GEOTECHNICAL INVESTIGATION

WATER LINE REPLACEMENT IN INNSDALE AREA
WBS NO. S-000035-0206-4
HOUSTON, TEXAS

Submitted by:

GEOTEST ENGINEERING, INC.

Houston, Texas

REPORT NO. 1140208301

May 15, 2015

Key Map No. 453 B, C, D, F, G & H

GEOTEST ENGINEERING, INC.

Geotechnical Engineers & Materials Testing

5600 Bintliff Drive Houston, Texas 77036 Telephone: (713) 266-0588
Fax: (713) 266-2977

Report No. 1140208301
May 15, 2015

Mr. Shaheen Chowdhury, P.E., RPLS
Kuo & Associates, Inc.
10700 Richmond Avenue, Suite 113
Houston, Texas 77042

Reference: Geotechnical Investigation
Water Line Replacement in
Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

Dear Mr. Chowdhury:

We are pleased to present our geotechnical final report for the above referenced project. Preliminary boring logs were submitted to you on April 3, 2015. A draft report was submitted to you on April 14, 2015. This final report supersedes all previously submitted reports, transmittals, etc. for the referenced project. This study was authorized through authorization to proceed letter dated January 29, 2015 by accepting Geotest Engineering, Inc. (Geotest) Proposal No. 1140343699 dated October 7, 2014.

We appreciate this opportunity to be of service to you. If you have any questions regarding the report, or if we can be of further service to you, please call us.

Very truly yours,
GEOTEST ENGINEERING, INC.
TBPE Registration No. F-410

STATE OF TEXAS
5/15/15
NARESH KOLLI
110928
LICENSED
PROFESSIONAL ENGINEER

K. Naresh

Naresh Kolli, P.E.
Assistant Project Manager

B.C. B

Mohan Ballagere, P.E.
Vice President

STATE OF TEXAS
5/15/15
MOHAN BALLAGERE
87622
LICENSED
PROFESSIONAL ENGINEER

MB/NK/ego
Copies Submitted: (2+1pdf)
PC38:\Geotechnical\40208301F.doc

TABLE OF CONTENTS

		Page
EXECUTIVE SUMMARY		1
1.0	INTRODUCTION	3
	1.1 General	3
	1.2 Authorization	3
	1.3 Location and Description of Project	3
	1.4 Purpose and Scope	3
2.0	FIELD INVESTIGATION	5
	2.1 General	5
	2.2 Geotechnical Borings	5
	2.3 Piezometer Installation	6
3.0	LABORATORY TESTING	7
4.0	SUBSURFACE CONDITIONS	9
	4.1 Geology	9
	4.2 General Fault Information	9
	4.3 Existing Paving	9
	4.4 Soils Stratigraphy	12
	4.5 Range of Weak Soils Encountered in Borings	21
	4.6 Water Levels	23
	4.7 Environmental Concerns	24
5.0	ENGINEERING ANALYSES AND RECOMMENDATIONS	25
	5.1 General	25
	5.2 Trench Excavation(Auger Pits)	25
	5.2.1 Geotechnical Parameters	25
	5.2.2 Excavation Stability (Auger Pits)	25
	5.2.3 Groundwater Control	27
	5.2.4 Auger Pit Backfill	28
	5.3 Trenchless Installation - Pipe and Auger Casing	28
	5.3.1 Geotechnical Parameters for Pipe and Auger Casing	28

TABLE OF CONTENTS (Continued)

Page

5.3.2 Earth Pressure on Auger Casing 29

5.3.3 Live Loads on Pipeline Due to Traffic 29

5.3.4 Carrier Pipe Design Parameters 29

5.4 Piping System Thrust Restraint 29

5.4.1 Restrained Joints 30

5.5 Influence of Trenchless Operation on Adjacent Structures 30

5.6 Pavement Repair and Subgrade Stabilization 32

6.0 CONSTRUCTION CONSIDERATIONS 34

6.1 Auger Pit Excavation and Water Line Construction 34

6.2 Groundwater Control 34

7.0 LIMITATIONS 36

TABLES

Table

Summary of Boring Information 1

Geotechnical Design Parameter Summary – Open Cut Excavation (Auger Pits) 2

Geotechnical Design Parameter Summary – Trenchless Installation (Pipe and Auger Casing) ..... 3.1 thru 3.5

ILLUSTRATIONS

Figure

Vicinity Map 1

Plan of Borings ..... 2.1 thru 2.7

Boring Log Profile ..... 3.1 thru 3.19

Symbols and Abbreviations Used on Boring Log Profile 4

Trench Support Earth Pressures ..... 5.1 thru 5.3

Stability of Bottom for Braced Cut 6

Earth Pressure on Pipe and Auger Casing 7

Vertical Stress on Pipes Due to Traffic Loads 8

Thrust Forces Acting on a Bend 9

TABLE OF CONTENTS (Continued)

APPENDIX A

Figure

Log of Borings ..... A-1 thru A-58

Symbols and Terms Used on Boring Logs..... A-59

Piezometer Installation Reports ..... A-60 thru A-65

APPENDIX B

Figure

Summary of Laboratory Test Results..... B-1 thru B-58

Grain Size Distribution Curves ..... B-59 thru B-62

APPENDIX C

TDLR Piezometer Abandonment Reports

APPENDIX D

Laboratory Corrosivity Test Report

EXECUTIVE SUMMARY

A geotechnical investigation was performed for the design and construction of the proposed water line replacement in the Innsdale Area in Houston, Texas. The project calls for the design and construction of water line replacement in Innsdale Area in Houston, Texas. The proposed water line replacement is approximately 27,980 linear feet with new water line sizes ranging from 4 to 12 inches in diameter. The anticipated maximum depth of new water line ranges from 10 to 20 feet. The proposed water line will generally be installed by pipe augering or trenchless method. The locations of the auger pits are not known at this time. New pavement design will not be required for this project.

The purposes of this study were to evaluate soil and groundwater conditions and to provide geotechnical recommendations for the proposed water line replacement. This investigation included drilling and sampling fifty eight (58) borings to depths ranging from 15 to 30 feet, installing piezometers in six (6) existing borings, performing laboratory tests on soil samples recovered from the borings, performing engineering analyses and developing geotechnical recommendations and preparing a geotechnical report.

The principal findings and conclusions developed from this investigation are as follows:

- The subsurface soil beneath pavement as encountered in borings GB-1 through GB-58 along various streets in the project area consists of predominantly cohesive soils to the explored depths of 15 to 30 feet except in borings GB-16C, GB-22B, GB-23, GB-24, GB-26, GB-43B, GB-50A, GB-51, GB-52A, GB-53A, GB-54A, GB-55, GB-56C and GB-58. In borings GB-16C, GB-22B, GB-23, GB-24, GB-26, GB-43B, GB-50A, GB-51, GB-52A, GB-53A, GB-54A, GB-55, GB-56C and GB-58, the subsurface soil beneath pavement and existing grade consists of cohesive with intermittent or underlain by cohesionless soil to the explored depths of 15 to 30 feet. The cohesive soils consist of soft to hard dark gray, gray, brown, yellowish brown and reddish brown Sandy Lean Clay, Lean Clay with sand, Lean Clay, Fat Clay with sand and Fat Clay. The cohesionless soil consists of very loose to medium dense gray, reddish brown Silty Sand, Fine Sand with silt and Clayey Sand. Fill material consisting of soft to very stiff dark gray, brown and gray lean clay with sand and gray silty sand was encountered between the depths of 0 to 12 feet

in borings GB-4A, GB-11, GB-16B, GB-39A, GB-40, GB-41, GB-45, GB-46, GB-50 and GB-52A.

- Groundwater was encountered in borings GB-2, GB-11, GB-16C, GB-20, GB-22BP, GB-23, GB-24, GB-25, GB-26, GB-27, GB-31, GB-32, GB-33, GB-35, GB-37, GB-39A, GB-43B, GB-44, GB-45, GB-47, GB-52A, GB-53A, GB-54A, GB-55, GB-55, GB-57P and GB-58 at depths ranging from 6 to 18 feet during drilling. The groundwater level measured at 20 to 25 minutes after water was first encountered is at depths ranging from 3.5 to 13.5 feet in these borings. No groundwater was encountered in any other borings drilled for this study including the borings GB-4AP, GB-13P, GB-34P and GB-51P that were converted into piezometers during drilling. In piezometer borings GB-4AP, GB-13P, GB-22BP, GB- 34P, GB-51P and GB-57P, the water level measured at 30 days ranges from 3.2 feet to 9.4 feet.

- Based on the available information from U.S. Geological Survey (USGS) Maps and in-house records relating to geologic faults for the project area, no known surface faults exist within the project area. The nearest known surface fault is the Eureka Heights Fault and is located approximately 0.5 miles west of the nearest alignment in project area.

- The existing paving as obtained in the soil borings GB-1 through GB-58, predominantly consists of asphalt pavement consisting of 2 to 11 inches of asphalt over 2 to 12 inches of sand, limestone and shell mix. In borings GB-22, GB-31 through GB-37, GB-50 and GB-55, the existing pavement consists of 6 to 9.5 inches of concrete over 3 to 10.0 inches of sand and shell or cement stabilized sand. The boring GB-4A was drilled in the grass area.

- All excavation operations should be carried out in accordance with OSHA standards and the City of Houston Standard Specifications.

- Recommendations for installation of water lines by trenchless method (Pipe and Auger Casing) and other associated construction are included in Sections 5.2 and 5.3 of this report.

- Geotechnical parameters for design of piping system thrust restraint are provided in Section 5.4 of this report.

1.0 INTRODUCTION

1.1 General

The City of Houston selected Kuo & Associates, Inc. to perform engineering services for design and construction of water line replacement in Innsdale Area in Houston, Texas. Kuo Associates, Inc. retained Geotest Engineering, Inc. as part of the design team to perform geotechnical investigation for the above project.

1.2 Authorization

This study was authorized through "Authorization to Proceed" letter dated January 29, 2015 by accepting Geotest Engineering, Inc. (Geotest) Proposal No. 1140343699 dated October 7, 2014.

1.3 Location and Description of Project

The water line replacement is in Innsdale Area with Key Map page and grids 453 B, C, D, F, G and H in Houston, Texas. The project area is generally bounded by Berry Road to the south, Aldine Westfield Road to the east, Turner Street to the north and Meta Street to the west. The location of the project area is shown on Figure 1, Vicinity Map.

The project calls for the design and construction of water line replacement in Innsdale Area in Houston, Texas. The proposed water line replacement is approximately 27,980 linear feet with new water line size ranging from 4 to 12 inches in diameter. The anticipated maximum depths of new water line ranges from 10 to 20 feet. The proposed water line will generally be installed by pipe augering or trenchless method. The locations of the auger pits are not known at this time. New pavement design will not be required for this project.

1.4 Purpose and Scope

The purposes of this study were to evaluate soil and groundwater conditions and to provide geotechnical recommendations for the design and construction of the proposed water line replacement in Innsdale area. The scope of this investigation consisted of the following:

- Coring the existing concrete pavement at twelve (12) locations to access the subsurface soils below the pavement.
- Drilling and sampling fifty eight (58) borings to depths ranging from 15 feet to 30 feet.
- Converting six (6) borings into piezometers to monitor long term groundwater level.
- Performing appropriate laboratory tests in accordance with ASTM methods on selected samples to develop engineering properties of the soil.
- Reviewing available fault information to evaluate the potential for known active faults that may impact the project.
- Performing engineering analyses in accordance with the City of Houston Design Manual (December 2014) to develop geotechnical recommendations for the design and construction of the proposed water line replacement in Innsdale area.
- Preparing a geotechnical report that will include all field data, laboratory test data and geotechnical recommendations.
- Preparing a separate trench safety report for open excavation for auger pits.

2.0 FIELD INVESTIGATION

2.1 General

After obtaining the utilities clearance of proposed fifty eight (58) marked borings in the field, existing concrete pavement was cored at twelve (12) locations and borings were drilled to the explored depths at all locations including asphalt pavement boring locations. The borings were drilled utilizing a truck mounted drilling rig.

At boring locations GB-3, GB-4, GB-5, GB-16, GB-17, GB-19, GB-22, GB-23, GB-39, GB-42, GB-43, GB-46, GB-50, GB-52, GB-53, GB-54 and GB-56, obstructions were encountered at depths ranging from 2 to 10 feet and offset borings were drilled at these locations. At borings GB-16, GB-22, GB-43, GB-56 obstructions were encountered more than once and final offset borings were drilled to complete the borings to the proposed depths. It should be noted that the general project area is an old neighborhood and several unknown (not shown on the plans provided) underground utilities were located within the streets. The borings were drilled generally 5 to 15 feet from the actual water line location. The obstructions encountered in borings could be due to the existing unknown utilities which were not identified during the field investigation. The contractor should take extra precautions to locate the existing utilities at these locations during construction. Furthermore, loss of circulation was encountered in boring GB-50A at a depth of 7 feet. This could be due to the fact that the boring was drilled in close proximity to the existing storm sewer line.

The boring location is approximately 10 feet from the proposed water line alignment. Traffic control devices and personnel were utilized during coring and drilling to maintain safety of drill crew and people driving in the streets. All the drilling and sampling were performed in accordance with appropriate ASTM procedures.

2.2 Geotechnical Borings

Subsurface conditions were explored by drilling and sampling fifty-eight (58) soil borings (designated as GB-1 through GB-58) to depths ranging from 15 to 30 feet. The approximate boring locations are shown on Figures 2.1 through 2.7, Plan of Borings. Survey information (Northing and

Easting coordinates and ground surface elevation) of completed borings was provided to us by Kuo & Associates, Inc. The survey information of completed borings is summarized in Table 1.

The existing concrete pavement was cored at twelve (12) boring locations to provide access to the subsurface soils in these borings. In general, samples were obtained continuously to the termination depths or 20 feet for deeper borings, and at 5-foot intervals thereafter. Cohesive soils were obtained with a 3-inch thin-walled tube sampler in general accordance with ASTM Method D 1587. Cohesionless soil samples were obtained with a 2-inch split spoon barrel in accordance with ASTM Method D 1586. Each sample was removed from the sampler in the field, carefully examined and then logged by an experienced soils technician. Suitable portions of each sample were sealed and packaged for transportation to Geotest's Laboratory. The shear strength of cohesive soil samples was estimated using a pocket penetrometer in the field. Driving resistances for the split-barrel samples were recorded as "Blows per Foot" on the boring logs. All the borings, except the ones converted to piezometers, were grouted with cement-bentonite grout after completion of drilling and obtaining water level measurements.

Detailed descriptions of the soils encountered in the borings are given on the boring logs presented on Figures A-1 through A-58 in Appendix A. A key to symbols and terms used on boring logs is given on Figure A-59 in Appendix A.

2.3 Piezometer Installation

During the field investigation, a piezometer was installed in the open borehole of borings GB-4A, GB-13, GB-22B, GB-34, GB-51 and GB-57. The location of the piezometers, designated as GB-4AP, GB-13P, GB-22BP, GB-34P, GB-51P and GB-57P, are shown on Figures 2.1 through 2.7, Plan of Borings. The piezometer installation report showing the details of the construction of the piezometers are provided on Figures A-60 through A-65 in Appendix A. The piezometer layout generally (linear/radially in the project area) satisfies the City of Houston Design Standard spacing of 2,500 feet. The piezometer installation reports were submitted to Texas Department of Licensing and Regulations (TDLR).

The piezometers were abandoned in place after taking the final water level measurements. The piezometer abandonment reports are presented in Appendix C.

3.0 LABORATORY TESTING

The laboratory testing program was designed to evaluate the pertinent physical properties and shear strength characteristics of the subsurface soils. Classification tests were performed on selected samples to aid in soil classification. All the tests were performed in accordance with ASTM Standards.

Undrained shear strengths of selected cohesive samples were measured by unconsolidated undrained (UU) triaxial tests (ASTM D 2850). The results of the UU triaxial compression tests are plotted on the boring logs as solid squares. The shear strength of cohesive samples was measured in the field with a calibrated hand pocket penetrometer and also in the laboratory with a Torvane. The shear strength values obtained from the penetrometer and Torvane are plotted on the boring logs as open circles and triangles, respectively.

Measurements of moisture content and dry unit weight were taken for each UU triaxial test sample. Moisture content (ASTM D 2216) measurements were also made on other samples to define the moisture profile at each boring location. The liquid and plastic limit tests (ASTM D 4318), percent passing No. 200 sieves (ASTM D 1140) and sieve analysis (ASTM D422) were performed on appropriate samples.

The result of all tests are tabulated or summarized on the boring logs presented on Figures A-1 through A-58 in Appendix A. The summary of laboratory tests is also presented in a tabular form on Figures B-1 through B-58 in Appendix B. The grain size distribution curves are presented on Figures B-59 through B-62 in Appendix B.

The laboratory Corrosivity tests including pH, Chloride, Sulphate and resistivity tests were performed on selected samples. The test results are presented in Appendix D and also given below.

Boring No.	***Sample No.***	***Depth, ft.***	***pH***	***Resistivity (ohm-c)***	***Chloride (mg/kg)***	***Sulfate (mg/kg)***
GB-1	S#7	10-12	8.38	**1890**	<9.82	<9.82
GB-4A	S#5	8-10	8.69	8200	<9.96	<9.96
GB-6	S#9	14-16	8.51	**1680**	<9.94	<9.94
GB-8	S#6	8-10	8.20	2270	<9.82	12.9
GB-10	S#7	10-12	7.75	**1310**	<10.00	<10.00
GB-14	S#6	8-10	7.49	2500	<9.88	20.8
GB-18	S#6	8-10	8.82	**1440**	<9.96	13.6
GB-23	S#6	8-10	6.93	3530	<9.94	11.2
GB-27	S#6	8-10	8.38	**993**	<9.94	<9.94
GB-33	S#6	10-12	8.68	**746**	<9.92	<9.92
GB-41	S#9	14-16	8.38	**1290**	<9.98	<9.98
GB-44	S#7	10-12	9.01	**1480**	<9.82	10.7
GB-45	S#6	8-10	8.73	**1090**	<9.82	45.9
GB-47	S#6	8-10	8.85	**1810**	<10.0	<10.0
GB-50	S#10	18.5-20	8.90	10700	<10.0	12.8
GB-52A	S#6	8-10	8.56	3530	<10.0	29.1
GB-54A	S#6	8-10	8.36	2680	<9.80	<9.80
GB-55	S#6	8-10	8.10	3200	<9.86	15.7
GB-58	S#5	8-10	7.99	4070	<9.86	20.2

Bold: Bold indicates the soil samples are moderately corrosive to corrosive.

Based on the corrosivity test results, the degree of corrosivity of the subsurface soils are neutral to negligible in terms of pH, negligible to corrosive in terms of soils resistivity, below threshold in terms of chloride concentration and negligible in terms of sulfate concentration. At borings GB-1, GB-6, GB-10, GB-18, GB-27, GB-33, GB-41, GB-44, GB-45, and GB-47, due to moderately corrosive to corrosive nature of the soils in terms of resistivity, protective measures such as cathodical protection or cement coating may be required for ductile iron pipe. The details of the protective measures should be performed by program corrosion specialist.

4.0 SUBSURFACE CONDITIONS

4.1 Geology

The project area lies in the Beaumont Formation. The clays and sands of the Beaumont Formation are over-consolidated as a result of desiccation from frequent rising and lowering of the sea level and the groundwater table. Consequently, clays of this formation have moderate to high shear strength and relatively low compressibility. The sands of the Beaumont Formation are typically very fine and often silty. Further, there is occasional evidence in the Houston area of the occurrence of cemented material (sandstone and siltstone) deposits within the Beaumont Formation.

4.2 General Fault Information

A review of information in the Geotest library, relating to known surface and subsurface geologic faults in the general area of the project alignments, was undertaken. Based on the available information from U.S. Geological Survey (USGS) Maps and in-house records relating to geologic faults for the project area, no known surface faults exist within the project area. The nearest known surface fault is the Eureka Heights Fault and is located approximately 0.5 miles west of the nearest alignment in project area. Based on the location of the surficial fault, a Phase I Geological Fault Study is not recommended for the project.

4.3 Existing Paving

The existing paving as obtained in the soil borings GB-1 through GB-58, predominantly consists of asphalt pavement consisting of 2 to 11 inches of asphalt over 2 to 12 inches of sand, limestone and shell mix. In borings GB-22, GB-31 through GB-37, GB-50 and GB-55, the existing pavement consists of 6 to 9.5 inches of concrete over 3 to 10.0 inches of sand and shell or cement stabilized sand. The boring GB-4A was drilled in the grass area.

The details of the existing pavement thickness at each of the boring locations are summarized below:

Boring Nos.	**Asphalt Thickness (in.)**	**Base Thickness (in.)**	**Concrete Thickness (in.)**	**Subbase Thickness (in.)**	**Total (in.)**
GB-1	5.0	6.0			11.0
GB-2	4.0	11.0			15.0
GB-3	2.5	11.5			14.0
GB-3A	3.0	4.0			7.0
GB-4	3.0	8.0			11.0
GB-5	3.0	8.0			11.0
GB-5A	3.0	3.0			6.0
GB-6	6.0	6.0			12.0
GB-7		6.0			6.0
GB-8 (GB-8P)	4.0	8.0			12.0
GB-9	2.0	4.0			6.0
GB-10	3.0	2.0			5.0
GB-11	3.5	3.0			6.5
GB-12	6.0	4.0			10.0
GB-13 (GB-13P)	7.0	3.0			10.
GB-14	3.0	7.5			10.5
GB-15	4.0	6.0			10.0
GB-16	6.0	4.0			10.0
GB-16A	6.0	4.0			10.0
GB-16B	5.0	7.0			12.0
GB-17	4.0	8.0			12.0
GB-18	6.0	8.0			14.0
GB-19	5.0	10.0			15.0
GB-19A	4.0	8.0			12.0
GB-20	4.0	8.0			12.0
GB-21	6.0	10.0			16.0
GB-22			9.5	10.0	19.5
GB-22A			9.5	5.0	14.5
GB-22B (GB-22BP)			9.0	7.0	16.0
GB-23	6.0	12.0			18.0
GB-24	5.0	8.0			13.0
GB-25	7.0	7.0			14.0
GB-26	6.0	6.0			12.0
GB-27	6.0	5.0			11.0
GB-28	7.0	3.0			10.0
GB-29	5.0	5.0			10.0
GB-30	5.0	5.0			10.0
GB-31			6.75		6.75
GB-32			6.0		6.0

Boring Nos.	Asphalt Thickness (in.)	Base Thickness (in.)	Concrete Thickness (in.)	Subbase Thickness (in.)	Total (in.)
GB-33			7.5		7.5
GB-34 (GB-34P)			6.0	6.0	12.0
GB-35			6.0	4.0	10.0
GB-36			5.5		5.5
GB-37			6.0	2.0	8.0
GB-38	7.0	10.0			17.0
GB-39	4.0	8.0			12.0
GB-39A	3.0	8.0			11.0
GB-40	11.0				11.0
GB-41	7.0	8.0			15.0
GB-42	4.0	12.0			16.0
GB-42A	4.0	12.0			16.0
GB-43	3.0	6.0			9.0
GB-43A	3.0	6.0			9.0
GB-43B	4.0	9.0			13.0
GB-44	2.5	3.0			5.5
GB-45	2.5	6.0			8.5
GB-46	2.5	7.0			9.5
GB-46A	2.5	7.0			9.5
GB-47	8.0	8.0			16.0
GB-48	8.0	10.0			18.0
GB-49	10.0	8.0			18.0
GB-50	10.0	8.0			18.0
GB-50A			9.0		9.0
GB-51 (GB-51P)	6.0	6.0			12.0
GB-52	6.0				6.0
GB-52A	10.0				10.0
GB-53	3.0	6.0			9.0
GB-53A	4.0	8.0			12.0
GB-54	3.0	8.0			11.0
GB-54A	3.0	8.0			11.0
GB-55			8.0		8.0
GB-56	2.5	6.0			8.5
GB-56A					--
GB-56B					--
GB-56C	3.0	4.0			7.0
GB-57 (GB-57P)	2.0	6.5			8.5
GB-58	2.0	7.0			9.0

Note: (1) Borings GB-23 was drilled on the grass area.
(2) The base includes sand and shell and limestone.
(3) Subbase includes cement stabilized sand.

4.4 Soils Stratigraphy

Based on the subsurface soils encountered in the boreholes, nineteen (19) boring log profiles were developed and are presented on Figures 3.1 through 3.19. To the left of each boring shown on the profile is an indication of the consistency of each stratum. More than one consistency for an individual stratum indicates that the consistency is different at different depths within the stratum. For cohesive soils, consistency is related to the undrained shear strength of the soil. For cohesionless soils, the relative density is related to standard penetration resistance of the soil. To the right of each boring shown on the profile is the overall classification of the soil contained within each stratum. The symbols and abbreviations used on the boring log profile are given on Figure 4. The soil classification is based on ASTM Standards.

The subsurface soils beneath pavement as encountered in borings GB-1 through GB-58 and as shown in boring log profiles 3.1 through 3.19 along various streets in the project area are summarized below:

Boring No.	**Location/Street**	**Boring Depth (ft)**	**Soil Description**
GB-1 through GB-4	Meta, Meadow Lea and Madie	15 to 20	The subsurface soil beneath the pavement and existing grade along Meta, Meadow Lea and Madie as obtained in borings GB-1 through GB-4 and shown on the boring log profile presented on Figure 3.1 consists of soft to hard dark gray, yellowish brown, reddish brown and gray Lean Clay with sand, Sandy Lean Clay and Fat Clay to the explored depths of 15 to 20 feet. Fill material consisting of very stiff gray lean clay with asphalt and limestone fragments was encountered between the depths of 0 and 2 feet in boring GB-4A. The Lean Clay with sand and Sandy Lean Clay are of medium to high plasticity with liquid limits ranging from 27 to 44 and plasticity indices ranging from 11 to 27. The percent fines (percent passing No. 200 sieve) of Lean Clay with sand ranges from 73 to 77 percent and the percent fines of Sandy Lean Clay ranges from 68 to 70 percent.

Boring No.	**Location/Street**	**Boring Depth (ft)**	**Soil Description**
GB-5A, GB-6 and GB-7	Bauman	15 to 20	The subsurface soil beneath the pavement along Bauman as obtained in borings GB-5A, GB-6 and GB-7 and shown on the boring log profile presented on Figure 3.2 consists of medium stiff to hard gray, yellowish brown and gray Lean Clay with sand, Sandy Lean Clay and Fat Clay with sand to the explored depths of 15 to 20 feet. The Fat Clay with sand is of high plasticity with a liquid limit of about 57 and a plasticity index of about 40. The Lean Clay with sand and Sandy Lean Clay are of medium to high plasticity with liquid limits ranging from 28 to 46 and plasticity indices ranging from 15 to 31. The percent fines of Fat Clay with sand and Lean Clay with sand ranges from 77 to 78 percent. The percent fines of Sandy Lean Clay is about 69 percent.
GB-8 and GB-9	Burbank	15	The subsurface soil beneath the pavement along Burbank as obtained in borings GB-8 and GB-9 and as shown on the boring log profile presented on Figure 3.3 consists of soft to very stiff, gray and yellowish brown and gray Lean Clay with sand and Fat Clay to the explored depth of 15 feet. The Lean Clay with sand is of medium plasticity with liquid limits ranging from 29 to 37 and plasticity indices ranging from 13 to 18. The percent fines of Lean Clay with sand ranges from 72 to 81 percent.
GB-9 through GB-11	Highlawn	15 to 20	The subsurface soil beneath the pavement along Highlawn Street as obtained in borings GB-9 through GB-11 and as shown on the boring log profile presented on Figure 3.4, consists of soft to hard, gray, brown, yellowish brown and gray Lean Clay with sand and Lean Clay to the explored depths of 15 to 20 feet. The Lean Clay with sand and Lean Clay are of medium to high plasticity with liquid limits ranging from 29 to 44 and plasticity indices ranging from 15 to 27. The percent fines of Lean Clay with sand ranges from 72 to 79 percent. The percent fines of Lean Clay is about 87 percent.

Boring No.	**Location/Street**	**Boring Depth (ft)**	**Soil Description**
GB-10, GB-12 and GB-13	Luther	15	The subsurface soil beneath the pavement along Luther as obtained in borings GB-10, GB-12 and GB-14 and as shown on the boring log profile presented on Figure 3.5 consists of medium stiff to hard, dark gray, yellowish brown and gray Lean Clay with sand and Fat Clay to the explored depth of 15 feet. The Lean Clay with sand is of medium to high plasticity with liquid limits ranging from 30 to 44 and plasticity indices ranging from 14 to 27. The percent fines of Lean Clay with sand ranges from 75 to 79 percent.
GB-14	Wynell Terrace	15	The subsurface soil beneath the pavement along Wynell Terrace as shown on the boring log GB-14, consists of medium stiff to very stiff, gray and reddish brown and yellow Lean Clay with sand to the explored depth of 15 feet. The Lean Clay with sand is of high plasticity with a liquid limit of about 49 and a plasticity index of about 31. The Percent fines of Lean Clay with sand is about 83 percent.
GB-15, GB-16 B & C, GB-17, GB-18, GB-19, GB-20 and GB-21	McGallion	15 to 20	The subsurface soil beneath the pavement along McGallion as obtained in borings GB-15, GB-16 B & C and GB-17 through GB-21 and as shown on the boring log profile presented on Figure 3.6, consists of medium stiff to hard, dark gray and brown, yellowish brown and gray Sandy Lean Clay, Lean Clay with sand, Fat Clay with sand and Fat Clay to the explored depths of 15 to 20 feet. Medium dense to dense gray Fine Sand with silt was encountered between the depths of 8 and 13.5 in boring GB-16C. Fill material consisting of medium stiff to very stiff gray and yellowish brown fat clay with sand and calcareous nodules was encountered to a depth of 8 feet in boring GB-16B. The Fat Clay is of high to very high plasticity with liquid limits ranging from 54 to 84 and plasticity indices ranging from 32 to 54. The Sandy Lean Clay and Lean Clay with sand are of medium to high plasticity with liquid limits ranging from 26 to 47 and plasticity indices ranging from 12 to 30. The percent fines of Fat Clay ranges from 86 to 94 percent and the percent fines of Lean Clay with sand ranges from 73 to 83 percent. The percent fines of Sandy Lean Clay is about 69 percent. The percent fines of Fine Sand with silt is about 9 percent.

Boring No.	**Location/Street**	**Boring Depth (ft)**	**Soil Description**
GB-22BP and GB-23	Turner	20	The subsurface soil beneath the pavement along Turner as obtained in borings GB-22P and GB-23 and as shown on the boring log profile presented on Figure 3.7 consists of medium stiff to very stiff, dark gray, yellowish brown and gray Sandy Lean Clay to depths of 10 to 10.5 feet. The Sandy Lean Clay is underlain by loose to medium dense gray Silty Sand to depths of 18 to 19 feet. The Silty Sand is underlain by very stiff yellowish gray Lean Clay with sand to the explored depth of 20 feet. The Sandy Lean Clay is of high plasticity with liquid limits ranging from 38 to 41 and plasticity indices ranging from 24 to 26. The percent fines of Sandy Lean Clay ranges from 53 to 55 percent. The percent fines of Silty Sand ranges from 12 to 16 percent.
GB-23, GB-24, GB-25 and GB-27	Goldcrest	15 to 20	The subsurface soil beneath the pavement along Goldcrest as obtained in borings GB-23, GB-24, GB-25 and GB-27 and as shown on the boring log profile presented on Figure 3.8 consists of soft to very stiff, brown and yellowish brown and gray Lean Clay, Sandy Lean Clay, Fat Clay with sand and Fat Clay to the explored depths of 15 to 20 feet. Loose to medium dense gray Silty Sand and Fine Sand with silt was encountered between the depths of 8 and 19 feet in borings GB-23 and GB-24. The Fat Clay and Fat Clay with sand are of high plasticity with liquid limits ranging from 52 to 55 and plasticity indices ranging from 31 to 33. The Sandy Lean Clay is of high plasticity with liquid limits ranging from 37 to 41 and plasticity indices ranging from 24 to 26. The percent fines of Fat Clay is about 97 percent. The percent fines of Sandy Lean Clay ranges from 53 to 59 percent. The percent fines of Silty Sand is about 12 percent and percent fines of Fine Sand with silt ranges from 8 to 11 percent.

Boring No.	Location/Street	Depth (ft)	Soil Description
GB-18, GB-26, GB-27, GB-28 and GB-29	Cravens	15	The subsurface soil beneath the pavement along Cravens as obtained in borings GB-18, GB-26, GB-27, GB-28 and GB-29 and as shown on the boring log profile presented on Figure 3.9, consists of soft to very stiff, gray and brown and reddish brown and gray Fat Clay, Fat Clay with sand, Lean Clay with sand and Sandy Lean Clay to the explored depth of 15 feet. Loose brown and gray Silty Sand was encountered between the depths of 10 and 13 feet in boring GB-26. The Fat Clay and Fat Clay with sand are of high to very high plasticity with liquid limits ranging from 52 to 89 and plasticity indices ranging from 31 to 58. The Lean Clay with sand and Sandy Lean Clay are of high plasticity with liquid limits ranging from 42 to 47 and plasticity indices ranging from 25 to 30. The percent fines of Fat Clay ranges from 89 to 97 percent. The percent fines of Lean Clay with sand and Fat Clay with sand ranges from 75 to 77 percent. The percent fines of Sandy Lean clay ranges from 53 to 54 percent. The percent fines of Silty Sand is about 13 percent.
GB-30	Melrose	15	The subsurface soil beneath the pavement along Melrose Street as shown on the boring log GB-30, consists of stiff to very stiff, gray, reddish brown and gray Lean Clay, Lean Clay with sand and Fat Clay to the explored depth of 15 feet. The Lean Clay and Lean Clay with sand are of high plasticity with liquid limits ranging from 39 to 49 and plasticity indices ranging from 22 to 28. The percent fines of Lean Clay is about 86 percent. The percent fines of Lean Clay with sand is about 77 percent.
GB-20, GB-31 and GB-32	Hurley	12	The subsurface soil beneath the pavement along Hurley as obtained in borings GB-20, GB-31 and GB-32 and as shown on the boring log profile presented on Figure 3.10, consists of medium stiff to hard, gray and yellowish brown Lean Clay with sand and Fat Clay to the explored depth of 15 feet. The Lean Clay with sand is of medium to high plasticity with liquid limits ranging from 26 to 48 and plasticity indices ranging from 12 to 30. The Fat Clay is of very high plasticity with liquid limits ranging from 77 to 84 and plasticity indices ranging from 49 to 54. The percent fines of Lean Clay with sand ranges from 74 to 78 percent and the percent fines of Fat Clay ranges from 86 to 96 percent.

Boring No.	**Location/Street**	**Boring Depth (ft)**	**Soil Description**
GB-33, GB-34P and GB-35	Pennington	15 to 20	The subsurface soil beneath the pavement along Pennington as obtained in borings GB-33, GB-34P and GB-35 and as shown on the boring log profile presented on Figure 3.11, consists of soft to very stiff, dark gray and yellowish brown, reddish brown and gray Sandy Lean Clay, Lean Clay with sand and Fat Clay to depths of 15 to 20 feet the explored depth of borings. The Sandy Lean Clay and Lean Clay with sand are of medium to high plasticity with liquid limits ranging from 28 to 46 and the plasticity indices ranging from 14 to 26. The Fat Clay is of very high plasticity with liquid limits ranging from 66 to 71 and plasticity indices ranging from 41 to 45. The percent fines of Lean Clay with sand ranges from 74 to 79 percent. The percent fines of Sandy Lean Clay is about 70 percent and the percent fines of Fat clay ranges from 86 to 97 Percent.
GB-36 and GB-37	Hohl	15	The subsurface soil beneath the pavement along Hohl as obtained in borings GB-36 and GB-37 and as shown on boring log profile presented on Figure 3.12, consists of soft to very stiff gray, dark gray, and reddish brown and gray Lean Clay, Lean Clay with sand and Fat Clay to the explored depth of 15 feet. The Lean Clay with sand is of high plasticity with a liquid limit of about 49 and a plasticity index of about 32. The Fat Clay is of very high plasticity with a liquid limit of about 71 and plasticity index of about 45. The percent fines of Lean Clay with sand is about 78 percent and Fat Clay is about 86 percent.

Boring No.	**Location/Street**	**Boring Depth (ft)**	**Soil Description**
GB-38, GB-39A and GB-40	DeBoll	15	The subsurface soil beneath the pavement along DeBoll as obtained in borings GB-38, GB-39A and GB-40 and as shown on boring log profile presented on Figure 3.13, consists of medium stiff to hard dark gray, yellowish brown and gray Sandy Lean Clay, Lean Clay with sand, Lean Clay, Fat Clay with sand and Fat Clay to the explored depth of 15 feet. Fill material consisting of stiff to very stiff dark gray and brown sandy lean clay and gray silty sand was encountered to depths of 2 to 4 feet in borings GB-39A and GB-40. The Sandy Lean Clay and Lean Clay with sand are of medium to high plasticity with liquid limits ranging from 32 to 42 and plasticity indices ranging from 15 to 22. The Fat Clay with sand is of high plasticity with liquid limits ranging from 50 to 52 and plasticity indices ranging from 29 to 31. The percent fines of Sandy Lean Clay ranges from 67 to 70 percent. The percent fines of Lean Clay with sand and Fat Clay with sand ranges from 75 to 81 percent.
GB-41, GB-42A and GB-43B	Firnat	15 to 20	The subsurface soil beneath the pavement along Firnat as obtained in borings GB-41, GB-42A and GB-43B and as shown on boring log profile presented on Figure 3.14, consists of soft to very stiff dark gray, gray and yellowish brown and gray Sandy Lean Clay, Lean Clay with sand, Fat Clay with sand and Fat Clay to the explored depths of 15 to 20 feet. A layer of gray Clayey Sand was encountered between the depths of 12 and 14 feet in boring GB-43B. Fill material consists of medium stiff to stiff gray lean clay with sand was encountered in boring GB-41 to a depth of 6 feet. The Sandy Lean Clay and Lean Clay with sand are of medium to high plasticity with liquid limits ranging from 29 to 48 and plasticity indices ranging from 13 to 33. The Fat Clay and Fat Clay with sand are of high to very high plasticity with liquid limits ranging from 51 to 69 and plasticity indices ranging from 30 to 43. The percent fines of Sandy Lean Clay is about 63 percent. The percent fines of Lean Clay with sand and Fat Clay with sand ranges from 74 to 82 percent. The percent fines of Fat Clay is about 98 percent. The percent fines of Clayey Sand is about 44 percent.

Boring No.	**Location/Street**	**Boring Depth (ft)**	**Soil Description**
GB-44	Warner	15	The subsurface soil beneath the pavement along Warner as shown on boring log GB-44, consists of medium stiff to very stiff dark gray, yellowish brown and gray Lean Clay with sand to the explored depth of 15 feet. The Lean Clay with sand is of high plasticity with liquid limits ranging from 38 to 47 and plasticity indices ranging from 22 to 31. The percent fines of Lean Clay with sand ranges from 78 to 79 percent.
GB-45	Doverside	15	The subsurface soil beneath the pavement along Doverside Street as shown on boring log GB-45, consists of fill material consisting of medium stiff to stiff dark gray and brown and yellowish brown and gray Lean Clay with sand to a depth of 8 feet. The fill material is underlain by stiff to very stiff reddish brown and gray Lean Clay with sand and Fat Clay to the explored depth of 15 feet. The Lean Clay with sand is of high plasticity with a liquid limit of about 47 and plasticity index of about 32. The Fat Clay is of high plasticity with a liquid limit of about 54 and a plasticity index of about 32. The percent fines of Lean Clay with sand is about 73 percent and the percent fines of Fat Clay is about 99 percent.
GB-46A and GB-47	Helmers	15 to 20	The subsurface soil beneath the pavement along Helmers as obtained in borings GB-46A and GB-47 and as shown on boring log profile presented on Figure 3.15, consists of medium stiff to very stiff dark gray, gray, reddish brown and yellowish brown and gray Lean Clay with sand, Lean Clay and Fat Clay to the explored depths of 15 to 20 feet. Fill material consisting of medium stiff to stiff dark gray lean clay with sand and calcareous nodules was encountered to a depth of 4 feet in boring GB-46A. The Lean Clay and Lean Clay with sand are of medium to high plasticity with liquid limits ranging from 32 to 46 and plasticity indices ranging from 12 to 29. The percent fines of Lean Clay ranges from 86 to 98 percent. The percent fines of Lean Clay with sand ranges from 71 to 77 percent.

Boring No.	**Location/Street**	**Depth (ft)**	**Soil Description**
GB-47, GB-48, GB-49, GB-50A, GB-51 and GB-52	Duff	15 to 30	The subsurface soil beneath the pavement along Duff Lane as obtained in borings GB-47 through GB-52 and as shown on boring log profile presented on Figure 3.16, consists of soft to hard dark gray, gray, reddish brown and yellowish brown and gray Lean Clay, Lean Clay with sand and Fat Clay to the explored depths of 15 to 30 feet. Layers of loose to medium dense gray, brown and reddish brown Silty Sand was encountered between the depths of 0 to 2 feet and 12 to 20 feet in borings GB-50A, GB-51 and GB-52A. Fill material consisting of soft to very stiff gray and yellowish brown sandy lean clay with calcareous and ferrous nodules was encountered to a depth of 12 feet in boring GB-50A and GB-52A. The Lean Clay, Lean Clay with sand and sandy lean clay fill are of low to high plasticity with liquid limits ranging from 28 to 48 and plasticity indices ranging from 8 to 31. The percent fines of Lean Clay is about 98 percent. The percent fines of Lean Clay with sand ranges from 71 to 82 percent. The percent fines of sandy lean clay fill ranges from 53 to 58 percent. The percent fines of silty sand ranges from 12 to 41 percent.
GB-53A and GB-54A	Hendricks	15 to 20	The subsurface soil beneath the pavement along Hendricks as obtained in borings GB-53A and GB-54A and as shown on boring log profile presented on Figure 3.17, consists of medium stiff to very stiff dark gray, yellowish brown and gray Sandy Lean Clay and Fat Clay to the depth of 10 to 14 feet. Very loose to medium dense gray, brown Silty Sand was encountered between the depths of 10 to 12 feet, 14 to 15 feet in boring GB-54A and 12 to 20 feet in boring GB-53A. The Sandy Lean Clay is of medium to high plasticity with liquid limits ranging from 30 to 34 and plasticity indices ranging from 14 to 21. The percent fines of Sandy Lean Clay is about 50 percent. The percent fines of Silty Sand ranges from 21 to 25 percent.

Boring No.	**Location/Street**	**Depth (ft)**	**Soil Description**
GB-55 and GB-56C	Hector	15 to 20	The subsurface soil beneath the pavement along Hector as obtained in borings GB-55 and GB-56C and as shown on boring log profile presented on Figure 3.18, consists of medium stiff to very stiff dark gray, yellowish brown and gray Sandy Lean Clay to a depth of 10 feet. The Sandy Lean Clay soils are underlain by loose to medium dense gray Silty Sand to the explored depths of 15 to 20 feet. The Sandy Lean Clay is of medium to high plasticity with a liquid limit of about 36 and plasticity indices ranging from 18 to 21. The percent fines of Sandy Lean Clay ranges from 51 to 54 percent. The percent fines of Silty Sand ranges from 15 to 18 percent.
GB-56C, GB-57 and GB-58	Exeter	15	The subsurface soil beneath the pavement along Exeter as obtained in boring GB-56C, GB-57 and GB-58 and as shown on boring log profile presented on Figure 3.19, consists of soft to very stiff dark gray, yellowish brown and gray Sandy Lean Clay and Fat Clay to the explored depth of 15 feet. Layers of loose to medium dense gray Silty Sand and brown and gray Clayey Sand was encountered between the depths of 0 to 4 feet and 10 to 15 feet in borings GB-56C and GB-58 The Sandy Lean Clay is of medium to high plasticity with liquid limits ranging from 34 to 37 and plasticity indices ranging from 18 to 20. The Fat Clay is of very high plasticity with a liquid limit of about 67 and a plasticity index of about 42. The percent fines of Sandy Lean Clay ranges from 54 to 65 percent. The percent fines of Fat Clay is about 99 percent. The percent fines of Silty Sand and Clayey Sand ranges from 15 to 46 percent.

4.5 Range of Weak Soils Encountered in Borings

The range of soft cohesive soils and loose cohesionless soils as encountered in the borings are given below:

Boring No.	Location/Street	Range of Depth of Weak Soils Encountered, ft.		Soil Type
		From	To	
GB-4A	Madie	6	8	Soft to medium stiff Lean Clay with sand
GB-9	Burbank	0	2	Soft to medium stiff Lean Clay with sand
GB-11	Highlawn	2	4	Fill: silty sand
GB-23	Turner	10	12	Loose Silty Sand
		14	19	
GB-24	Goldcrest	8	10	Loose Silty Sand
		12	13.5	
GB-26	Cravens	6	10	Soft to medium stiff Sandy Lean Clay
		10	12	Loose Silty Sand
GB-27	Cravens	4	6	Soft to medium stiff Lean Clay
GB-33	Pennington	12	14	Soft to medium stiff Lean Clay with sand
GB-37	Hohl	2	4	Soft to medium stiff Lean Clay
GB-43B	Firnat	14	16	Soft to stiff Sandy Lean Clay
GB-50A	Duff	2	12	Fill: Soft to medium stiff sandy lean clay
		18.5	20	Loose Silty Sand
GB-52A	Duff		10	Fill: Soft to medium stiff sandy lean clay
GB-54A	Hendricks	10	12	Very loose Silty Sand
GB-56C	Hector	10	12	Loose Silty Sand
GB-58	Exeter	4	6	Soft to medium stiff Sandy Lean Clay

Thus extra precautions (such as use of temporary sheeting, qualified personnel onsite to confirm the soft soils are fully penetrated or over excavated to firm soil and properly backfilled) should be carried out by using appropriate construction equipment and methods to protect ground during the installation of water line through the weak soil areas.

4.6 Water Levels

Groundwater was encountered in borings GB-2, GB-11, GB-16C, GB-20, GB-22BP, GB-23, GB-24, GB-26, GB-27, GB-31, GB-32M GB-33, GB-35, GB-37, GB-39A, GB-43B, GB-44, GB-45, GB-47, GB-52A, GB-53A, GB-54A, GB-55, GB-55, GB-57P and GB-58 at depths ranging from 6 to 18 feet during drilling. The groundwater level measured at 20 to 25 minutes after water was first encountered is at depths ranging from3.5 to 13.5 feet in these borings. The water level as encountered in borings is summarized below.

Boring No.	**Groundwater Depth First Encountered (ft)**	**Groundwater Depth Measured 20 to 25 Min After Water Was First Encountered (ft)**	**Groundwater Depth After 24 Hours (ft)**	**Groundwater Depth After 30 Days (ft)**
GB-2	15.0	11.8	--	--
GB-4A (GB-4AP)	Dry	Dry	6.0 (3-1-15)	5.0 (4-3-15)
GB-11	18.0	6.7	--	--
GB-13 (GB-13P)	Dry	Dry	8.2 (3-1-15)	9.2 (4-3-15)
GB-16C	12.0	9.2	--	--
GB-20	15.0	11.0	--	--
GB-22B (GB-22BP)	12.5	--	7.5 (3-1-15)	5.3 (4-3-15)
GB-23	16	10.3	--	--
GB-24	15	6.7	--	--
GB-25	14	11.5	--	--
GB-26	13	6.0	--	--
GB-27	15	9.9	--	--
GB-31	15	9.6	--	--
GB-32	13	8.8	--	--
GB-33	16	10	--	--
GB-34 (GB-34P)	Dry	Dry	1.8 (3-1-15)	3.3 (4-3-15)
GB-35	15	9.8	--	--
GB-37	15	9.6	--	--
GB-39A	14	13	--	--

Boring No.	**Groundwater Depth First Encountered (ft)**	**Groundwater Depth Measured 20 to 25 Min After Water Was First Encountered (ft)**	**Groundwater Depth After 24 Hours (ft)**	**Groundwater Depth After 30 Days (ft)**
GB-43B	14	11	--	--
GB-44	14	13	--	--
GB-45	14	13	--	--
GB-47	16	13.5	--	--
GB-51 (GB-51P)	Dry	Dry	9.6 (3-1-15)	9.4 (4-3-15)
GB-52A	12	7	--	--
GB-53A	14	7.5	--	--
GB-54A	8	3.5	--	--
GB-55	12	6.5	--	--
GB-57 (GB-57P)	10	5	1.2 (3-1-15)	3.2 (4-3-15)
GB-58	6	6	--	--

However, it should be noted that various environmental and man-made factors such as amount of precipitation, nearby subsurface construction activities, and change in area drainage can substantially influence the groundwater level.

4.7 Environmental Concerns

No environmental concerns were observed or noticed in any of the borings (GB-1 through GB-58) drilled for this study.

5.0 ENGINEERING ANALYSES AND RECOMMENDATIONS

5.1 General

The project calls for the design and construction of water line replacement in Innsdale Area in Houston, Texas. The proposed water line replacement is approximately 27,980 linear feet with new water line sizes ranging from 4 to 12 inches in diameter. The anticipated maximum depth of new water line ranges from 10 to 20 feet. The proposed water line will generally be installed by pipe augering or trenchless method. The locations of the auger pits are not known at this time. New pavement design will not be required for this project.

5.2 Trench Excavation (Auger Pits)

Based on the information provided by Kuo & Associates, Inc., it is understood that the water line replacement will be by trenchless method of construction. The following subsections provide information for the design and construction of the water lines and the excavations required for the proposed auger pits installation.

5.2.1 Geotechnical Parameters. Based on the soil conditions revealed by the borings GB-1 through GB-58, geotechnical parameters were developed for the design of auger pits construction as part of the water line replacement. The design parameters are provided in Table 2. For design, the groundwater level should be assumed to exist at the ground surface.

5.2.2 Excavation Stability (Auger Pits). The open excavation may be shored or laid back to a stable slope or supported by some other equivalent means used to provide safety for workers and adjacent structures, if any. The excavating operations should be in accordance with OSHA Standards, OSHA 2207, Subpart P, latest revision and the City of Houston Standard Specification.

- Excavation Shallower Than 5 Feet - Excavations that are less than 5 feet deep **(critical height)** should be effectively protected when an indication of dangerous ground movement is anticipated.

- Excavations Deeper Than 5 Feet - Excavations that are deeper than 5 feet should be sloped, shored, sheeted, braced or laid back to a stable slope or supported by some other equivalent means or protection such that workers are not exposed to moving ground or cave-ins. The slopes and shoring should be in accordance with the trench safety requirements as per OSHA Standards. The following items provide design criteria for excavation stability.

  (i) OSHA Soil Type. Based on the soil conditions revealed by borings drilled for this study and assumed groundwater level at surface, OSHA soil type "C" should be used for determination of allowable maximum slope and/or the design of shoring along the alignment for full proposed depth of open excavation. For shoring deeper than 20 feet (if needed), an engineering evaluation is required and deeper soil borings will be needed.

  (ii) Excavation Support Earth Pressure. Based on the subsurface conditions indicated by our field investigation and laboratory testing results, excavation support earth pressure diagrams were developed and are presented on Figures 5.1 through 5.3. These pressure diagrams can be used for the design of temporary trench bracing. For a trench box, a lateral earth pressure resulting from an equivalent fluid with a unit weight of 94 pcf can be used. The effects of any surcharge loads at the ground surface should be added to the computed lateral earth pressures. A surcharge load, q, will typically result in a lateral load equal to 0.5 q. The above value of equivalent fluid pressure is based on assumption that the groundwater level is near the ground surface, since these conditions may exist after a heavy rain or flooding.

  (iii) Bottom Stability. In braced cuts, if tight sheeting is terminated at the base of the cut, the bottom of the excavation can become unstable. The parameters that govern the stability of the excavation base are the soil shear strength and the differential hydrostatic head between the groundwater level within the retained soils and the groundwater level at the interior of the trench excavation. For cut in cohesive soils as predominantly encountered for the proposed excavation depths in most of the

borings, the bottom stability can be evaluated as outlined on Figure 6. However, at locations near borings GB-16C, GB-22B, GB-23, GB-24, GB-26, GB-50A, GB-52A, GB-53A, GB-54A, GB-55, GB-56C and GB-58 where cohesionless soils (such as silty sand, clayey sand and fine sand with silt) were encountered between depths of 0 and 23 feet (at invert or within 3 feet of bottom of excavation), dewatering will be necessary to avoid bottom stability problems, if excavation are planned during or after a heavy rainfall season.

5.2.3 Groundwater Control. Excavations for the water line may encounter groundwater seepage to varying degrees depending upon the groundwater conditions at the time of construction and the location and depth of the trench.

In general, for cohesive soils as predominantly encountered for most of the borings for the excavation depths, the groundwater if encountered may be managed by collection in excavation bottom sumps for pumped disposal. However, in borings GB-16C, GB-22B, GB-23, GB-24, GB-26, GB-50A, GB-52A, GB-53A, GB-54A, GB-55, GB-56C and GB-58 where cohesionless soils were encountered at invert or within 3 feet of bottom of the excavation; dewatering will be required, if the excavation is planned during or after a heavy rainfall event. Dewatering such as vacuum well points up to 15 feet or deep wells with submersible pumps for excavation greater than 15 feet may be required to lower the groundwater level to at least 5 feet below the bottom of the excavation (auger pits). It is recommended that the actual groundwater conditions should be verified by the contractor at the time of construction and that groundwater control should be performed in general accordance with the City of Houston Standard Specifications, Section 01578.

The range of cohesionless soils as encountered in the borings are given below:

Boring No.	**Location/Street**	**Range of Depth of Cohesionless Soils Encountered, ft.**		**Soil Type**
		From	**To**	
GB-16C	McGallion	8	13.5	Fine Sand with silt
GB-22B	Turner	10.5	18	Silty Sand
GB-23	Goldcrest	10	19	Silty Sand

Boring No.	Location/Street	Range of Depth of Cohesionless Soils Encountered, ft.		Soil Type
		From	To	
GB-24	Goldcrest	8	13.5	Fine Sand with silt
GB-26	Cravens	10	13	Silty Sand
GB-43B	Firnat	12	14	Clayey Sand
GB-50A	Duff	12	23	Silty Sand
GB-51		0	2	Silty Sand
GB-52A		12	15	Silty Sand
GB-53A	Hendricks	12	20	Silty Sand
GB-54A		10	12	Silty Sand
GB-55	Hector	10	20	Silty Sand
GB-56C		10	15	Silty Sand
GB-58	Exeter	0	4	Silty Sand
		10	12	Clayey Sand

5.2.4 Auger Pit Backfill. The excavated auger pits should be backfilled per the City of Houston Standard Specification Section 02447, Subsection 3.04 and Drawing No. 02447-01.

5.3 Trenchless Installation - Pipe and Auger Casing

It is understood that the proposed water lines will be installed using trenchless method. The trenchless method is predominantly by pipe and auger casing.

5.3.1 Geotechnical Parameters for Pipe and Auger Casing. Based on the soil conditions revealed by borings GB-1 through GB-58 and laboratory test data, geotechnical design parameters were developed for cohesive soils and cohesionless soils for Pipe and Auger Casing installation and are provided in Tables 3.1 through 3.5. For design conditions, the groundwater levels should be assumed to exist at the ground surface.

5.3.2 Earth Pressure on Auger Casing. The earth pressures on the auger casing should be determined from Figure 7. Equations to calculate the tunnel liner loads are also shown in Figure 7. For crossing under the major roads, the stress due to traffic loads should be considered.

5.3.3 Live Loads on Pipeline Due to Traffic. Loads on the pipe due to traffic should be considered. A graph providing calculated vertical stress on pipe due to traffic loads is given on Figure 8.

5.3.4 Carrier Pipe Design Parameters. Carrier pipe must be sufficiently strong to withstand anticipated long-term ground loads and must not be subject to deterioration by substance either in the ground or in the auger casing. The carrier pipe design should include consideration of not only the loads applied to the pipe but also factors other than soil loading. These factors could include minimum structural code requirements, loading from pipe jacking operations and other construction loads. The drained geotechnical design parameters given in Tables 3.1 through 3.5 should be used in analyzing the soil structure interaction of the carrier pipe.

5.4 Piping System Thrust Restraint

Unbalanced thrust forces will occur at any point in the pipe where the direction or cross sectional area of the flow changes. The force diagram shown in Figure 9 illustrates the thrust force generated by flow at a bend in the pipe. The equations for computing this thrust force are also given in this figure. The thrust force will often require more resistance or support than is available just from the pipe bearing against the backfill. In order to prevent intolerable movement and overstressing of the pipe, suitable buttressing should be provided.

Based on the drawings provided to us, it was noted that several horizontal bends are proposed which may require restraint in addition to that supplied by the pipe bearing on the backfill. In general, thrust blocks, both horizontal and vertical and restrained joints are common methods of supplying additional reaction. However, it is noted that restrained joints are considered for supplying additional reaction for the project and is discussed below.

5.4.1 Restrained Joints. Where thrust blocks are not practical, restrained joints, allowing thrust and shear forces to be transmitted across the pipe joints, are employed to allow a number of pipe sections to act integrally in bearing. The equations necessary to determine the restrained pipe length on each side of the bend are given below:

$$L = \frac{PA\ (1 - Cos\theta)}{\mu(W_e + W_p + W_w)}$$

where, L = restrained pipe length on each side of the bend, in feet

P = internal pressure, in pounds per square inch

A = cross sectional area of first unrestrained pipe joint, in square inches

θ = deflection angle of bend, in degrees

μ = co-efficient of friction between pipe and soil (recommended 0.3)

W_e = overburden load, in pounds per liner foot = $\Upsilon_b B_c H$

W_p = weight of pipe, in pounds per linear foot

W_w = weight of water in pipe, in pounds per linear foot

Υ_b = wet unit weight of backfill material, in pounds per cubic foot (recommended 120 pcf)

B_c = pipe outer diameter, in feet

H = earth cover, in feet

Reinforced concrete encasement may be used in lieu of the manufactured joint restrained system. The equations and soil parameters given above can be used for the design of reinforced concrete encasement.

5.5 Influence of Trenchless Operation on Adjacent Structures

Surface and near-surface structures near the pipe and casing augering primarily consist of residential buildings, city streets and public utilities.

Ground movement, in terms of loss of ground or ground lost, is commonly associated with soft ground augering. If such ground movement is excessive, it may cause damage to the structures, roads and services located above the auger casing. While ground movement cannot be eliminated, it can be controlled within certain limits by the use of proper construction techniques and good quality workmanship. These include, but are not limited to, prevention of excessive ground loss during trenchless operation with the use of grouting and filling the annular space between the pipe or casing and the surrounding soil and prevention of undue loss of fines through dewatering.

The selection and execution of trenchless methods that are best suited to anticipated ground conditions along the proposed auger casing are, in fact, the contractor's primary contribution to successful completion of the proposed auger casing. Review of the boring logs revealed that the ground conditions for augering (excavation face) will be primarily through Sandy Lean Clay, Lean Clay with sand, Lean Clay, Fat Clay and Fat Clay with sand. The cohesive soils within the natural soils are soft to very stiff in consistency and the ground in this area may be expected to behave as squeezing to raveling ground near the invert. The existing natural soils consisting of Silty Sand was encountered near the proposed invert depths of trenchless installation in borings GB-16C, GB-22B, GB-23, GB-24, GB-26, GB-50A, GB-52A, GB-53A, GB-54A, GB-55, GB-56 and GB-58. The cohesionless soils (silty sand, clayey sand and fine sand with silt) within the natural soils are loose to medium dense and the ground at these locations may be expected to behave raveling to running ground near the invert depths. In addition to the cohesionless soils, fill material consisting of soft to very stiff dark gray, brown and gray lean clay with sand and gray silty sand was encountered between the depths of 0 to 12 feet in borings GB-11, GB-16B, GB-39A, GB-40, GB-41, GB-42, GB-45, GB-46, GB-46A, GB-50, GB-50A, GB-52A and GB-54. Hence, extra precautions will be required at these locations during the trenchless installation to prevent any excessive ground loss due to the disturbance and removal of the cohesionless soils. Close monitoring of ground movement should be carried out during the trenchless installation.

The extra precautions may include:

- Shorten duration between auger excavation and pushing of casing/pipe as minimum as possible.
- Alternatively use steel pipe in these areas.
- If any excessive ground loss is observed during closed monitoring, grouting will be required to fill any voids.

At locations near borings GB-16C, GB-22B, GB-23, GB-24, GB-26, GB-50A, GB-53A, GB-55, GB-56 and GB-58, the ground conditions for trenchless operation (excavation face) will be through cohesive soil interface with cohesionless soils or in cohesionless soils. In such conditions, dewatering will be necessary.

The proposed auger casing is parallel with or crosses beneath a number of water, gas, power, telephone and storm and sanitary sewer lines. The largest potential problems from utilities may result from:

- Leaking water pipes
- Gas pipe breakage leading to a potential explosion
- Breakage of storm or sanitary sewers

In general, it is the contractor's responsibility to investigate these and other possible third party interactions along the proposed water line alignment and to accommodate all of these interactions with the use of good construction methods.

5.6 Pavement Repair and Subgrade Stabilization

The pavement repair at the auger pit locations and other locations, where required, should be performed in accordance with City of Houston Standard Specification No. 02951 "Pavement Repair and Restoration" and City of Houston Standard Drawing Nos. 02951-01, 02 and 03.

The subgrade stabilization for the pavement repair should be performed as described below.

Based on the field and laboratory test data, the surficial subgrade soils in the project area consists of cohesive soils (sandy lean clay and lean clay with sand) with medium to high plasticity. These high plasticity cohesive soils should be stabilized with a minimum of 5% hydrated lime (by dry unit weight) to a depth of minimum 6-inches.

The lime stabilization of clay subgrade should be performed in accordance with City of Houston Standard Specification No. 02336 "Lime Stabilized Subgrade."

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Auger Pit Excavation and Water Line Construction

Whenever practical, excavations should be performed during dry weather. All excavated areas (auger pits) should be adequately protected from surface run-off water with appropriate measures to prevent ponding of water in and around the excavation. Excavations should be properly sloped, shored, braced, or protected in accordance with OSHA's excavation safety standard, 29CFR Part 1926, Subpart P (Excavations and Trenches) Standards.

The selection and execution of augering methods that are best suited to anticipate ground conditions along the proposed auger casing and directional drilling should be contractor's primary responsibility for successful completion of proposed augering. The anticipated ground conditions for augering (excavation force) are discussed in Section 5.5.

6.2 Groundwater Control

Excavations for the water line may encounter groundwater seepage to varying degrees depending upon the groundwater conditions at the time of construction and the location and depth of the trench.

In general, for cohesive soils as predominantly encountered for most of the borings for the excavation depths, the groundwater if encountered may be managed by collection in excavation bottom sumps for pumped disposal. However, in borings GB-16C, GB-22B, GB-23, GB-24, GB-26, GB-50A, GB-52A, GB-53A, GB-54A, GB-55, GB-56C and GB-58 where cohesionless soils were encountered at invert or within 3 feet of bottom of the excavation; dewatering will be required, if the excavation is planned during or after a heavy rainfall event. Dewatering such as vacuum well points up to 15 feet or deep wells with submersible pumps for excavation greater than 15 feet may be required to lower the groundwater level to at least 5 feet below the bottom of the excavation (auger pits). It is recommended that the actual groundwater conditions should be verified by the contractor at the time of construction and that groundwater control should be performed in general accordance with the City of Houston Standard Specifications, Section 01578.

The range of cohesionless soils as encountered in the borings is given below:

Boring No.	**Location/Street**	**Range of Depth of Cohesionless Soils Encountered, ft.**		**Soil Type**
		From	**To**	
GB-16C	McGallion	8	13.5	Fine Sand with silt
GB-22B	Turner	10.5	18	Silty Sand
GB-23	Goldcrest	10	19	Silty Sand
GB-24	Goldcrest	8	13.5	Fine Sand with silt
GB-26	Cravens	10	13	Silty Sand
GB-43B	Firnat	12	14	Clayey Sand
GB-50A	Duff	12	23	Silty Sand
GB-51		0	2	Silty Sand
GB-52A		12	15	Silty Sand
GB-53A	Hendricks	12	20	Silty Sand
GB-54A		10	12	Silty Sand
GB-55	Hector	10	20	Silty Sand
GB-56C		10	15	Silty Sand
GB-58	Exeter	0	4	Silty Sand
		10	12	Clayey Sand

7.0 LIMITATIONS

The description of subsurface conditions and the design information contained in this report are based on the soil borings made at the time of drilling at specific locations. However, some variation in soil conditions may occur between soil borings. Should any subsurface conditions other than those described in our boring logs be encountered, Geotest should be immediately notified so that further investigation and supplemental recommendations can be provided. The depth of the groundwater level may vary with changes in environmental conditions such as frequency and magnitude of rainfall. The stratification lines on the log of borings represent the approximate boundaries between soil types, however, the transition between soil types may be more gradual than depicted.

This report has been prepared for the exclusive use of City of Houston and Kuo & Associates, Inc. for the Water Line Replacement in Innsdale Area in Houston, Texas. This report shall not be reproduced without the written permission of Geotest Engineering, Inc., The City of Houston or Kuo & Associates, Inc.

TABLES

Table

Summary of Boring Information 1

Geotechnical Design Parameter Summary – Open Cut Excavation (Auger Pits) 2

Geotechnical Design Parameter Summary – Trenchless Installation

(Pipe and Auger Casing) ..... 3.1 thru 3.5

TABLE 1

SUMMARY OF BORING INFORMATION

Boring No.	Depth (feet)	Street	Northing	Easting	Elevation (feet)
GB-1	20	Meta	13871477.35	3116051.25	64.94
GB-2	15	Meadow Lea	13871195.50	3116368.36	64.09
GB-3A	15	Meadow Lea	13871222.08	3116863.47	63.35
GB-4A (GB-4AP)	20	Madie	13871438.38	3117180.59	62.28
GB-5A	15	Bauman	13875671.92	3118857.22	67.28
GB-6	20	Bauman	13875184.96	3118880.16	66.90
GB-7	20	Bauman	13874754.18	3118891.94	65.56
GB-8	15	Burbank	13875359.50	3118618.75	67.63
GB-9	15	Burbank	13875343.40	3118181.63	68.07
GB-10	15	Luther	13874974.57	3118094.74	67.39
GB-11	20	Highlawn	13874692.04	3118081.77	64.97
GB-12	15	Luther	13874955.07	3117600.94	67.61
GB-13 (GB-13P)	15	Luther	13874949.88	3118410.01	67.66
GB-14	15	Wynell	13874306.59	3118976.02	66.52
GB-15	20	McGallion	13876875.36	3120061.26	70.25
GB-16C	15	McGallion	13876433.51	3120090.77	69.55
GB-17	15	McGallion	13875934.60	3119962.99	69.52
GB-18	15	McGallion	13875487.46	3119964.61	68.86
GB-19A	20	McGallion	13875033.41	3119980.65	68.07
GB-20	15	McGallion	13874478.08	3120011.93	68.02
GB-21	15	McGallion	13874085.67	3120029.27	67.83
GB-22B (GB-22BP)	20	Turner	13877030.47	3121869.68	66.83
GB-23	20	Goldcrest	13876956.01	3121291.61	68.64
GB-24	15	Goldcrest	13876539.37	3121311.63	67.86
GB-25	15	Goldcrest	13876028.38	3121334.36	67.72
GB-26	15	Cravens	13875561.68	3121753.37	66.45
GB-27	15	Cravens	13875551.52	3121395.67	68.81

TABLE 1 (cont'd)
SUMMARY OF BORING INFORMATION

Boring No.	Depth (feet)	Street	Northing	Easting	Elevation (feet)
GB-28	15	Cravens	13875532.23	3120967.19	68.86
GB-29	15	Cravens	13875508.50	3120421.53	68.87
GB-30	15	Melrose	13874414.38	3120311.89	67.90
GB-31	15	Hurley	13874526.94	3120715.58	67.95
GB-32	15	Hurley	13874540.40	3121232.99	69.66
GB-33	20	Pennington	13874294.89	3121465.05	67.73
GB-34 (GB-34P)	15	Pennington	13874274.72	3121069.59	67.75
GB-35	15	Helmers	13874156.12	3120618.79	67.71
GB-36	15	Hohl	13873994.55	3120985.79	67.82
GB-37	15	Hohl	13874010.41	3121389.24	67.81
GB-38	15	DeBoll	13873630.34	3120550.36	67.86
GB-39A	15	DeBoll	13873659.46	3120996.08	67.90
GB-40	15	DeBoll	13873666.37	3121542.53	68.19
GB-41	20	Firnat	13873288.95	3122099.56	67.31
GB-42A	15	Firnat	13873303.21	3122486.42	67.53
GB-43B	20	Firnat	13873330.78	3122892.52	67.39
GB-44	15	Warner	13872940.09	3120874.06	67.84
GB-45	15	Doverside	13872595.60	3120841.37	67.89
GB-46A	15	Helmers	13871857.10	3120843.08	67.39
GB-47	20	Duff	13872225.34	3120817.83	68.05
GB-48	15	Duff	1387244.07	3121330.00	67.88
GB-49	15	Duff	13872263.13	3121846.58	68.14
GB-50A	30	Duff	13872285.67	3122308.10	65.92
GB-51 (GB-51P)	15	Duff	13872294.59	3122774.79	67.14
GB-52A	15	Duff	13872320.44	3123336.35	66.37
GB-53A	20	Hendricks	13872598.47	3123837.66	65.85

TABLE 1 (cont'd)
SUMMARY OF BORING INFORMATION

Boring No.	Depth (feet)	Street	Northing	Easting	Elevation (feet)
GB-54A	15	Hendricks	13872622.31	3124320.74	65.73
GB-55	20	Hector	13874205.13	3123384.60	66.20
GB-56C	15	Exeter	13874183.29	3123803.34	66.69
GB-57 (GB-57P)	15	Exeter	13874634.66	3123779.99	65.74
GB-58	15	Exeter	13875151.72	3123756.45	63.81

Note: Survey information was provided by Kuo & Associates, Inc.

TABLE 2

GEOTECHNICAL DESIGN PARAMETER SUMMARY
OPEN-CUT EXCAVATION (AUGER PITS)

Alignments	Boring Nos.	Stratigraphic Unit	Range of Depths, ft	Wet Unit Weight, γ, pcf	Submerged Unit Weight, γ', pcf	Undrained Cohesion, psf	Internal Friction Angle, φ, degree
8" Water Line along Meta, Meadow Lea and Madie	GB-1 thru GB-4A	Cohesive	0-4 4-12 12-14 14-16 16-20	125 130 130 128 125	63 65 65 64 63	800 500 1,000 400 1,500	-- -- -- -- --
12" Water Line along Bauman	GB-5A, GB-6 and GB-7	Cohesive	0-4 4-15 15-20 (GB-6 & GB-7 only)	125 128 124	63 64 62	800 900 1,000	-- -- --
8" Water Line along Burbank	GB-8 and GB-9	Cohesive	0-4 4-12 12-15	125 128 125	63 64 63	600 1,000 1,500	-- -- --
8" Water Line along Highlawn	GB-10 and GB-11	Cohesive	0-4 4-10 10-20 (GB-11 only)	125 130 128	63 65 64	800 1,500 1,400	-- -- --
8" Water Line along Luther	GB-12 and GB-13	Cohesive	0-8 8-10 10-12 12-15	125 132 128 124	63 66 64 62	800 1,000 500 2,000	-- -- -- --
8" Water Line along Wynell Terrace	GB-14	Cohesive	0-4 4-6 6-15	125 128 130	63 64 65	1,000 1,500 2,100	-- -- --
8" Water Line along McGallion	GB-15, GB-17, GB-18, GB-19A, GB-20 and GB-21	Cohesive	0-6 6-14 14-20 (GB-15 & GB-19A only)	115 122 118	58 61 59	800 1,000 2,000	-- -- --
	GB-16B and GB-16C	Cohesive Cohesionless Cohesive	0-8 8-13.5 13.5-15	125 116 125	63 58 63	600 -- 1,000	-- 30 --
8" Water Line along Turner	GB-22B and GB-23	Cohesive Cohesionless Cohesive	0-10 10-18 18-20	128 105 125	64 53 63	1,000 -- 1,000	-- 30 --
8" Water Line along Goldcrest	GB-24	Cohesive Cohesionless Cohesive	0-8 8-13.5 13.5-15	135 115 125	68 56 63	1,200 -- 1,000	-- 25 --
	GB-25 and GB-27	Cohesive	0-4 4-6 6-10 10-12 12-15	120 125 127 127 125	60 63 64 64 63	1,000 400 1,200 500 1,400	-- -- -- -- --

TABLE 2 (cont'd)

GEOTECHNICAL DESIGN PARAMETER SUMMARY
OPEN-CUT EXCAVATION (AUGER PITS)

Alignments	Boring Nos.	Stratigraphic Unit	Range of Depths, ft	Wet Unit Weight, γ, Pcf	Submerged Unit Weight, γ', pcf	Undrained Cohesion, psf	Internal Friction Angle, φ, degree
8" Water Line along Cravens	GB-26	Cohesive	0-4	130	65	1,000	--
			4-6	120	60	1,500	--
			6-10	125	63	400	--
		Cohesionless	10-13	104	52	--	25
		Cohesive	13-15	120	60	1,600	--
	GB-27, GB-28 and GB-29	Cohesive	0-4	120	60	1,200	--
			4-6	120	60	400	--
			6-10	128	64	1,200	--
			10-12	126	63	500	--
			12-15	125	63	800	--
8" Water Line along Melrose	GB-30	Cohesive	0-4	125	63	1,000	--
			4-15	130	65	2,000	--
8" Water Line along Hurley	GB-31 and GB-32	Cohesive	0-4	125	63	1,000	--
			4-10	120	60	1,800	--
			10-15	118	59	1,000	--
8" Water Line along Pennington	GB-33, GB-34 and GB-35	Cohesive	0-4	125	63	1,000	--
			4-12	120	60	1,500	--
			12-15	126	63	400	--
			15-20 (GB-33 only)	127	64	500	--
8" Water Line along Hohl	GB-36 and GB-37	Cohesive	0-4	120	60	500	--
			4-10	122	61	1,800	--
			10-15	130	65	1,500	--
8" Water Line along DeBoll	GB-38, GB-39A and GB-40	Cohesive	0-6	125	63	500	--
			6-15	130	65	1,000	--
8" Water Line along Firnat	GB-41, and GB-42A	Cohesive	0-6	125	63	1,000	--
			6-8	132	66	1,300	--
			8-10	132	66	2,000	--
			10-15	128	64	400	--
			15-20 (GB-41 only)	125	63	1,600	--
	GB-43B	Cohesive	0-4	125	63	1,000	--
			4-12	132	66	2,000	--
		Cohesionless	12-14	105	53	--	30
			14-20	120	60	500	--

TABLE 2 (cont'd)

GEOTECHNICAL DESIGN PARAMETER SUMMARY
OPEN-CUT EXCAVATION (AUGER PITS)

Alignments	Boring Nos.	Stratigraphic Unit	Range of Depths, ft	Wet Unit Weight, γ, Pcf	Submerged Unit Weight, γ', pcf	Undrained Cohesion, psf	Internal Friction Angle, φ, degree
8" Water Line along Warner	GB-44	Cohesive	0-10 10-15	126 132	63 66	800 1,600	-- --
8" Water Line along Doverside	GB-45	Cohesive	0-8 8-15	130 130	65 65	1,000 1,500	-- --
8" Water Line along Helmers	GB-46A and GB-47	Cohesive	0-15 15-20 (GB-47 only)	128 130	64 65	1,000 2,000	-- --
8" Water Line along Duff	GB-47 through GB-49	Cohesive	0-4 4-15 15-20 (GB-47 only)	125 128 130	63 64 65	1,000 1,000 2,000	-- -- --
	GB-50A	Cohesive Cohesionless Cohesive	0-12 12-23 23-30	126 106 130	63 53 65	400 -- 3,000	-- 30 --
	GB-51 and GB-52A	Cohesive Cohesionless	0-4 4-10 10-12 12-15	125 125 125 105	63 63 63 53	1,000 300 500 --	-- -- -- 30
8" Water Line along Hendricks	GB-53A	Cohesive Cohesionless	0-12 12-20	132 106	66 53	500 --	-- 30
	GB-54A	Cohesive Cohesionless Cohesive Cohesionless	0-10 10-12 12-14 14-15	130 125 125 106	65 63 63 53	1,000 -- 1,000 --	-- 25 -- 30
8" Water Line along Hector	GB-55 and GB-56C	Cohesive Cohesionless	0-10 10-15 15-20 (GB-55 only)	132 102 102	66 51 51	1,000 -- --	-- 30 30
8" Water Line along Exeter	GB-57	Cohesive	0-6 6-15	130 130	65 65	1,000 1,500	-- --
	GB-58	Cohesionless Cohesive Cohesionless Cohesive	0-4 4-10 10-12 12-15	106 135 100 130	53 68 55 65	-- 1,000 -- 1,700	30 -- 30 --

Note: 1) Cohesive soils include Sandy Lean Clay, Lean Clay w/sand, Lean Clay, Fat Clay w/sand, and Fat Clay
2) Cohesionless soils include Silty Sand, Fine Sand with silt and Clayey Sand.

TABLE 3.1

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION ALONG
META, MEADOW LEA & MADIE
(BORINGS GB-1 THROUGH GB-4A)

PROPERTY		COHESIVE SOILS[1]
Wet Unit Weight, γ, pcf		
	0-4	125
	4-12	130
	12-14	130
	14-16	128
	16-20	125 (GB-1 & GB-4A only)
Submerged Unit Weight, γ', pcf		
	0-4	63
	4-12	65
	12-14	65
	14-16	64
	16-20	63 (GB-1 & GB-4A only)
Moisture Content (%)		
	0-4	16
	4-12	18
	12-14	16
	14-16	20
	16-20	18 (GB-1 & GB-4A only)
UNDRAINED PROPERTIES		
Undrained Cohesion, C_u, psf		
	0-4*	800
	4-12*	500
	12-14*	1,000
	14-16*	400
	16-18*	1,500 (GB-1 & GB-4A only)
Angle of Internal Friction, ϕ, degrees	0-4*	--
	4-12*	--
	12-14*	--
	14-16*	--
	16-18*	--
Elastic Modulus, E, psf		
	0-4*	320,000
	4-12*	150,000
	12-14*	400,000
	14-16*	120,000
	16-18*	450,000 (GB-1 & GB-4A only)
Coefficient of Lateral Earth Pressure at Rest, K_o,	0-4*	1.2
	4-12*	1.2
	12-14*	1.2
	14-16*	1.2
	16-18*	1.2 (GB-1 & GB-4A only)
Poisson's Ratio, μ		0.45

TABLE 3.1 (cont'd)

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION ALONG
META, MEADOW LEA & MADIE
(BORINGS GB-1 THROUGH GB-4A)

PROPERTY		COHESIVE SOILS[1]
DRAINED PROPERTIES		
Drained Cohesion, C′, psf		
	0-4*	0
	4-12*	0
	12-14*	0
	14-16*	0
	16-18*	0
Angle of Internal Friction, ϕ', degrees	0-4*	26
	4-12*	25
	12-14*	25
	14-16*	24
	16-18*	24 (GB-1 & GB-4A only)
Elastic Modulus, E, psf		
	0-4*	192,000
	4-12*	90,000
	12-14*	240,000
	14-16*	72,000
	16-18*	270,000 (GB-1 & GB-4A only)

Notes: 1. Cohesive soils include Fat Clay, Lean Clay with sand and Sandy Lean Clay.
*Tunnel zone which includes invert depth plus 6 feet above invert plus 6 feet below invert.

TABLE 3.2

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION ALONG
BAUMAN, BURBANK, HIGHLAWN, LUTHER AND WYNELL TERRACE
(BORINGS GB-5A THROUGH GB-14)

PROPERTY		COHESIVE SOILS[1]
Wet Unit Weight, γ, pcf		
	0-4	125
	4-6	128
	6-8	128
	8-10	130
	10-12	128
	12-15	130
	15-20	124 (GB-6, GB-7 & GB-11 only)
Submerged Unit Weight, γ', pcf		
	0-4	63
	4-6	64
	6-8	64
	8-10	65
	10-12	64
	12-15	65
	15-20	62 (GB-6, GB-7 & GB-11 only)
Moisture Content (%)		
	0-4	18
	4-6	16
	6-8	18
	8-10	16
	10-12	19
	12-15	22
	15-20	23 (GB-6, GB-7 & GB-11 only)
UNDRAINED PROPERTIES		
Undrained Cohesion, C_u, psf		
	0-4*	600
	4-15*	900
	15-18*	1,000 (GB-6, GB-7 & GB-11 only)
Angle of Internal Friction, ϕ, degrees	0-4*	--
	4-15*	--
	15-18*	--
Elastic Modulus, E, psf		
	0-4*	180,000
	4-15*	270,000
	15-18*	300,000 (GB-6, GB-7 & GB-11 only)

TABLE 3.2 (cont'd)

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION ALONG
BAUMAN, BURBANK, HIGHLAWN, LUTHER AND WYNELL TERRACE
(BORINGS GB-5A THROUGH GB-14)

PROPERTY		COHESIVE SOILS[1]
Coefficient of Lateral Earth Pressure at Rest, K_o,	0-4*	1.2
	4-15*	1.2
	15-18*	1.2 (GB-6, GB-7 & GB-11 only)
Poisson's Ratio, μ		0.45
DRAINED PROPERTIES		
Drained Cohesion, C′, psf	0-4*	0
	4-15*	0
	15-18*	0
Angle of Internal Friction, ϕ', degrees	0-4*	25
	4-15*	26
	15-18*	26 (GB-6, GB-7 & GB-11 only)
Elastic Modulus, E, psf	0-4*	108,000
	4-15*	162,000
	15-18*	180,000 (GB-6, GB-7 & GB-11 only)

Notes: 1. Cohesive soils include Fat Clay, Lean Clay with sand and Sandy Lean Clay.
*Tunnel zone which includes invert depth plus 6 feet above invert plus 6 feet below invert.

TABLE 3.3

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION ALONG
McGALLION, TURNER, GOLDCREST, CRAVENS, MELROSE, HURLEY,
PENNINGTON, HOHL AND DeBOLL
(BORINGS GB-15 THROUGH GB-40)

PROPERTY		COHESIVE SOILS[1]	COHESIONLESS SOILS[2]
Wet Unit Weight, γ, pcf			
	0-4	124	--
	4-8	126	--
	8-10	125	**115** (GB-16C and GB-24 only)
	10-13.5	120	**100** (GB-16C, GB-22B, GB-23, GB-24 and GB-26 only)
	13.5-18	122	**105** (GB-22B and GB-23 only)
	18-20	124	**105** (GB-22B and GB-23only)
Submerged Unit Weight, γ', pcf			
	0-4	62	--
	4-8	63	--
	8-10	63	**58** (GB-16C and GB-24 only)
	10-13.5	60	**50** (GB-16C, GB-22B, GB-23, GB-24 and GB-26 only)
	13.5-18	61	**53** (GB-22B and GB-23 only)
	18-20	62	**53** (GB-22B and GB-23only)
Moisture Content (%)			
	0-4	14	--
	4-8	16	--
	8-10	17	**18** (GB-16C and GB-24 only)
	10-13.5	15	**21** (GB-16C, GB-22B, GB-23, GB-24 and GB-26 only)
	13.5-18	18	**22** (GB-22B and GB-23 only)
	18-20	20	**20** (GB-22B and GB-23only)
UNDRAINED PROPERTIES			
Undrained Cohesion, C_u, psf			
	0-4*	500	--
	4-8*	400	--
	8-10*	500	--
	10-13.5*	400	--
	13.5-16*	800	--
Angle of Internal Friction, ϕ, degrees	0-4*	--	--
	4-8*	--	--
	8-10*	--	**25** (GB-16C and GB-24 only)
	10-13.5*	--	**25** (GB-16C, GB-22B, GB-23, GB-24 and GB-26 only)
	13.5-16*	--	**30** (GB-22B and GB-23 only)
Elastic Modulus, E, psf			
	0-4*	200,000	--
	4-8*	120,000	--
	8-10*	150,000	**126,000** (GB-16C and GB-24 only)
	10-13.5*	120,000	**140,000** (GB-16C, GB-22B, GB-23, GB-24 and GB-26 only)
	13.5-16*	240,000	**84,000** (GB-22B and GB-23 only)

TABLE 3.3 (cont'd)

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION ALONG
McGALLION, TURNER, GOLDCREST, CRAVENS, MELROSE, HURLEY,
PENNINGTON, HOHL AND DeBOLL
(BORINGS GB-15 THROUGH GB-40)

PROPERTY		COHESIVE SOILS[1]	COHESIONLESS SOILS[2]
Coefficient of Lateral Earth Pressure at Rest, K_o,	0-4*	1.2	--
	4-8*	1.2	--
	8-10*	1.2	**0.58** (GB-16C and GB-24 only)
	10-13.5*	1.2	**0.58** (GB-16C, GB-22B, GB-23, GB-24 and GB-26 only)
	13.5-16*	1.2	**0.5** (GB-22B and GB-23 only)
Poisson's Ratio, μ		0.45	0.3
DRAINED PROPERTIES			
Drained Cohesion, C′, psf			
	0-4*	0	--
	4-8*	0	--
	8-10*	0	--
	10-13.5*	0	--
	13.5-16*	0	--
Angle of Internal Friction, ϕ', degrees	0-4*	24	--
	4-8*	22	--
	8-10*	20	**25** (GB-16C and GB-24 only)
	10-13.5*	22	**25** (GB-16C, GB-22B, GB-23, GB-24 and GB-26 only)
	13.5-16*	22	**30** (GB-22B and GB-23 only)
Elastic Modulus, E, psf			
	0-4*	120,000	-
	4-8*	72,000	-
	8-10*	90,000	**126,000** (GB-16C and GB-24 only)
	10-13.5*	72,000	**140,000** (GB-16C, GB-22B, GB-23, GB-24 and GB-26 only)
	13.5-16*	144,000	**84,000** (GB-22B and GB-23 only)

Notes:
1. Cohesive soils include Fat Clay, Fat Clay with sand, Lean Clay, Lean Clay with sand and Sandy Lean Clay.
2. Cohesionless soil includes Silty Sand and Fine Sand with silt.

* Tunnel zone which includes invert depth plus 6 feet above invert plus 6 feet below invert.

TABLE 3.4

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION ALONG
FIRNAT, WARNER, DOVERSIDE, HELMERS, DUFF AND HENDRICKS
(BORINGS GB-41 THROUGH GB-54A)

PROPERTY		COHESIVE SOILS[1]	COHESIONLESS SOILS[2]
Wet Unit Weight, γ, pcf			
	0-4	124	--
	4-10	126	--
	10-12	125	**100** (GB-54A only)
	12-14	120	**105** (GB-43B, GB-50A, GB-52A and GB-53A only)
	14-15	122	**105** (GB-50A, GB-52A, GB-53A and GB-54A only)
	15-20	124	**105** (GB-50A and GB-53A only)
	20-23	--	**106** (GB-50A only)
	23-30	135 (GB-50A only)	--
Submerged Unit Weight, γ', pcf			
	0-4	62	--
	4-10	62	--
	10-12	63	**50** (GB-54A only)
	12-14	63	**53** (GB-43B, GB-50A, GB-52A and GB-53A only)
	14-15	60	**53** (GB-50A, GB-52A, GB-53A and GB-54A only)
	15-20	61	**53** (GB-50A and GB-53A only)
	20-23	--	**53** (GB-50A only)
	23-30	68 (GB-50A only)	--
Moisture Content (%)			
	0-4	14	--
	4-10	16	--
	10-12	17	**23** (GB-54A only)
	12-14	15	**20** (GB-43B, GB-50A, GB-52A and GB-53A only)
	14-15	18	**25** (GB-50A, GB-52A, GB-53A and GB-54A only)
	15-20	20	**25** (GB-50A and GB-53A only)
	20-23	--	**24** (GB-50A only)
	23-30	24 (GB-50A only)	--
UNDRAINED PROPERTIES			
Undrained Cohesion, C_u, psf			
	0-4*	800	--
	4-10*	400	--
	10-12*	600	--
	12-14*	1,000	--
	14-15*	1,500	--
	15-20*	1,000	--
	20-23*	--	--
	23-26*	3,000 (GB-50A only)	--

TABLE 3.4 (cont'd)

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION ALONG
FIRNAT, WARNER, DOVERSIDE, HELMERS, DUFF AND HENDRICKS
(BORINGS GB-41 THROUGH GB-54A)

PROPERTY		COHESIVE SOILS(1)	COHESIONLESS SOILS(2)
Angle of Internal Friction, ϕ, degrees	0-4*	--	--
	4-10*	--	--
	10-12*	--	**30** (GB-54A only)
	12-14*	--	**30** (GB-43B, GB-50A, GB-52A and GB-53A only)
	14-15*	--	**30** (GB-50A, GB-52A, GB-53A and GB-54A only)
	15-20*	--	**30** (GB-50A and GB-53A only)
	20-23*	--	**30** (GB-50A only)
	23-26*	--	--
Elastic Modulus, E, psf	0-4*	320,000	--
	4-10*	160,000	--
	10-12*	240,000	**168,000** (GB-54A only)
	12-14*	300,000	**196,000** (GB-43B, GB-50A, GB-52A and GB-53A only)
	14-15*	450,000	**168,000** (GB-50A, GB-52A, GB-53A and GB-54A only)
	15-20*	300,000	**182,000** (GB-50A and GB-53A only)
	20-23*	-	**126,000** (GB-50A only)
	23-26*	1,200,000 (GB-50A only)	--
Coefficient of Lateral Earth Pressure at Rest, K_o,	0-4*	1.2	--
	4-10*	1.2	--
	10-12*	1.2	**0.5** (GB-54A only)
	12-14*	1.2	**0.5** (GB-43B, GB-50A, GB-52A and GB-53A only)
	14-15*	1.2	**0.5** (GB-50A, GB-52A, GB-53A and GB-54A only)
	15-20*	1.2	**0.5** (GB-50A and GB-53A only)
	20-23*	--	**0.5** (GB-50A only)
	23-26*	1.2 (GB-50A only)	--
Poisson's Ratio, μ		0.45	0.3
DRAINED PROPERTIES			
Drained Cohesion, C′, psf	0-4*	0	--
	4-10*	0	--
	10-12*	0	--
	12-14*	0	--
	14-15*	0	--
	15-20*	0	--
	20-23*	0	--
	23-26*	0	--

TABLE 3.4 (cont'd)

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION ALONG
FIRNAT, WARNER, DOVERSIDE, HELMERS, DUFF AND HENDRICKS
(BORINGS GB-41 THROUGH GB-54A)

PROPERTY		COHESIVE SOILS[1]	COHESIONLESS SOILS[2]
Angle of Internal Friction, ϕ', degrees	0-4*	26	--
	4-10*	26	--
	10-12*	25	**30** (GB-54A only)
	12-14*	24	**30** (GB-43B, GB-50A, GB-52A and GB-53A only)
	14-15*	24	**30** (GB-50A, GB-52A, GB-53A and GB-54A only)
	15-20*	21	**30** (GB-50A and GB-53A only)
	20-23*	--	**30** (GB-50A only)
	23-26*	24 (GB-50A only)	--
Elastic Modulus, E, psf			
	0-4*	192,000	--
	4-10*	96,000	--
	10-12*	144,000	**168,000** (GB-54A only)
	12-14*	180,000	**196,000** (GB-43B, GB-50A, GB-52A and GB-53A only)
	14-15*	270,000	**168,000** (GB-50A, GB-52A, GB-53A and GB-54A only)
	15-20*	180,000	**182,000** (GB-50A and GB-53A only)
	20-23*	--	**126,000** (GB-50A only)
	23-26*	720,000 (GB-50A only)	--

Notes:
1. Cohesive soils include Fat Clay, Fat Clay with sand, Lean Clay, Lean Clay with sand and Sandy Lean Clay.
2. Cohesionless soil includes Silty Sand, Fine Sand with silt and Clayey Sand

* Tunnel zone which includes invert depth plus 6 feet above invert plus 6 feet below invert.

TABLE 3.5

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION ALONG
HECTOR AND EXETER
(BORINGS GB-55 THROUGH GB-58)

PROPERTY		COHESIVE SOILS[1]	COHESIONLESS SOILS[2]
Wet Unit Weight, γ, pcf			
	0-4	124	**106** (GB-58 only)
	4-10	125	--
	10-12	122 (GB-57 only)	**100** (GB-55, GB-56C and GB-58 only)
	12-15	124 (GB-57 & GB-58 only)	**102** (GB-55 and GB-56C only)
	15-20	125	**106** (GB-55 only)
Submerged Unit Weight, γ', pcf			
	0-4	62	**53** (GB-58 only)
	4-10	63	--
	10-12	61 (GB-57 only)	**50** (GB-55, GB-56C and GB-58 only)
	12-15	62(GB-57 & GB-58 only)	**51** (GB-55 and GB-56C only)
	15-20	63	**53** (GB-55 only)
Moisture Content (%)			
	0-4	18	**16** (GB-58 only)
	4-10	20	--
	10-12	22 (GB-57 only)	**19** (GB-55, GB-56C and GB-58 only)
	12-15	24(GB-57 & GB-58 only)	**21** (GB-55 and GB-56C only)
	15-20	18	20 (GB-55 only)
UNDRAINED PROPERTIES			
Undrained Cohesion, C_u, psf			
	0-4*	1,000	--
	4-10*	1,000	--
	10-12*	1,500 (GB-57 only)	--
	12-15*	1,500 (GB-57 & GB-58 only)	--
	15-16*	--	--
Angle of Internal Friction, ϕ, degrees	0-4*	--	**30** (GB-58 only)
	4-10*	--	--
	10-12*	--	**30** (GB-55, GB-56C and GB-58 only)
	12-15*	--	**30** (GB-55 and GB-56C only)
	15-16*	--	**30** (GB-55 only)
Elastic Modulus, E, psf			
	0-4*	400,000	**140,000** (GB-58 only)
	4-10*	400,000	--
	10-12*	600,000 (GB-57 only)	**112,000**(GB-55, GB-56C and GB-58 only)
	12-15*	450,000 (GB-57 & GB-58 only)	**210,000** (GB-55 and GB-56C only)
	15-16*	--	**196,000** (GB-55 only)

TABLE 3.5 (cont'd)

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION ALONG
HECTOR AND EXETER
(BORINGS GB-55 THROUGH GB-58)

PROPERTY		COHESIVE SOILS[1]	COHESIONLESS SOILS[2]
Coefficient of Lateral Earth Pressure at Rest, K_o,	0-4*	1.2	**0.5** (GB-58 only)
	4-10*	1.2	--
	10-12*	1.2 (GB-57 only)	**0.5** (GB-55, GB-56C and GB-58 only)
	12-15*	1.2 (GB-57 & GB-58 only)	**0.5** (GB-55 and GB-56C only)
	15-16*	--	**0.5** (GB-55 only)
Poisson's Ratio, μ		0.45	0.3
DRAINED PROPERTIES			
Drained Cohesion, C', psf			
	0-4*	0	--
	4-10*	0	--
	10-12*	0	--
	12-15*	0	--
	15-16*	--	--
Angle of Internal Friction, ϕ', degrees	0-4*	27	**30** (GB-58 only)
	4-10*	26	--
	10-12*	26 (GB-57 only)	**30** (GB-55, GB-56C and GB-58 only)
	12-15*	21 (GB-57 & GB-58 only)	**30** (GB-55 and GB-56C only)
	15-16*	--	**30** (GB-55 only)
Elastic Modulus, E, psf			
	0-4*	240,000	**140,000** (GB-58 only)
	4-10*	240,000	--
	10-12*	360,000 (GB-57 only)	**112,000**(GB-55, GB-56C and GB-58 only)
	12-15*	270,000 (GB-57 & GB-58 only)	**210,000** (GB-55 and GB-56C only)
	15-16*	--	**196,000** (GB-55 only)

Notes:
1. Cohesive soils include Fat Clay, Fat Clay with sand, Lean Clay, Lean Clay with sand and Sandy Lean Clay.
2. Cohesionless soil includes Silty Sand and Fine Sand with silt

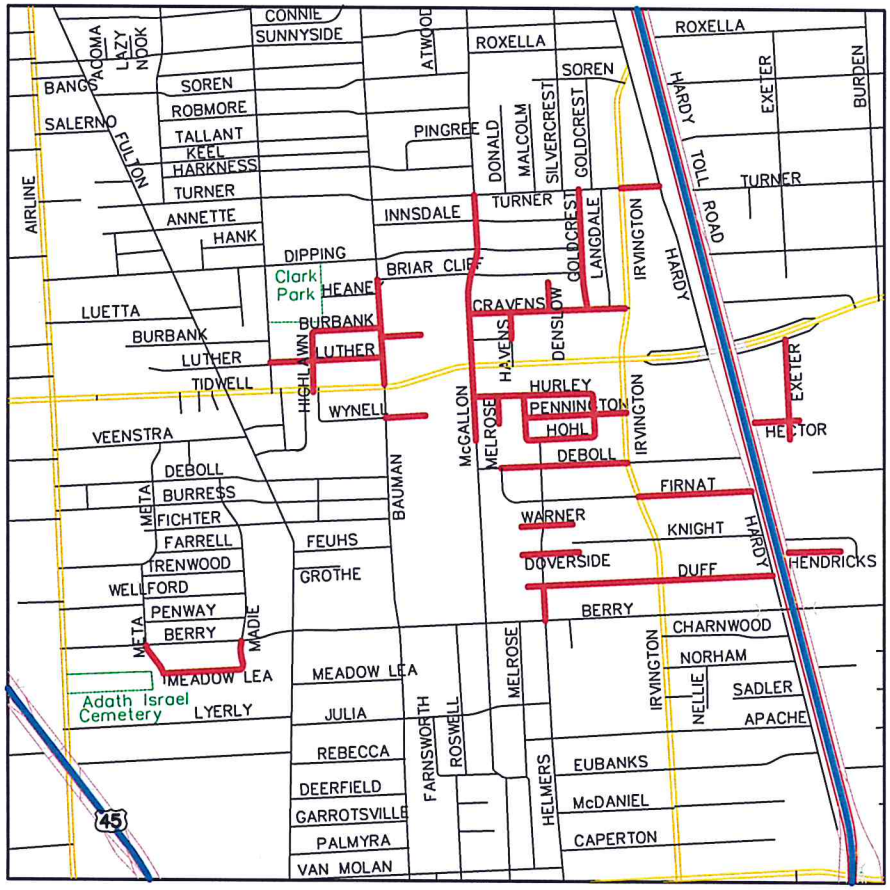
* Tunnel zone which includes invert depth plus 6 feet above invert plus 6 feet below invert.

ILLUSTRATIONS

	Figure
Vicinity Map	1
Plan of Borings	2.1 thru 2.7
Boring Log Profile	3.1 thru 3.19
Symbols and Abbreviations Used on Boring Log Profile	4
Trench Support Earth Pressures	5.1 thru 5.3
Stability of Bottom for Braced Cut	6
Earth Pressure on Pipe and Auger Casing	7
Vertical Stress on Pipes Due to Traffic Loads	8
Thrust Forces Acting on a Bend	9

PUBLIC WORKS AND ENGINEERING DEPARTMENT
ENGINEERING & CONSTRUCTION DIVISION

WATER LINE REPLACEMENT IN INNSDALE AREA
WBS NO.: S-000035-0206-4



N

N.T.S.

STREET NAME	ADDRESS	START STREET	END STREET	OLD SIZE	NEW SIZE	LENGTH IN FEET	KEY MAP
CRAVENS	600–999	McGALLION	IRVINGTON	6	8	1,840	453C
TURNER	1100–1199	IRVINGTON	HARDY	8	8	500	453C,D
McGALLION	9300–9999	TURNER	approx. 540' S of HURLEY	8	8	2,120	453C,G
HAVENS	9400–9499	LUTHER	CRAVENS	0	6	330	453C
DENSLOW	9600–9699	CRAVENS	END (NORTH)	2	4	230	453C
GOLDCREST	9600–9999	TURNER	CRAVENS	6	8	1,460	453C
BAUMAN	9400–9699	BRIARCLIFF	TIDWELL	12	12	1,280	453C
BURBANK	200–299	HIGHLAWN	BAUMAN	6	8	820	453B,C
LUTHER	150–299	CLARK	BAUMAN	6	8	1,370	453B,C
HIGHLAWN	9400–9599	TIDWELL	BURBANK	8	8	710	453B
MEADOWLEA	0–99	META	MADIE	8	8	930	453F
MELROSE	9200–9299	HURLEY	END (SOUTH)	2	6	320	453G
HURLEY	700–899	McGALLION	GOLDCREST	6	8	1,460	453G
HELMERS	9100–9299	HURLEY	HOHL	6, 8	8	920	453G
HELMERS	8500–8599	DUFF	BERRY	12	8	390	453G
GOLDCREST	9100–9299	HURLEY	HOHL	6	8	530	453G
PENNINGTON	700–999	HELMERS	IRVINGTON	8	8	1,230	453G
HOHL	700–899	HELMERS	GOLDCREST	6	8	830	453G
DEBOLL	0–899	180' E OF FIRNAT	IRVINGTON	8	8	1,500	453G
WARNER	600–799	END (EAST)	END (WEST)	2	6	550	453G
DOVERSIDE	600–799	END (EAST)	END (WEST)	2	6	550	453G
DUFF	600–1499	END (WEST)	HARDY	12	8	2,920	453G,H
FIRNAT	1200–1499	IRVINGTON	HARDY	8	8	1,360	453G,H
HENDRICKS	1500–1699	HARDY	END (EAST)	6	8	600	453H
EXETER	9100–9499	TIDWELL	END (SOUTH)	2, 8	8	1,260	453D,H
HECTOR	1700–1899	HARDY	END (EAST)	2, 8	8	600	453H
META	8400–8499	BERRY	MEADOWLEA	8	8	500	453F
MADIE	8400–8499	BERRY	MEADOWLEA	8	8	320	453F
WYNELL	300–335	BAUMAN	END (EAST)	2	6	520	453G
LINE IN ESMT.	9400–9499 MCGALLION	BAUMAN	END (EAST)	3,8	8	420	453C
				TOTAL		27,980	

VICINITY MAP

KEY MAP NO. 453 B, C, D, F, G & H
GIM MAP# 5360 B, 5361 D, 5460 A, 5461 A&C
COUNCIL DISTRICT H
COUNCIL MEMBER
EDWARD GONZALEZ

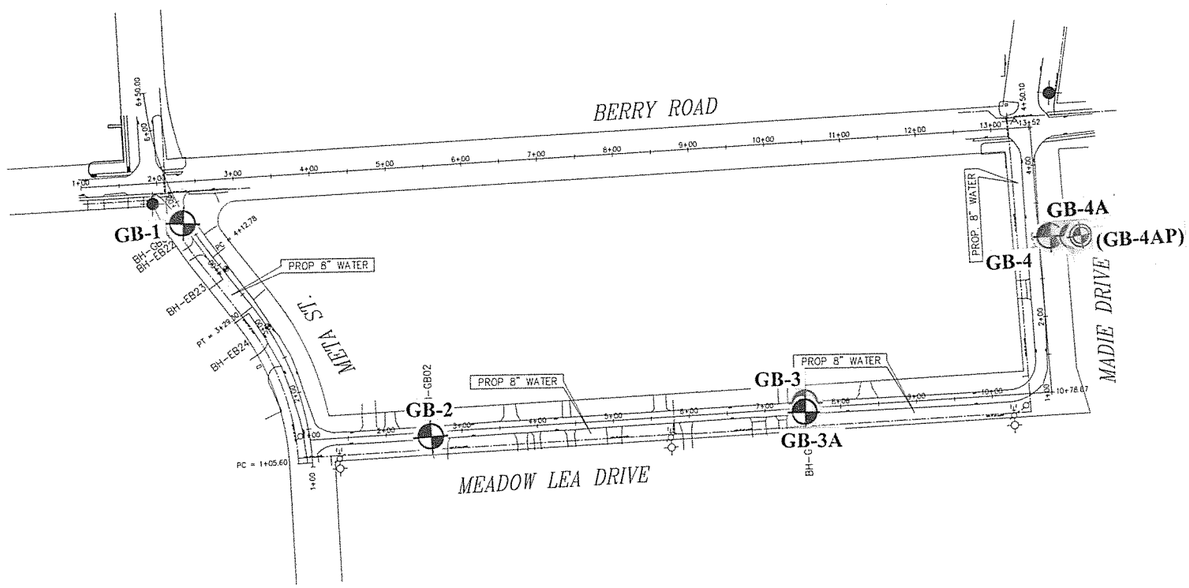
LEGEND:

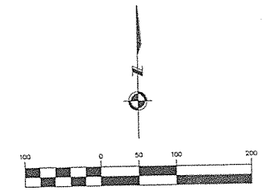
EXISTING ROAD
ROAD DESIGNATED FOR PROPOSED WATER LINE

KUO & associates, Inc
Consulting Engineers & Surveyors
10700 Richmond Ave., Suite 113
Houston, TX 77042
Tel: (713) 975-8769
Fax: (713) 975-0920
www.kuoassociates.com
Texas Firm Registration No. F-4578

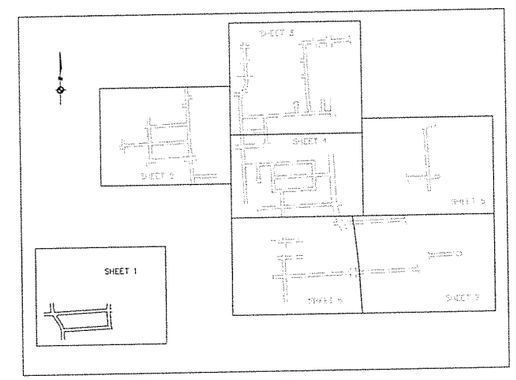
FIGURE 1

Job No. 1140208301





Scale in Feet



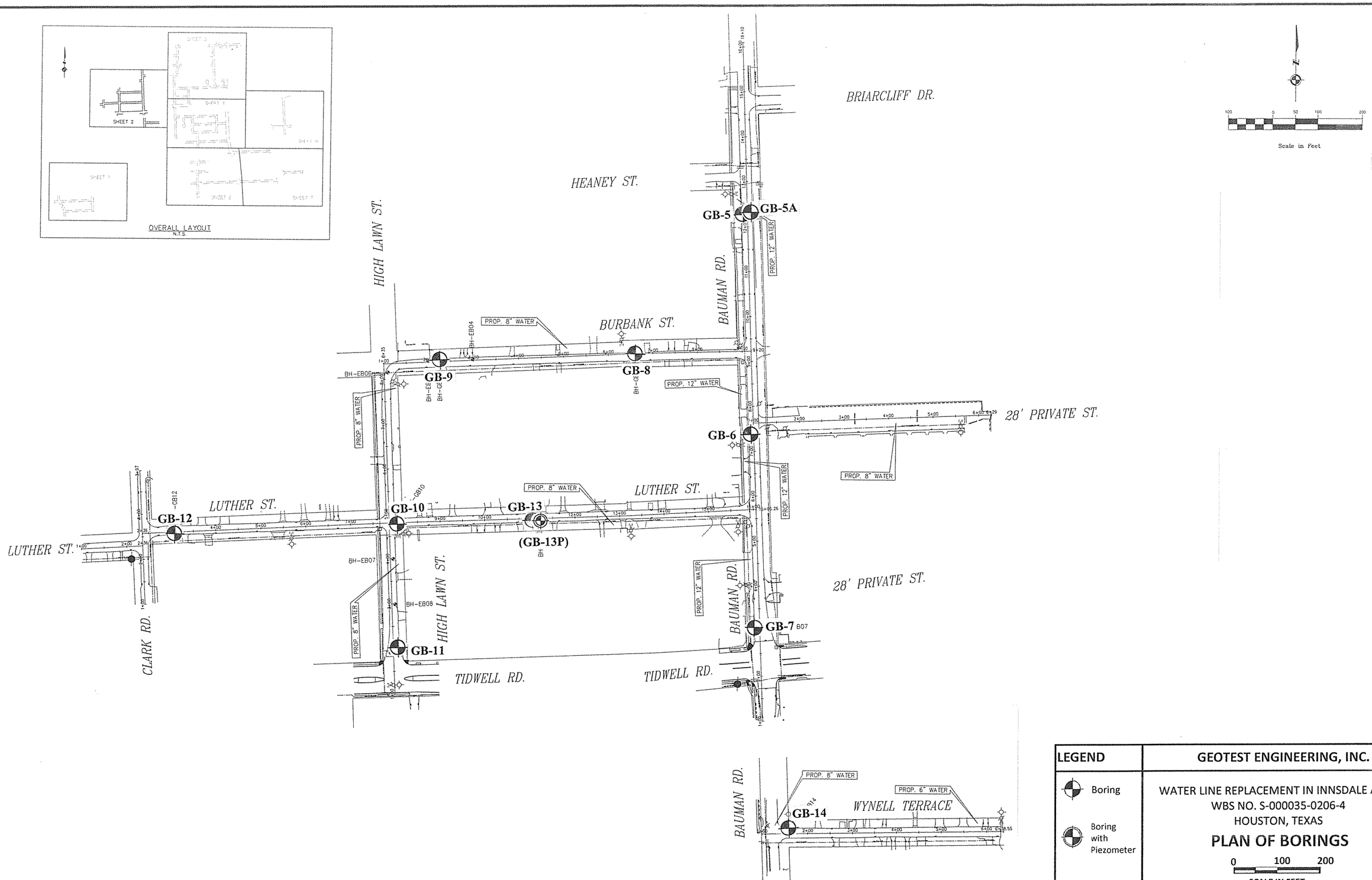
OVERALL LAYOUT
N.T.S.

LEGEND	GEOTEST ENGINEERING, INC.
Boring Boring with Piezometer	WATER LINE REPLACEMENT IN INNSDALE AREA WBS NO. S-000035-0206-4 HOUSTON, TEXAS **PLAN OF BORINGS** 0 100 200 SCALE IN FEET

Geotest Engineering, Inc.

FIGURE 2.1

Job No. 1140208301

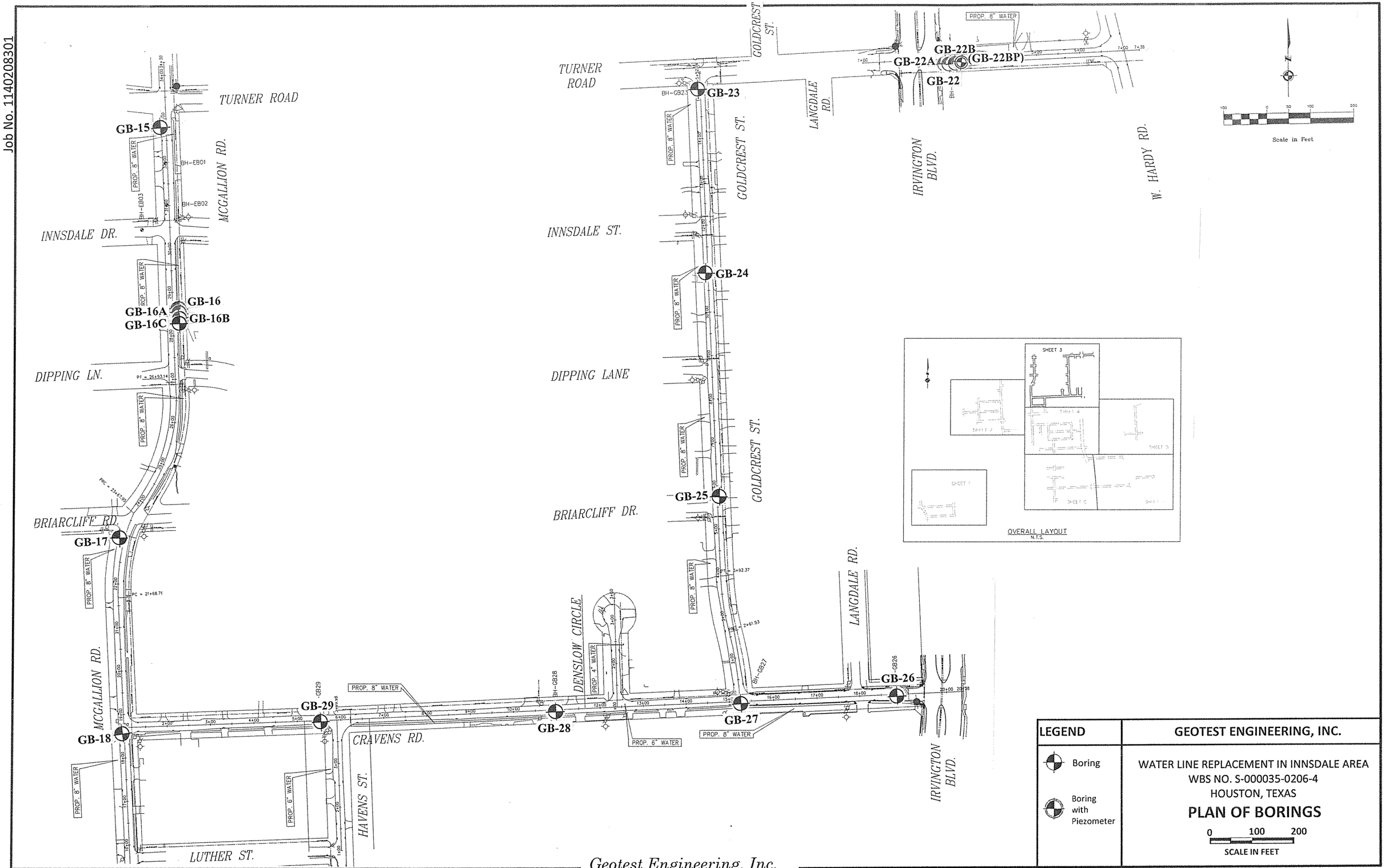


LEGEND	GEOTEST ENGINEERING, INC.
Boring	WATER LINE REPLACEMENT IN INNSDALE AREA WBS NO. S-000035-0206-4 HOUSTON, TEXAS
Boring with Piezometer	**PLAN OF BORINGS** 0 100 200 SCALE IN FEET

Geotest Engineering, Inc.

FIGURE 2.2

Job No. 1140208301

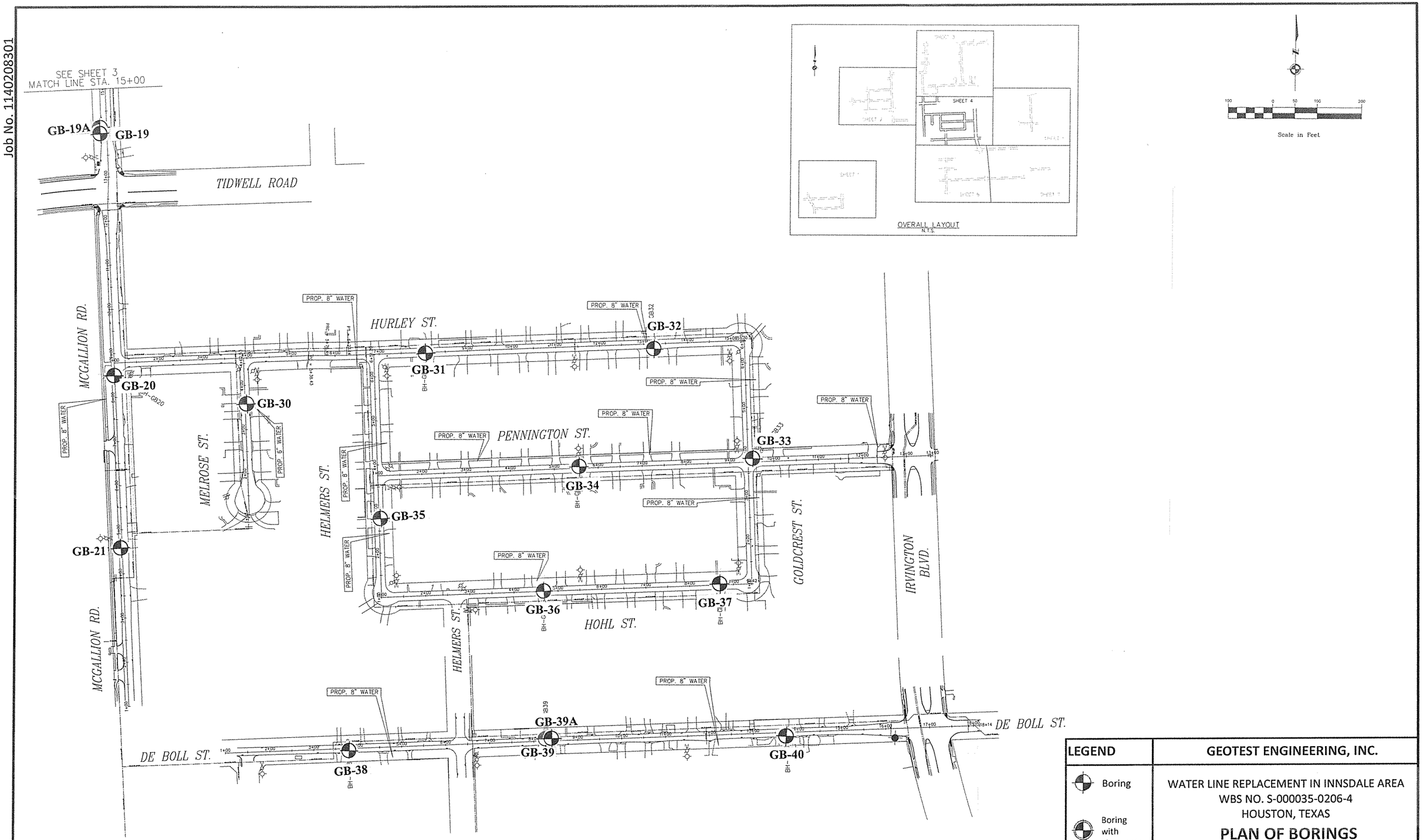


LEGEND	GEOTEST ENGINEERING, INC.
Boring Boring with Piezometer	WATER LINE REPLACEMENT IN INNSDALE AREA WBS NO. S-000035-0206-4 HOUSTON, TEXAS **PLAN OF BORINGS** 0 100 200 SCALE IN FEET

Geotest Engineering, Inc.

FIGURE 2.3

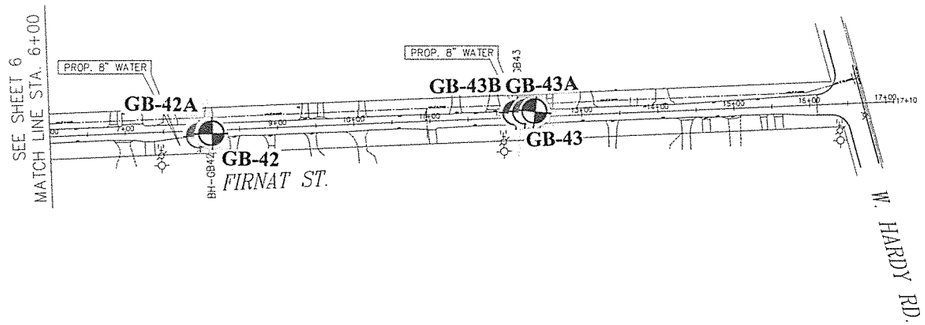
Job No. 1140208301

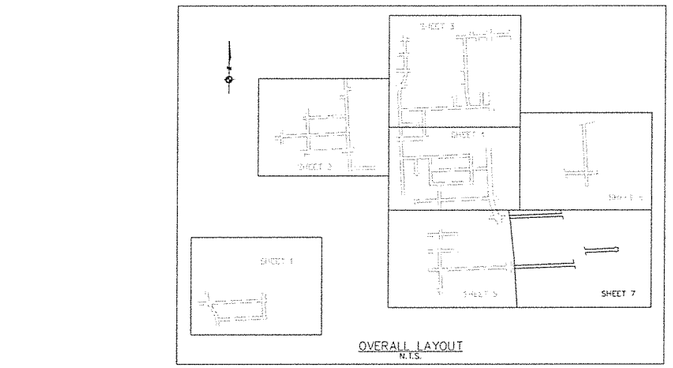


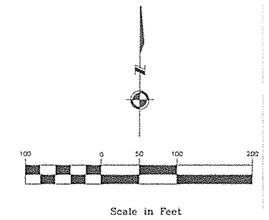
Geotest Engineering, Inc.

FIGURE 2.4

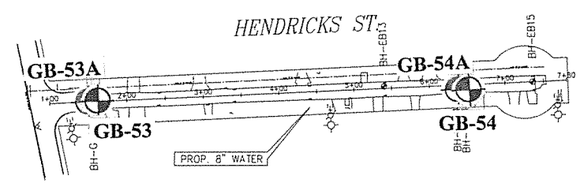
Job No. 1140208301



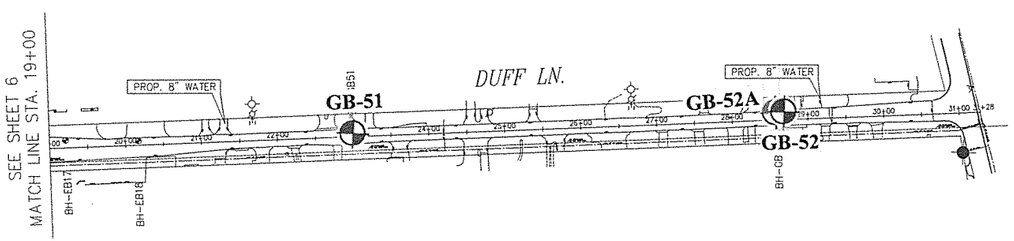




E. HARDY RD.

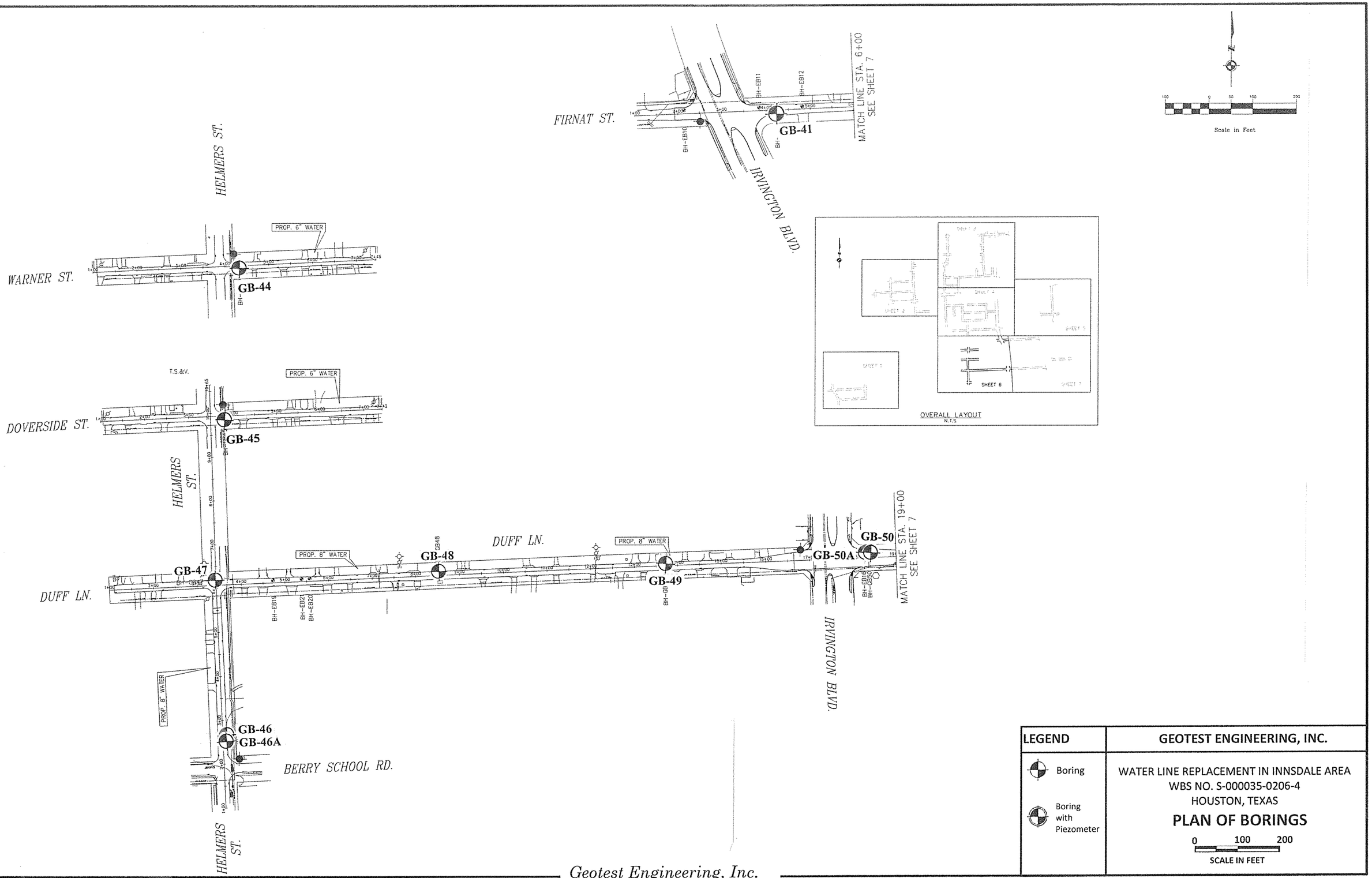


W. HARDY RD.



LEGEND	GEOTEST ENGINEERING, INC.
Boring Boring with Piezometer	WATER LINE REPLACEMENT IN INNSDALE AREA WBS NO. S-000035-0206-4 HOUSTON, TEXAS **PLAN OF BORINGS** 0 100 200 SCALE IN FEET

Job No. 1140208301

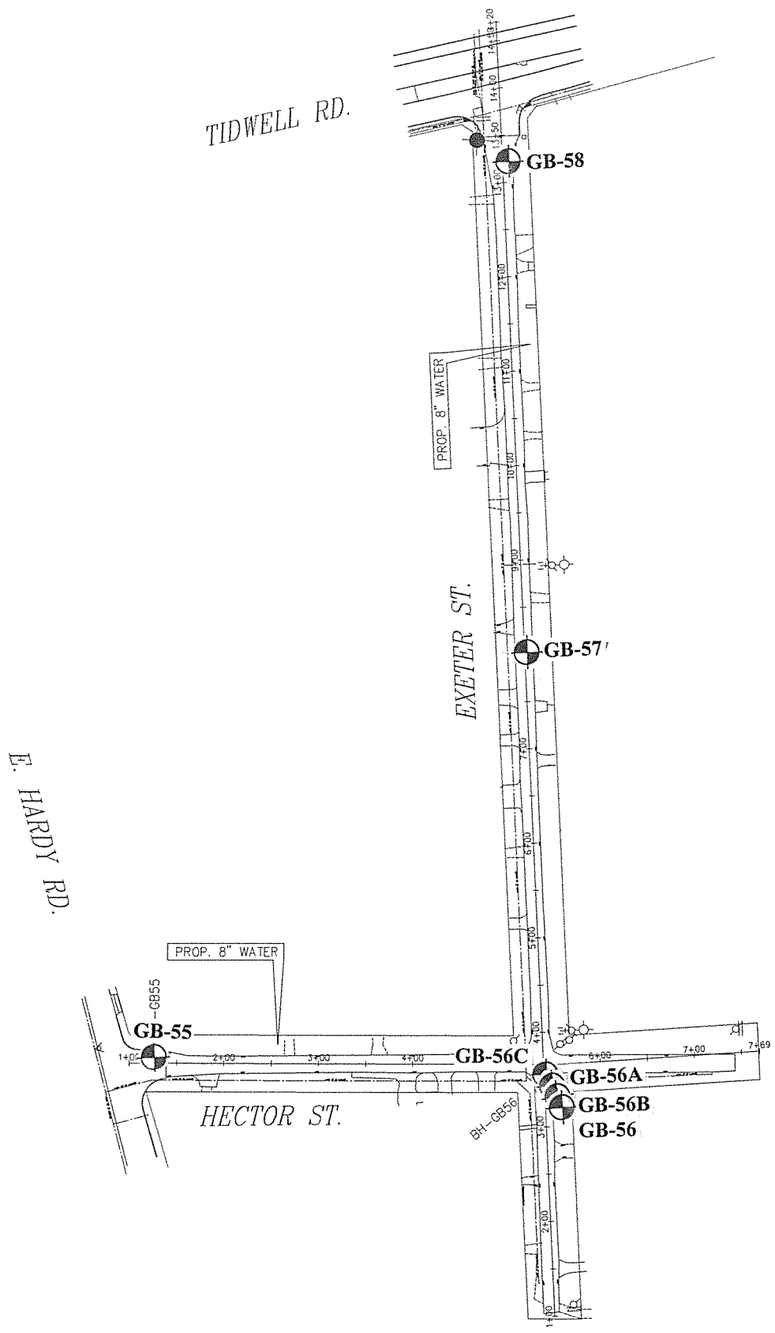


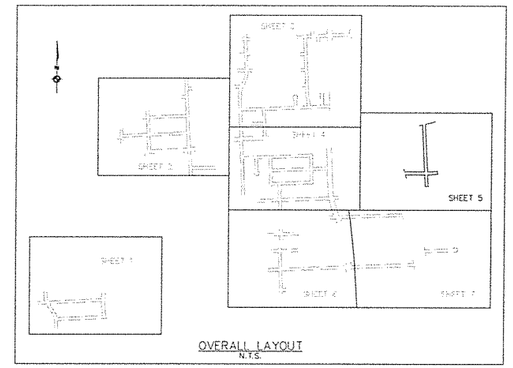
LEGEND	GEOTEST ENGINEERING, INC.
Boring Boring with Piezometer	WATER LINE REPLACEMENT IN INNSDALE AREA WBS NO. S-000035-0206-4 HOUSTON, TEXAS **PLAN OF BORINGS** 0 100 200 SCALE IN FEET

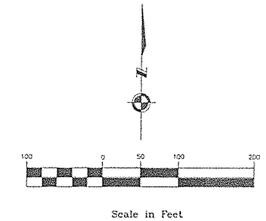
Geotest Engineering, Inc.

FIGURE 2.6

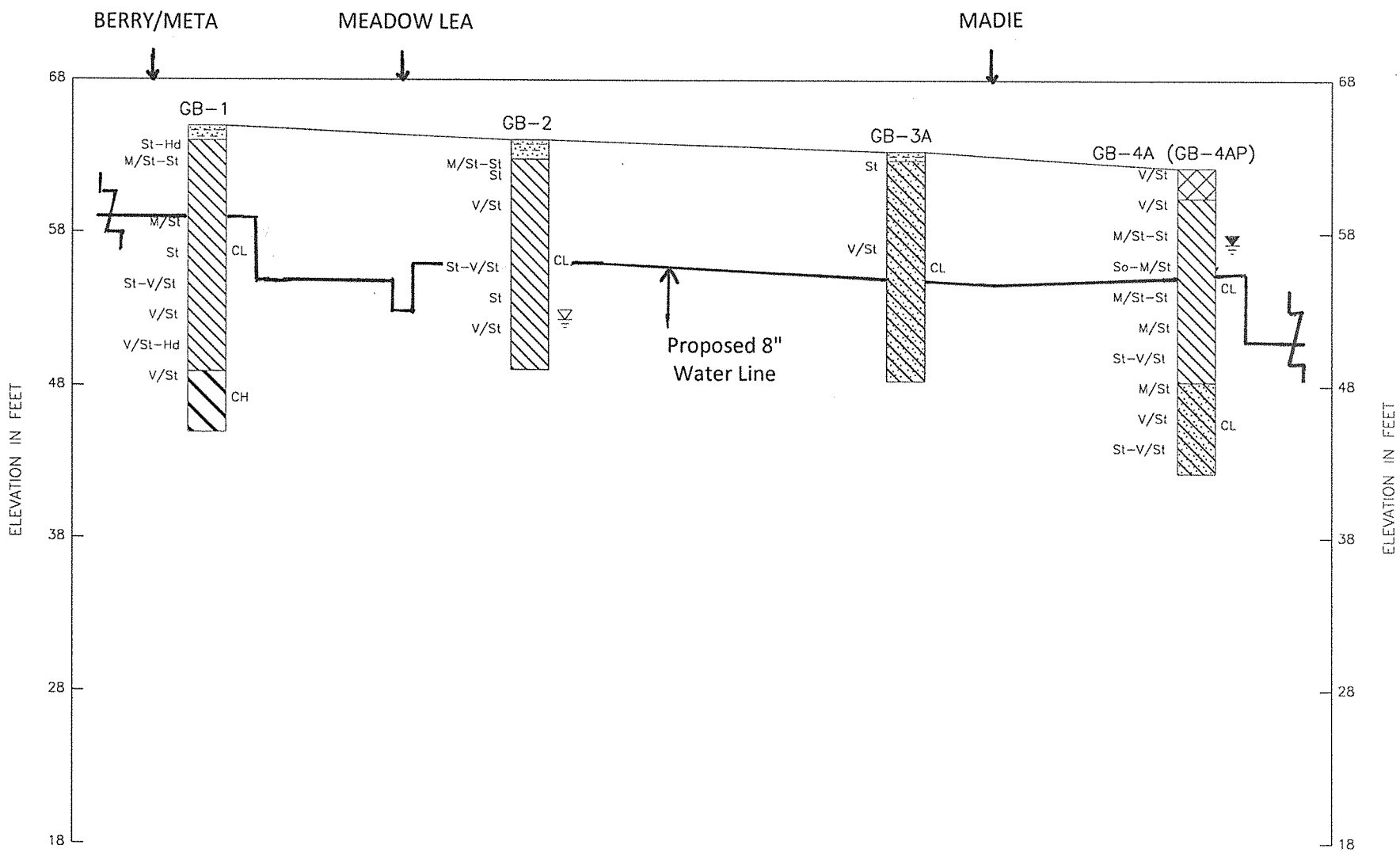
Job No. 1140208301







LEGEND	GEOTEST ENGINEERING, INC.
Boring Boring with Piezometer	WATER LINE REPLACEMENT IN INNSDALE AREA WBS NO. S-000035-0206-4 HOUSTON, TEXAS **PLAN OF BORINGS** 0 100 200 SCALE IN FEET



GENERAL NOTES:

1. See Figure 2.1 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

BORING LOG PROFILE

META, MEADOW LEA & MADIE

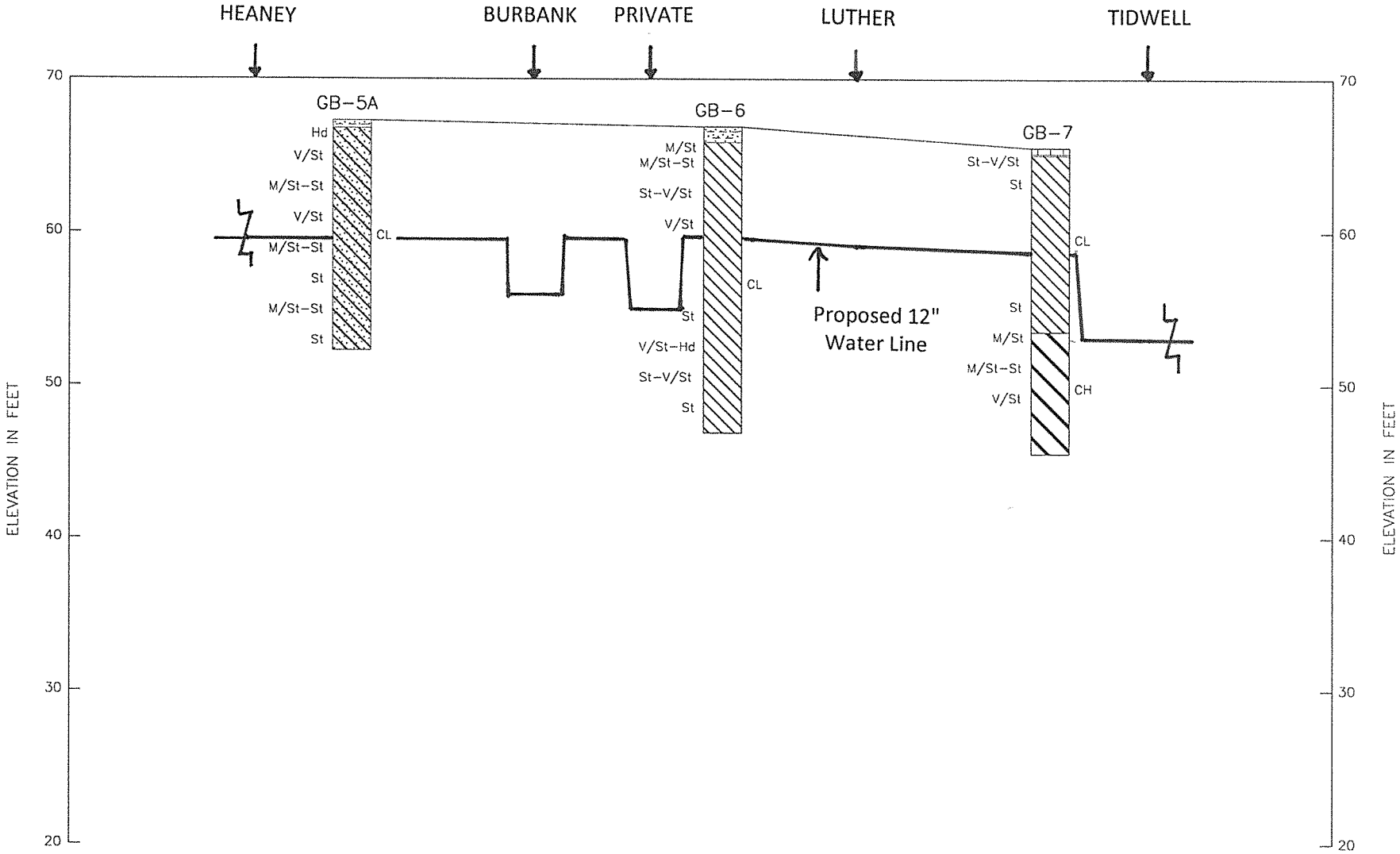
0 100 200 300 400

HORIZONTAL SCALE IN FEET

Job No. 1140208301

Geotest Engineering, Inc.

FIGURE 3.1



GENERAL NOTES:

1. See Figure 2.2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

BORING LOG PROFILE

BAUMAN

0 100 200 300 400

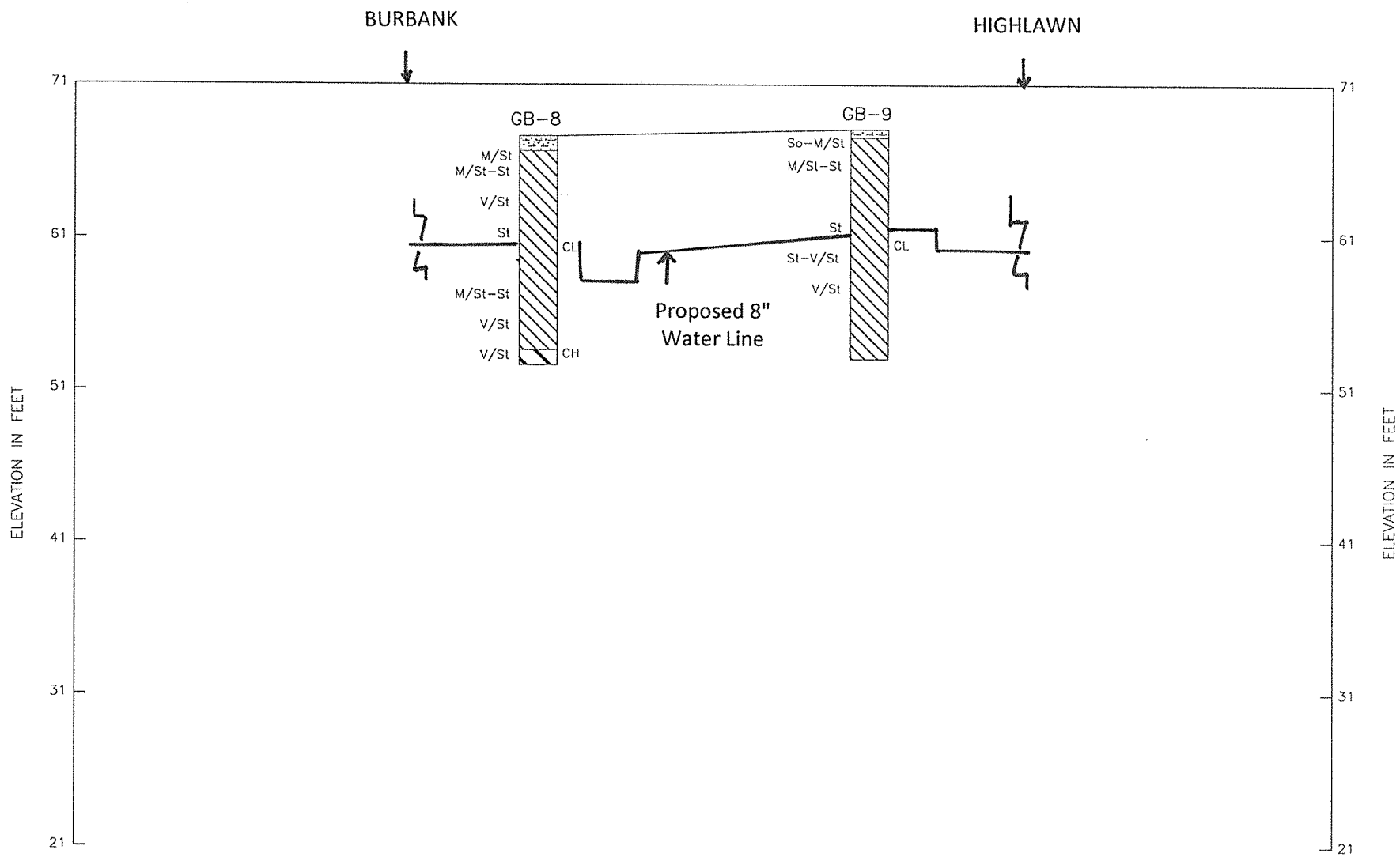
HORIZONTAL SCALE IN FEET

Job No. 1140208.J01

Geotest Engineering, Inc.

FIGURE 3.2

Job No. 1140208301



GENERAL NOTES:

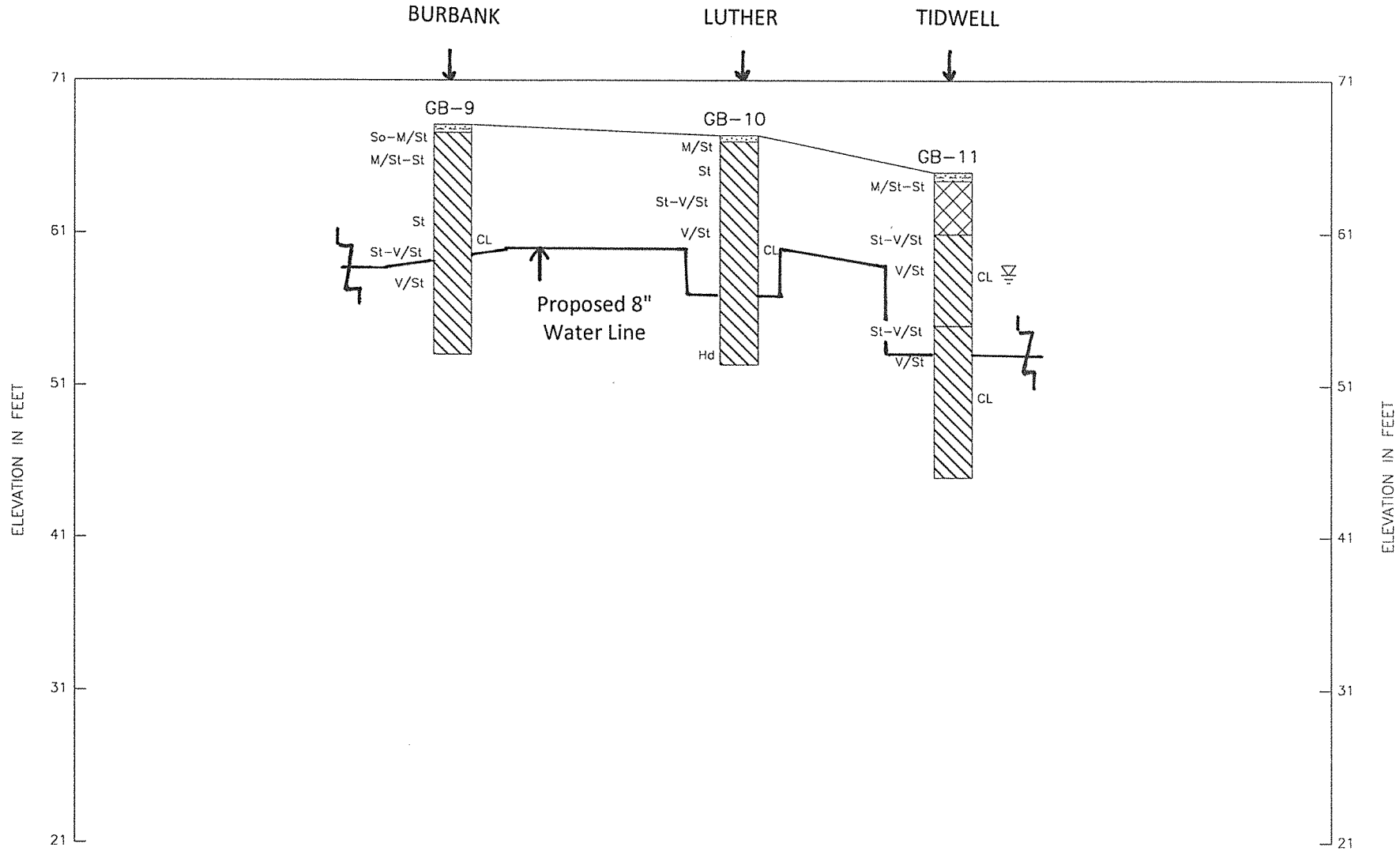
1. See Figure 2.2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

BORING LOG PROFILE
BURBANK

0 100 200 300 400
HORIZONTAL SCALE IN FEET

Geotest Engineering, Inc.

FIGURE 3.3



GENERAL NOTES:

1. See Figure 2.2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

BORING LOG PROFILE

HIGHLAWN

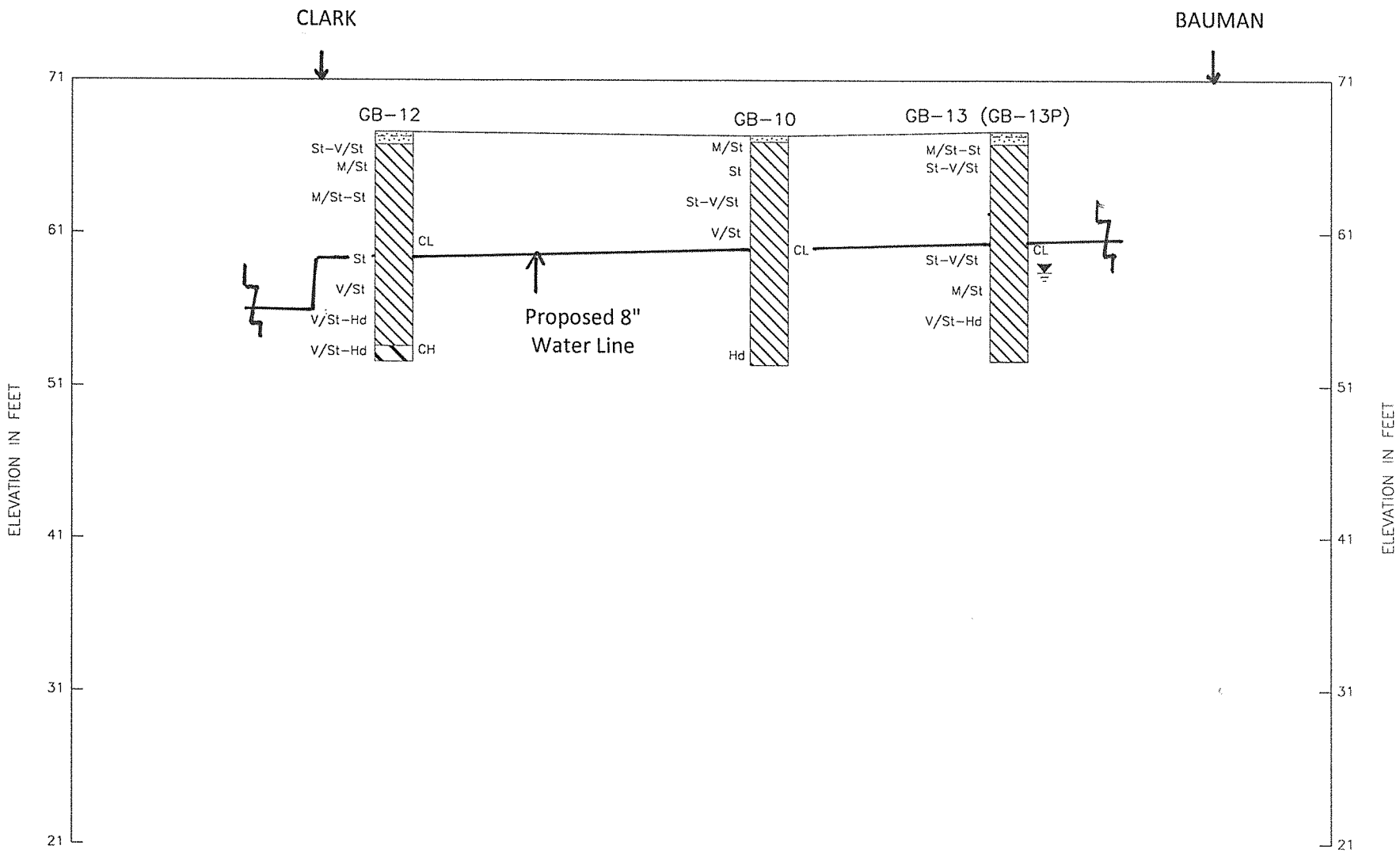
0 100 200 300 400

HORIZONTAL SCALE IN FEET

Job No. 1140208301

Geotest Engineering, Inc.

FIGURE 3.4



GENERAL NOTES:

1. See Figure 2.2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

BORING LOG PROFILE
LUTHER

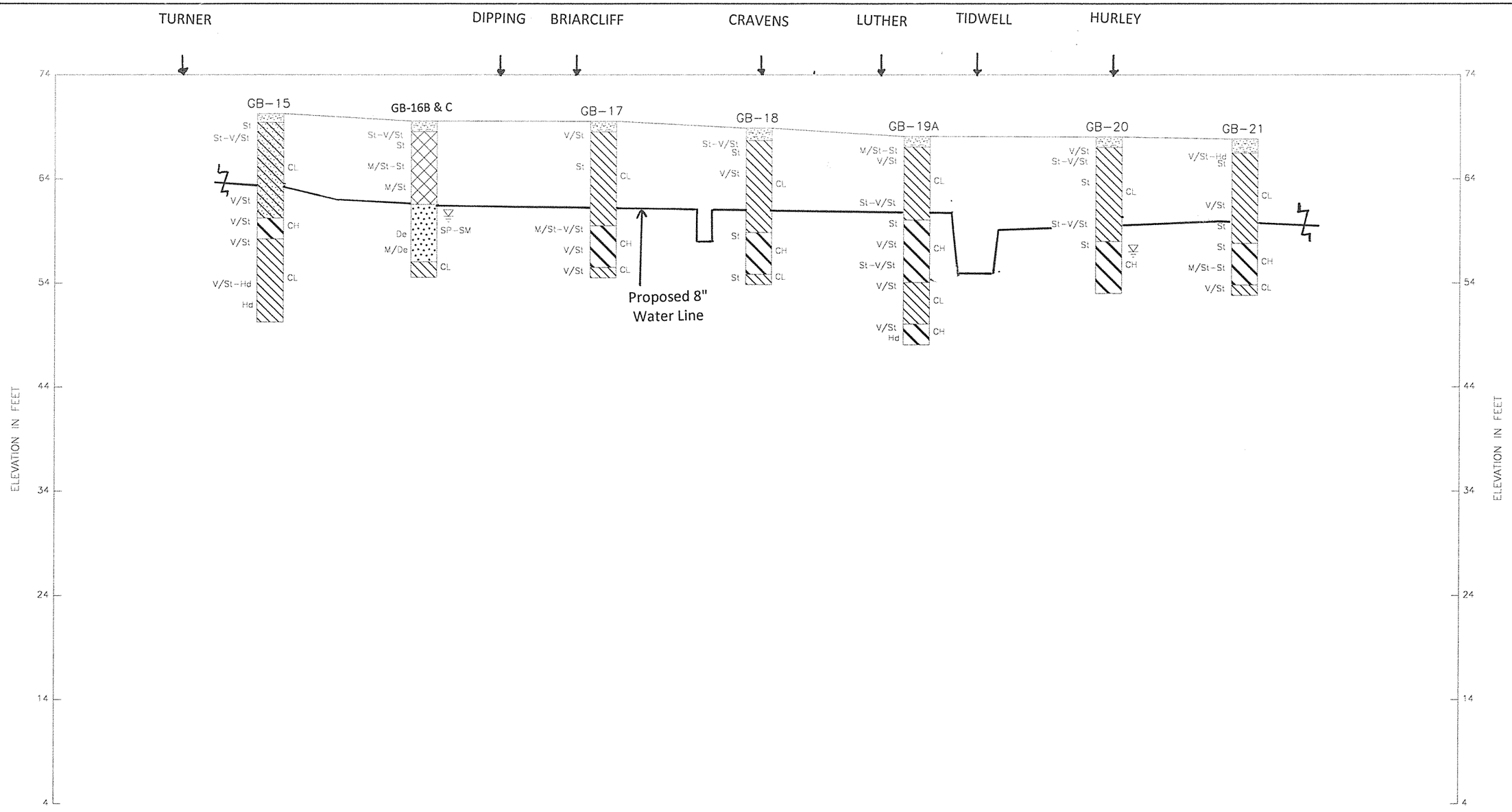
0 100 200 300 400

HORIZONTAL SCALE IN FEET

Job No. 1140208301

Geotest Engineering, Inc.

FIGURE 3.5



GENERAL NOTES:

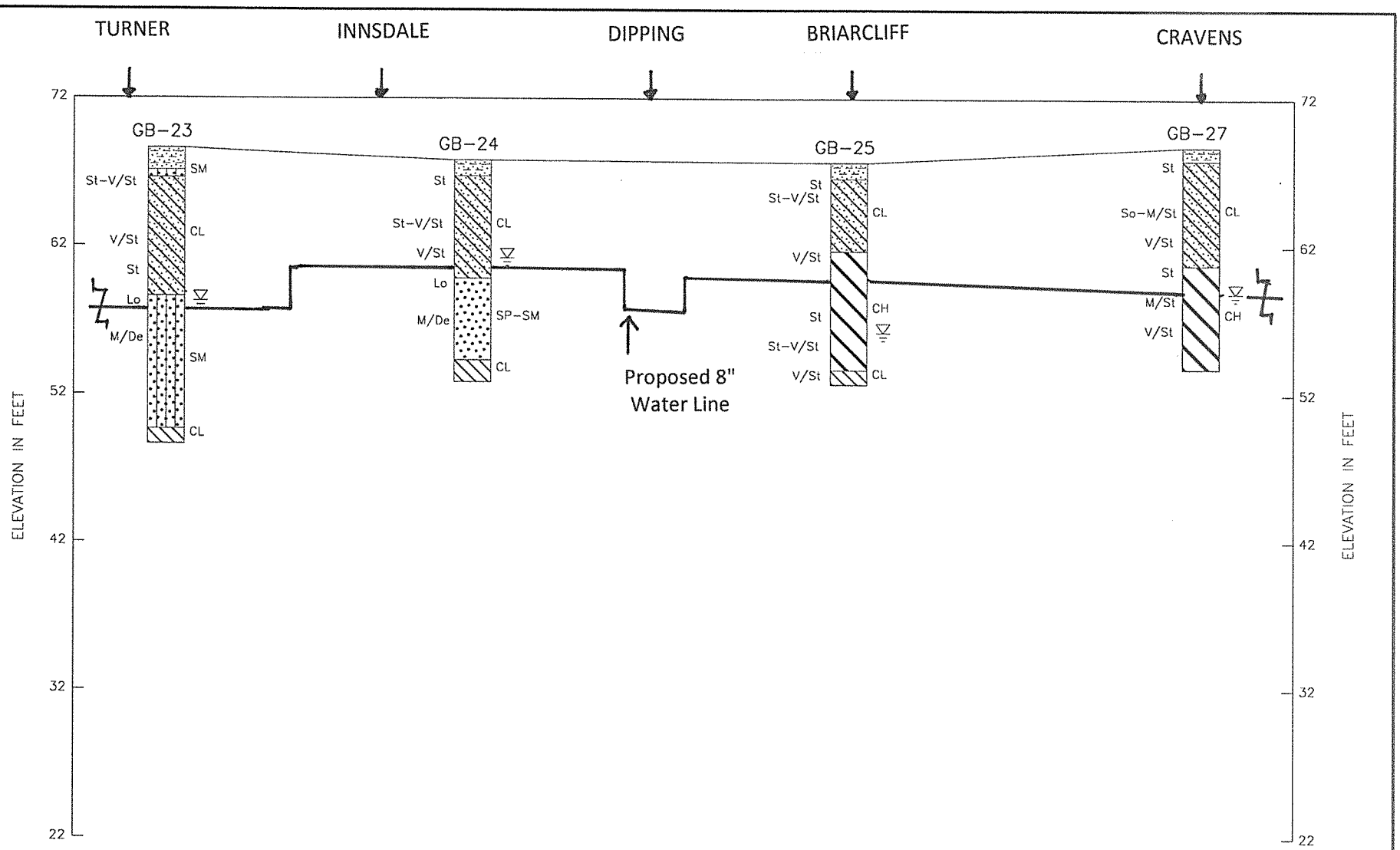
1. See Figures 2.3 & 2.4 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

BORING LOG PROFILE

McGALLION

0 150 300 450 600

HORIZONTAL SCALE IN FEET



GENERAL NOTES:

1. See Figure 2.3 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

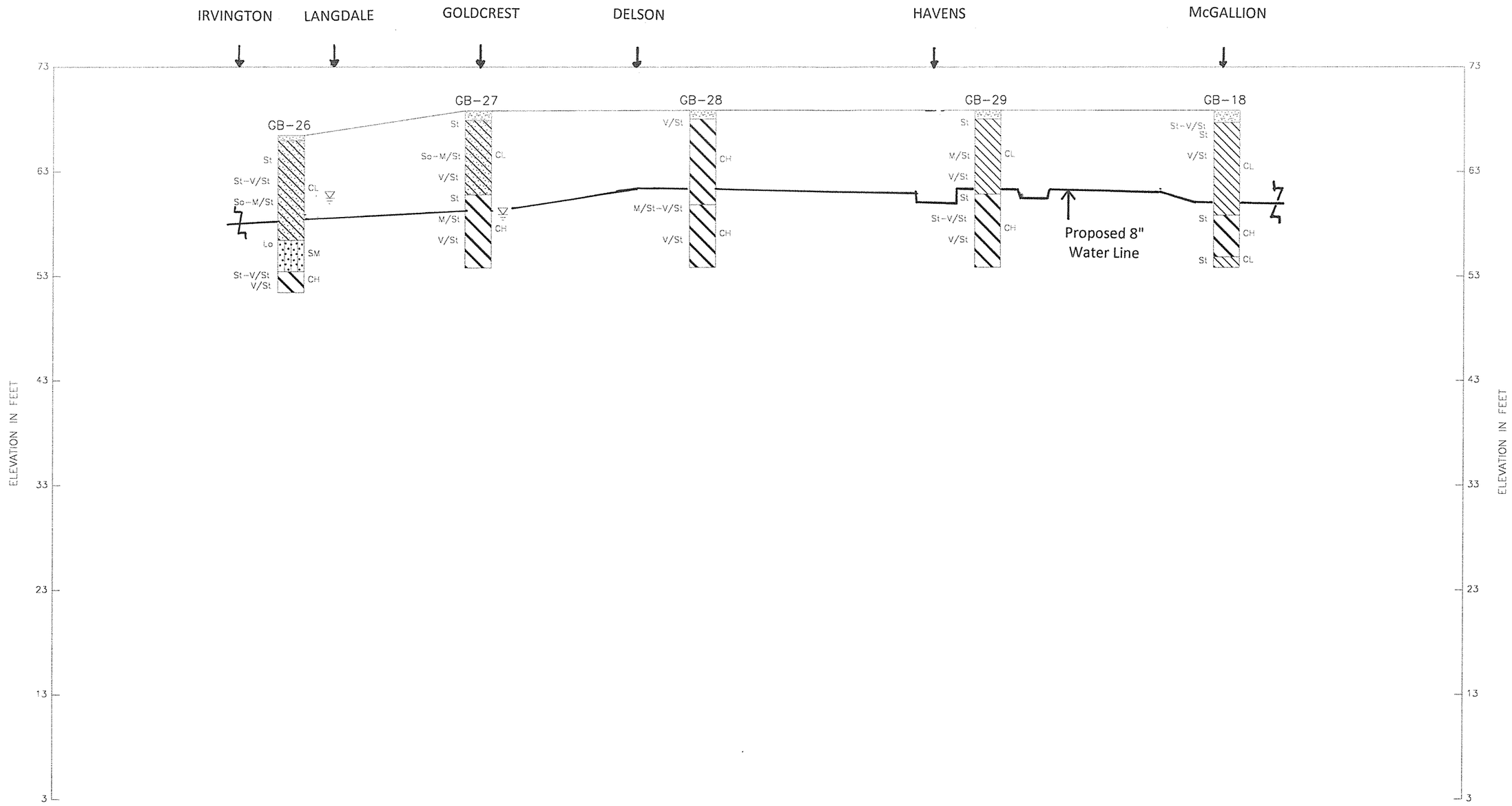
BORING LOG PROFILE
GOLDCREST

0 100 200 300 400
HORIZONTAL SCALE IN FEET

Job No. 1140208301

Geotest Engineering, Inc.

FIGURE 3.8



GENERAL NOTES:

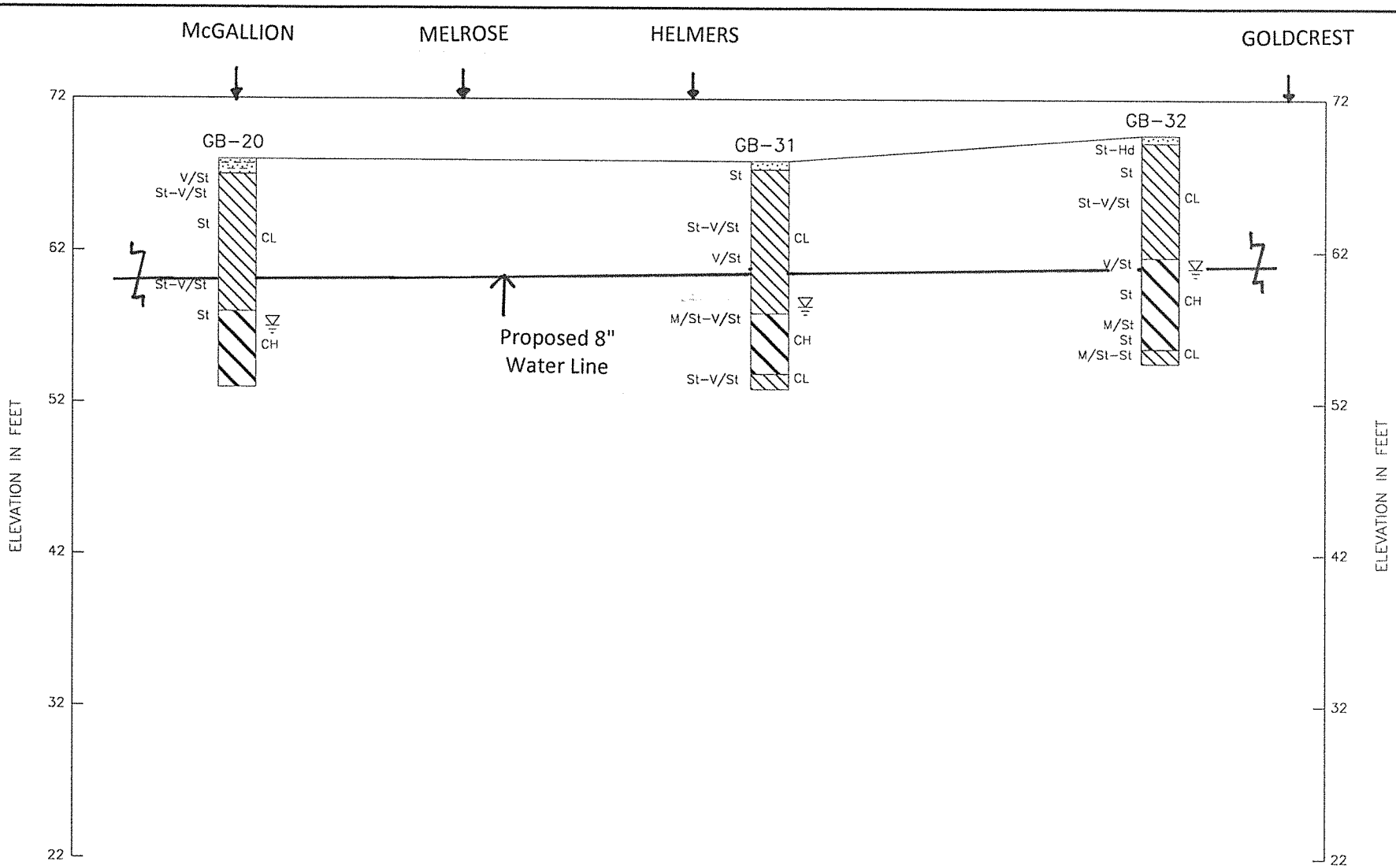
1. See Figure 2.3 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

BORING LOG PROFILE

CRAVENS

0 100 200 300 400

HORIZONTAL SCALE IN FEET



GENERAL NOTES:

1. See Figure 2.4 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

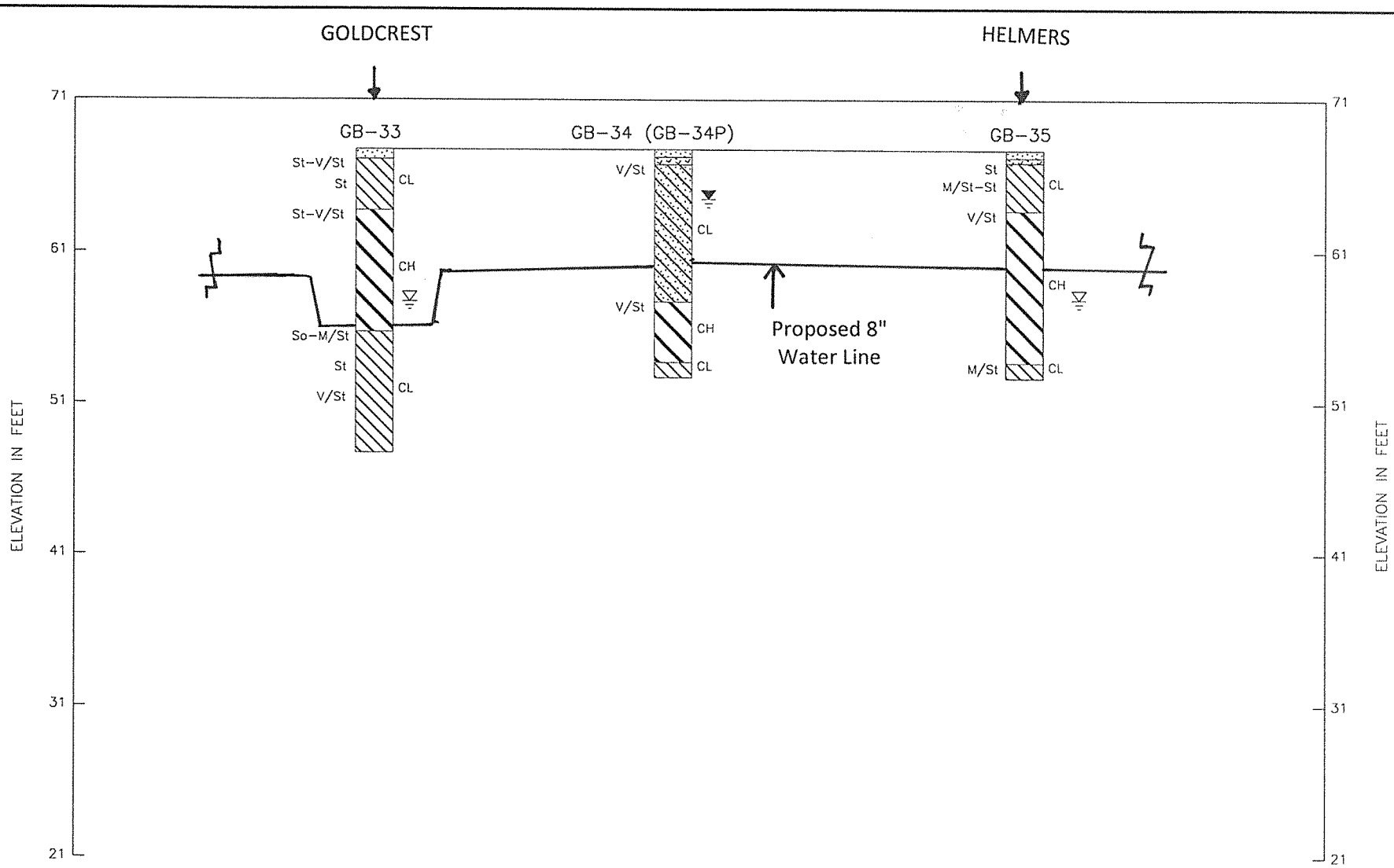
BORING LOG PROFILE
HURLEY

0 100 200 300 400
HORIZONTAL SCALE IN FEET

Job No. 1140208301

Geotest Engineering, Inc.

FIGURE 3.10



GENERAL NOTES:

1. See Figure 2.4 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

BORING LOG PROFILE

PENNINGTON

0 100 200 300 400

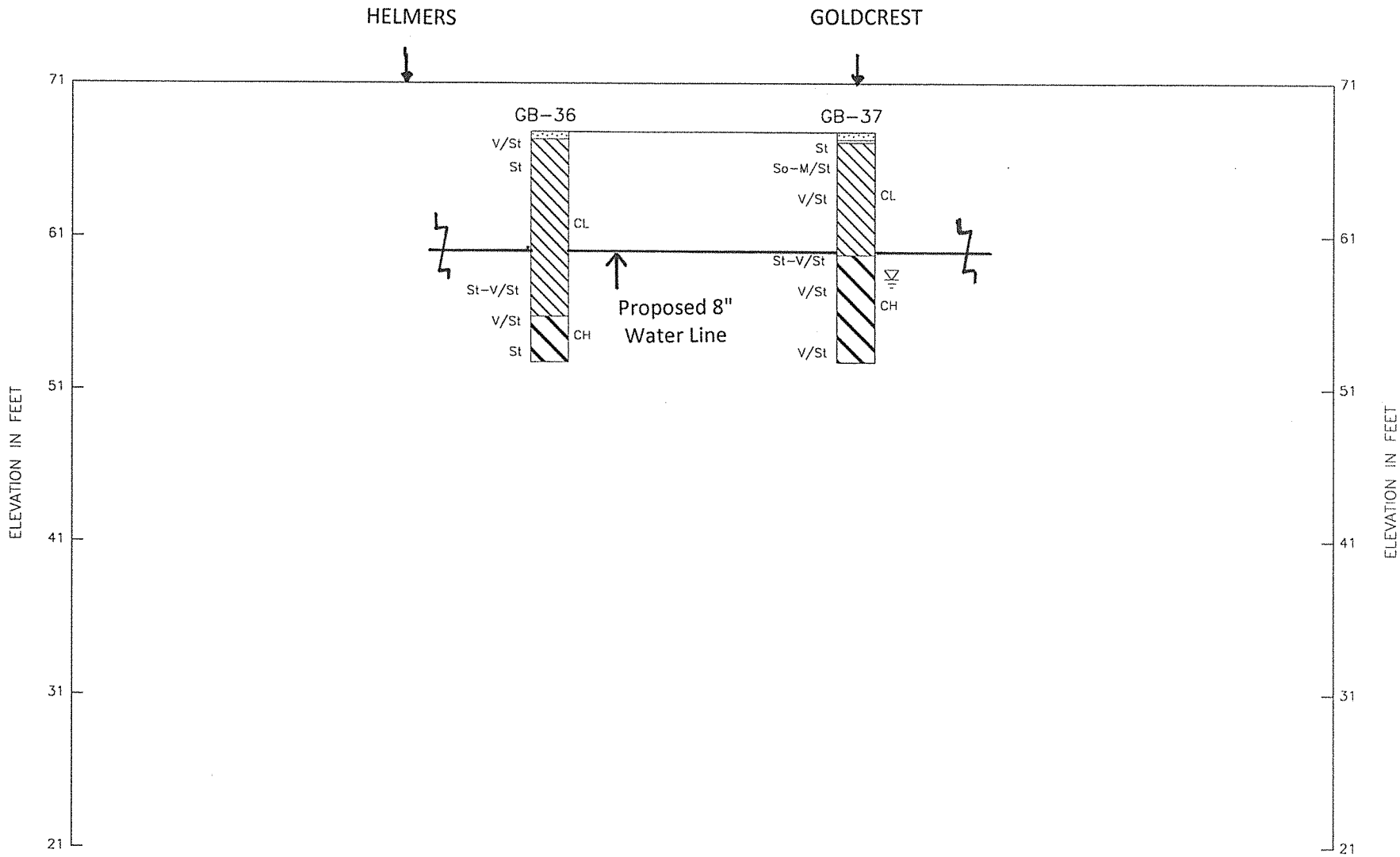
HORIZONTAL SCALE IN FEET

Job No. 1140208301

Geotest Engineering, Inc.

FIGURE 3.11

Job No. 1140208301



GENERAL NOTES:

1. See Figure 2.4 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

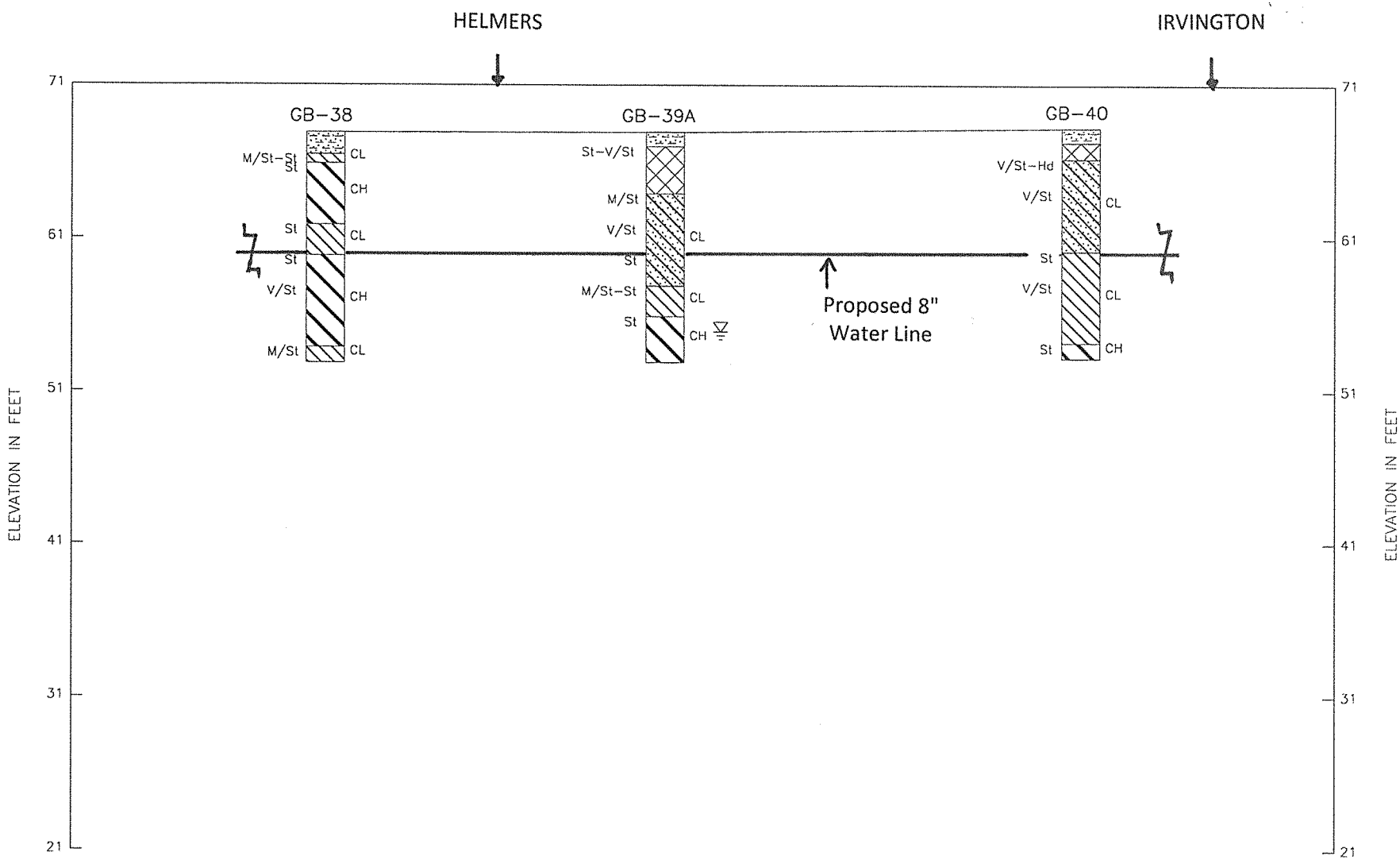
BORING LOG PROFILE
HOHL

0 100 200 300 400

HORIZONTAL SCALE IN FEET

Geotest Engineering, Inc.

FIGURE 3.12



GENERAL NOTES:

1. See Figure 2.4 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

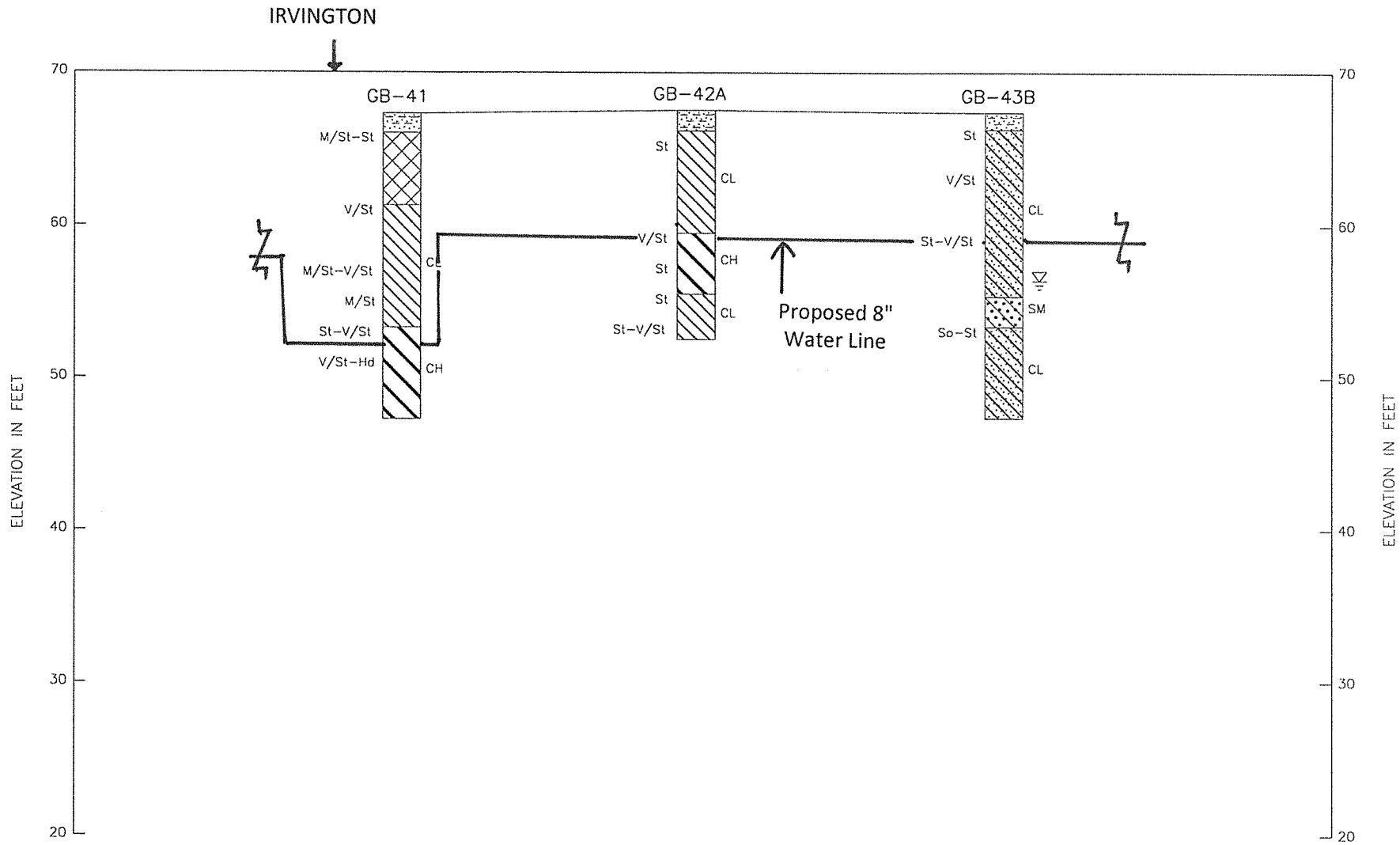
BORING LOG PROFILE
DEBOLL

0 100 200 300 400
HORIZONTAL SCALE IN FEET

Job No. 1140208301

Geotest Engineering, Inc.

FIGURE 3.13



GENERAL NOTES:

1. See Figure 2.6 & 2.7 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

BORING LOG PROFILE

FIRNAT

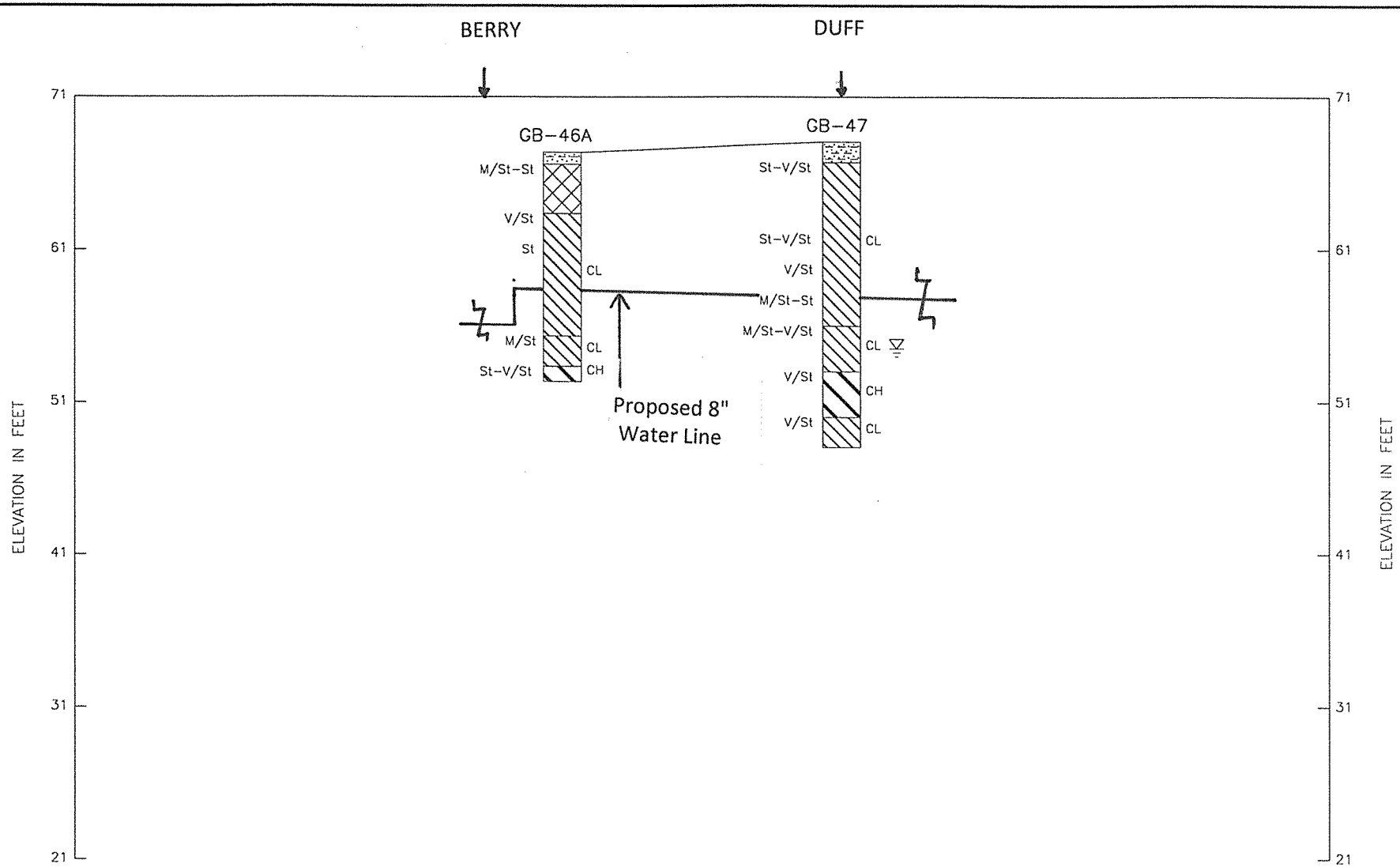
0 100 200 300 400

HORIZONTAL SCALE IN FEET

Job No. 1140208.301

Geotest Engineering, Inc.

FIGURE 3.14



GENERAL NOTES:

1. See Figure 2.6 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

BORING LOG PROFILE
HELMERS

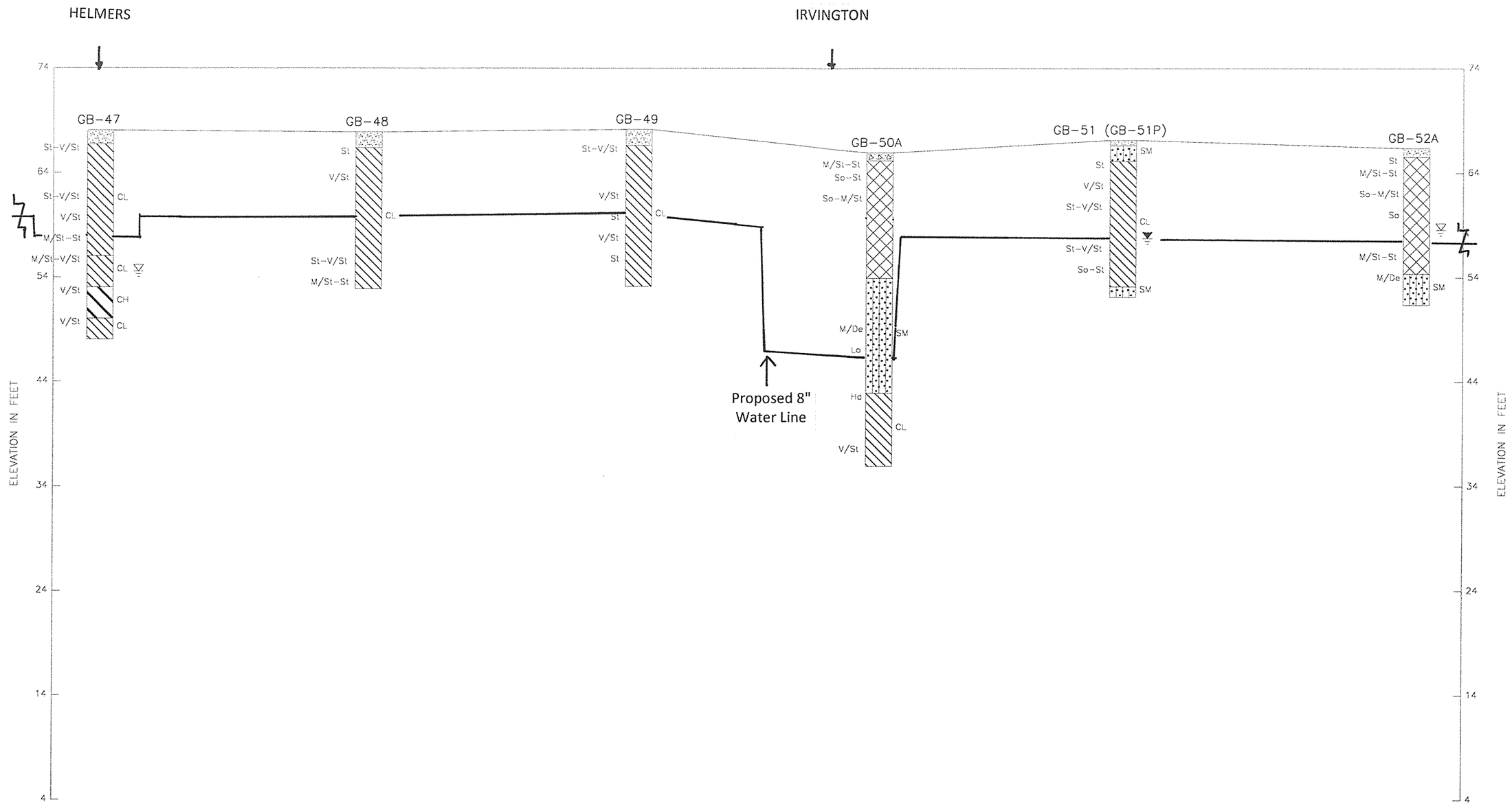
0 100 200 300 400

HORIZONTAL SCALE IN FEET

Job No. 1140208301

Geotest Engineering, Inc.

FIGURE 3.15



GENERAL NOTES:

1. See Figure 2.6 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

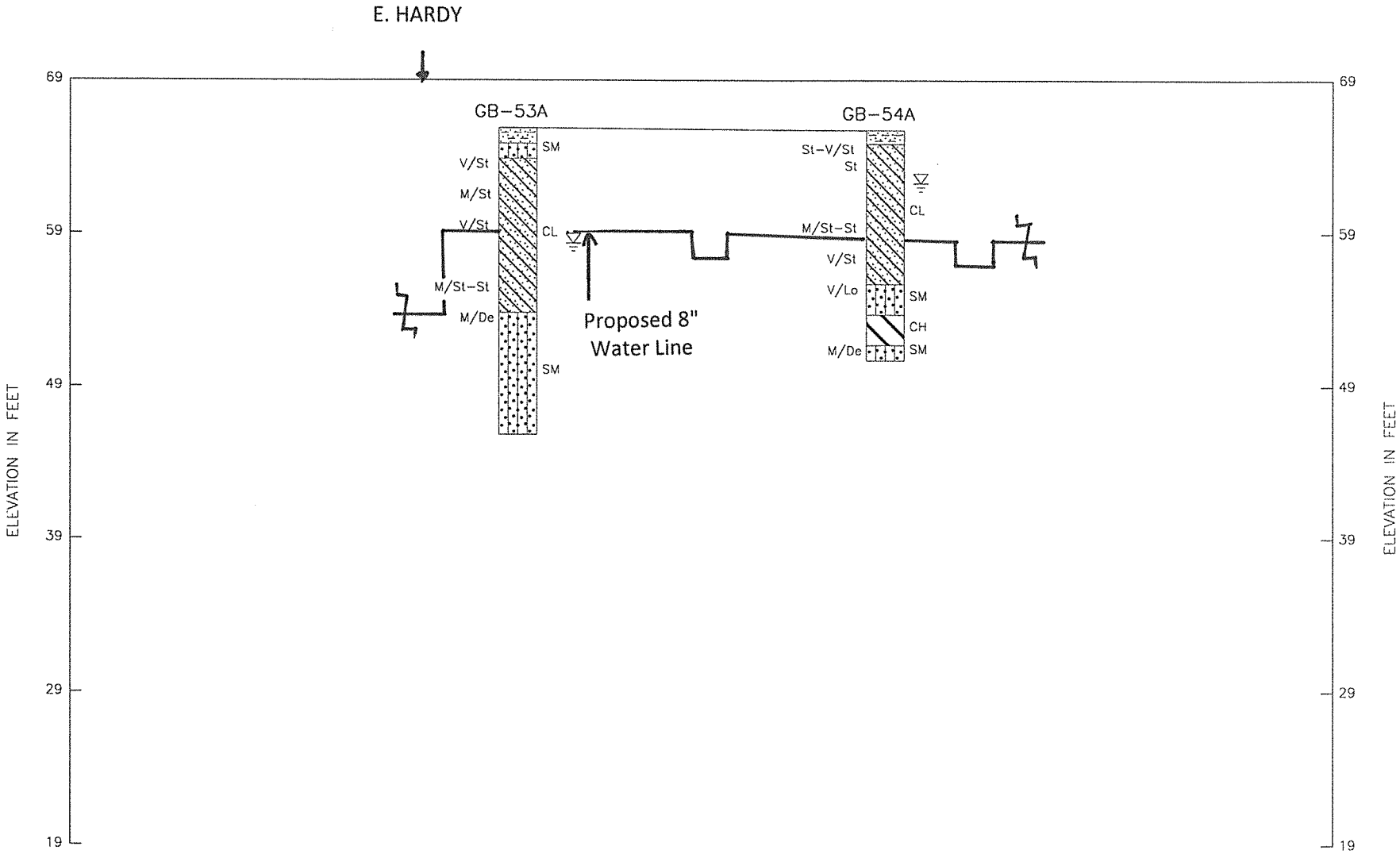
BORING LOG PROFILE

DUFF

0 100 200 300 400

HORIZONTAL SCALE IN FEET

Job No. 1140208301



GENERAL NOTES:

1. See Figure 2.7 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

BORING LOG PROFILE
HENDRICKS

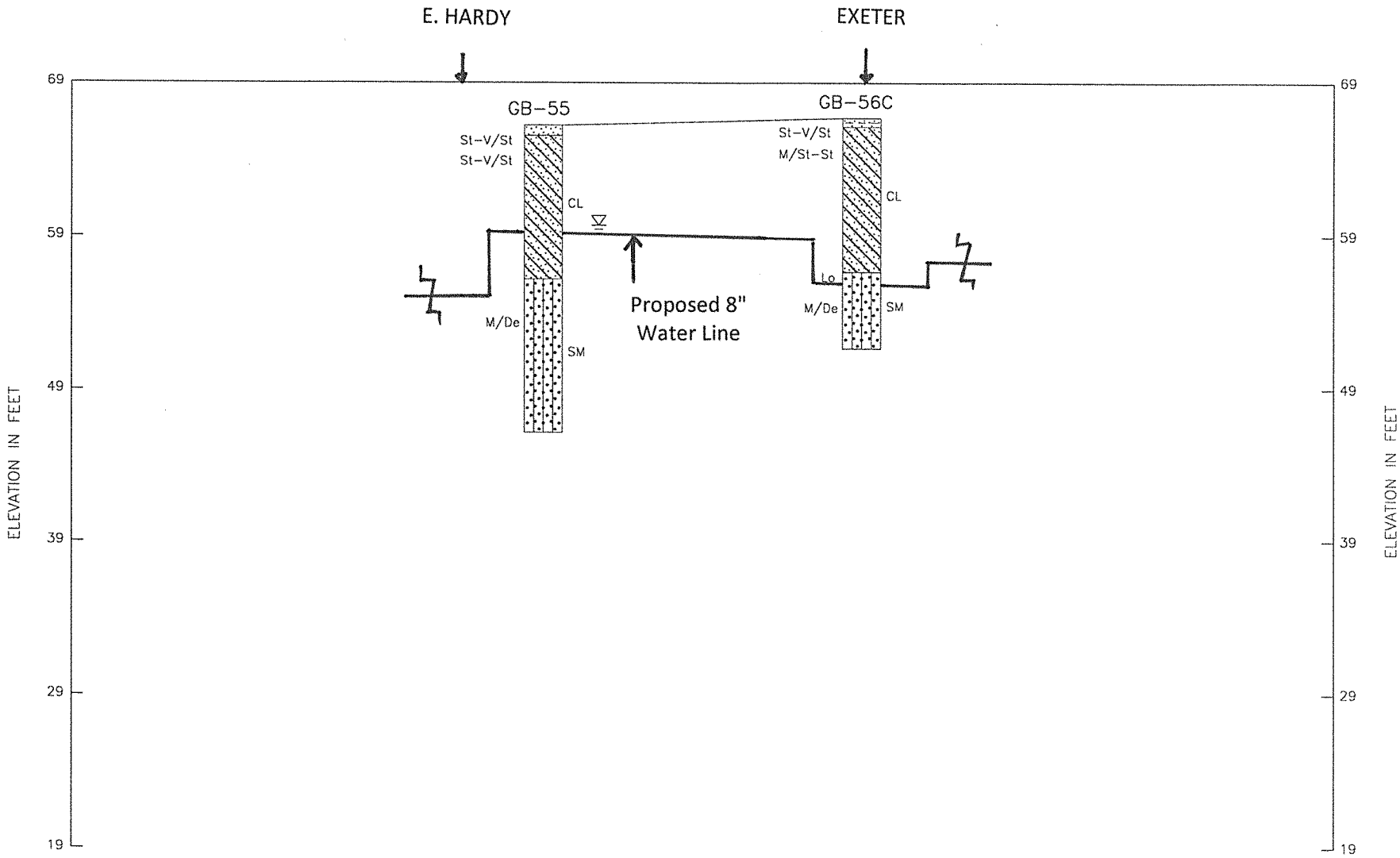
0 100 200 300 400

HORIZONTAL SCALE IN FEET

Geotest Engineering, Inc.

FIGURE 3.17

Job No. 1140208.301



GENERAL NOTES:

1. See Figure 2.5 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

BORING LOG PROFILE

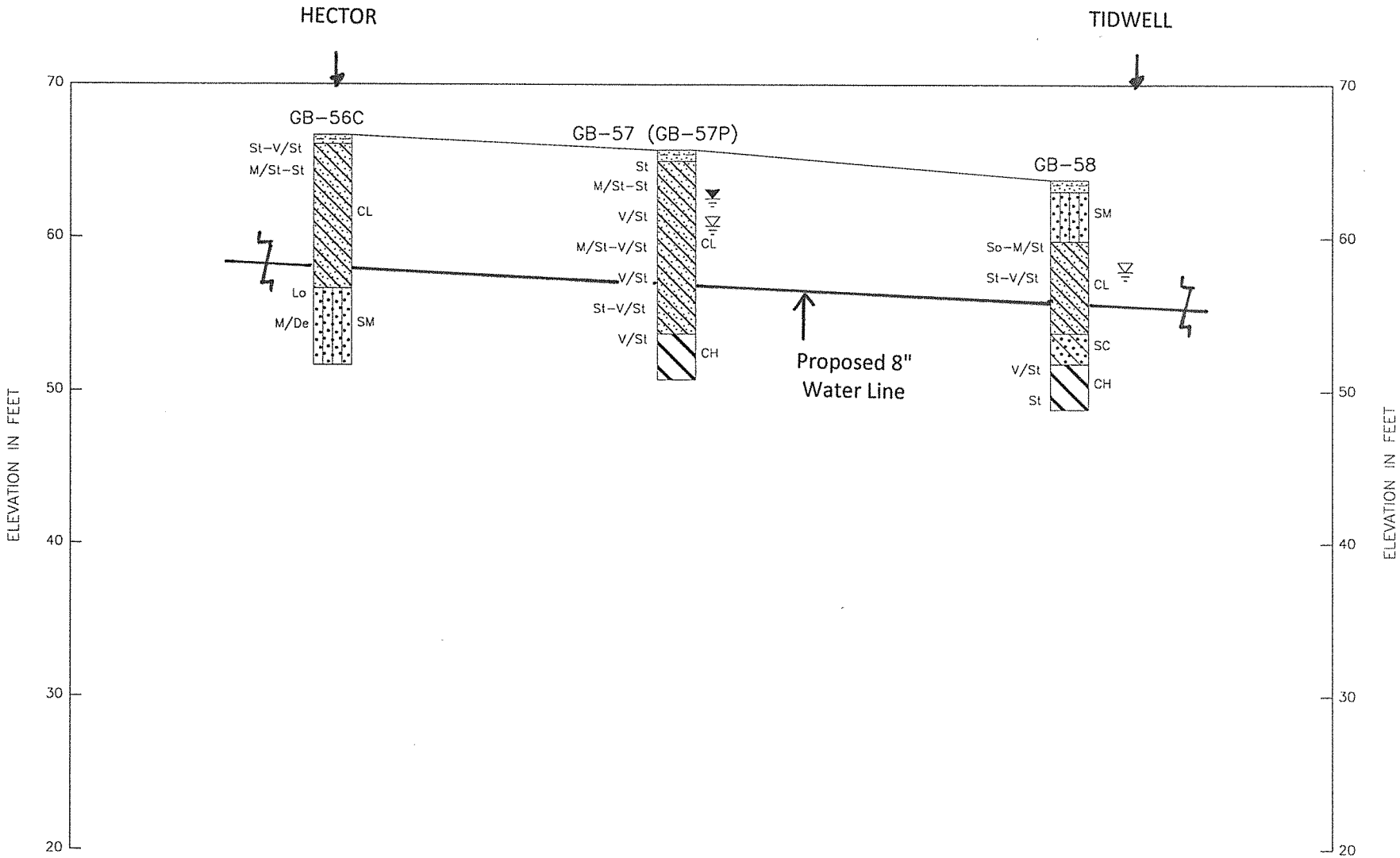
HECTOR

0 100 200 300 400

HORIZONTAL SCALE IN FEET

Geotest Engineering, Inc.

FIGURE 3.18



GENERAL NOTES:

1. See Figure 2.5 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by Kuo & Associates, Inc.

BORING LOG PROFILE
EXETER

0 100 200 300 400
HORIZONTAL SCALE IN FEET

Job No. 1140208301

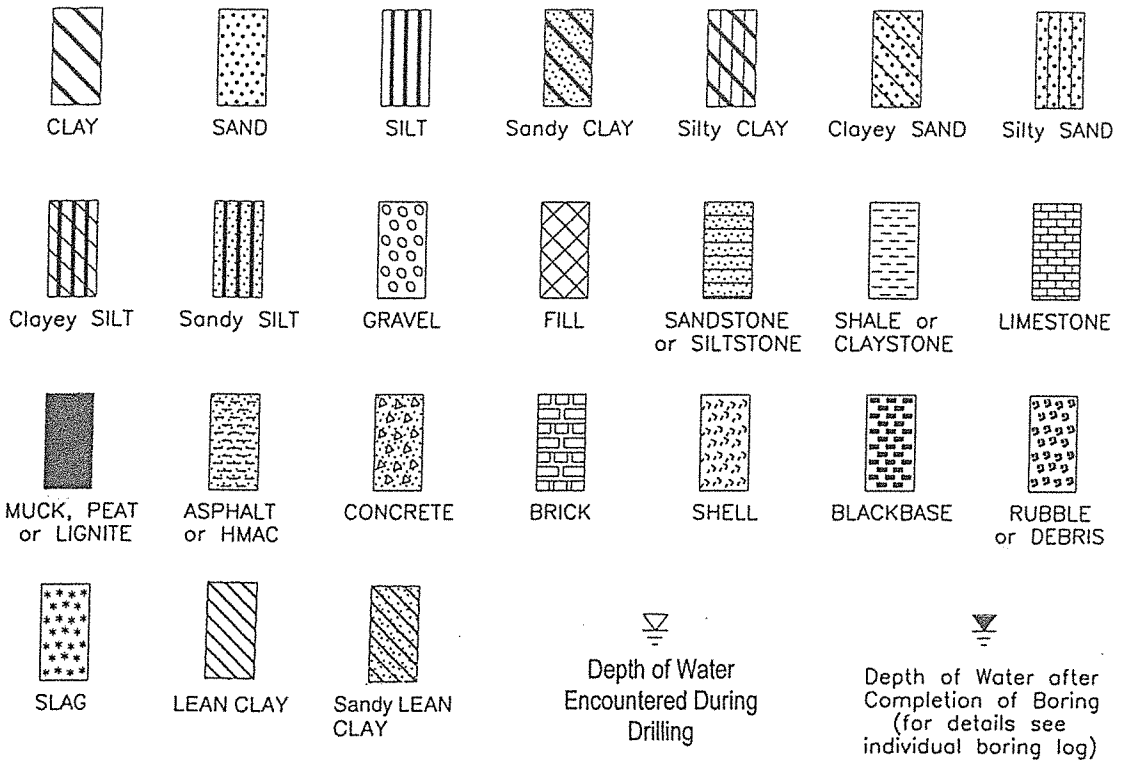
Geotest Engineering, Inc.

FIGURE 3.19

Job No. 1140208301

SYMBOLS AND ABBREVIATIONS USED ON BORING LOG PROFILE

LEGEND



ABBREVIATIONS USED FOR CONSISTENCY/DENSITY

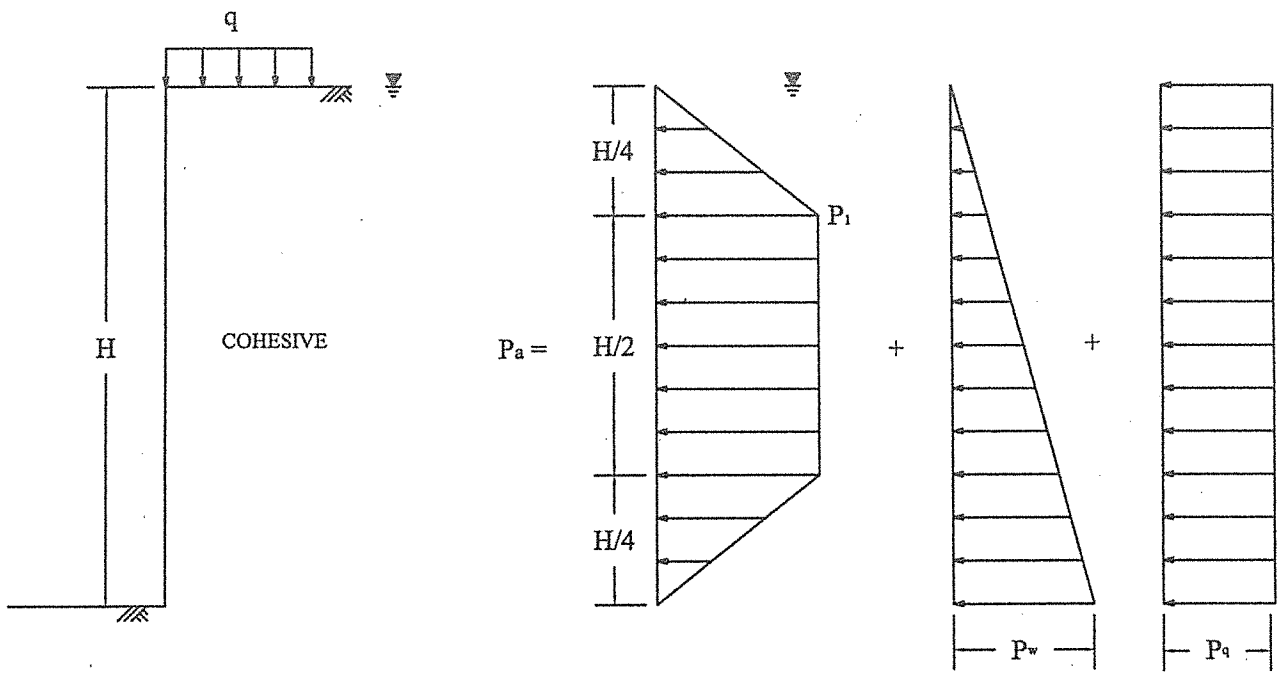
COHESIVE SOILS

V/So : Very Soft
So : Soft
Fm : Firm
M/St : Medium Stiff
St : Stiff
V/St : Very Stiff
Hd : Hard
V/Hd : Very Hard

COHESIONLESS SOILS

V/Lo : Very Loose
Lo : Loose
S/Co : Slightly Compact
Co : Compact
M/De : Medium Dense
De : Dense
V/De : Very Dense

Job No. 1140208301



TYPICAL SOIL PARAMETERS

See Table 2 for typical values of soil parameters

BRACED WALL

For $\gamma H/c \leq 4$

$P_1 = 0.3\ \gamma_c'\ H$
$P_w = \gamma_w\ H = 62.4\ H$
$P_q = 0.5\ q$

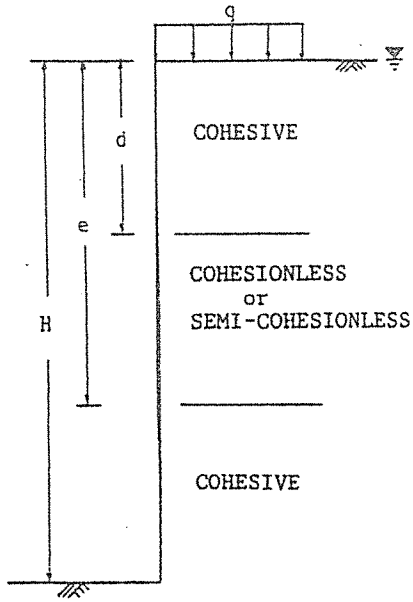
Where:

γ_c' = Submerged unit weight of cohesive soil, pcf;
γ_w = Unit weight of water, pcf;
q = Surcharge load at surface, psf;
P_a = Lateral pressure, psf;
P_1 = Active earth pressure, psf;
P_q = Horizontal pressure due to surcharge, psf;
P_w = Hydrostatic pressure due to groundwater, psf;
H = Depth of braced excavation, feet
c = Shear strength of cohesion soil, psf;

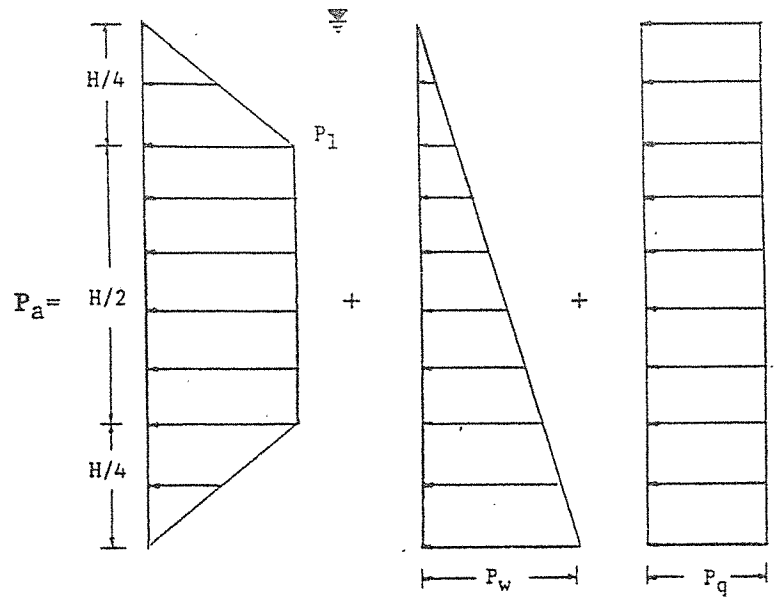
TRENCH SUPPORT EARTH PRESSURE

SUBMERGED COHESIVE SOIL

Job No. 1140208301



TYPICAL SOIL PARAMETERS



BRACED WALL

See Table 2 for typical values of soil parameters

$P_1 = 0.3\ \gamma'_{avg}\ H$

$P_w = \gamma_w\ H = 62.4\ H$

$P_q = 0.5q$

$$\gamma'_{avg} = \frac{\gamma_c'\ d + \gamma_s'\ (e-d) + \gamma_c'\ (H-e)}{H}$$

$\gamma_w = 62.4$ pcf

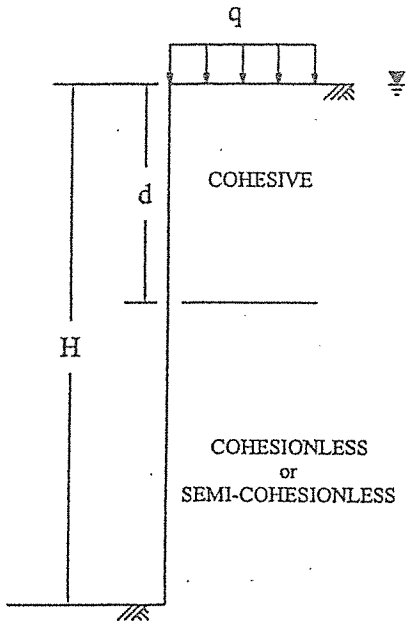
Where:

- γ_c' = Submerged unit weight of cohesive soil, pcf ;
- γ_s' = Submerged unit weight of cohesionless or semi-cohesionless soil, pcf ;
- γ_w = Unit weight of water, pcf;
- γ'_{avg} = Average submerged unit weight of soil, pcf ;
- q = Surcharge load at surface, psf;
- P_a = Lateral pressure, psf;
- P_1 = Active earth pressure, psf;
- P_q = Horizontal pressure due to surcharge, psf;
- P_w = Hydrostatic pressure due to groundwater, psf;
- H = Depth of braced excavation, feet

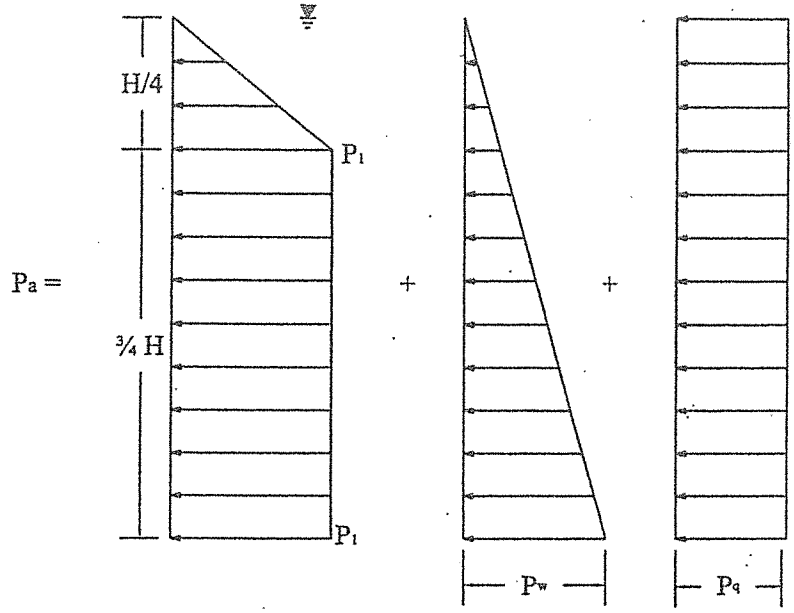
TRENCH SUPPORT EARTH PRESSURE

SUBMERGED COHESIVE SOIL
INTERBEDDED WITH COHESIONLESS OR
SEMI-COHESIONLESS SOIL

Job No. 1140208301



TYPICAL SOIL PARAMETERS



BRACED WALL

See Table 2 for typical values of soil parameters

$$\gamma'_{avg} = \frac{\gamma_c' d + \gamma_s' (H-d)}{H}$$

$P_1 = 0.3\ \gamma'_{avg}\ H$
$P_w = 62.4\ H$
$P_q = 0.5\ q$

Where:

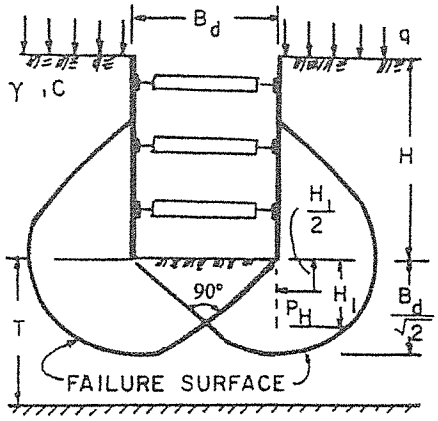
- γ_c' = Submerged unit weight of cohesive soil, pcf;
- γ_s' = Submerged unit weight of cohesionless soil, pcf;
- γ'_{avg} = Average submerged unit weight of soils, pcf;
- q = Surcharge load at surface, psf;
- P_a = Lateral pressure, psf;
- P_1 = Active earth pressure, psf;
- P_q = Horizontal pressure due to surcharge, psf;
- P_w = Hydrostatic pressure due to groundwater, psf;
- H = Depth of braced excavation, feet

TRENCH SUPPORT EARTH PRESSURE

SUBMERGED COHESIVE SOIL OVER
COHESIONLESS OR SEMI-COHESIONLESS SOIL

Job No. 1140208301

CUT IN COHESIVE SOIL,
DEPTH OF COHESIVE SOIL UNLIMITED ($T > 0.7\ B_d$)
L = LENGTH OF CUT



If sheeting terminates at base of cut:

$$\text{Safety factor, } F_S = \frac{N_C C}{\gamma H + q}$$

N_C = Bearing capacity factor, which depends on dimensions of the excavation : B_d , L and H (use N_C from graph below)

C = Undrained shear strength of clay in failure zone beneath and surrounding base of cut

γ = Wet unit weight of soil (see Table 2)

q = Surface surcharge (assumed q = 500 psf)

If safety factor is less than 1.5, sheeting or soldier piles must be carried below the base of cut to insure stability - (see note)

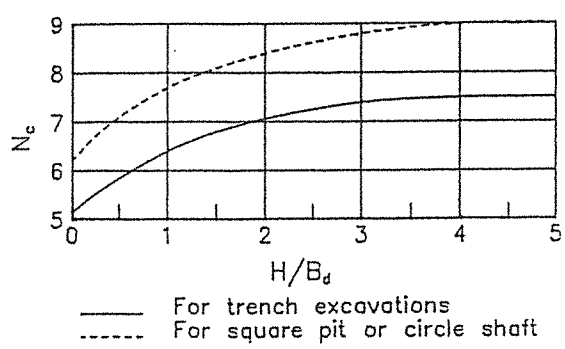
$$H_1 = \text{Buried length} = \frac{B_d}{2} \geq 5 \text{ feet}$$

Note : If soldier piles are used, the center to center spacing should not exceed 3 times the width or diameter of soldier pile .

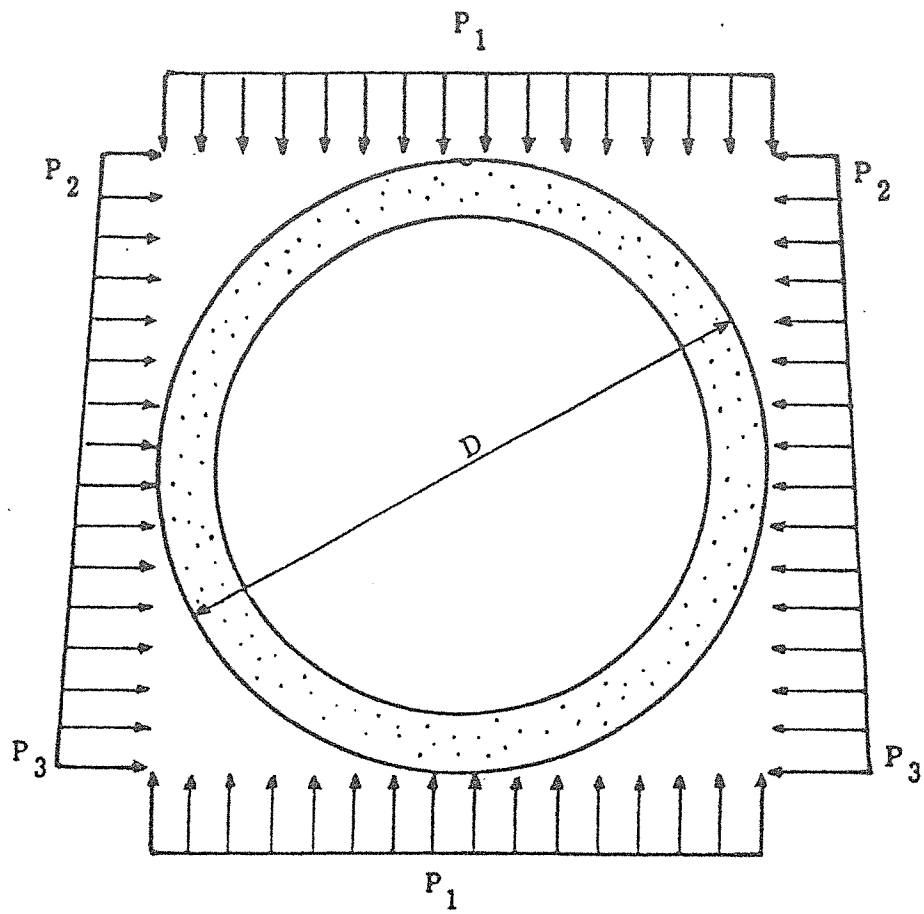
Force on buried length, P_H:

If $H_1 > \frac{2}{3}\frac{B_d}{\sqrt{2}}$, $P_H = 0.7\ (\gamma\ HB_d - 1.4CH - \pi CB_d)$ in lbs/ linear foot

If $H_1 < \frac{2}{3}\frac{B_d}{\sqrt{2}}$, $P_H = 1.5H_1\ (\gamma\ H - \frac{1.4CH}{B_d} - \pi C)$ in lbs/ linear foot



STABILITY OF BOTTOM
FOR
BRACED CUT



$$P_1 = [(H + \frac{D}{2}) \times (\gamma - \gamma_w) + D_w \times \gamma_w] + q_s \text{, for } D_w < H + \frac{D}{2}$$

$$P_1 = [(H + \frac{D}{2}) \times \gamma] + q_s \text{, for } D_w \geq H + \frac{D}{2}$$

$$P_2 = (H \times \gamma) + q_s$$

$$P_3 = [(H + D) \times \gamma] + q_s$$

Where: P_1, P_2, P_3 = Tunnel liner load, psf.

D = Tunnel outside diameter, ft.

H = Depth to top of tunnel; ft.

D_w = Depth to ground water level; ft.

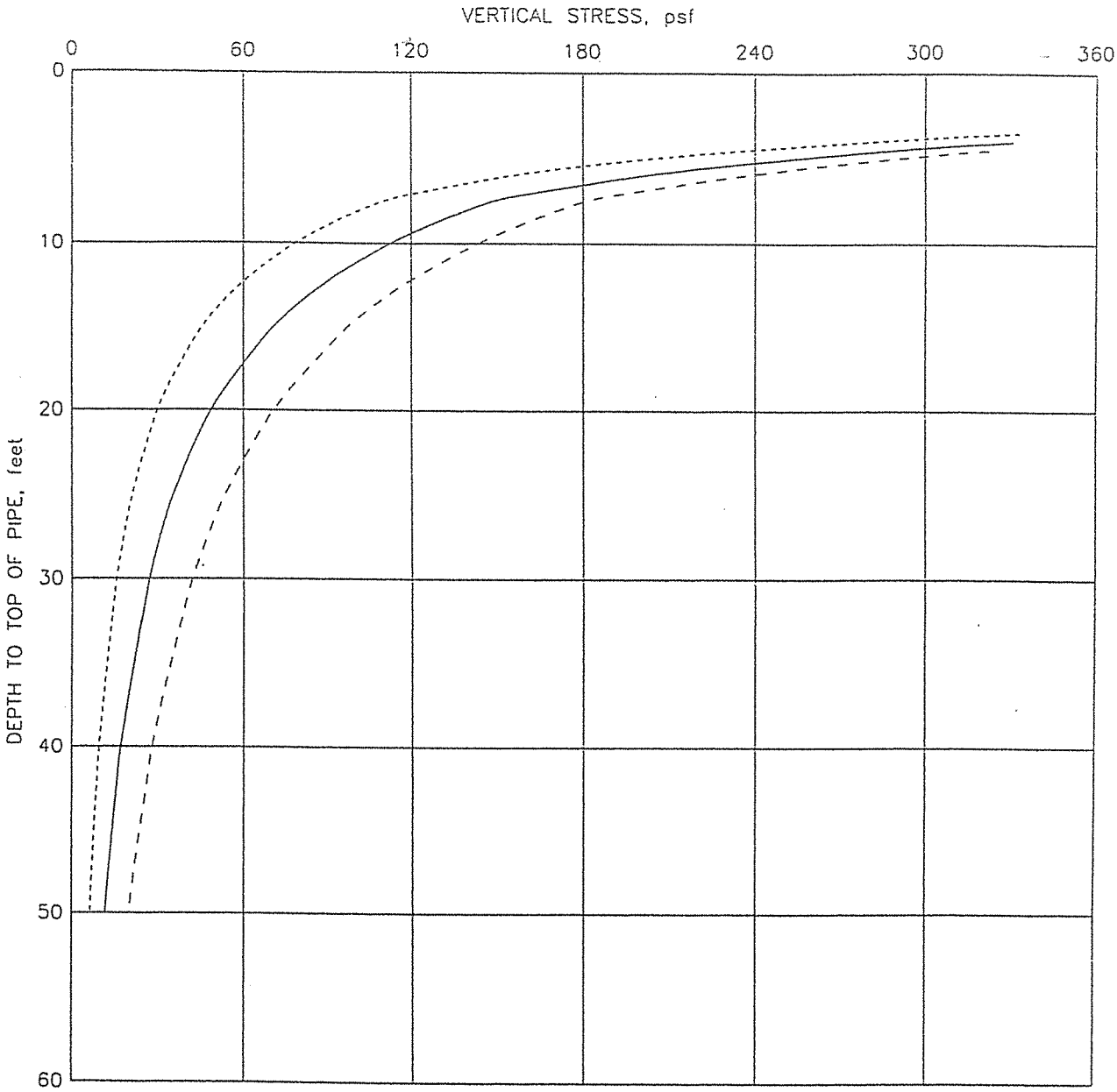
γ = Wet unit weight of soil, pcf (see Table 3)

γ_w = Unit weight of water, 62.4 pcf

q_s = Surcharge load, psf.

EARTH PRESSURE ON PIPE AND CASING AUGERING

Job No. 1140208301

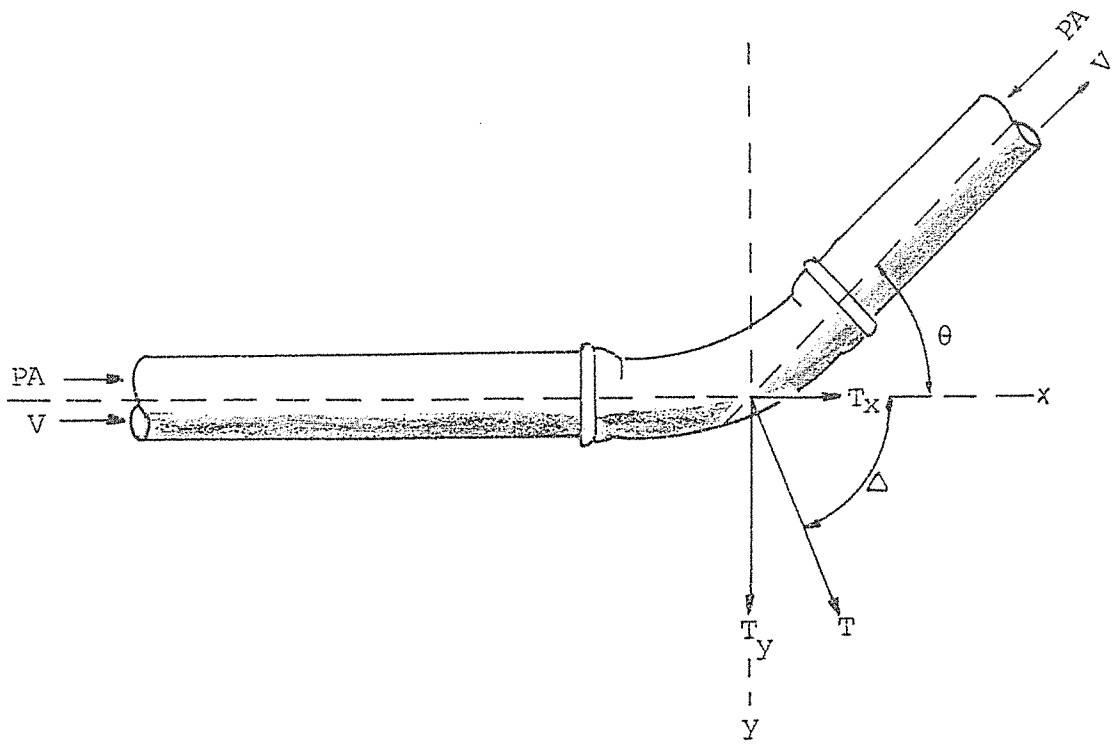


Legend:

------ One passing truck
——— Two passing trucks
– – – Four passing trucks

Notes: 1. The vertical stress was estimated using AASHTO H20 or HS20 truck axle loadings on paved surfaces.
2. Impact factor was included in the vertical stress.

VERTICAL STRESS ON PIPES
DUE TO TRAFFIC LOADS



$T_x = PA\ (1 - \cos\theta)$

$T_y = PA \sin\theta$

$T = 2\ PA \sin\frac{\theta}{2}$

$\Delta = (90 - \frac{\theta}{2})$

Where:

- T is the resultant force on the bend
- T_x is the component of thrust force in x-direction
- T_y is the component of thrust force in y-direction
- P is the maximum sustained pressure
- A is the pipe cross-sectional area
- θ is the bend deflection angle
- Δ is the angle between T and X-axis
- V is the fluid velocity

THRUST FORCES ACTING ON A BEND

APPENDIX A

	Figure
Log of Borings	A-1 thru A-58
Symbols and Terms Used on Boring Logs	A-59
Piezometer Installation Reports	A-60 thru A-65

LOG OF BORING NO. GB-1

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13871477.35, E 3116051.25
Meta Street; See Plan of Borings (Figure 2.1)

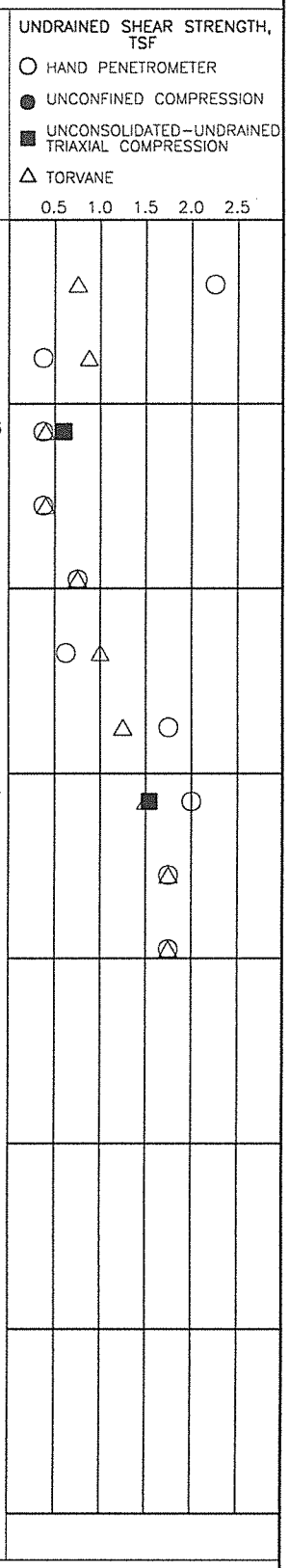
COMPLETION DEPTH : 20.0 FT.

SURFACE ELEVATION : 64.94 FT.

DATE : 02-13-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 20.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
64.9	0	5" Asphalt over 6" Oyster Shell and Sand Mix							
64.0		Stiff to hard gray and brown LEAN CLAY (CL) w/sand and calcareous nodules				14			
						16			
	5	-medium stiff to stiff 2'-6'							
		-w/ferrous stains 2'-8'		74	111	18	40	17	23
		-medium stiff gray and yellowish brown 6'-8'							
		-stiff 8'-10'				20			
						15			
	10	-stiff to very stiff 10'-12'							
		-very stiff 12'-14'				20			
		-very stiff to hard 14'-16'				16			
	15								
48.9		Very stiff gray and red FAT CLAY (CH) w/calcareous nodules, slickensided		77	119	16	44	17	27
						22			
44.9	20					23			
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-1

LOG OF BORING NO. GB-2

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13871195.50, E 3116368.36
Meadow Lea Drive; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 15.0 FT.

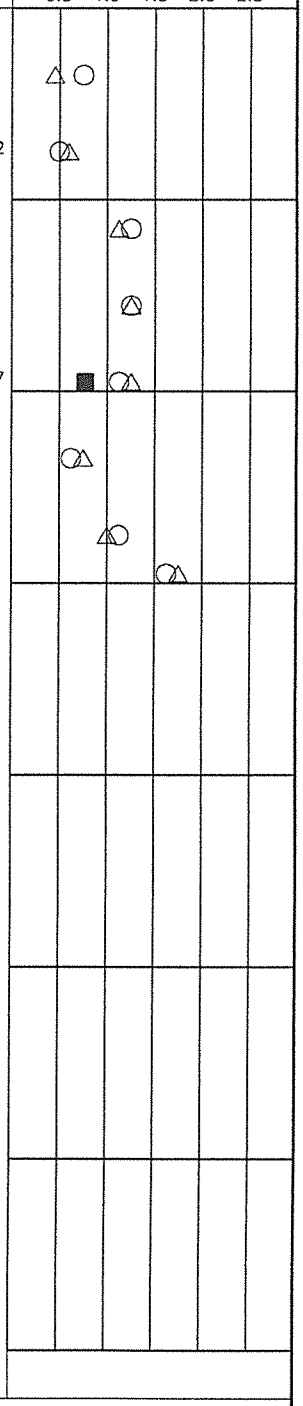
SURFACE ELEVATION : 64.09 FT.

DATE : 02-13-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
64.1	0	4" Asphalt over 11" Limestone, Shell, and Sand Mix							
62.8		Medium stiff to stiff yellowish brown and gray LEAN CLAY (CL) w/sand, ferrous nodules, and ferrous stains				19			
				75		20	38	16	22
	5	-stiff crawfish hole 2'-4'				17			
		-very stiff w/calcareous nodules 4'-8'				17			
		-stiff to very stiff 8'-10'							
		-gray and brown 8'-15'							
	10	-stiff 10'-12'		77	114	18	43	16	27
		-very stiff 12'-15'				24			
		-yellowish brown and gray 14'-15'				16			
49.1	15					17			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 15.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 11.8 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-2

LOG OF BORING NO. GB-3

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Meadow Lea Drive
See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 2.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-13-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 2.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER; ● UNCONFINED COMPRESSION; ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION; △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			2.5" Asphalt over 11.5" Stabilized Sand								
				Stiff gray LEAN CLAY (CL)								○
				NOTE : Obstruction was encountered at 2 feet and boring was offset to GB-3A.								
	5											
	10											
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 2.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-3

LOG OF BORING NO. GB-3A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13871222.08, E 3116863.47
Meadow Lea Drive; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 15.0 FT.

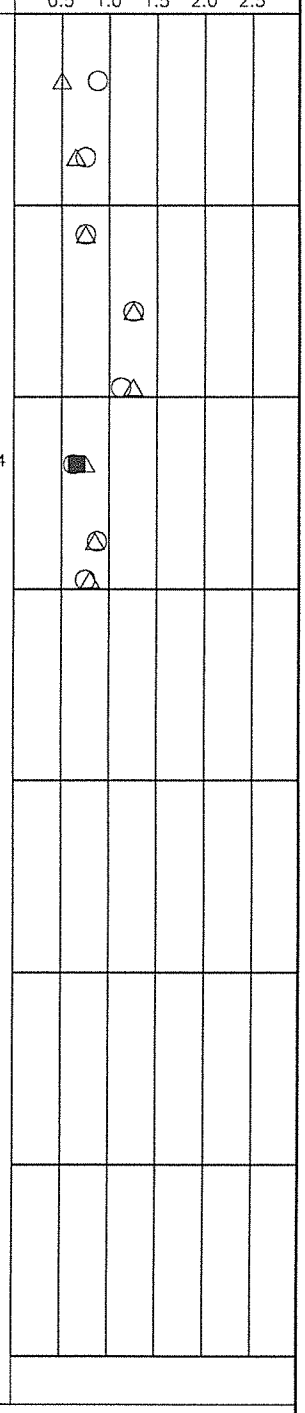
SURFACE ELEVATION : 63.35 FT.

DATE : 02-27-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
63.3	0								
62.8		3" Asphalt over 4" Sand and Shell Mix							
		Stiff gray SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules				14			
						16			
	5								
		-very stiff 6'-10'				17			
		-gray and yellowish brown w/ferrous stains 6'-15'				17			
	10					18			
				68	112	18	40	16	24
						20			
48.3	15					17			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-3A

LOG OF BORING NO. GB-4

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Madie Drive
See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 2.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-27-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 2.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (0.5 1.0 1.5 2.0 2.5)
	0			3" Asphalt over 8" Sand and Shell Mix								
	5			NOTE : Obstruction was encountered at 2 feet and boring was offset to GB-4A.								
	10											
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 2.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-4

LOG OF BORING NO. GB-4A (GB-4AP)

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13871438.38, E 3117180.59
Madie Drive; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 20.0 FT.

SURFACE ELEVATION : 62.28 FT.

DATE : 02-27-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 20.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
62.3	0	FILL: very stiff gray lean clay w/asphalt, and limestone fragments							
60.3		-w/grass roots 0'-2'				14			
		Very stiff gray and brown LEAN CLAY (CL) w/sand and calcareous nodules				16			
	5	-medium stiff to stiff 4'-6'				19			
		-soft to medium stiff 6'-8'							
		-medium stiff to stiff 8'-10'		73	113	20	27	16	11
	10	-medium stiff 10'-12'				20			
		-stiff to very stiff 12'-14'				19			
48.3						20			
	15	Medium stiff yellowish brown and gray SANDY LEAN CLAY (CL) w/ferrous nodules and ferrous stains		70	115	20	29	15	14
		-very stiff 16'-18'				15			
		-stiff to very stiff 18'-20'							
42.3	20					14			
		NOTE : See Piezometer GB-4AP for water level measurements.							
	25								
	30								
	35								

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
▼: WATER DEPTH AT 5.0 FT., HOLE OPEN TO 20.0 FT. ON 04-03-15.

Geotest Engineering, Inc.

FIGURE A-4A

LOG OF BORING NO. GB-5

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Bauman Drive
See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 2.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-28-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 2.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			3" Asphalt over 8" Limestone and Sand Mix								
	5			NOTE : Obstruction was encountered at 2 feet and boring was offset to GB-5A.								
	10											
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 2.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-5

LOG OF BORING NO. GB-5A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13875671.92, E 3118857.22
Bauman Drive; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 15.0 FT.

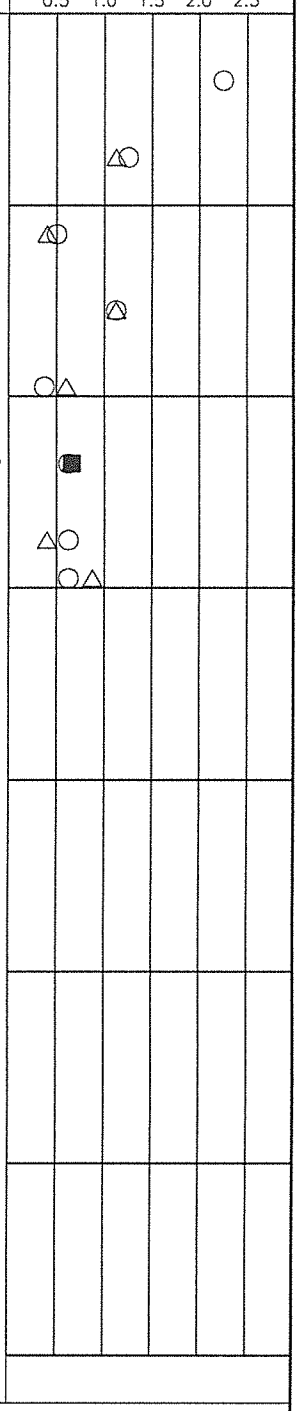
SURFACE ELEVATION : 67.28 FT.

DATE : 02-28-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.3	0	3" Asphalt over 3" Sand and Limestone Mix							
66.8		Hard gray SANDY LEAN CLAY (CL) w/ferrous nodules and ferrous stains				12			
		-very stiff 2'-4'				16			
	5	-medium stiff to stiff 4'-6'							
		-w/calcareous nodules 4'-12'				20			
		-very stiff 6'-8'							
		-gray and brown 6'-15'							
		-medium stiff to stiff 8'-10'				17			
	10	-stiff 10'-12'				18			
		-medium stiff to stiff 12'-14'		69	114	19	28	13	15
		-stiff 14'-15'				20			
52.3	15					16			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-5A

LOG OF BORING NO. GB-6

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13875184.96, E 3118880.16
Bauman Drive; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 20.0 FT.

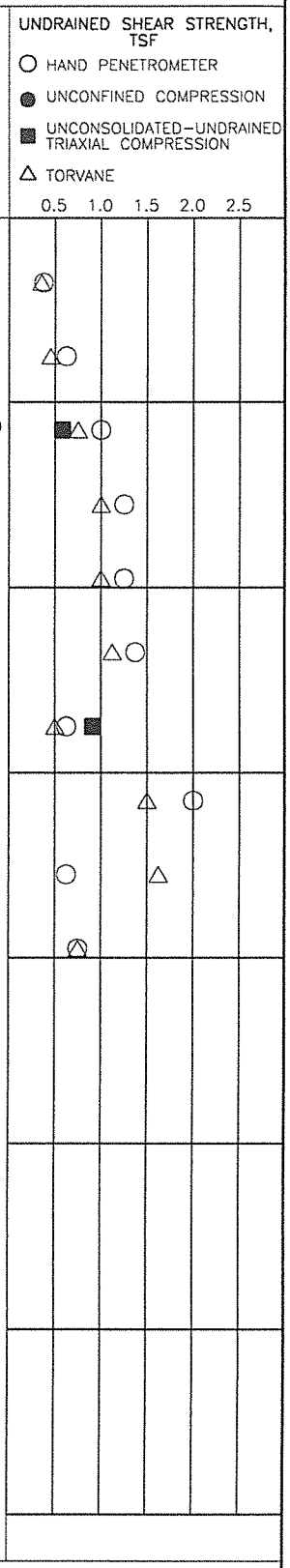
SURFACE ELEVATION : 66.90 FT.

DATE : 02-27-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 20.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
66.9 (0)	6" Asphalt over 6" Limestone, Shell, and Sand Mix				19			
65.9	Medium stiff yellowish gray LEAN CLAY (CL) w/sand, calcareous and ferrous nodules				28			
(5)	-medium stiff to stiff 2'-4'		77	111	20	46	16	30
	-stiff to very stiff 4'-6'							
	-very stiff 6'-12'							
	-w/ferrous stains 8'-14'				19			
(10)					18			
	-stiff 12'-14'				17			
	-very stiff to hard 14'-16'		77	109	17	46	15	31
(15)	-stiff to very stiff 16'-18'				14			
	-stiff 18'-20'				15			
46.9 (20)					18			
(25)								
(30)								
(35)								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-6

LOG OF BORING NO. GB-7

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874754.18, E 3118891.94
Bauman Drive; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 20.0 FT.

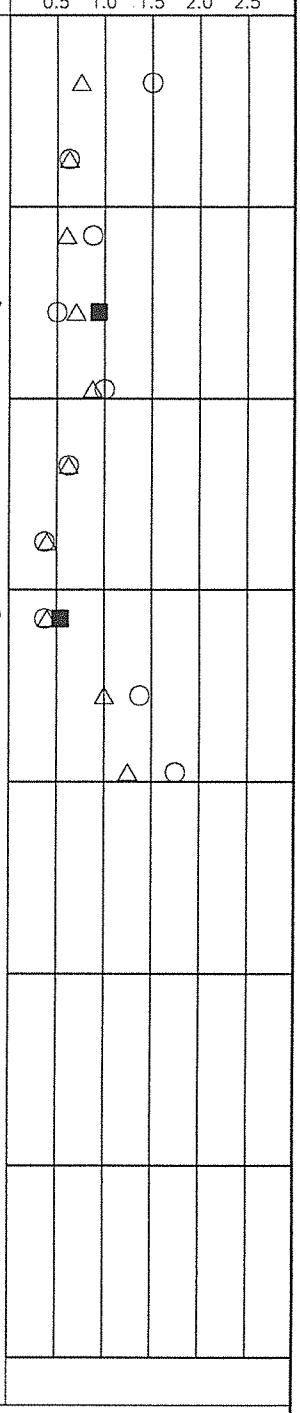
SURFACE ELEVATION : 65.56 FT.

DATE : 02-27-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 20.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
65.6	0								
65.1		6" Limestone, Gravel, and Sand Mix							
		Stiff to very stiff gray LEAN CLAY (CL) w/sand, ferrous nodules, and ferrous stains				11			
		-stiff 2'-8'				16			
	5	-yellowish brown and gray 2'-12'				17			
				78	114	17	33	16	17
	10	-stiff 10'-12'				17			
53.6		Medium stiff yellowish brown and gray FAT CLAY (CH) w/sand and calcareous and ferrous nodules				19			
						22			
	15	-medium stiff to stiff 14'-16'		78	105	23	57	17	40
		-very stiff 16'-20'				18			
45.6	20					14			
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-7

LOG OF BORING NO. GB-8

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13875359.50, E 3118618.75
Burbank Street; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 15.0 FT.

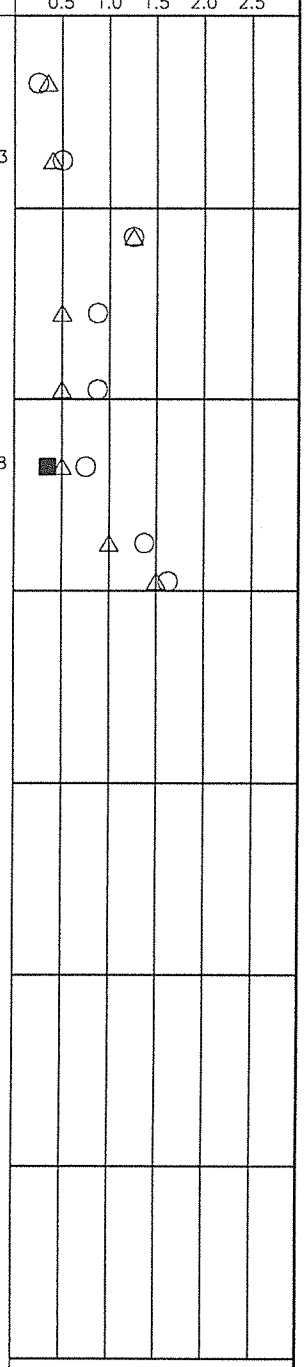
SURFACE ELEVATION : 67.63 FT.

DATE : 02-13-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.6	0	4" Asphalt over 8" Sand and Shell Mix							
66.6		Medium stiff gray LEAN CLAY (CL) w/sand				17			
		-medium stiff to stiff 2'-4'		78		18	30	17	13
		-very stiff 4'-6'							
	5	-yellowish brown and gray w/ferrous nodules and ferrous stain				16			
		-stiff 6'-10'							
		-crawfish hole 8'-12'				18			
	10	-medium stiff to stiff 10'-12'				20			
		-very stiff 12'-14'		81	109	18	37	19	18
53.6						20			
52.6	15	Very stiff reddish brown and gray FAT CLAY (CH) w/sand				22			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-8

LOG OF BORING NO. GB-9

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13875343.40, E 3118181.63
Burbank Street; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 15.0 FT.

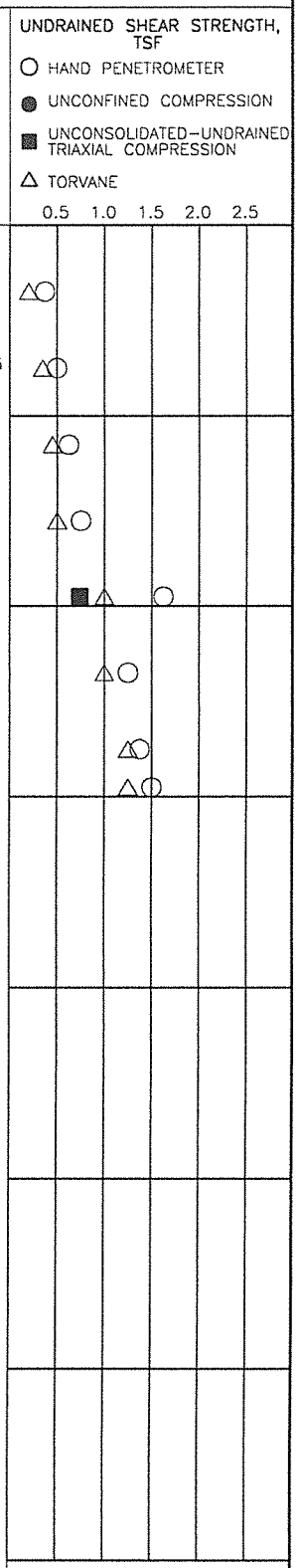
SURFACE ELEVATION : 68.07 FT.

DATE : 02-17-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
68.1	0								
67.6		2" Asphalt over 4" Oyster Shell and Sand Mix							
		Soft to medium stiff gray LEAN CLAY (CL) w/sand and calcareous nodules				16			
		-medium stiff to stiff 2'-6'		72		18	29	14	15
	5	-stiff 6'-8'				18			
		-w/ferrous stains 6'-15'							
		-stiff to very stiff 8'-10'				19			
	10	-very stiff 10'-15'			117	21			
						17			
						18			
53.1	15					17			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-9

LOG OF BORING NO. GB-10

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874974.57, E 3118094.74
Luther Street; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 15.0 FT.

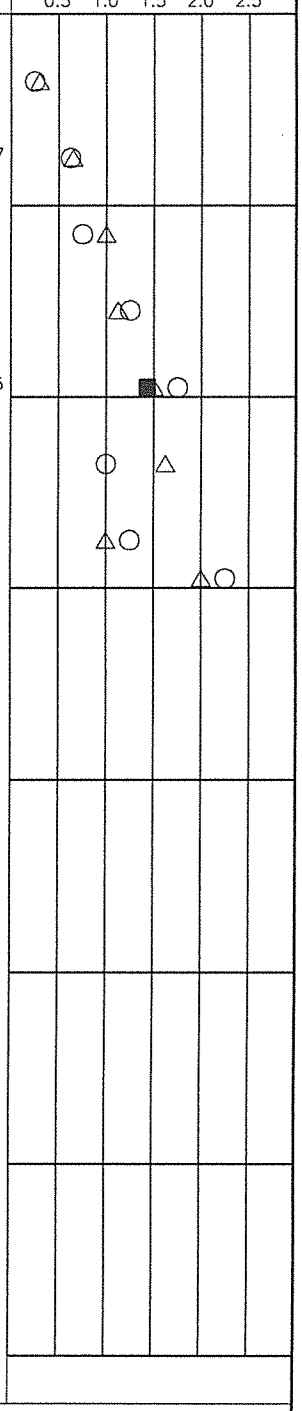
SURFACE ELEVATION : 67.39 FT.

DATE : 02-17-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.4	0								
67.0		3" Asphalt over 2" Oyster Shell and Sand Mix							
		Medium stiff gray LEAN CLAY (CL) w/sand				20			
		-stiff 2'-4'		79		21	44	18	27
		-stiff to very stiff 4'-6'							
	5					18			
		-very stiff 6'-14'							
		-w/ferrous nodules and ferrous stains 6'-15'				19			
				78	118	16	42	17	25
	10								
						17			
		-hard 14'-15'				20			
52.4	15					19			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-10

LOG OF BORING NO. GB-11

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874692.04, E 3118081.77
Highlawn Street; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 20.0 FT.

SURFACE ELEVATION : 64.97 FT.

DATE : 02-17-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 18.0 FT.
WET ROTARY : 18.0 TO 20.0 FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
65.0	0								
64.4		3.5" Asphalt over 3" Sand and Shell Mix							
		FILL: medium stiff to stiff brown and gray lean clay w/sand and ferrous nodules				22			
61.0						14			
	5	-brown and gray silty sand 2'-4'		77	113	20	38	22	16
		Stiff to very stiff yellowish brown and gray LEAN CLAY (CL) w/sand, ferrous nodules, and ferrous stains				18			
		-very stiff 6'-10'				17			
55.0	10								
		Stiff to very stiff reddish brown and gray LEAN CLAY (CL) w/ferrous stains			100	28			
		-very stiff 12'-20'		87		18	43	19	24
		-w/calcareous nodules 14'-20'							
	15					19			
						18			
45.0	20		27	87		18			
	25								
	30								
	35								

DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 18.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 6.7 FT.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-11

LOG OF BORING NO. GB-12

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874955.07, E 3117600.94
Luther Street; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 15.0 FT.

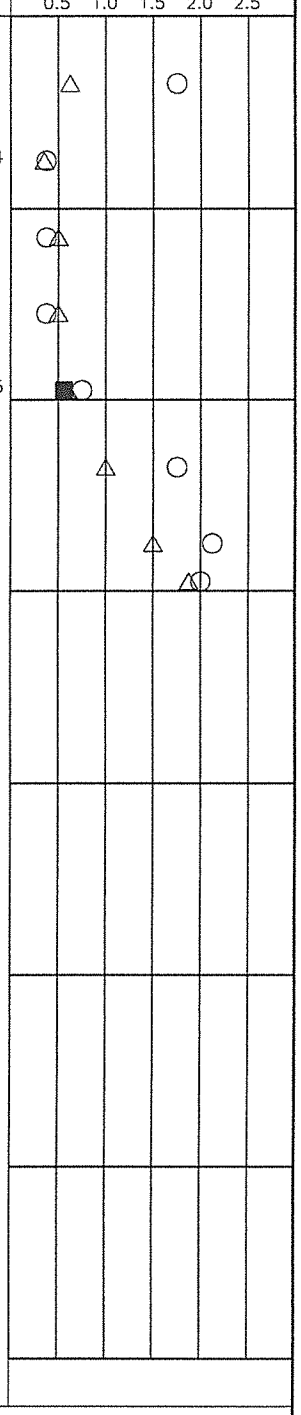
SURFACE ELEVATION : 67.61 FT.

DATE : 02-17-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.6	0	6" Asphalt over 4" Sand and Shell Mix							
66.8		Stiff to very stiff gray LEAN CLAY (CL) w/sand				17			
		-medium stiff w/calcareous nodules 2'-4'				16	30	16	14
	5	-medium stiff to stiff 4'-8' -w/ferrous stains 4'-15'				18			
		-stiff 8'-10'				20			
	10	-very stiff 10'-12'		75	108	19	40	15	25
		-very stiff to hard 12'-14'				17			
53.6						15			
52.6	15	Very stiff to hard yellowish gray FAT CLAY (CH) w/ferrous stains				21			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-12

LOG OF BORING NO. GB-13 (GB-13P)

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874949.88, E 3118410.01
Luther Street; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 67.66 FT.

DATE : 02-28-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.7	0	7" Asphalt over 3" Sand and Shell Mix							
66.8		Medium stiff to stiff gray LEAN CLAY (CL) w/sand and ferrous stains				18			
		-stiff to very stiff 2'-4'				18			
	5	-w/calcareous and ferrous nodules 4'-12'				20			
		-medium stiff 6'-8'							
		-stiff to very stiff 8'-10'				20			
	10	-medium stiff 10'-12'		75	116	16	39	15	24
		-very stiff to hard 12'-15'				19			
						17			
52.7	15					17			
	20								
	25								
	30								
	35								

NOTE :
See Piezometer GB-13P for water level measurements.

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
▼: WATER DEPTH AT 9.2 FT., HOLE OPEN TO 15.0 FT. ON 04-03-15.

Geotest Engineering, Inc.

FIGURE A-13

LOG OF BORING NO. GB-14

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874306.59, E 3118976.02
Wynell Terrace; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 15.0 FT.

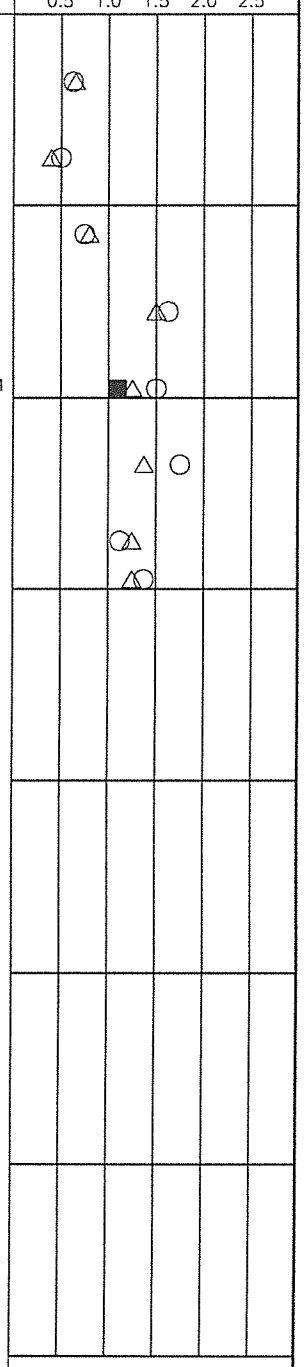
SURFACE ELEVATION : 66.52 FT.

DATE : 02-13-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
66.5	0	3" Asphalt over 7.5" Shell and Sand Mix							
65.6		Stiff gray and yellow LEAN CLAY (CL) w/sand and ferrous nodules -medium stiff to stiff 2'-4'				15			
						18			
	5	-very stiff w/ferrous stains 6'-15'				17			
						16			
	10			83	117	20	49	18	31
						16			
						15			
51.5	15					17			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-14

LOG OF BORING NO. GB-15

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13876875.36, E 3120061.26
McGallion Street ; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 20.0 FT.

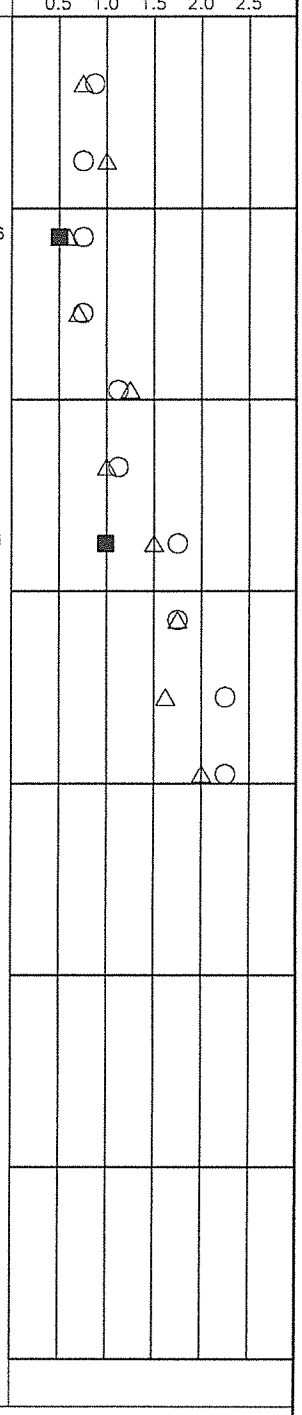
SURFACE ELEVATION : 70.25 FT.

DATE : 02-18-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 20.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
70.2	0	4" Asphalt over 6" Shell and Sand Mix							
69.4		Stiff gray SANDY LEAN CLAY (CL) w/silt seams				17			
		-stiff to very stiff 2'-4'				17			
		-w/calcareous nodules 4'-10'							
	5	-w/ferrous stains 6'-15'		69	114	16	32	16	16
		-very stiff 8'-10'				18			
						19			
60.2	10	Very stiff yellowish gray FAT CLAY (CH) w/sand and calcareous and ferrous nodules				27			
58.2		Very stiff gray and yellow LEAN CLAY (CL) w/sand		83	112	18	46	15	31
	15	-very stiff to hard 16'-18'				17			
		-hard reddish brown and gray 18'-20'				16			
50.2	20					18			
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-15

LOG OF BORING NO. GB-16

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : McGallion Street
See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 10.0 FT.

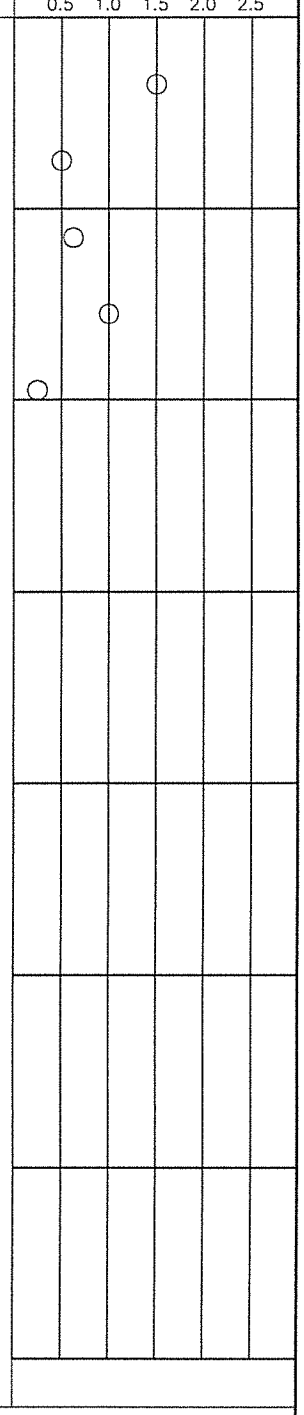
SURFACE ELEVATION : Existing Grade

DATE : 02-18-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 10.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
	0			6" Asphalt over 4" Cement Stabilized Sand and Gravel							
				Very stiff dark gray LEAN CLAY (CL) w/sand, calcareous and ferrous nodules, and ferrous stains							
	5			-stiff 2'-6'							
				-medium stiff 8'-10'							
	10			NOTE : Obstruction was encountered at 10 feet and boring was offset to GB-16A.							
	15										
	20										
	25										
	30										
	35										

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 10.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-16

LOG OF BORING NO. GB-16A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : McGallion Street
See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 4.5 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-18-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 4.5 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			Auger to 4.5'								
	5			NOTE : Obstruction was encountered at 4.5 feet and boring was offset to GB-16B.								
	10											
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 4.5 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-16A

LOG OF BORING NO. GB-16B

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : McGallion Street
See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 8.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-28-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 8.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (0.5 1.0 1.5 2.0 2.5)
	0			5" Asphalt over 7" Sand and Limestone Mix								
				FILL: stiff to very stiff gray and yellowish brown and gray fat clay w/sand and calcareous nodules				25				△ ○
								19				△○
	5			-stiff 2'-4'								
				-medium stiff to stiff 4'-6'		83	99	28	54	22	32	■ △
				-medium stiff 6'-8'								
								23				○△
	10			NOTE : Obstruction was encountered at 8 feet and boring was offset to GB-16C.								
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 8.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-16B

LOG OF BORING NO. GB-16C

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13876433.51, E 3120090.77
McGallion Street; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 69.55 FT.

DATE : 02-28-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE
0.5 1.0 1.5 2.0 2.5

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
69.6	0			Auger to 8' -See boring GB-16B for soil information.							
	5										
61.6				Gray FINE SAND (SP-SM) w/silt							
	10			-dense 10.5'-12'				28			
				-medium dense 12'-13.5'	38	9		30			
56.1				Yellowish gray LEAN CLAY (CL) w/sand	11			29			
54.6	15				16			17			
	20										
	25										
	30										
	35										

DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 12.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 9.2 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-16C

LOG OF BORING NO. GB-17

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13875934.60, E 3119962.99
McGallion Street; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 15.0 FT.

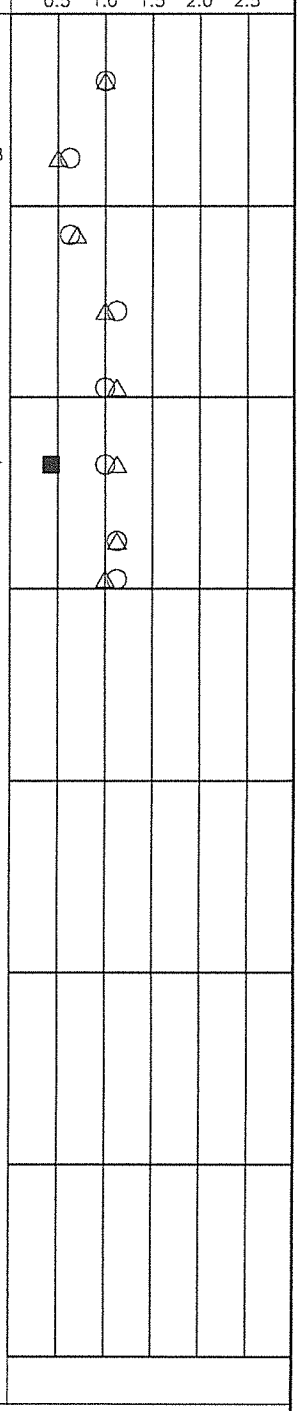
SURFACE ELEVATION : 69.52 FT.

DATE : 02-18-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
69.5	0	4" Asphalt over 8" Cement Stabilized Sand w/shell							
68.5		Very stiff dark gray LEAN CLAY (CL) w/sand, ferrous nodules and ferrous stains				19			
		-stiff 4'-6'		77		19	36	18	18
	5	-w/calcareous nodules 4'-14'							
		-yellowish brown and gray 6'-10'				19			
						21			
						23			
59.5	10	Medium stiff to very stiff reddish brown and gray FAT CLAY (CH) w/silt seams and calcareous nodules		94	83	37	84	30	54
		-very stiff 12'-14'				33			
55.5		Very stiff yellowish gray LEAN CLAY (CL) w/sand				18			
54.5	15								
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-17

LOG OF BORING NO. GB-18

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13875487.46, E 3119964.61
McGallion Street; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 15.0 FT.

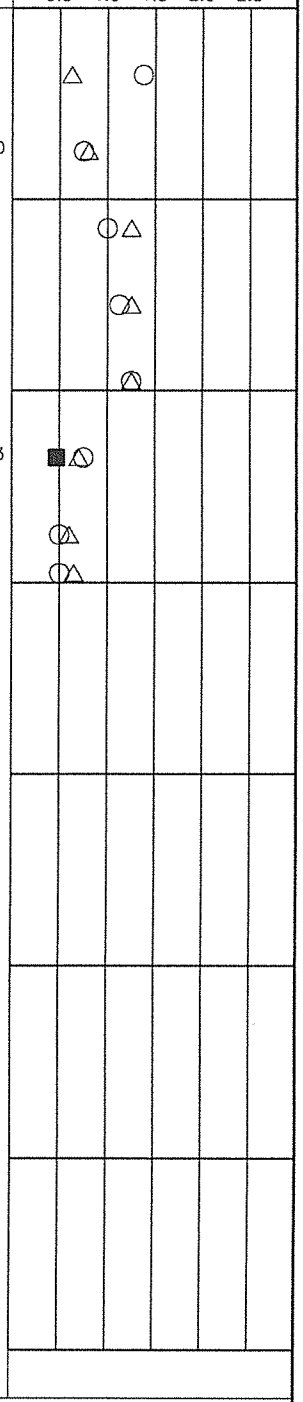
SURFACE ELEVATION : 68.86 FT.

DATE : 02-18-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
68.9	0	6" Asphalt over 8" Cement Stabilized Sand w/shell							
67.7		Stiff to very stiff dark gray LEAN CLAY (CL) w/sand				17			
		-stiff 2'-4'		77		21	47	17	30
	5	-very stiff yellowish brown and gray w/ferrous nodules and ferrous stains 4'-10'				18			
						20			
58.9	10					20			
		Stiff reddish brown and gray FAT CLAY (CH) w/silt seams		89	95	31	69	26	43
54.9						23			
53.9	15	Stiff gray LEAN CLAY (CL) w/sand		77		22			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-18

LOG OF BORING NO. GB-19

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : McGallion Street
See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 4.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-20-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 4.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (0.5 1.0 1.5 2.0 2.5)
	0			5" Asphalt over 10" Shell and Sand Mix								
				FILL: stiff dark gray lean clay w/sand -medium stiff 2'-4'								○ ○
	5			NOTE : Obstruction was encountered at 4 feet and boring was offset to GB-19A.								
	10											
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 4.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-19

LOG OF BORING NO. GB-19A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13875033.41, E 3119980.65
McGallion Street; See Plan of Borings (Figure 2.4)

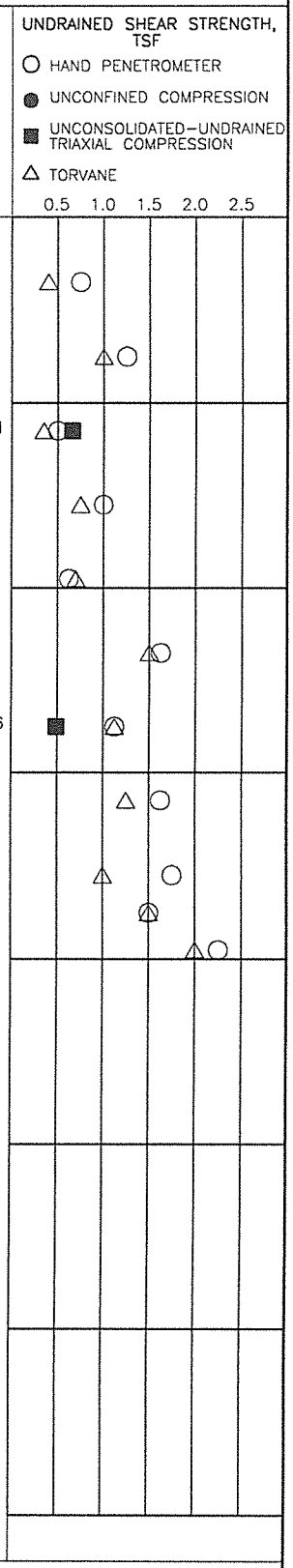
COMPLETION DEPTH : 20.0 FT.

SURFACE ELEVATION : 68.07 FT.

DATE : 02-20-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 20.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
68.1	0	4" Asphalt over 8" Sand and Shell Mix							
67.1		Medium stiff to stiff dark gray LEAN CLAY (CL) w/sand, ferrous nodules, and ferrous stains				19			
		-very stiff 2'-4'				15			
	5	-gray 2'-6'		73	110	19	37	16	21
		-w/calcareous nodules 2'-8'							
		-stiff to very stiff gray and yellowish brown 6'-8'				16			
60.1		Stiff reddish brown and gray FAT CLAY (CH) w/silt seams				23			
	10	-very stiff 10'-12'							
		-stiff to very stiff 12'-14'				25			
54.1				92	96	26	73	27	46
	15	Very stiff yellowish brown and gray LEAN CLAY (CL) w/sand seams				17			
50.1						17			
		Very stiff reddish brown and gray FAT CLAY (CH) w/silt seams and calcareous nodules				21			
48.1	20	-hard 19'-20'				22			
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-19A

LOG OF BORING NO. GB-20

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874478.08, E 3120011.93
McGallion Street; See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 15.0 FT.

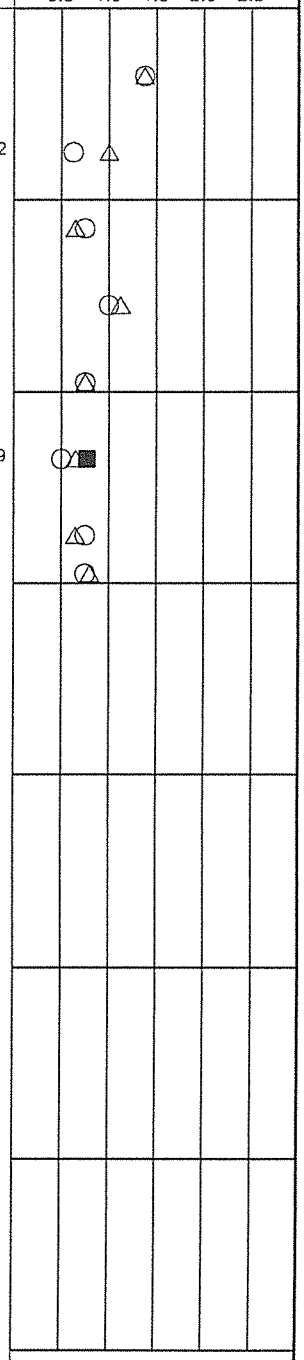
SURFACE ELEVATION : 68.02 FT.

DATE : 02-20-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
68.0	0	4" Asphalt over 8" Sand and Shell Mix							
67.0		Very stiff dark gray LEAN CLAY (CL) w/sand and calcareous and ferrous nodules				17			
				78		16	26	14	12
	5	-stiff to very stiff gray 2'-4'				19			
		-stiff 4'-6'							
		-gray and yellowish gray w/ferrous stains 4'-10'				19			
		-stiff to very stiff 8'-10'							
58.0	10					20			
		Stiff reddish brown and gray FAT CLAY (CH) w/silt seams		86	101	30	77	28	49
		-w/calcareous nodules 14'-15'				30			
53.0	15					34			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 15.0 FT. DURING DRILLING; AFTER 25.0 MIN. AT 11.0 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-20

LOG OF BORING NO. GB-21

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874085.67, E 3120029.27
McGallion Street; See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 15.0 FT.

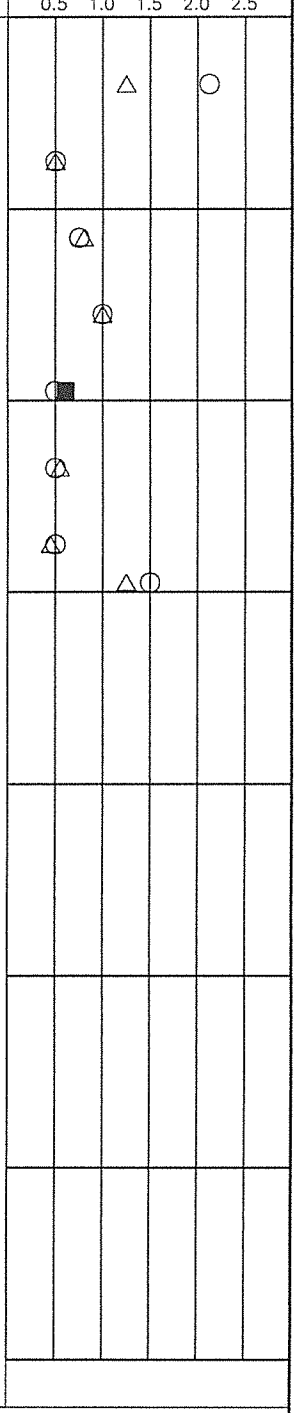
SURFACE ELEVATION : 67.83 FT.

DATE : 02-23-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.8	0	6" Asphalt over 10" Stabilized Sand and Shell Mix							
66.5		Very stiff to hard dark gray LEAN CLAY (CL) w/sand and ferrous nodules				16			
		-w/silt seams and ferrous stains 16"-14'				21			
	5	-stiff 2'-6'				19			
		-w/calcareous nodules 4'-10'				19			
		-very stiff 6'-8'							
		-stiff 8'-10'		74	112	18	46	20	26
57.8	10	Stiff reddish brown and gray FAT CLAY (CH) w/sand and calcareous nodules				36			
		-medium stiff to stiff 12'-14'		82		31	77	28	49
53.8		Very stiff reddish brown and gray LEAN CLAY (CL) w/sand seams				16			
52.8	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-21

LOG OF BORING NO. GB-22

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Turner Road
See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 2.5 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-23-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 2.5 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			9.5" Concrete								
				10" Cement Stabilized Sand								
				FILL: dark gray lean clay w/sand								
	5			NOTE : Obstruction was encountered at 2.5 feet and boring was offset to GB-22A.								
	10											
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 2.5 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-22

LOG OF BORING NO. GB-22A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Turner Road
See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 6.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-23-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 6.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER; ● UNCONFINED COMPRESSION; ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION; △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			9.5" Concrete								
				5" Cement Stabilized Sand								
				FILL: stiff dark gray lean clay w/sand								
	5											
				NOTE : Obstruction was encountered at 6 feet and boring was offset to GB-22B.								
	10											
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 6.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-22A

LOG OF BORING NO. GB-22B (GB-22BP)

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13877030.47, E 3121869.68
Turner Road; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 20.0 FT.

SURFACE ELEVATION : 66.83 FT.

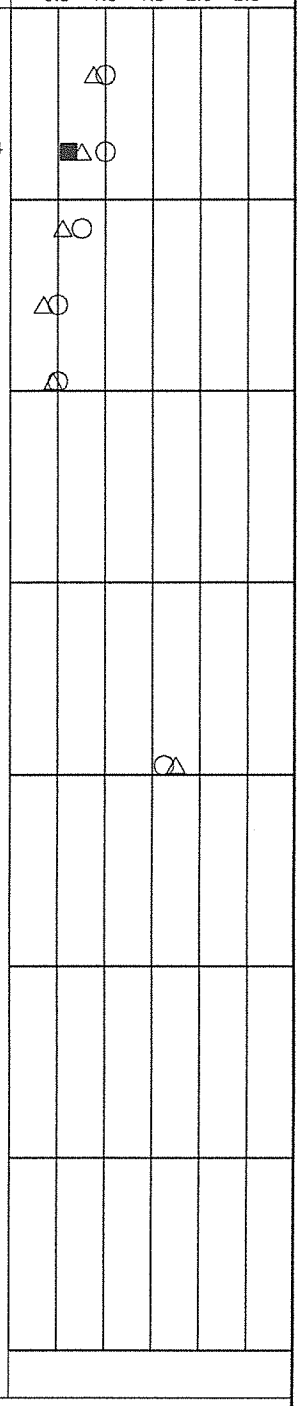
DATE : 02-25-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.5 FT.
WET ROTARY : 12.5 TO 20.0 FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
66.8	0	9" Concrete							
66.1		7" Cement Stabilized Sand							
65.5		Stiff to very stiff dark gray SANDY LEAN CLAY (CL) w/ferrous nodules				14			
		-stiff 4'-6'		55	110	20	38	14	24
	5	-gray and yellowish brown 4'-10.5'				17			
		-medium stiff to stiff 6'-10'				17			
	10					17			
56.3		Medium dense gray SILTY SAND (SM)	14	16		19			
			24			23			
	15		10			23			
			11			23			
48.8		Very stiff yellowish gray LEAN CLAY (CL) w/sand							
46.8	20					17			
	25								
	30								
	35								

NOTE :
See Piezometer GB-22BP for water level measurements.



DEPTH TO WATER IN BORING :
▽: FREE WATER ENCOUNTERED AT 12.5 FT. DURING DRILLING.
▼: WATER DEPTH AT 5.3 FT., HOLE OPEN TO 20.0 FT. ON 04-03-15.

Geotest Engineering, Inc.

FIGURE A-22B

LOG OF BORING NO. GB-23

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13876956.01, E 3121291.61
Goldcrest Street; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 20.0 FT.

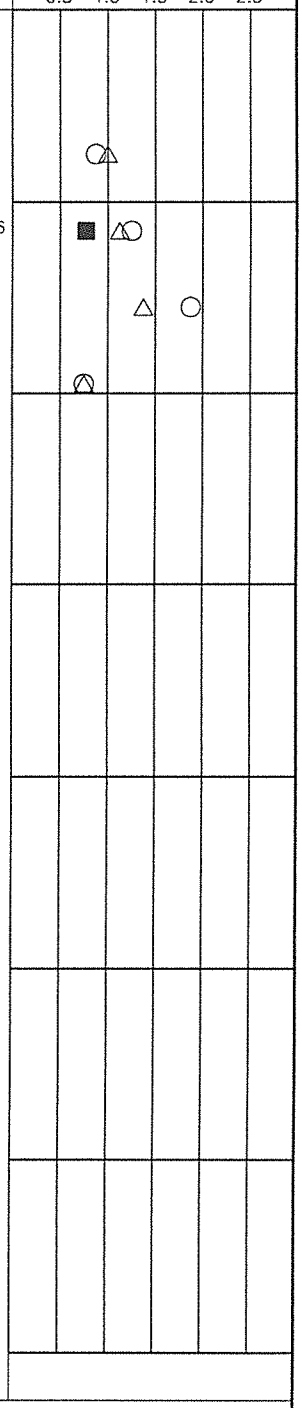
SURFACE ELEVATION : 68.64 FT.

DATE : 02-18-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 16.0 FT.
WET ROTARY : 16.0 TO 20.0 FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
68.6	0	6" Asphalt over 12" Sand and Shell Mix							
67.1						12			
66.6		Brown SILTY SAND (SM)							
		Stiff to very stiff yellowish brown and gray SANDY LEAN CLAY (CL) w/calcareous nodules				17			
	5	-very stiff 6'-8'		53	117	16	41	15	26
		-stiff 8'-10'				14			
58.6	10					14			
		Loose gray SILTY SAND (SM)	9			17			
		-medium dense w/clay seams 12.5'-14'	14			20			
	15		9	12		21			
			9			20			
49.6									
48.6	20	Gray LEAN CLAY (CL) w/sand	7			16			
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 16.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 10.3 FT.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-23

LOG OF BORING NO. GB-24

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13876539.37, E 3121311.63
Goldcrest Street; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 15.0 FT.

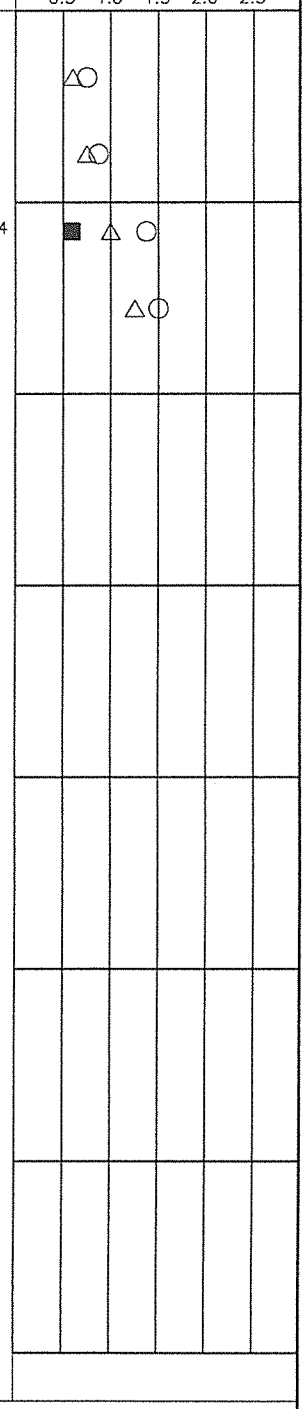
SURFACE ELEVATION : 67.86 FT.

DATE : 02-19-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.9	0	5" Asphalt over 8" Sand, Shell, and Limestone							
66.8		Stiff gray SANDY LEAN CLAY (CL) w/silt, ferrous nodules, and ferrous stains				17			
						18			
	5	-stiff to very stiff 4'-6'		53	121	16	37	13	24
		-very stiff 6'-8'							
						14			
59.9		Loose yellowish gray FINE SAND (SP-SM) w/silt							
	10	-medium dense 10.5'-12'	8			20			
			14	8		22			
54.4			6	11		22			
52.9	15	Yellowish brown and gray LEAN CLAY (CL) w/sand	6			18			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 15.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 6.7 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-24

LOG OF BORING NO. GB-25

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13876028.38, E 3121334.36
Goldcrest Street; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 15.0 FT.

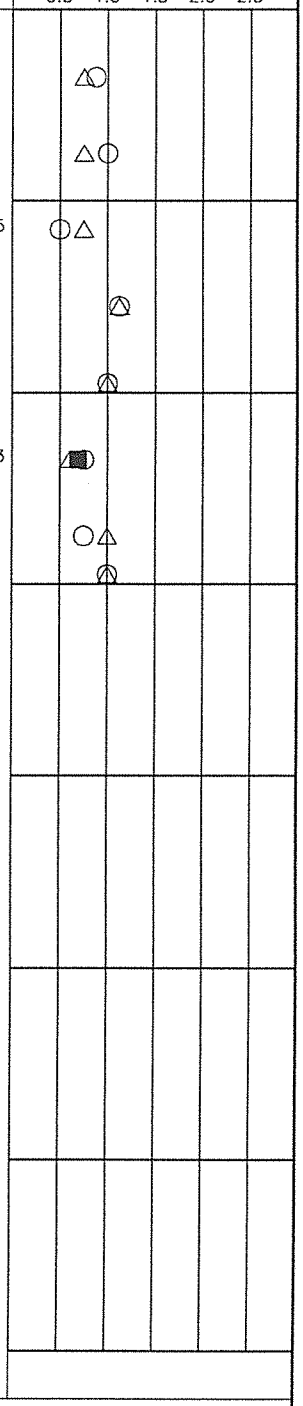
SURFACE ELEVATION : 67.72 FT.

DATE : 02-20-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.7 (0)	7" Asphalt over 7" Cement Stabilized Sand and Shell							
66.6	Stiff dark gray SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules -stiff to very stiff 2'-4' -gray and brown 2'-6'				19			
					18			
(5)			59		18	40	15	25
61.7	Very stiff yellowish gray and brown FAT CLAY (CH) w/calcareous nodules -w/sand seams 6'-8' -reddish brown and gray 8'-14' -stiff 10'-12' -stiff to very stiff 12'-14'				31			
(10)					33			
			97	95	28	55	22	33
					32			
53.7	Very stiff yellowish gray LEAN CLAY (CL) w/sand				16			
52.7 (15)								
(20)								
(25)								
(30)								
(35)								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 14.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 11.5 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-25

LOG OF BORING NO. GB-26

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13875561.68, E 3121753.37
Cravens Road; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 15.0 FT.

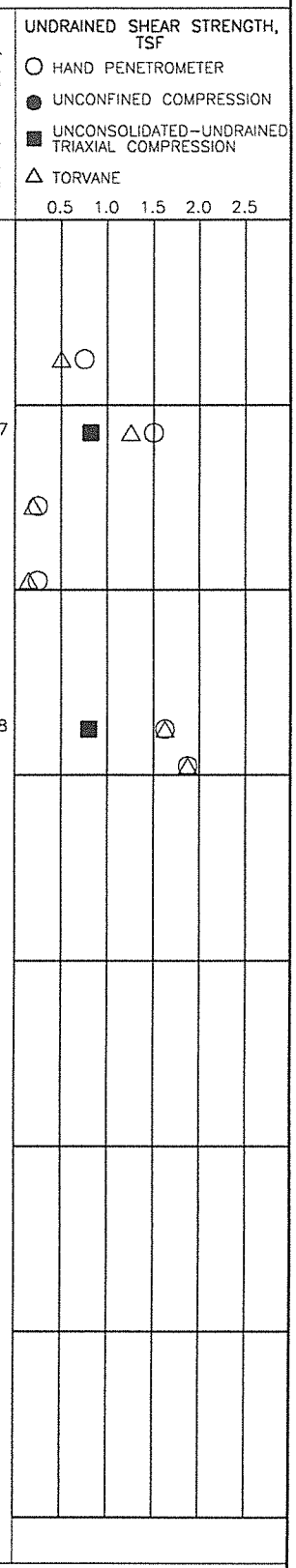
SURFACE ELEVATION : 66.45 FT.

DATE : 02-17-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 13.0 FT.
WET ROTARY : 13.0 TO 15.0 FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
66.4	0	6" Asphalt over 6" Stabilized Sand and Shell Mix							
65.9		Gray SANDY LEAN CLAY (CL) w/ferrous nodules -stiff 2'-4' -stiff to very stiff 4'-6' -yellowish brown and gray 4'-8' -soft to medium stiff 6'-10'				18			
						19			
	5			53	113	18	42	15	27
						22			
				54		25			
56.4	10	Loose brown and gray SILTY SAND (SM)	8	13		21			
						22			
53.4		Stiff to very stiff reddish gray FAT CLAY (CH) -very stiff 14'-15'		89	103	22	89	31	58
51.4	15					16			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 13.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 6.0 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-26

LOG OF BORING NO. GB-27

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13875551.52, E 3121395.67
Cravens Road; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 68.81 FT.

DATE : 02-17-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
68.8	0	6" Asphalt over 5" Sand and Shell Mix							
67.9		Stiff gray SANDY LEAN CLAY (CL) w/silt and calcareous nodules				18			
		-soft to medium stiff 4'-6'				19			
	5	-very stiff w/ferrous stains 6'-8'				19			
60.8		Stiff reddish gray FAT CLAY (CH) w/sand and calcareous nodules				18			
	10	-medium stiff 10'-12'		76	103	23	52	21	31
		-very stiff 12'-15'				23			
						18	52	21	31
53.8	15					17			
	20								
	25								
	30								
	35								

DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 15.0 FT. DURING DRILLING; AFTER 15.0 MIN. AT 9.9 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-27

LOG OF BORING NO. GB-28

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13875532.23, E 3120967.19
Cravens Road; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 15.0 FT.

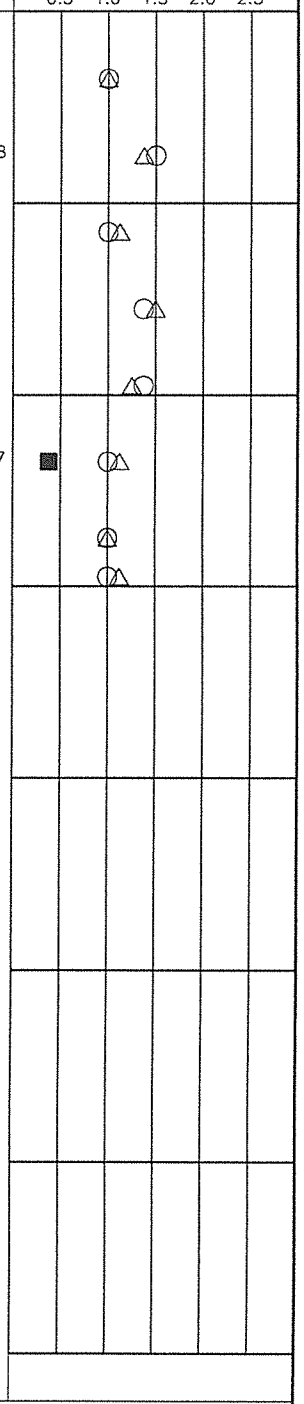
SURFACE ELEVATION : 68.86 FT.

DATE : 02-18-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
68.9	0	7" Asphalt over 3" Cement Stabilized Sand							
68.0		Very stiff dark gray FAT CLAY (CH) w/sand -w/ferrous nodules and ferrous stains 2'-9'				20			
				75		19	54	16	38
	5					21			
						19			
59.9		Medium stiff to very stiff reddish brown and gray FAT CLAY (CH) w/silt seams and calcareous nodules -very stiff 12'-15'				19			
	10			97	99	28	88	31	57
						29			
53.9	15					26			
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-28

LOG OF BORING NO. GB-29

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13875508.50, E 3120421.53
Cravens Road; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 68.87 FT.

DATE : 02-18-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
68.9	0	5" Asphalt over 5" Cement Stabilized Sand w/shell fragments							
68.0		Stiff dark gray LEAN CLAY (CL) w/sand, calcareous and ferrous nodules, and ferrous stains				21			
		-medium stiff 4'-6'		74		21	43	18	25
	5	-very stiff yellowish brown and gray 6'-8'				23			
60.9		Stiff reddish brown and gray FAT CLAY (CH) w/silt seams				18			
	10	-stiff to very stiff 10'-12'				29			
		-very stiff 12'-14'		97	99	28	69	26	43
						27			
53.9	15					21			
	20								
	25								
	30								
	35								

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-29

LOG OF BORING NO. GB-30

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874414.38, E 3120311.90
Melrose Street; See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 15.0 FT.

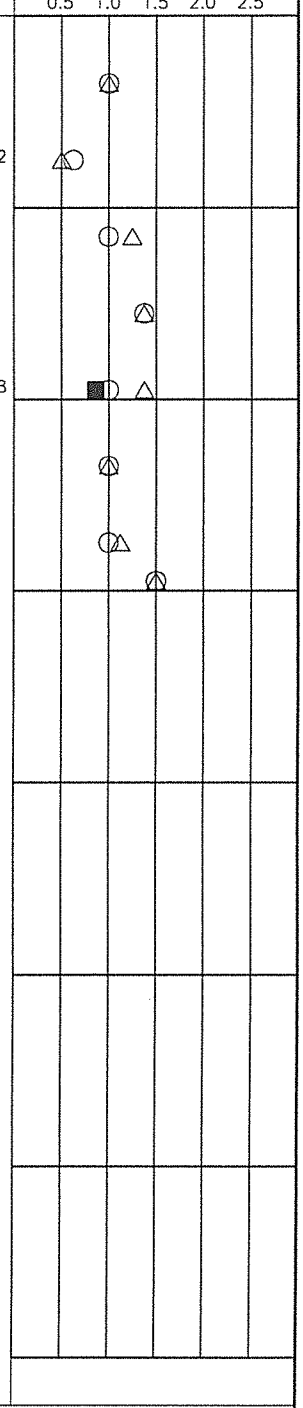
SURFACE ELEVATION : 67.90 FT.

DATE : 02-19-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.9 (0)	5" Asphalt over 5" Sand and Shell Mix							
67.1	Very stiff gray LEAN CLAY (CL) w/silt seams -stiff 2'-4'				18			
63.9			86		24	39	17	22
(5)	Very stiff gray and brown LEAN CLAY (CL) w/sand, ferrous nodules, and ferrous stains -stiff to very stiff 8'-10'				23			
					18			
57.9 (10)			77	114	19	49	21	28
	Very stiff reddish brown and gray FAT CLAY (CH) w/calcareous nodules				30			
53.9					33			
52.9 (15)	Very stiff gray and brown LEAN CLAY (CL) w/sand and ferrous nodules				17			
(20)								
(25)								
(30)								
(35)								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-30

LOG OF BORING NO. GB-31

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874526.94, E 3120715.58
Hurley Street; See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 15.0 FT.

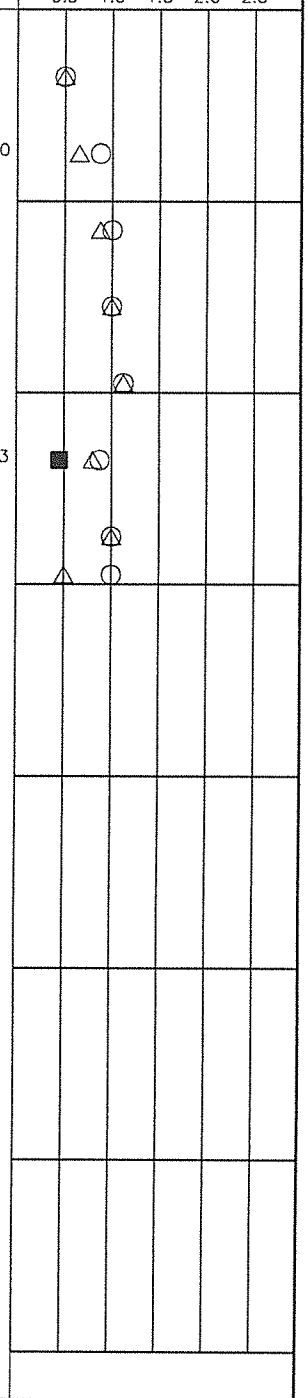
SURFACE ELEVATION : 67.95 FT.

DATE : 02-19-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.9	0	6.75" Concrete							
67.4		Stiff gray LEAN CLAY (CL) w/sand and calcareous nodules				23			
		-stiff to very stiff 4'-6'		75		23	48	18	30
	5	-very stiff 6'-10'				21			
		-w/ferrous stains 8'-12'				19			
57.9	10					19			
		Medium stiff to stiff yellowish gray FAT CLAY (CH) w/calcareous nodules -very stiff 10'-12'		96	86	35	82	29	53
53.9						27			
52.9	15	Stiff to very stiff gray LEAN CLAY (CL) w/sand				18			
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 15.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 9.6 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-31

LOG OF BORING NO. GB-32

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874540.40, E 3121232.99
Hurley Street; See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 15.0 FT.

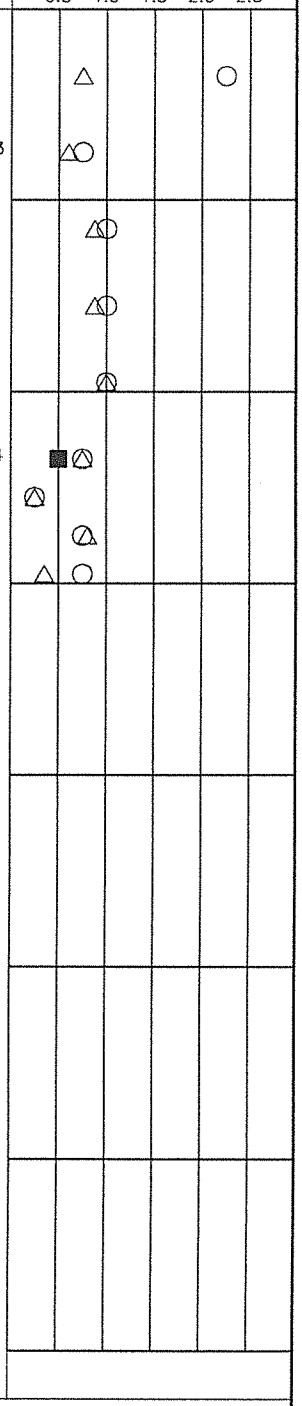
SURFACE ELEVATION : 69.66 FT.

DATE : 02-19-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
69.7	0	6" Concrete							
69.2		Stiff to hard gray LEAN CLAY (CL) w/sand, calcareous and ferrous nodules				13			
		-stiff 2'-4'		74		16	36	13	23
	5	-stiff to very stiff 4'-8'				17			
						17			
61.7		Very stiff yellowish brown and gray FAT CLAY (CH) w/ferrous stains				32			
	10	-stiff 10'-12'							
		-medium stiff 12'-13'		95	89	35	84	30	54
		-stiff 13'-14'				27			
55.7						33			
54.7	15	Medium stiff to stiff brown and gray LEAN CLAY (CL) w/sand				18			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 13.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 8.8 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-32

LOG OF BORING NO. GB-33

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874294.89, E 3121465.05
Pennington Street; See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 20.0 FT.

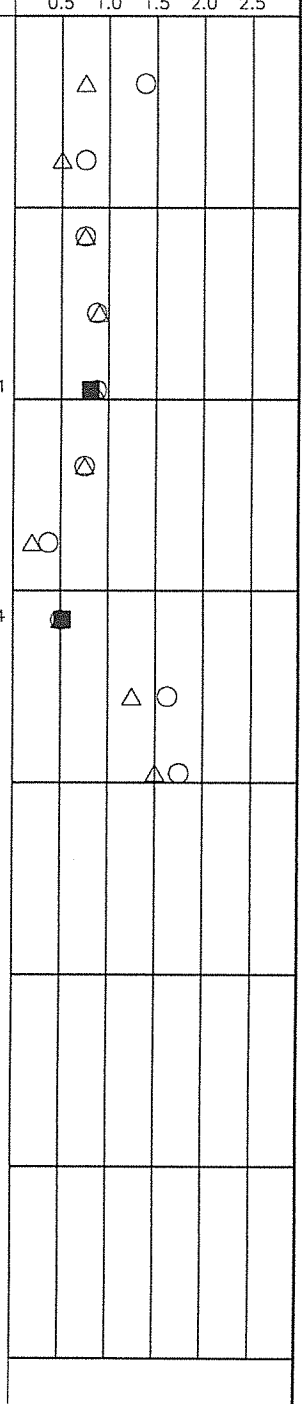
SURFACE ELEVATION : 67.73 FT.

DATE : 02-23-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 16.0 FT.
WET ROTARY : 16.0 TO 20.0 FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.7	0	7.5" Concrete							
67.1		Stiff to very stiff dark gray LEAN CLAY (CL) w/sand -stiff 2'-4'				16			
						23			
63.7	5	Stiff dark gray FAT CLAY (CH) w/silt seams, calcareous and ferrous nodules, and ferrous stains				26			
						24			
	10			86	101	29	66	25	41
55.7		Soft to medium stiff reddish brown and gray LEAN CLAY (CL) w/sand and calcareous nodules -stiff 14'-16' -very stiff 16'-20'				40			
						25			
	15			79	106	21	28	14	14
						16			
47.7	20					14			
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 16.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 10.0 FT.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-33

LOG OF BORING NO. GB-34 (GB-34P)

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874274.72, E 3121069.60
Pennington Street; See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 67.75 FT.

DATE : 02-23-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.8	0	6" Concrete				17			
67.3		6" Shell Base				19			
66.8		Very stiff dark gray SANDY LEAN CLAY (CL) w/silt seams, ferrous nodules and ferrous stains -stiff 2'-6' -w/calcareous nodules 2'-14' -stiff to very stiff 6'-8'				18			
	5					17			
				70	116	17	46	20	26
						23			
57.8	10	Very stiff reddish brown and gray FAT CLAY (CH) w/calcareous and ferrous nodules		97		34	68	26	42
53.8						24			
52.8	15	Stiff gray LEAN CLAY (CL) w/sand seams and ferrous nodules				19			
	20								
	25								
	30								
	35								

NOTE :
See Piezometer GB-34P for water level measurements.

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
▼: WATER DEPTH AT 3.3 FT., HOLE OPEN TO 15.0 FT. ON 04-03-15.

Geotest Engineering, Inc.

FIGURE A-34

LOG OF BORING NO. GB-35

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874156.12, E 3120618.79
Helmers Street; See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 15.0 FT.

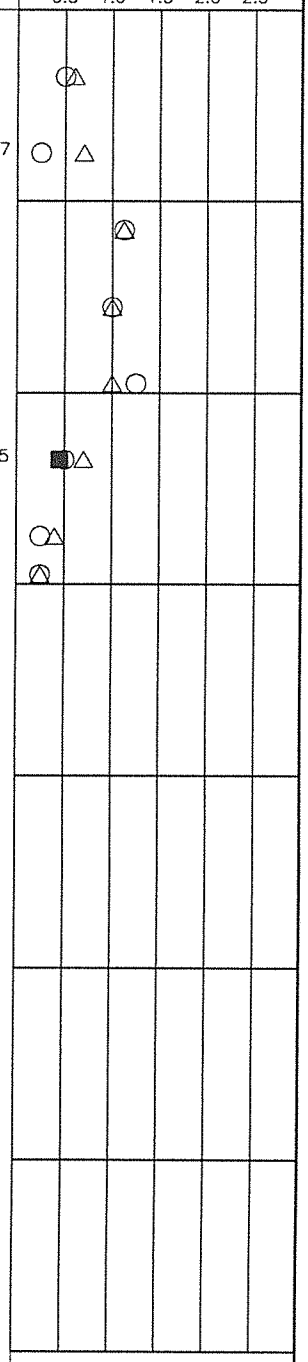
SURFACE ELEVATION : 67.71 FT.

DATE : 02-19-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.7	0	6" Concrete							
67.2		4" Oyster Shell							
66.9		Stiff gray LEAN CLAY (CL) w/sand and calcareous nodules				19			
63.7		-medium stiff to stiff 2'-4'		74		21	42	15	27
	5	Very stiff gray FAT CLAY (CH) w/calcareous nodules				18			
		-w/ferrous stains 8'-12'				25			
	10	-medium stiff to stiff 10'-12'				21			
		-medium stiff 12'-14'		90	91	35	71	26	45
53.7		Medium stiff gray and brown LEAN CLAY (CL) w/sand				40			
52.7	15					22			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 15.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 9.8 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-35

LOG OF BORING NO. GB-36

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13873994.55, E 3120985.79
Hohl Street; See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 15.0 FT.

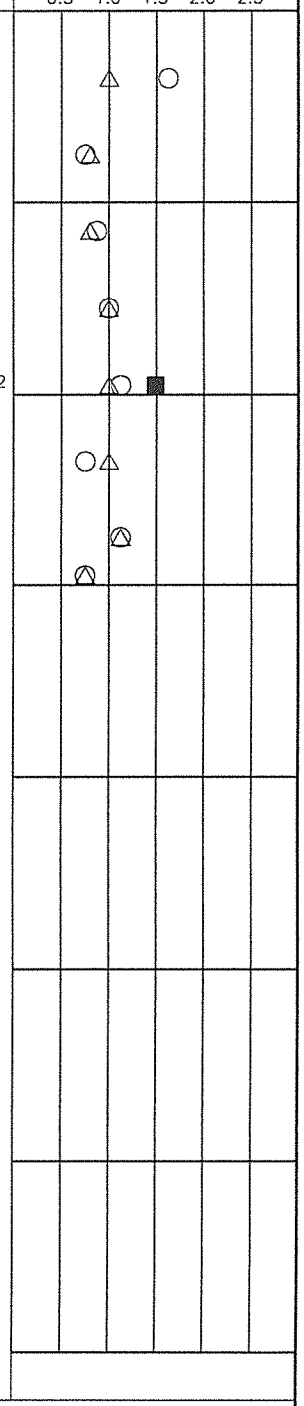
SURFACE ELEVATION : 67.82 FT.

DATE : 02-23-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.8	0	5.5" Concrete							
67.4		Very stiff dark gray LEAN CLAY (CL) w/sand, calcareous nodules, and silt seams				18			
		-stiff 2'-6'				24			
	5	-w/ferrous nodules and ferrous stains 6'-15'				24			
		-yellowish brown and gray 8'-12'				29			
	10	-stiff to very stiff 10'-12'		78	113	21	49	17	32
55.8		Very stiff reddish brown FAT CLAY (CH) w/silt seams				22			
		-stiff 14'-15'				33			
52.8	15					41			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-36

LOG OF BORING NO. GB-37

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874010.41, E 3121389.24
Hohl Street; See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 15.0 FT.

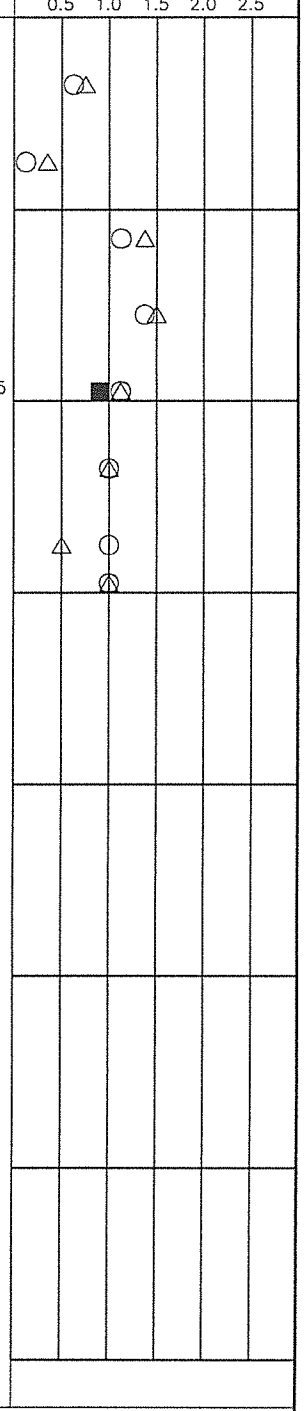
SURFACE ELEVATION : 67.81 FT.

DATE : 02-19-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.8	0	6" Concrete							
67.3		2" Oyster Shell and Sand Mix				18			
67.1		Stiff gray LEAN CLAY (CL) w/silt and calcareous nodules				22			
	5	-soft to medium stiff 2'-4'				17			
		-very stiff 4'-8'				19			
59.8		Stiff to very stiff gray and reddish brown FAT CLAY (CH) w/calcareous nodules		86	100	29	71	26	45
	10	-very stiff 10'-12'				38			
		-crawfish hole 12'-14'				35			
		-very stiff 14'-15'				30			
52.8	15								
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 15.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 9.6 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-37

LOG OF BORING NO. GB-38

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13873630.34, E 3120550.36
DeBoll Street; See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 15.0 FT.

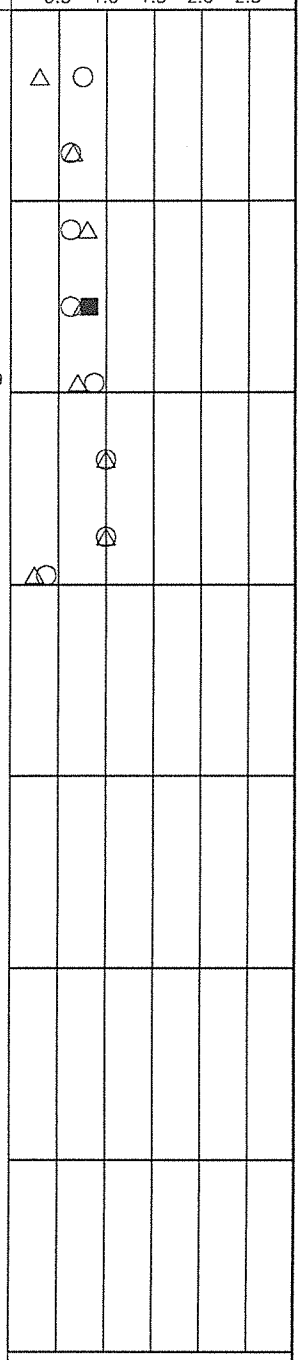
SURFACE ELEVATION : 67.86 FT.

DATE : 02-19-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.9	0	7" Asphalt over 10" Sand and Shell Mix							
66.4		Medium stiff to stiff gray LEAN CLAY (CL) w/silt seams				17			
65.9				76		24	52	21	31
	5	Stiff gray and brown FAT CLAY (CH) w/sand				21			
61.9		Stiff yellowish brown and gray LEAN CLAY (CL) w/sand and ferrous stains			111	19			
59.9		Stiff reddish brown and gray FAT CLAY (CH) w/sand and calcareous nodules -very stiff 10'-14'		81		25	50	21	29
	10					31			
53.9						33			
52.9	15	Medium stiff gray and brown LEAN CLAY (CL) w/sand				19			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-38

LOG OF BORING NO. GB-39

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : DeBoll Street
See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 8.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-20-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 8.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER, ● UNCONFINED COMPRESSION, ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION, △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			4" Asphalt over 8" Sand and Shell Mix								
				FILL: medium stiff dark gray lean clay w/sand								
	5											
	10			NOTE : Obstruction was encountered at 8 feet and boring was offset to GB-39A.								
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 8.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-39

LOG OF BORING NO. GB-39A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13873659.46, E 3120996.08
DeBoll Street; See Plan of Borings (Figure 2.4)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 67.90 FT.

DATE : 02-20-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 14.0 FT.
WET ROTARY : 14.0 TO 15.0 FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.9	0	3" Asphalt over 8" Sand and Shell Mix							
67.0		FILL: stiff to very stiff dark gray sandy lean clay w/ferrous nodules and ferrous stains				14			
63.9						22			
	5	-medium stiff to stiff w/grass roots 2'-4'		67	110	19	33	17	16
		Medium stiff yellowish brown and gray SANDY LEAN CLAY (CL) w/ferrous nodules				16			
57.9	10	-very stiff 6'-8' -stiff 8'-10'				17			
55.9		Medium stiff to stiff yellowish brown and gray LEAN CLAY (CL) w/sand		75	107	21	32	17	15
		Stiff reddish brown FAT CLAY (CH) w/ferrous stains				36			
52.9	15					27			
	20								
	25								
	30								
	35								

DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 14.0 FT. DURING DRILLING; AFTER 25.0 MIN. AT 13.0 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-39A

LOG OF BORING NO. GB-40

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13873666.37, E 3121542.53
DeBoll Street; See Plan of Borings (Figure 2.4)

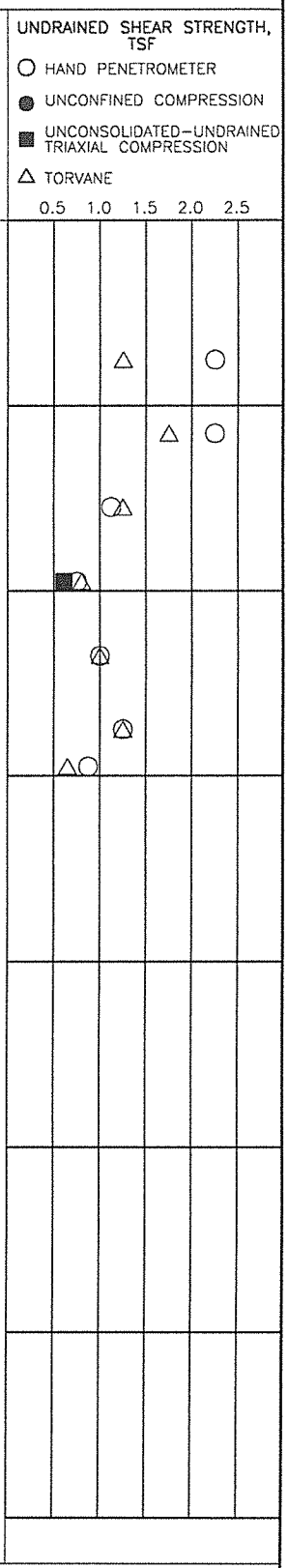
COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 68.19 FT.

DATE : 02-20-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
68.2	0	11" Asphalt							
67.3		FILL: gray silty sand				5			
66.2		Very stiff to hard dark gray SANDY LEAN CLAY (CL) w/calcareous nodules		70		12	36	21	15
	5	-very stiff 6'-8'				15			
						18			
60.2		Stiff yellowish brown and gray LEAN CLAY (CL) w/sand, calcareous and ferrous nodules		78	109	21	42	20	22
	10	-very stiff 10'-14'				21			
						23			
54.2		Stiff reddish brown FAT CLAY (CH) w/calcareous nodules				32			
53.2	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-40

LOG OF BORING NO. GB-41

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13873288.95, E 3122099.56
Firnat Street; See Plan of Borings (Figure 2.6)

COMPLETION DEPTH : 20.0 FT.

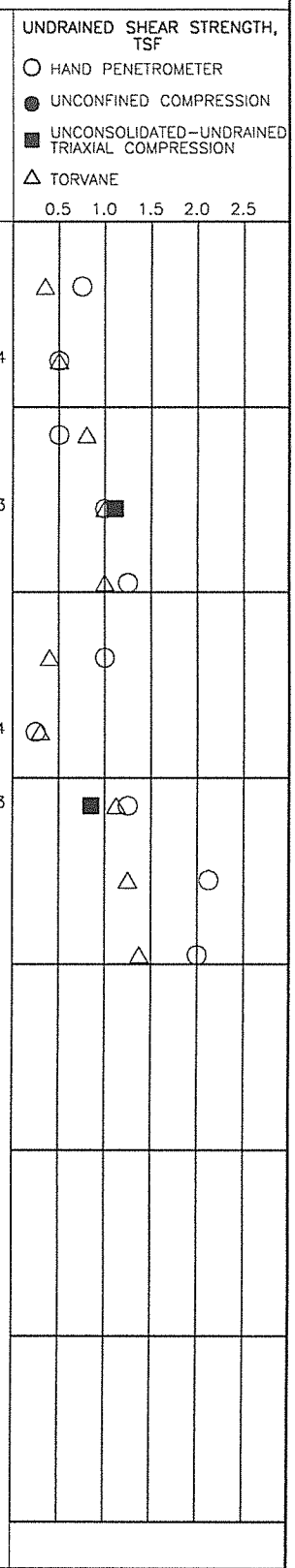
SURFACE ELEVATION : 67.31 FT.

DATE : 02-23-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 20.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.3	0	7" Asphalt over 8" Sand and Shell Mix							
66.1		FILL: medium stiff to stiff gray lean clay w/sand, calcareous and ferrous nodules, and ferrous stains				17			
				74		17	32	18	14
	5	-stiff 2'-6'				15			
61.3		Very stiff yellowish brown and gray LEAN CLAY (CL) w/sand and calcareous nodules		78	116	17	48	15	33
	10	-medium stiff to very stiff 10'-12'				18			
		-medium stiff 12'-14'				23			
53.3				82		22	38	14	24
	15	Stiff to very stiff reddish brown and gray FAT CLAY (CH)		98	99	27	69	26	43
		-very stiff to hard 16'-20'				23			
47.3	20					26			
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-41

LOG OF BORING NO. GB-42

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Firnat Street
See Plan of Borings (Figure 2.7)

COMPLETION DEPTH : 10.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-23-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 10.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (0.5 1.0 1.5 2.0 2.5)
	0			4" Asphalt over 12" Shell and Sand Mix								
				FILL: medium stiff gray sandy lean clay								○ ○
	5											○ ○
				-soft 8'-10'								○
	10			NOTE : Obstruction was encountered at 10 feet and boring was offset to GB-42A.								
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 10.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-42

LOG OF BORING NO. GB-42A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13873303.21, E 3122486.42
Firnat Street; See Plan of Borings (Figure 2.7)

COMPLETION DEPTH : 15.0 FT.

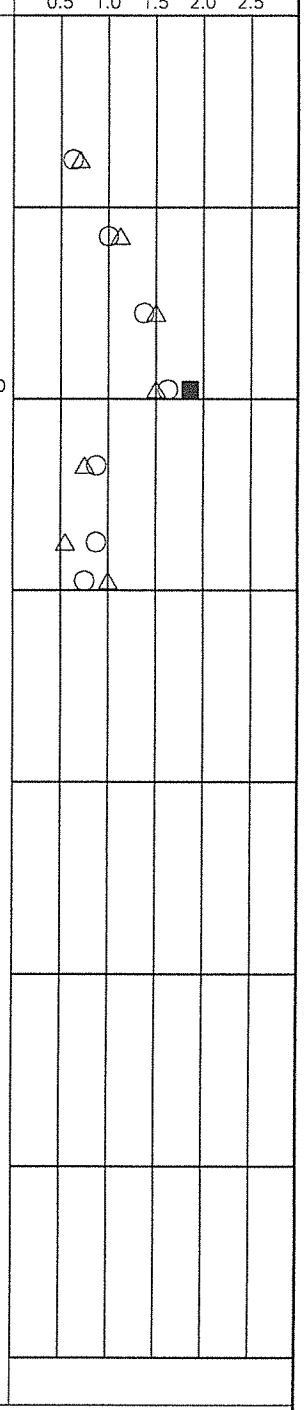
SURFACE ELEVATION : 67.53 FT.

DATE : 02-23-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.5	0	4" Asphalt over 12" Sand and Shell Mix							
66.2		Dark gray LEAN CLAY (CL) w/sand, ferrous nodules, and ferrous stains -w/shell fragments 16"-2' -stiff 2'-4' -very stiff yellowish brown and gray 4'-8' -w/calcareous nodules 6'-8'				12			
	5					24			
						18			
						16			
59.5		Very stiff reddish brown and gray FAT CLAY (CH) w/sand and calcareous nodules -stiff 10'-12'		74	117	16	51	21	30
	10								
55.5		Stiff gray LEAN CLAY (CL) w/sand and ferrous nodules -stiff to very stiff reddish brown and gray 14'-15'				23			
						21			
52.5	15					22			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-42A

LOG OF BORING NO. GB-43

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Firnat Street
See Plan of Borings (Figure 2.7)

COMPLETION DEPTH : 6.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-23-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 6.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER, ● UNCONFINED COMPRESSION, ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION, △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			3" Asphalt over 6" Cement Stabilized Sand								
				FILL: stiff brown and gray lean clay w/sand -medium stiff 2'-6'								
	5											
				NOTE : Obstruction was encountered at 6 feet and boring was offset to GB-43A.								
	10											
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 6.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-43

LOG OF BORING NO. GB-43A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Firnat Street
See Plan of Borings (Figure 2.7)

COMPLETION DEPTH : 10.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-23-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 10.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER; ● UNCONFINED COMPRESSION; ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION; △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			3" Asphalt over 6" Cement Stabilized Sand								
				Stiff dark gray LEAN CLAY (CL) w/sand								
				-very stiff yellowish brown and gray w/ferrous nodules and ferrous stains 4'-10'								
	5											
	10			NOTE : Obstruction was encountered at 10 feet and boring was offset to GB-43B.								
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 10.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-43A

LOG OF BORING NO. GB-43B

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13873330.78, E 3122892.52
Firnat Street; See Plan of Borings (Figure 2.7)

COMPLETION DEPTH : 20.0 FT.

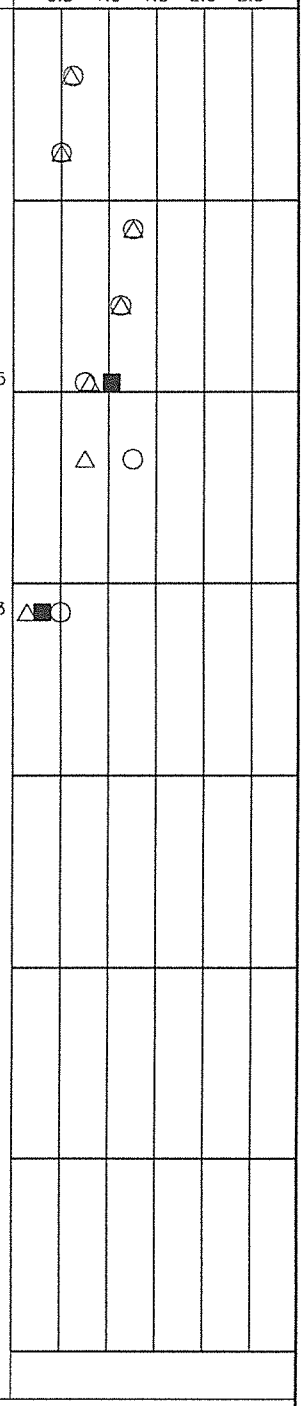
SURFACE ELEVATION : 67.39 FT.

DATE : 02-23-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 20.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.4	0	4" Asphalt over 9" Sand and Shell Mix							
66.3		Stiff dark gray SANDY LEAN CLAY (CL) w/ferrous nodules and ferrous stains -yellowish brown and gray 2'-12' -very stiff 4'-8' -stiff to very stiff 8'-12'				16			
						18			
	5					16			
						16			
	10			63	115	17	41	16	25
						19			
55.4		Gray CLAYEY SAND (SC) w/clay seams							
53.4		Soft to stiff yellowish brown and gray SANDY LEAN CLAY (CL) w/ferrous nodules		44		20			
	15				117	18	29	16	13
			11			21			
47.4	20					23			
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 14.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 11.0 FT.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-43B

LOG OF BORING NO. GB-44

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13872940.09, E 3120874.06
Warner Street; See Plan of Borings (Figure 2.6)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 67.84 FT.

DATE : 02-25-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.8 / 67.4 (DEPTH 0)	2.5" Asphalt over 3" Sand, Limestone, and Shell Mix							
	Medium stiff to stiff dark gray LEAN CLAY (CL) w/sand, ferrous nodules, and ferrous stains				17			
			79		20	38	16	22
(DEPTH 5)	-w/roots 2'-4'							
	-gray and yellowish brown w/calcareous nodules 4'-8'				20			
	-stiff 6'-8'				19			
(DEPTH 10)	-stiff to very stiff 10'-12'		78	105	23	47	16	31
	-very stiff 12'-14'				23			
	-stiff to very stiff 14'-15'				16			
52.8 (DEPTH 15)					17			

DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 14.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 13.0 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-44

LOG OF BORING NO. GB-45

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13872595.60, E 3120841.37
Doverside Street; See Plan of Borings (Figure 2.6)

COMPLETION DEPTH : 15.0 FT.

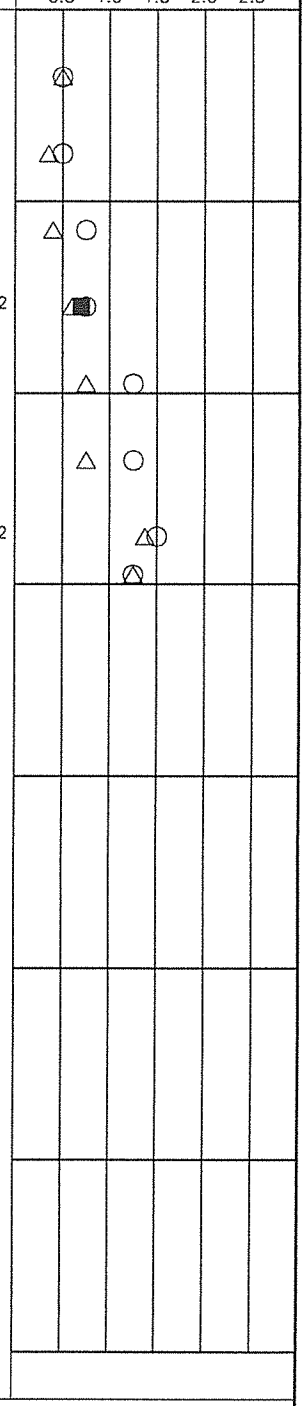
SURFACE ELEVATION : 67.89 FT.

DATE : 02-25-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.9	0	2.5" Asphalt over 6" Sand, Limestone, and Shell Mix							
66.6		FILL: stiff dark gray lean clay w/sand, ferrous nodules, and ferrous stains				19			
						19			
	5	-medium stiff to stiff 2'-6'							
		-w/calcareous nodules 2'-8'				16			
		-yellowish brown and gray 4'-6'							
59.9		-gray 6'-8'		73	110	20	47	15	32
		Stiff to very stiff reddish brown and gray LEAN CLAY (CL) w/sand							
	10					22			
55.9						22			
		Very stiff reddish brown FAT CLAY (CH) w/silt seams		99		28	54	22	32
52.9	15					34			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 14.0 FT. DURING DRILLING; AFTER 15.0 MIN. AT 13.0 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-45

LOG OF BORING NO. GB-46

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Helmers Street
See Plan of Borings (Figure 2.6)

COMPLETION DEPTH : 5.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-25-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 5.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER, ● UNCONFINED COMPRESSION, ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION, △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			2.5" Asphalt over 7" Cement Stabilized Sand								
				FILL: very stiff gray lean clay w/sand -stiff 2'-4'								
	5			NOTE : Obstruction was encountered at 5 feet and boring was offset to GB-46A.								
	10											
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 5.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-46

LOG OF BORING NO. GB-46A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13871857.10, E 3120843.08
Helmers Street; See Plan of Borings (Figure 2.6)

COMPLETION DEPTH : 15.0 FT.

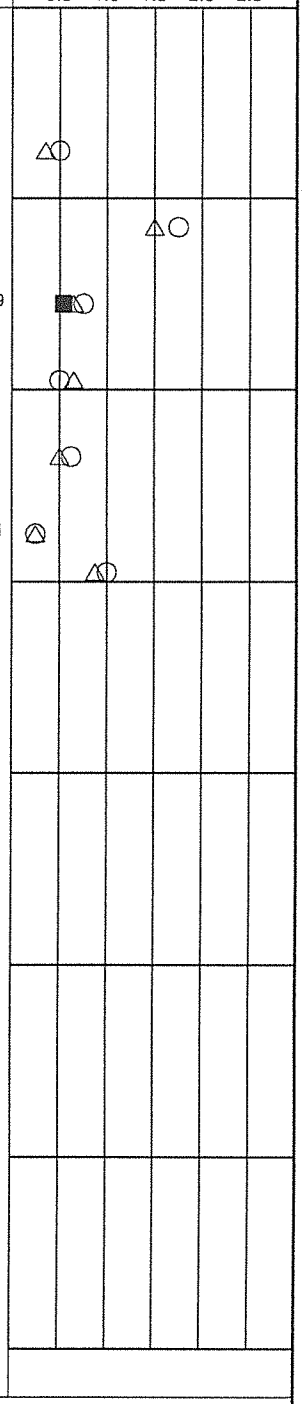
SURFACE ELEVATION : 67.39 FT.

DATE : 02-25-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.4	0	2.5" Asphalt over 7" Cement Stabilized Sand and Shell Mix				14			
66.6		FILL: medium stiff to stiff dark gray lean clay w/sand and calcareous nodules				18			
63.4	5	Very stiff yellowish brown and gray LEAN CLAY (CL) w/sand, calcareous and ferrous nodules -stiff 6'-12'		77	111	16	46	17	29
						20			
	10					22			
55.4		Medium stiff brown and gray LEAN CLAY (CL) w/ferrous nodules		86		29	39	18	21
53.4						27			
52.4	15	Stiff to very stiff reddish brown FAT CLAY (CH) w/silt seams				35			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-46A

LOG OF BORING NO. GB-47

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13872225.34, E 3120817.83
Duff Lane; See Plan of Borings (Figure 2.6)

COMPLETION DEPTH : 20.0 FT.

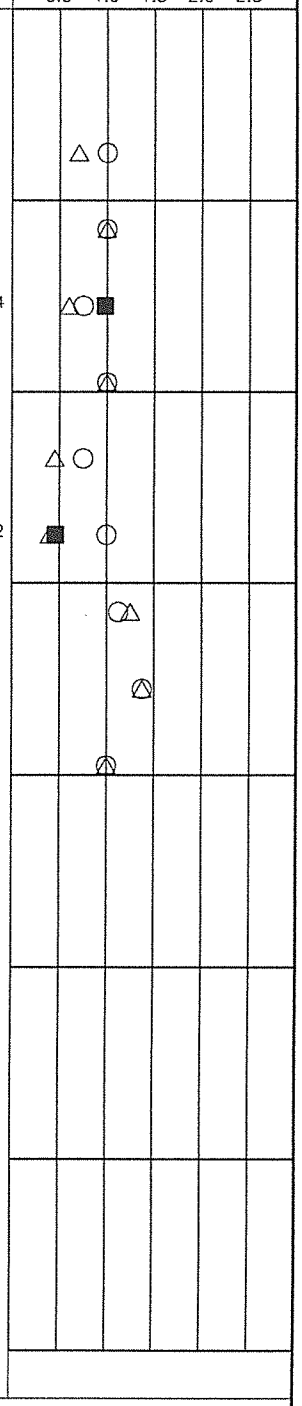
SURFACE ELEVATION : 68.05 FT.

DATE : 02-24-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 14.0 FT.
WET ROTARY : 14.0 TO 20.0 FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
68.0	0	8" Asphalt over 8" Sand and Shell Fragments							
66.7		Stiff to very stiff dark gray LEAN CLAY (CL) w/sand, calcareous and ferrous nodules, and ferrous stains				12			
						18			
	5	-w/silt seams 2'-12'				16			
		-very stiff 4'-6'							
		-gray 4'-10'							
		-very stiff 8'-10'		71	112	18	39	15	24
						20			
	10	-medium stiff to stiff reddish brown and gray 10'-12'							
56.0						24			
		Medium stiff to very stiff reddish brown LEAN CLAY (CL) w/calcareous nodules		98	104	24	32	20	12
53.0	15	Very stiff reddish brown and gray FAT CLAY (CH) w/calcareous and ferrous nodules				20			
50.0						29			
		Very stiff gray and yellowish gray LEAN CLAY (CL) w/sand				16			
48.0	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 16.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 13.5 FT.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-47

LOG OF BORING NO. GB-48

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13872244.07, E 3121330.00
Duff Lane; See Plan of Borings (Figure 2.6)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 67.88 FT.

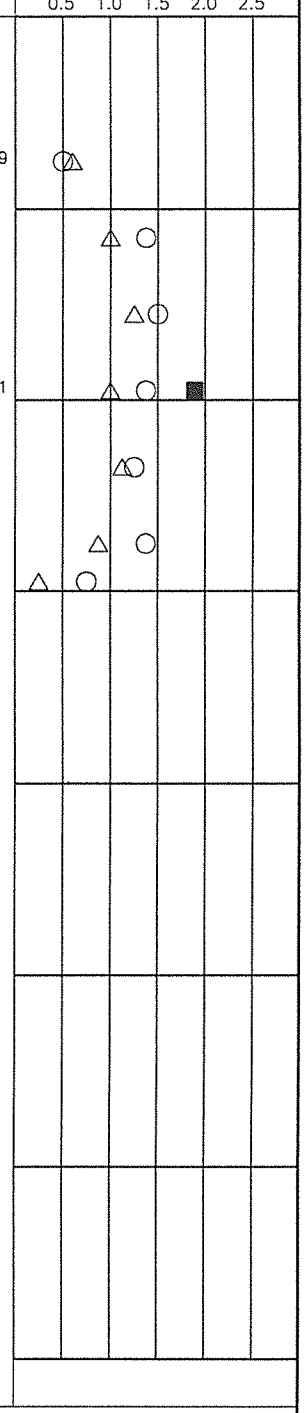
DATE : 02-24-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.9	0	8" Asphalt over 10" Sand and Shell Mix							
66.4		Stiff dark gray LEAN CLAY (CL) w/sand, ferrous nodules, and ferrous stains				11			
				80		25	48	19	29
	5	-very stiff 4'-12'							
		-Yellowish brown and gray 6'-12'				18			
						15			
				78	117	17	48	17	31
	10								
		-stiff to very stiff 12'-14'				19			
		-medium stiff to stiff 14'-15'				20			
52.9	15					21			
	20								
	25								
	30								
	35								

SYMBOL / SAMPLES

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-48

LOG OF BORING NO. GB-49

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13872263.13, E 3121846.58
Duff Lane; See Plan of Borings (Figure 2.6)

COMPLETION DEPTH : 15.0 FT.

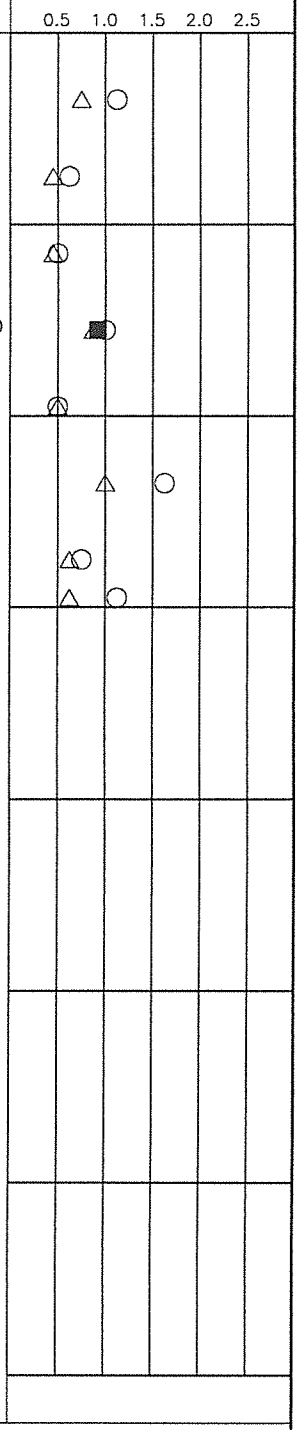
SURFACE ELEVATION : 68.14 FT.

DATE : 02-24-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
68.1	0	10" Asphalt over 8" Sand, Shell, and Limestone Mix							
66.6		Stiff to very stiff dark gray LEAN CLAY (CL) w/sand, ferrous nodules, and ferrous stains				15			
						17			
	5	-medium stiff to stiff 2'-6'							
		-yellowish brown and gray 4'-6'				17			
		-w/calcareous nodules 4'-12'							
		-very stiff 6'-8'		81	111	18	46	16	30
		-yellowish gray 6'-10'							
		-stiff 8'-10'							
	10	-very stiff gray 10'-12'				22			
		-stiff 12'-14'				20			
						20			
53.1	15					26			
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-49

LOG OF BORING NO. GB-50

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Duff Lane
See Plan of Borings (Figure 2.6)

COMPLETION DEPTH : 9.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-24-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 9.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			10" Asphalt over 8" Sand and Shell Mix								
				FILL: brown silty sand								
	5											
	10			NOTE : Obstruction was encountered at 9 feet and boring was offset to GB-50A.								
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 9.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-50

LOG OF BORING NO. GB-50A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13872285.67, E 3122308.10
Duff Lane; See Plan of Borings (Figure 2.6)

COMPLETION DEPTH : 30.0 FT.

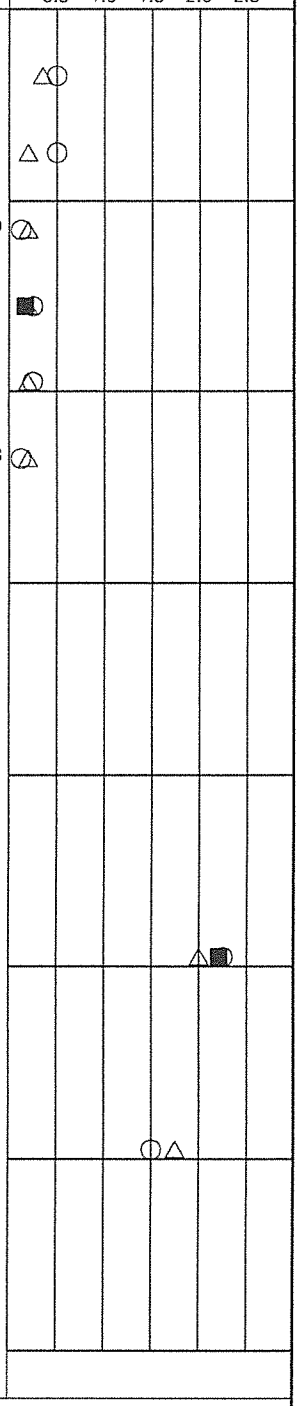
SURFACE ELEVATION : 65.92 FT.

DATE : 02-27-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 22.0 FT.
WET ROTARY : 22.0 TO 30.0 FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
65.9	0	9" Concrete							
65.2		FILL: medium stiff to stiff gray and yellow sandy lean clay -soft to stiff 2'-4' -soft to medium stiff 4'-12'							
						21			
	5			58		22	28	19	9
					106	20			
	10					20			
53.9		Reddish brown SILTY SAND (SM) w/clay seams		53		23	30	22	8
				41		23			
	15					23			
		-brown and gray 16'-23' -medium dense 16.5'-18.5'							
			14	12		25			
		-loose 18.5'-20'							
	20		9			24			
42.9		Hard gray and yellow LEAN CLAY (CL) w/sand, ferrous nodules, and ferrous stains		82	120	15	40	17	23
	25								
		-very stiff 28'-30'							
35.9	30					17			
		NOTE : Loss of circulation during wet rotary at 7 feet. Used 1,000 gallons of water.							
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 30.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-50A

LOG OF BORING NO. GB-51 (GB-51P)

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13872294.59, E 3122774.79
Duff Lane; See Plan of Borings (Figure 2.7)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 67.14 FT.

DATE : 02-24-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
67.1	6" Asphalt over 6" Sand, Shell, and Limestone Mix							
66.6					11			
65.1	Gray and brown SILTY SAND (SM)							
	Stiff yellowish brown and gray LEAN CLAY (CL) w/sand and ferrous nodules				18			
	-very stiff 4'-6'				17			
	-stiff to very stiff 6'-8'							
	-w/ferrous stains 6'-10'				17			
	-stiff to very stiff 10'-12'		76	114	18	39	16	23
	-soft to stiff 12'-14'				21			
53.1					22			
52.1	Gray SILTY SAND (SM) w/ferrous nodules and clay seams				24			

NOTE :
See Piezometer GB-51P for water level measurements.

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
▼: WATER DEPTH AT 9.4 FT., HOLE OPEN TO 15.0 FT. ON 04-03-15.

Geotest Engineering, Inc.

FIGURE A-51

LOG OF BORING NO. GB-52

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Duff Lane
See Plan of Borings (Figure 2.7)

COMPLETION DEPTH : 2.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-24-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 2.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			6" Asphalt								
				Gray SANDY LEAN CLAY (CL) w/silt								
				NOTE : Obstruction was encountered at 2 feet and boring was offset to GB-52A.								
	5											
	10											
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 2.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-52

LOG OF BORING NO. GB-52A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13872320.44, E 3123336.35
Duff Lane; See Plan of Borings (Figure 2.7)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 66.37 FT.

DATE : 02-24-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 14.0 FT.
WET ROTARY : 14.0 TO 15.0 FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
66.4	0	10" Asphalt							
65.5		FILL: stiff gray and brown sandy lean clay w/calcareous nodules and ferrous stains				14			
						16			
	5	-medium stiff to stiff 2'-4' -soft to medium stiff 4'-6' -soft 6'-10'				19			
						17			
	10	-medium stiff to stiff 10'-12'		54	116	20	33	14	19
						17			
54.4		Medium dense brown and gray SILTY SAND (SM)	12	14		23			
51.4	15		19			21			
	20								
	25								
	30								
	35								

DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 12.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 7.8 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-52A

LOG OF BORING NO. GB-53

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Hendricks Street
See Plan of Borings (Figure 2.7)

COMPLETION DEPTH : 1.5 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-28-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 1.5 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER, ● UNCONFINED COMPRESSION, ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION, △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			3" Asphalt over 6" Sand, Limestone, and Shell Mix								
				FILL: dark gray silty sand								
				NOTE : Obstruction was encountered at 1.5 feet and boring was offset to GB-53A.								
	5											
	10											
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 1.5 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-53

LOG OF BORING NO. GB-53A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13872598.47, E 3123837.66
Hendricks Street; See Plan of Borings (Figure 2.7)

COMPLETION DEPTH : 20.0 FT.

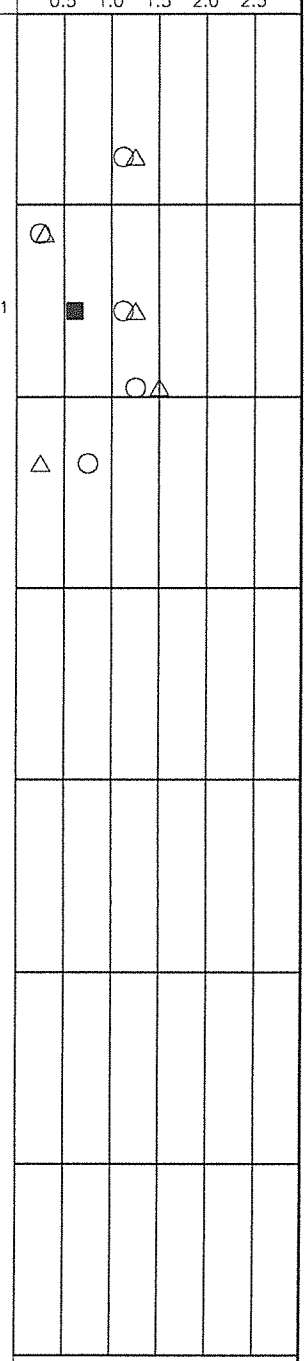
SURFACE ELEVATION : 65.85 FT.

DATE : 02-28-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 20.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
65.9	0	4" Asphalt over 8" Sand, Limestone, and Shell Mix							
64.9		Dark gray SILTY SAND (SM)				11			
63.9		Very stiff gray SANDY LEAN CLAY (CL) w/ferrous nodules				15			
	5	-medium stiff 4'-6'				18			
		-stiff to very stiff 6'-8'		50	116	15	34	13	21
	10	-medium stiff to stiff 10'-12'				15			
53.9		Medium dense brown and gray SILTY SAND (SM)				16			
			12	21		19			
	15		17			21			
			22			23			
45.9	20		27			19			
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 14.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 7.5 FT.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-53A

LOG OF BORING NO. GB-54

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Hendricks Street
See Plan of Borings (Figure 2.7)

COMPLETION DEPTH : 5.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-26-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 5.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER; ● UNCONFINED COMPRESSION; ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION; △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			3" Asphalt over 8" Sand and Clay Mix								
				FILL: stiff dark gray sandy lean clay -medium stiff 2'-4'								
	5			NOTE : Obstruction was encountered at 5 feet and boring was offset to GB-54A.								
	10											
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 5.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-54A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13872622.31, E 3124320.74
Hendricks Street; See Plan of Borings (Figure 2.7)

COMPLETION DEPTH : 15.0 FT.

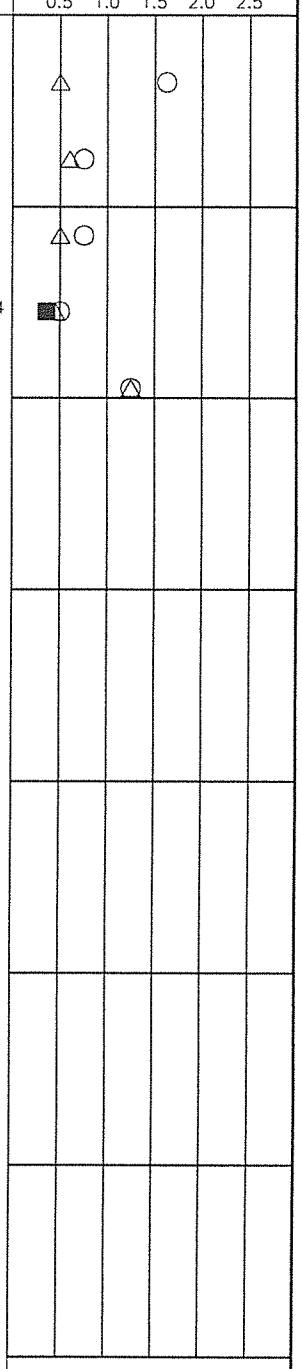
SURFACE ELEVATION : 65.73 FT.

DATE : 02-26-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 8.0 FT.
WET ROTARY : 8.0 TO 15.0 FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
65.7	0	3" Asphalt over 8" Sand and Shell Mix							
64.8		Stiff to very stiff dark gray SANDY LEAN CLAY (CL) w/calcareous nodules				14			
		-w/grass roots 11"-4'				18			
	5	-stiff 2'-6'							
		-medium stiff to stiff 6'-8'				18			
		-very stiff yellowish brown and gray 8'-10'		50	111	18	30	16	14
55.7	10	Very loose gray SILTY SAND (SM)				16			
53.7		Reddish brown FAT CLAY (CH) w/sand seams	2	25		23			
51.7			10			31			
50.7	15	Medium dense gray SILTY SAND (SM)	10			18			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 8.0 FT. DURING DRILLING; AFTER 15.0 MIN. AT 3.5 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-54A

LOG OF BORING NO. GB-55

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874205.13, E 3123384.60
Hector Street; See Plan of Borings (Figure 2.5)

COMPLETION DEPTH : 20.0 FT.

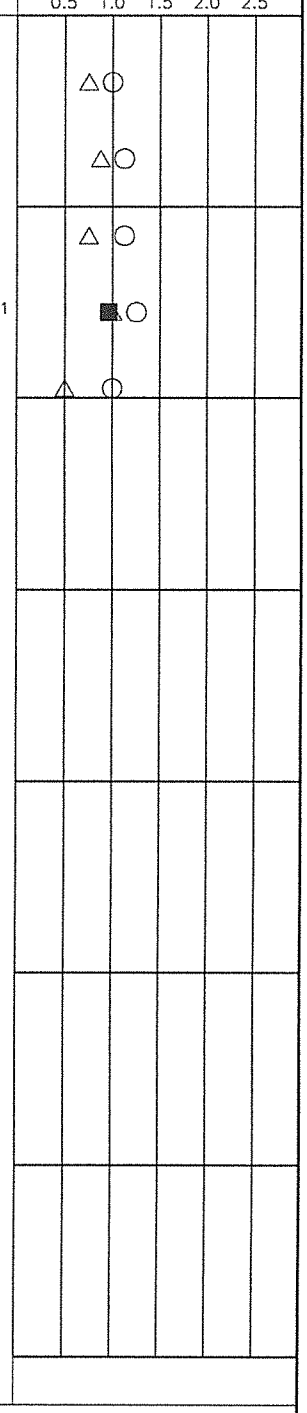
SURFACE ELEVATION : 66.20 FT.

DATE : 02-26-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 FT.
WET ROTARY : 12.0 TO 20.0 FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
66.2	0	8" Concrete							
65.5		Stiff to very stiff dark gray SANDY LEAN CLAY (CL) w/ferrous nodules				14			
		-stiff to very stiff yellowish brown and gray 2'-10'				15			
	5					15			
		-very sandy clay 8'-10'		51	120	14	36	15	21
56.2	10	Gray SILTY SAND (SM)				16			
		-medium dense 12.5'-20'				19			
			17	18		27			
	15		15			23			
			14			21			
46.2	20		22			20			
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 12.0 FT. DURING DRILLING; AFTER 15.0 MIN. AT 6.5 FT.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-55

LOG OF BORING NO. GB-56

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Exeter Street
See Plan of Borings (Figure 2.5)

COMPLETION DEPTH : 8.0 FT.

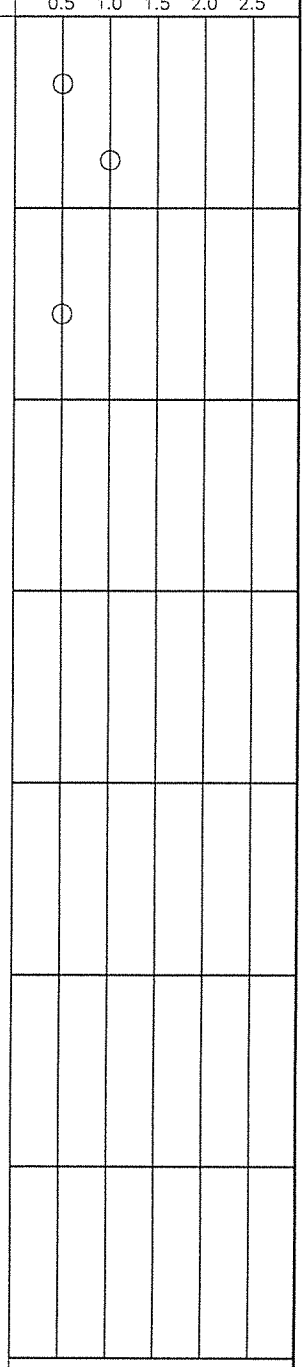
SURFACE ELEVATION : Existing Grade

DATE : 02-26-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 8.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
	0			2.5" Asphalt over 6" Lime Stabilized Shell Base							
				Stiff dark gray SANDY LEAN CLAY (CL) w/ferrous nodules and ferrous stains -very stiff 2'-4'							
	5										
	10			NOTE : Obstruction was encountered at 8 feet and boring was offset to GB-56A.							
	15										
	20										
	25										
	30										
	35										

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 8.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-56

LOG OF BORING NO. GB-56A

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Exeter Street
See Plan of Borings (Figure 2.5)

COMPLETION DEPTH : 10.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-26-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 10.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER; ● UNCONFINED COMPRESSION; ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION; △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			Auger to 8'								
	5											
				Very stiff yellowish brown and gray SANDY CLAY (CL)								
	10			NOTE : Obstruction was encountered at 10 feet and boring was offset to GB-56B.								
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 10.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-56A

LOG OF BORING NO. GB-56B

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : Exeter Street
See Plan of Borings (Figure 2.5)

COMPLETION DEPTH : 8.0 FT.

SURFACE ELEVATION : Existing Grade

DATE : 02-26-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 8.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE) 0.5 1.0 1.5 2.0 2.5
	0			Auger to 8'								
	5											
	10			NOTE : Obstruction was encountered at 8 feet and boring was offset to GB-56C.								
	15											
	20											
	25											
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 8.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-56B

LOG OF BORING NO. GB-56C

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874183.29, E 3123803.34
Exeter Street; See Plan of Borings (Figure 2.5)

COMPLETION DEPTH : 15.0 FT.

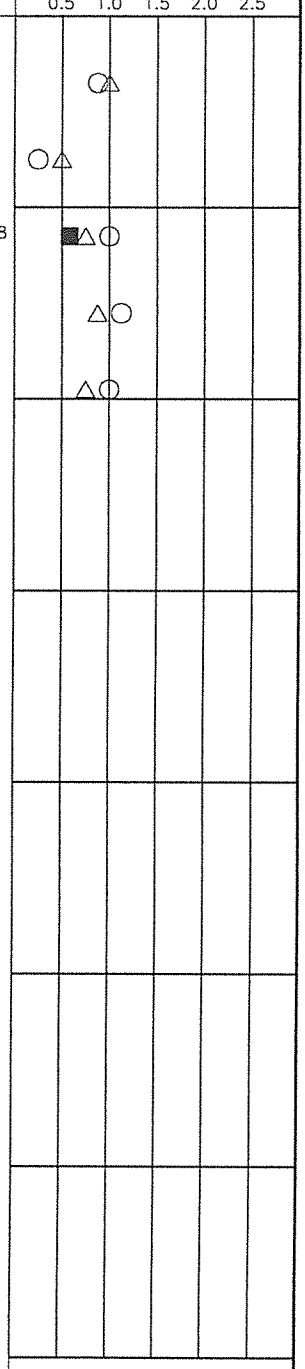
SURFACE ELEVATION : 66.69 FT.

DATE : 02-28-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
66.7	0								
66.1		3" Asphalt over 4" Sand and Shell Mix							
		Stiff to very stiff gray SANDY LEAN CLAY (CL) w/sand seams and calcareous nodules -medium stiff to stiff 2'-4'				13			
						20			
	5			54	115	17	36	18	18
						15			
						16			
56.7	10	Loose brown and gray SILTY SAND (SM) -medium dense 12'-15'							
			8	15		20			
			15			20			
51.7	15		17			20			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-56C

LOG OF BORING NO. GB-57 (GB-57P)

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13874634.66, E 3123779.99
Exeter Street; See Plan of Borings (Figure 2.5)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 65.74 FT.

DATE : 02-26-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 10.0 FT.
WET ROTARY : 10.0 TO 15.0 FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
65.7	0	2" Asphalt over 6.5" Sand and Shell Mix							
65.0		Stiff dark gray SANDY LEAN CLAY (CL) w/ferrous nodules and ferrous stains -medium stiff to stiff 2'-4' -very stiff gray 4'-6' -medium stiff to very stiff 6'-8' -gray and yellowish brown 6'-12' -very stiff 8'-10'				17			
						18			
	5					17			
				65	113	18	34	16	18
	10					21			
53.7		Very stiff reddish brown FAT CLAY (CH)				22			
				99		30	67	25	42
50.7	15					27			
	20								
	25								
	30								
	35								

NOTE :
See Piezometer GB-57P for water level measurements.

DEPTH TO WATER IN BORING :
: FREE WATER 1st ENCOUNTERED AT 10.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 5.0 FT.
: WATER DEPTH AT 3.2 FT., HOLE OPEN TO 15.0 FT. ON 04-03-15.

Geotest Engineering, Inc.

FIGURE A-57

LOG OF BORING NO. GB-58

PROJECT : Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas

PROJECT NO. : 1140208301

LOCATION : N 13875151.72, E 3123756.45
Exeter Street; See Plan of Borings (Figure 2.5)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 63.81 FT.

DATE : 02-26-15

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 6.0 FT.
WET ROTARY : 6.0 TO 15.0 FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
63.8	0	2" Asphalt over 7" Sand, Limestone, and Gravel Mix							
63.1		Gray SILTY SAND (SM)				13			
				39		18			
59.8	5	Soft to medium stiff yellowish brown and gray SANDY LEAN CLAY (CL) -stiff to very stiff 6'-10'				22			
						19			
53.8	10			58	114	18	37	17	20
		Yellowish brown and gray CLAYEY SAND (SC) w/clay seams		46		19			
51.8		Very stiff reddish brown FAT CLAY (CH) -stiff 14'-15'				30			
48.8	15					32			
	20								
	25								
	30								
	35								

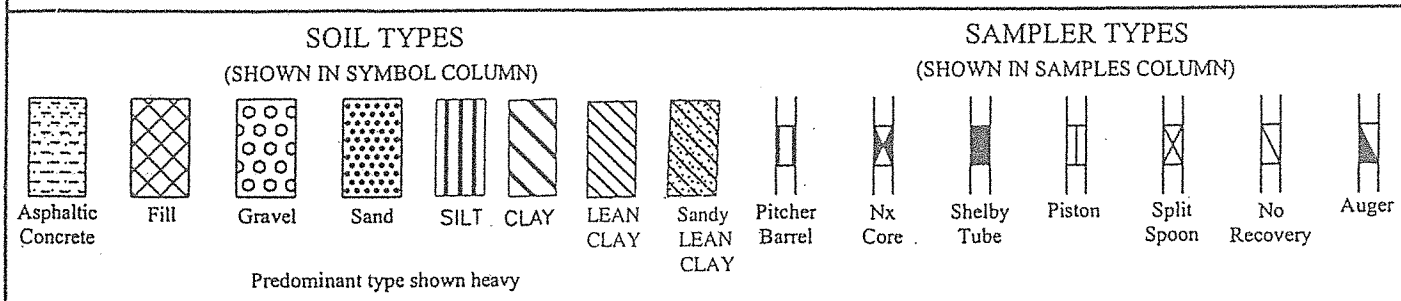
DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 6.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 6.0 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-58

Job No. 1140208301

SYMBOLS AND TERMS USED ON BORING LOGS



TERMS DESCRIBING CONSISTENCY OR CONDITION

Basic Soil Type	Density or Consistency	Standard Penetration Resistance, (1) Blows/ft.	Unconfined Compressive Strength (q_u), (2) Tons/sq. ft.
Cohesionless	Very loose	Less than 4	Not applicable
	Loose	4 to <10	Not applicable
	Medium dense	10 to <30	Not applicable
	Dense	30 to <50	Not applicable
	Very dense	50 or greater	Not applicable
Cohesive	Very soft	Less than 2	Less than 0.25
	Soft	2 to <4	0.25 to <0.5
	Firm/Medium stiff	4 to <8	0.5 to <1.0
	Stiff	8 to <15	1.0 to <2.0
	Very stiff	15 to <30	2.0 to <4.0
	Hard	30 or greater	4 or greater

(1) Number of blows from 140-lb. weight falling 30-in. to drive 2-in. OD, 1-3/8-in. ID, split barrel sampler (ASTM D1586)

(2) q_u may also be approximated using a pocket penetrometer

TERMS CHARACTERIZING SOIL STRUCTURE

Parting: -paper thin in size Seam: -1/8" to 3" thick Layer: -greater than 3"

Slickensided	- having inclined planes of weakness that are slick and glossy in appearance.
Fissured	- containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated	- composed of thin layers of varying color and texture.
Interbedded	- composed of alternate layers of different soil types.
Calcareous	- containing appreciable quantities of calcium carbonate.
Well graded	- having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly graded	- predominantly of one grain size, or having a range of sizes with some intermediate size missing.
Flocculated	- pertaining to cohesive soils that exhibit a loose knit or flakey structure.

Job No. 1140208301

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN INNISDALE AREA WBS NO. S-000035-0206-4; HOUSTON, TEXAS		PIEZOMETER NUMBER: GB-4AP
GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT KUO & ASSOCIATES, INC.	HOUSTON, TEXAS

COMPLETION DATE 02-27-15

DRY AUGERED 0 TO 20 FT

WASH BORED -- TO -- FT

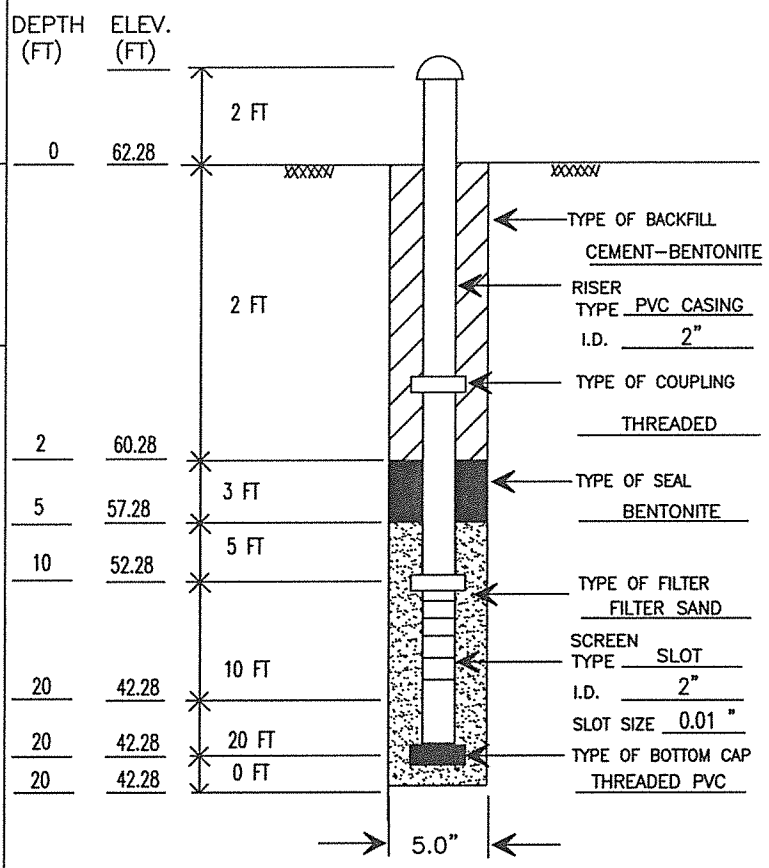
DRILLING FLUID: WATER

DEVELOPMENT DATE: 02-27-15

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READINGS:

DATE	DEPTH (TOG)	ELEVATION
03-01-15	6.0	56.3
04-03-15	5.0	57.3



(NOT TO SCALE)

REMARKS:

NOTES:

1. DIMENSIONS NOMINAL UNLESS OTHERWISE NOTED
2. TOG = TOP OF GROUND

DRILLED BY: MJ	STARTED: 02-27-15	NORTHING: 13871438.38 EASTING: 3117180.59
LOGGED BY: JG	COMPLETED: 02-27-15	GROUND LEVEL (MSL): 62.28
CHECKED BY: NK	APPROVED BY: MB	SHEET 1 OF 1

Job No. 1140208301

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN INNISDALE AREA WBS NO. S-000035-0206-4; HOUSTON, TEXAS	PIEZOMETER NUMBER: GB-13P

GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT KUO & ASSOCIATES, INC.	HOUSTON, TEXAS

COMPLETION DATE 02-28-15

DRY AUGERED 0 TO 15 FT

WASH BORED -- TO -- FT

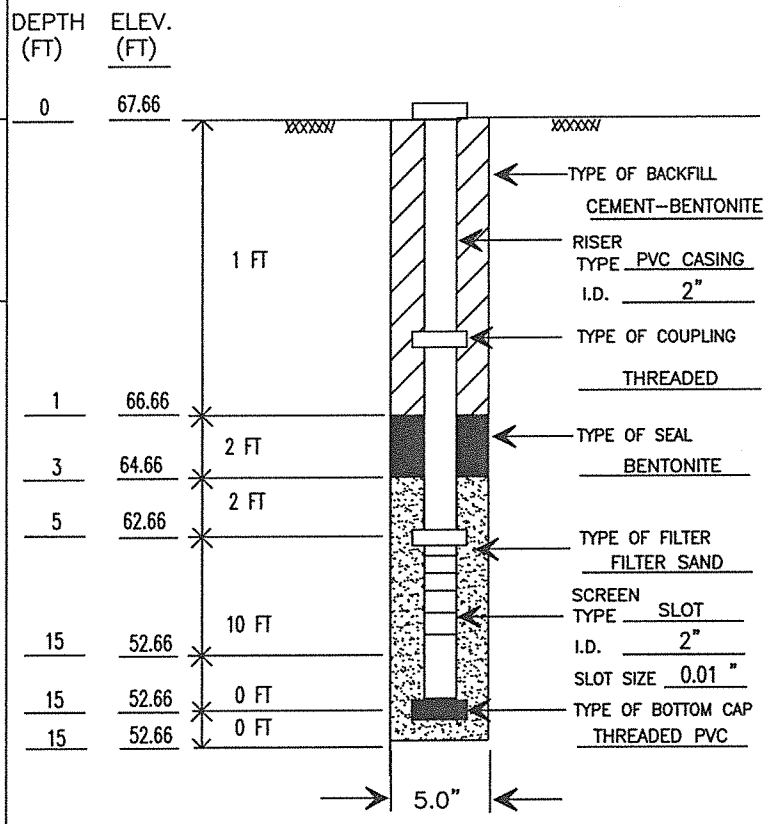
DRILLING FLUID: WATER

DEVELOPMENT DATE: 02-28-15

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READINGS:

DATE	DEPTH (TOG)	ELEVATION
03-01-15	8.2	59.5
04-03-15	9.2	58.5



(NOT TO SCALE)

REMARKS:

NOTES:

1. DIMENSIONS NOMINAL UNLESS OTHERWISE NOTED
2. TOG = TOP OF GROUND

DRILLED BY: MJ	STARTED: 02-28-15	NORTHING: 13874949.88 EASTING: 3118410.010
LOGGED BY: JG	COMPLETED: 02-28-15	GROUND LEVEL (MSL): 67.66
CHECKED BY: NK	APPROVED BY: MB	SHEET 1 OF 1

Job No. 1140208301

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN INNISDALE AREA WBS NO. S-000035-0206-4; HOUSTON, TEXAS	PIEZOMETER NUMBER: GB-22BP

GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT KUO & ASSOCIATES, INC.	HOUSTON, TEXAS

COMPLETION DATE 02-25-15

DRY AUGERED 0 TO 12.5 FT

WASH BORED 12.5 TO 20 FT

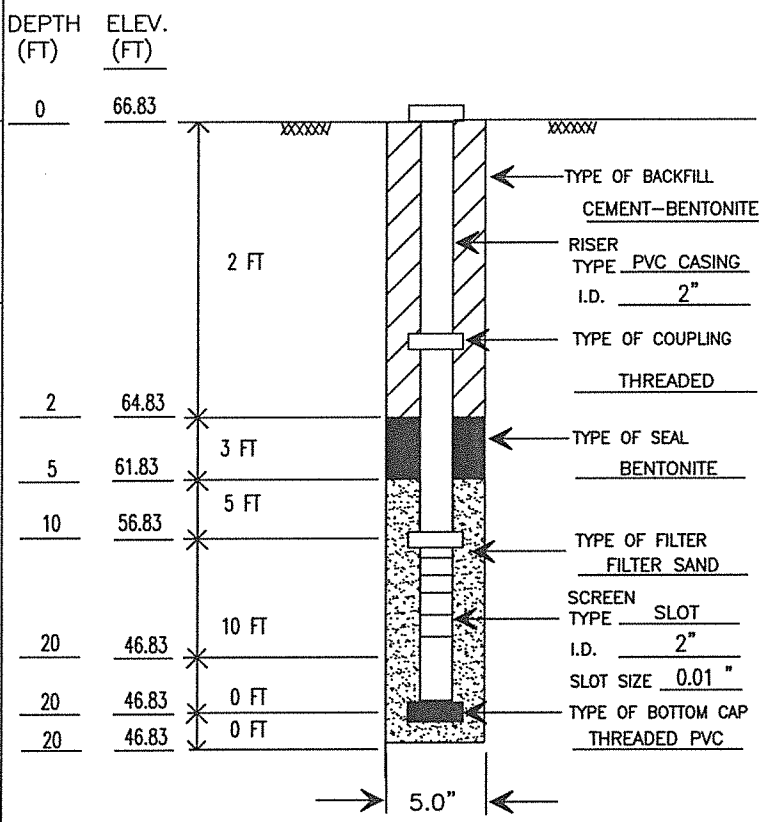
DRILLING FLUID: WATER

DEVELOPMENT DATE: 02-25-15

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READINGS:

DATE	DEPTH (TOG)	ELEVATION
03-01-15	7.5	59.3
04-03-15	5.3	61.5



(NOT TO SCALE)

REMARKS:

NOTES:

1. DIMENSIONS NOMINAL UNLESS OTHERWISE NOTED
2. TOG = TOP OF GROUND

DRILLED BY: MJ	STARTED: 02-25-15	NORTHING: 13877030.466 EASTING: 3121869.682
LOGGED BY: JG	COMPLETED: 02-25-15	GROUND LEVEL (MSL): 66.83
CHECKED BY: NK	APPROVED BY: MB	SHEET 1 OF 1

Job No. 1140208301

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN INNISDALE AREA WBS NO. S-000035-0206-4; HOUSTON, TEXAS	PIEZOMETER NUMBER: GB-34P

GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT KUO & ASSOCIATES, INC.	HOUSTON, TEXAS

COMPLETION DATE 02-23-15

DRY AUGERED 0 TO 15 FT

WASH BORED -- TO -- FT

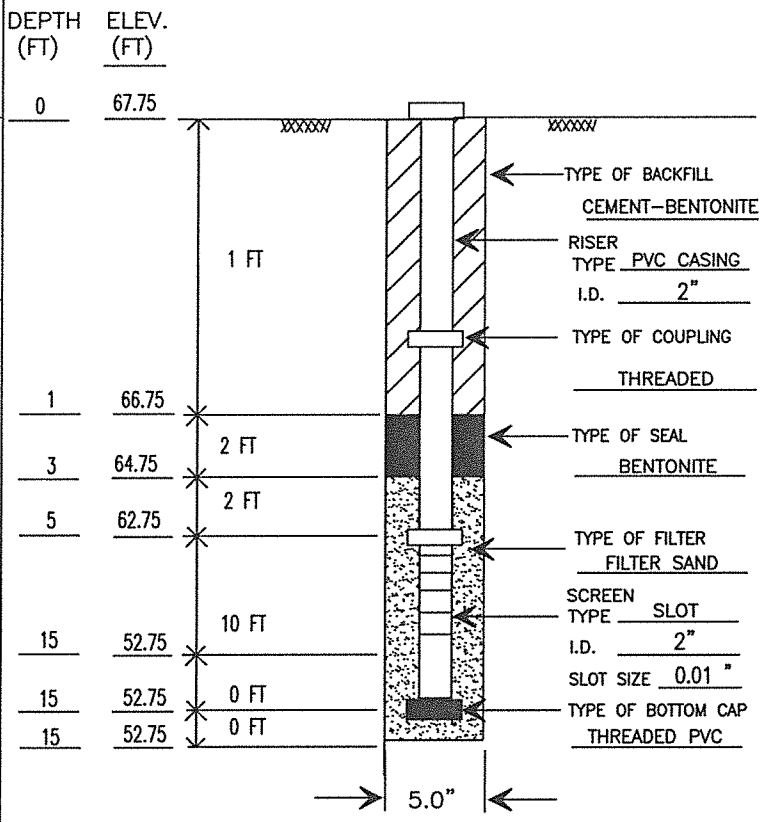
DRILLING FLUID: WATER

DEVELOPMENT DATE: 02-23-15

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READINGS:

DATE	DEPTH (TOG)	ELEVATION
03-01-15	1.8	66.0
04-03-15	3.3	64.5



(NOT TO SCALE)

REMARKS:

NOTES:

1. DIMENSIONS NOMINAL UNLESS OTHERWISE NOTED
2. TOG = TOP OF GROUND

DRILLED BY: MJ	STARTED: 02-23-15	NORTHING: 13874274.718 EASTING: 3121069.594
LOGGED BY: JG	COMPLETED: 02-23-15	GROUND LEVEL (MSL): 67.75
CHECKED BY: NK	APPROVED BY: MB	SHEET 1 OF 1

Job No. 1140208301

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN INNISDALE AREA WBS NO. S-000035-0206-4; HOUSTON, TEXAS	PIEZOMETER NUMBER: GB-51P

GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT KUO & ASSOCIATES, INC.	HOUSTON, TEXAS

COMPLETION DATE 02-24-15

DRY AUGERED 0 TO 15 FT

WASH BORED -- TO -- FT

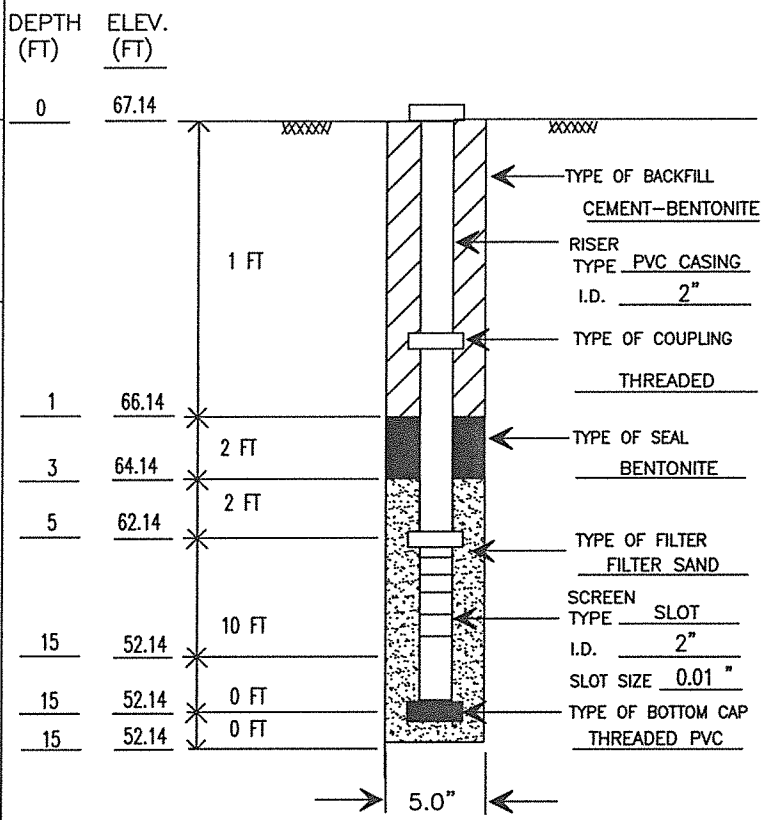
DRILLING FLUID: WATER

DEVELOPMENT DATE: 02-24-15

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READINGS:

DATE	DEPTH (TOG)	ELEVATION
03-01-15	9.6	57.5
04-03-15	9.4	57.7



(NOT TO SCALE)

REMARKS:

NOTES:

1. DIMENSIONS NOMINAL UNLESS OTHERWISE NOTED
2. TOG = TOP OF GROUND

DRILLED BY: MJ	STARTED: 02-24-15	NORTHING: 13872294.588 EASTING: 3122774.787
LOGGED BY: JG	COMPLETED: 02-24-15	GROUND LEVEL (MSL): 67.14
CHECKED BY: NK	APPROVED BY: MB	SHEET 1 OF 1

Job No. 1140208301

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN INNISDALE AREA WBS NO. S-000035-0206-4; HOUSTON, TEXAS	PIEZOMETER NUMBER: GB-57P

GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT KUO & ASSOCIATES, INC.	HOUSTON, TEXAS

COMPLETION DATE 02-26-15

DRY AUGERED 0 TO 10 FT

WASH BORED 10 TO 15 FT

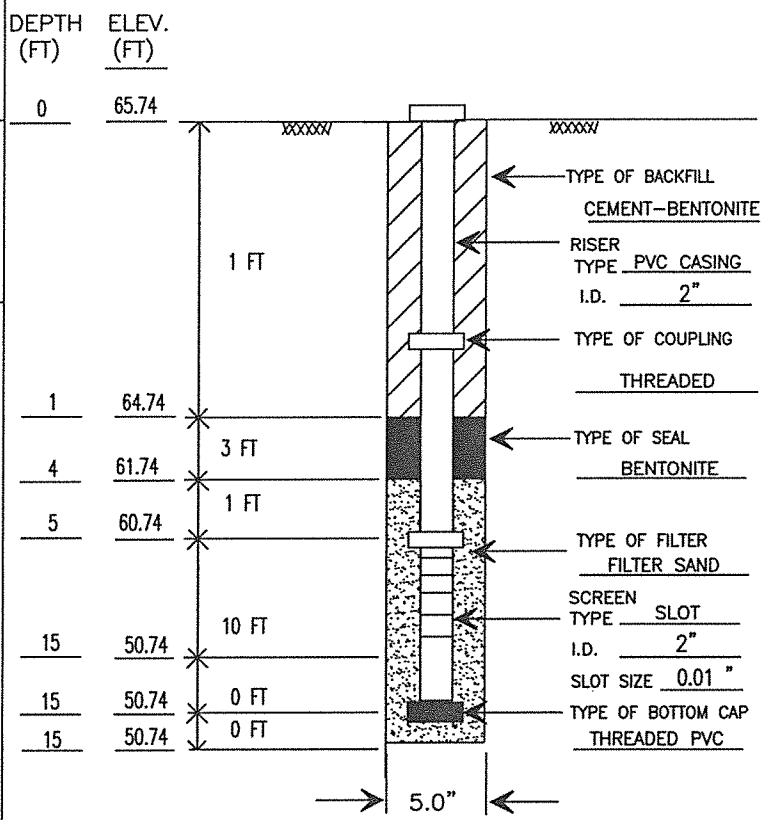
DRILLING FLUID: WATER

DEVELOPMENT DATE: 02-26-15

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READINGS:

DATE	DEPTH (TOG)	ELEVATION
03-01-15	1.2	64.5
04-03-15	3.2	62.5



(NOT TO SCALE)

REMARKS:

NOTES:

1. DIMENSIONS NOMINAL UNLESS OTHERWISE NOTED
2. TOG = TOP OF GROUND

DRILLED BY: MJ	STARTED: 02-26-15	NORTHING: 13874634.659 EASTING: 3123779.989
LOGGED BY: JG	COMPLETED: 02-26-15	GROUND LEVEL (MSL): 65.74
CHECKED BY: NK	APPROVED BY: MB	SHEET 1 OF 1

APPENDIX B

Figure

Summary of Laboratory Test Results ..... B-1 thru B-58

Grain Size Distribution Curves ..... B-59 thru B-62

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-1	2	0.9	2.0	UD		14									0.75	2.25	Lean Clay
	3	2.0	4.0	UD		16									0.88	0.38	Lean Clay
	4	4.0	6.0	UD		18	111	40	17	23	74		0.60	0.43	0.40	0.38	Lean Clay
	5	6.0	8.0	UD		20									0.40	0.38	Lean Clay
	6	8.0	10.0	UD		15									0.75	0.75	Lean Clay
	7	10.0	12.0	UD		20									1.00	0.63	Lean Clay
	8	12.0	14.0	UD		16									1.25	1.75	Lean Clay
	9	14.0	16.0	UD		16	119	44	17	27	77		1.54	1.15	1.50	2.00	Lean Clay
	10	16.0	18.0	UD		22									1.75	1.75	Fat Clay
	11	18.0	20.0	UD		23									1.75	1.75	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-1

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-2	2	1.3	2.0	UD		19									0.45	0.75	Lean Clay
	3	2.0	4.0	UD		20		38	16	22	75				0.60	0.50	Lean Clay
	4	4.0	6.0	UD		17									1.13	1.25	Lean Clay
	5	6.0	8.0	UD		17									1.25	1.25	Lean Clay
	6	8.0	10.0	UD		18	114	43	16	27	77		0.77	0.72	1.25	1.13	Lean Clay
	7	10.0	12.0	UD		24									0.75	0.63	Lean Clay
	8	12.0	14.0	UD		16									1.00	1.13	Lean Clay
	9	14.0	15.0	UD		17									1.75	1.63	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-2

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-3A	2	0.5	2.0	UD		14									0.50	0.88	Sandy Lean Clay
	3	2.0	4.0	UD		16									0.65	0.75	Sandy Lean Clay
	4	4.0	6.0	UD		17									0.75	0.75	Sandy Lean Clay
	5	6.0	8.0	UD		17									1.25	1.25	Sandy Lean Clay
	6	8.0	10.0	UD		18									1.25	1.13	Sandy Lean Clay
	7	10.0	12.0	UD		18	112	40	16	24	68		0.66	0.86	0.75	0.63	Sandy Lean Clay
	8	12.0	14.0	UD		20									0.85	0.88	Sandy Lean Clay
	9	14.0	15.0	UD		17									0.80	0.75	Sandy Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-3

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-4A (GB-4AP)	1	0.0	2.0	UD		14									1.63	1.63	Fill
	2	2.0	4.0	UD		16									1.13	1.13	Lean Clay
	3	4.0	6.0	UD		19									0.35	0.50	Lean Clay
	4	6.0	8.0	UD		20	113	27	16	11	73		0.27	0.58	0.20	0.13	Lean Clay
	5	8.0	10.0	UD		20									0.30	0.50	Lean Clay
	6	10.0	12.0	UD		19									0.30	0.38	Lean Clay
	7	12.0	14.0	UD		20									0.50	1.00	Lean Clay
	8	14.0	16.0	UD		20	115	29	15	14	70		0.22	1.15	0.30	0.38	Sandy Lean Clay
	9	16.0	18.0	UD		15									1.25	1.75	Sandy Lean Clay
	10	18.0	20.0	UD		14									0.75	1.13	Sandy Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-4

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-5A	2	0.5	2.0	UD		12										2.25	Sandy Lean Clay
	3	2.0	4.0	UD		16									1.13	1.25	Sandy Lean Clay
	4	4.0	6.0	UD		20									0.40	0.50	Sandy Lean Clay
	5	6.0	8.0	UD		17									1.13	1.13	Sandy Lean Clay
	6	8.0	10.0	UD		18									0.60	0.38	Sandy Lean Clay
	7	10.0	12.0	UD		19	114	28	13	15	69		0.66	0.86	0.65	0.63	Sandy Lean Clay
	8	12.0	14.0	UD		20									0.40	0.63	Sandy Lean Clay
	9	14.0	15.0	UD		16									0.88	0.63	Sandy Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-5

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-6	2	1.0	2.0	UD		19									0.35	0.38	Lean Clay
	3	2.0	4.0	UD		28									0.45	0.63	Lean Clay
	4	4.0	6.0	UD		20	111	46	16	30	77		0.58	0.43	0.75	1.00	Lean Clay
	5	6.0	8.0	UD		19									1.00	1.25	Lean Clay
	6	8.0	10.0	UD		18									1.00	1.25	Lean Clay
	7	10.0	12.0	UD		17									1.13	1.38	Lean Clay
	8	12.0	14.0	UD		17	109	46	15	31	77		0.91	1.01	0.50	0.63	Lean Clay
	9	14.0	16.0	UD		14									1.50	2.00	Lean Clay
	10	16.0	18.0	UD		15									1.63	0.63	Lean Clay
	11	18.0	20.0	UD		18									0.75	0.75	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-6

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-7	2	0.5	2.0	UD		11									0.75	1.50	Lean Clay
	3	2.0	4.0	UD		16									0.63	0.63	Lean Clay
	4	4.0	6.0	UD		17									0.60	0.88	Lean Clay
	5	6.0	8.0	UD		17	114	33	16	17	78		0.94	0.58	0.70	0.50	Lean Clay
	6	8.0	10.0	UD		17									0.88	1.00	Lean Clay
	7	10.0	12.0	UD		19									0.63	0.63	Lean Clay
	8	12.0	14.0	UD		22									0.40	0.38	Fat Clay
	9	14.0	16.0	UD		23	105	57	17	40	78		0.54	1.15	0.40	0.38	Fat Clay
	10	16.0	18.0	UD		18									1.00	1.38	Fat Clay
	11	18.0	20.0	UD		14									1.25	1.75	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-7

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-8	2	1.0	2.0	UD		17									0.35	0.25	Lean Clay
	3	2.0	4.0	UD		18		30	17	13	78				0.40	0.50	Lean Clay
	4	4.0	6.0	UD		16									1.25	1.25	Lean Clay
	5	6.0	8.0	UD		18									0.50	0.88	Lean Clay
	6	8.0	10.0	UD		20									0.50	0.88	Lean Clay
	7	10.0	12.0	UD		18	109	37	19	18	81		0.35	0.86	0.50	0.75	Lean Clay
	8	12.0	14.0	UD		20									1.00	1.38	Lean Clay
	9	14.0	15.0	UD		22									1.50	1.63	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-8

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-9	2	0.5	2.0	UD		16									0.20	0.38	Lean Clay
	3	2.0	4.0	UD		18		29	14	15	72				0.35	0.50	Lean Clay
	4	4.0	6.0	UD		18									0.45	0.63	Lean Clay
	5	6.0	8.0	UD		19									0.50	0.75	Lean Clay
	6	8.0	10.0	UD		21	117						0.74	0.72	1.00	1.63	Lean Clay
	7	10.0	12.0	UD		17									1.00	1.25	Lean Clay
	8	12.0	14.0	UD		18									1.25	1.38	Lean Clay
	9	14.0	15.0	UD		17									1.25	1.50	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-9

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-10	2	0.4	2.0	UD		20									0.30	0.25	Lean Clay
	3	2.0	4.0	UD		21		44	18	27	79				0.65	0.63	Lean Clay
	4	4.0	6.0	UD		18									1.00	0.75	Lean Clay
	5	6.0	8.0	UD		19									1.13	1.25	Lean Clay
	6	8.0	10.0	UD		16	118	42	17	25	78		1.43	0.72	1.50	1.75	Lean Clay
	7	10.0	12.0	UD		17									1.63	1.00	Lean Clay
	8	12.0	14.0	UD		20									1.00	1.25	Lean Clay
	9	14.0	15.0	UD		19									2.00	2.25	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-10

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-11	2	0.5	2.0	UD		22									0.50	0.38	Fill
	3	2.0	4.0	UD		14											Fill
	4	4.0	6.0	UD		20	113	38	22	16	77		0.76	0.43	1.00	0.63	Lean Clay
	5	6.0	8.0	UD		18									1.00	1.25	Lean Clay
	6	8.0	10.0	UD		17									1.13	1.50	Lean Clay
	7	10.0	12.0	UD		28	100						0.67	0.86	0.75	1.25	Lean Clay
	8	12.0	14.0	UD		18		43	19	24	87				1.00	1.38	Lean Clay
	9	14.0	16.0	UD		19									1.25	1.13	Lean Clay
	10	16.0	18.0	UD		18									1.25	1.13	Lean Clay
	11	18.5	20.0	SS	27	18					87						Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-11

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-12	2	0.8	2.0	UD		17									0.63	1.75	Lean Clay
	3	2.0	4.0	UD		16		30	16	14					0.35	0.38	Lean Clay
	4	4.0	6.0	UD		18									0.50	0.38	Lean Clay
	5	6.0	8.0	UD		20									0.50	0.38	Lean Clay
	6	8.0	10.0	UD		19	108	40	15	25	75		0.56	0.72	0.60	0.75	Lean Clay
	7	10.0	12.0	UD		17									1.00	1.75	Lean Clay
	8	12.0	14.0	UD		15									1.50	2.13	Lean Clay
	9	14.0	15.0	UD		21									1.88	2.00	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-12

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-13 (GB-13P)	2	0.8	2.0	UD		18									0.25	0.75	Lean Clay
	3	2.0	4.0	UD		18									0.88	1.00	Lean Clay
	4	4.0	6.0	UD		20									0.40	0.50	Lean Clay
	5	6.0	8.0	UD		20									0.30	0.38	Lean Clay
	6	8.0	10.0	UD		16	116	39	15	24	75		0.93	0.72	1.25	1.25	Lean Clay
	7	10.0	12.0	UD		19									0.35	0.25	Lean Clay
	8	12.0	14.0	UD		17									1.38	2.25	Lean Clay
	9	14.0	15.0	UD		17									1.63	2.25	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-13

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-14	2	0.9	2.0	UD		15									0.65	0.63	Lean Clay
	3	2.0	4.0	UD		18									0.40	0.50	Lean Clay
	4	4.0	6.0	UD		17									0.80	0.75	Lean Clay
	5	6.0	8.0	UD		16									1.50	1.63	Lean Clay
	6	8.0	10.0	UD		20	117	49	18	31	83		1.10	0.72	1.25	1.50	Lean Clay
	7	10.0	12.0	UD		16									1.38	1.75	Lean Clay
	8	12.0	14.0	UD		15									1.25	1.13	Lean Clay
	9	14.0	15.0	UD		17									1.25	1.38	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	PL	PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-15	2	0.8	2.0	UD		17									0.75	0.88	Sandy Lean Clay
	3	2.0	4.0	UD		17									1.00	0.75	Sandy Lean Clay
	4	4.0	6.0	UD		16	114	32	16	16	69		0.50	0.43	0.60	0.75	Sandy Lean Clay
	5	6.0	8.0	UD		18									0.70	0.75	Sandy Lean Clay
	6	8.0	10.0	UD		19									1.25	1.13	Sandy Lean Clay
	7	10.0	12.0	UD		27									1.00	1.13	Fat Clay
	8	12.0	14.0	UD		18	112	46	15	31	83		0.99	1.01	1.50	1.75	Lean Clay
	9	14.0	16.0	UD		17									1.75	1.75	Lean Clay
	10	16.0	18.0	UD		16									1.63	2.25	Lean Clay
	11	18.0	20.0	UD		18									2.00	2.25	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-15

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-16C	2	8.0	10.0	AG		28											Sand
	3	10.5	12.0	SS	38	30					9						Sand
	4	12.0	13.5	SS	11	29											Sand
	5	13.5	15.0	SS	16	17											Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-16

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-17	2	1.0	2.0	UD		19									1.00	1.00	Lean Clay
	3	2.0	4.0	UD		19		36	18	18	77				0.50	0.63	Lean Clay
	4	4.0	6.0	UD		19									0.70	0.63	Lean Clay
	5	6.0	8.0	UD		21									1.00	1.13	Lean Clay
	6	8.0	10.0	UD		23									1.13	1.00	Lean Clay
	7	10.0	12.0	UD		37	83	84	30	54	94		0.43	0.86	1.13	1.00	Fat Clay
	8	12.0	14.0	UD		33									1.13	1.13	Fat Clay
	9	14.0	15.0	UD		18									1.00	1.13	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-17

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-18	2	1.2	2.0	UD		17									0.63	1.38	Lean Clay
	3	2.0	4.0	UD		21		47	17	30	77				0.80	0.75	Lean Clay
	4	4.0	6.0	UD		18									1.25	1.00	Lean Clay
	5	6.0	8.0	UD		20									1.25	1.13	Lean Clay
	6	8.0	10.0	UD		20									1.25	1.25	Lean Clay
	7	10.0	12.0	UD		31	95	69	26	43	89		0.47	0.86	0.70	0.75	Fat Clay
	8	12.0	14.0	UD		23									0.60	0.50	Fat Clay
	9	14.0	15.0	UD		22					77				0.65	0.50	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-18

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-19A	2	1.0	2.0	UD		19									0.40	0.75	Lean Clay
	3	2.0	4.0	UD		15									1.00	1.25	Lean Clay
	4	4.0	6.0	UD		19	110	37	16	21	73		0.66	0.43	0.35	0.50	Lean Clay
	5	6.0	8.0	UD		16									0.75	1.00	Lean Clay
	6	8.0	10.0	UD		23									0.70	0.63	Fat Clay
	7	10.0	12.0	UD		25									1.50	1.63	Fat Clay
	8	12.0	14.0	UD		26	96	73	27	46	92		0.49	1.01	1.13	1.13	Fat Clay
	9	14.0	16.0	UD		17									1.25	1.63	Lean Clay
	10	16.0	18.0	UD		17									1.00	1.75	Lean Clay
	11	17.0	19.0	UD		17									1.00	1.75	Fat Clay
	12	18.0	20.0	UD		21									1.50	1.50	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-19

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-20	2	1.0	2.0	UD		17									1.38	1.38	Lean Clay
	3	2.0	4.0	UD		16		26	14	12	78				1.00	0.63	Lean Clay
	4	4.0	6.0	UD		19									0.65	0.75	Lean Clay
	5	6.0	8.0	UD		19									1.13	1.00	Lean Clay
	6	8.0	10.0	UD		20									0.75	0.75	Lean Clay
	7	10.0	12.0	UD		30	101	77	28	49	86		0.77	0.86	0.65	0.50	Fat Clay
	8	12.0	14.0	UD		30									0.65	0.75	Fat Clay
	9	14.0	15.0	UD		34									0.80	0.75	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-20

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-21	2	1.3	2.0	UD		16									1.25	2.13	Lean Clay
	3	2.0	4.0	UD		21									0.50	0.50	Lean Clay
	4	4.0	6.0	UD		19									0.80	0.75	Lean Clay
	5	6.0	8.0	UD		19									1.00	1.00	Lean Clay
	6	8.0	10.0	UD		18	112	46	20	26	74		0.61	0.72	0.60	0.50	Lean Clay
	7	10.0	12.0	UD		36									0.55	0.50	Fat Clay
	8	12.0	14.0	UD		31		77	28	49	82				0.45	0.50	Fat Clay
	9	14.0	15.0	UD		16									1.25	1.50	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-21

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
CB-228 (CB-228P)	3	1.3	2.0	UD		14									0.88	1.00	Sandy Lean Clay
	4	2.0	4.0	UD		20	110	38	14	24	55		0.61	0.29	0.75	1.00	Sandy Lean Clay
	5	4.0	6.0	UD		17									0.55	0.75	Sandy Lean Clay
	6	6.0	8.0	UD		17									0.35	0.50	Sandy Lean Clay
	7	8.0	10.0	UD		17									0.45	0.50	Sandy Lean Clay
	8	10.5	12.0	SS	14	19					16						Silty Sand
	9	12.5	14.0	SS	24	23											Silty Sand
	10	14.5	16.0	SS	10	23											Silty Sand
	11	16.5	18.0	SS	11	23											Silty Sand
	12	18.0	20.0	UD		17									1.75	1.63	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-22

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-23	2	1.5	2.0	UD		12											Silty Sand
	3	2.0	4.0	UD		17									1.00	0.88	Sandy Lean Clay
	4	4.0	6.0	UD		16	117	41	15	26	53		0.77	0.43	1.13	1.25	Sandy Lean Clay
	5	6.0	8.0	UD		14									1.38	1.88	Sandy Lean Clay
	6	8.0	10.0	UD		14									0.75	0.75	Sandy Lean Clay
	7	10.5	12.0	SS	9	17											Silty Sand
	8	12.5	14.0	SS	14	20											Silty Sand
	9	14.5	16.0	SS	9	21					12						Silty Sand
	10	16.5	18.0	SS	9	20											Silty Sand
	11	18.5	20.0	SS	7	16											Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-23

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-24	2	1.1	2.0	UD		17									0.60	0.75	Sandy Lean Clay
	3	2.0	4.0	UD		18									0.75	0.88	Sandy Lean Clay
	4	4.0	6.0	UD		16	121	37	13	24	53		0.59	0.43	1.00	1.38	Sandy Lean Clay
	5	6.0	8.0	UD		14									1.25	1.50	Sandy Lean Clay
	6	8.5	10.0	SS	8	20											Sand
	7	10.5	12.0	SS	14	22					8						Sand
	8	12.0	13.5	SS	6	22					11						Sand
	9	13.5	15.0	SS	6	18											Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-24

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-25	2	1.2	2.0	UD		19									0.75	0.88	Sandy Lean Clay
	3	2.0	4.0	UD		18									0.75	1.00	Sandy Lean Clay
	4	4.0	6.0	UD		18		40	15	25	59				0.75	0.50	Sandy Lean Clay
	5	6.0	8.0	UD		31									1.13	1.13	Fat Clay
	6	8.0	10.0	UD		33									1.00	1.00	Fat Clay
	7	10.0	12.0	UD		28	95	55	22	33	97		0.69	0.86	0.60	0.75	Fat Clay
	8	12.0	14.0	UD		32									1.00	0.75	Fat Clay
	9	14.0	15.0	UD		16									1.00	1.00	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-25

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-26	2	1.0	2.0	UD		18											Sandy Lean Clay
	3	2.0	4.0	UD		19									0.50	0.75	Sandy Lean Clay
	4	4.0	6.0	UD		18	113	42	15	27	53		0.82	0.43	1.25	1.50	Sandy Lean Clay
	5	6.0	8.0	UD		22									0.20	0.25	Sandy Lean Clay
	6	8.0	10.0	UD		25					54				0.15	0.25	Sandy Lean Clay
	7	10.5	12.0	SS	8	21					13						Silty Sand
	8	12.0	13.0	UD		22											Silty Sand
	9	13.0	14.0	UD		22	103	89	31	58	89		0.80	1.01	1.63	1.63	Fat Clay
	10	14.0	15.0	UD		16									1.88	1.88	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-26

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-27	2	0.9	2.0	UD		18									0.60	0.75	Sandy Lean Clay
	3	2.0	4.0	UD		19									0.60	0.75	Sandy Lean Clay
	4	4.0	6.0	UD		19									0.35	0.13	Sandy Lean Clay
	5	6.0	8.0	UD		18									1.00	1.13	Sandy Lean Clay
	6	8.0	10.0	UD		23	103	52	21	31	76		0.63	0.72	0.60	0.75	Fat Clay
	7	10.0	12.0	UD		23									0.30	0.25	Fat Clay
	8	12.0	14.0	UD		18		52	21	31					1.25	1.38	Fat Clay
	9	14.0	15.0	UD		17									1.38	1.50	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-27

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-28	2	0.8	2.0	UD		20									1.00	1.00	Fat Clay
	3	2.0	4.0	UD		19		54	16	38	75				1.38	1.50	Fat Clay
	4	4.0	6.0	UD		21									1.13	1.00	Fat Clay
	5	6.0	8.0	UD		19									1.50	1.38	Fat Clay
	6	8.0	10.0	UD		19									1.25	1.38	Fat Clay
	7	10.0	12.0	UD		28	99	88	31	57	97		0.38	0.86	1.13	1.00	Fat Clay
	8	12.0	14.0	UD		29									1.00	1.00	Fat Clay
	9	14.0	15.0	UD		26									1.13	1.00	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-28

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-29	2	0.8	2.0	UD		21									0.65	0.75	Lean Clay
	3	2.0	4.0	UD		21		43	18	25	74				0.60	0.75	Lean Clay
	4	4.0	6.0	UD		23									0.40	0.38	Lean Clay
	5	6.0	8.0	UD		18									1.13	1.38	Lean Clay
	6	8.0	10.0	UD		29									0.60	0.75	Fat Clay
	7	10.0	12.0	UD		28	99	69	26	43	97		0.64	0.86	1.13	1.00	Fat Clay
	8	12.0	14.0	UD		27									1.25	1.25	Fat Clay
	9	14.0	15.0	UD		21									0.65	0.75	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-29

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-30	2	0.8	2.0	UD		18									1.00	1.00	Lean Clay
	3	2.0	4.0	UD		24		39	17	22	86				0.50	0.63	Lean Clay
	4	4.0	6.0	UD		23									1.25	1.00	Lean Clay
	5	6.0	8.0	UD		18									1.38	1.38	Lean Clay
	6	8.0	10.0	UD		19	114	49	21	28	77		0.86	0.72	1.38	1.00	Lean Clay
	7	10.0	12.0	UD		30									1.00	1.00	Fat Clay
	8	12.0	14.0	UD		33									1.13	1.00	Fat Clay
	9	14.0	15.0	UD		17									1.50	1.50	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-30

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-31	2	0.6	2.0	UD		23									0.50	0.50	Lean Clay
	3	2.0	4.0	UD		23		48	18	30	75				0.65	0.88	Lean Clay
	4	4.0	6.0	UD		21									0.88	1.00	Lean Clay
	5	6.0	8.0	UD		19									1.00	1.00	Lean Clay
	6	8.0	10.0	UD		19									1.13	1.13	Lean Clay
	7	10.0	12.0	UD		35	86	82	29	53	96		0.45	0.86	0.80	0.88	Fat Clay
	8	12.0	14.0	UD		27									1.00	1.00	Fat Clay
	9	14.0	15.0	UD		18									0.50	1.00	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-31

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-32	2	0.5	2.0	UD		13									0.75	2.25	Lean Clay
	3	2.0	4.0	UD		16		36	13	23	74				0.60	0.75	Lean Clay
	4	4.0	6.0	UD		17									0.88	1.00	Lean Clay
	5	6.0	8.0	UD		17									0.88	1.00	Lean Clay
	6	8.0	10.0	UD		32									1.00	1.00	Fat Clay
	7	10.0	12.0	UD		35	89	84	30	54	95		0.50	0.86	0.75	0.75	Fat Clay
	8	12.0	13.0	UD		27									0.25	0.25	Fat Clay
	9	13.0	14.0	UD		33									0.80	0.75	Fat Clay
	10	14.0	15.0	UD		18									0.35	0.75	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-32

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-33	2	0.6	2.0	UD		16									0.75	1.38	Lean Clay
	3	2.0	4.0	UD		23									0.50	0.75	Lean Clay
	4	4.0	6.0	UD		26									0.75	0.75	Fat Clay
	5	6.0	8.0	UD		24									0.90	0.88	Fat Clay
	6	8.0	10.0	UD		29	101	66	25	41	86		0.81	0.72	0.85	0.88	Fat Clay
	7	10.0	12.0	UD		40									0.75	0.75	Fat Clay
	8	12.0	14.0	UD		25									0.20	0.38	Lean Clay
	9	14.0	16.0	UD		21	106	28	14	14	79		0.52	1.15	0.50	0.50	Lean Clay
	10	16.0	18.0	UD		16									1.25	1.63	Lean Clay
	11	18.0	20.0	UD		14									1.50	1.75	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-33

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-34 (GB-34P)	2	0.5	1.0	UD		17											Shell
	3	1.0	2.0	UD		19									1.13	1.00	Sandy Lean Clay
	4	2.0	4.0	UD		18									0.60	0.75	Sandy Lean Clay
	5	4.0	6.0	UD		17									0.85	0.88	Sandy Lean Clay
	6	6.0	8.0	UD		17	116	46	20	26	70		0.87	0.58	1.25	1.38	Sandy Lean Clay
	7	8.0	10.0	UD		23									1.00	1.00	Sandy Lean Clay
	8	10.0	12.0	UD		34		68	26	42	97				1.13	1.00	Fat Clay
	9	12.0	14.0	UD		24									1.63	1.75	Fat Clay
	10	14.0	15.0	UD		19									0.50	0.75	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-34

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-35	3	0.8	2.0	UD		19									0.60	0.50	Lean Clay
	4	2.0	4.0	UD		21		42	15	27	74				0.70	0.25	Lean Clay
	5	4.0	6.0	UD		18									1.13	1.13	Fat Clay
	6	6.0	8.0	UD		25									1.00	1.00	Fat Clay
	7	8.0	10.0	UD		21									1.00	1.25	Fat Clay
	8	10.0	12.0	UD		35	91	71	26	45	90		0.45	0.86	0.70	0.50	Fat Clay
	9	12.0	14.0	UD		40									0.40	0.25	Fat Clay
	10	14.0	15.0	UD		22									0.25	0.25	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-35

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-36	2	1.0	2.0	UD		18									1.00	1.63	Lean Clay
	3	2.0	4.0	UD		24									0.80	0.75	Lean Clay
	4	4.0	6.0	UD		24									0.80	0.88	Lean Clay
	5	6.0	8.0	UD		29									1.00	1.00	Lean Clay
	6	8.0	10.0	UD		21	113	49	17	32	78		1.49	0.72	1.00	1.13	Lean Clay
	7	10.0	12.0	UD		22									1.00	0.75	Lean Clay
	8	12.0	14.0	UD		33									1.13	1.13	Fat Clay
	9	14.0	15.0	UD		41									0.75	0.75	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-36

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-37	3	0.7	2.0	UD		18									0.75	0.63	Lean Clay
	4	2.0	4.0	UD		22									0.35	0.13	Lean Clay
	5	4.0	6.0	UD		17									1.38	1.13	Lean Clay
	6	6.0	8.0	UD		19									1.50	1.38	Lean Clay
	7	8.0	10.0	UD		29	100	71	26	45	86		0.90	0.72	1.13	1.13	Fat Clay
	8	10.0	12.0	UD		38									1.00	1.00	Fat Clay
	9	12.0	14.0	UD		35									0.50	1.00	Fat Clay
	10	14.0	15.0	UD		30									1.00	1.00	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-37

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-38	2	1.4	2.0	UD		17									0.30	0.75	Lean Clay
	3	2.0	4.0	UD		24		52	21	31	76				0.65	0.63	Fat Clay
	4	4.0	6.0	UD		21									0.80	0.63	Fat Clay
	5	6.0	8.0	UD		19	111						0.82	0.58	0.75	0.63	Lean Clay
	6	8.0	10.0	UD		25		50	21	29	81				0.70	0.88	Fat Clay
	7	10.0	12.0	UD		31									1.00	1.00	Fat Clay
	8	12.0	14.0	UD		33									1.00	1.00	Fat Clay
	9	14.0	15.0	UD		19									0.25	0.38	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-38

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-39A	2	0.9	2.0	UD		14									0.50	1.63	Fill
	3	2.0	4.0	UD		22									0.50	0.38	Fill
	4	4.0	6.0	UD		19	110	33	17	16	67		0.21	0.43	0.35	0.38	Sandy Lean Clay
	5	6.0	8.0	UD		16									1.13	1.50	Sandy Lean Clay
	6	8.0	10.0	UD		17									0.70	0.88	Sandy Lean Clay
	7	10.0	12.0	UD		21	107	32	17	15	75		0.33	0.86	0.30	0.50	Lean Clay
	8	12.0	14.0	UD		36									0.75	0.75	Fat Clay
	9	14.0	15.0	UD		27									0.70	0.75	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-40	2	0.9	2.0	UD		5											Fill
	3	2.0	4.0	UD		12		36	21	15	70				1.25	2.25	Sandy Lean Clay
	4	4.0	6.0	UD		15									1.75	2.25	Sandy Lean Clay
	5	6.0	8.0	UD		18									1.25	1.13	Sandy Lean Clay
	6	8.0	10.0	UD		21	109	42	20	22	78		0.61	0.72	0.80	0.75	Lean Clay
	7	10.0	12.0	UD		21									1.00	1.00	Lean Clay
	8	12.0	14.0	UD		23									1.25	1.25	Lean Clay
	9	14.0	15.0	UD		32									0.65	0.88	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-40

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-41	2	1.3	2.0	UD		17									0.35	0.75	Fill
	3	2.0	4.0	UD		17		32	18	14	74				0.50	0.50	Fill
	4	4.0	6.0	UD		15									0.80	0.50	Fill
	5	6.0	8.0	UD		17	116	48	15	33	78		1.11	0.58	1.00	1.00	Lean Clay
	6	8.0	10.0	UD		18									1.00	1.25	Lean Clay
	7	10.0	12.0	UD		23									0.40	1.00	Lean Clay
	8	12.0	14.0	UD		22		38	14	24	82				0.30	0.25	Lean Clay
	9	14.0	16.0	UD		27	99	69	26	43	98		0.85	1.15	1.13	1.25	Fat Clay
	10	16.0	18.0	UD		23									1.25	2.13	Fat Clay
	11	18.0	20.0	UD		26									1.38	2.00	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-41

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-42A	2	1.3	2.0	UD		12											Lean Clay
	3	2.0	4.0	UD		24									0.70	0.63	Lean Clay
	4	4.0	6.0	UD		18									1.13	1.00	Lean Clay
	5	6.0	8.0	UD		16									1.50	1.38	Lean Clay
	6	8.0	10.0	UD		16	117	51	21	30	74		1.86	0.72	1.50	1.63	Fat Clay
	7	10.0	12.0	UD		23									0.75	0.88	Fat Clay
	8	12.0	14.0	UD		21									0.55	0.88	Lean Clay
	9	14.0	15.0	UD		22									1.00	0.75	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-42

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	PL	PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-43B	2	1.1	2.0	UD		16									0.60	0.63	Sandy Lean Clay
	3	2.0	4.0	UD		18									0.50	0.50	Sandy Lean Clay
	4	4.0	6.0	UD		16									1.25	1.25	Sandy Lean Clay
	5	6.0	8.0	UD		16									1.13	1.13	Sandy Lean Clay
	6	8.0	10.0	UD		17	115	41	16	25	63		1.03	0.72	0.80	0.75	Sandy Lean Clay
	7	10.0	12.0	UD		19									0.75	1.25	Sandy Lean Clay
	8	12.0	14.0	UD		20					44						Clayey Sand
	9	14.0	16.0	UD		18	117	29	16	13			0.31	1.15	0.15	0.50	Sandy Lean Clay
	10	16.5	18.0	SS	11	21											Sandy Lean Clay
	11	18.0	20.0	UD		23											Sandy Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-43

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-44	2	0.5	2.0	UD		17									0.40	0.63	Lean Clay
	3	2.0	4.0	UD		20		38	16	22	79				0.45	0.50	Lean Clay
	4	4.0	6.0	UD		20									0.45	0.63	Lean Clay
	5	6.0	8.0	UD		19									0.60	0.88	Lean Clay
	6	8.0	10.0	UD		23	105	47	16	31	78		0.36	0.72	0.35	0.50	Lean Clay
	7	10.0	12.0	UD		23									0.88	1.25	Lean Clay
	8	12.0	14.0	UD		16									1.00	1.25	Lean Clay
	9	14.0	15.0	UD		17									1.25	0.88	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-44

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-45	2	0.7	2.0	UD		19									0.50	0.50	Fill
	3	2.0	4.0	UD		19									0.35	0.50	Fill
	4	4.0	6.0	UD		16									0.40	0.75	Fill
	5	6.0	8.0	UD		20	110	47	15	32	73		0.70	0.58	0.60	0.75	Fill
	6	8.0	10.0	UD		22									0.75	1.25	Lean Clay
	7	10.0	12.0	UD		22									0.75	1.25	Lean Clay
	8	12.0	14.0	UD		28		54	22	32	99				1.38	1.50	Fat Clay
	9	14.0	15.0	UD		34									1.25	1.25	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-45

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-46A	2	0.8	2.0	UD		14											Fill
	3	2.0	4.0	UD		18									0.35	0.50	Fill
	4	4.0	6.0	UD		16									1.50	1.75	Lean Clay
	5	6.0	8.0	UD		20	111	46	17	29	77		0.54	0.58	0.65	0.75	Lean Clay
	6	8.0	10.0	UD		22									0.65	0.50	Lean Clay
	7	10.0	12.0	UD		29									0.50	0.63	Lean Clay
	8	12.0	14.0	UD		27		39	18	21	86				0.25	0.25	Lean Clay
	9	14.0	15.0	UD		35									0.88	1.00	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-47	2	1.3	2.0	UD		12											Lean Clay
	3	2.0	4.0	UD		18									0.70	1.00	Lean Clay
	4	4.0	6.0	UD		16									1.00	1.00	Lean Clay
	5	6.0	8.0	UD		18	112	39	15	24	71		0.98	0.58	0.60	0.75	Lean Clay
	6	8.0	10.0	UD		20									1.00	1.00	Lean Clay
	7	10.0	12.0	UD		24									0.45	0.75	Lean Clay
	8	12.0	14.0	UD		24	104	32	20	12	98		0.46	1.01	0.40	1.00	Lean Clay
	9	14.0	16.0	UD		20									1.25	1.13	Fat Clay
	10	16.0	18.0	UD		29									1.38	1.38	Fat Clay
	11	18.0	20.0	UD		16									1.00	1.00	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-47

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-48	2	1.5	2.0	UD		11											Lean Clay
	3	2.0	4.0	UD		25		48	19	29	80				0.60	0.50	Lean Clay
	4	4.0	6.0	UD		18									1.00	1.38	Lean Clay
	5	6.0	8.0	UD		15									1.25	1.50	Lean Clay
	6	8.0	10.0	UD		17	117	48	17	31	78		1.89	0.72	1.00	1.38	Lean Clay
	7	10.0	12.0	UD		19									1.13	1.25	Lean Clay
	8	12.0	14.0	UD		20									0.88	1.38	Lean Clay
	9	14.0	15.0	UD		21									0.25	0.75	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-48

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	PL	PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-49	2	1.5	2.0	UD		15									0.75	1.13	Lean Clay
	3	2.0	4.0	UD		17									0.45	0.63	Lean Clay
	4	4.0	6.0	UD		17									0.45	0.50	Lean Clay
	5	6.0	8.0	UD		18	111	46	16	30	81		0.92	0.58	0.88	1.00	Lean Clay
	6	8.0	10.0	UD		22									0.50	0.50	Lean Clay
	7	10.0	12.0	UD		20									1.00	1.63	Lean Clay
	8	12.0	14.0	UD		20									0.63	0.75	Lean Clay
	9	14.0	15.0	UD		26									0.63	1.13	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-49

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-50A	2	0.8	2.0	UD											0.35	0.50	Fill
	3	2.0	4.0	UD		21									0.20	0.50	Fill
	4	4.0	6.0	UD		22		28	19	9	58				0.20	0.13	Fill
	5	6.0	8.0	UD		20	106						0.17	0.58	0.20	0.25	Fill
	6	8.0	10.0	UD		20									0.20	0.25	Fill
	7	10.0	12.0	UD		23		30	22	8	53				0.20	0.13	Fill
	8	12.0	14.0	UD		23					41						Silty Sand
	9	14.0	16.0	UD		23											Silty Sand
	10	16.5	18.0	SS	14	25					12						Silty Sand
	11	18.5	20.0	SS	9	24											Silty Sand
	12	23.0	25.0	UD		15	120	40	17	23	82		2.21	1.80	2.00	2.25	Lean Clay
	13	28.0	30.0	UD		17									1.75	1.50	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-50

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-51 (GB-51P)	2	0.5	2.0	UD		11											Silty Sand
	3	2.0	4.0	UD		18									0.60	0.88	Lean Clay
	4	4.0	6.0	UD		17									1.00	1.00	Lean Clay
	5	6.0	8.0	UD		17									1.00	0.88	Lean Clay
	6	8.0	10.0	UD		18	114	39	16	23	76		0.51	0.72	0.55	0.75	Lean Clay
	7	10.0	12.0	UD		21									0.75	1.00	Lean Clay
	8	12.0	14.0	UD		22									0.20	0.50	Lean Clay
	9	14.0	15.0	UD		24											Silty Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-51

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-52A	2	0.8	2.0	UD		14									0.63	0.50	Fill
	3	2.0	4.0	UD		16									0.45	0.88	Fill
	4	4.0	6.0	UD		19									0.25	0.13	Fill
	5	6.0	8.0	UD		17									0.15	0.13	Fill
	6	8.0	10.0	UD		20	116	33	14	19	54		0.16	0.72	0.15	0.13	Fill
	7	10.0	12.0	UD		17									0.75	0.25	Fill
	8	12.0	13.5	SS	12	23					14						Silty Sand
	9	13.5	15.0	SS	19	21											Silty Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	PL	PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-53A	2	1.5	2.0	AG		11											Silty Sand
	3	2.0	4.0	UD		15									1.25	1.13	Sandy Lean Clay
	4	4.0	6.0	UD		18									0.30	0.25	Sandy Lean Clay
	5	6.0	8.0	UD		15	116	34	13	21	50		0.61	0.58	1.25	1.13	Sandy Lean Clay
	6	8.0	10.0	UD		15									1.50	1.25	Sandy Lean Clay
	7	10.0	12.0	UD		16									0.25	0.75	Sandy Lean Clay
	8	12.5	14.0	SS	12	19					21						Silty Sand
	9	14.5	16.0	SS	17	21											Silty Sand
	10	16.5	18.0	SS	22	23											Silty Sand
	11	18.5	20.0	SS	27	19											Silty Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-53

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-54A	2	0.9	2.0	UD		14									0.50	1.63	Sandy Lean Clay
	3	2.0	4.0	UD		18									0.60	0.75	Sandy Lean Clay
	4	4.0	6.0	UD		18									0.50	0.75	Sandy Lean Clay
	5	6.0	8.0	UD		18	111	30	16	14	50		0.36	0.58	0.45	0.50	Sandy Lean Clay
	6	8.0	10.0	UD		16									1.25	1.25	Sandy Lean Clay
	7	10.5	12.0	SS	2	23					25						Silty Sand
	8	12.0	13.5	SS	10	31											Fat Clay
	9	13.5	15.0	SS	10	18											Silty Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-54

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-55	2	0.7	2.0	UD		14									0.75	1.00	Sandy Lean Clay
	3	2.0	4.0	UD		15									0.88	1.13	Sandy Lean Clay
	4	4.0	6.0	UD		15									0.75	1.13	Sandy Lean Clay
	5	6.0	8.0	UD		14	120	36	15	21	51		0.96	0.58	1.00	1.25	Sandy Lean Clay
	6	8.0	10.0	UD		16									0.50	1.00	Sandy Lean Clay
	7	10.0	12.0	UD		19											Silty Sand
	8	12.5	14.0	SS	17	27					18						Silty Sand
	9	14.5	16.0	SS	15	23											Silty Sand
	10	16.5	18.0	SS	14	21											Silty Sand
	11	18.5	20.0	SS	22	20											Silty Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-55

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-56C	2	0.6	2.0	UD		13									1.00	0.88	Sandy Lean Clay
	3	2.0	4.0	UD		20									0.50	0.25	Sandy Lean Clay
	4	4.0	6.0	UD		17	115	36	18	18	54		0.58	0.43	0.75	1.00	Sandy Lean Clay
	5	6.0	8.0	UD		15									0.88	1.13	Sandy Lean Clay
	6	8.0	10.0	UD		16									0.75	1.00	Sandy Lean Clay
	7	10.5	12.0	SS	8	20					15						Silty Sand
	8	12.0	13.5	SS	15	20											Silty Sand
	9	13.5	15.0	SS	17	20											Silty Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-56

SUMMARY OF LABORATORY TEST RESULTS

CEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

BORING NO.	SAMPLE No.	SAMPLE Depth (ft.) Top	SAMPLE Depth (ft.) Bottom	SAMPLE Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-57 (GB-57P)	2	0.7	2.0	UD		17									0.50	0.75	Sandy Lean Clay
	3	2.0	4.0	UD		18									0.40	0.88	Sandy Lean Clay
	4	4.0	6.0	UD		17									1.00	1.25	Sandy Lean Clay
	5	6.0	8.0	UD		18	113	34	16	18	65		0.40	0.58	0.75	1.13	Sandy Lean Clay
	6	8.0	10.0	UD		21									1.00	1.25	Sandy Lean Clay
	7	10.0	12.0	UD		22									0.70	0.88	Sandy Lean Clay
	8	12.0	14.0	UD		30		67	25	42	99				1.38	1.00	Fat Clay
	9	14.0	15.0	UD		27									1.38	1.25	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-57

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Innsdale Area
WBS No. S-000035-0206-4
Houston, Texas
PROJECT NUMBER: 1140208301

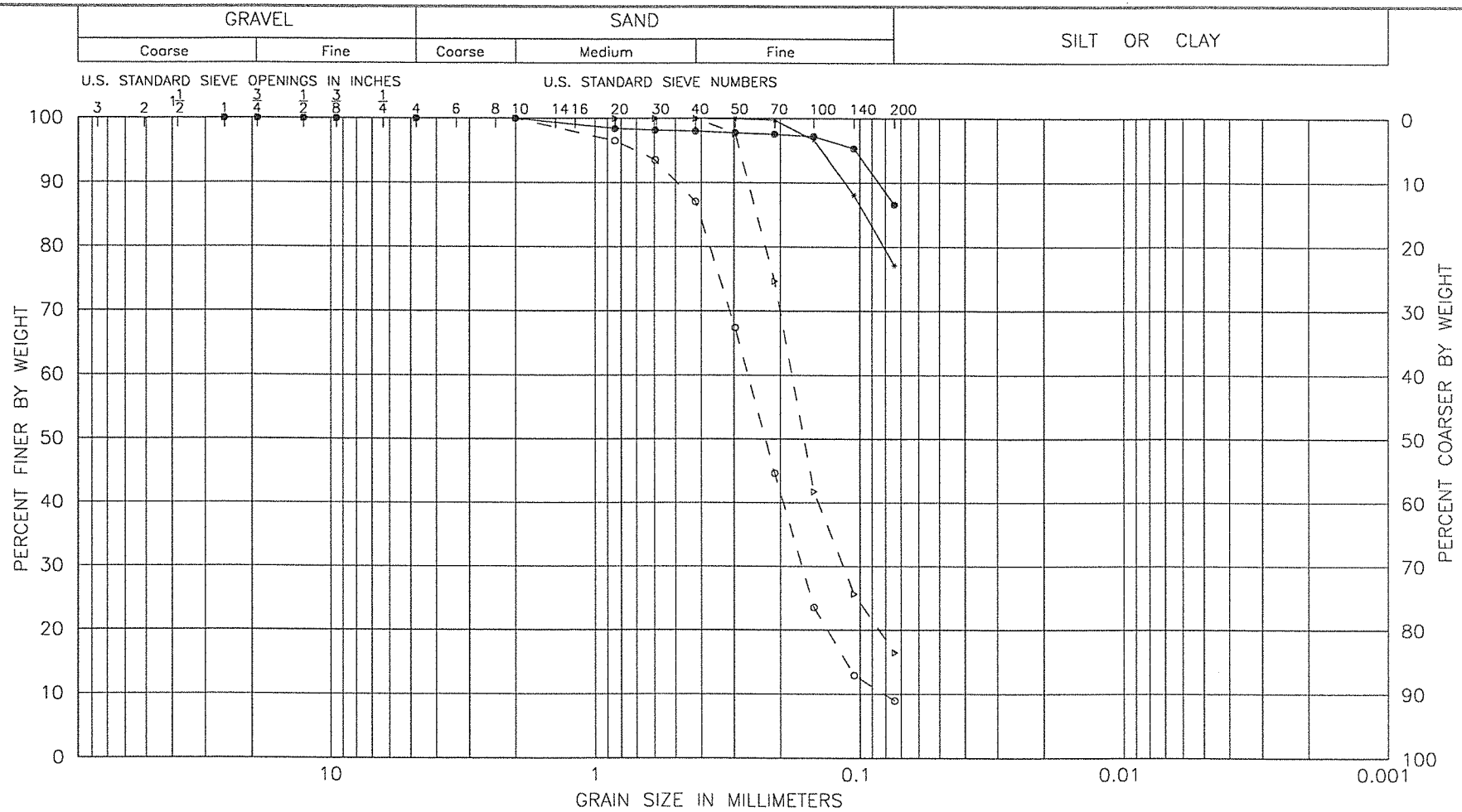
BORING NO.	SAMPLE No.	Depth (ft.) Top	Depth (ft.) Bottom	Type	SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Shear Strength (tsf)	TRIAXIAL COMPRESSION TEST (U-U) Conf. Press. (tsf)	TORVANE Shear Strength (tsf)	POCKET PENE-TROMETER Shear Strength (tsf)	TYPE OF MATERIAL
GB-58	2	0.8	2.0	UD		13											Silty Sand
	3	2.0	4.0	UD		18					39						Silty Sand
	4	4.0	6.0	UD		22									0.20	0.25	Sandy Lean Clay
	5	6.0	8.0	UD		19									1.00	0.50	Sandy Lean Clay
	6	8.0	10.0	UD		18	114	37	17	20	58		0.68	0.72	0.88	1.88	Sandy Lean Clay
	7	10.0	12.0	UD		19					46						Clayey Sand
	8	12.0	14.0	UD		30									1.00	1.00	Fat Clay
	9	14.0	15.0	UD		32									0.90	0.88	Fat Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-58

Job No. 1140208301



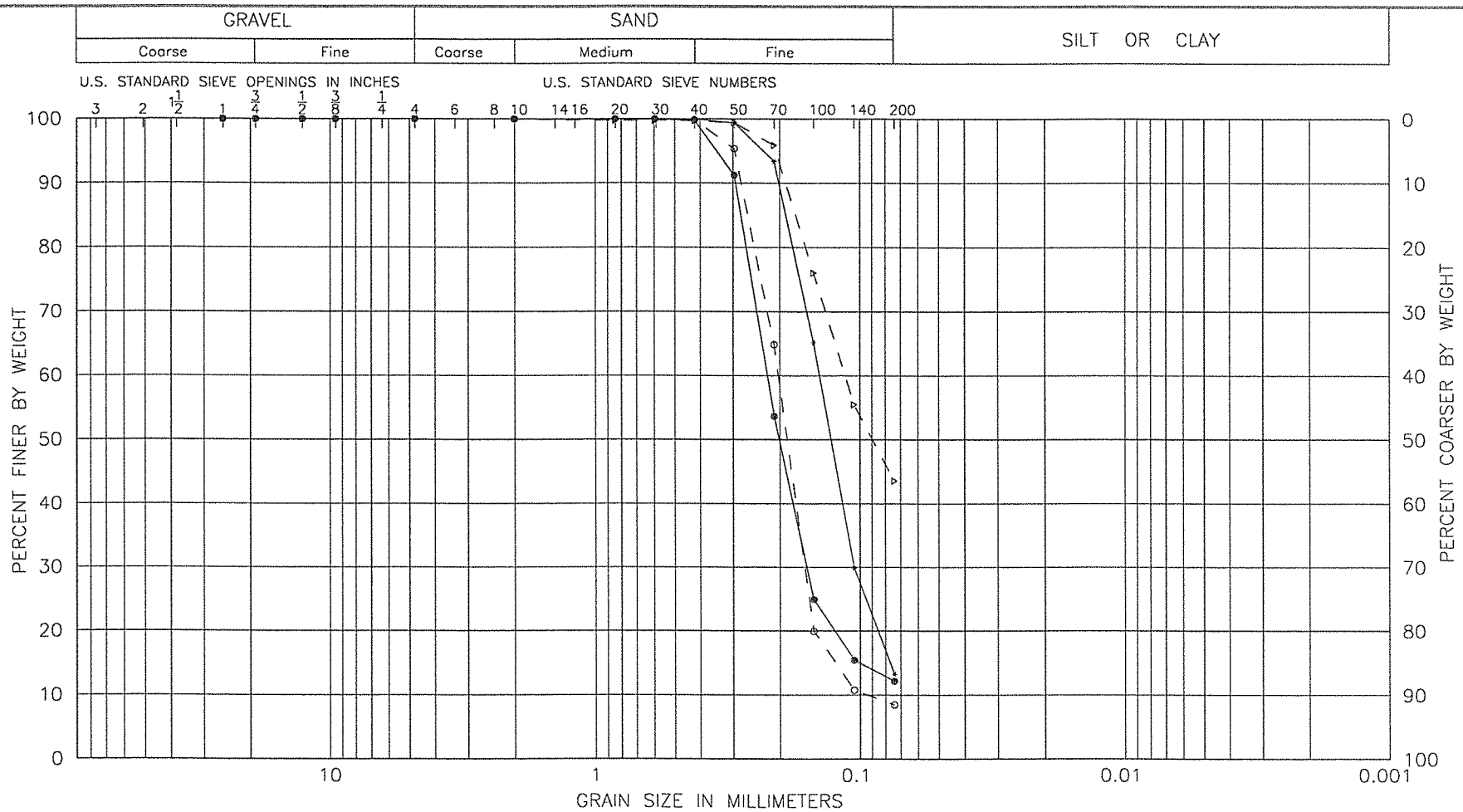
LEGEND	BORING NO.	SAMPLE NO.	DEPTH FT.	SAMPLE DESCRIPTION
●—●—●—●	GB–11	S–11	18.5–20	Reddish brown and gray lean clay
○—○—○—○	GB–16c	S–2	10.5–12	Gray fine sand w/silt
×—×—×—×	GB–18	S–9	14–15	Gray lean clay w/sand
▷—▷—▷—▷	GB–22b	S–7	10.5–12	Gray silty sand

GRAIN SIZE DISTRIBUTION CURVES

Geotest Engineering, Inc.

FIGURE B–59

Job No. 1140208301



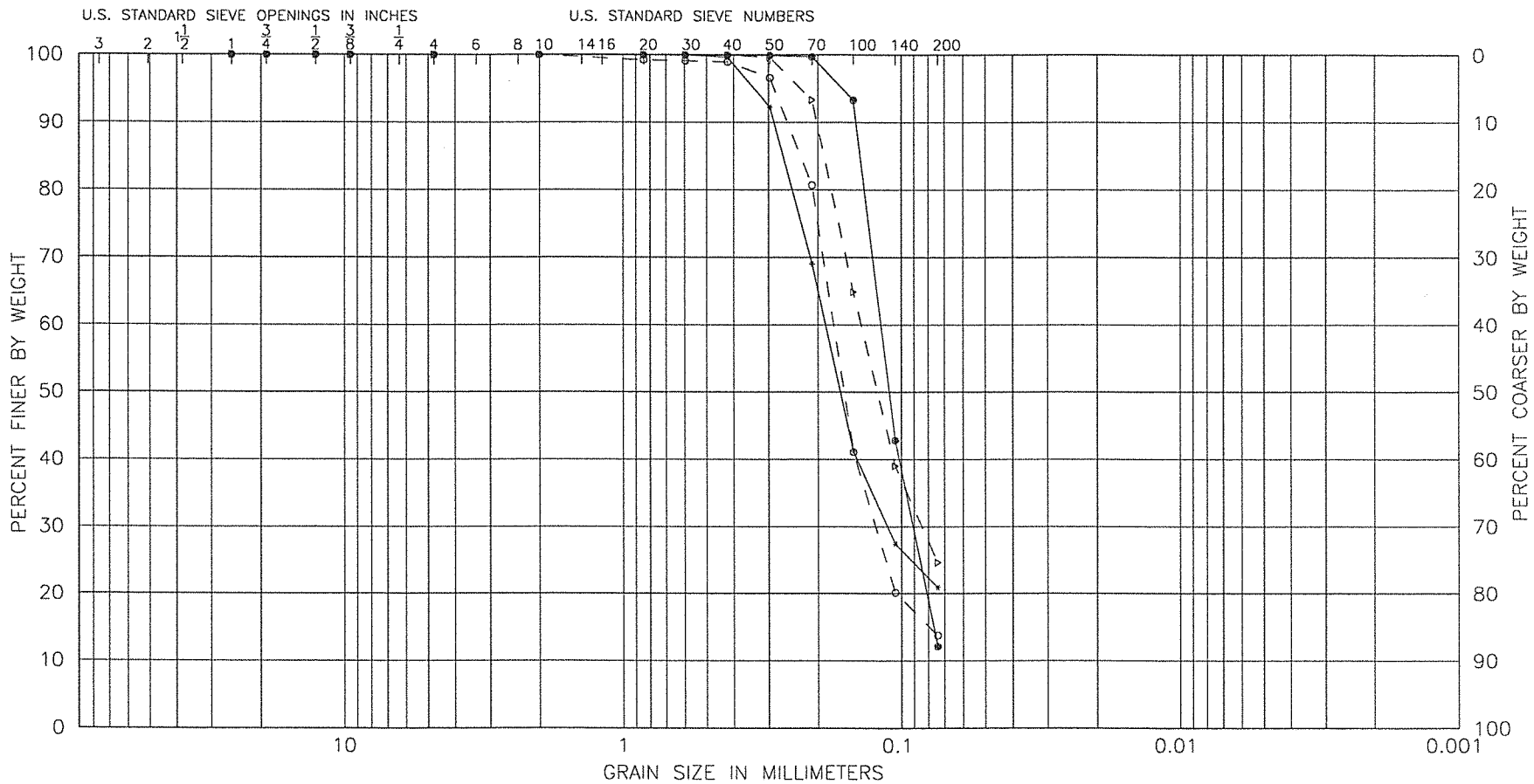
LEGEND	BORING NO.	SAMPLE NO.	DEPTH FT.	SAMPLE DESCRIPTION
●—●—●—●	GB-23	S-10	14.5-16	Gray silty sand
○—○—○—○	GB-24	S-7	10-12	Yellowish gray fine sand w/silt
×—×—×—×	GB-26	S-7	10.5-12	Brown and gray silty sand
▷—▷—▷—▷	GB-43b	S-8	12-14	Gray clayey sand w/clay seams

GRAIN SIZE DISTRIBUTION CURVES

Geotest Engineering, Inc.

FIGURE B-60

Job No. 1140208301



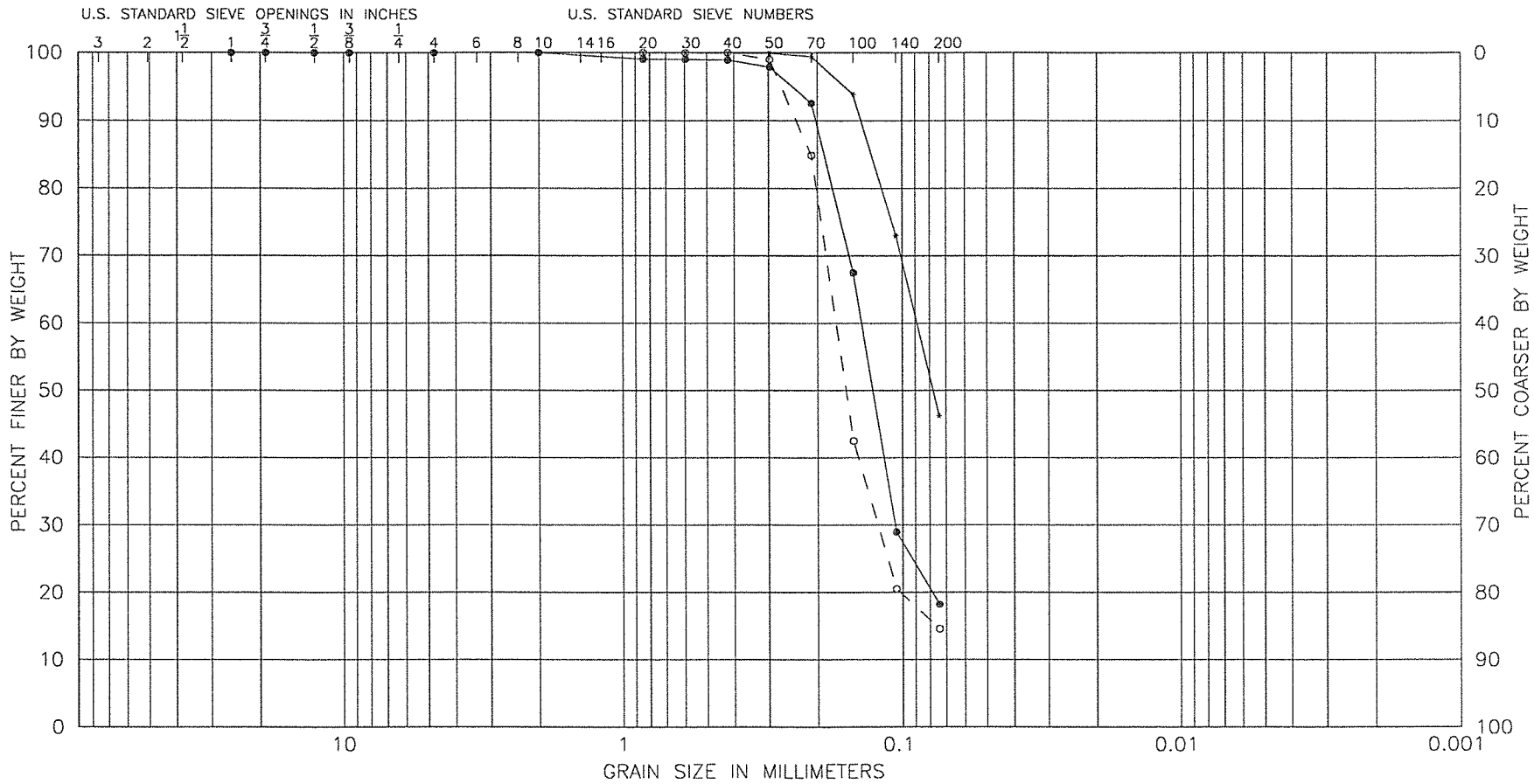
LEGEND	BORING NO.	SAMPLE NO.	DEPTH FT.	SAMPLE DESCRIPTION
●—●—●—●	GB–50a	S–9	16.5–18	Reddish brown silty sand w/clay seams
○—○—○—○	GB–52a	S–7	12–13.5	Brown and gray silty sand
×—×—×—×	GB–53a	S–8	12.5–14	Brown and gray silty sand
▷—▷—▷—▷	GB–54a	S–7	10.5–12	Gray silty sand

GRAIN SIZE DISTRIBUTION CURVES

Geotest Engineering, Inc.

FIGURE B–61

Job No. 1140208301



LEGEND	BORING NO.	SAMPLE NO.	DEPTH FT.	SAMPLE DESCRIPTION
●●●●●	GB-55	S-7	12.5-14	Gray silty sand
○○○○○	GB-56c	S-7	10.5-12	Brown and gray silty sand
×-×-×-×	GB-58	S-7	10-12	Yellowish brown and gray clayey sand w/clay seams

GRAIN SIZE DISTRIBUTION CURVES

Geotest Engineering, Inc.

FIGURE B-62

APPENDIX C

TDLR Piezometer Abandonment Reports

STATE OF TEXAS WELL REPORT for Tracking #393771

1140208301

Owner:	**Geotest Engineering**	Owner Well #:	**4A**
Address:	**5600 Bintliff Dr Houston , TX 77036**	Grid #:	**65-14-1**
Well Location:	**N/A Madie Dr Houston , TX 77022**	Latitude:	**29° 50' 08" N**
Well County:	**Harris**	Longitude:	**095° 22' 24" W**
Elevation:	**No Data**	GPS Brand Used:	**Magellan**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **2/27/2015** Completed: **2/27/2015**
Diameter of Hole:	Diameter: **4 in From Surface To 20 ft**
Drilling Method:	**Mud Rotary**
Borehole Completion:	Other: **(No Data)**
Annular Seal Data:	1st Interval: **From 0 ft to 8 ft with 1 bentonite (#sacks and material)** 2nd Interval: **No Data** 3rd Interval: **No Data** Method Used: **No Data** Cemented By: **No Data** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**No Data**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**20/40 8 to 20**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No Data** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for

completion and resubmittal.

Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Driller License Number:	**58171**
Licensed Well Driller Signature:	**Jaime Vasquez**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#393771**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft)	To (ft)	Description
0	**20**	**Gray sandy clay**

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2	**New**	**PVC Riser 0-10 sch. 40**	
2	**New**	**PVC Screen 10-20 .010**	

STATE OF TEXAS PLUGGING REPORT for Tracking #101862

1140209301

Owner:	**Geotest Engineering**	Owner Well #:	**4A**
Address:	**5600 Bintliff Dr Houston , TX 77036**	Grid #:	**65-14-1**
Well Location:	**N/A Madie Dr Houston , TX 77022**	Latitude:	**29° 50' 08" N**
Well County:	**Harris**	Longitude:	**095° 22' 24" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Jaime Vasquez**
Driller's License Number of Original Well Driller:	**58171**
Date Well Drilled:	**2/27/2015**
Well Report Tracking Number:	**393771**
Diameter of Borehole:	**4 inches**
Total Depth of Borehole:	**20 feet**

Date Well Plugged:	**4/16/2015**
Person Actually Performing Plugging Operation:	**Brian Johnson**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **2 inches diameter, From 0 ft to 10 ft** 2nd Interval: **2 inches diameter, From 10 ft to 20 ft** 3rd Interval: **No Data**
Cement/Bentonite	1st Interval: **From 0 ft to 8 ft; Sack(s)/type of cement used: bentonite**

Plugs Placed in Well:	2nd Interval: **No Data** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**

Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#101862**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS WELL REPORT for Tracking #393779

Owner:	**Geotest Engineering**	Owner Well #:	**13**
Address:	**5600 Bintliff Dr Houston , TX 77036**	Grid #:	**65-14-1**
Well Location:	**N/A Luther St. Houston , TX 77076**	Latitude:	**29° 50' 08" N**
Well County:	**Harris**	Longitude:	**095° 22' 24" W**
Elevation:	**No Data**	GPS Brand Used:	**Magellan**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **2/28/2015** Completed: **2/28/2015**
Diameter of Hole:	Diameter: **4 in From Surface To 15 ft**
Drilling Method:	**Mud Rotary**
Borehole Completion:	Other: **(No Data)**
Annular Seal Data:	1st Interval: **From 0 ft to 3 ft with 1 bentonite (#sacks and material)** 2nd Interval: **No Data** 3rd Interval: **No Data** Method Used: **No Data** Cemented By: **No Data** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**No Data**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**20/40 3 to 15**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No Data** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for

completion and resubmittal.

Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Driller License Number:	**58171**
Licensed Well Driller Signature:	**Jaime Vasquez**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#393779**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft)	To (ft)	Description
0	**15**	**Grey sandy clay**

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2	**New**	**PVC Riser 0-5 sch. 40**	
2	**New**	**PVC Screen 5-15 .010**	

STATE OF TEXAS PLUGGING REPORT for Tracking #101865

Owner:	**Geotest Engineering**	Owner Well #:	**13**
Address:	**5600 Bintliff Dr Houston , TX 77036**	Grid #:	**65-14-1**
Well Location:	**N/A Luther St. Houston , TX 77076**	Latitude:	**29° 50' 29" N**
Well County:	**Harris**	Longitude:	**095° 22' 15" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Jaime Vasquez**
Driller's License Number of Original Well Driller:	**58171**
Date Well Drilled:	**2/28/2015**
Well Report Tracking Number:	**393779**
Diameter of Borehole:	**4 inches**
Total Depth of Borehole:	**15 feet**

Date Well Plugged:	**4/16/2015**
Person Actually Performing Plugging Operation:	**Brian Johnson**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **2 inches diameter, From 0 ft to 5 ft** 2nd Interval: **2 inches diameter, From 5 ft to 15 ft** 3rd Interval: **No Data**
Cement/Bentonite	1st Interval: **From 0 ft to 3 ft; Sack(s)/type of cement used: bentonite**

Plugs Placed in Well:	2nd Interval: **No Data** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**

Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#101865**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS WELL REPORT for Tracking #393781

Owner:	**Geotest Engineering**	Owner Well #:	**22**
Address:	**5600 Bintliff Dr Houston , TX 77036**	Grid #:	**65-14-1**
Well Location:	**N/A Turner Dr Houston , TX 77076**	Latitude:	**29° 51' 04" N**
Well County:	**Harris**	Longitude:	**095° 21' 26" W**
Elevation:	**No Data**	GPS Brand Used:	**Magellan**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **2/27/2015** Completed: **2/27/2015**
Diameter of Hole:	Diameter: **4 in From Surface To 20 ft**
Drilling Method:	**Mud Rotary**
Borehole Completion:	Other: **(No Data)**
Annular Seal Data:	1st Interval: **From 0 ft to 8 ft with 1 bentonite (#sacks and material)** 2nd Interval: **No Data** 3rd Interval: **No Data** Method Used: **No Data** Cemented By: **No Data** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**No Data**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**20/40 8 to 20**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No Data** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for

completion and resubmittal.

Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Driller License Number:	**58171**
Licensed Well Driller Signature:	**Jaime Vasquez**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#393781**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft)	To (ft)	Description
0	**8**	**Grey sandy clay**
8	**18**	**Grey silty clay**
18	**20**	**Grey sandy clay**

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2	**New**	**PVC Riser**	**0-10 sch. 40**
2	**New**	**PVC Screen**	**10-20 .010**

STATE OF TEXAS PLUGGING REPORT for Tracking #101866

Owner:	**Geotest Engineering**	Owner Well #:	**22**
Address:	**5600 Bintliff Dr Houston , TX 77036**	Grid #:	**65-14-1**
Well Location:	**N/A Turner Dr Houston , TX 77076**	Latitude:	**29° 51' 04" N**
Well County:	**Harris**	Longitude:	**095° 21' 26" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Jaime Vasquez**
Driller's License Number of Original Well Driller:	**58171**
Date Well Drilled:	**2/27/2015**
Well Report Tracking Number:	**393781**
Diameter of Borehole:	**4 inches**
Total Depth of Borehole:	**20 feet**

Date Well Plugged:	**4/16/2015**
Person Actually Performing Plugging Operation:	**Brian Johnson**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **2 inches diameter, From 0 ft to 10 ft** 2nd Interval: **2 inches diameter, From 10 ft to 20 ft** 3rd Interval: **No Data**
Cement/Bentonite	1st Interval: **From 0 ft to 8 ft; Sack(s)/type of cement used: bentonite**

Plugs Placed in Well:	2nd Interval: **No Data** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**

Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#101866**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS WELL REPORT for Tracking #393787

Owner:	**Geotest Engineering**	Owner Well #:	**GB-34P**
Address:	**5600 Bintliff Dr Houston , TX 77036**	Grid #:	**65-14-1**
Well Location:	**N/A Pennington St Houston , TX 77022**	Latitude:	**29° 50' 24" N**
Well County:	**Harris**	Longitude:	**095° 21' 33" W**
Elevation:	**No Data**	GPS Brand Used:	**Magellan**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **2/23/2015** Completed: **2/23/2015**
Diameter of Hole:	Diameter: **4 in From Surface To 15 ft**
Drilling Method:	**Mud Rotary**
Borehole Completion:	Other: **(No Data)**
Annular Seal Data:	1st Interval: **From 0 ft to 3 ft with 1 bentonite (#sacks and material)** 2nd Interval: **No Data** 3rd Interval: **No Data** Method Used: **No Data** Cemented By: **No Data** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**No Data**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**20/40 3 to 15**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No Data** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for

completion and resubmittal.

Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Driller License Number:	**58171**
Licensed Well Driller Signature:	**Jaime Vasquez**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#393787**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft)	To (ft)	Description
0	**15**	**Grey sandy clay**

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2	**New**	**PVC Riser 0-5 sch. 40**	
2	**New**	**PVC Screen 5-15 .010**	

STATE OF TEXAS PLUGGING REPORT for Tracking #101868

Owner:	**Geotest Engineering**	Owner Well #:	**GB-34P**
Address:	**5600 Bintliff Dr Houston , TX 77036**	Grid #:	**65-14-1**
Well Location:	**N/A Penningnton St Houston , TX 77022**	Latitude:	**29° 50' 24" N**
Well County:	**Harris**	Longitude:	**095° 21' 33" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Jaime Vasquez**
Driller's License Number of Original Well Driller:	**58171**
Date Well Drilled:	**2/23/2015**
Well Report Tracking Number:	**393787**
Diameter of Borehole:	**4 inches**
Total Depth of Borehole:	**15 feet**

Date Well Plugged:	**4/16/2015**
Person Actually Performing Plugging Operation:	**Brian Johnson**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **2 inches diameter, From 0 ft to 5 ft** 2nd Interval: **2 inches diameter, From 5 ft to 15 ft** 3rd Interval: **No Data**
Cement/Bentonite	1st Interval: **From 0 ft to 3 ft; Sack(s)/type of cement used: bentonite**

Plugs Placed in Well:	2nd Interval: **No Data** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**

Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#101868**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS WELL REPORT for Tracking #393783

Owner:	**Geotest Engineering**	Owner Well #:	**51**
Address:	**5600 Bintliff Dr Houston , TX 77036**	Grid #:	**65-14-1**
Well Location:	**N/A Duff Rd Houston , TX 77022**	Latitude:	**29° 50' 12" N**
Well County:	**Harris**	Longitude:	**095° 21' 21" W**
Elevation:	**No Data**	GPS Brand Used:	**Magellan**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **2/28/2015**
Completed: **2/28/2015**

Diameter of Hole: Diameter: **4 in From Surface To 15 ft**

Drilling Method: **Mud Rotary**

Borehole Completion: Other: **(No Data)**

Annular Seal Data: 1st Interval: **From 0 ft to 3 ft with 1 bentonite (#sacks and material)**
2nd Interval: **No Data**
3rd Interval: **No Data**
Method Used: **No Data**
Cemented By: **No Data**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **No Data**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **20/40 3 to 15**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No Data**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for

completion and resubmittal.

Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Driller License Number:	**58171**
Licensed Well Driller Signature:	**Jaime Vasquez**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#393783**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft)	To (ft)	Description
0	**15**	**Grey sandy clay**

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2	**New**	**PVC Riser 0-5 sch. 40**	
2	**New**	**PVC Screen 5-15 .010**	

STATE OF TEXAS PLUGGING REPORT for Tracking #101867

Owner:	**Geotest Engineering**	Owner Well #:	**51**
Address:	**5600 Bintliff Dr Houston , TX 77036**	Grid #:	**65-14-1**
Well Location:	**N/A Duff Rd Houston , TX 77022**	Latitude:	**29° 50' 12" N**
Well County:	**Harris**	Longitude:	**095° 21' 21" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Jaime Vasquez**
Driller's License Number of Original Well Driller:	**58171**
Date Well Drilled:	**2/28/2015**
Well Report Tracking Number:	**393783**
Diameter of Borehole:	**4 inches**
Total Depth of Borehole:	**15 feet**

Date Well Plugged:	**4/16/2015**
Person Actually Performing Plugging Operation:	**Brian Johnson**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **2 inches diameter, From 0 ft to 5 ft** 2nd Interval: **2 inches diameter, From 5 ft to 15 ft** 3rd Interval: **No Data**
Cement/Bentonite	1st Interval: **From 0 ft to 3 ft; Sack(s)/type of cement used: bentonite**

Plugs Placed in Well:	2nd Interval: **No Data** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**

Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#101867**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS WELL REPORT for Tracking #393788

Owner:	**Geotest Engineering**	Owner Well #:	**GB-57P**
Address:	**5600 Bintliff Dr Houston , TX 77036**	Grid #:	**65-14-1**
Well Location:	**N/A Exeter St Houston , TX 77093**	Latitude:	**29° 50' 24" N**
Well County:	**Harris**	Longitude:	**095° 21' 33" W**
Elevation:	**No Data**	GPS Brand Used:	**Magellan**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **2/26/2015** Completed: **2/26/2015**
Diameter of Hole:	Diameter: **4 in From Surface To 15 ft**
Drilling Method:	**Mud Rotary**
Borehole Completion:	Other: **(No Data)**
Annular Seal Data:	1st Interval: **From 0 ft to 3 ft with 1 bentonite (#sacks and material)** 2nd Interval: **No Data** 3rd Interval: **No Data** Method Used: **No Data** Cemented By: **No Data** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**No Data**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**20/40 3 to 15**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No Data** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for

completion and resubmittal.

Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Driller License Number:	**58171**
Licensed Well Driller Signature:	**Jaime Vasquez**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#393788**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft)	To (ft)	Description
0	**15**	**Grey sandy clay**

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2	**New**	**PVC Riser 0-5 sch. 40**	
2	**New**	**PVC Screen 5-15 .010**	

STATE OF TEXAS PLUGGING REPORT for Tracking #101869

Owner:	**Geotest Engineering**	Owner Well #:	**GB-57P**
Address:	**5600 Bintliff Dr Houston , TX 77036**	Grid #:	**65-14-1**
Well Location:	**N/A Exeter St Houston , TX 77093**	Latitude:	**29° 50' 24" N**
Well County:	**Harris**	Longitude:	**095° 21' 33" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Jaime Vasquez**
Driller's License Number of Original Well Driller:	**58171**
Date Well Drilled:	**2/23/2015**
Well Report Tracking Number:	**393788**
Diameter of Borehole:	**4 inches**
Total Depth of Borehole:	**15 feet**

Date Well Plugged:	**4/16/2015**
Person Actually Performing Plugging Operation:	**Brian Johnson**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **2 inches diameter, From 0 ft to 5 ft** 2nd Interval: **2 inches diameter, From 5 ft to 15 ft** 3rd Interval: **No Data**
Cement/Bentonite	1st Interval: **From 0 ft to 3 ft; Sack(s)/type of cement used: bentonite**

Plugs Placed in Well:	2nd Interval: **No Data** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**

Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#101869**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

APPENDIX D

Laboratory Corrosivity Test Report

Analytical Report 505381

for

Geotest Engineering, Inc.

Project Manager: Naresh Kolli

Water Line Replacement in Innsdale Area

1140208301

13-APR-15

Collected By: Client

4143 Greenbriar Dr., Stafford, TX 77477

Xenco-Houston (EPA Lab code: TX00122):
Texas (T104704215-14-18), Arizona (AZ0765), Florida (E871002), Louisiana (03054)
New Jersey (TX007), North Carolina(681), Oklahoma (9218), Pennsylvania (68-03610)

Xenco-Atlanta (EPA Lab Code: GA00046):
Florida (E87429), North Carolina (483), South Carolina (98015), Kentucky (85), DoD (L10-135)
Texas (T104704477), Louisiana (04176), USDA (P330-07-00105)

Xenco-Lakeland: Florida (E84098)
Xenco-Odessa (EPA Lab code: TX00158): Texas (T104704400-TX)
Xenco-Dallas (EPA Lab code: TX01468): Texas (T104704295-TX)
Xenco Phoenix (EPA Lab Code: AZ00901): Arizona(AZ0757)
Xenco-Phoenix Mobile (EPA Lab code: AZ00901): Arizona (AZM757)
Xenco Tucson (EPA Lab code:AZ000989): Arizona (AZ0758)

13-APR-15

Project Manager: **Naresh Kolli**
Geotest Engineering, Inc.
5600 Bintliff
Houston, TX 77036

Reference: XENCO Report No(s): **505381**
Water Line Replacement in Innsdale Area
Project Address:

Naresh Kolli:

We are reporting to you the results of the analyses performed on the samples received under the project name referenced above and identified with the XENCO Report Number(s) 505381. All results being reported under this Report Number apply to the samples analyzed and properly identified with a Laboratory ID number. Subcontracted analyses are identified in this report with either the NELAC certification number of the subcontract lab in the analyst ID field, or the complete subcontracted report attached to this report.

Unless otherwise noted in a Case Narrative, all data reported in this Analytical Report are in compliance with NELAC standards. The uncertainty of measurement associated with the results of analysis reported is available upon request. Should insufficient sample be provided to the laboratory to meet the method and NELAC Matrix Duplicate and Matrix Spike requirements, then the data will be analyzed, evaluated and reported using all other available quality control measures.

The validity and integrity of this report will remain intact as long as it is accompanied by this letter and reproduced in full, unless written approval is granted by XENCO Laboratories. This report will be filed for at least 5 years in our archives after which time it will be destroyed without further notice, unless otherwise arranged with you. The samples received, and described as recorded in Report No. 505381 will be filed for 60 days, and after that time they will be properly disposed without further notice, unless otherwise arranged with you. We reserve the right to return to you any unused samples, extracts or solutions related to them if we consider so necessary (e.g., samples identified as hazardous waste, sample sizes exceeding analytical standard practices, controlled substances under regulated protocols, etc).

We thank you for selecting XENCO Laboratories to serve your analytical needs. If you have any questions concerning this report, please feel free to contact us at any time.

Respectfully,

Debbie Simmons

Debbie Simmons
Project Manager

Recipient of the Prestigious Small Business Administration Award of Excellence in 1994.
Certified and approved by numerous States and Agencies.
A Small Business and Minority Status Company that delivers SERVICE and QUALITY

Houston - Dallas - Odessa - San Antonio - Tampa - Lakeland - Atlanta - Phoenix - Oklahoma - Latin America

Sample Cross Reference 505381

Geotest Engineering, Inc., Houston, TX

Water Line Replacement in Innsdale Area

Sample Id	Matrix	Date Collected	Sample Depth	Lab Sample Id
GB-1 S#7	S	02-13-15 00:00	10 - 12 ft	505381-001
GB-4A S#5	S	02-27-15 00:00	8 - 10 ft	505381-002
GB-6 S#9	S	02-27-15 00:00	14 - 16 ft	505381-003
GB-8 S#6	S	02-13-15 00:00	8 - 10 ft	505381-004
GB-10 S#7	S	02-17-15 00:00	10 - 12 ft	505381-005
GB-14 S#6	S	02-13-15 00:00	8 - 10 ft	505381-006
GB-18 S#6	S	02-18-15 00:00	8 - 10 ft	505381-007
GB-23 S#6	S	02-18-15 00:00	8 - 10 ft	505381-008
GB-27 S#6	S	02-17-15 00:00	8 - 10 ft	505381-009
GB-33 S#6	S	02-23-15 00:00	10 - 12 ft	505381-010
GB-41 S#9	S	02-23-15 00:00	14 - 16 ft	505381-011
GB-44 S#7	S	02-25-15 00:00	10 - 12 ft	505381-012
GB-45 S#6	S	02-25-15 00:00	8 - 10 ft	505381-013
GB-47 S#6	S	02-24-15 00:00	8 - 10 ft	505381-014
GB-50 S#10	S	02-24-15 00:00	18.5 - 20 ft	505381-015
GB-52A S#6	S	02-24-15 00:00	8 - 10 ft	505381-016
GB-54A S#6	S	02-26-15 00:00	8 - 10 ft	505381-017
GB-55 S#6	S	02-26-15 00:00	8 - 10 ft	505381-018
GB-58 S#5	S	02-26-15 00:00	8 - 10 ft	505381-019

CASE NARRATIVE

Client Name: Geotest Engineering, Inc.

Project Name: Water Line Replacement in Innsdale Area

Project ID: *1140208301*
Work Order Number(s): *505381*

Report Date: *13-APR-15*
Date Received: *04/04/2015*

Sample receipt non conformances and comments:

Sample receipt non conformances and comments per sample:

None

Analytical non conformances and comments:

Batch: LBA-965525 Soil Resistivity (As Received) by NACE
Samples were received out of hold time by the lab. SKC 04/07/2015.

Certificate of Analysis Summary 505381

Geotest Engineering, Inc., Houston, TX

Project Name: Water Line Replacement in Innsdale Area

Project Id: 1140208301
Contact: Naresh Kolli
Project Location:

Date Received in Lab: Sat Apr-04-15 10:30 am
Report Date: 13-APR-15
Project Manager: Debbie Simmons

Analysis Requested													
	Lab Id:	505381-001		505381-002		505381-003		505381-004		505381-005		505381-006	
	Field Id:	GB-1 S#7		GB-4A S#5		GB-6 S#9		GB-8 S#6		GB-10 S#7		GB-14 S#6	
	Depth:	10-12 ft		8-10 ft		14-16 ft		8-10 ft		10-12 ft		8-10 ft	
	Matrix:	SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
	Sampled:	Feb-13-15 00:00		Feb-27-15 00:00		Feb-27-15 00:00		Feb-13-15 00:00		Feb-17-15 00:00		Feb-13-15 00:00	
Inorganic Anions by SW 9056	***Extracted:***	Apr-06-15 13:00		Apr-06-15 13:00		Apr-06-15 13:00		Apr-06-15 13:00		Apr-06-15 13:00		Apr-06-15 13:00	
	Analyzed:	Apr-07-15 14:00		Apr-07-15 14:19		Apr-07-15 14:37		Apr-07-15 14:56		Apr-07-15 15:14		Apr-07-15 15:33	
	Units/RL:	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL
Chloride		BRL	9.82	BRL	9.96	BRL	9.94	BRL	9.82	BRL	10.0	BRL	9.88
Sulfate		BRL	9.82	BRL	9.96	BRL	9.94	12.9 K	9.82	BRL	10.0	20.8 K	9.88
Soil Resistivity (As Received) by NACE	***Extracted:***												
	Analyzed:	Apr-07-15 10:05		Apr-07-15 10:15		Apr-07-15 10:25		Apr-07-15 10:35		Apr-07-15 10:45		Apr-07-15 10:55	
	Units/RL:	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL
Soil Resistivity +		1890 K		8200 K		1680 K		2270 K		1310 K		2500 K	
Soil pH by EPA 9045C	***Extracted:***												
	Analyzed:	Apr-07-15 13:21		Apr-07-15 13:23		Apr-07-15 13:24		Apr-07-15 13:25		Apr-07-15 13:26		Apr-07-15 13:27	
	Units/RL:	SU	RL	SU	RL	SU	RL	SU	RL	SU	RL	SU	RL
pH		8.38 K		8.69 K		8.51 K		8.20 K		7.75 K		7.49 K	

This analytical report, and the entire data package it represents, has been made for your exclusive and confidential use.
The interpretations and results expressed throughout this analytical report represent the best judgment of XENCO Laboratories.
XENCO Laboratories assumes no responsibility and makes no warranty to the end use of the data hereby presented.
Our liability is limited to the amount invoiced for this work order unless otherwise agreed to in writing.

Houston - Dallas - San Antonio - Atlanta - Tampa - Boca Raton - Latin America - Odessa - Corpus Christi

Debbie Simmons
Project Manager

Final 1.000

Certificate of Analysis Summary 505381

Geotest Engineering, Inc., Houston, TX

Project Name: Water Line Replacement in Innsdale Area

Project Id: 1140208301
Contact: Naresh Kolli
Project Location:

Date Received in Lab: Sat Apr-04-15 10:30 am
Report Date: 13-APR-15
Project Manager: Debbie Simmons

Analysis Requested													
	Lab Id:	505381-007		505381-008		505381-009		505381-010		505381-011		505381-012	
	Field Id:	GB-18 S#6		GB-23 S#6		GB-27 S#6		GB-33 S#6		GB-41 S#9		GB-44 S#7	
	Depth:	8-10 ft		8-10 ft		8-10 ft		10-12 ft		14-16 ft		10-12 ft	
	Matrix:	SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
	Sampled:	Feb-18-15 00:00		Feb-18-15 00:00		Feb-17-15 00:00		Feb-23-15 00:00		Feb-23-15 00:00		Feb-25-15 00:00	
Inorganic Anions by SW 9056	***Extracted:***	Apr-06-15 13:00		Apr-06-15 13:00		Apr-06-15 13:00		Apr-06-15 13:00		Apr-06-15 13:00		Apr-06-15 13:00	
	Analyzed:	Apr-07-15 15:51		Apr-07-15 16:09		Apr-07-15 17:05		Apr-07-15 17:23		Apr-07-15 18:18		Apr-07-15 18:37	
	Units/RL:	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL
Chloride		BRL	9.96	BRL	9.94	BRL	9.94	BRL	9.92	BRL	9.98	BRL	9.82
Sulfate		13.6 K	9.96	11.2 K	9.94	BRL	9.94	BRL	9.92	BRL	9.98	10.7 K	9.82
Soil Resistivity (As Received) by NACE	***Extracted:***												
	Analyzed:	Apr-07-15 11:05		Apr-07-15 11:15		Apr-07-15 11:25		Apr-07-15 11:35		Apr-07-15 11:45		Apr-07-15 12:05	
	Units/RL:	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL
Soil Resistivity +		1440 K		3530 K		993 K		746 K		1290 K		1480 K	
Soil pH by EPA 9045C	***Extracted:***												
	Analyzed:	Apr-07-15 13:28		Apr-07-15 13:29		Apr-07-15 13:30		Apr-07-15 13:31		Apr-10-15 13:01		Apr-10-15 13:03	
	Units/RL:	SU	RL	SU	RL	SU	RL	SU	RL	SU	RL	SU	RL
pH		8.82 K		6.93 K		8.38 K		8.68 K		8.38 K		9.01 K	

This analytical report, and the entire data package it represents, has been made for your exclusive and confidential use.
The interpretations and results expressed throughout this analytical report represent the best judgment of XENCO Laboratories.
XENCO Laboratories assumes no responsibility and makes no warranty to the end use of the data hereby presented.
Our liability is limited to the amount invoiced for this work order unless otherwise agreed to in writing.

Houston - Dallas - San Antonio - Atlanta - Tampa - Boca Raton - Latin America - Odessa - Corpus Christi

Debbie Simmons
Project Manager

Final 1.000

Certificate of Analysis Summary 505381

Geotest Engineering, Inc., Houston, TX

Project Name: Water Line Replacement in Innsdale Area

Project Id: 1140208301
Contact: Naresh Kolli
Project Location:

Date Received in Lab: Sat Apr-04-15 10:30 am
Report Date: 13-APR-15
Project Manager: Debbie Simmons

Analysis Requested													
	Lab Id:	505381-013		505381-014		505381-015		505381-016		505381-017		505381-018	
	Field Id:	GB-45 S#6		GB-47 S#6		GB-50 S#10		GB-52A S#6		GB-54A S#6		GB-55 S#6	
	Depth:	8-10 ft		8-10 ft		18.5-20 ft		8-10 ft		8-10 ft		8-10 ft	
	Matrix:	SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
	Sampled:	Feb-25-15 00:00		Feb-24-15 00:00		Feb-24-15 00:00		Feb-24-15 00:00		Feb-26-15 00:00		Feb-26-15 00:00	
Inorganic Anions by SW 9056	***Extracted:***	Apr-06-15 13:00		Apr-06-15 13:00		Apr-06-15 13:00		Apr-06-15 13:00		Apr-06-15 13:00		Apr-06-15 13:00	
	Analyzed:	Apr-07-15 18:55		Apr-07-15 19:13		Apr-07-15 19:32		Apr-07-15 20:27		Apr-07-15 20:45		Apr-07-15 21:04	
	Units/RL:	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL
Chloride		BRL	9.82	BRL	10.0	BRL	10.0	BRL	10.0	BRL	9.80	BRL	9.86
Sulfate		45.9 K	9.82	BRL	10.0	12.8 K	10.0	29.1 K	10.0	BRL	9.80	15.7 K	9.86
Soil Resistivity (As Received) by NACE	***Extracted:***												
	Analyzed:	Apr-07-15 12:15		Apr-07-15 12:25		Apr-07-15 12:35		Apr-07-15 12:45		Apr-07-15 12:55		Apr-07-15 13:05	
	Units/RL:	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL
Soil Resistivity +		1090 K		1810 K		10700 K		3530 K		2680 K		3200 K	
Soil pH by EPA 9045C	***Extracted:***												
	Analyzed:	Apr-10-15 13:04		Apr-10-15 13:05		Apr-10-15 13:06		Apr-10-15 13:07		Apr-10-15 13:08		Apr-10-15 13:09	
	Units/RL:	SU	RL	SU	RL	SU	RL	SU	RL	SU	RL	SU	RL
pH		8.73 K		8.85 K		8.90 K		8.56 K		8.36 K		8.10 K	

This analytical report, and the entire data package it represents, has been made for your exclusive and confidential use.
The interpretations and results expressed throughout this analytical report represent the best judgment of XENCO Laboratories.
XENCO Laboratories assumes no responsibility and makes no warranty to the end use of the data hereby presented.
Our liability is limited to the amount invoiced for this work order unless otherwise agreed to in writing.

Houston - Dallas - San Antonio - Atlanta - Tampa - Boca Raton - Latin America - Odessa - Corpus Christi

Debbie Simmons
Project Manager

Final 1.000

Certificate of Analysis Summary 505381

Geotest Engineering, Inc., Houston, TX

Project Name: Water Line Replacement in Innsdale Area

Project Id: 1140208301
Contact: Naresh Kolli
Project Location:

Date Received in Lab: Sat Apr-04-15 10:30 am
Report Date: 13-APR-15
Project Manager: Debbie Simmons

Analysis Requested							
	Lab Id:	505381-019					
	Field Id:	GB-58 S#5					
	Depth:	8-10 ft					
	Matrix:	SOIL					
	Sampled:	Feb-26-15 00:00					
Inorganic Anions by SW 9056	***Extracted:***	Apr-06-15 13:00					
	Analyzed:	Apr-07-15 21:22					
	Units/RL:	mg/kg RL					
Chloride		BRL 9.86					
Sulfate		20.2 K 9.86					
Soil Resistivity (As Received) by NACE	***Extracted:***						
	Analyzed:	Apr-07-15 13:15					
	Units/RL:	Ohm-cm RL					
Soil Resistivity +		4070 K					
Soil pH by EPA 9045C	***Extracted:***						
	Analyzed:	Apr-10-15 13:10					
	Units/RL:	SU RL					
pH		7.99 K					

This analytical report, and the entire data package it represents, has been made for your exclusive and confidential use.
The interpretations and results expressed throughout this analytical report represent the best judgment of XENCO Laboratories.
XENCO Laboratories assumes no responsibility and makes no warranty to the end use of the data hereby presented.
Our liability is limited to the amount invoiced for this work order unless otherwise agreed to in writing.

Houston - Dallas - San Antonio - Atlanta - Tampa - Boca Raton - Latin America - Odessa - Corpus Christi

Debbie Simmons
Project Manager

XENCO Laboratories
CHRONOLOGY OF HOLDING TIMES

Analytical Method : Soil pH by EPA 9045C

Client : Geotest Engineering, Inc.

Work Order #: **505381**

Project ID: 1140208301

Field Sample ID	Date Collected	Date Received	Date Extracted	Max Holding Time Extracted (Days)	Time Held Extracted (Days)	Date Analyzed	Max Holding Time Analyzed (Days)	Time Held Analyzed **(Days)**	Q
GB-6 S#9	Feb. 27, 2015	Apr. 4, 2015				Apr.7, 2015	28	39	F
GB-33 S#6	Feb. 23, 2015	Apr. 4, 2015				Apr.7, 2015	28	43	F
GB-41 S#9	Feb. 23, 2015	Apr. 4, 2015				Apr.10, 2015	28	46	F
GB-23 S#6	Feb. 18, 2015	Apr. 4, 2015				Apr.7, 2015	28	48	F
GB-27 S#6	Feb. 17, 2015	Apr. 4, 2015				Apr.7, 2015	28	49	F
GB-45 S#6	Feb. 25, 2015	Apr. 4, 2015				Apr.10, 2015	28	44	F
GB-52A S#6	Feb. 24, 2015	Apr. 4, 2015				Apr.10, 2015	28	45	F
GB-10 S#7	Feb. 17, 2015	Apr. 4, 2015				Apr.7, 2015	28	49	F
GB-47 S#6	Feb. 24, 2015	Apr. 4, 2015				Apr.10, 2015	28	45	F
GB-50 S#10	Feb. 24, 2015	Apr. 4, 2015				Apr.10, 2015	28	45	F
GB-54A S#6	Feb. 26, 2015	Apr. 4, 2015				Apr.10, 2015	28	43	F
GB-1 S#7	Feb. 13, 2015	Apr. 4, 2015				Apr.7, 2015	28	53	F
GB-14 S#6	Feb. 13, 2015	Apr. 4, 2015				Apr.7, 2015	28	53	F
GB-58 S#5	Feb. 26, 2015	Apr. 4, 2015				Apr.10, 2015	28	43	F
GB-8 S#6	Feb. 13, 2015	Apr. 4, 2015				Apr.7, 2015	28	53	F
GB-4A S#5	Feb. 27, 2015	Apr. 4, 2015				Apr.7, 2015	28	39	F
GB-18 S#6	Feb. 18, 2015	Apr. 4, 2015				Apr.7, 2015	28	48	F
GB-44 S#7	Feb. 25, 2015	Apr. 4, 2015				Apr.10, 2015	28	44	F
GB-55 S#6	Feb. 26, 2015	Apr. 4, 2015				Apr.10, 2015	28	43	F

XENCO Laboratories
CHRONOLOGY OF HOLDING TIMES

Analytical Method : Inorganic Anions by SW 9056

Client : Geotest Engineering, Inc.

Work Order #: **505381**

Project ID: 1140208301

Field Sample ID	Date Collected	Date Received	Date Extracted	Max Holding Time Extracted (Days)	Time Held Extracted (Days)	Date Analyzed	Max Holding Time Analyzed (Days)	Time Held Analyzed **(Days)**	Q
GB-18 S#6	Feb. 18, 2015	Apr. 4, 2015	Apr. 6, 2015	28	47	Apr.7, 2015	28	1	F
GB-52A S#6	Feb. 24, 2015	Apr. 4, 2015	Apr. 6, 2015	28	41	Apr.7, 2015	28	1	F
GB-55 S#6	Feb. 26, 2015	Apr. 4, 2015	Apr. 6, 2015	28	39	Apr.7, 2015	28	1	F
GB-27 S#6	Feb. 17, 2015	Apr. 4, 2015	Apr. 6, 2015	28	48	Apr.7, 2015	28	1	F
GB-44 S#7	Feb. 25, 2015	Apr. 4, 2015	Apr. 6, 2015	28	40	Apr.7, 2015	28	1	F
GB-1 S#7	Feb. 13, 2015	Apr. 4, 2015	Apr. 6, 2015	28	52	Apr.7, 2015	28	1	F
GB-8 S#6	Feb. 13, 2015	Apr. 4, 2015	Apr. 6, 2015	28	52	Apr.7, 2015	28	1	F
GB-10 S#7	Feb. 17, 2015	Apr. 4, 2015	Apr. 6, 2015	28	48	Apr.7, 2015	28	1	F
GB-45 S#6	Feb. 25, 2015	Apr. 4, 2015	Apr. 6, 2015	28	40	Apr.7, 2015	28	1	F
GB-50 S#10	Feb. 24, 2015	Apr. 4, 2015	Apr. 6, 2015	28	41	Apr.7, 2015	28	1	F
GB-6 S#9	Feb. 27, 2015	Apr. 4, 2015	Apr. 6, 2015	28	38	Apr.7, 2015	28	1	F
GB-14 S#6	Feb. 13, 2015	Apr. 4, 2015	Apr. 6, 2015	28	52	Apr.7, 2015	28	1	F
GB-54A S#6	Feb. 26, 2015	Apr. 4, 2015	Apr. 6, 2015	28	39	Apr.7, 2015	28	1	F
GB-58 S#5	Feb. 26, 2015	Apr. 4, 2015	Apr. 6, 2015	28	39	Apr.7, 2015	28	1	F
GB-4A S#5	Feb. 27, 2015	Apr. 4, 2015	Apr. 6, 2015	28	38	Apr.7, 2015	28	1	F
GB-41 S#9	Feb. 23, 2015	Apr. 4, 2015	Apr. 6, 2015	28	42	Apr.7, 2015	28	1	F
GB-23 S#6	Feb. 18, 2015	Apr. 4, 2015	Apr. 6, 2015	28	47	Apr.7, 2015	28	1	F
GB-33 S#6	Feb. 23, 2015	Apr. 4, 2015	Apr. 6, 2015	28	42	Apr.7, 2015	28	1	F
GB-47 S#6	Feb. 24, 2015	Apr. 4, 2015	Apr. 6, 2015	28	41	Apr.7, 2015	28	1	F

F = These samples were analyzed outside the recommended holding time.
P = Samples analyzed within the recommended holding time.

Flagging Criteria

X In our quality control review of the data a QC deficiency was observed and flagged as noted. MS/MSD recoveries were found to be outside of the laboratory control limits due to possible matrix /chemical interference, or a concentration of target analyte high enough to affect the recovery of the spike concentration. This condition could also affect the relative percent difference in the MS/MSD.

B A target analyte or common laboratory contaminant was identified in the method blank. Its presence indicates possible field or laboratory contamination.

D The sample(s) were diluted due to targets detected over the highest point of the calibration curve, or due to matrix interference. Dilution factors are included in the final results. The result is from a diluted sample.

E The data exceeds the upper calibration limit; therefore, the concentration is reported as estimated.

F RPD exceeded lab control limits.

J The target analyte was positively identified below the quantitation limit and above the detection limit.

U Analyte was not detected.

L The LCS data for this analytical batch was reported below the laboratory control limits for this analyte. The department supervisor and QA Director reviewed data. The samples were either reanalyzed or flagged as estimated concentrations.

H The LCS data for this analytical batch was reported above the laboratory control limits. Supporting QC Data were reviewed by the Department Supervisor and QA Director. Data were determined to be valid for reporting.

K Sample analyzed outside of recommended hold time.

JN A combination of the "N" and the "J" qualifier. The analysis indicates that the analyte is "tentatively identified" and the associated numerical value may not be consistent with the amount actually present in the environmental sample.

** Surrogate recovered outside laboratory control limit.

BRL Below Reporting Limit.

RL Reporting Limit

MDL Method Detection Limit **SDL** Sample Detection Limit **LOD** Limit of Detection

PQL Practical Quantitation Limit **MQL** Method Quantitation Limit **LOQ** Limit of Quantitation

DL Method Detection Limit

NC Non-Calculable

+ NELAC certification not offered for this compound.

***** (Next to analyte name or method description) = Outside XENCO's scope of NELAC accreditation

Blank Spike Recovery

Project Name: **Water Line Replacement in Innsdale A**

Work Order #: 505381 **Project ID:** 1140208301

Lab Batch #: 965524 **Sample:** 690930-1-BKS **Matrix:** Solid

Date Analyzed: 04/07/2015 **Date Prepared:** 04/06/2015 **Analyst:** BHRE

Reporting Units: mg/kg **Batch #:** 1 **BLANK /BLANK SPIKE RECOVERY STUDY**

Inorganic Anions by SW 9056 Analytes	Blank Result [A]	Spike Added [B]	Blank Spike Result [C]	Blank Spike %R [D]	Control Limits %R	Flags
Chloride	<10.0	100	97.0	97	80-120	
Sulfate	<10.0	100	98.2	98	80-120	

Blank Spike Recovery [D] = 100*[C]/[B]
All results are based on MDL and validated for QC purposes.

BRL - Below Reporting Limit

Form 3 - MS / MSD Recoveries

Project Name: Water Line Replacement in Innsdale Area

Work Order # : 505381 **Project ID:** 1140208301

Lab Batch ID: 965524 **QC- Sample ID:** 505381-003 S **Batch #:** 1 **Matrix:** Soil

Date Analyzed: 04/07/2015 **Date Prepared:** 04/06/2015 **Analyst:** BHRE

Reporting Units: mg/kg

MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY STUDY

Inorganic Anions by SW 9056 Analytes	Parent Sample Result [A]	Spike Added [B]	Spiked Sample Result [C]	Spiked Sample %R [D]	Spike Added [E]	Duplicate Spiked Sample Result [F]	Spiked Dup. %R [G]	RPD %	Control Limits %R	Control Limits %RPD	Flag
Chloride	<9.94	99.4	97.1	98	99.4	97.4	98	0	80-120	20	
Sulfate	<9.94	99.4	100	101	99.4	101	102	1	80-120	20	

Lab Batch ID: 965524 **QC- Sample ID:** 505381-015 S **Batch #:** 1 **Matrix:** Soil

Date Analyzed: 04/07/2015 **Date Prepared:** 04/06/2015 **Analyst:** BHRE

Reporting Units: mg/kg

MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY STUDY

Inorganic Anions by SW 9056 Analytes	Parent Sample Result [A]	Spike Added [B]	Spiked Sample Result [C]	Spiked Sample %R [D]	Spike Added [E]	Duplicate Spiked Sample Result [F]	Spiked Dup. %R [G]	RPD %	Control Limits %R	Control Limits %RPD	Flag
Chloride	<10.0	100	110	110	100	110	110	0	80-120	20	
Sulfate	12.8	100	116	103	100	115	102	1	80-120	20	

Matrix Spike Percent Recovery [D] = 100*(C-A)/B

Matrix Spike Duplicate Percent Recovery [G] = 100*(F-A)/E

Relative Percent Difference RPD = 200*|(C-F)/(C+F)|

ND = Not Detected, J = Present Below Reporting Limit, B = Present in Blank, NR = Not Requested, I = Interference, NA = Not Applicable

N = See Narrative, EQL = Estimated Quantitation Limit, NC = Non Calculable - Sample amount is > 4 times the amount spiked.

Sample Duplicate Recovery

Project Name: Water Line Replacement in Innsdale Area

Work Order #: 505381

Lab Batch #: 965525 **Project ID:** 1140208301
Date Analyzed: 04/07/2015 10:08 **Date Prepared:** 04/07/2015 **Analyst:** KCS
QC- Sample ID: 505381-001 D **Batch #:** 1 **Matrix:** Soil
Reporting Units: Ohm-cm

Soil Resistivity (As Received) by NACE	SAMPLE / SAMPLE DUPLICATE RECOVERY				
Analyte	Parent Sample Result [A]	Sample Duplicate Result [B]	RPD	Control Limits %RPD	Flag
Soil Resistivity	1890	1880	1	20	

Lab Batch #: 965525
Date Analyzed: 04/07/2015 11:55 **Date Prepared:** 04/07/2015 **Analyst:** KCS
QC- Sample ID: 505381-011 D **Batch #:** 1 **Matrix:** Soil
Reporting Units: Ohm-cm

Soil Resistivity (As Received) by NACE	SAMPLE / SAMPLE DUPLICATE RECOVERY				
Analyte	Parent Sample Result [A]	Sample Duplicate Result [B]	RPD	Control Limits %RPD	Flag
Soil Resistivity	1290	1270	2	20	

Lab Batch #: 965491
Date Analyzed: 04/07/2015 13:22 **Date Prepared:** 04/07/2015 **Analyst:** KCS
QC- Sample ID: 505381-001 D **Batch #:** 1 **Matrix:** Soil
Reporting Units: SU

Soil pH by EPA 9045C	SAMPLE / SAMPLE DUPLICATE RECOVERY				
Analyte	Parent Sample Result [A]	Sample Duplicate Result [B]	RPD	Control Limits %RPD	Flag
pH	8.38	8.38	0	20	

Lab Batch #: 965752
Date Analyzed: 04/10/2015 13:02 **Date Prepared:** 04/10/2015 **Analyst:** JGT
QC- Sample ID: 505381-011 D **Batch #:** 1 **Matrix:** Soil
Reporting Units: SU

Soil pH by EPA 9045C	SAMPLE / SAMPLE DUPLICATE RECOVERY				
Analyte	Parent Sample Result [A]	Sample Duplicate Result [B]	RPD	Control Limits %RPD	Flag
pH	8.38	8.38	0	20	

Spike Relative Difference RPD 200 * | (B-A)/(B+A) |
All Results are based on MDL and validated for QC purposes.

BRL - Below Reporting Limit

CHAIN OF CUSTODY

XENCO LABORATORIES

Setting the Standard since 1990

Stafford,Texas (281-240-4200)

Dallas Texas (214-902-0300)

Service Center - San Antonio, Texas (210-509-3334)

www.xenco.com

Odessa, Texas (432-563-1800)

Norcross, Georgia (770-449-8800)

Lakeland, Florida (863-646-8526)

Tampa, Florida (813-620-2000)

Xenco Quote #

Xenco Job # 505381-1

Client / Reporting Information

Company Name / Branch: Geotest Engineering, Inc.

Company Address: 5600 Bintliff Drive Houston Texas

Email: nkolli@geotesteng.com

Phone No: 7132660588

Project Contact: Naresh Kolli

Samplers's Name Tiffany Murry

Project Information Water Line Replacement in Innsdale Area

Project Name/Number: 1140208301

Project Location: Houston, Texas

Invoice To: Accounting

PO Number:

Analytical Information

Matrix Codes

S = Soil/Sed/Solid
GW =Ground Water
DW = Drinking Water
P = Product
SW = Surface water
SL = Sludge
OW =Ocean/Sea Water
W = Wipe
O = Oil
WW= Waste Water
A = Air

No.	Field ID / Point of Collection	Collection: Sample Depth	Collection: Date	Collection: Time	Matrix	# of bottles	HCl	NaOH/Zn Acetate	HNO3	H2SO4	NaOH	NaHSO4	MEOH	NONE	pH	Resistivity	Suphate	Chloride							Field Comments
1	GB-1 S# 7	10--12	2/13/2015		s	1 Bag									X	X	X	X							
2	GB-4AS#5	8--10	2/27/2015		s	1 Bag									X	X	X	X							
3	GB-6 S#9	14--16	2/27/2015		s	1 Bag									X	X	X	X							
4	GB-8 S#6	8--10	2/13/2015		s	1 Bag									X	X	X	X							
5	GB-10 S# 7	10--12	2/17/2015		s	1 Bag									X	X	X	X							
6	GB-14 S#6	8--10	2/13/2015		s	1 Bag									X	X	X	X							
7	GB-18 S# 6	8--10	2/18/2015		s	1 Bag									X	X	X	X							
8	GB-23 S#6	8--10	2/18/2015		s	1 Bag									X	X	X	X							
9	GB-27 S# 6	8--10	2/17/2015		s	1 Bag									X	X	X	X							
10	GB-33 S#6	10--12	2/23/2015		s	1 Bag									X	X	X	X							

Turnaround Time (Business days)

- [ ] Same Day TAT
- [x] 5 Day TAT
- [ ] Next Day EMERGENCY
- [ ] 7 Day TAT
- [ ] 2 Day EMERGENCY
- [ ] Contract TAT
- [ ] 3 Day EMERGENCY

TAT Starts Day received by Lab, if received by 3:00 pm

Data Deliverable Information

- [ ] Level II Std QC
- [ ] Level IV (Full Data Pkg /raw data)
- [ ] Level III Std QC+ Forms
- [ ] TRRP Level IV
- [ ] Level 3 (CLP Forms)
- [ ] UST / RG -411
- [ ] TRRP Checklist

Notes:

FED-EX / UPS: Tracking #

SAMPLE CUSTODY MUST BE DOCUMENTED BELOW EACH TIME SAMPLES CHANGE POSSESSION, INCLUDING COURIER DELIVERY

Relinquished by Sampler:	Date Time:	Received By:	Relinquished By:	Date Time:	Received By:
1 S. Ahm	10.30 4/3/15	1	2 4-4-15 10:30		2
Relinquished by: 3	Date Time:	Received By: 3	Relinquished By: 4	Date Time:	Received By: 4
Relinquished by: 5	Date Time:	Received By: 5	Custody Seal #	Preserved where applicable	On Ice

Cooler Temp. Thermo. Corr. Factor
Temp: 5.8 Temp Gun ID: IR-31
C/F:-1.2
Corrected Temp: 4.6

Notice: Signature of this document and relinquishment of samples constitutes a valid purchase order from client company to XENCO Laboratories and its affiliates, subcontractors and assigns XENCO's standard terms and conditions of service unless previously negotiated u

CHAIN OF CUSTODY

XENCO LABORATORIES

Setting the Standard since 1990

Stafford,Texas (281-240-4200)

Dallas Texas (214-902-0300)

Service Center - San Antonio, Texas (210-509-3334)

www.xenco.com

Odessa, Texas (432-563-1800)

Norcross, Georgia (770-449-8800)

Lakeland, Florida (863-646-8526)

Tampa, Florida (813-620-2000)

Xenco Quote #

Xenco Job # 505381-1

Client / Reporting Information

Company Name / Branch: Geotest Engineering, Inc.

Company Address: 5600 Bintliff Drive Houston Texas

Email: nkolli@geotesteng.com

Phone No: 7132660588

Project Contact: Naresh Kolli

Samplers's Name Tiffany Murry

Project Information Water Line Replacement in Innsdale Area

Project Name/Number: 1140208301

Project Location: Houston, Texas

Invoice To: Accounting

PO Number:

Analytical Information

Matrix Codes

S = Soil/Sed/Solid
GW =Ground Water
DW = Drinking Water
P = Product
SW = Surface water
SL = Sludge
OW =Ocean/Sea Water
W = Wipe
O = Oil
WW= Waste Water
A = Air

No.	Field ID / Point of Collection	Collection: Sample Depth	Collection: Date	Collection: Time	Matrix	# of bottles	HCl	NaOH/Zn Acetate	HNO3	H2SO4	NaOH	NaHSO4	MEOH	NONE	pH	Resistivity	Suphate	Chloride							Field Comments
1	GB-41 S# 9	14--16	2/23/2015		s	1 Bag									X	X	X	X							
2	GB-44 S#7	10--12	2/25/2015		s	1 Bag									X	X	X	X							
3	GB-45 S#6	8--10	2/25/2015		s	1 Bag									X	X	X	X							
4	GB-47 S#6	8--10	2/24/2015		s	1 Bag									X	X	X	X							
5	GB-50 S#10	18.5-20	2/24/2015		s	1 Bag									X	X	X	X							
6	GB-52A S#6	8--10	2/24/2015		s	1 Bag									X	X	X	X							
7	GB-54A S# 6	8--10	2/26/2015		s	1 Bag									X	X	X	X							
8	GB-55 S#6	8--10	2/26/2015		s	1 Bag									X	X	X	X							
9	GB-58 S# 5	8--10	2/26/2015		s	1 Bag									X	X	X	X							
		234][																							

Turnaround Time (Business days)

- [ ] Same Day TAT
- [ ] Next Day EMERGENCY
- [ ] 2 Day EMERGENCY
- [ ] 3 Day EMERGENCY
- [x] 5 Day TAT
- [ ] 7 Day TAT
- [ ] Contract TAT

TAT Starts Day received by Lab, if received by 3:00 pm

Data Deliverable Information

- [ ] Level II Std QC
- [ ] Level III Std QC+ Forms
- [ ] Level 3 (CLP Forms)
- [ ] TRRP Checklist
- [ ] Level IV (Full Data Pkg /raw data)
- [ ] TRRP Level IV
- [ ] UST / RG -411

Notes:

FED-EX / UPS: Tracking #

SAMPLE CUSTODY MUST BE DOCUMENTED BELOW EACH TIME SAMPLES CHANGE POSSESSION, INCLUDING COURIER DELIVERY

Relinquished by Sampler:	Date Time:	Received By:	Relinquished By:	Date Time:	Received By:
1 S. Ahi	10:30 4/3/15	1	2 4-4-15 10:30		2
Relinquished by: 3	Date Time:	Received By: 3	Relinquished By: 4	Date Time:	Received By: 4
Relinquished by: 5	Date Time:	Received By: 5	Custody Seal #	Preserved where applicable	On Ice

Cooler Temp. Thermo. Corr. Factor

Temp: 5.8 Temp Gun ID: IR-31

C/F:-1.2

Corrected Temp: 4.6

Notice: Signature of this document and relinquishment of samples constitutes a valid purchase order from client company to XENCO Laboratories and its affiliates, subcontractors and assigns XENCO's standard terms and conditions of service unless previously negotiated un

XENCO Laboratories

Prelogin/Nonconformance Report- Sample Log-In

Client: Geotest Engineering, Inc.

Date/ Time Received: 04/04/2015 10:30:00 AM

Work Order #: 505381

Acceptable Temperature Range: 0 - 6 degC
Air and Metal samples Acceptable Range: Ambient

Temperature Measuring device used :

Sample Receipt Checklist		Comments
#1 *Temperature of cooler(s)?	4.6	
#2 *Shipping container in good condition?	**Yes**	
#3 *Samples received on ice?	**Yes**	
#4 *Custody Seals intact on shipping container/ cooler?	**No**	
#5 Custody Seals intact on sample bottles?	**N/A**	
#6 *Custody Seals Signed and dated?	**N/A**	
#7 *Chain of Custody present?	**Yes**	
#8 Sample instructions complete on Chain of Custody?	**Yes**	
#9 Any missing/extra samples?	**No**	
#10 Chain of Custody signed when relinquished/ received?	**Yes**	
#11 Chain of Custody agrees with sample label(s)?	**Yes**	Coc & bag labels do not list collection times.
#12 Container label(s) legible and intact?	**Yes**	
#13 Sample matrix/ properties agree with Chain of Custody?	**Yes**	
#14 Samples in proper container/ bottle?	**Yes**	
#15 Samples properly preserved?	**N/A**	
#16 Sample container(s) intact?	**Yes**	
#17 Sufficient sample amount for indicated test(s)?	**Yes**	
#18 All samples received within hold time?	**No**	Received all samples out of recommended 28 day hold time.
#19 Subcontract of sample(s)?	**N/A**	
#20 VOC samples have zero headspace (less than 1/4 inch bubble)?	**N/A**	
#21 <2 for all samples preserved with HNO3,HCL, H2SO4? Except for samples for the analysis of HEM or HEM-SGT which are verified by the analysts.	**N/A**	
#22 >10 for all samples preserved with NaAsO2+NaOH, ZnAc+NaOH?	**N/A**	

*** Must be completed for after-hours delivery of samples prior to placing in the refrigerator**

Analyst: CH

PH Device/Lot#:

Checklist completed by: Carrie Hurtado — Date: 04/04/2015

Checklist reviewed by: Debbie Simmons — Date: 04/06/2015