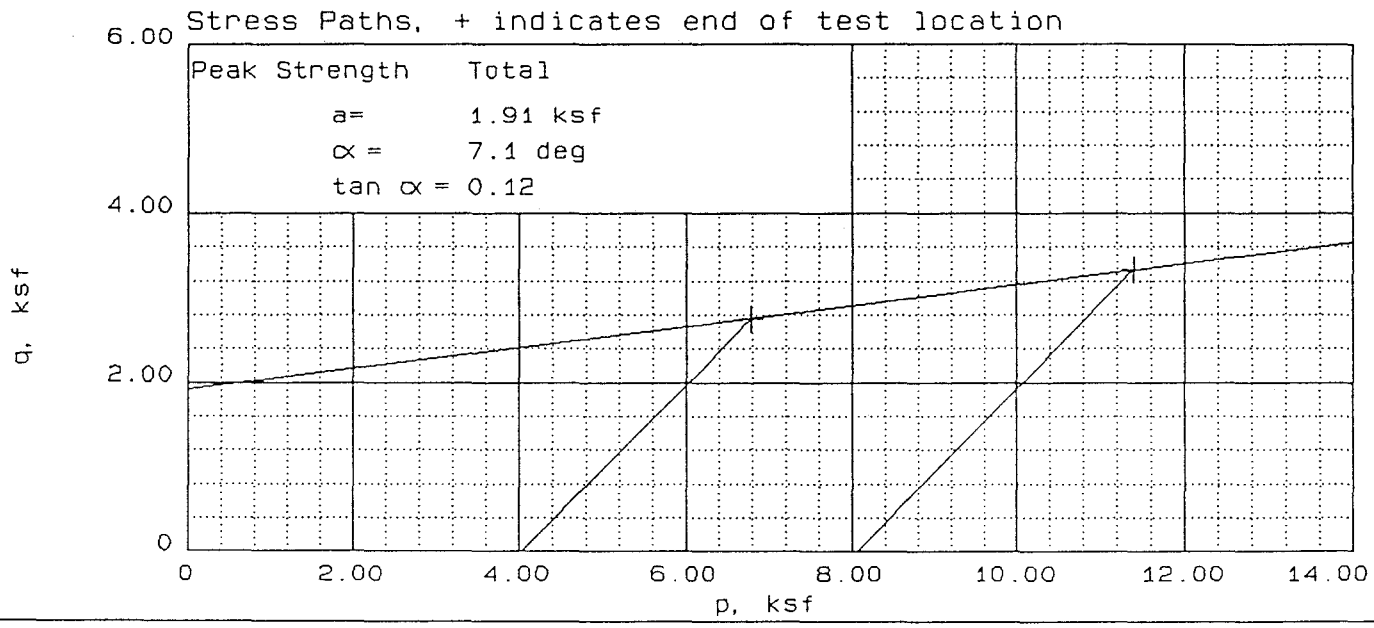
PROJ. NO.: 5810763701 DATE: Oct.4, 1994

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.





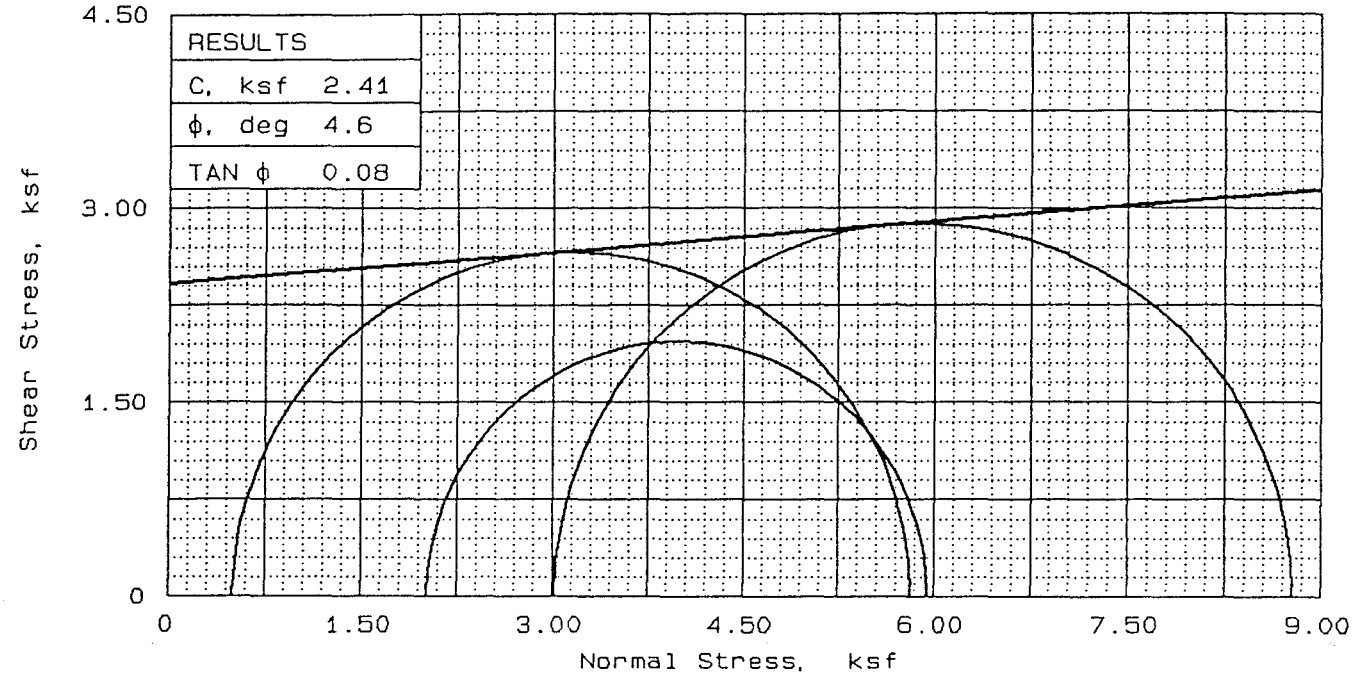


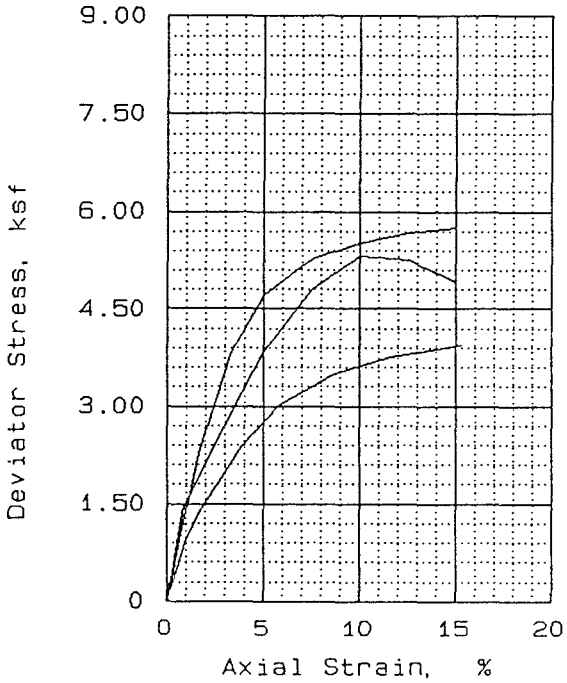
Client:

Project: New Johnsonville

Location: 94-11 UD @ 42-44 Ft.

File: 763701 Project No.: 5810763701 Page 2/2 Fig. No. ____





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	22.1	19.7	22.5
	DRY DENSITY, pcf	101.2	105.9	103.7
	SATURATION, %	92.0	93.0	100.0
	VOID RATIO	0.636	0.562	0.596
	DIAMETER, in	2.82	2.85	2.84
	HEIGHT, in	5.18	6.00	6.00
AT TEST	WATER CONTENT, %	22.1	19.7	22.5
	DRY DENSITY, pcf	101.2	105.9	103.7
	SATURATION, %	92.0	93.0	100.0
	VOID RATIO	0.636	0.562	0.596
	DIAMETER, in	2.82	2.85	2.84
	HEIGHT, in	5.18	6.00	6.00
BACK PRESSURE, ksf		0.00	0.00	0.00
CELL PRESSURE, ksf		2.02	0.50	3.02
FAILURE STRESS, ksf		3.94	5.32	5.76
PORE PRESSURE, ksf				
STRAIN RATE, %/min.		1.000	1.000	1.000
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
σ_1 FAILURE, ksf		5.95	5.82	8.78
σ_3 FAILURE, ksf		2.02	0.5	3.02

TYPE OF TEST:
Unconsolidated undrained

SAMPLE TYPE: Undisturbed

DESCRIPTION: Brown Lean Clay with Gravel

LL= 38 PL= 17 PI= 21.0

SPECIFIC GRAVITY= 2.65

REMARKS: Tested by: HJ

Reviewed by: RLB

FIG. NO.

CLIENT:

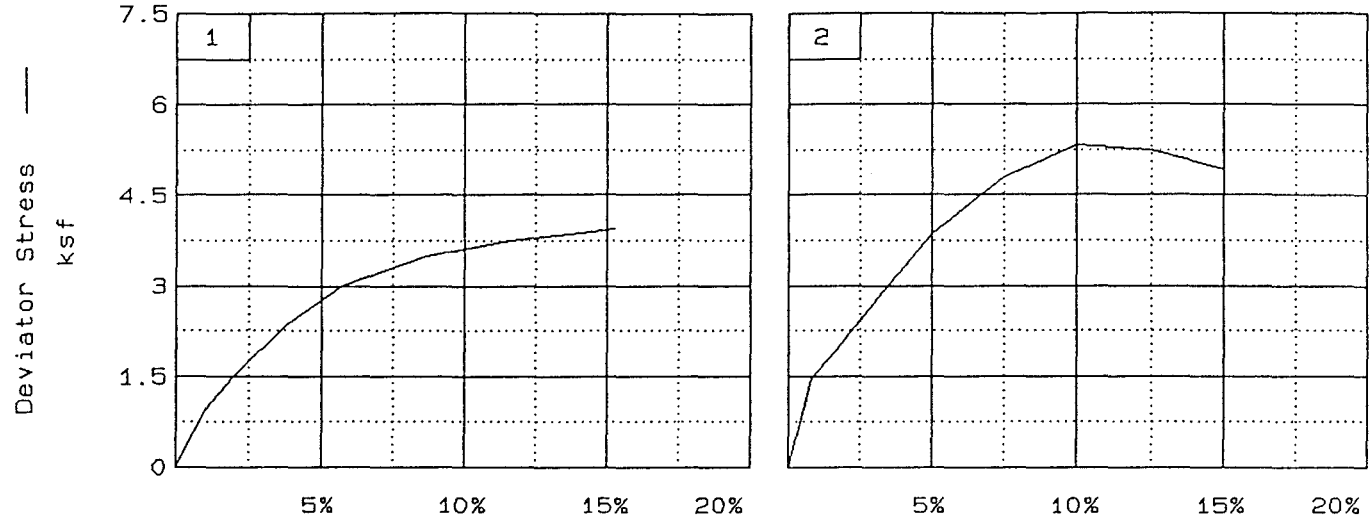
PROJECT: New Johnsonville

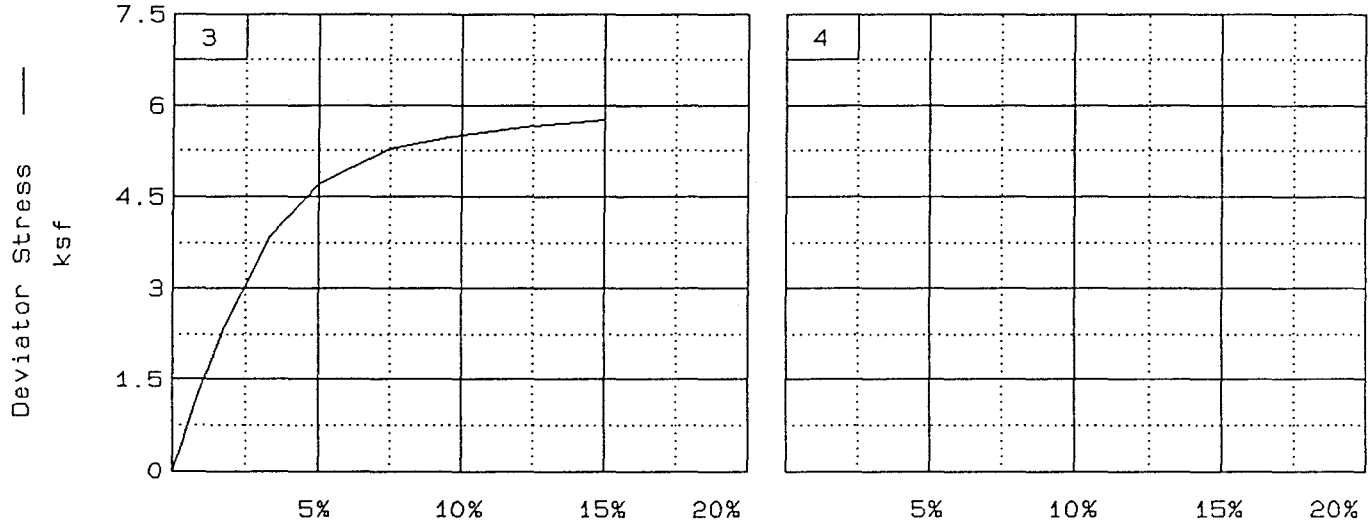
SAMPLE LOCATION: 94-14 Ud @ 12-14 Ft.
94-5 Ud @ 6-7.5 Ft.

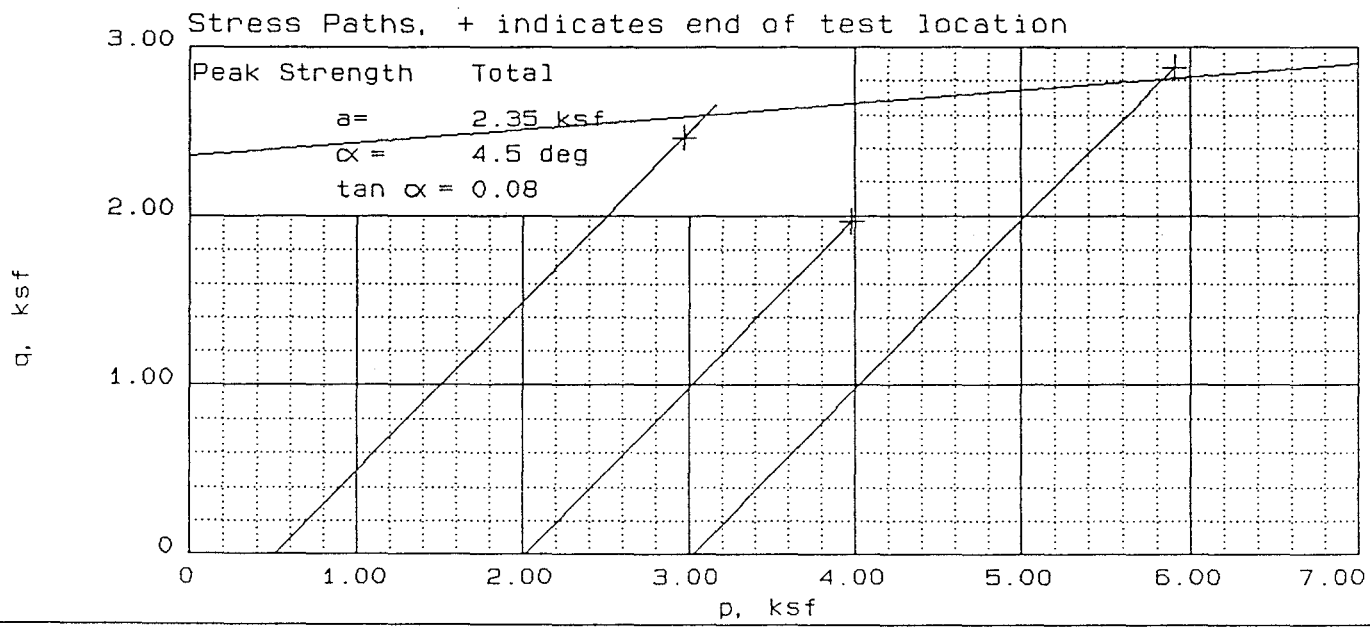
PROJ. NO.: 5810763701 DATE: Oct. 4, 1994

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.







Client:

Project: New Johnsonville

Location: 94-14 Ud @ 12-14 Ft. 94-5 Ud @ 6-7.5 Ft.

File: 763701G Project No.: 5810763701 Page 2/2 Fig. No. ____