GEOTECHNICAL INVESTIGATION

WATER LINE REPLACEMENT IN SHARPSTOWN II AREA WBS NO. S-000035-0194-4 HOUSTON, TEXAS

Submitted by:

GEOTEST ENGINEERING, INC.

Houston, Texas

REPORT NO. 1140196001

October 22, 2013

Key Map No. 530 K, L, P, Q & R

GEOTEST ENGINEERING, INC.

Geotechnical Engineers & Materials Testing

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

Report No. 1140196001
October 22, 2013

Mr. H. Prasad Kolluru, P.E.
Amani Engineering, Inc.
8313 Southwest Freeway, Suite 350
Houston, Texas 77074

Reference: Geotechnical Investigation
Water Line Replacement in
Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

Dear Mr. Kolluru:

We are pleased to present our final geotechnical report for the above referenced project. A draft report was sent to you on September 27, 2013. This final report supersedes all previously submitted reports, transmittals, etc. for the referenced project. This study was authorized through authorization to proceed letter dated July 25, 2013 by accepting Geotest Engineering, Inc. (Geotest) Proposal No. 1140333999 dated June 21, 2013.

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

K. Naresh

Naresh Kolli, P.E.
Assistant Project Manager

STATE OF TEXAS
10/22/13
NARESH KOLLI
110928
LICENSED
PROFESSIONAL ENGINEER

B.C. K

Mohan Ballagere, P.E.
Vice President

STATE OF TEXAS
10/22/13
MOHAN BALLAGERE
87622
LICENSED
PROFESSIONAL ENGINEER

MB/NK/ego
Copies Submitted: (2+1pdf)
PC38:\Geotechnical\40196001F.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	4
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	11
	4.5 Range of Cohesionless Soils Encountered in Borings	19
	4.6 Water Levels	20
	4.7 Environmental Concerns	20
5.0	ENGINEERING ANALYSES AND RECOMMENDATIONS	21
	5.1 General	21
	5.2 Trench Excavation(Auger Pits)	21
	5.2.1 Geotechnical Parameters	21
	5.2.2 Excavation Stability (Auger Pits)	21
	5.2.3 Groundwater Control	23
	5.2.4 Auger Pit Backfill	23
	5.3 Trenchless Installation - Pipe and Auger Casing	24
	5.3.1 Geotechnical Parameters for Pipe and Auger Casing	24

TABLE OF CONTENTS (Continued)

Page

5.3.2 Earth Pressure on Auger Casing/Tunnel Liner 24

5.3.3 Live Loads on Pipeline Due to Traffic 24

5.3.4 Carrier Pipe Design Parameters 24

5.4 Piping System Thrust Restraint 24

5.4.1 Restrained Joints 25

5.5 Influence of Trenchless Operation on Adjacent Structures 26

5.6 Pavement Repair and Subgrade Stabilization 27

6.0 CONSTRUCTION CONSIDERATIONS 29

6.1 Auger Pit Excavation and Water Line Construction 29

6.2 Groundwater Control 29

7.0 LIMITATIONS 30

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

ILLUSTRATIONS

Figure

Vicinity Map 1

Plan of Borings ..... 2.1 thru 2.3

Boring Log Profile ..... 3.1 thru 3.15

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-56

Borings from Previous Study ..... A-57 thru A-60

Symbols and Terms Used on Boring Logs A-61

Piezometer Installation Reports ..... A-62 thru A-66

APPENDIX B

Figure

Summary of Laboratory Test Results ..... B-1 thru B-56

Grain Size Distribution Curves ..... B-57 thru B-58

APPENDIX C

Laboratory Corrosivity Test Report

APPENDIX D

Piezometer Abandonment Reports

EXECUTIVE SUMMARY

A geotechnical investigation was performed for the design and construction of the proposed water line replacement in the Sharpstown II Area in Houston, Texas. The project calls for the design and construction of water lines replacement in Sharpstown II Area in Houston, Texas. The proposed water lines replacement is approximately 36,995 linear feet with new waterline size ranging from 6 to 12 inches in diameter. The anticipated maximum depth of new water lines range from 5 to 19 feet. It should be noted that the proposed water line, where it crosses the HCFCD channels will be constructed by trenchless method (with access pits outside the HCFCD R.O.W.) and will not be supported on bridge. Hence, the HCFCD Guidelines will not be required at the water line crossing for the channels. 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 lines replacement. This investigation included drilling and sampling fifty six (56) borings to depths ranging from 12 to 24 feet, installing piezometers in five (5) existing borings and utilizing four (4) borings from previous study, 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-56 along various streets in the project area consists of predominantly cohesive soils to the explored depths of 12 to 24 feet except in borings GB-8, GB-11, GB-12, GB-14, GB-25, GB-26, GB-38 and GB-54. In borings GB-8, GB-11, GB-12, GB-14, GB-25, GB-26, GB-38 and GB-54, the subsurface soil beneath pavement and existing grade consists of cohesive with intermittent or underlain by cohesionless soil to the depths of 9.5 to 23 feet. The cohesive soils consist of dark gray, gray, brown, yellowish brown and reddish brown medium stiff to hard Sandy Lean Clay, Lean Clay with sand, Lean Clay, Sandy Fat Clay,

Fat Clay with sand and Fat Clay. The cohesionless soil consists of loose to very dense gray, reddish brown Silty Sand.

- Groundwater was encountered in borings GB-8, GB-11, GB-25, GB-26, GB-41, GB-54 and GB-56 at depths ranging from 15 to 17 feet during drilling. No groundwater was encountered in any other borings drilled for this study including the borings converted into piezometer during the field investigation. In piezometer borings GB-8P, GB-25P, and GB-41P, the water level measured at 30 days ranges from 9.8 to 16.2 feet. No groundwater level was encountered in piezometers GB-2P and GB-56P at 30 days.

- 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 existing within the project area. The nearest known surface fault is the Blue Ridge Fault and is located approximately 4.5 miles southeast of the nearest alignment in project area.

- The existing paving as obtained in the soil borings GB-1 through GB-56 and B-1 through B-3 and B-9 (performed during previous study), predominantly consists of rigid pavement consisting of 5 to 9.0 inches of concrete over 0 to 4 inches of sand and shell base. In borings GB-5 through GB-8, GB-11 and GB-48 through GB-52, the existing pavement consists of 2 to 6.5 inches of asphalt over 3 to 8.0 inches of sand and shell base. The boring GB-23 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 waterlines 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 Amani Engineering, Inc. to perform engineering services for design and construction of water line replacement in Sharpstown II Area in Houston, Texas. Amani Engineering, 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 July 25, 2013 by accepting Geotest Engineering, Inc. (Geotest) Proposal No. 1140333999 dated June 21, 2013.

1.3 Location and Description of Project

The water line replacement in Sharpstown II Area with Key Map page and grid 530 K, L, P, Q & R in Houston, Texas. The project area is bounded by Bissonnet Street to the south, Fondren Street to the east, Beechnut Street to the north and Brae Acres Drive to the west. The location of the project is shown on Figure 1, Vicinity Map.

The project calls for the design and construction of water lines replacement in Sharpstown II Area in Houston, Texas. The proposed water lines replacement is approximately 36,995 linear feet with new waterline size ranging from 6 to 12 inches in diameter. The anticipated maximum depth of new water lines range from 5 to 19 feet. It should be noted that the proposed water line, where it crosses the HCFCD channels will be constructed by trenchless method (with access pits outside the HCFCD R.O.W.) and will not be supported on bridge. Hence, the HCFCD Guidelines will not be required at the water line crossing for the channels. 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 Sharpstown II area. The scope of this investigation consisted of the following:

- Utilizing four (4) borings from previous study.
- Coring the existing concrete pavement at Forty Five (45) locations to access the subsurface soils below the pavement.
- Drilling and sampling fifty six (56) borings to depths ranging from 12 feet to 24 feet.
- Converting five (5) 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.
- Performing engineering analyses in accordance with the City of Houston Design Manual (July 2012) to develop geotechnical recommendations for the design and construction of the proposed water line replacement in Sharpstown II 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 six (56) marked borings in the field, existing concrete pavement was cored at forty five (45) 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 location GB-51, hard obstruction was encountered at a depth of 6 feet and also at offset boring GB-51A and boring was finally offset to GB-51B, where it is completed to the explored depth of 12 feet. 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 soil borings (designated as GB-1 through GB-56) to depths ranging from 12 to 24 feet. The approximate boring locations are shown on Figures 2.1 through 2.3, Plan of Borings. Survey information (Northing and Easting coordinates and ground surface elevation) of completed borings was provided to us by Amani Engineering, Inc. The survey information of completed borings is summarized in Table 1.

The existing concrete pavement was cored at forty five (45) boring locations to provide access to the subsurface soils in the borings. Borings GB-11, GB-14 and GB-38 were extended an additional 5 feet due to silt was encountered at the bottom of the 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-56 in Appendix A. Four (4) borings from previous study (GEI Report No. 1140141601, dated September 24, 2003) utilized for the project are presented on Figures A-57 through A-60 in Appendix A. A key to symbols and terms used on boring logs is given on Figure A-61 in Appendix A.

2.3 Piezometer Installation

During the field investigation, a piezometer was installed in the open borehole of borings GB-2, GB-8, GB-25, GB-41 and GB-56. The location of the piezometers, designated as GB-2P, GB-8P, GB-25P, GB-41P and GB-56P, are shown on Figures 2.1 through 2.3, Plan of Borings. The piezometer installation report showing the details of the construction of the piezometers are provided on Figures A-62 through A-66 in Appendix A.

Piezometers were abandoned in place after taking the final water level readings. The piezometer abandonment reports are presented in Appendix D.

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), sieve analysis (ASTM D422) and percent passing No. 200 sieves (ASTM D 1140) 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-56 in Appendix A. The summary of laboratory tests is also presented in a tabular form on Figures B-1 through B-56 in Appendix B. The grain size distribution curves are presented on Figures B-57 and B-58 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)***	***Sulphate (mg/kg)***
GB-1	S#6	10-12	8.94	**1270**	<9.49	<9.49
GB-3	S#5	8-10	8.96	**1530**	<9.84	<9.84
GB-5	S#6	8-10	8.72	**800**	16.7	<9.09
GB-6	S#6	8-10	8.51	**700**	27.9	<9.46
GB-8	S#7	10-12	8.67	2070	13.5	<9.38
GB-12	S#4	6-8	8.96	**813**	<9.46	<9.46
GB-13	S#5	8-10	8.93	**1640**	<8.82	<8.82
GB-18	S#6	8-10	9.01	**885**	<8.82	<8.82
GB-20	S#6	8-10	9.10	**844**	<9.09	<9.09
GB-24	S#6	8-10	8.82	**1420**	<10.0	<10.0
GB-26	S#6	10-12	8.46	4440	<9.52	<9.52
GB-28	S#6	8-10	8.83	**1270**	<9.52	<9.52
GB-30	S#8	14-16	8.92	**934**	11.5	<9.09
GB-40	S#10	16-18	8.98	**692**	<9.38	<9.38
GB-44	S#8	16-18	8.43	**1540**	16.7	<9.58
GB-54	S#8	12-14	8.92	**885**	15.0	<9.74

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

Based on the corrosivity test results, the degree of corrosivity of the surface soils is negligible in terms of pH, moderate 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-3, GB-5, GB-6, GB-12, GB-13, GB-18, GB-20, GB-24, GB-28, GB-30, GB-40, GB-44 and GB-54, due to moderately corrosive to corrosive nature of the soils in terms of resistivity, protective measures such as cathodical protection or cement north 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 exists within the project. The nearest known surface fault is the Blue Ridge Fault and is located approximately 4.5 miles southeast of the nearest alignment in project area. A detailed fault study is not part of the project scope.

4.3 Existing Paving

The existing paving as obtained in the soil borings GB-1 through GB-56 and B-1 through B-3 and B-9 (performed during previous study), predominantly consists of rigid pavement consisting of 5 to 9.0 inches of concrete over 0 to 4 inches of sand and shell base. In borings GB-5 through GB-8, GB-11 and GB-48 through GB-52, the existing pavement consists of 2 to 6.5 inches of asphalt over 3 to 8.0 inches of sand and shell base. The boring GB-23 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			9.0		9.0
GB-2 (GB-2P)			6.5	1.5	8.0
GB-3			6.25		6.25
GB-4			6.0	1	7.0
GB-5	6.0	7.0			13.0
GB-6	4.0	8.0			12.0
GB-7	5.0	7.0			12.0
GB-8 (GB-8P)	4.0	7.0			11.0
GB-9			6.0	2.0	8.0
GB-10			6.25	2.0	8.25
GB-11	6.5	3.0			9.5
GB-12			6.0		6.0
GB-13			6.5		6.5
GB-14			6.0		6.0
GB-15			6.0	3.0	9.0
GB-16			6.5	2.0	8.5
GB-17			5.5	4.0	9.5
GB-18			6.0	2.0	8.0
GB-19			6.0	1.0	7.0
GB-20			6.5	2.0	8.5
GB-21			6.0	4.0	10.0
GB-22			7.0	1.0	8.0
GB-24			6.0	2.0	8.0
GB-25 (GB-25P)			5.5		5.5
GB-26			6.5		6.5
GB-27			6.0		6.0
GB-28			6.5	1.0	7.5
GB-29			6.5	2.0	8.5
GB-30			8.5		8.5
GB-31			6.0	3.0	9.0
GB-32			5.0	3.0	8.0
GB-33			6.0	1.0	7.0
GB-34			6.0	1.0	7.0
GB-35			6.0		6.0
GB-36			6.0	1.0	7.0
GB-37			7.0	1.0	8.0
GB-38			5.0	1.0	6.0
GB-39			6.0		6.0
GB-40			6.5		6.5

Boring Nos.	Asphalt Thickness (in.)	Base Thickness (in.)	Concrete Thickness (in.)	Subbase Thickness (in.)	Total (in.)
GB-41 (GB-41P)			6.25		6.25
GB-42			6.75		6.75
GB-43			7.5		7.5
GB-44			7.5		7.5
GB-45			6.5	2.0	8.5
GB-46			6.0	1.0	7.0
GB-47			6.5	1.0	7.5
GB-48	2.0	5.0			7.0
GB-49	3.0	3.0			6.0
GB-50	3.0	5.0			8.0
GB-51B	2.0	7.0			9.0
GB-52	3.0	6.0			9.0
GB-53			5.0	3.0	8.0
GB-54			7.0	1.0	8.0
GB-55			7.0		7.0
GB-56 (GB-56P)			6.5		6.5
B-1*			6.0	2.0	8.0
B-2*			6.0	2.0	8.0
B-3*			7.0	3.0	10.0
B-9*			8.75		8.75

Note: (1) Borings GB-23 was drilled on the grass area.
(2) The base includes sand and shell, limestone and subbase includes sand, and shell mix.
* Borings from previous study.

4.4 Soils Stratigraphy

Based on the subsurface soils encountered in the boreholes, fifteen (15) boring log profiles were developed and are presented on Figures 3.1 through 3.15. 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-56 and as shown in boring log profiles 3.1 through 3.15 along various streets in the project area are summarized below:

Boring No.	**Location/Street**	**Boring Depth (ft)**	**Soil Description**
GB-1 through GB-8	Brae Acres	12 to 23	The subsurface soil beneath the pavement along Brae Acres as shown on the boring log profile presented on Figure 3.1 consists of medium stiff to hard dark gray, reddish brown and gray Lean Clay with sand, Sandy Lean Clay, Fat Clay, Fat Clay with sand and Sandy Fat Clay to the explored depths of 12 to 23 feet. Medium dense brown Silty Sand was encountered between the depths 12 to 23 feet in boring GB-8. The Lean Clay with sand and Sandy Lean Clay is of medium to high plasticity with liquid limits ranging from 32 to 44 plasticity indices ranging from 14 to 25. The Fat Clay and Fat Clay with sand is of high to very high plasticity with liquid limits ranging from 50 to 68 and plasticity indices ranging from 29 to 42. The percent fines (percent passing No. 200 sieve) of Lean Clay with sand is about 81 percent. The percent fines of Sandy Lean Clay is about 70 percent. The percent fines of Fat Clay and Fat Clay with sand ranges from 83 to 98 percent. The percent fines of Sandy Fat Clay is about 58 percent. The percent fines of Silty Sand ranges from 12 to 22 percent.
GB-9, GB-10, GB-31, GB-32, GB-45 and GB-46	Troulon	12 to 13	The subsurface soil beneath the pavement along Troulon as shown on the boring log profile 3.2, consists of stiff to hard gray, reddish brown and yellowish brown and gray Lean Clay with sand and Fat Clay with sand to the explored depths of 12 to 13 feet. The Fat Clay with sand is of high plasticity with liquid limits ranging from 50 to 58 and plasticity indices ranging from 28 to 35. The Lean Clay with sand is of medium to high plasticity with liquid limits ranging from 43 to 48 and plasticity indices ranging from 26 to 31. The percent fines of Fat Clay with sand ranges from 77 to 84 percent. The percent fines of Lean Clay with sand ranges from 73 to 79 percent.

Boring No.	**Location/Street**	**Boring Depth (ft)**	**Soil Description**
GB-2, GB-11, GB-33, GB-34, B-1, B-2 and B-3 (from Previous Study)	Tanager	12 to 17	The subsurface soil beneath the pavement along Tanager as shown on the boring log profile 3.3 consists of stiff to hard, dark gray and reddish brown and gray Sandy Lean Clay and Fat Clay with sand to the explored depths of 12 to 17 feet. A layer of loose silty sand was encountered between the depths of 11 feet and 17 feet in boring GB-11. The Sandy Lean Clay is of medium to high plasticity with liquid limits ranging from 34 to 48 and plasticity indices ranging from 17 to 28. The Fat Clay is of high to very high plasticity with liquid limits ranging from 50 to 62 and plasticity indices ranging from 29 to 41. The percent fines of Sandy Lean Clay ranges from 55 to 66 percent. The percent fines of Fat Clay with sand ranges from 81 to 83 percent. The percent fines of Silty Sand is about 23 percent.
GB-12 through GB-15	Carew	12 to 17	The subsurface soil beneath the pavement along Carew Street as shown on the boring log profile presented on Figure 3.4, consists of medium stiff to hard, gray, brown, yellowish brown and gray Sandy Lean Clay and Fat Clay with Sand to the explored depths of 12 feet to 17 feet. A layer of loose to medium dense Silty Sand was encountered between the depths of 10 and 16 feet in borings GB-12 and GB-14. The Fat Clay with sand is of high plasticity with liquid limits ranging from 50 to 61 and plasticity indices ranging from 29 to 37. The Sandy Lean Clay is of medium plasticity with liquid limits ranging from 32 to 34 and a plasticity index of about 16. The percent fines of Fat Clay with sand ranges from 82 to 84 percent. The percent fines of Sandy Lean Clay ranges from 56 to 70 percent. The percent fines of Silty Sand ranges from 18 to 31 percent.

Boring No.	**Location/Street**	**Boring Depth (ft)**	**Soil Description**
GB-17, GB-18, GB-27 and GB-37	Grape	12 to 14	The subsurface soil beneath the pavement along Grape as shown on the boring log profile 3.5 consists of stiff to hard, dark gray, yellowish brown and gray Fat Clay, Fat Clay with sand and Lean Clay w/sand to the explored depths of 12 feet to 14 feet. The Fat Clay and Fat Clay with sand is of high plasticity with liquid limits ranging from 52 to 65 and plasticity indices ranging from 32 to 40. The percent fines of Fat Clay and Fat Clay with sand ranged from 82 to 93 percent.
GB-5 and GB-19	Jackwood	12 to 16	The subsurface soil beneath the pavement along Jackwood as shown on the boring log profile presented on Figure 3.6, consists of stiff to hard, dark gray and reddish brown and yellowish brown and gray Fat Clay and Lean Clay with sand to depths of 12 to 16 feet. The Fat Clay is of high to very plasticity with liquid limits ranging from 57 to 68 and plasticity indices ranging from 37 to 42. The percent fines of Fat Clay ranges from 86 to 98 percent.
GB-20 and GB-29	Jason	14 to 18	The subsurface soil beneath the pavement along Jason as shown on the boring log profile presented on Figure 3.7, consists of medium stiff to hard, dark gray and brown, yellowish brown and gray Fat Clay and Lean Clay with sand to the explored depths of 14 to 18 feet. The Fat Clay is of Very high plasticity with liquid limits ranging from 68 to 70 and plasticity indices ranging from 42 to 44. The Lean Clay with sand is of medium plasticity with a liquid limit of about 26 and a plasticity index of about 13. The percent fines of Fat Clay ranges from 86 to 89 percent and the percent fines of Lean Clay with sand is about 72 percent.

Boring No.	**Location/Street**	**Boring Depth (ft)**	**Soil Description**
GB-6, GB-22 and GB-23	Imogene	12 to 18	The subsurface soil beneath the pavement along Imogene as shown on the boring log profile presented on Figure 3.8, consists of medium stiff to hard, dark gray and reddish brown and gray Lean Clay with sand , Fat Clay and Fat Clay with sand to depths of 12 to 18 feet. The Fat Clay and Fat Clay with Sand is of high to very high plasticity with liquid limits ranging from 55 to 77 and plasticity indices ranging from 35 to 49. The percent fines of Fat Clay ranges from 91 to 99 percent. The percent fines of Fat Clay with sand ranges from 83 to 84 percent.
GB-10, GB-13, GB-16, GB-18 and GB-21	Braes River	12 to 14	The subsurface soil beneath the pavement along Braes River as shown on the boring log profile presented on Figure 3.9, consists of medium stiff to hard, dark gray, brown and yellowish brown Fat Clay, Lean Clay with Sand, Sandy Lean Clay and Lean Clay to the explored depths of 12 to 14 feet. The Fat Clay is of high to very high plasticity with liquid limits ranging from 56 to 75 and plasticity indices ranging from 34 to 47. The Sandy Lean Clay, Lean Clay with sand and Lean Clay is of medium to high plasticity with liquid limits ranging from 32 to 49 and plasticity indices ranging from 16 to 30. The percent fines of Fat Clay and Lean Clay ranges from 89 to 93 percent. The percent fines of Lean Clay with sand is about 73 percent. The percent fines of Sandy Lean Clay is about 70 percent.

Boring No.	**Location/Street**	**Depth (ft)**	**Soil Description**
GB-24 through GB-30	Breaburn Valley	12-24	The subsurface soil beneath the pavement along Breaburn Valley as shown on the boring log profile presented on Figure 3.10, consists of medium stiff to hard, 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 depths of 12 to 24 feet. Medium dense to dense gray and brown Silty Sand was encountered between the depths of 12 and 22 feet in borings GB-25 and GB-26. The Fat Clay and Fat Clay with sand is of high to very high plasticity with liquid limits ranging from 50 to 73 and plasticity indices ranging from 28 to 46. Lean Clay with sand and Sandy Lean Clay is of medium to high plasticity with liquid limits ranging from 26 to 40 and plasticity indices ranging from 13 to 22. The percent fines of Fat Clay ranges from 86 to 93 percent. The percent fines of Lean Clay with sand and Fat Clay with sand ranges from 72 to 82 percent. The percent fines of Sandy Lean clay is about 70 percent. The percent fines of Silty Sand ranges from 13 to 15 percent.
GB-35 and GB-36	Darnell	12	The subsurface soil beneath the pavement along Darnell Street as shown on the boring log profile presented on Figure 3.11, consists of stiff to hard, gray, yellowish brown and gray Fat Clay with sand, Sandy Lean Clay and Lean Clay to the explored depth of 12 feet. The Sandy Lean Clay and Lean Clay is of medium to high plasticity with liquid limits ranging from 44 to 49 and plasticity indices ranging from 28 to 33. The Fat Clay with sand is of high plasticity with a liquid limit of about 52 and plasticity index of about 31. The percent fines of Lean Clay is about 92 percent. The percent fines of Fat Clay with sand is about 81 percent and the percent fines of Sandy Lean Clay is about 68 percent.

Boring No.	**Location/Street**	**Boring Depth (ft)**	**Soil Description**
GB-37	Reims	12	The subsurface soil beneath the pavement along Reims as shown on the boring log GB-37, consists of stiff to hard, gray and yellowish brown Fat Clay to the explored depth of 12 feet. The Fat Clay is of high plasticity with a liquid limit of about 65 and a plasticity index of about 40. The percent fines of Fat Clay is about 90 percent.
GB-38	Jackwood	17	The subsurface soil beneath the pavement along Jackwood as shown on the boring log GB-38, consists of very stiff to hard, dark gray and yellowish brown and gray Sandy Fat Clay to a depth of 10 feet. The Sandy Fat Clay is underlain by medium dense Silty Sand to the explored depth of 17 feet. The Sandy Fat Clay is of high plasticity with a liquid limit of about 51 and a plasticity index of about 30. The percent fines of Sandy Fat Clay is about 69 percent. The percent fines of Silty Sand is about 33 percent.
GB-39 through GB-44	Bonhomme	12 to 24	The subsurface soil beneath the pavement along Bonhomme as shown on boring log profile presented on Figure 3.12, consists of stiff to hard gray, dark gray, yellowish brown and gray, and reddish brown and gray Fat Clay, Fat Clay w/sand, Sandy Fat Clay, Lean Clay w/sand, Sandy Lean Clay to the explored depths of 12 to 24 feet. The Fat Clay, Fat Clay w/sand and Sandy Fat Clay is of high plasticity with liquid limits ranging from 50 to 60 and plasticity indices ranging from 29 to 36. The Lean Clay with sand and Sandy Lean Clay is of medium to high plasticity with liquid limits ranging from 32 to 47 and plasticity indices ranging from 19 to 29. The percent fines of Sandy Lean Clay and Sandy Fat Clay is about 57 percent. The percent fines of Fat Clay with sand and Lean Clay with sand ranges from 76 to 84 percent. The percent fines of Fat Clay is about 97 percent.

Boring No.	**Location/Street**	**Boring Depth (ft)**	**Soil Description**
GB-47	Lugary	12	The subsurface soil beneath the pavement along Lugary as shown on boring log GB-47 consists of very stiff dark gray and yellowish brown and gray Fat Clay with sand to the explored depth of 12 feet. The Fat Clay with sand is of high plasticity with a liquid limit of about 56 and a plasticity index of about 34. The percent fines of Fat Clay with sand ranges from 80 to 84 percent.
GB-48 through GB-52	Back Lines (Easement A, B, C & D)	12	The subsurface soil beneath the pavement along Back Lines (Easement A, B, C & D) as shown on boring log profile presented on Figure 3.13, consists of medium stiff to very stiff dark gray, gray and yellowish brown and gray Fat Clay with sand, Lean Clay and Lean Clay with sand to the explored depth of 12 feet. The Fat Clay with sand is of high plasticity with liquid limits ranging from 52 to 64 and plasticity indices ranging from 32 to 39. The percent fines of Fat Clay with sand ranges from 78 to 84 percent.
GB-53, GB-54 and B-9	Kingsgate Circle	12 to 24	The subsurface soil beneath the pavement along Kingsgate Circle as shown on boring log profile presented on Figure 3.14, consists of medium stiff to hard dark gray, reddish brown and yellowish brown Fat Clay with sand and Sandy Lean Clay to depths of 12 to 15 feet. A layer of medium dense to dense yellowish brown and gray Fine Sand w/silt was encountered between the depths of 14 to 24 feet in boring GB-54. The Fat Clay with sand is of high to very high plasticity with liquid limits ranging from 55 to 68 and plasticity indices ranging from 33 to 42. The Sandy Lean Clay is of high plasticity with a liquid limit of about 36 and a plasticity index of about 22. The percent fines of Fat Clay with sand is about 82 percent. The percent fines of Sandy Lean Clay is about 60 percent and the percent fines of Fine Sand w/silt is about 11 percent.

Boring No.	Location/Street	Depth (ft)	Soil Description
GB-55 and GB-56	Fonvilla	12	The subsurface soil beneath the pavement along Fonvilla Street as shown on boring log profile presented on Figure 3.15, consists of stiff to hard dark gray and brown and yellowish brown and gray Fat Clay with sand and Lean Clay with sand to the explored depth of 12 feet. The Fat Clay with sand is of high plasticity with liquid limits ranging from 50 to 58 and plasticity indices ranging from 29 to 38. The percent fines of Fat Clay with sand ranges from 81 to 84 percent.

4.5 Range of Cohesionless Soils Encountered in Borings

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

Boring No.	Location/Street	Range of Depth of Cohesionless Soils Encountered, ft.		Soil Type
		From	To	
GB-8	Brae Acres	12	23	Medium dense Silty Sand
GB-11	Tanager (West)	11	17	Loose brown Silty Sand
GB-12	Carew	10	16	Loose to medium dense brown Silty Sand
GB-14	Carew	9.5	16	Medium dense yellow and gray Silty Sand
GB-25	Braeburn Valley	12	22	Medium dense gray Silty Sand
GB-26	Braeburn Valley	12	22	Medium dense to dense brown and gray Silty Sand
GB-38	Jackwood (East)	10	17	Medium dense brown and gray Silty Sand
GB-54	Kingsgate	14	24	Medium dense yellowish brown and gray Fine Sand w/silt

4.6 Water Levels

Groundwater was encountered in borings GB-8, GB-11, GB-25, GB-26, GB-41, GB-54 and GB-56 at depths ranging from 15 to 17 feet during drilling. No groundwater was encountered in any other borings drilled for this study including the borings converted into piezometer during the field investigation. In piezometer borings GB-8P, GB-25P, and GB-41P, the water level measured at 30 days ranges from 9.8 to 16.2 feet. No groundwater level was encountered in piezometers GB-2P and GB-56P at 30 days. The water level encountered in Piezometer borings is summarized below.

Boring No.	Location/Street Name	Groundwater Depth During Drilling (ft)	Groundwater Depth After 24 Hours (ft)	Groundwater Depth After 30 Days (ft)
GB-2 (GB-2P)	Brae Acres	Dry	Dry	Dry on 9-8-13
GB-8 (GB-8P)	Brae Acres	16.0	16.2	16.2 on 9-8-13
GB-25 (GB-25P)	Braburn Valley	16.0	15.5	15.7 on 6-17-13
GB-41 (GB-41P)	Bonhomme	Dry	Dry	9.8 on 9-8-13
GB-56 (GB-56P)	Fonvilla	Dry	Dry	Dry on 9-8-13

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-56) drilled for this study. However, hydrocarbon odor was observed between the depths of 4 and 15 feet in boring B-3 from previous study drilled on Tanager Street. Based on the Phase II ESA study performed by Geotest identified the area along Tanager Street as Potentially Petroleum Contaminated Area (PPCA).

5.0 ENGINEERING ANALYSES AND RECOMMENDATIONS

5.1 General

The project calls for the design and construction of water lines replacement in Sharpstown II Area in Houston, Texas. The proposed water lines replacement is approximately 36,995 linear feet with new waterline size ranging from 6 to 12 inches in diameter. The anticipated maximum depth of new water lines range from 5 to 19 feet. It should be noted that the proposed water line, where it crosses the HCFCD channels will be constructed by trenchless method (with access pits outside the HCFCD R.O.W.) and will not be supported on bridge. Hence, the HCFCD Guidelines will not be required at the water line crossing for the channels. 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 Amani Engineering, 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 pit installation.

5.2.1 Geotechnical Parameters. Based on the soil conditions revealed by the borings GB-1 through GB-56, borings B-1 through B-3 and B-9 (from previous study), geotechnical parameters were developed for the design of auger pit 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 93 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-14, GB-25, GB-26 and GB-38 where cohesionless soils (such as silty sand) were encountered between depths of 9.5 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-14, GB-25, GB-26 and GB-38 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.

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-56 and borings B-1 through B-3 and B-9 (from previous study) 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 Table 3. 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 Table 3 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, Fat Clay with sand and Sandy Fat Clay. The cohesive soils within the natural soils are medium stiff 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-14, GB-25, GB-26 and GB-38. The cohesionless soils (silty sand) 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. 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-14, GB-25, GB-28 and GB-38, 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, lean clay with sand, fat clay, fat clay with sand and sandy fat clay) with high plasticity. These high plasticity cohesive soils should be stabilized with a minimum of 6% 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

Auger pit excavations may encounter groundwater seepage. It is our opinion that in cohesive soils, as encountered in most of the borings for the proposed excavation depths, the groundwater may be collected in excavation bottom sumps for pumped disposal. However, in borings GB-14, GB-25, GB-26 and GB-38 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 3 feet below the bottom of the excavation (auger pits). The contractor should verify the groundwater level at the time of construction and should provide an adequate dewatering system, where required.

7.0 LIMITATIONS

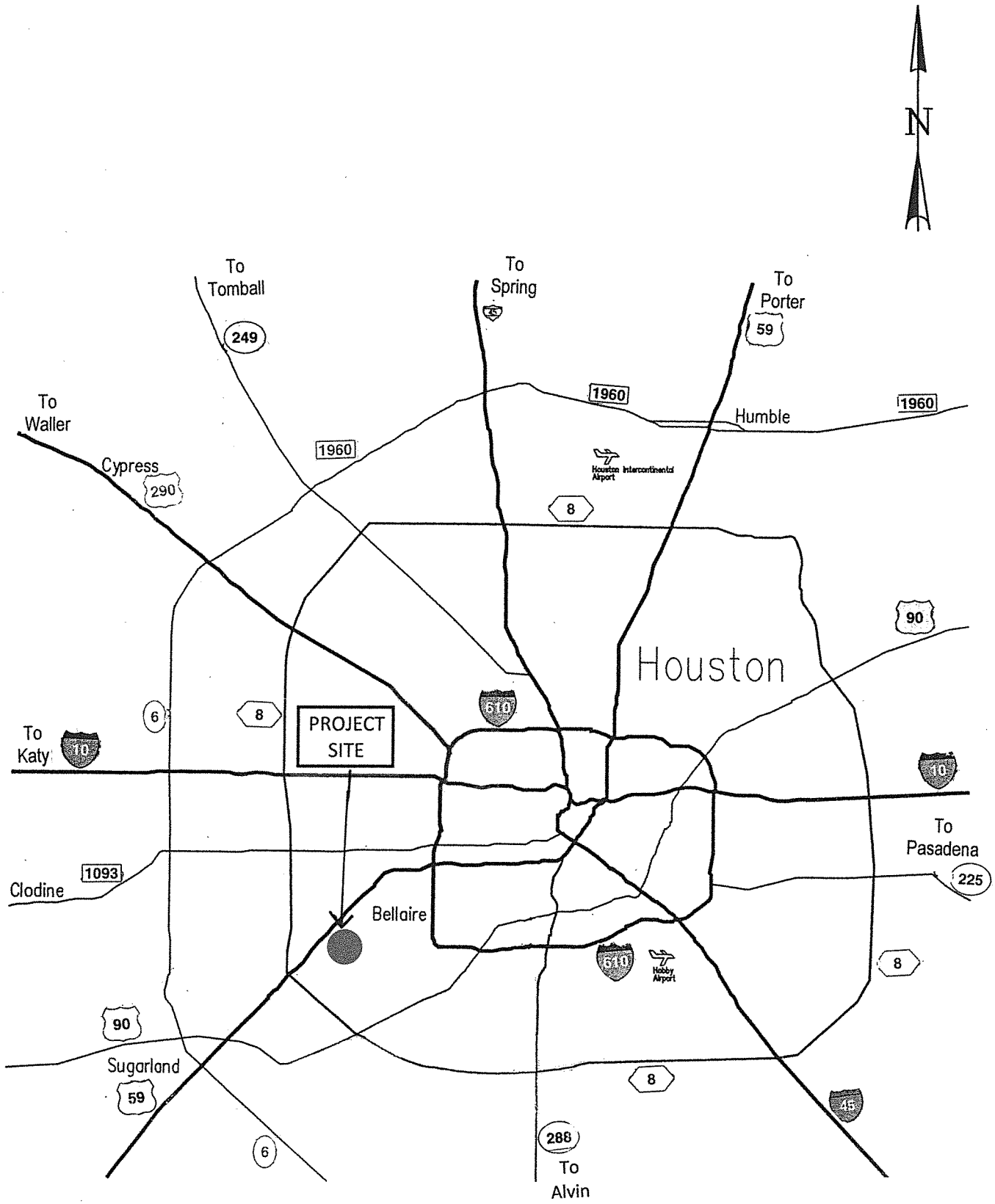
The description of subsurface conditions and the design information contained in this report are based on the soil borings made at the time of drilling at specific locations. However, some variation in soil conditions may occur between soil borings. Should any subsurface conditions other than those described 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, Texas, and Amani Engineering, Inc. for the Water Line Replacement in Sharpstown II Area in Houston, Texas. This report shall not be reproduced without the written permission of Geotest Engineering, Inc., The City of Houston or Amani Engineering, Inc.

ILLUSTRATIONS

	Figure
Vicinity Map	1
Plan of Borings	2.1 thru 2.3
Boring Log Profile	3.1 thru 3.15
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

Job No. 1140196001



VICINITY MAP

(NOT TO SCALE)

Geotest Engineering, Inc.

FIGURE 1

Job No. 1140196001

KEY MAP NO.: 530 K, L, P, Q &R

Legend:

- Boring
- Boring with Piezometer

0 100 200 300 400
SCALE IN FEET

PLAN OF BORINGS

AMANI ENGINEERING, INC.

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

WATER LINE REPLACEMENT IN SHARPSTOWN II AREA

SHEET LAYOUT/CORE BORING PLAN
(SHEET 1 OF 3)

S-000035-0194-3

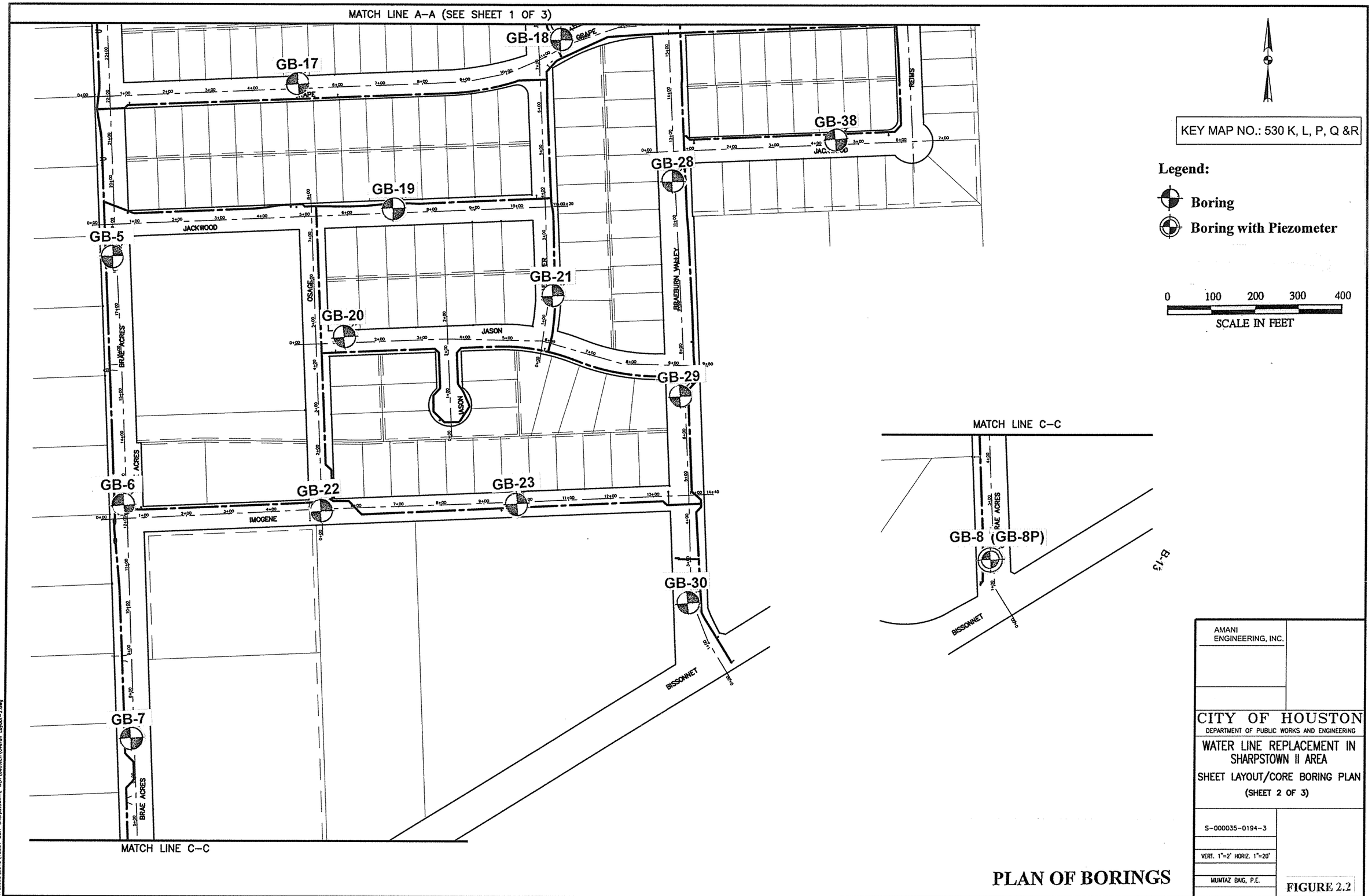
VERT. 1"=2' HORIZ. 1"=20'

MUMTAZ BAIG, P.E.

FIGURE 2.1

V:\Coded\2013\13001 CDH-Sharpstown-2 WLR\Geotech\Overall Layout-1.dwg

Job No. 1140196001



AMANI ENGINEERING, INC.

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

WATER LINE REPLACEMENT IN SHARPSTOWN II AREA

SHEET LAYOUT/CORE BORING PLAN
(SHEET 2 OF 3)

S-000035-0194-3

VERT. 1"=2' HORIZ. 1"=20'

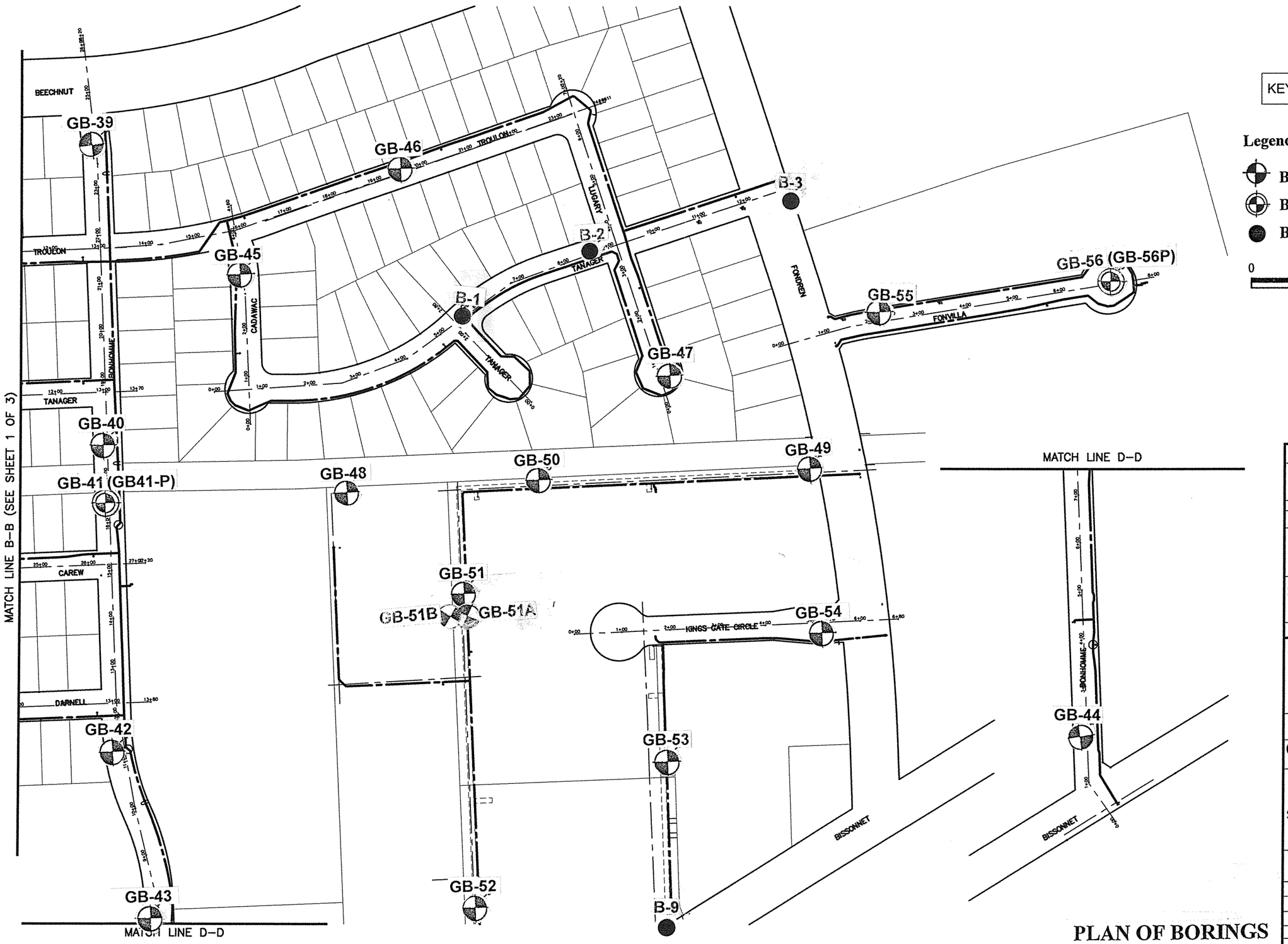
MUMTAZ BAIG, P.E.

PLAN OF BORINGS

FIGURE 2.2

X:\Cost\2012\13001 CDH-Sharpstown-2 WLR\Geotech\Overall Layout-2.dwg

Job No. 1140196001



PLAN OF BORINGS

TO ARRANGE FOR LINES TO BE TURNED OFF OR MOVED, CALL CENTERPOINT ENERGY AT 713-207-2222

NOTICE:
For your safety, you are required by Texas law to call 811 at least 48 hours before you dig so that underground lines can be marked. This Verification does not fulfill your obligation to call 811

VERIFICATION OF PRIVATE UTILITY LINES

Date:
CenterPoint Energy/Natural Gas Facilities Verification ONLY
(This Signature verifies that you have shown CNP Natural Gas lines correctly – not to be used for conflict verification.) (Gas service lines are not shown.)
Signature Valid for six months.

Date:
CenterPoint Energy/UNDERGROUND Electrical Facilities Verification ONLY
(This Signature verifies existing underground facilities – not to be used for conflict verification.)
Signature Valid for six months.

Date:
Approved for AT&T Texas/SWBT underground conduit facilities only.
Signature valid for one year.

AMANI ENGINEERING, INC.
8313 SOUTHWEST FREEWAY
SUITE 350
HOUSTON, TEXAS 77074
TEL: (713) 270-5700
TBPE REG. NO.: F-4528

SEAL

SURVEYED BY: AMANI
FB NO. P-5778

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

WATER LINE REPLACEMENT IN SHARPSTOWN II AREA

SHEET LAYOUT/CORE BORING PLAN

(SHEET 3 OF 3)

WBS NO.
S-000035-0194-3

DRAWING SCALE
VERT. 1"=2' HORIZ. 1"=20'

CITY OF HOUSTON, PM
MUMTAZ BAIG, P.E.

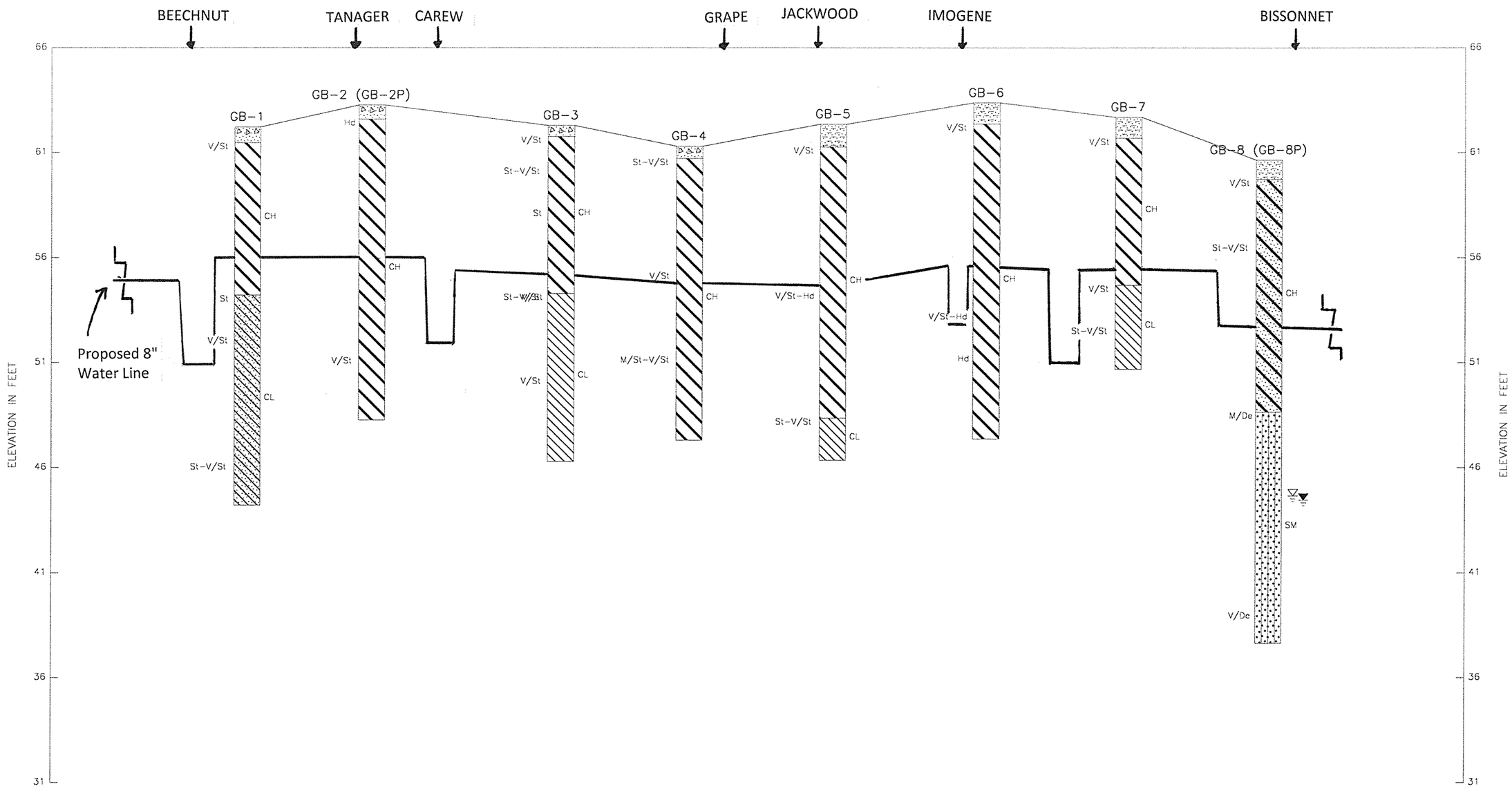
SHEET NO. XX OF 170

FIGURE 2.3

V:\Cadd\2013\13001 COH-Sharpstown-2 WLR\Geotech\Overall Layout-3.dwg

ORIGINAL SCALE IN INCHES

FILE NAME:



GENERAL NOTES:

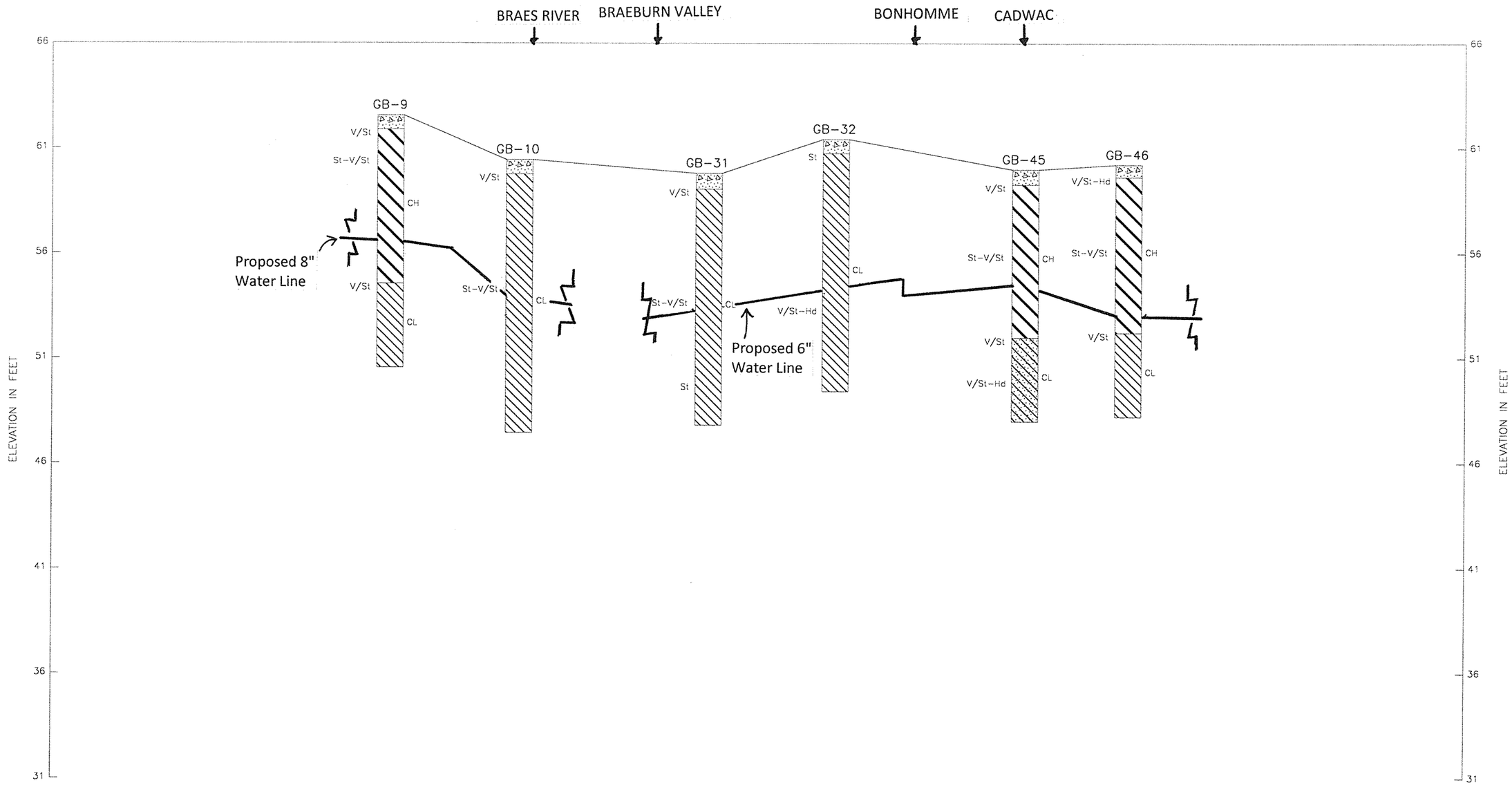
1. See Figures 2.1 and 2.2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered 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 Amani Engineering, Inc.

BORING LOG PROFILE

Brae Acre

0 200 400 600 800

HORIZONTAL SCALE IN FEET



GENERAL NOTES:

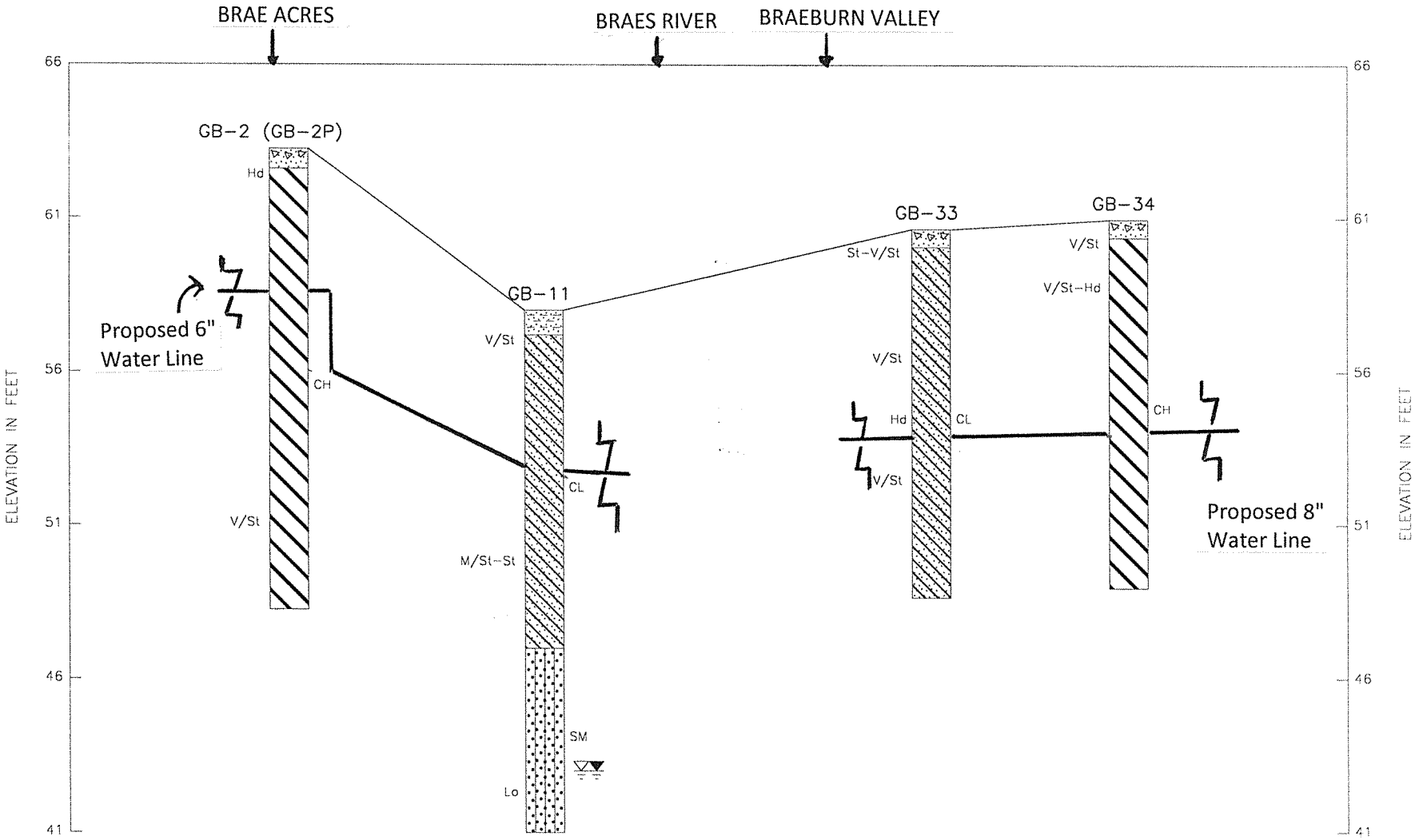
1. See Figures 2.1 and 2.2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered 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 Amani Engineering, Inc.

BORING LOG PROFILE

Troulon

0 200 400 600 800

HORIZONTAL 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 Amani Engineering, Inc.

BORING LOG PROFILE

Tanager

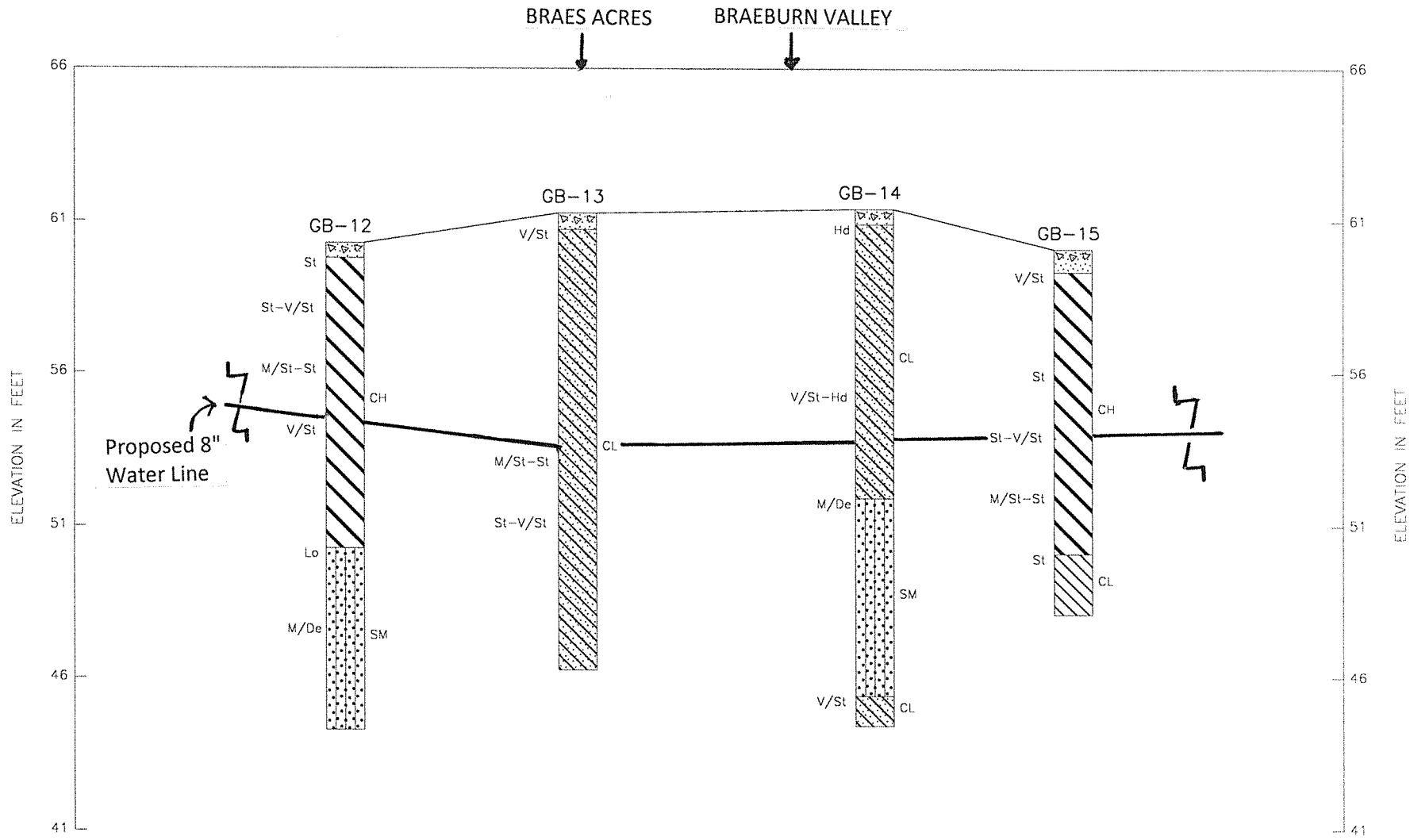
0 200 400 600 800

HORIZONTAL SCALE IN FEET

Job No. 1140196001

Geotest Engineering, Inc.

FIGURE 3.3



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 Amani Engineering, Inc.

BORING LOG PROFILE

Carew

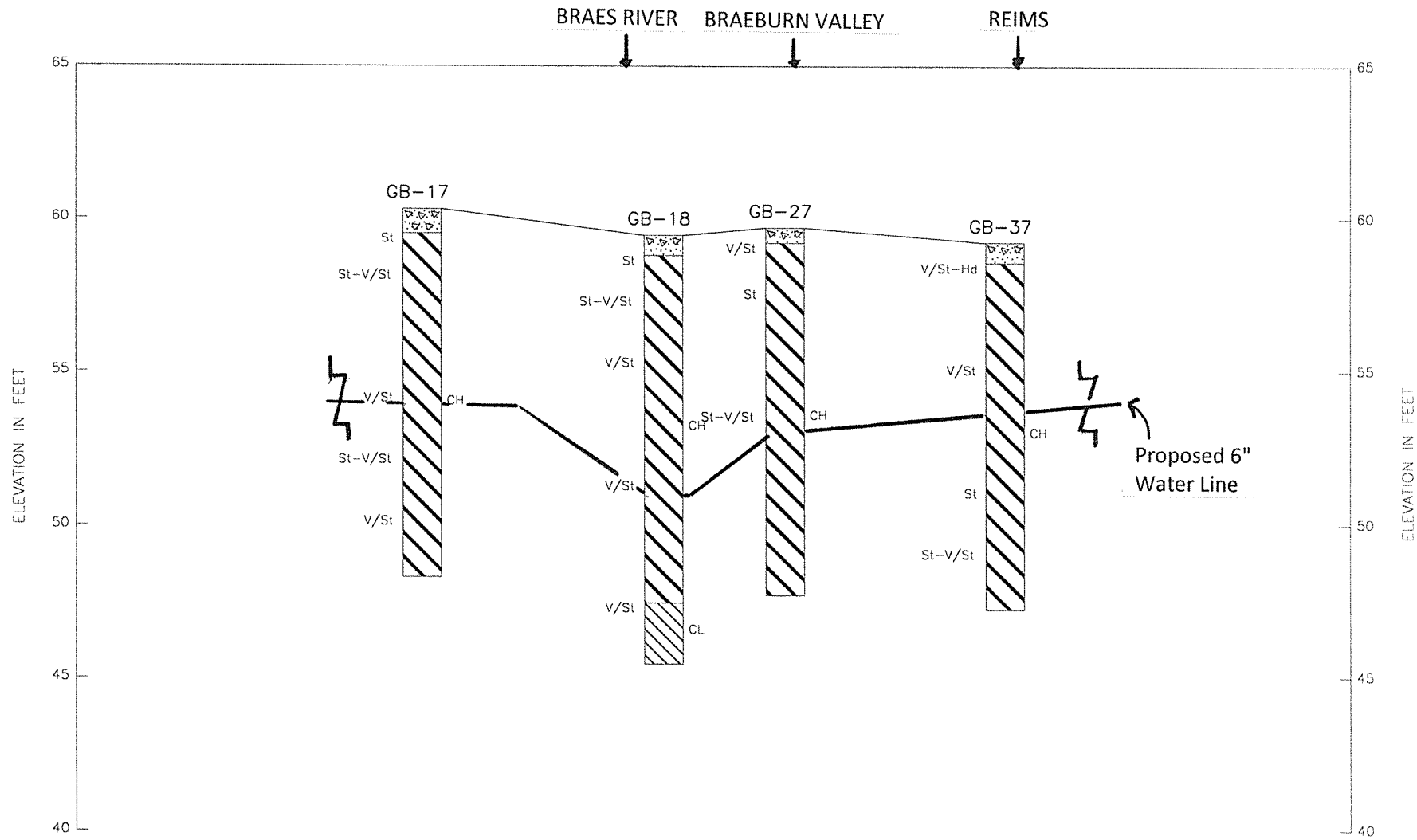
0 200 400 600 800

HORIZONTAL SCALE IN FEET

Job No. 1140196001

Geotest Engineering, Inc.

FIGURE 3.4



GENERAL NOTES:

1. See Figures 2.1 and 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 Amani Engineering, Inc.

BORING LOG PROFILE

Grape

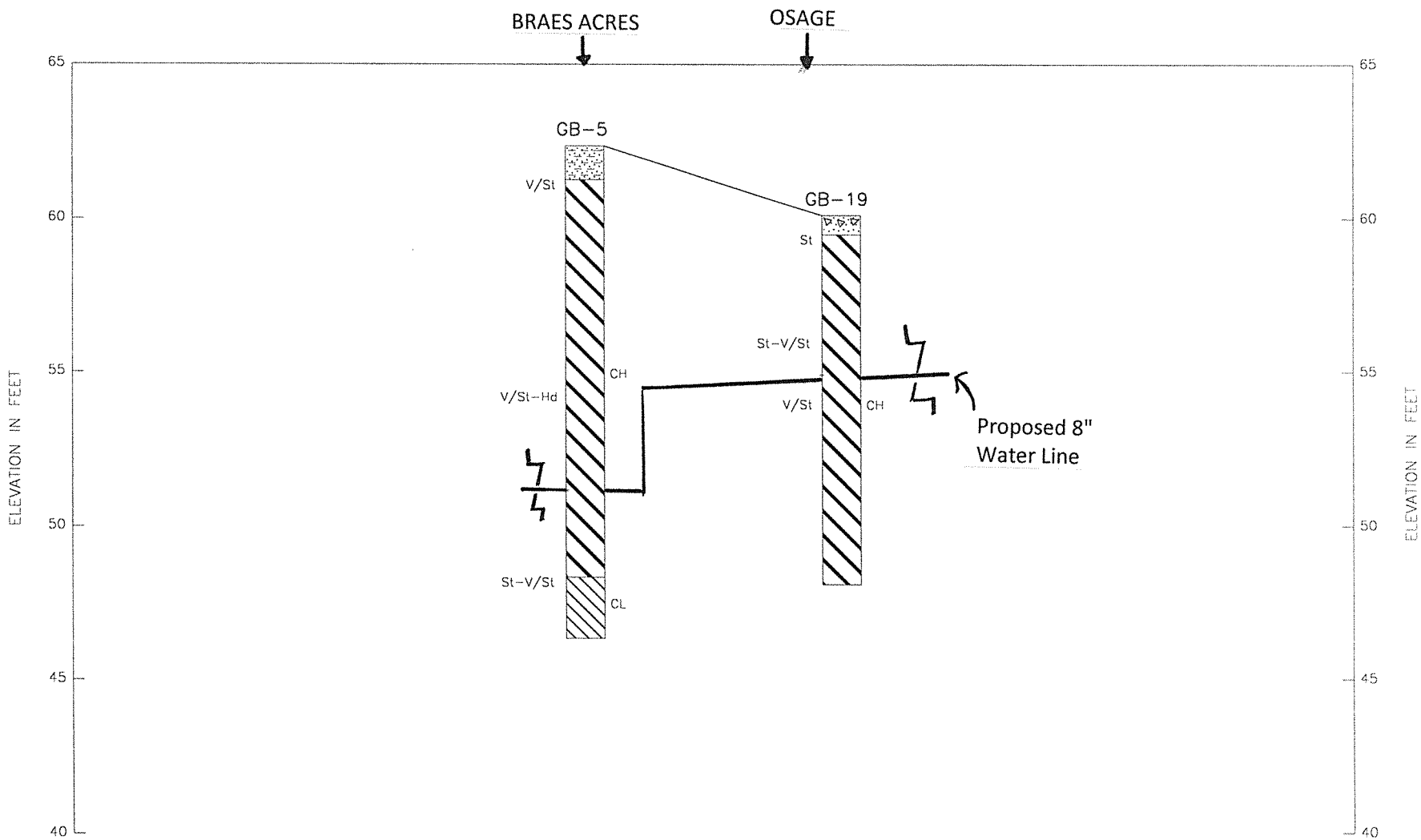
0 200 400 600 800

HORIZONTAL SCALE IN FEET

Job No. 1140196001

Geotest Engineering, Inc.

FIGURE 3.5



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 Amani Engineering, Inc.

BORING LOG PROFILE

Jackwood

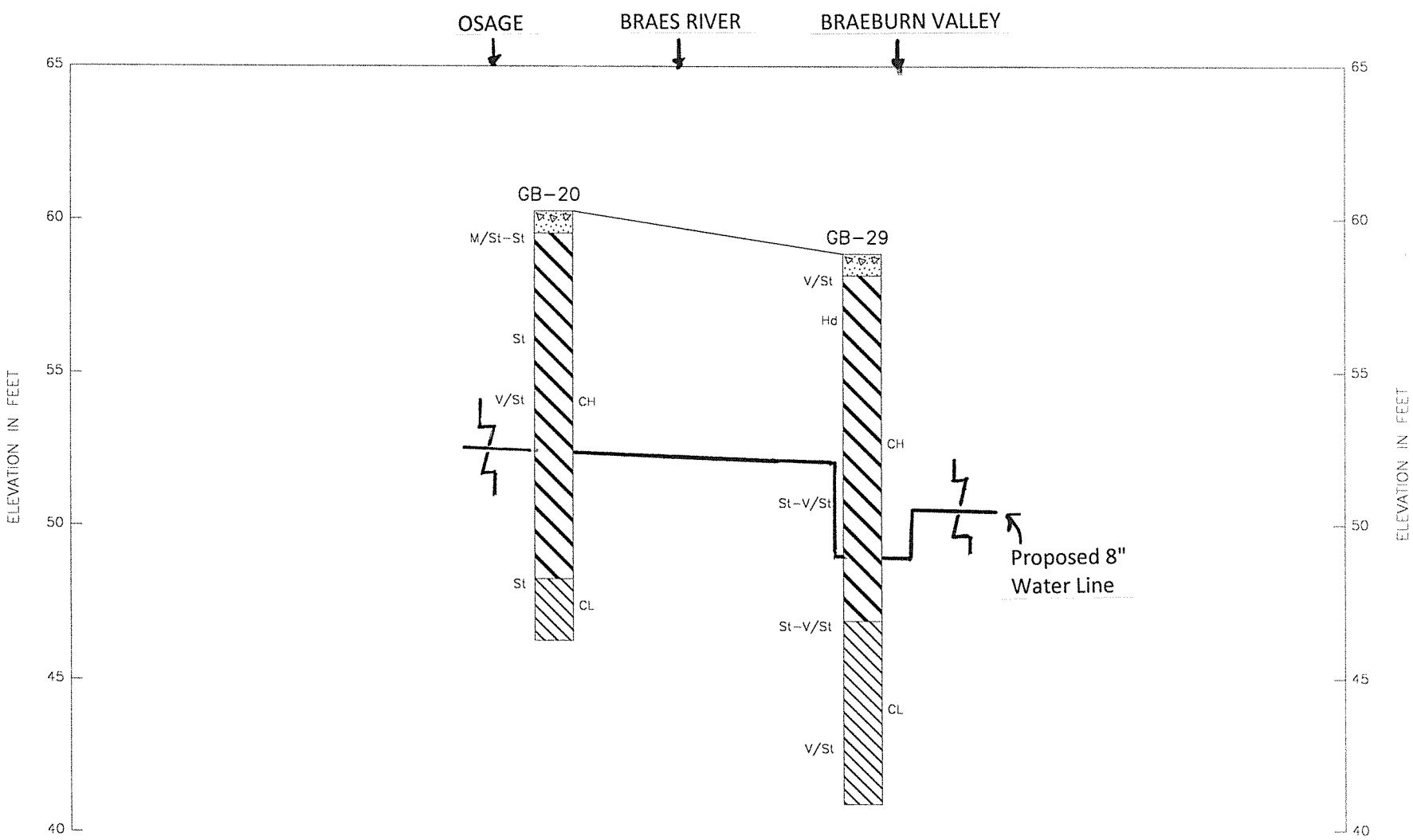
0 200 400 600 800

HORIZONTAL SCALE IN FEET

Job No. 1140196001

Geotest Engineering, Inc.

FIGURE 3.6



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 Amani Engineering, Inc.

BORING LOG PROFILE

Jason

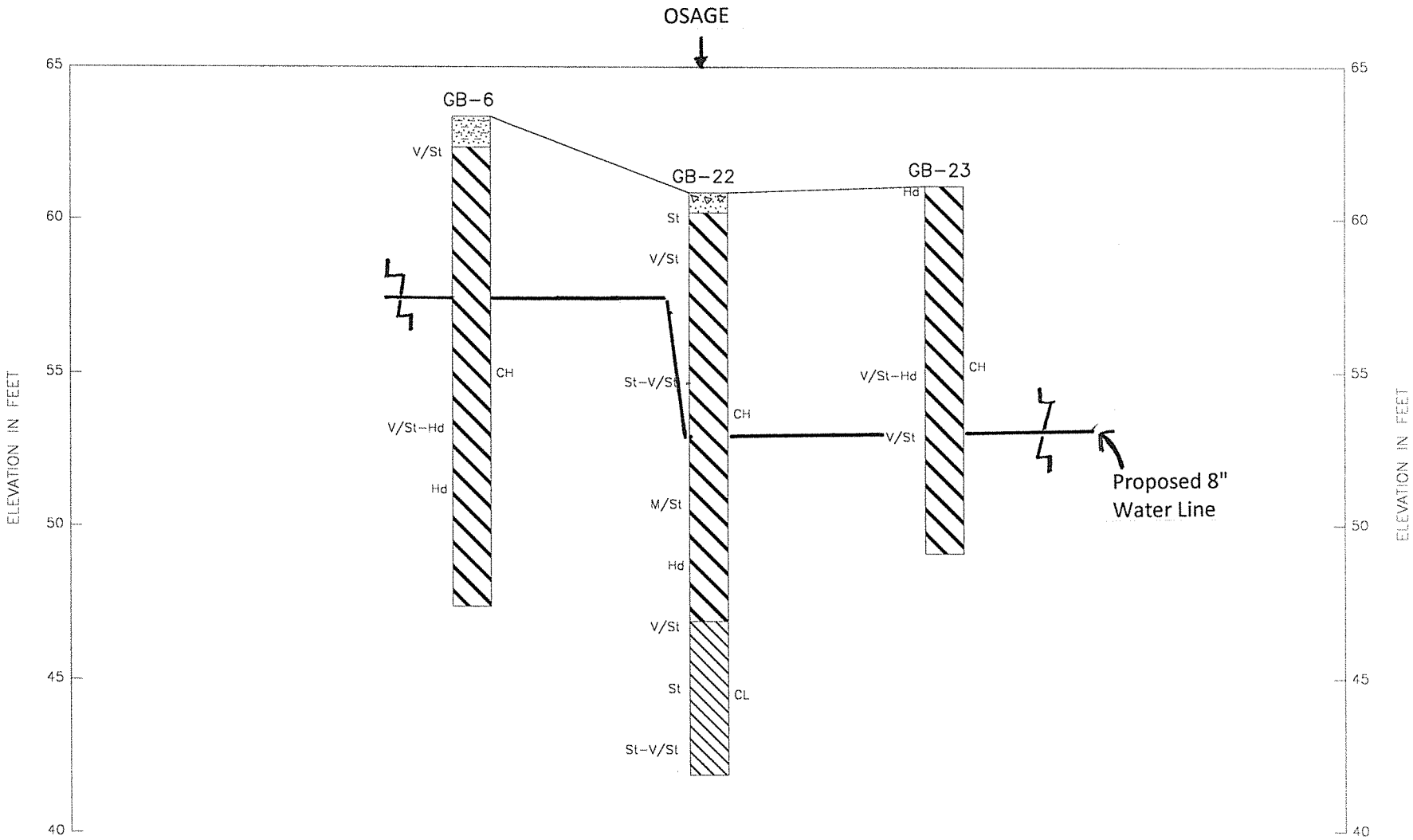
0 200 400 600 800

HORIZONTAL SCALE IN FEET

Job No. 1140196001

Geotest Engineering, Inc.

FIGURE 3.7



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 Amani Engineering, Inc.

BORING LOG PROFILE

Imogine

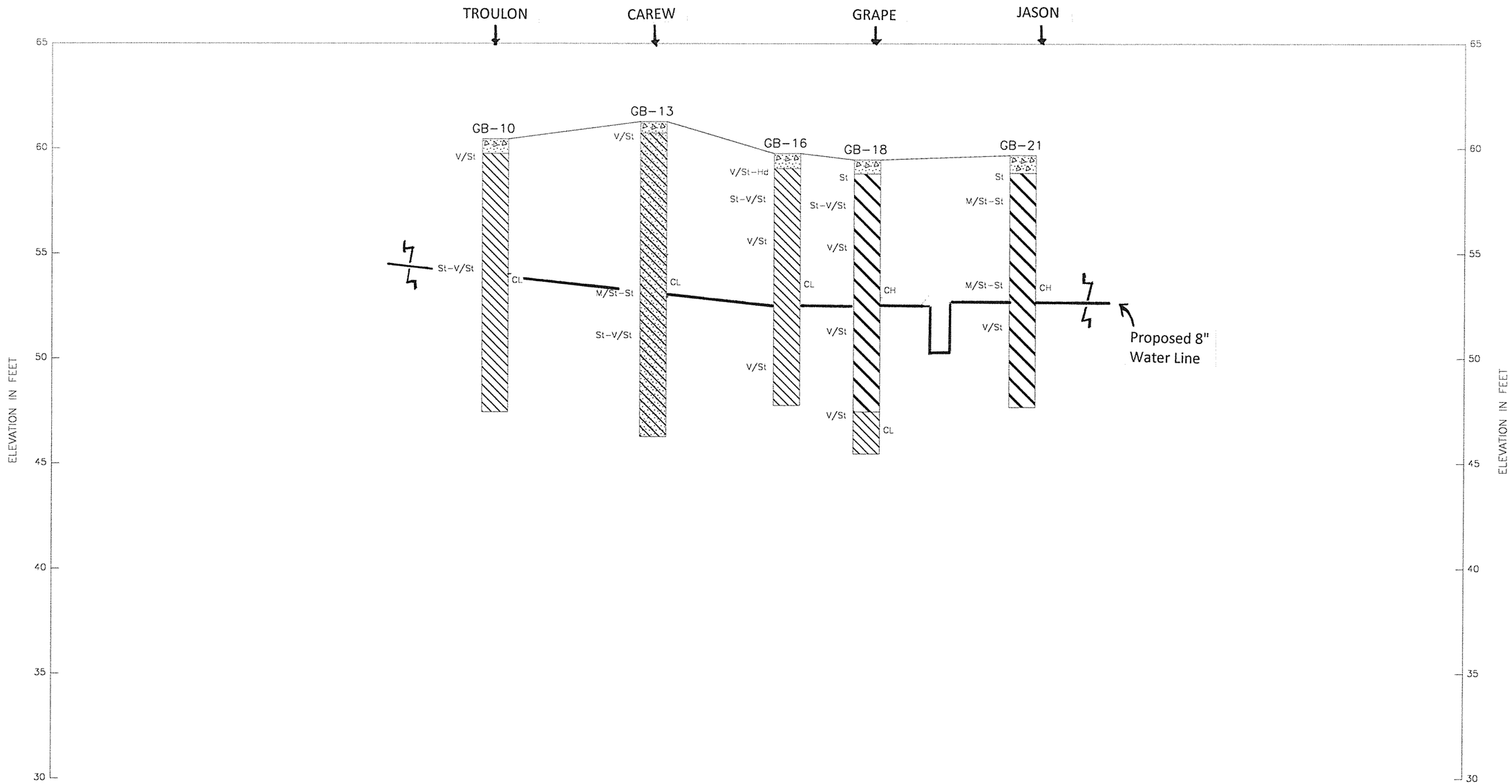
0 150 300 450 600

HORIZONTAL SCALE IN FEET

Job No. 114019600

Geotest Engineering, Inc.

FIGURE 3.8



GENERAL NOTES:

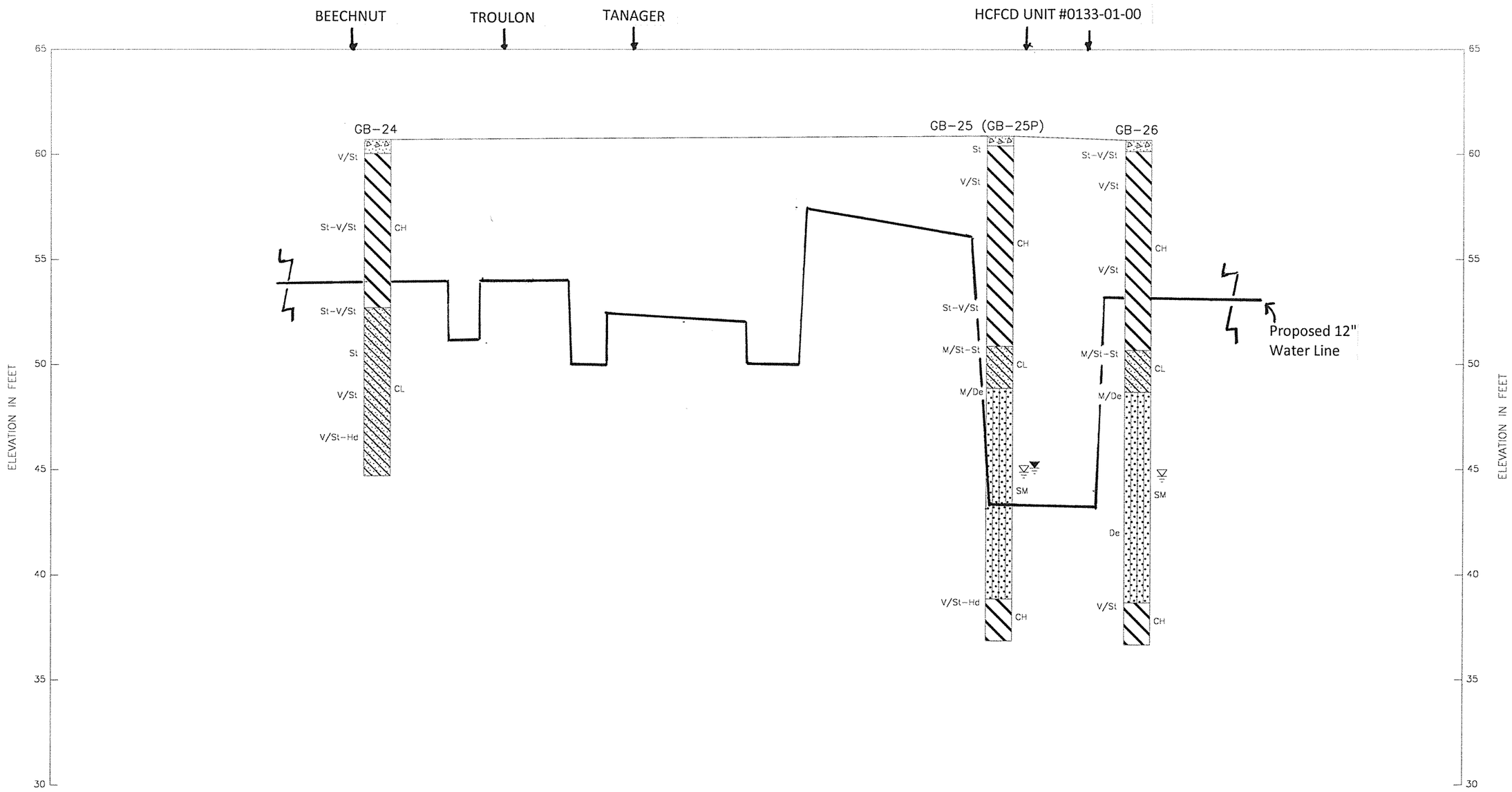
1. See Figures 2.1 and 2.2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered 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 Amani Engineering, Inc.

BORING LOG PROFILE

Braes River

0 200 400 600 800

HORIZONTAL SCALE IN FEET



GENERAL NOTES:

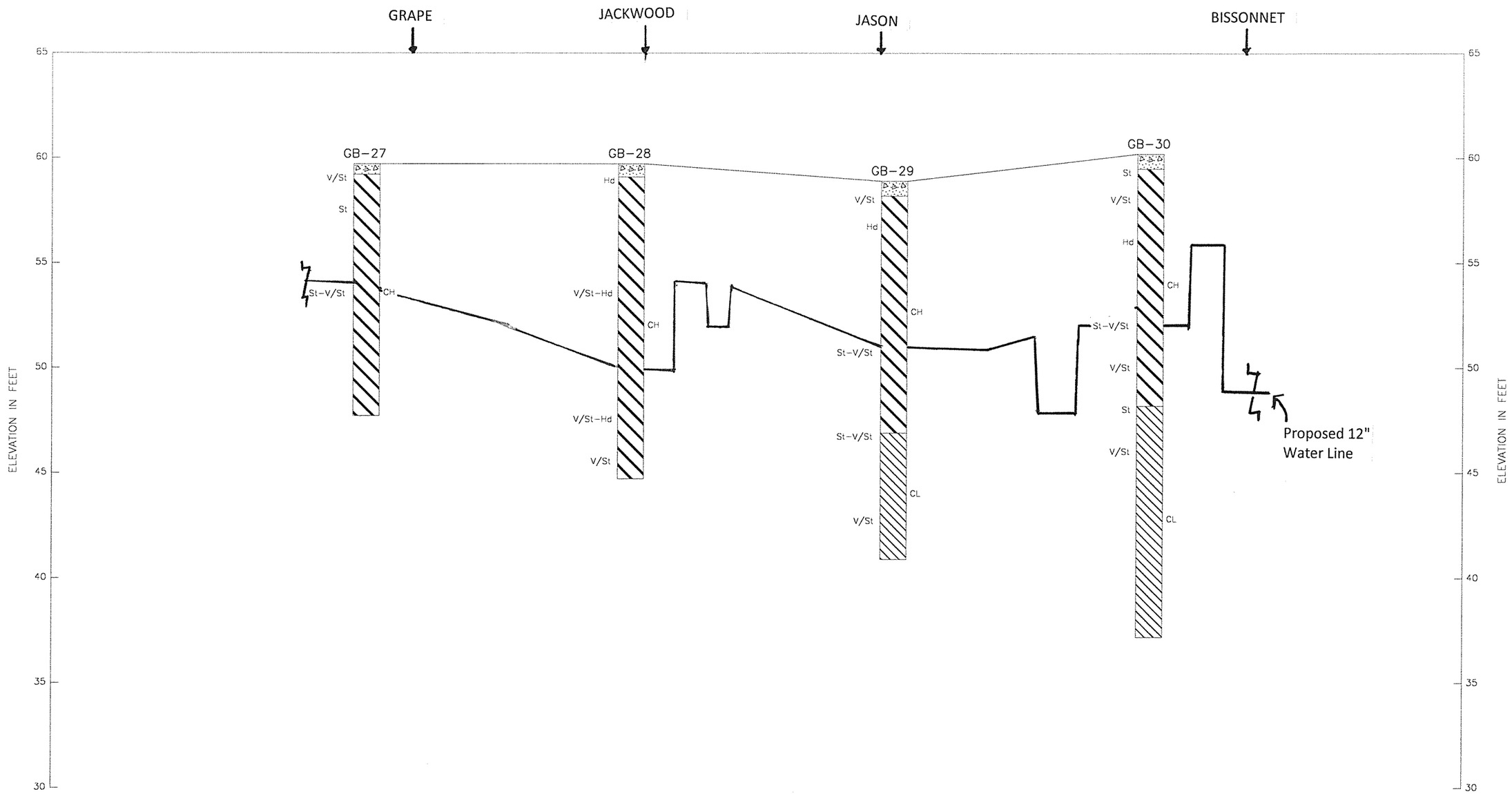
1. See Figures 2.2 and 2.3 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered 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 Amani Engineering, Inc.

BORING LOG PROFILE

Braeburn Valley

0 50 100 150 200

HORIZONTAL SCALE IN FEET



GENERAL NOTES:

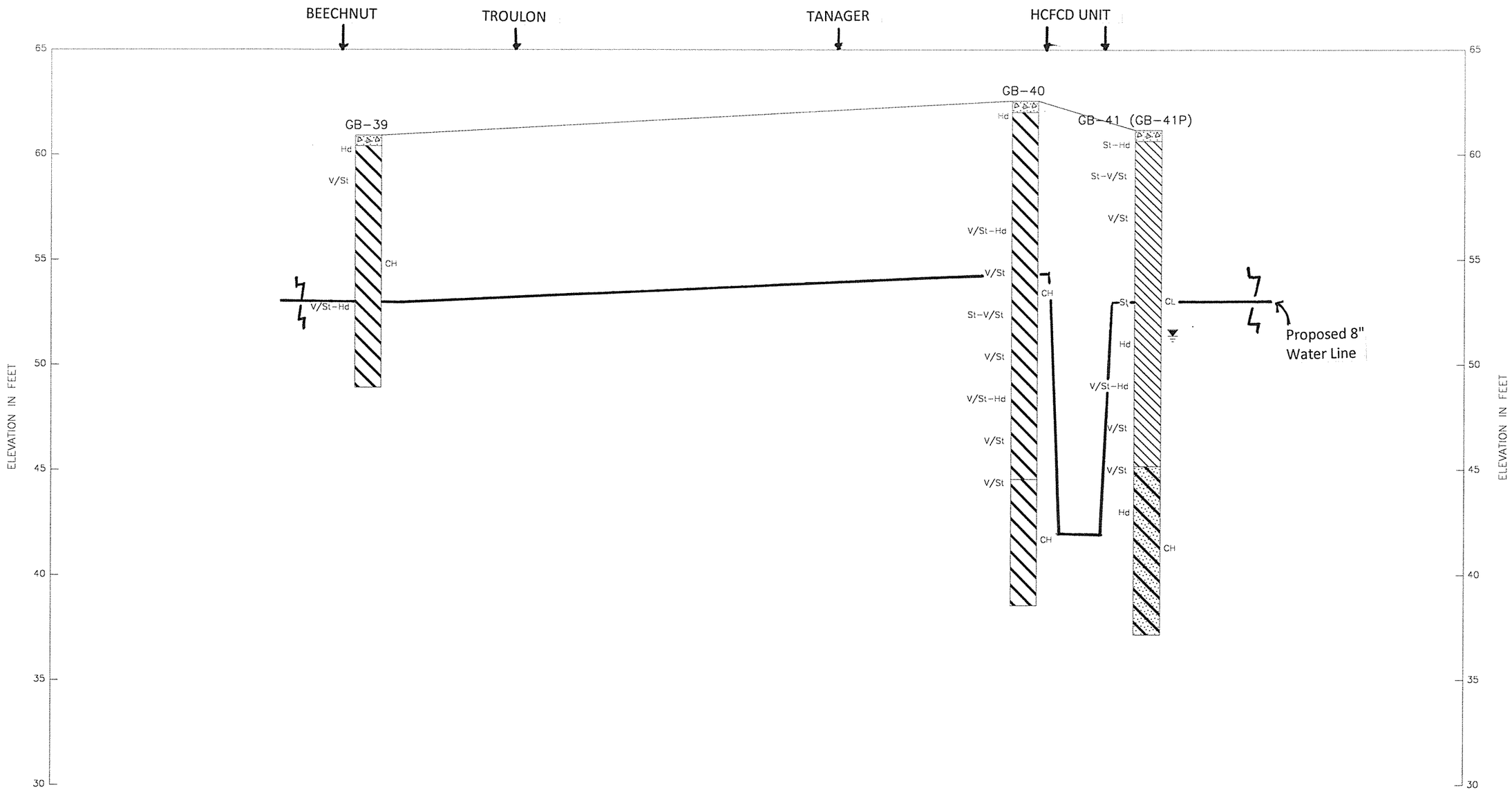
1. See Figures 2.2 and 2.3 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered 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 Amani Engineering, Inc.

BORING LOG PROFILE

Braeburn Valley

0 100 200 300 400

HORIZONTAL SCALE IN FEET



GENERAL NOTES:

1. See Figures 2.2 and 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 Amani Engineering, Inc.

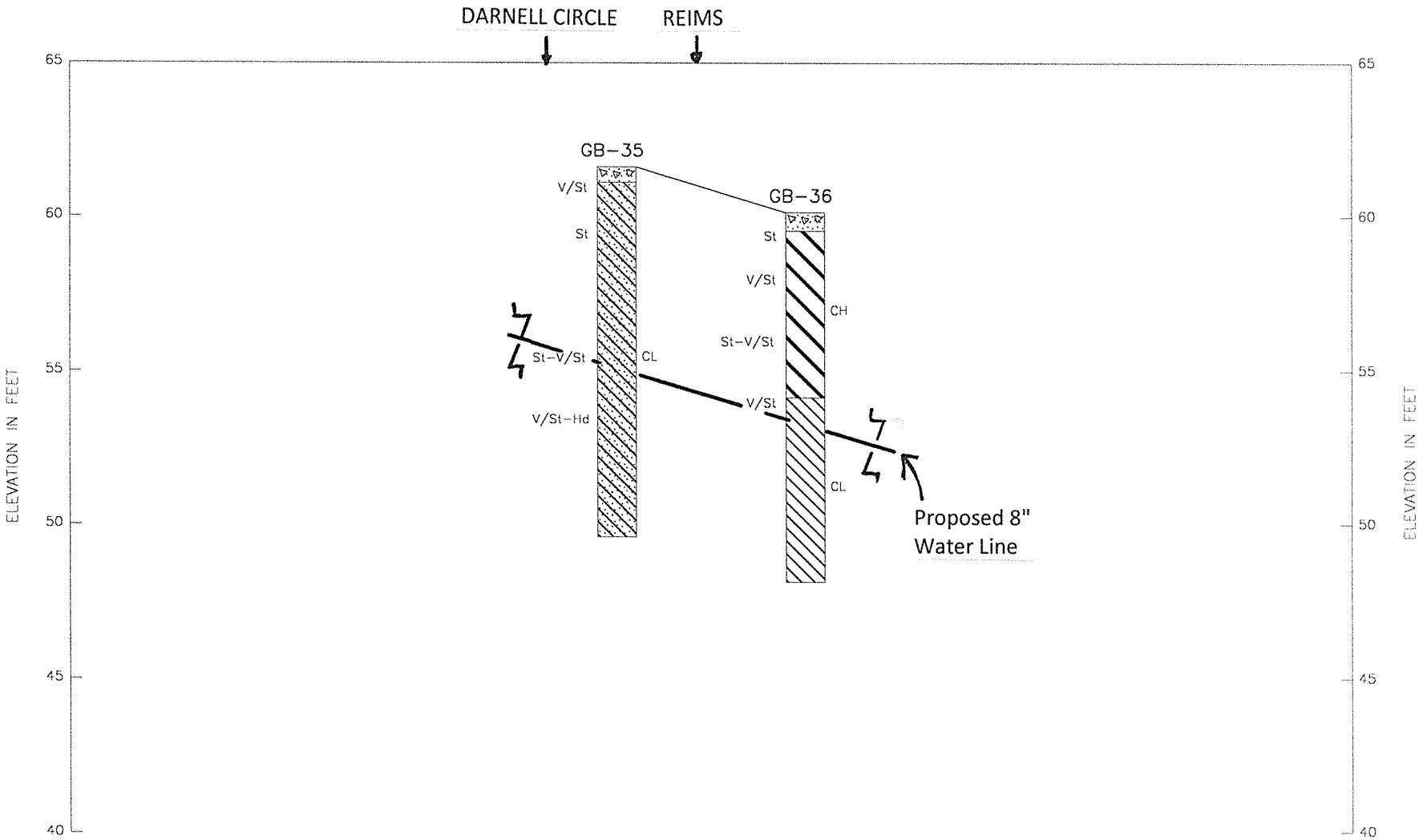
BORING LOG PROFILE

Bonhomme

0 50 100 150 200

HORIZONTAL SCALE IN FEET

Job No. 114019600



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 Amani Engineering, Inc.

BORING LOG PROFILE

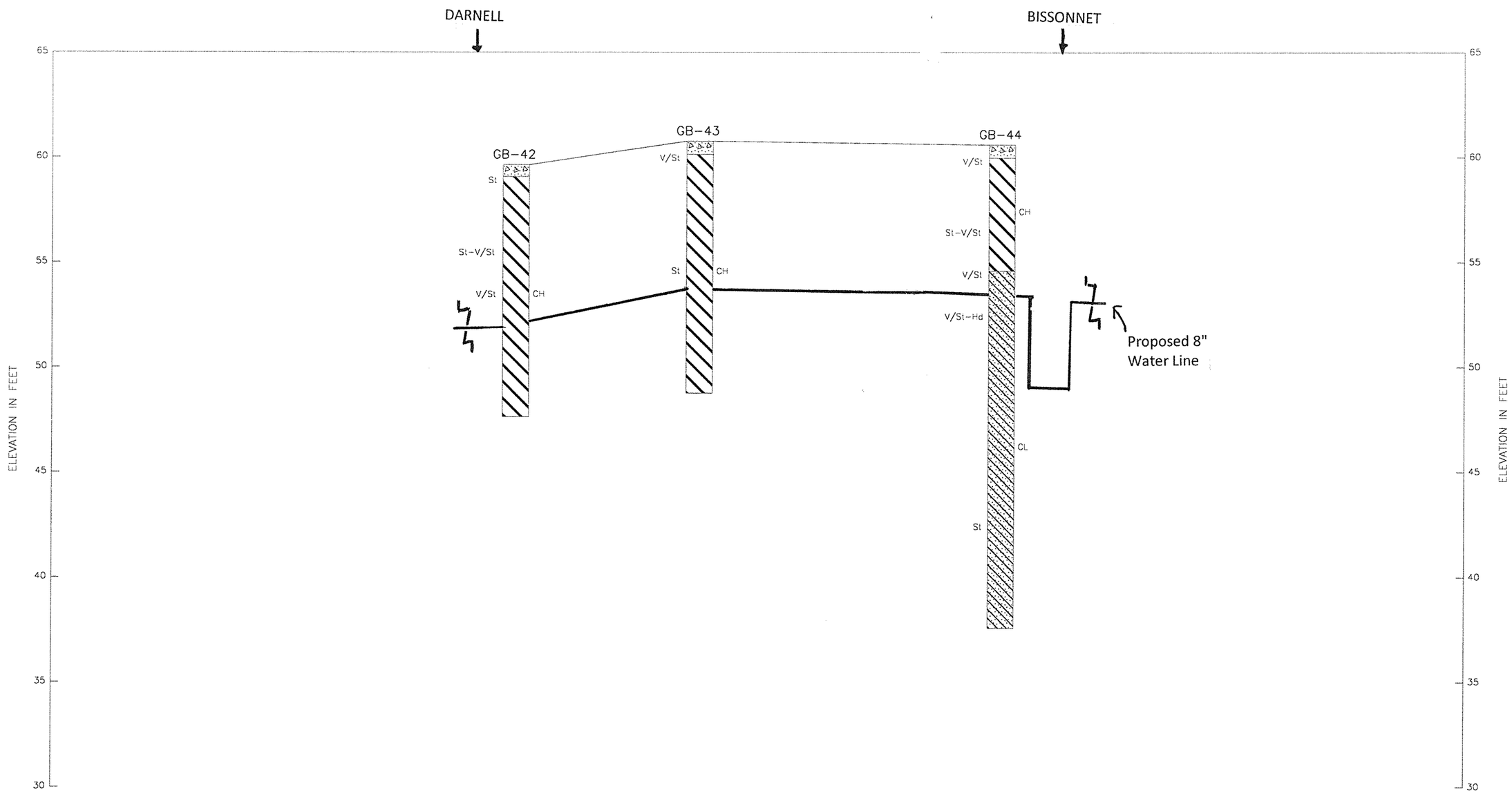
Darnell

0 200 400 600 800

HORIZONTAL SCALE IN FEET

Geotest Engineering, Inc.

FIGURE 3.11



GENERAL NOTES:

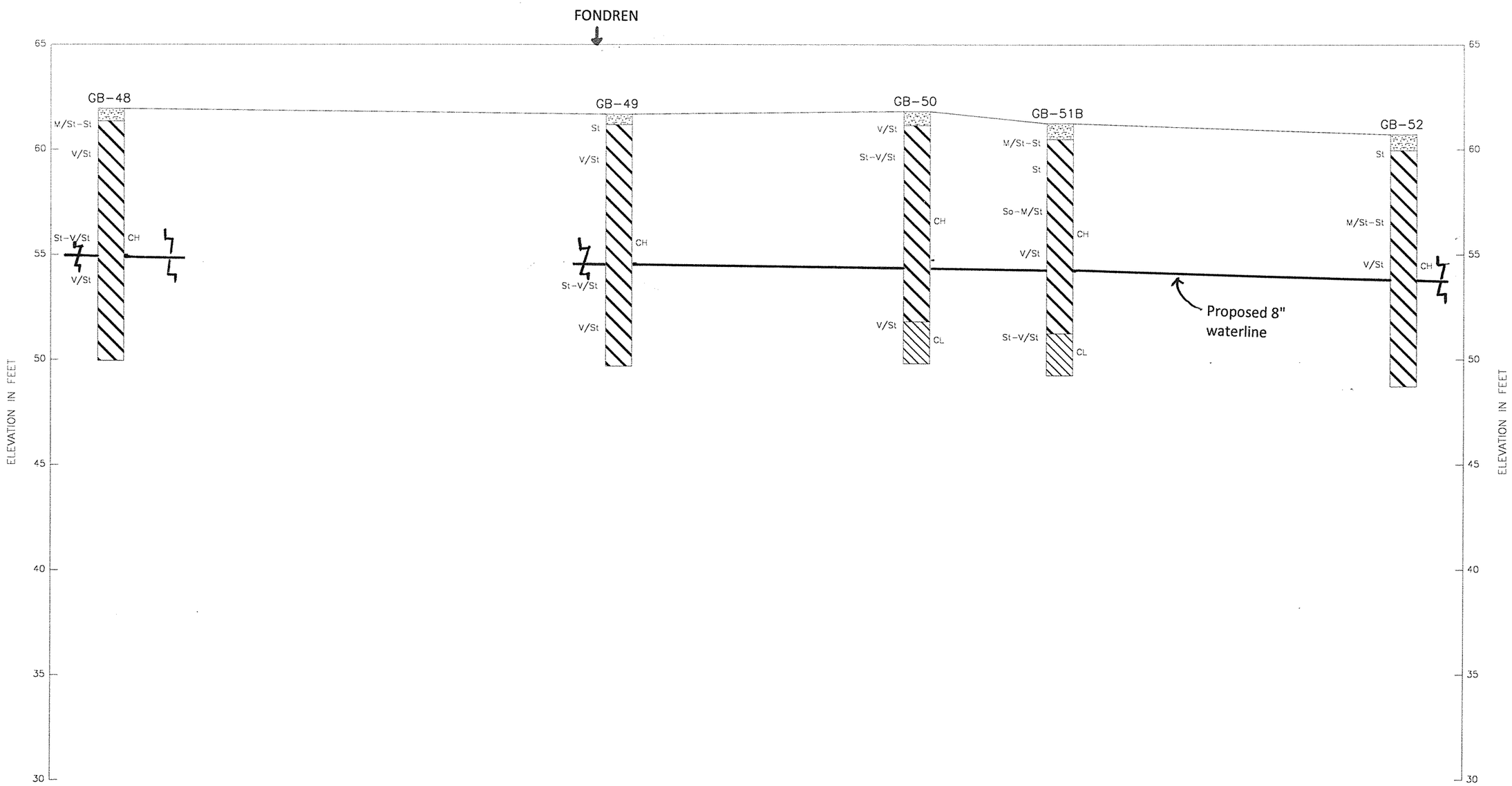
1. See Figures 2.2 and 2.3 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered 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 Amani Engineering, Inc.

BORING LOG PROFILE

Bonhomme

0 100 200 300 400

HORIZONTAL SCALE IN FEET



GENERAL NOTES:

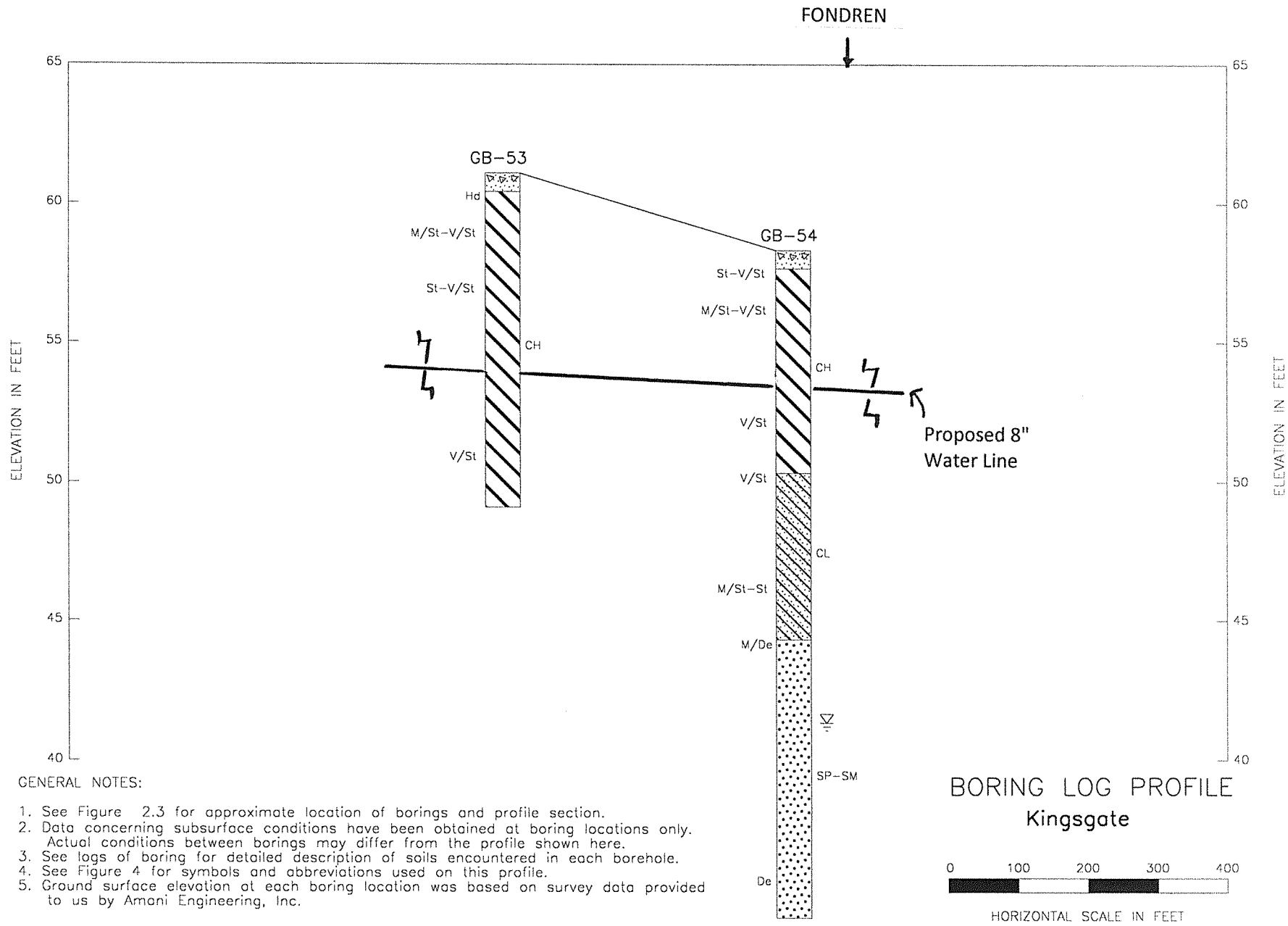
1. See Figure 2.3 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered 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 Amani Engineering, Inc.

BORING LOG PROFILE

Backlines (ESMT A–C)

0 100 200 300 400

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 Amani Engineering, Inc.

BORING LOG PROFILE

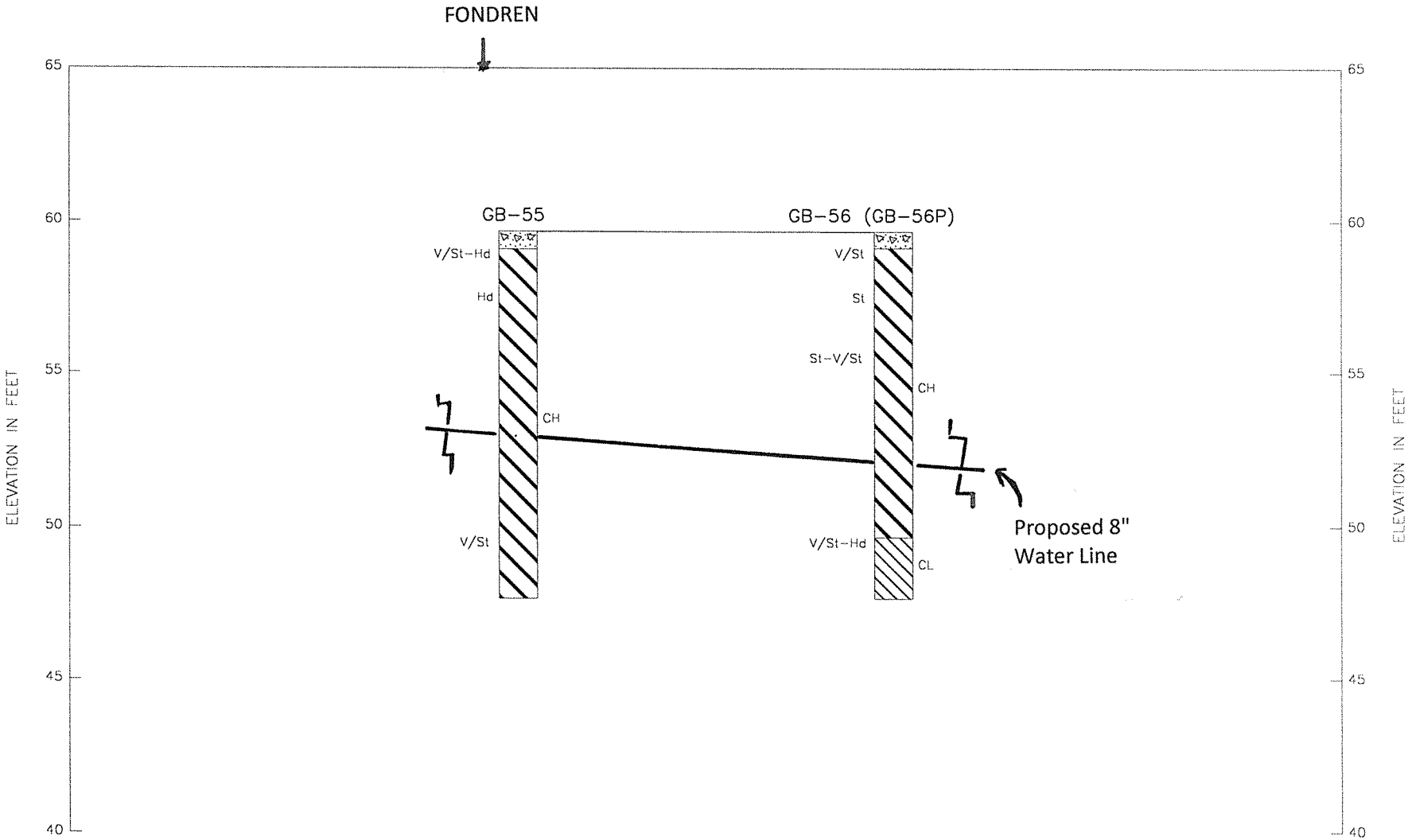
Kingsgate

Job No. 114019600

Geotest Engineering, Inc.

FIGURE 3.14

Job No. 114096001



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 Amani Engineering, Inc.

BORING LOG PROFILE

Fonvilla

0 100 200 300 400

HORIZONTAL SCALE IN FEET

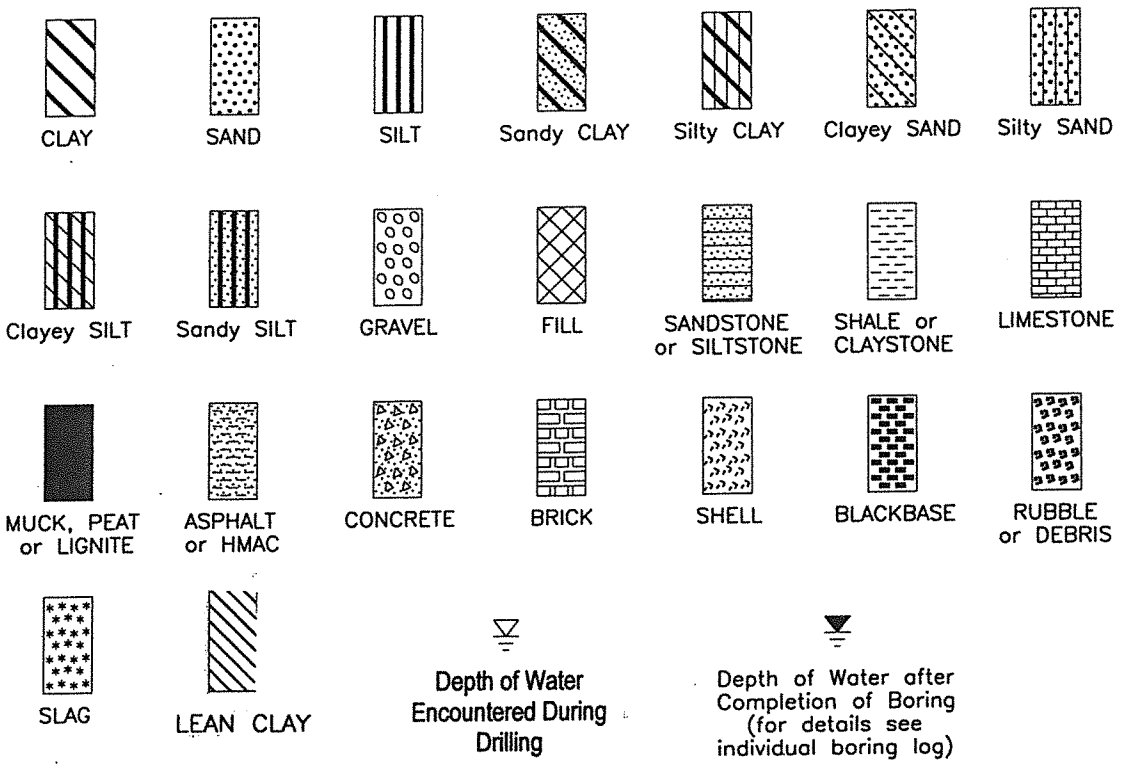
Geotest Engineering, Inc.

FIGURE 3.15

Job No. 1140196001

SYMBOLS AND ABBREVIATIONS USED ON BORING LOG PROFILE

LEGEND



ABBREVIATIONS USED FOR CONSISTENCY/DENSITY

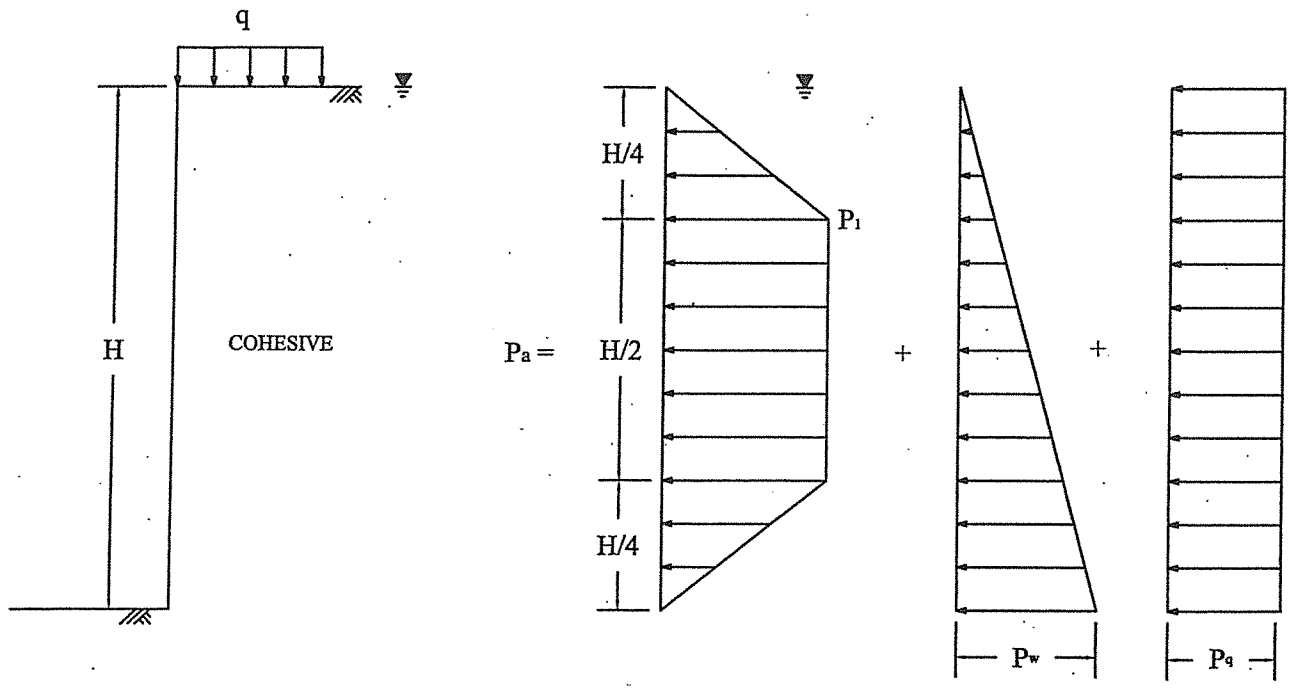
COHESIVE SOILS

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. 1140196001



TYPICAL SOIL PARAMETERS

BRACED WALL

See Table 2 for typical values of soil parameters

For $\gamma H/c \leq 4$

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

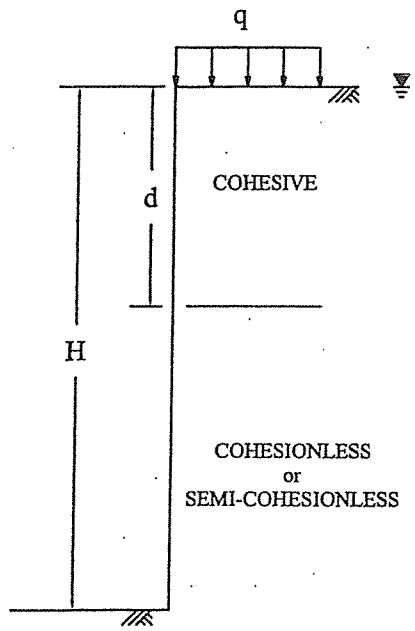
Where:

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;

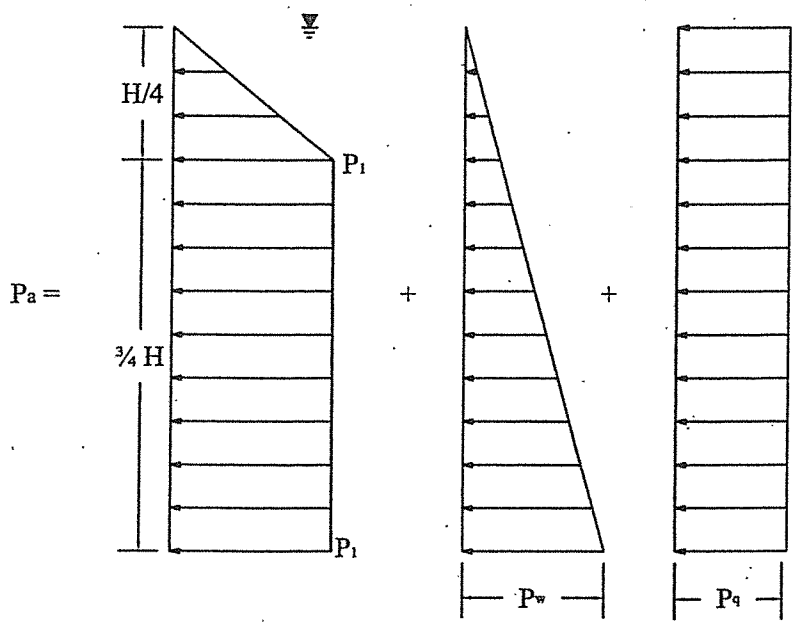
TRENCH SUPPORT EARTH PRESSURE

SUBMERGED COHESIVE SOIL

Job No. 1140196001



TYPICAL SOIL PARAMETERS



BRACED WALL

See Table 2 for typical values of soil parameters

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

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

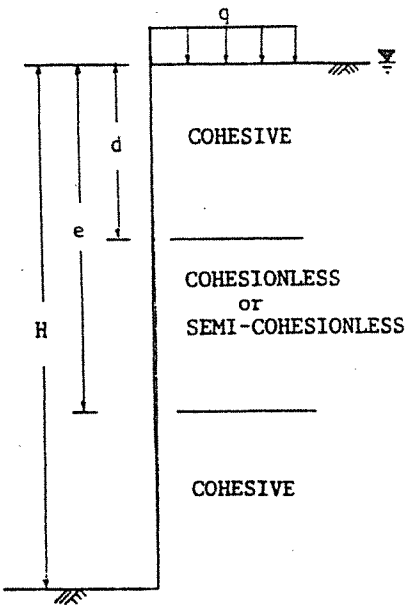
Where:

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

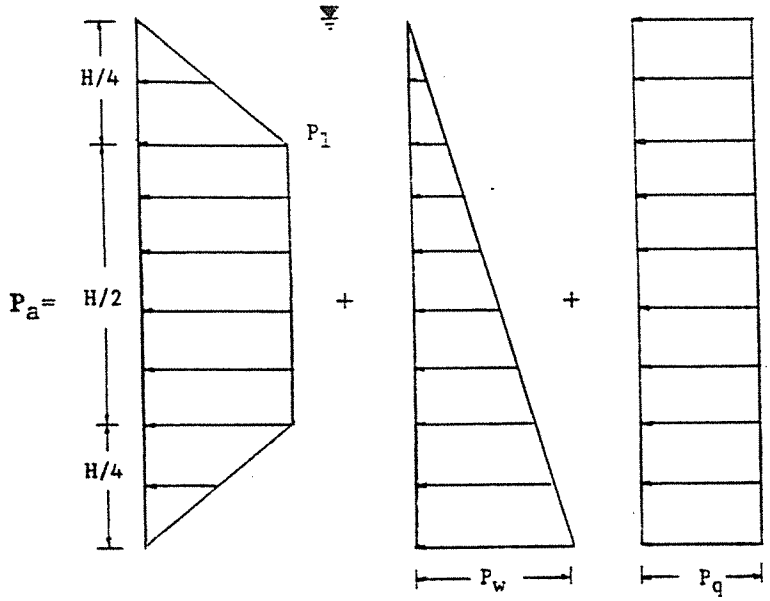
TRENCH SUPPORT EARTH PRESSURE

SUBMERGED COHESIVE SOIL OVER
COHESIONLESS OR SEMI-COHESIONLESS SOIL

Job No. 1140196001



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:

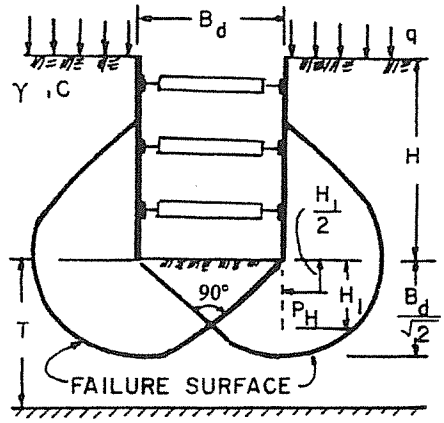
- γ_c' = Submerged unit weight of cohesive soil, pcf ;
- γ_s' = Submerged unit weight of cohesionless or semi-cohesionless soil, pcf ;
- γ_w = Unit weight of water, pcf;
- γ'_{avg} = Average submerged unit weight of soil, pcf ;
- q = Surcharge load at surface, psf;
- P_a = Lateral pressure, psf;
- P_1 = 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. 1140196001

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 (assume 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)

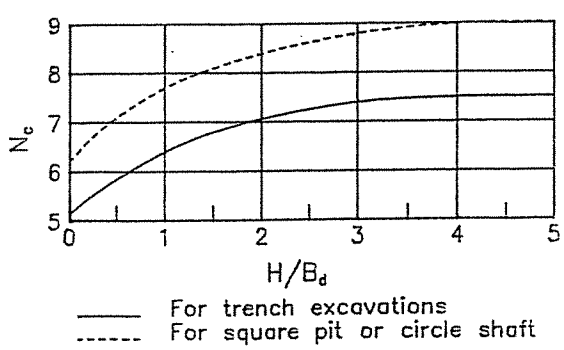
$$H_1 = \text{Buried length} = \frac{B_d}{2} \geq 5 \text{ feet}$$

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

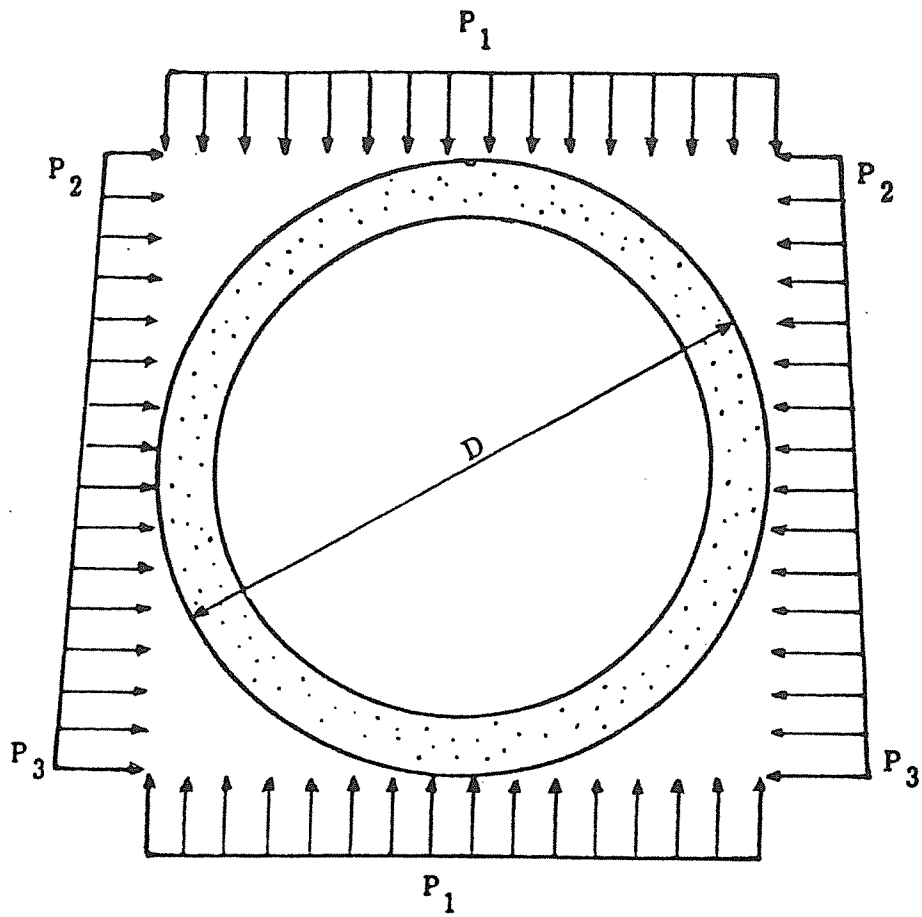
Force on buried length, P_H:

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.

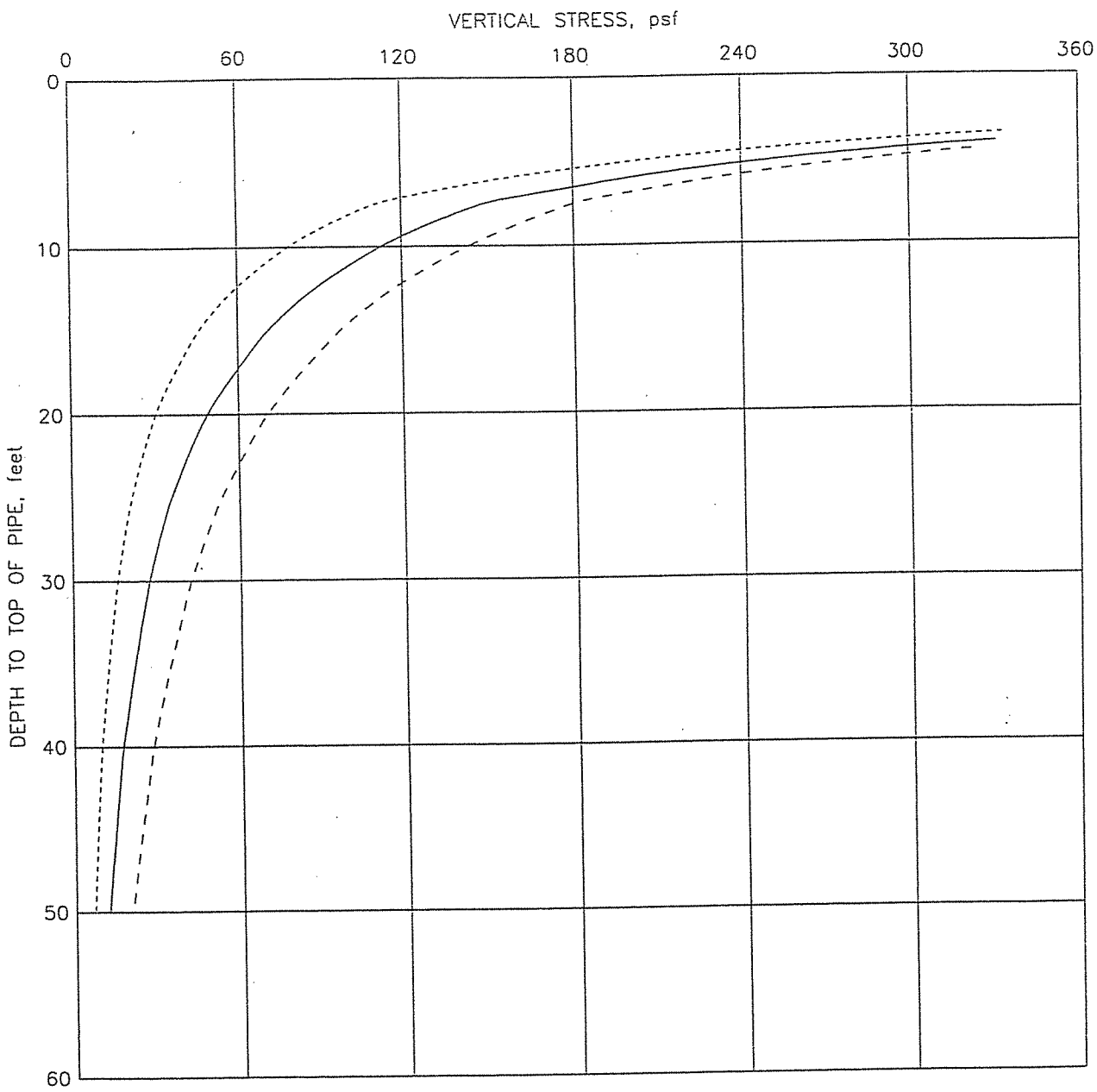
γ = Wet unit weight of soil, pcf (see Table 3)

γ_w = Unit weight of water, 62.4 pcf

q_s = Surcharge load, psf.

EARTH PRESSURE
ON PIPE AND CASING AUGERING

Job No. 1140196001



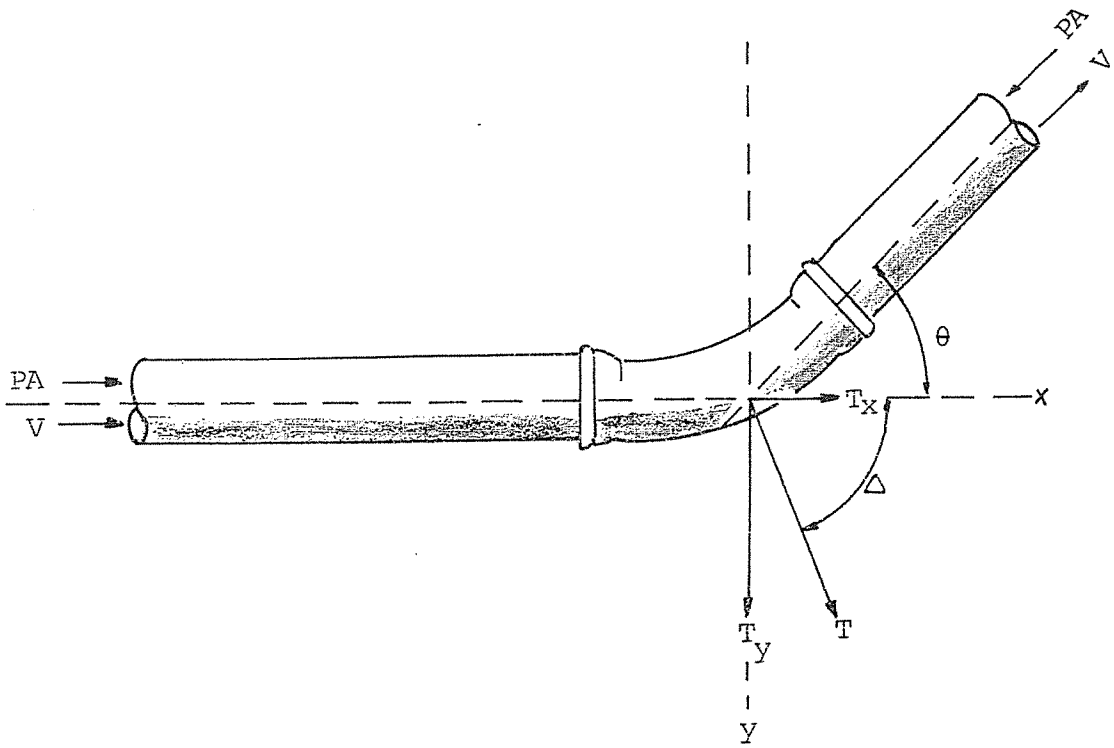
Legend:

------ 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

Job No. 1140196001



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

$T_y = PA \sin\theta$

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

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

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

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

TABLE 1

SUMMARY OF BORING INFORMATION

Boring No.	Depth (feet)	Street	Northing	Easting	Elevation (feet)
GB-1	18	Brae Acres	13815299.78	3072605.89	62.21
GB-2 (GB-2P)	15	Brae Acres	13814826.75	3072626.35	63.26
GB-3	16	Brae Acres	13814104.82	3072658.2	62.29
GB-4	14	Brae Acres	13813614.81	3072678.61	61.30
GB-5	16	Brae Acres	13813066.54	3072700.17	62.35
GB-6	16	Brae Acres	13812483.06	3072726.84	63.37
GB-7	12	Brae Acres	13811938.87	3072750.91	62.69
GB-8 (GB-8P)	23	Brae Acres	13811401.17	3072770.19	60.65
GB-9	12	Troulon (West)	13815051.97	3073069.14	62.55
GB-10	13	Troulon (West)	13814960.24	3073556.49	60.44
GB-11	17	Tanager (West)	13814679.54	3073273.25	58.00
GB-12	16	Carew	13814471.65	3072953.24	60.28
GB-13	15	Carew	13814354.85	3073551.82	61.27
GB-14	17	Carew	13814307.82	3074326.88	61.41
GB-15	12	Carew	13814327.07	3074847.30	60.10
GB-16	12	Braes River	13813866.88	3073698.61	59.76
GB-17	12	Grape	13813468.35	3073125.68	60.31
GB-18	14	Grape	13813565.71	3073748.05	59.46
GB-19	12	Jackwood (West)	13813172.84	3073355.69	60.11
GB-20	14	Jason	13812876.00	3073241.31	60.27
GB-21	12	Braes River	13812971.24	3073730.12	59.68
GB-22	19	Imogene	13812469.07	3073189.25	60.88
GB-23	12	Imogene	13812489.18	3073650.06	61.10
GB-24	16	Braburn Valley	13815139.08	3073944.86	60.70
GB-25 (GB-25P)	24	Braburn Valley	13814544.55	3073969.15	60.87

TABLE 1 (cont'd)
SUMMARY OF BORING INFORMATION

Boring No.	Depth (feet)	Street	Northing	Easting	Elevation (feet)
GB-26	24	Braburn Valley	13814413.21	3073974.50	60.68
GB-27	12	Braburn Valley	13813749.40	3074005.00	59.71
GB-28	15	Braburn Valley	13813242.63	3074013.03	59.72
GB-29	18	Braburn Valley	13812739.94	3074033.01	58.90
GB-30	23	Braburn Valley	13812251.18	3074052.56	60.20
GB-31	12	Troulon (East)	13814949.40	3074278.61	59.80
GB-32	12	Troulon (East)	13814960.66	3074763.04	61.42
GB-33	12	Bayou Timber	13814650.55	3074278.63	60.65
GB-34	12	Bayou Timber	13814663.23	3074791.39	60.96
GB-35	12	Darnell	13814004.46	3074385.05	61.60
GB-36	12	Darnell	13814024.57	3074871.65	60.13
GB-37	12	Reims	13813657.45	3074571.90	59.23
GB-38	17	Jackwood (East)	13813333.44	3074392.57	59.79
GB-39	12	Bonhomme	13815201.89	3075175.37	60.91
GB-40	24	Bonhomme	13814575.68	3075199.48	62.56
GB-41 (GB-41P)	24	Bonhomme	13814458.18	3075203.48	61.17
GB-42	12	Bonhomme	13813935.57	3075225.16	59.63
GB-43	12	Bonhomme	13813595.16	3075307.47	60.76
GB-44	23	Bonhomme	13813016.83	3075331.71	60.59
GB-45	12	Cadawac	13814933.09	3075487.07	59.99
GB-46	12	Troulon	13815150.23	3075816.51	60.22
GB-47	12	Lugary	13814722.93	3076380.32	60.11
GB-48	12	Esmt C (West)	13814479.17	3075706.34	61.94
GB-49	12	Esmt B (North)	13814524.45	3076675.04	61.68
GB-50	12	Esmt B (North)	13814499.07	3076106.93	61.81
GB-51B	12	Esmt B	13814270.11	3075956.95	61.24

TABLE 1 (cont'd)
SUMMARY OF BORING INFORMATION

Boring No.	Depth (feet)	Street	Northing	Easting	Elevation (feet)
GB-52	12	Esmt B	13813612.75	3075986.18	60.72
GB-53	12	Esmt A-D	13813920.22	3076384.86	61.09
GB-54	24	Kingsgate	13814185.14	3076705.51	58.32
GB-55	12	Fonvilla	13814859.80	3076821.76	59.67
GB-56 (GB-56P)	12	Fonvilla	13814919.85	3077307.54	59.66

Note: Survey information was provided by Amani Engineering, 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" Waterline along Brae Acres	GB-1 thru GB-7	Cohesive	0-8 8-12 12-17	125 128 130	63 64 65	1,000 800 2,000	-- -- --
	GB-8	Cohesive Cohesionless	0-12 12-23	125 112	63 56	1,200 --	-- 30
8" Waterline along Troulon	GB-9, GB-10, GB-31, GB-32, GB-45 and GB-46	Cohesive	0-12	125	63	1,000	--
8" Waterline along Tanager	GB-2, GB-33, GB-34, and B-1 through B-3 (Previous Study)	Cohesive	0-4 4-6 6-10 10-15	130 132 134 130	65 66 67 60	1,200 2,600 2,400 1,600	-- -- -- --
	GB-11	Cohesive Cohesionless	0-8 8-11 11-17	130 130 102	65 65 51	1,000 800 --	-- -- 30
8" Waterline along Carew	GB-12 and GB-14	Cohesive Cohesionless Cohesive (GB-14 only)	0-10 10-16 16-17	125 106 120	63 53 60	800 -- 1,000	-- 30 --
	GB-13 and GB-15	Cohesive	0-8 8-12 12-15	125 130 120	63 65 60	1500 500 900	-- -- --
8" Waterline along Grape	GB-17, GB-18, GB-27 and GB-37	Cohesive	0-10 10-14	125 130	63 65	1,000 1,000	-- --
8" Waterline along Jackwood	GB-5 and GB-19	Cohesive	0-4 4-16	125 125	63 63	1,500 2,000	-- --
8" Waterline along Jason	GB-20 and GB-29	Cohesive	0-4 4-18	125 130	63 65	500 1,500	-- --
8" Waterline along Imogine	GB-6, GB-22 and GB-23	Cohesive	0-10 10-14 14-18	126 130 125	63 65 63	1,500 800 1,000	-- -- --
8" Waterline along Braes River	GB-10, GB-13, GB-16, GB-18, GB-21	Cohesive	0-12 12-14	125 130	63 65	800 1000	-- --

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
12" Waterline along Braeburn Valley	GB-24, GB-27 through GB-30	Cohesive	0-2 2-8 8-15 15-23	120 125 130 125	60 63 65 63	1,200 1,500 1,200 2,000	-- -- -- --
	GB-25 and GB-26	Cohesive Cohesionless Cohesive	0-10 10-12 12-22 22-24	130 125 102 120	65 63 51 60	1,500 600 -- 2,200	-- -- 30 --
8" Waterline along Darnell	GB-35 and GB-36	Cohesive	0-6 6-10 10-12	130 130 125	65 65 63	1,500 2,500 2,000	-- -- --
8" Waterline along Reims	GB-37	Cohesive	0-6 6-12	128 125	64 63	3,000 1,000	-- --
8" Waterline along Jackwood	GB-38	Cohesive Cohesionless	0-10 10-17	130 100	65 50	3,000 --	-- 30
8" Waterline along Bonhomme	GB-39 through GB-44	Cohesive	0-6 6-12 12-18 18-24	125 130 125 125	63 65 63 63	1,600 1,000 2,000 2,200	-- -- -- --
8" Waterline along Lugary	GB-47 and B-2 (previous study)	Cohesive	0-10 10-12 12-15	125 125 125	63 63 63	1,000 2,000 2,200	-- -- --
8" to 12" Waterline along Backlines (Easements A, B, C & D)	GB-48 through GB-52	Cohesive	0-6 6-12	125 130	63 65	500 1,000	-- --
8" Waterline along Kingsgate Circle	GB-53	Cohesive	0-4 4-12	120 130	60 65	500 1,800	-- --
	GB-54	Cohesive Cohesionless	0-6 6-12 12-14 14-24	125 115 120 106	63 58 60 53	800 2,000 800 --	-- -- -- 30
8" Waterline along Fonvilla	GB-55 and GB-56	Cohesive	0-6 6-12	126 125	63 63	1,600 1,500	-- --

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

TABLE 3

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION

PROPERTY	COHESIVE SOILS[1]	COHESIONLESS SOILS[2]
Wet Unit Weight, γ, pcf		
0-2	120	--
2-4	120	--
4-6	125	--
6-8	125	--
8-10	125	--
10-12	130	**102** (GB-11, GB-12, GB-14 and GB-38 only)
12-14	130	**102** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 only)
14-17	130	**102** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 and GB-54only)
17-22	125	**106** (GB-8, GB-25, GB-26 and GB-54 only)
22-24	120	**106** (GB-54 only)
Submerged Unit Weight, γ', pcf		
0-2	60	--
2-4	60	--
4-6	63	--
6-8	63	--
8-10	63	--
10-12	65	**51** (GB-11, GB-12, GB-14 and GB-38 only)
12-14	65	**51** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 only)
14-17	65	**51** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 and GB-54only)
17-22	63	**53** (GB-8, GB-25, GB-26 and GB-54 only)
22-24	60	**53** (GB-54 only)
Moisture Content (%)		
0-2	13	--
2-4	14	--
4-6	16	--
6-8	15	--
8-10	18	--
10-12		**12** (GB-11, GB-12, GB-14 and GB-38 only)
12-14	17	**14** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 only)
14-17	18	**15** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 and GB-54only)
17-22	19	**14** (GB-8, GB-25, GB-26 and GB-54 only)
22-24	20	**21** (GB-54 only)
UNDRAINED PROPERTIES		
Undrained Cohesion, C_u, psf		
2-4*	500	--
4-6*	500	--
6-8*	800	--
8-10*	500	--
10-12*	1000	--
12-14*	1000	--
14-17*	1200	--
17-22*	2000	--
22-24*	2400	--

TABLE 3 (cont'd)

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION

PROPERTY		COHESIVE SOILS[1]	COHESIONLESS SOILS[2]
UNDRAINED PROPERTIES			
Angle of Internal Friction, ϕ, degrees			--
	2-4*	--	--
	4-6*	--	--
	6-8*	--	--
	8-10*	--	--
	10-12*	--	**30** (GB-11, GB-12, GB-14 and GB-38 only)
	12-14*	--	**30** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 only)
	14-17*	--	**30** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 and GB-54only)
	17-22*		**30** (GB-8, GB-25, GB-26 and GB-54 only)
	22-24*	--	**30** (GB-54 only)
Elastic Modulus, E, psf			
	2-4*	150,000	--
	4-6*	150,000	--
	6-8*	240,000	--
	8-10*	150,000	--
	10-12*	300,000	**140,000** (GB-11, GB-12, GB-14 and GB-38 only)
	12-14*	300,000	**168,000** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 only)
	14-17*	360,000	**140,000** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 and GB-54only)
	17-22*	800,000	**322,000** (GB-8, GB-25, GB-26 and GB-54 only)
	22-24*	720,000	**420,000** (GB-54 only)
Coefficient of Lateral Earth Pressure at Rest, K_o,	2-4*	1.2	--
	4-6*	1.2	--
	6-8*	1.2	--
	8-10*	1.2	--
	10-12*	1.2	**0.5** (GB-11, GB-12, GB-14 and GB-38 only)
	12-14*	1.2	**0.5** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 only)
	14-17*	1.2	**0.5** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 and GB-54only)
	17-22*	1.2	**0.5** (GB-8, GB-25, GB-26 and GB-54 only)
	22-24*	1.2	**0.5** (GB-54 only)
Poisson's Ratio, μ		0.45	0.3

TABLE 3 (cont'd)

GEOTECHNICAL DESIGN PARAMETER SUMMARY
TRENCHLESS INSTALLATION

PROPERTY		COHESIVE SOILS[1]	COHESIONLESS SOILS[2]
DRAINED PROPERTIES			
Drained Cohesion, C′, psf			
	2-4*	0	--
	4-6*	0	--
	6-8*	0	--
	8-10*	0	--
	10-12*	0	--
	12-14*	0	--
	14-17*	0	--
	17-22*	0	--
	22-24*	0	--
Angle of Internal Friction, ϕ′, degrees	2-4*	23	--
	4-6*	23	--
	6-8*	21	--
	8-10*	20	--
	10-12*	20	**30** (GB-11, GB-12, GB-14 and GB-38 only)
	12-14*	21	**30** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 only)
	14-17*	22	**30** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 and GB-54only)
	17-22*	26	**30** (GB-8, GB-25, GB-26 and GB-54 only)
	22-24*	21	**30** (GB-54 only)
Elastic Modulus, E, psf			
	2-4*	90,000	--
	4-6*	90,000	--
	6-8*	144,000	--
	8-10*	90,000	--
	10-12*	180,000	**140,000** (GB-11, GB-12, GB-14 and GB-38 only)
	12-14*	180,000	**168,000** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 only)
	14-17*	216,000	**140,000** (GB-8, GB-11, GB-12, GB-14, GB-25, GB-26 & GB-38 and GB-54only)
	17-22*	480,000	**322,000** (GB-8, GB-25, GB-26 and GB-54 only)
	22-24*	432,000	**420,000** (GB-54 only)

Notes:
1. Cohesive soils include Fat Clay, Fat Clay with sand, Sandy Fat Clay, 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.

APPENDIX A

	Figure
Log of Borings	A-1 thru A-56
Borings from Previous Study	A-57 thru A-60
Symbols and Terms Used on Boring Logs	A-61
Piezometer Installation Reports	A-62 thru A-66

LOG OF BORING NO. GB-1

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13815299.78, E 3072605.89
Brae Acres; See Plan of Borings (Figure 2.1)

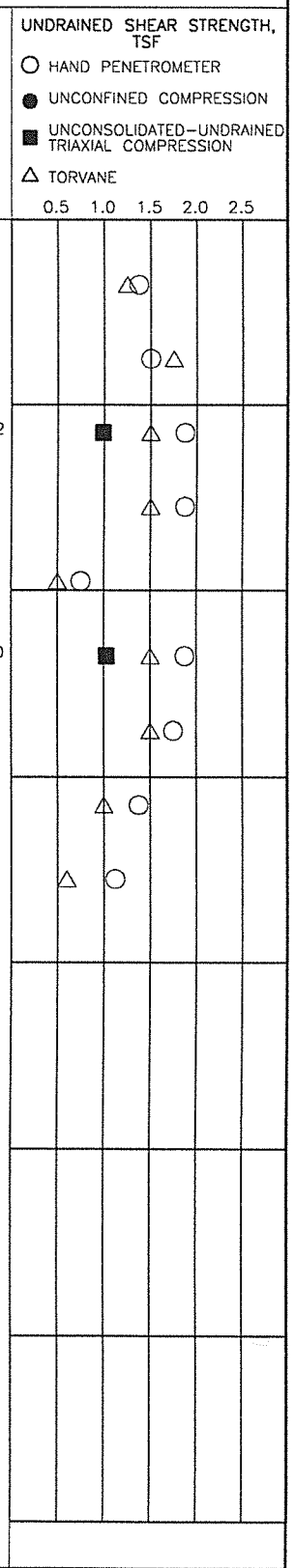
COMPLETION DEPTH : 18.0 FT.

SURFACE ELEVATION : 62.21 FT.

DATE : 08-06-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 18.0 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, %
62.2	0	9" Concrete							
61.5		Very stiff gray FAT CLAY (CH) w/sand, calcareous and ferrous nodules and ferrous stains -yellowish brown and gray 2'-8'				22			
						20			
	5			85	108	19	54	22	32
						22			
54.2		Stiff gray and yellowish brown SANDY LEAN CLAY (CL) -very stiff 10'-16'				16			
	10			70	114	17	35	15	20
						16			
	15	-stiff to very stiff 16'-18'				14			
44.2						19			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 18.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-1

LOG OF BORING NO. GB-2 (GB-2P)

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814826.75, E 3072626.35
Brae Acres; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 15.0 FT.

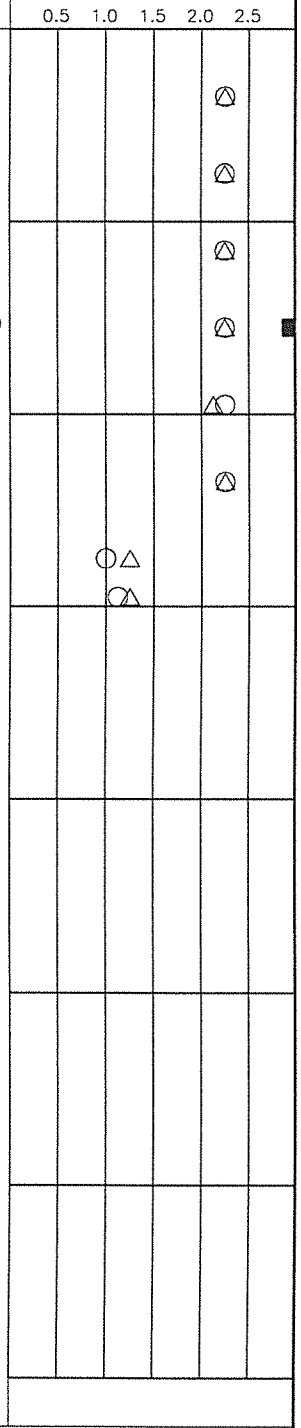
SURFACE ELEVATION : 63.26 FT.

DATE : 08-07-13

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								
62.6		6.5" Concrete over 1.5" Oyster Shell							
		Hard brown FAT CLAY (CH) w/sand, calcareous and ferrous nodules and ferrous stains				11			
						13			
	5	-yellowish brown and gray 2'-15'				15			
				83	116	15	50	21	29
	10					12			
		-very stiff 12'-15'				15			
						19			
48.3	15					18			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
NO GROUNDWATER ENCOUNTERED, HOLE OPEN TO 15.0 FT. ON 09-08-13.

Geotest Engineering, Inc.

FIGURE A-2

LOG OF BORING NO. GB-3

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814104.82, E 3072658.20
Brae Acres; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 16.0 FT.

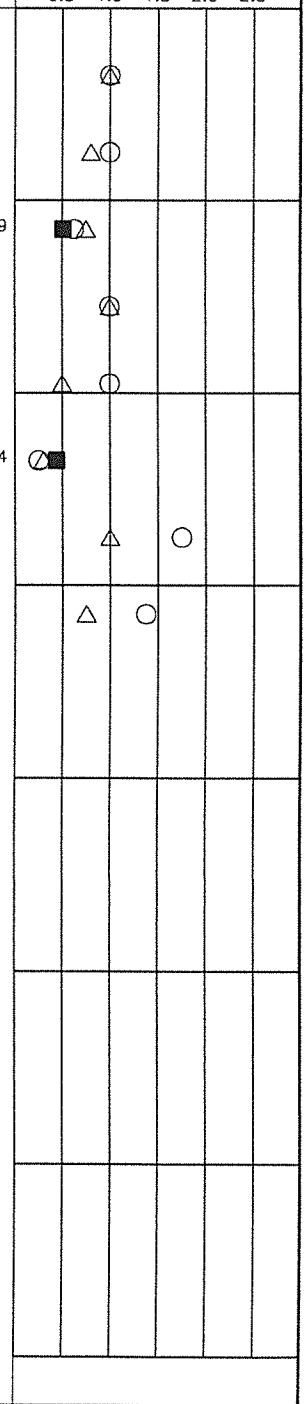
SURFACE ELEVATION : 62.29 FT.

DATE : 08-06-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 16.0 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	6.25" Concrete							
61.8		Very stiff dark gray FAT CLAY (CH) w/calcareous and ferrous nodules and ferrous stains				20			
						22			
	5	-stiff to very stiff gray 2'-4'							
		-yellowish brown and gray 2'-8'		87	98	25	63	24	39
		-stiff 4'-6'							
54.3						25			
		Stiff to very stiff reddish brown and gray LEAN CLAY (CL) w/sand and calcareous nodules				19			
	10	-medium stiff 10'-12'		81	109	20	32	18	14
		-very stiff 12'-14'							
						15			
	15								
46.3						15			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 16.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-3

LOG OF BORING NO. GB-4

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813614.81, E 3072678.61
Brae Acres; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 14.0 FT.

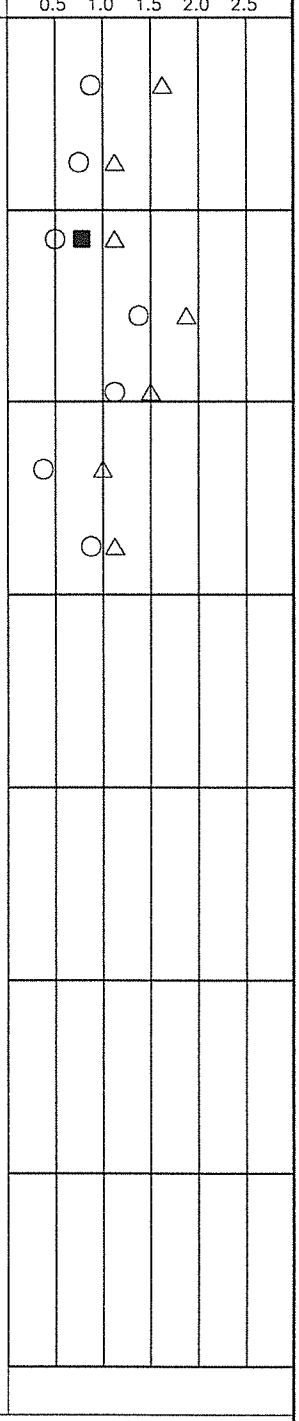
SURFACE ELEVATION : 61.30 FT.

DATE : 08-07-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 14.0 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, %
61.3	0										
60.7				6" Concrete over 1" Oyster Shell							
				Stiff to very stiff dark gray FAT CLAY (CH) w/calcareous and ferrous nodules and ferrous stains				18			
								20			
	5			-very stiff gray and reddish brown 6'-10'		86	106	21	58	23	35
								20			
	10			-stiff to very stiff 10'-12'				20			
								24			
47.3								19			
	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 14.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-4

LOG OF BORING NO. GB-5

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813066.54, E 3072700.17
Brae Acres; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 16.0 FT.

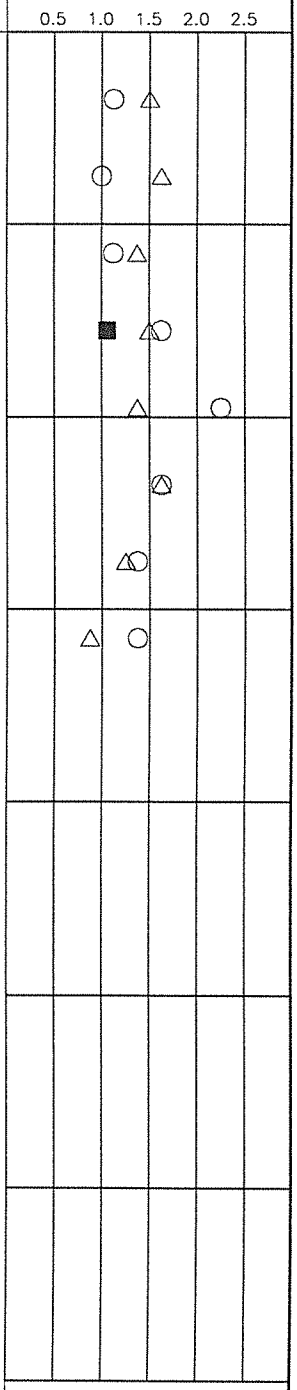
SURFACE ELEVATION : 62.35 FT.

DATE : 08-07-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 16.0 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, %
62.3	0	6" Asphalt over 7" Sand and Shell Mix							
61.3		Very stiff dark gray FAT CLAY (CH) w/calcareous and ferrous nodules -yellowish brown and gray 4'-8'				20			
						19			
	5					20			
		-very stiff to hard 8'-10' -reddish brown and gray 8'-14'		86	107	21	57	20	37
	10					20			
				98		25	68	26	42
48.3		Stiff to very stiff gray and brown LEAN CLAY (CL) w/sand, calcareous and ferrous nodules				27			
	15								
46.3						19			
	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 16.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-5

LOG OF BORING NO. GB-6

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13812483.06, E 3072726.84
Brae Acres; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 16.0 FT.

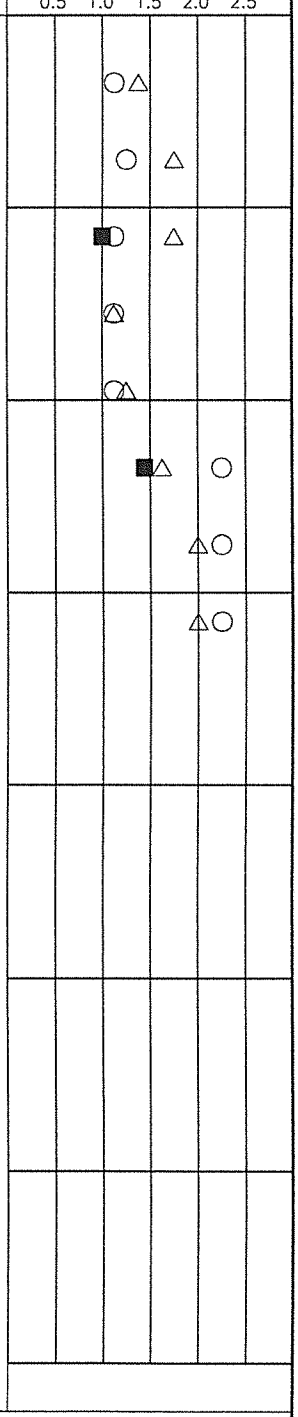
SURFACE ELEVATION : 63.37 FT.

DATE : 08-07-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 16.0 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, %
63.4	0	4" Asphalt over 8" Sand and Shell Mix							
62.4		Very stiff dark gray FAT CLAY (CH) w/sand, calcareous and ferrous nodules				23			
						20			
	5	-yellowish brown and gray 6'-10'		83	108	19	55	20	35
		-w/vertical sand seams 8'-10'				22			
	10	-very stiff to hard 10'-12'				25			
		-reddish brown and gray 10'-16'		84	114	20	66	22	44
		-hard 12'-16'				19			
	15					23			
47.4									
	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 16.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-6

LOG OF BORING NO. GB-7

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13811938.87, E 3072750.91
Brae Acres; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 12.0 FT.

SURFACE ELEVATION : 62.69 FT.

DATE : 08-02-13

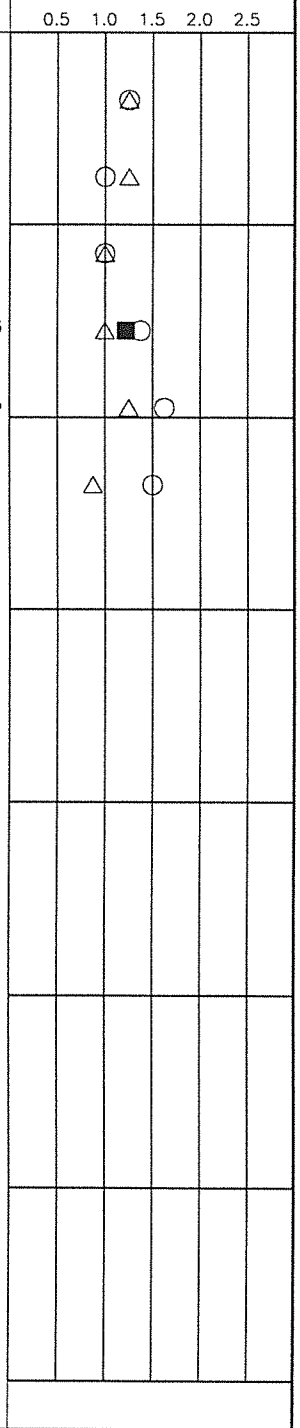
SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 FT.
WET ROTARY : -- TO -- FT.

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, %
62.7	0	5" Asphalt over 7" Shell, Sand and Clay Mix							
61.7		Very stiff dark gray FAT CLAY (CH) w/sand, calcareous and ferrous nodules and ferrous stains -yellowish brown and gray 4'-6'				23			
						27			
	5					20			
54.7		Very stiff gray LEAN CLAY (CL) w/sand -stiff to very stiff 10'-12'		84	105	20	56	20	36
	10			80		16	44	19	25
50.7						16			
	15								
	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 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-7

LOG OF BORING NO. GB-8 (GB-8P)

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13811401.17, E 3072770.19
Brae Acres; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 23.0 FT.

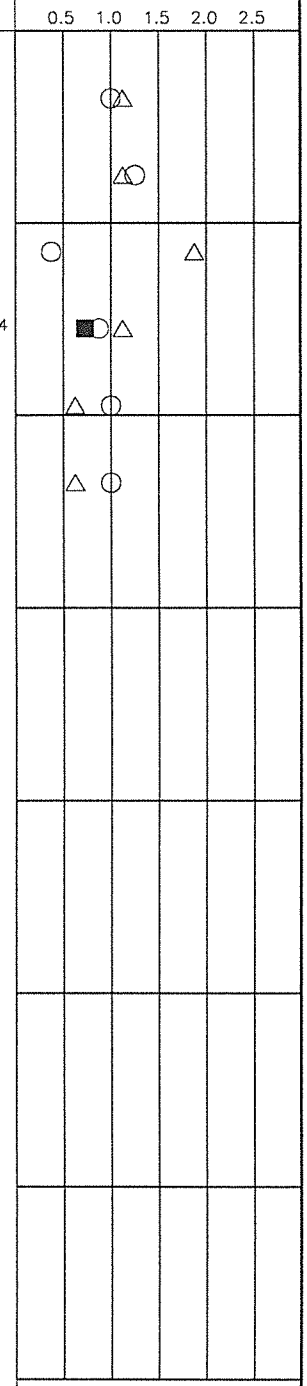
SURFACE ELEVATION : 60.65 FT.

DATE : 08-07-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 16.0 FT.
WET ROTARY : 16.0 TO 23.0 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, %
60.7	0	4" Asphalt over 7" Brown Stabilized Sand							
59.7		Very stiff gray SANDY FAT CLAY (CH) w/calcareous and ferrous nodules				24			
						23			
	5	-stiff yellowish brown and gray 4'-12'				17			
				68	103	22	53	19	34
	10					20			
48.7						18			
		Medium dense brown SILTY SAND (SM)	10			8			
	15		10	22		25			
			11			22			
	20		26	12		23			
		-very dense 21.5'-23'							
37.7			57			22			
	25	NOTE : See Piezometer GB-8P for water level measurements.							
	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 16.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 16.0 FT.
▼: WATER DEPTH AT 16.2 FT., HOLE OPEN TO 23.0 FT. ON 09-08-13.

Geotest Engineering, Inc.

FIGURE A-8

LOG OF BORING NO. GB-9

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13815051.97, E 3073069.14
Troulon (West); See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 12.0 FT.

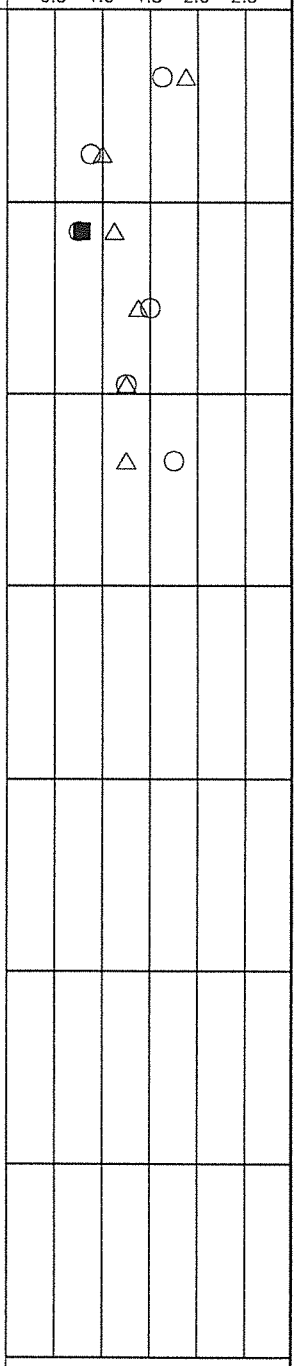
SURFACE ELEVATION : 62.55 FT.

DATE : 08-07-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
62.5	0								
61.9		6" Concrete over 2" Oyster Shell							
		Very stiff gray FAT CLAY (CH) w/sand, calcareous and ferrous nodules and ferrous stains				16			
						22			
	5	-stiff to very stiff yellowish brown and gray 2'-6'		84	106	22	58	23	35
54.5						21			
		Very stiff reddish brown and gray LEAN CLAY (CL) w/sand							
	10					17			
50.5						16			
	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-9

LOG OF BORING NO. GB-10

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814960.24, E 3073556.49
Troulon (West); See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 13.0 FT.

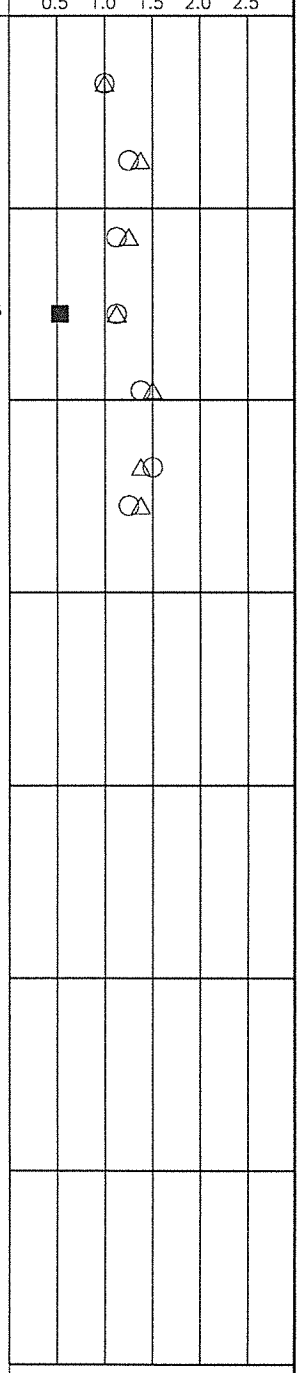
SURFACE ELEVATION : 60.44 FT.

DATE : 08-07-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 13.0 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, %
60.4	0			6.25" Concrete over 2" Oyster Shell							
59.8				Very stiff yellowish brown and gray LEAN CLAY (CL) w/sand, calcareous and ferrous nodules and ferrous stains				19			
								17			
	5			-stiff to very stiff 6'-8'				21			
						73	107	21	43	17	26
	10							18			
								18			
47.4								17			
	15										
	20										
	25										
	30										
	35										



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 13.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-10

LOG OF BORING NO. GB-11

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814679.54, E 3073273.25
Tanager (West); See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 17.0 FT.

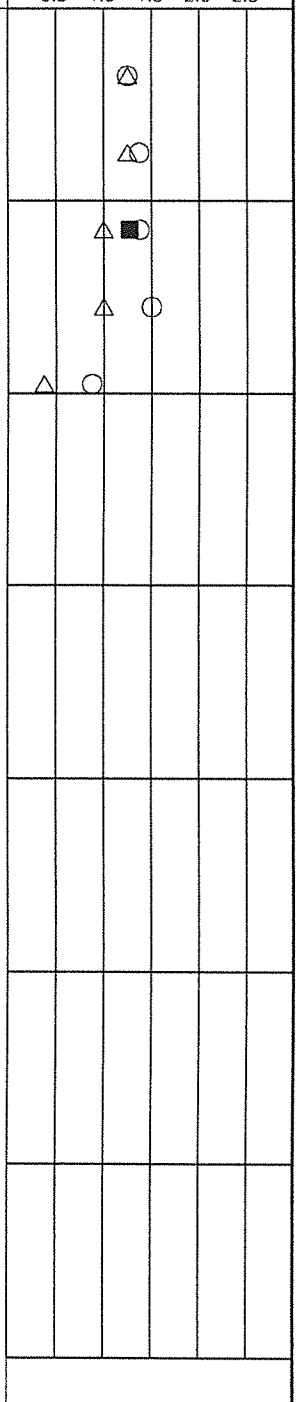
SURFACE ELEVATION : 58.00 FT.

DATE : 08-07-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 17.0 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, %
58.0	0	6.5" Asphalt over 3" Oyster Shell							
57.2		Very stiff yellowish brown and gray SANDY LEAN CLAY (CL) w/sand seams, calcareous nodules and ferrous stains				16			
						17			
	5			66	114	18	42	16	26
		-medium stiff to stiff gray 8'-10'				19			
	10					20			
47.0		Brown SILTY SAND (SM)		23		15			
	15	-loose 15.5'-17'							
41.0			6						
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 17.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 15.0 FT.
▼: WATER DEPTH AT 15.0 FT., HOLE OPEN TO 17.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-11

LOG OF BORING NO. GB-12

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814471.65, E 3072953.24
Carew; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 16.0 FT.

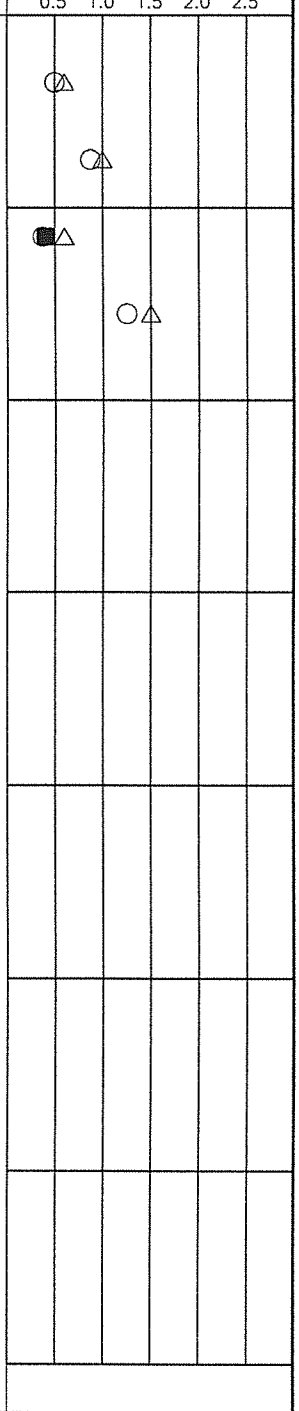
SURFACE ELEVATION : 60.28 FT.

DATE : 08-08-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 16.0 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, %
60.3	0								
59.8		6" Concrete							
		Stiff yellow and gray FAT CLAY (CH) w/sand, calcareous and ferrous nodules and ferrous stains				24			
		-stiff to very stiff 2'-4'				22			
	5	-medium stiff to stiff 4'-6'							
		-very stiff reddish brown and gray 6'-8'		82	97	25	50	21	29
						21			
						15			
50.3	10	Loose brown SILTY SAND (SM)							
			6	18		6			
		-medium dense 12.5'-14'							
		-w/clay seams 12.5'-16'	13			22			
	15								
44.3			9			24			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 16.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-12

LOG OF BORING NO. GB-13

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814354.85, E 3073551.82
Carew; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 15.0 FT.

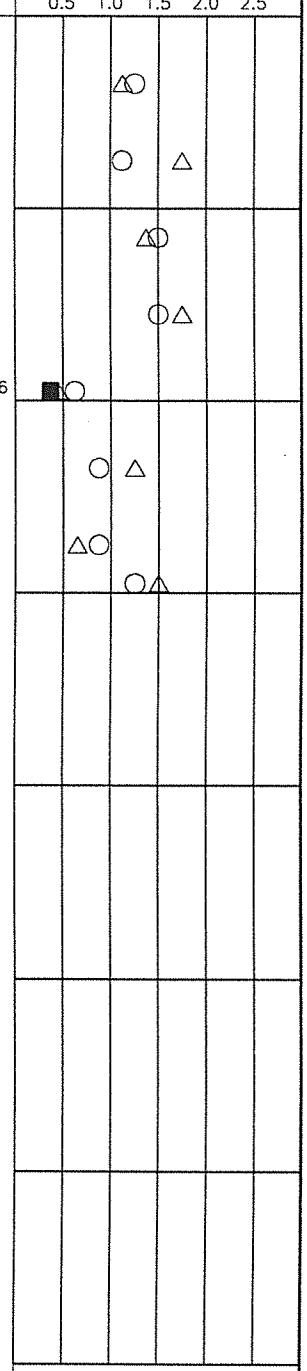
SURFACE ELEVATION : 61.27 FT.

DATE : 08-08-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 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, %
61.3	0			6.5" Concrete							
60.7				Very stiff dark gray SANDY LEAN CLAY (CL) w/sand seams, calcareous and ferrous nodules				17			
								18			
	5			-yellowish brown and gray 2'-8'							
				-w/ferrous stains 4'-15'				18			
				-medium stiff to stiff 8'-10'				22			
				-gray and brown 8'-15'		70	110	19	32	16	16
	10			-stiff to very stiff 10'-14'							
								18			
								18			
46.3	15							16			
	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-13

LOG OF BORING NO. GB-14

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814307.82, E 3074326.88
Carew; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 17.0 FT.

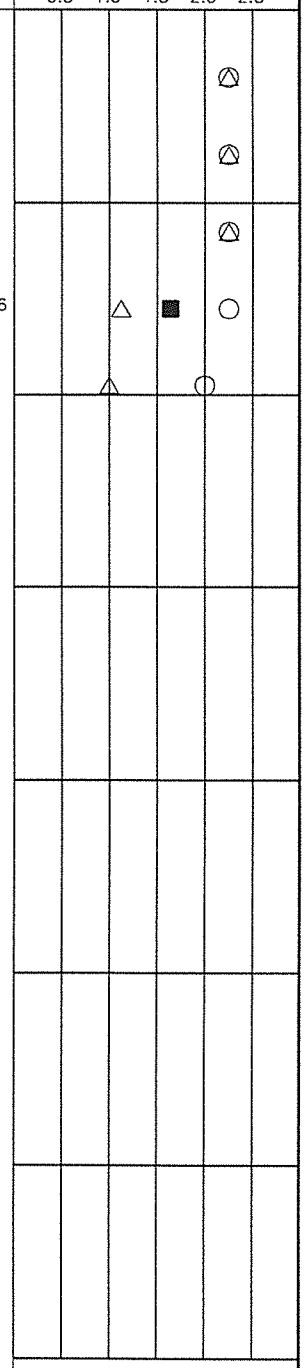
SURFACE ELEVATION : 61.41 FT.

DATE : 08-01-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 17.0 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, %
61.4	0	6" Concrete							
60.9		Hard dark gray SANDY LEAN CLAY (CL) w/calcareous nodules and ferrous stains -w/roots 2'-4'				12			
						14			
	5	-very stiff to hard gray 6'-10'				15			
				56	116	13	34	18	16
51.9	10	Medium dense yellow and gray SILTY SAND (SM)				14			
			12	31		11			
	15								
45.4		Very stiff gray and brown SANDY LEAN CLAY (CL) w/sand seams	16						
44.4									
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 17.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-14

LOG OF BORING NO. GB-15

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814327.07, E 3074847.30
Carew; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 12.0 FT.

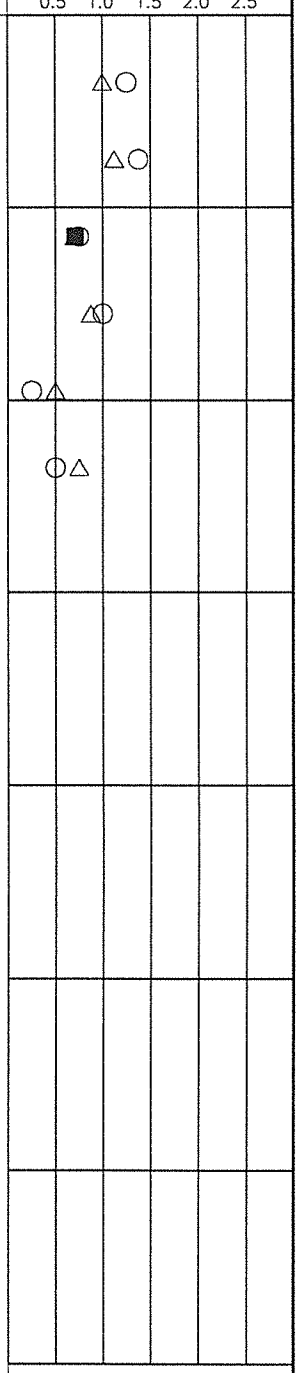
SURFACE ELEVATION : 60.10 FT.

DATE : 08-01-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
60.1	0	6" Concrete over 3" Gray Sand and Shell							
59.3		Very stiff gray FAT CLAY (CH) w/sand, calcareous and ferrous nodules and ferrous stains				20			
						22			
	5	-stiff 4'-6'							
		-yellowish brown and gray 4'-10'		84	102	24	61	24	37
		-stiff to very stiff 6'-8'				19			
		-medium stiff to stiff 8'-10'				23			
50.1	10	Stiff yellowish brown and gray LEAN CLAY (CL) w/sand, calcareous and ferrous nodules							
48.1						9			
	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-16

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813866.88, E 3073698.61
Braes River; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 12.0 FT.

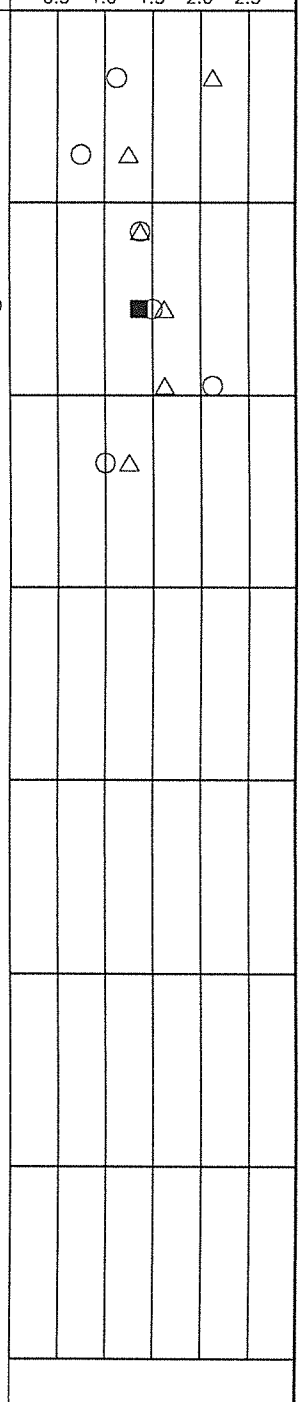
SURFACE ELEVATION : 59.76 FT.

DATE : 08-08-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
59.8	0			6.5" Concrete over 2" Oyster Shell							
59.1				Very stiff to hard yellow and gray LEAN CLAY (CL) w/calcareous and ferrous nodules and ferrous stains				18			
								25			
	5			-stiff to very stiff w/grass roots 2'-4'				27			
				-very stiff 4'-8'							
				-gray and brown 4'-12'		89	106	22	49	19	30
	10			-very stiff reddish brown and gray 10'-12'				20			
47.8								16			
	15										
	20										
	25										
	30										
	35										



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-17

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No.. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813468.35, E 3073125.68
Grape; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 12.0 FT.

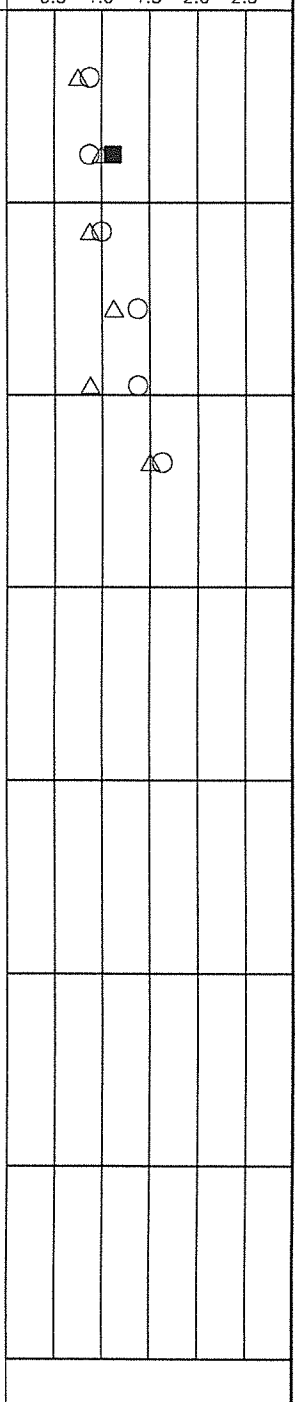
SURFACE ELEVATION : 60.31 FT.

DATE : 08-01-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
60.3	0	5.5" Concrete over 4" Shell							
59.5		Stiff gray FAT CLAY (CH) w/sand, calcareous and ferrous nodules				21			
		-stiff to very stiff 2'-6'		85	108	20	56	21	35
		-yellowish brown and gray w/ferrous stains 4'-12'							
	5	-very stiff 6'-8'				25			
		-stiff to very stiff 8'-10'				21			
	10	-very stiff 10'-12'				19			
48.3						24			
	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 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-18

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813565.71, E 3073748.05
Grape; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 14.0 FT.

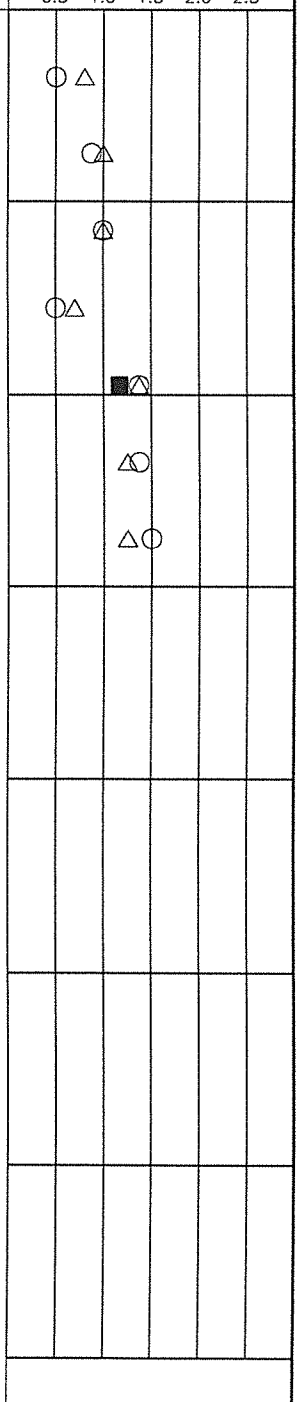
SURFACE ELEVATION : 59.46 FT.

DATE : 08-08-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 14.0 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, %
59.5	0								
58.8		6" Concrete over 2" Oyster Shell							
		Stiff dark gray FAT CLAY (CH) w/ferrous nodules and ferrous stains				25			
		-stiff to very stiff yellow and gray 2'-4'				25			
	5	-very stiff 4'-6'				29			
		-w/calcareous nodules 4'-12'							
		-very stiff 8'-12'				34			
	10			93	101	26	56	22	34
47.5		Very stiff gray and yellowish brown LEAN CLAY (CL) w/sand				23			
45.5						18			
	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 14.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-18

LOG OF BORING NO. GB-19

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813172.84, E 3073355.69
Jackwood (West); See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 12.0 FT.

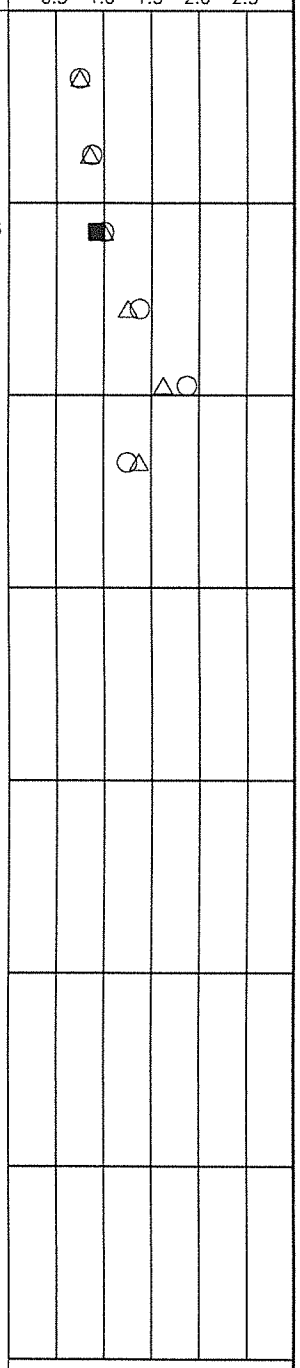
SURFACE ELEVATION : 60.11 FT.

DATE : 08-01-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
60.1	0			6.5" Concrete over 1" Shell							
59.5				Stiff dark gray FAT CLAY (CH) w/calcareous and ferrous nodules				25			
				-stiff to very stiff 4'-6'				21			
	5			-yellowish brown and gray 4'-12		91	103	25	62	24	38
				-very stiff 6'-12'				27			
	10							26			
48.1								24			
	15										
	20										
	25										
	30										
	35										



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-19

LOG OF BORING NO. GB-20

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13812876.00, E 3073241.31
Jason; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 14.0 FT.

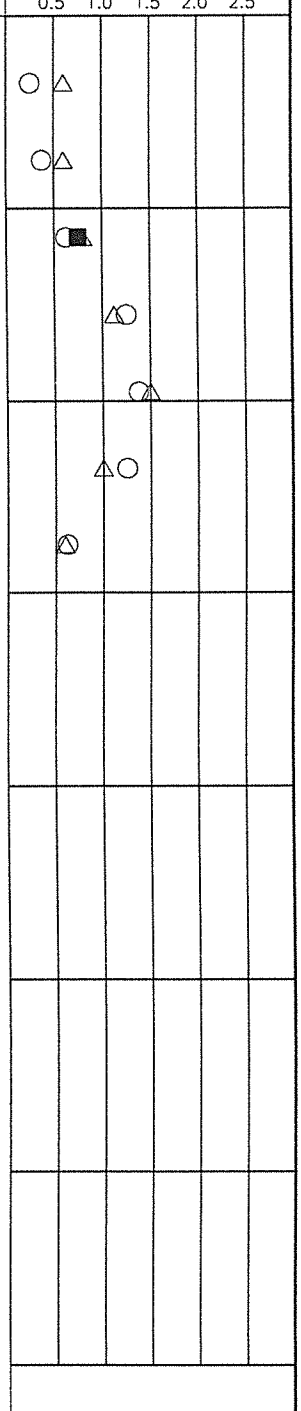
SURFACE ELEVATION : 60.27 FT.

DATE : 08-09-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 14.0 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, %
60.3	0			6.5" Concrete over 2" Oyster Shell							
59.6				Medium stiff to stiff gray FAT CLAY (CH) w/ferrous nodules and ferrous stains				27			
				-yellow and gray 2'-4'				26			
	5			-stiff 4'-6'							
				-gray and brown 6'-8'		89	98	25	70	26	44
				-very stiff 6'-12'				28			
				-reddish brown and gray 8'-12'				27			
	10							26			
48.3				Stiff reddish brown and gray LEAN CLAY (CL) w/sand							
46.3								17			
	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 14.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-20

LOG OF BORING NO. GB-21

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13812971.24, E 3073730.12
Braes River; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 12.0 FT.

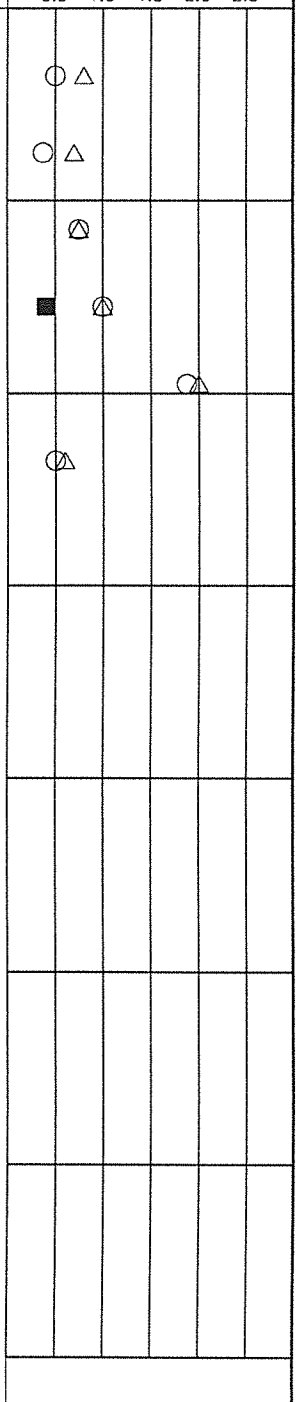
SURFACE ELEVATION : 59.68 FT.

DATE : 08-01-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
59.7	0	6" Concrete over 4" Shell							
58.8		Stiff dark gray FAT CLAY (CH)				24			
		-medium stiff to stiff 2'-4'							
		-yellowish brown and gray 4'-6'				27			
	5	-w/calcareous and ferrous nodules and ferrous stains 4'-12'				28			
		-medium stiff to stiff, slickensided 6'-8'		93	91	31	75	28	47
		-very stiff 8'-10'				22			
	10								
47.7						34			
	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-21

LOG OF BORING NO. GB-22

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13812469.07, E 3073189.25
Imogene; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 19.0 FT.

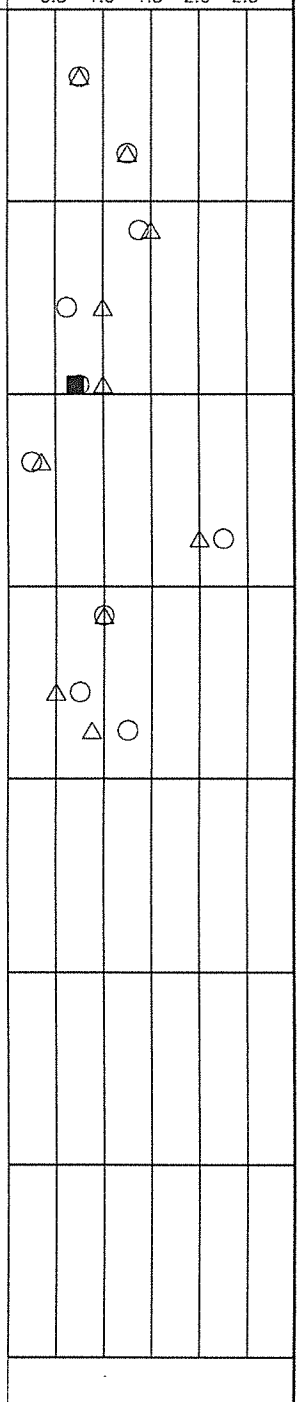
SURFACE ELEVATION : 60.88 FT.

DATE : 08-09-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 19.0 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, %
60.9	7" Concrete over 1" Oyster Shell							
60.2	Stiff gray FAT CLAY (CH) w/ferrous nodules				24			
	-very stiff 2'-6'				21			
	-yellow and gray 4'-6'							
	-w/calcareous and ferrous nodules and ferrous stains 4'-19'				21			
	-stiff to very stiff 6'-10'				26			
	-reddish brown and gray 8'-19'							
	-medium stiff w/sand seams 10'-12'		91	97	26	77	28	49
	-hard 12'-14'				22			
46.9	Very stiff reddish brown and gray LEAN CLAY (CL) w/sand		99		22	64	25	39
	-stiff 16'-18'				16			
	-stiff to very stiff 18'-19'				19			
41.9					18			



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 19.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-23

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13812489.18, E 3073650.06
Imogene; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 12.0 FT.

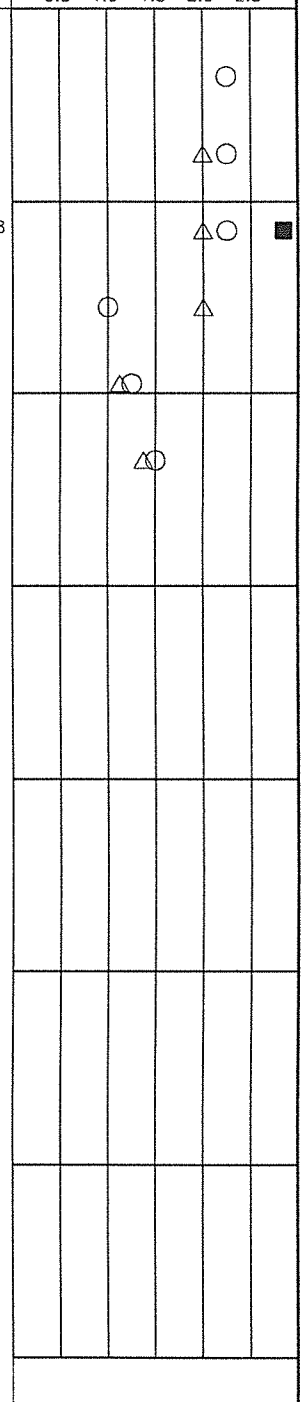
SURFACE ELEVATION : 61.10 FT.

DATE : 08-01-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
61.1	0			Hard dark gray FAT CLAY (CH)							
				-w/grass roots 0'-2'				15			
				-w/ferrous stains and ferrous nodules 2'-12'				19			
				-yellowish brown and gray 4'-8'							
	5			-very stiff to hard 6'-8'		92	106	20	62	24	38
				-very stiff reddish brown and gray w/calcareous nodules 8'-12				25			
	10							29			
49.1								24			
	15										
	20										
	25										
	30										
	35										



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-23

LOG OF BORING NO. GB-24

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13815139.08, E 3073944.86
Braburn Valley; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 16.0 FT.

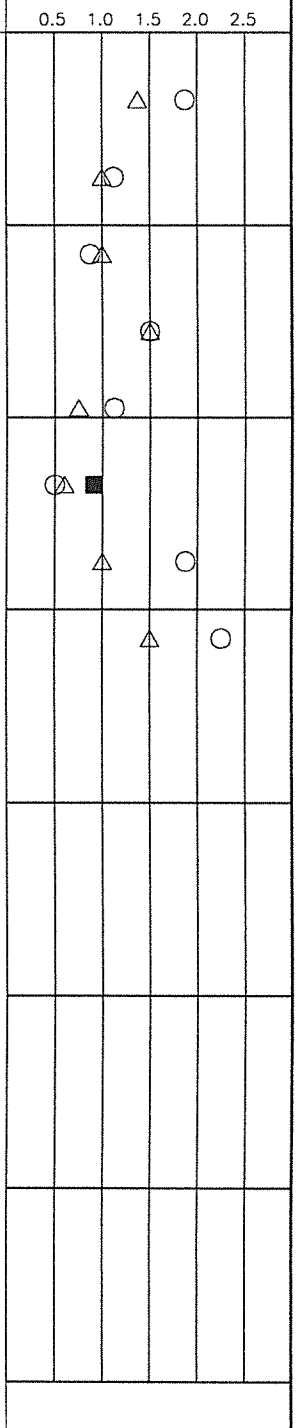
SURFACE ELEVATION : 60.70 FT.

DATE : 08-08-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 16.0 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, %
60.7 (0)	6" Concrete over 2" Oyster Shell							
60.0	Very stiff gray FAT CLAY (CH) w/calcareous and ferrous nodul -stiff to very stiff 4'-6' -brown and gray w/calcareous nodules 4'-10'				15			
					19			
(5)					20			
52.7	Stiff to very stiff yellowish brown and gray SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules -stiff 10'-12' -very stiff 12'-14' -yellowish brown and gray 12'-16' -very stiff to hard 14'-16'		90		23	50	21	29
(10)					16			
			70	113	19	40	18	22
					14			
(15)					13			
44.7								
(20)								
(25)								
(30)								
(35)								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 16.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-25 (GB-25P)

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814544.55, E 3073969.15
Braburn Valley; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 24.0 FT.

SURFACE ELEVATION : 60.87 FT.

DATE : 07-31-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 16.0 FT.
WET ROTARY : 16.0 TO 24.0 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, %
60.9	0	5.5" Concrete							
60.4		Stiff dark gray FAT CLAY (CH) w/sand and ferrous nodules				18			
		-very stiff yellowish brown and gray 2'-8'				16			
	5	-w/ferrous stains 4'-12'		81	113	18	50	22	28
		-stiff to very stiff reddish brown and gray 8'-10'				18			
50.9	10					20			
		Medium stiff to stiff yellowish brown and gray SANDY LEAN CLAY (CL)				17			
48.9		Medium dense gray SILTY SAND (SM)	11			11			
		-w/clay seams 12.5'-14'							
	15		10	15		22			
			12			24			
	20		23			20			
38.9		Very stiff to hard gray FAT CLAY (CH) w/calcareous nodules							
36.9				86		19	52	24	28
	25								
	30								
	35								

NOTE :
See Piezometer GB-25P for water level measurements.

DEPTH TO WATER IN BORING :
▽: FREE WATER ENCOUNTERED AT 16.0 FT. DURING DRILLING.
▼: WATER DEPTH AT 15.8 FT., HOLE OPEN TO 24.0 FT. ON 09-08-13.

Geotest Engineering, Inc.

FIGURE A-25

LOG OF BORING NO. GB-26

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814413.21, E 3073974.50
Braburn Valley; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 24.0 FT.

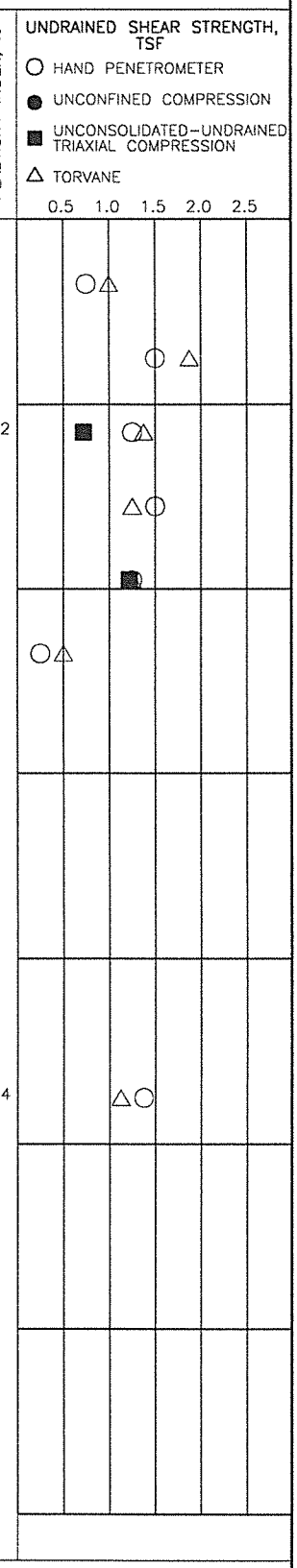
SURFACE ELEVATION : 60.68 FT.

DATE : 08-01-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 16.0 FT.
WET ROTARY : 16.0 TO 24.0 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, %
60.7	0	6.5" Concrete							
60.1		Stiff to very stiff gray FAT CLAY (CH) w/sand, calcareous no				19			
		-very stiff 2'-4'				15			
		-yellowish brown and gray 2'-10'							
	5	-w/ferrous nodules and ferrous stains 2'-12'		80	111	20	54	22	32
		-slickensided 4'-6'							
		-very stiff 6'-10'				19			
					112	18			
50.7	10	Medium stiff to stiff gray SANDY LEAN CLAY (CL)				15			
48.7		Medium dense brown and gray SILTY SAND (SM)	14	13		6			
		-gray 14.5'-16'							
	15		14			20			
			10			23			
		-dense w/clay seams 18.5'-20'							
	20		37			21			
38.7		Very stiff gray FAT CLAY (CH) w/calcareous nodules							
36.7				89		27	70	26	44
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 16.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 16.0 FT.
HOLE OPEN TO 24.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-26

LOG OF BORING NO. GB-27

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813749.40, E 3074005.00
Braburn Valley; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 12.0 FT.

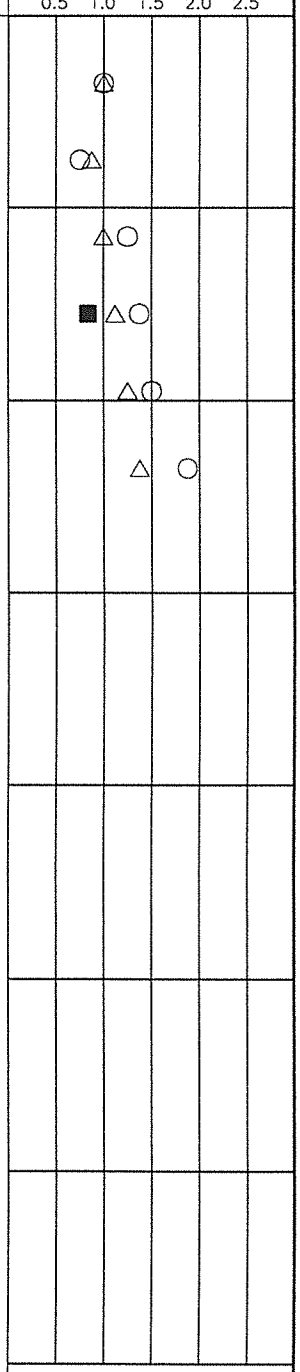
SURFACE ELEVATION : 59.71 FT.

DATE : 08-01-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
59.7	0			6" Concrete							
59.2				Very stiff dark gray FAT CLAY (CH) w/sand, calcareous and ferrous nodules -stiff 2'-4' -w/ferrous stains 4'-12' -stiff to very stiff yellowish brown and gray 6'-8'				20			
								20			
	5							20			
						82	105	22	52	20	32
	10							19			
47.7								20			
	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 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-28

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813242.63, E 3074013.03
Braburn Valley; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 15.0 FT.

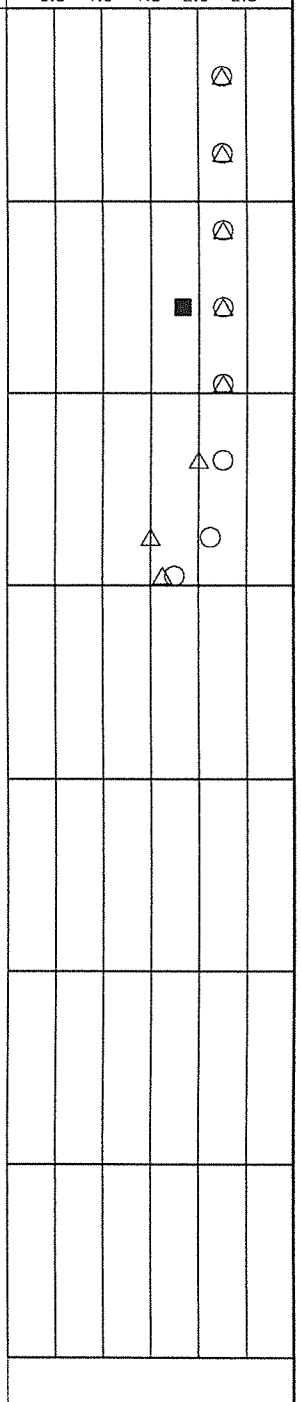
SURFACE ELEVATION : 59.72 FT.

DATE : 08-08-13

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, %
59.7	0								
59.1		6.5" Concrete over 1" Oyster Shell							
		Hard yellow and brown FAT CLAY (CH) w/calcareous and ferrous nodules				16			
		-w/ferrous stains 4'-15'				18			
	5					19			
		-very stiff to hard gray and brown 6'-8'							
		-reddish brown and gray 8'-15'		92	107	20	73	27	46
	10	-w/sand seams 10'-15'				18			
		-very stiff to hard 12'-14'				16			
		-very stiff 14'-15'				16			
44.7	15					18			
	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-28

LOG OF BORING NO. GB-29

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13812739.94, E 3074033.01
Braburn Valley; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 18.0 FT.

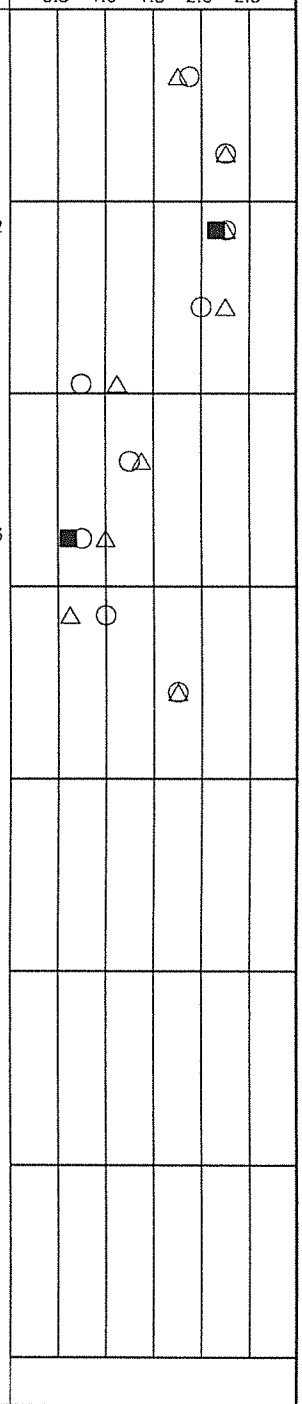
SURFACE ELEVATION : 58.90 FT.

DATE : 08-08-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 18.0 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, %
58.9	0								
58.2		6.5" Concrete over 2" Oyster Shell							
		Very stiff gray FAT CLAY (CH) w/ferrous nodules and ferrous stains				23			
		-hard 2'-8'				19			
	5	-gray and yellowish brown 4'-10'		86	106	18	68	26	42
		-w/calcareous nodules 4'-14'							
		-stiff to very stiff 8'-10'				16			
	10	-brown and gray 10'-12'				30			
46.9		Stiff to very stiff reddish brown and gray LEAN CLAY (CL) w/sand and ferrous stains				27			
				72	116	16	26	13	13
	15	-very stiff 16'-18'				17			
40.9						16			
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 18.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-30

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13812251.18, E 3074052.56
Braburn Valley; See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 23.0 FT.

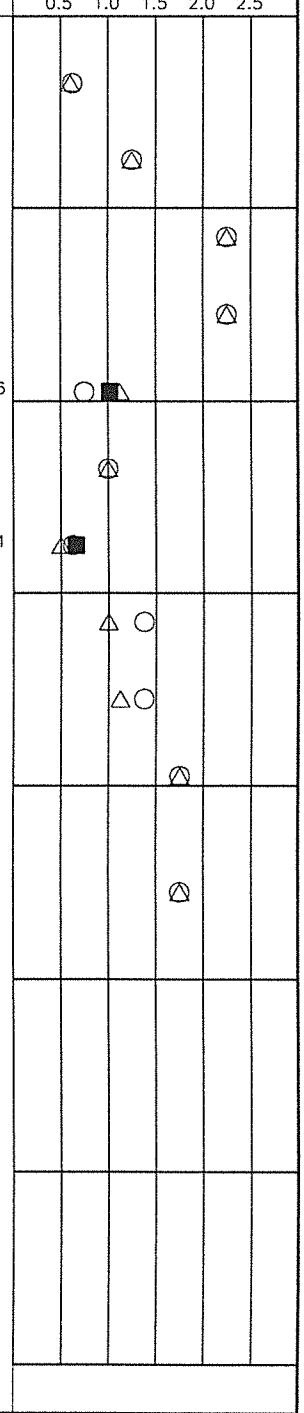
SURFACE ELEVATION : 60.20 FT.

DATE : 08-08-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 23.0 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, %
60.2	0	8.5" Concrete							
59.5		Stiff dark gray FAT CLAY (CH) w/ferrous nodules				25			
		-very stiff 2'-4'							
		-yellowish brown and gray 4'-6'				22			
	5	-hard 4'-8'							
		-w/calcareous nodules and ferrous stains 4'-12'				21			
		-stiff to very stiff reddish brown and gray 8'-10'				21			
	10	-very stiff 10'-12'		93	99	27	73	27	46
48.2		Stiff yellowish brown and gray LEAN CLAY (CL) w/sand				25			
		-very stiff 14'-23'		72	112	19	36	15	21
	15					19			
						19			
	20					24			
		-reddish brown and gray 21'-23'							
37.2						28			
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 23.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-30

LOG OF BORING NO. GB-31

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814949.40, E 3074278.61
Troulon (East); See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 12.0 FT.

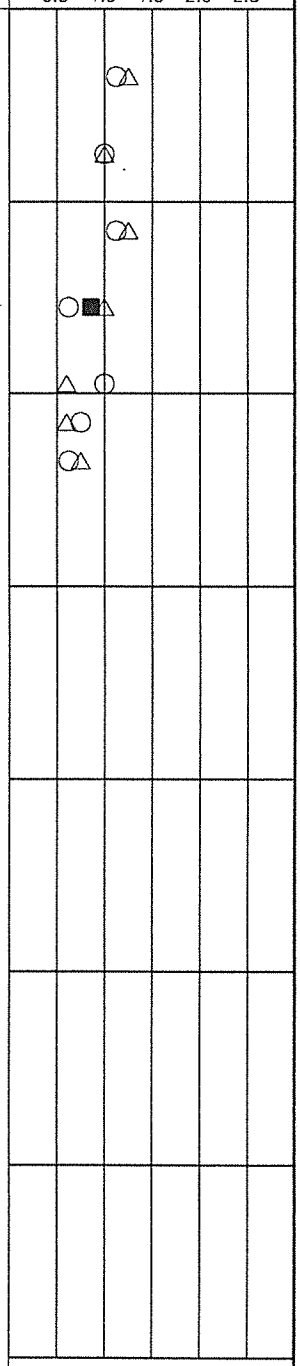
SURFACE ELEVATION : 59.80 FT.

DATE : 08-02-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
59.8	0	6" Concrete over 3" Shell							
59.0		Very stiff gray LEAN CLAY (CL) w/sand, calcareous and ferrous nodules				20			
		-yellowish brown and gray 2'-8'				20			
	5	-w/ferrous stains 4'-12'							
		-stiff to very stiff 6'-10'				21			
		-reddish brown and gray 8'-12'		79	105	20	44	20	24
	10	-stiff 10'-12'				20			
						16			
47.8						19			
	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-31

LOG OF BORING NO. GB-32

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814960.66, E 3074763.04
Troulon (East); See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 12.0 FT.

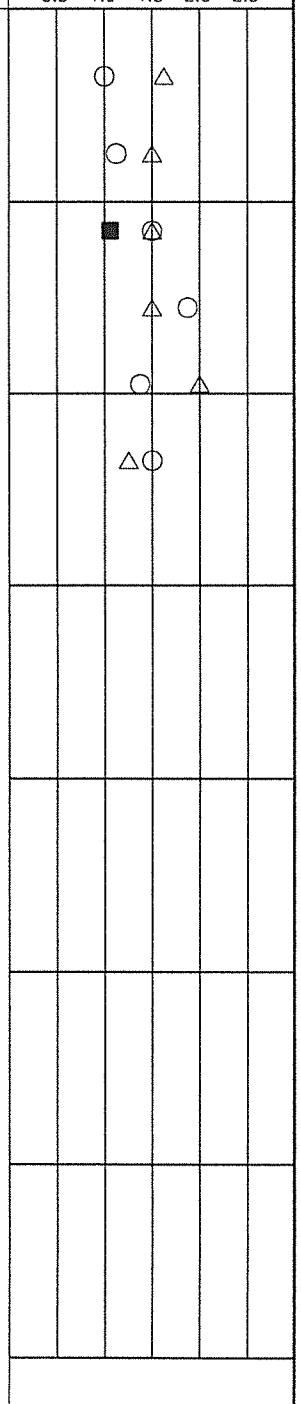
SURFACE ELEVATION : 61.42 FT.

DATE : 08-06-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
61.4	0										
60.8				5" Concrete over 3" Shell							
				Vert stiff gray LEAN CLAY (CL) w/sand and calcareous nodules				19			
				-yellowish brown and gray 2'-12'				19			
	5			-w/ferrous nodules and ferrous stains 4'-12'		79	108	19	48	17	31
				-very stiff to hard 8'-10'				19			
	10							17			
49.4								16			
	15										
	20										
	25										
	30										
	35										



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-32

LOG OF BORING NO. GB-33

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814650.55, E 3074278.63
Tanager (East); See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 12.0 FT.

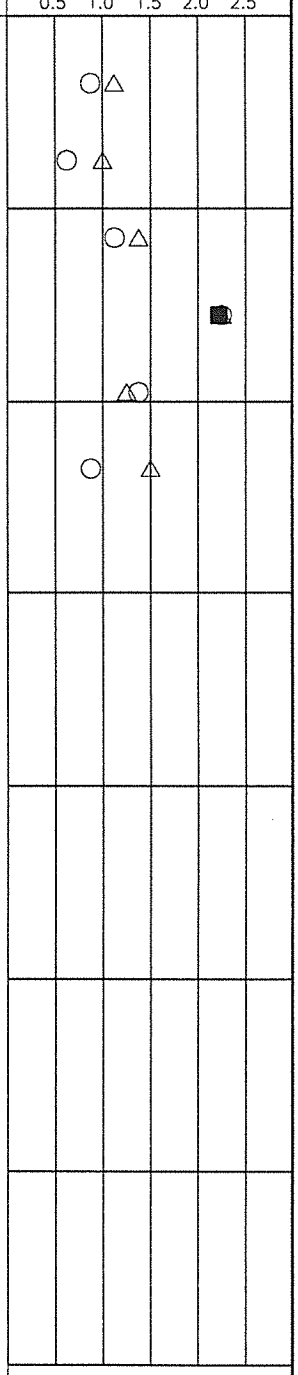
SURFACE ELEVATION : 60.65 FT.

DATE : 08-02-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
60.7	0			6" Concrete over 1" Shell							
60.1				Stiff to very stiff gray SANDY LEAN CLAY (CL) w/ferrous nodules and ferrous stains				16			
				-very stiff 4'-6'				18			
	5			-yellowish brown and gray 4'-10'				19			
				-w/calcareous nodules 4'-12'							
				-hard 6'-8'		55	116	16	45	19	26
				-very stiff 8'-10'							
	10			-reddish brown and gray 10'-12'				20			
48.7								18			
	15										
	20										
	25										
	30										
	35										



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-33

LOG OF BORING NO. GB-34

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814663.23, E 3074791.39
Tanager (East); See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 12.0 FT.

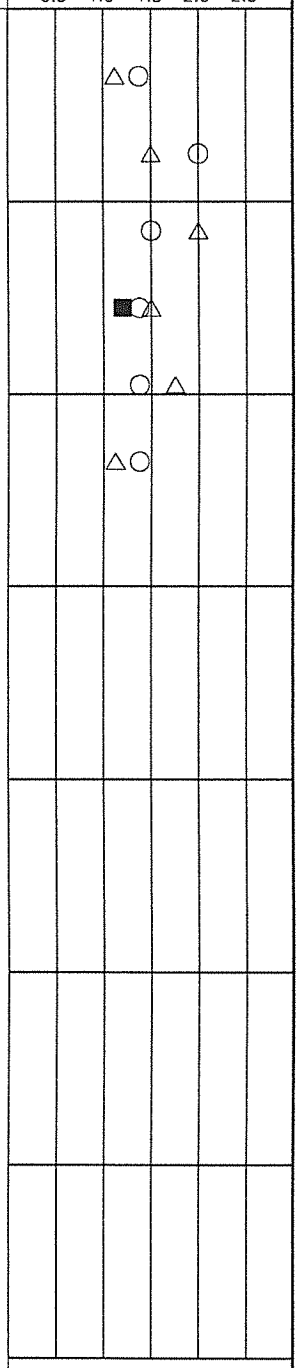
SURFACE ELEVATION : 60.96 FT.

DATE : 08-02-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
61.0	0										
60.4				6" Concrete over 1" Shell							
				Very stiff dark gray FAT CLAY (CH) w/sand and ferrous nodules				18			
				-very stiff to hard 2'-6'				17			
	5			-yellowish brown and gray 2'-8'							
				-w/calcareous nodules and ferrous stains 6'-12'				17			
				-reddish brown and gray 8'-12'		81	114	18	62	21	41
	10							18			
49.0								17			
	15										
	20										
	25										
	30										
	35										



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-34

LOG OF BORING NO. GB-35

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814004.46, E 3074385.05
Darnell; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 12.0 FT.

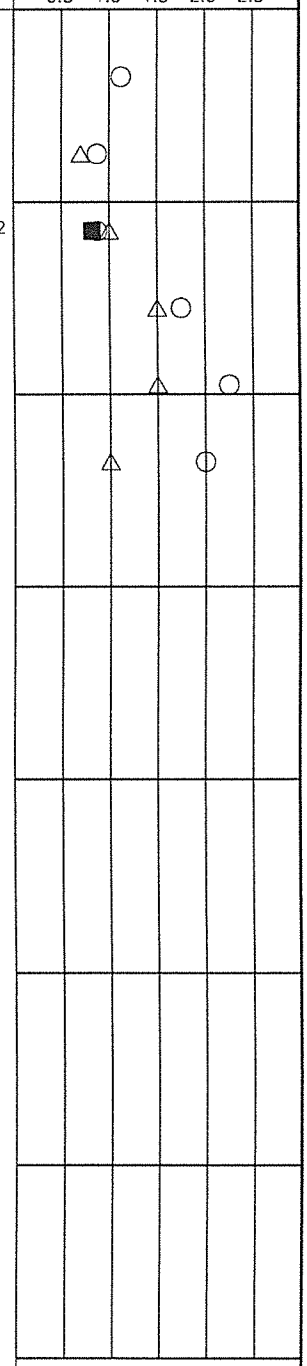
SURFACE ELEVATION : 61.60 FT.

DATE : 08-02-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
61.6	0			6" Concrete							
61.1				Very stiff gray SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules -stiff 2'-4'				22			
	5			-stiff to very stiff 6'-8' -yellowish brown and gray w/ferrous stains 6'-12' -very stiff to hard 8'-12'		68	108	19	49	17	32
								18			
	10							21			
49.6								17			
	15										
	20										
	25										
	30										
	35										



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-35

LOG OF BORING NO. GB-36

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814024.57, E 3074871.65
Darnell; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 12.0 FT.

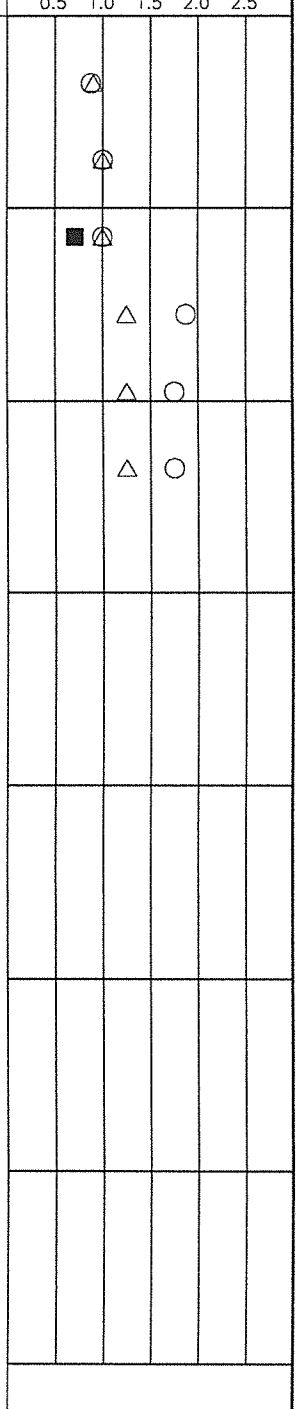
SURFACE ELEVATION : 60.13 FT.

DATE : 08-02-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
60.1	0			6" Concrete over 1" Shell							
59.5				Stiff gray FAT CLAY (CH) w/sand				19			
				-very stiff 2'-4'				23			
	5			-stiff to very stiff yellowish brown and gray w/ferrous stain		81	108	22	52	21	31
54.1				Very stiff yellowish brown and gray LEAN CLAY (CL) w/sand, calcareous and ferrous nodules				18			
	10					92		19	44	16	28
48.1								16			
	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 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-36

LOG OF BORING NO. GB-37

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813657.45, E 3074571.90
Reims; See Plan of Borings (Figure 2.1)

COMPLETION DEPTH : 12.0 FT.

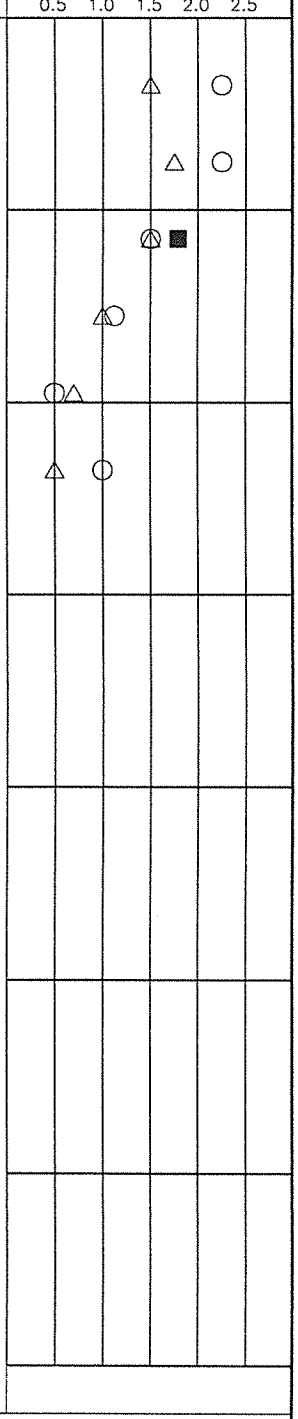
SURFACE ELEVATION : 59.23 FT.

DATE : 08-06-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
59.2	0	7" Concrete over 1" Oyster Shell and Clay Mix							
58.6		Very stiff to hard gray FAT CLAY (CH)				15			
		-very stiff 4'-8'				17			
	5	-gray and yellowish brown w/calcareous and ferrous nodules an		90	103	24	65	25	40
		-stiff 8'-10'				16			
	10	-stiff to very stiff 10'-12'				21			
47.2						15			
	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-38

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813333.44, E 3074392.57
Jackwood (East); See Plan of Borings (Figure 2.2)

COMPLETION DEPTH : 17.0 FT.

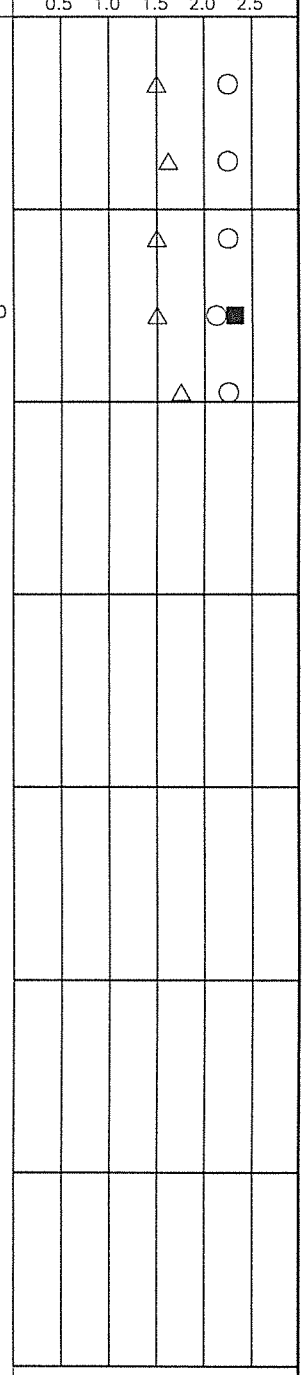
SURFACE ELEVATION : 59.79 FT.

DATE : 08-02-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 17.0 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, %
59.8	0	5" Concrete over 1" Shell							
59.3		Very stiff to hard dark gray SANDY FAT CLAY (CH) w/ferrous nodules				17			
						17			
	5	-gray and yellowish brown w/calcareous nodules 4'-6' -w/ferrous stains 4'-10'				13			
				69	112	17	51	21	30
						17			
49.8	10	Brown and gray SILTY SAND (SM)		33		6			
	15	-medium dense 15.5'-17'	12						
42.8									
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 17.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-38

LOG OF BORING NO. GB-39

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13815201.89, E 3075175.37
Bonhomme; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 12.0 FT.

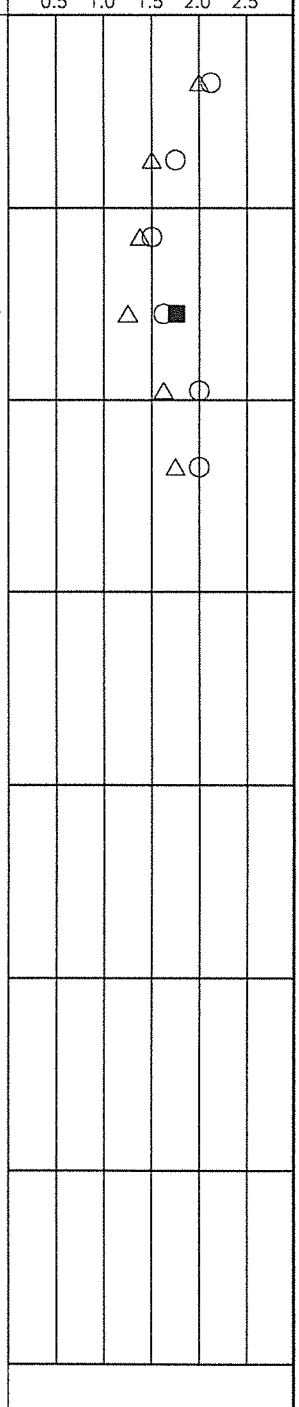
SURFACE ELEVATION : 60.91 FT.

DATE : 08-05-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
60.9	0			6" Concrete							
60.4				Hard gray FAT CLAY (CH) w/sand, calcareous and ferrous nodules -very stiff 2'-8' -yellowish brown and gray 2'-12'				18			
								16			
	5							18			
				-very stiff to hard 8'-12'		76	111	17	50	14	36
	10							15			
48.9								15			
	15										
	20										
	25										
	30										
	35										



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-39

LOG OF BORING NO. GB-40

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814575.68, E 3075199.48
Bonhomme; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 24.0 FT.

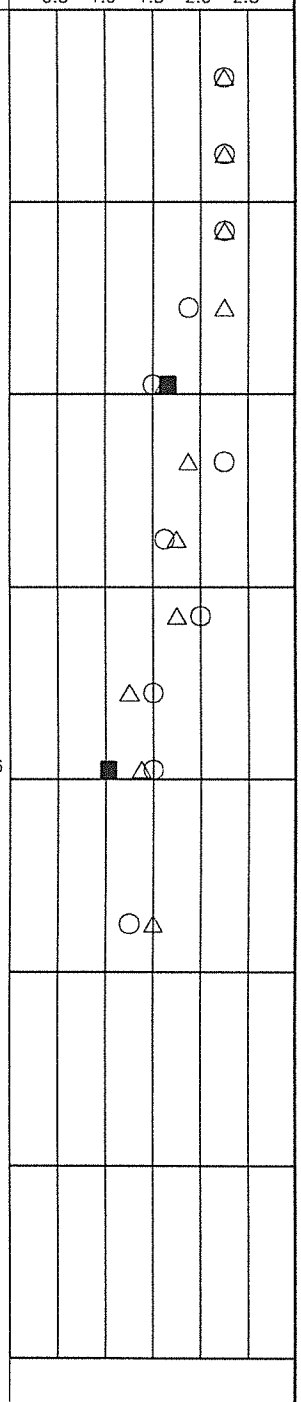
SURFACE ELEVATION : 62.56 FT.

DATE : 07-31-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 24.0 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, %
62.6	0								
62.0		6.5" Concrete							
		Hard dark gray FAT CLAY (CH) w/sand, calcareous nodules and ferrous stains				14			
						14			
	5								
		-very stiff to hard gray and yellowish brown 6'-8'				15			
		-w/ferrous nodules 6'-18'				16			
		-very stiff 8'-10'							
	10	-stiff to very stiff 10'-12'		78	113	18	52	21	31
		-reddish brown and gray w/calcareous nodules 10'-18'				15			
		-very stiff 12'-14'							
		-very stiff to hard 14'-16'				14			
	15								
		-very stiff 16'-18'				16			
44.6						20			
		Very stiff reddish brown and gray FAT CLAY (CH) w/calcareous and ferrous nodules		97	100	26	60	24	36
	20								
38.6						30			
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 24.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-41 (GB-41P)

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814458.18, E 3075203.48
Bonhomme; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 24.0 FT.

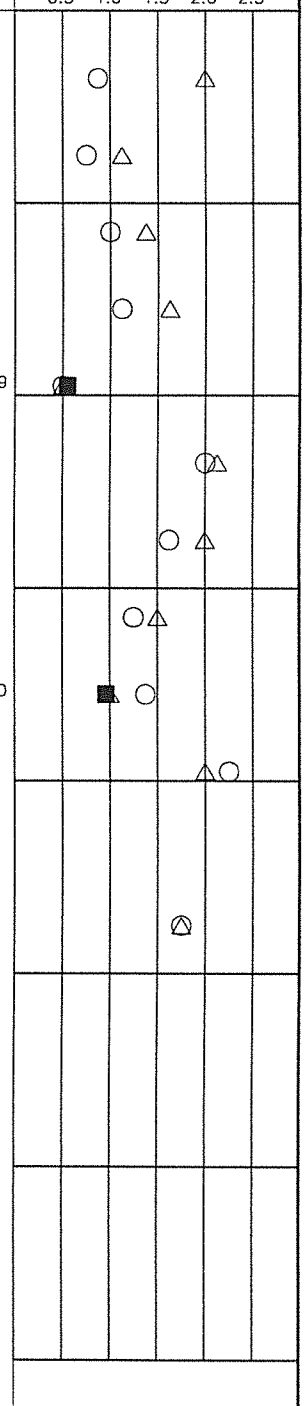
SURFACE ELEVATION : 61.17 FT.

DATE : 07-31-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 24.0 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, %
61.2	0	6.25" Concrete							
60.6		Stiff to hard dark gray LEAN CLAY (CL) w/sand and ferrous stains				16			
		-stiff to very stiff 2'-4'				17			
		-very stiff 4'-8'							
	5	-yellowish brown and gray 4'-10'				19			
		-w/calcareous and ferrous nodules 4'-16'							
		-stiff 8'-10'				20			
	10	-hard 10'-12'		83	101	24	47	18	29
		-very stiff to hard 12'-14'				21			
		-very stiff 14'-16'				16			
	15								
45.2		Very stiff reddish brown and gray SANDY FAT CLAY (CH) w/calcareous and ferrous nodules				16			
		-hard 18'-20'		57	113	18	50	20	30
	20					26			
37.2						29			
	25	NOTE : See Piezometer GB-41P for water level measurements.							
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
▼: WATER DEPTH AT 9.8 FT., HOLE OPEN TO 24.0 FT. ON 09-08-13.

Geotest Engineering, Inc.

FIGURE A-41

LOG OF BORING NO. GB-42

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813935.57, E 3075225.16
Bonhomme; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 12.0 FT.

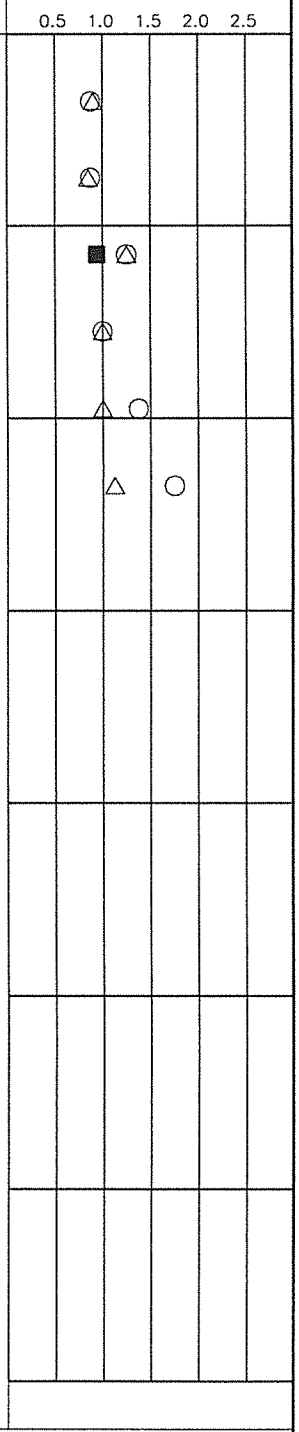
SURFACE ELEVATION : 59.63 FT.

DATE : 08-05-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
59.6	0	6.75" Concrete							
59.1		Stiff yellowish brown and gray FAT CLAY (CH) w/sand, ferrous and calcareous nodules				22			
						20			
	5	-stiff to very stiff, slickensided 4'-6'							
		-very stiff 6'-12'		84	107	22	51	21	30
		-reddish brown and gray 8'-12'				20			
	10					19			
47.6						21			
	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 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-42

LOG OF BORING NO. GB-43

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813595.16, E 3075307.47
Bonhomme; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 12.0 FT.

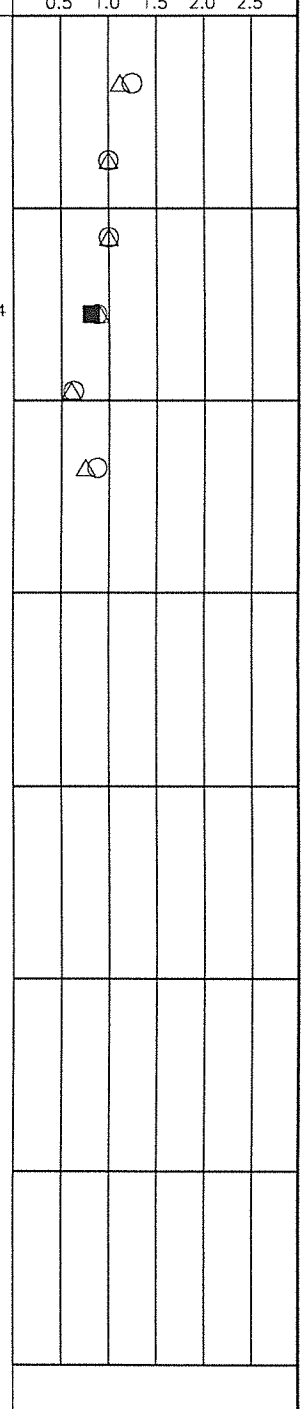
SURFACE ELEVATION : 60.76 FT.

DATE : 08-05-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
60.8	0	7.5" Concrete							
60.1		Very stiff dark gray FAT CLAY (CH) w/sand, ferrous nodules and ferrous stains				20			
		-yellowish brown and gray 4'-12'				22			
	5	-stiff 6'-12'				22			
				84	104	23	57	23	34
	10					29			
48.8						28			
	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-43

LOG OF BORING NO. GB-44

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813016.83, E 3075331.71
Bonhomme; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 23.0 FT.

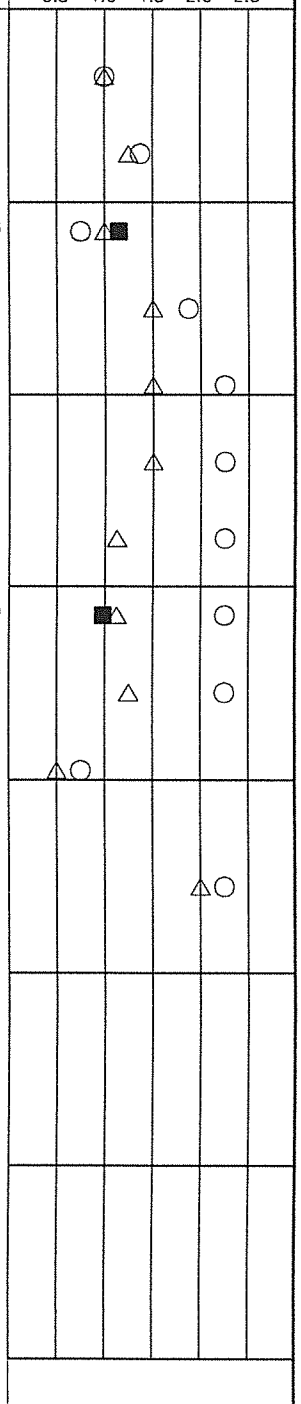
SURFACE ELEVATION : 60.59 FT.

DATE : 08-08-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 23.0 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, %
60.6	0	7.5" Concrete							
60.0		Very stiff dark gray FAT CLAY (CH) w/sand -w/calcareous and ferrous nodules 2'-8' -stiff to very stiff 4'-6' -yellowish brown and gray 4'-8'				22			
						19			
	5			80	110	20	59	23	36
54.6		Very stiff reddish brown and gray SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules -very stiff to hard 8'-18'				16			
	10					14			
						13			
						13			
	15			57	120	13	32	13	19
		-stiff 18'-20'				13			
	20					14			
			26	55		18			
37.6						23			
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 23.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-45

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814933.09, E 3075487.07
Cadawac; See Plan of Borings (Figure 2.3)

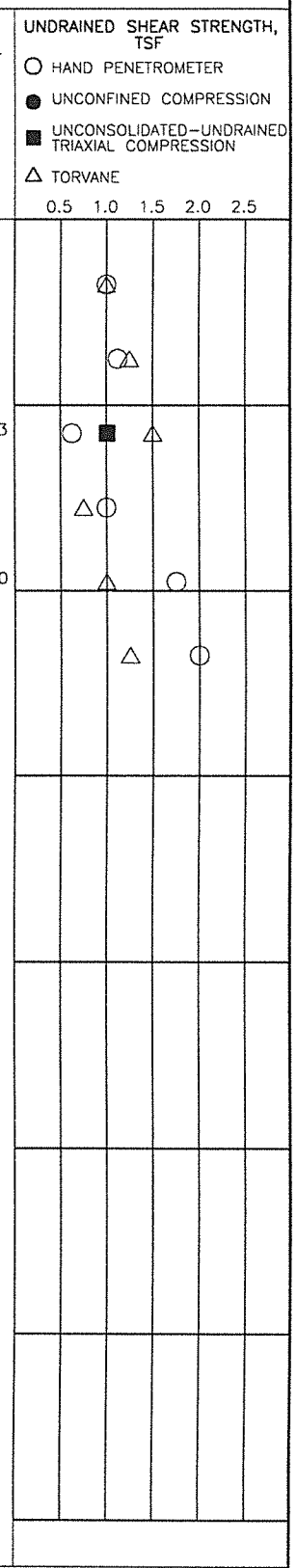
COMPLETION DEPTH : 12.0 FT.

SURFACE ELEVATION : 59.99 FT.

DATE : 08-07-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
60.0	0								
59.3		6.5" Concrete over 2" Oyster Shell							
		Very stiff dark gray FAT CLAY (CH) w/sand				21			
		-yellowish brown and gray 2'-4'				17			
	5	-stiff to very stiff w/calcareous and ferrous nodules and fer		83	109	20	55	22	33
52.0						22			
		Very stiff yellowish brown and gray SANDY LEAN CLAY (CL)							
	10	-very stiff to hard 10'-12'		58		13	32	12	20
48.0						15			
	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-45

LOG OF BORING NO. GB-46

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13815150.23, E 3075816.51
Troulon (East); See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 12.0 FT.

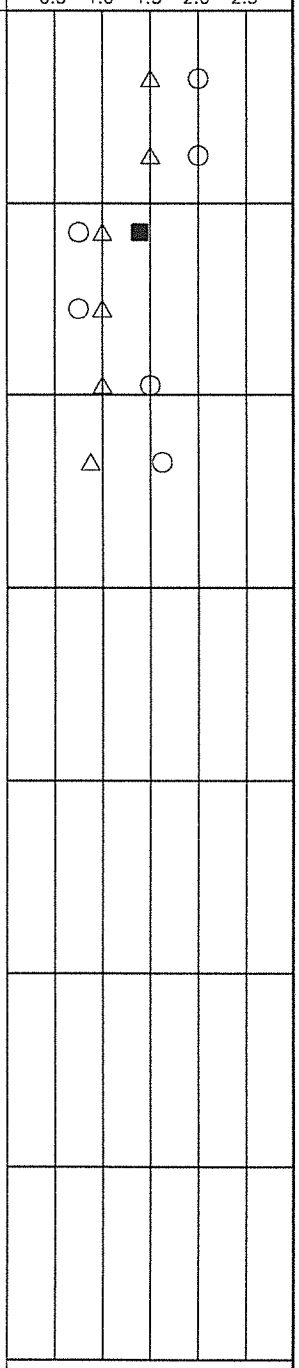
SURFACE ELEVATION : 60.22 FT.

DATE : 08-06-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
60.2	0			6" Concrete over 1" Oyster Shell							
59.6				Very stiff to hard yellowish brown and gray FAT CLAY (CH) w/sand, calcareous and ferrous nodules				15			
								15			
	5			-stiff to very stiff 4'-8' -w/ferrous stains 6'-12'		77	110	19	50	22	28
52.2				Very stiff yellowish brown and gray LEAN CLAY (CL) w/sand, ferrous nodules and ferrous stains				18			
	10							16			
48.2								15			
	15										
	20										
	25										
	30										
	35										



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-47

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814722.93, E 3076380.32
Lugary; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 12.0 FT.

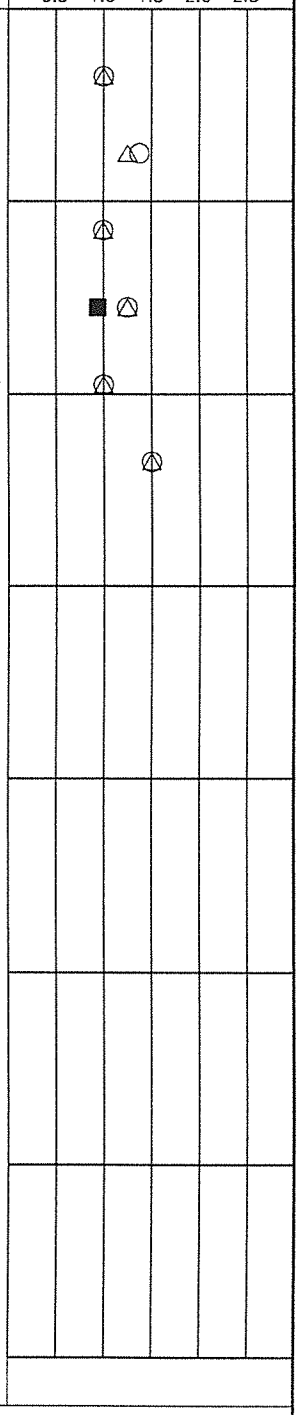
SURFACE ELEVATION : 60.11 FT.

DATE : 08-06-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
60.1	0	6.5" Concrete over 1" Oyster Shell and Gravel Mix				20			
59.5		Very stiff dark gray FAT CLAY (CH) w/sand, calcareous and ferrous nodules				19			
	5	-gray and yellowish brown 6'-8'				21			
				84	104	23	56	22	34
	10			80		21	56	22	34
48.1						19			
	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-48

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814479.17, E 3075706.34
Esmt C (West); See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 12.0 FT.

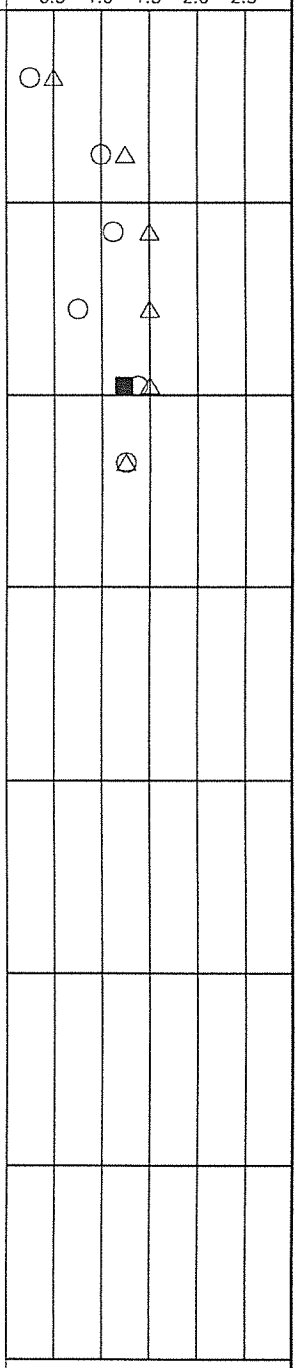
SURFACE ELEVATION : 61.94 FT.

DATE : 08-09-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
61.9	0	2" Asphalt over 5" Shell and Sand Mix							
61.4		Medium stiff to stiff yellowish brown and gray FAT CLAY (CH) w/sand, calcareous and ferrous nodules -very stiff 2'-6' -w/ferrous stains 2'-12' -stiff to very stiff 6'-8' -very stiff 8'-12'				23			
	5					19			
						21			
						19			
	10			81	109	19	52	20	32
49.9						17			
	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-48

LOG OF BORING NO. GB-49

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814524.45, E 3076675.04
Esmt B (North); See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 12.0 FT.

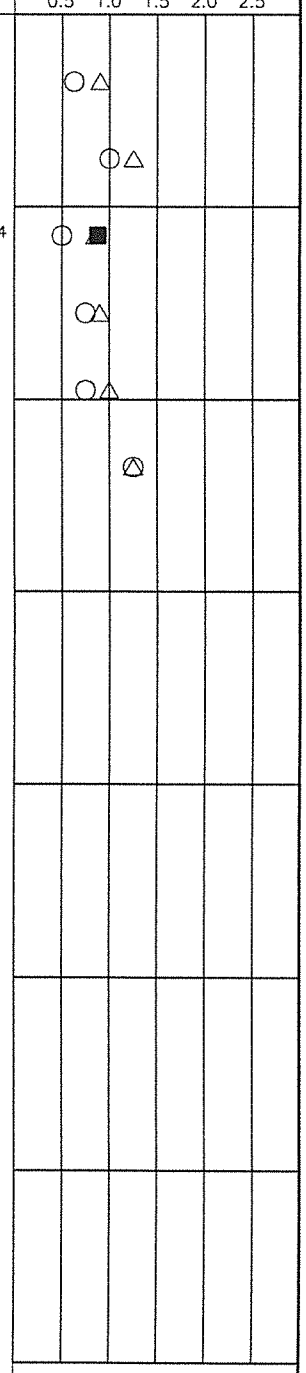
SURFACE ELEVATION : 61.68 FT.

DATE : 08-09-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
61.7	0			3" Asphalt over 3" Sand and Shell Mix							
61.2				Stiff yellow and gray FAT CLAY (CH) w/calcareous and ferrous nodules and ferrous stains				22			
								19			
	5			-very stiff dark gray 2'-4'							
				-yellowish brown and gray 6'-8'		81	105	21	56	22	34
				-stiff to very stiff 8'-10'				22			
	10			-very stiff 10'-12'				24			
49.7								24			
	15										
	20										
	25										
	30										
	35										



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-49

LOG OF BORING NO. GB-50

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814499.07, E 3076106.93
Esmt B (North); See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 12.0 FT.

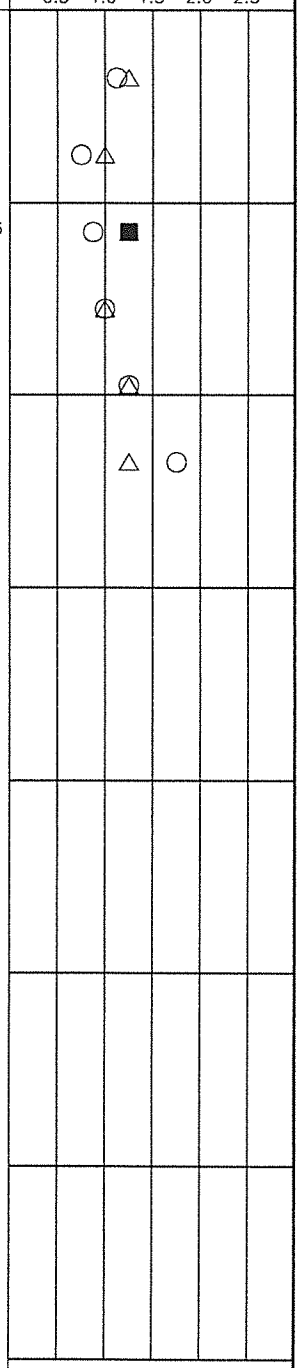
SURFACE ELEVATION : 61.81 FT.

DATE : 08-09-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
61.8	0								
61.1		3" Asphalt over 5" Limestone							
		Very stiff dark gray FAT CLAY (CH) w/sand				17			
		-stiff to very stiff gray 2'-6'				20			
	5	-w/calcareous and ferrous nodules and ferrous stains 4'-12'		81	103	23	59	23	36
		-yellowish brown and gray 6'-10'				26			
51.8	10					23			
		Very stiff yellowish brown and gray LEAN CLAY (CL) w/sand and calcareous nodules				18			
49.8									
	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-50

LOG OF BORING NO. GB-51B

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814270.11, E 3075956.95
Esmt B; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 12.0 FT.

SURFACE ELEVATION : 61.24 FT.

DATE : 08-09-13

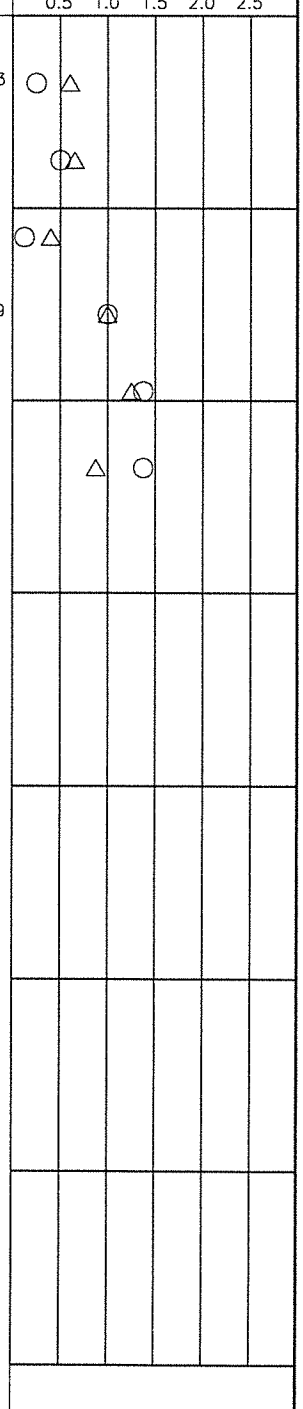
SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 FT.
WET ROTARY : -- TO -- FT.

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, %
61.2	0	2" Asphalt over 7" Limestone							
60.5		Medium stiff to stiff dark gray FAT CLAY (CH) w/sand and calcareous nodules -stiff dark gray 2'-4' -soft to medium stiff 4'-6' -very stiff 6'-10'		82		26	55	22	33
						25			
	5					26			
				84	96	31	64	25	39
51.2	10	Stiff to very stiff yellowish brown and gray LEAN CLAY (CL)				28			
49.2						18			
	15								
	20								
	25								
	30								
	35								

NOTE :
Encountered obstruction at 6' in boring GB-51.

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 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-51

LOG OF BORING NO. GB-52

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813612.75, E 3075986.18
Esmt B; See Plan of Borings (Figure 2.3)

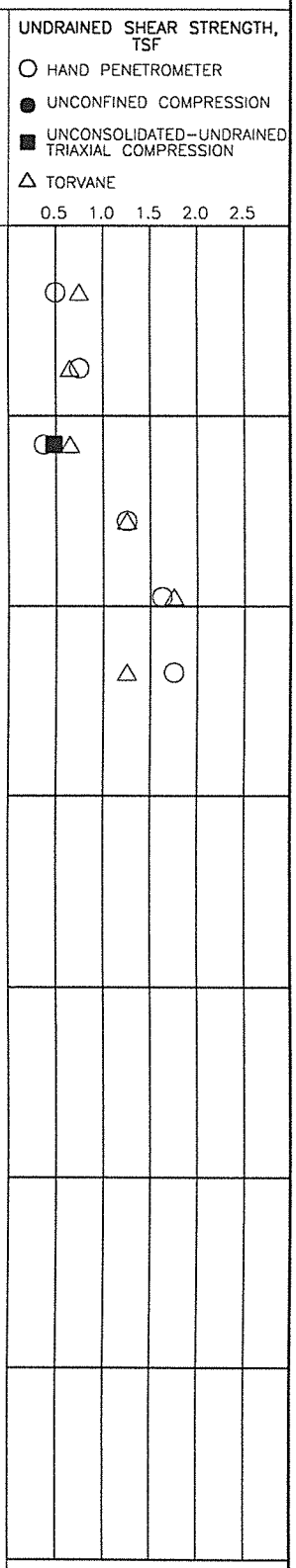
COMPLETION DEPTH : 12.0 FT.

SURFACE ELEVATION : 60.72 FT.

DATE : 08-09-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
60.7	0	3" Asphalt over 6" Limestone							
60.0		Stiff dark gray FAT CLAY (CH) w/sand and calcareous nodules -gray 2'-6' -medium stiff to stiff 4'-6' -yellowish brown and gray 6'-12' -very stiff w/ferrous nodules and ferrous stains 6'-12'				19			
						24			
	5			78	101	23	53	21	32
						23			
	10					21			
48.7						20			
	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-52

LOG OF BORING NO. GB-53

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13813920.22, E 3076384.86
Esmt A-D; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 12.0 FT.

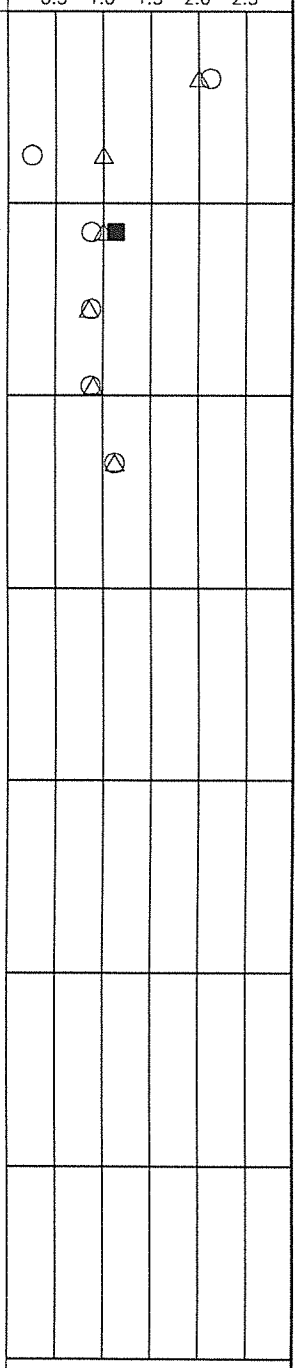
SURFACE ELEVATION : 61.09 FT.

DATE : 08-09-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
61.1	0			5" Concrete over 3" Limestone							
60.4				Hard dark gray FAT CLAY (CH) w/sand -medium stiff to very stiff 2'-4' -yellowish brown and gray 4'-6' -stiff to very stiff 4'-10' -w/calcareous and ferrous nodules and ferrous stains 4'-12' -very stiff 10'-12'				20			
								22			
	5					82	105	21	56	22	34
								25			
	10							26			
49.1								29			
	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 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-53

LOG OF BORING NO. GB-54

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814185.14, E 3076705.51
Kingsgate; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 24.0 FT.

SURFACE ELEVATION : 58.32 FT.

DATE : 08-09-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 18.5 FT.
WET ROTARY : 18.5 TO 24.0 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, %
58.3	0	7" Concrete over 1" Oyster Shell							
57.7		Stiff to very stiff gray FAT CLAY (CH) w/sand, ferrous nodules and ferrous stains				21			
						21			
	5	-medium stiff to very stiff 2'-4'		82	101	24	68	26	42
		-yellow and gray 4'-6'							
		-very stiff w/calcareous nodules 6'-8'				25			
50.3		Very stiff yellowish brown and gray SANDY LEAN CLAY (CL) w/sand							
	10					19			
		-medium stiff to stiff gray 12'-14'		60		14	36	14	22
		-clayey sand 13'-14'				16			
44.3		Medium dense yellowish brown and gray FINE SAND (SP-SM) w/silt							
	15		18	11		15			
			27			21			
	20		29			21			
		-dense 22.5'-24'							
34.3			30			21			
	25								
	30								
	35								

DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 17.0 FT. DURING DRILLING;
HOLE OPEN TO 24.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-54

LOG OF BORING NO. GB-55

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814859.80, E 3076821.76
Fonvilla; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 12.0 FT.

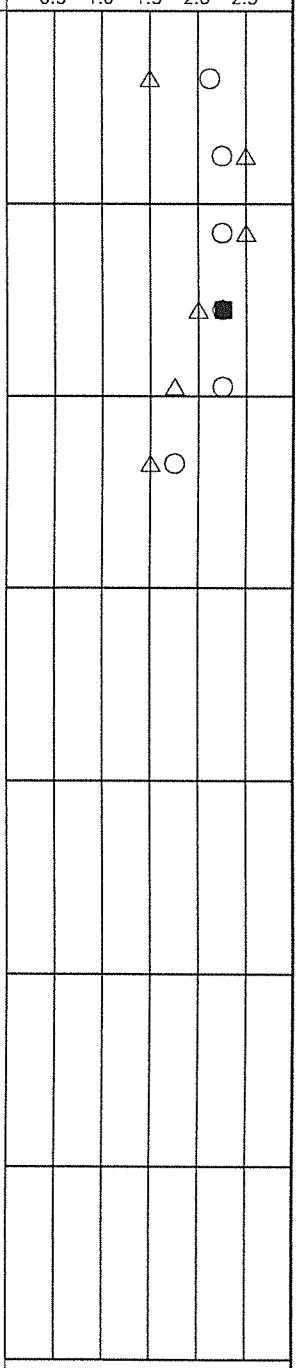
SURFACE ELEVATION : 59.67 FT.

DATE : 08-09-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
59.7	0			7" Concrete							
59.1				Very stiff to hard dark gray FAT CLAY (CH) w/sand, ferrous nodules and ferrous stains				14			
				-w/grass roots 7"-2'				13			
	5			-hard 2'-8'							
				-yellowish brown and gray 4'-12'				13			
				-w/calcareous nodules 6'-12'		84	111	15	50	21	29
	10			-very stiff 10'-12'				19			
47.7								18			
	15										
	20										
	25										
	30										
	35										



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 12.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-56 (GB-56P)

PROJECT : Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas

PROJECT NO. : 1140196001

LOCATION : N 13814919.85, E 3077307.54
Fonvilla; See Plan of Borings (Figure 2.3)

COMPLETION DEPTH : 12.0 FT.

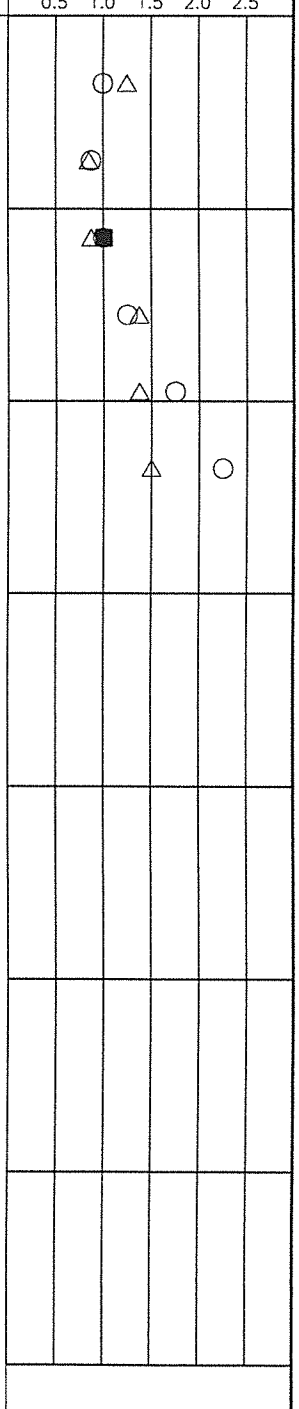
SURFACE ELEVATION : 59.66 FT.

DATE : 07-31-13

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 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, %
59.7	0								
59.1		6.5" Concrete							
		Very stiff dark gray FAT CLAY (CH) w/sand and ferrous nodules				18			
		-stiff 2'-4'				21			
		-stiff to very stiff 4'-6'							
	5	-yellowish brown and gray w/calcareous nodules 6'-10'		81	107	20	58	20	38
						20			
49.7	10					24			
		Very stiff to hard yellowish brown and gray LEAN CLAY (CL) w/sand and calcareous nodules				16			
47.7									
	15	NOTE : See Piezometer GB-56P for water level measurements.							
	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.
NO GROUNDWATER ENCOUNTERED, HOLE OPEN TO 12.0 FT. ON 09-08-13.

Geotest Engineering, Inc.

FIGURE A-56

LOG OF BORING NO. B-1

PROJECT : Sharpstown Area Drainage Improvements
Houston, Texas
File No. SM-5041, GFS No. M-0256-01-2

PROJECT NO. : 1140141601

LOCATION : See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

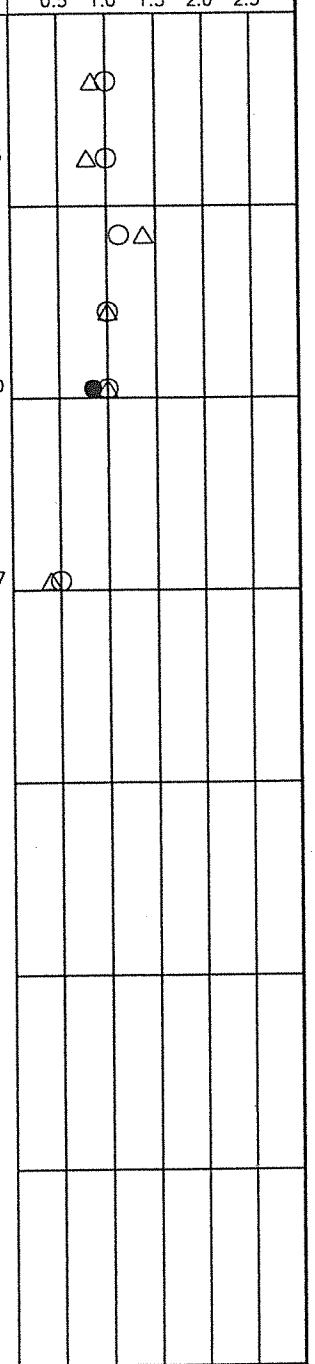
SURFACE ELEVATION : 60.58 FT.

DATE : 07-10-03

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, %
60.6	0	6" Portland Cement Concrete over 2" shell							
59.9		Stiff to very stiff gray & yellow CLAY (CH), slickensided, w/calcareous & ferrous nodules				19			
					100	23	55	22	33
	5	-gray & yellowish brown 4'-6'				21			
						20			
52.6		Stiff to very stiff gray & yellow SANDY CLAY (CL)							
	10	-w/sand & silt seams 10'-13'			103	20	34	14	20
		-gray & yellowish brown, w/calcareous & ferrous nodules 13'-15'				18	34	17	17
45.6	15								
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.

Geotest Engineering, Inc.

FIGURE A-57

LOG OF BORING NO. B-2

PROJECT : Sharpstown Area Drainage Improvements
Houston, Texas
File No. SM-5041, GFS No. M-0256-01-2

PROJECT NO. : 1140141601

LOCATION : See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

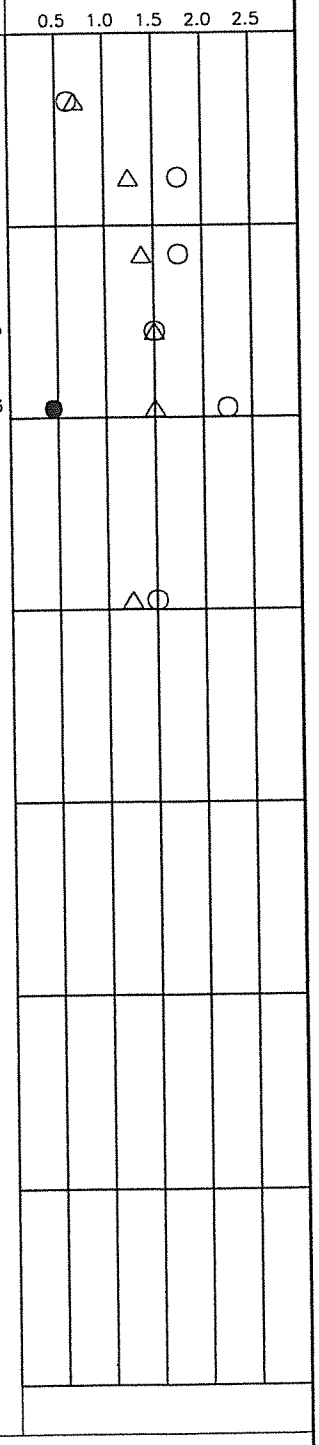
SURFACE ELEVATION : 59.48 FT.

DATE : 07-10-03

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, %
59.5	0	6" Portland Cement Concrete over 2" shell							
58.8		Stiff dark gray SILTY CLAY (CL), w/clay seams & ferrous nodules				20			
		-very stiff, gray & yellowish brown 2'-6'			103	20	48	20	28
	5	-w/calcareous nodules 4'-6'				19			
53.5		Very stiff to hard gray & yellow SANDY CLAY (CL), w/sand seams, and calcareous & ferrous nodules				15	40	15	25
	10	-w/ferrous stains 8'-15'			107	16	37	14	23
						18			
44.5	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.

Geotest Engineering, Inc.

FIGURE A-58

LOG OF BORING NO. B-3

PROJECT : Sharpstown Area Drainage Improvements
Houston, Texas
File No. SM-5041, GFS No. M-0256-01-2

PROJECT NO. : 1140141601

LOCATION : See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

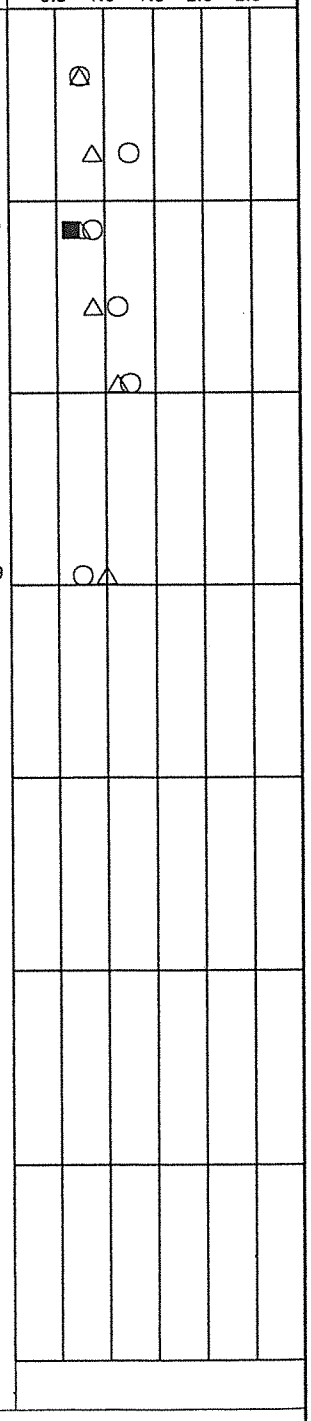
SURFACE ELEVATION : 58.90 FT.

DATE : 07-10-03

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, %
58.9	0	7" Portland Cement Concrete over 3" shell							
58.1		Stiff to very stiff gray & yellow CLAY (CH), slickensided, w/calcareous & ferrous nodules				21			
						21			
	5	-gray 2'-4'							
		-gray & yellowish brown, w/HYDROCARBON ODOR 4'-13'			97	26	50	21	29
						20			
	10					26			
45.9		Stiff gray SANDY CLAY (CL), w/calcareous & ferrous nodules, & HYDROCARBON ODOR							
43.9	15	-w/sand layer 14'-15'				16	35	16	19
	20								
	25								
	30								
	35								



DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.

Geotest Engineering, Inc.

FIGURE A-59

LOG OF BORING NO. B-9

PROJECT : Sharpstown Area Drainage Improvements
Houston, Texas
File No. SM-5041, GFS No. M-0256-01-2

PROJECT NO. : 1140141601

LOCATION : See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

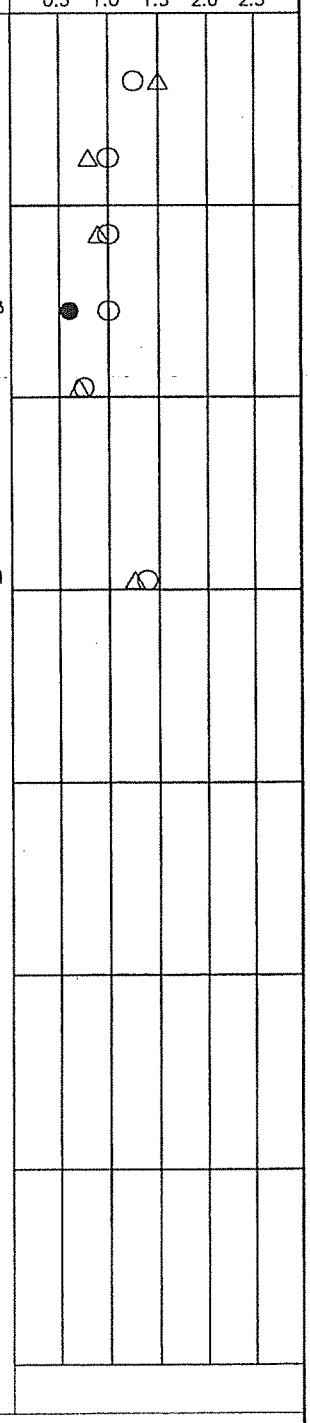
SURFACE ELEVATION : 61.66 FT.

DATE : 07-10-03

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, %
61.7	0	8.75" Portland Cement Concrete							
60.9		Stiff to very stiff dark gray CLAY (CH) -gray & yellow 2'-13' -slickensided, w/calcareous & ferrous nodules 4'-13'				20			
					103	19			
	5					21			
					99	22	55	22	33
	10					22			
48.7		Very stiff gray & yellow SANDY CLAY (CL), w/ferrous stains							
46.7	15					14	36	15	21
	20								
	25								
	30								
	35								



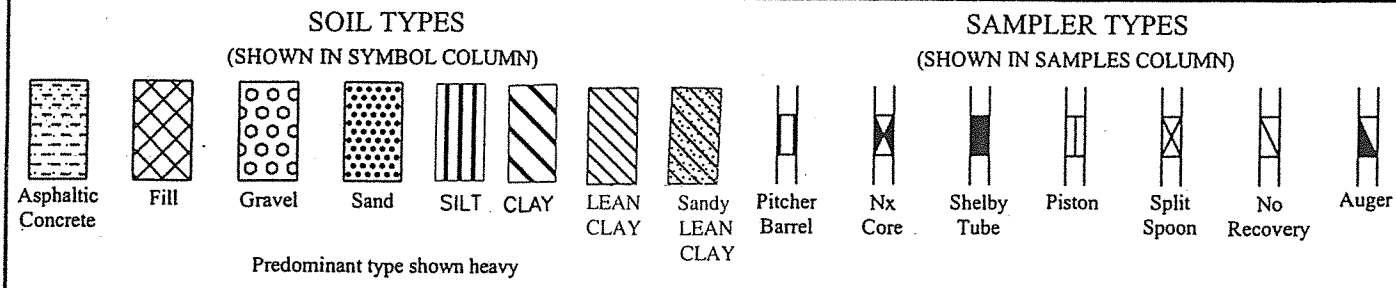
DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.

Geotest Engineering, Inc.

FIGURE A-60

Job No. 1140196001

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. 1140196001

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN SHARPSTOWN II AREA WBS NO. S-000035-0194-4		PIEZOMETER NUMBER: GB-2P
GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT AMANI ENGINEERING, INC.	HOUSTON, TEXAS

COMPLETION DATE 08-07-13

DRY AUGERED 0 TO 15 FT

WASH BORED -- TO -- FT

DRILLING FLUID: WATER

DEVELOPMENT DATE: 08-07-13

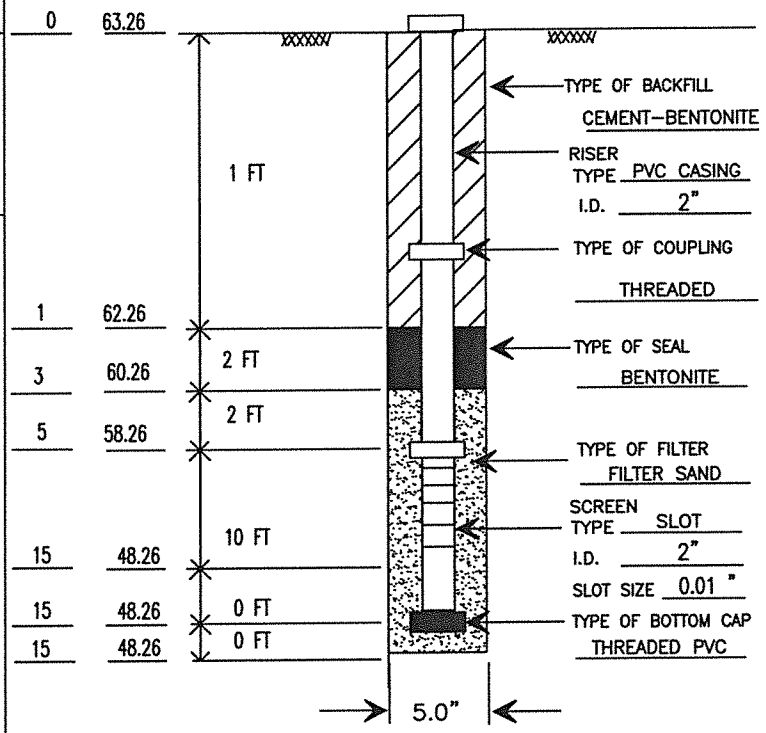
METHOD OF DEVELOPMENT:

BAILING

WATER LEVEL READINGS:

DATE	DEPTH (TOG)	ELEVATION
08-08-13	14.7	48.56
9-8-13	DRY	

DEPTH (FT)	ELEV. (FT)
0	63.26
1	62.26
3	60.26
5	58.26
15	48.26
15	48.26
15	48.26



(NOT TO SCALE)

REMARKS:

NOTES:

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

DRILLED BY: MG	STARTED: 08-07-13	NORTHING: 13814826.75 EASTING: 3072626.35
LOGGED BY: TM	COMPLETED: 08-07-13	GROUND LEVEL (MSL): 63.26 FT
CHECKED BY: NK	APPROVED BY: MB	SHEET 1 OF 1

Job No. 1140196001

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN SHARPSTOWN II AREA WBS NO. S-000035-0194-4	PIEZOMETER NUMBER: GB-8P

GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT AMANI ENGINEERING, INC.	HOUSTON, TEXAS

COMPLETION DATE 08-07-13

DRY AUGERED 0 TO 16 FT

WASH BORED 16 TO 23 FT

DRILLING FLUID: WATER

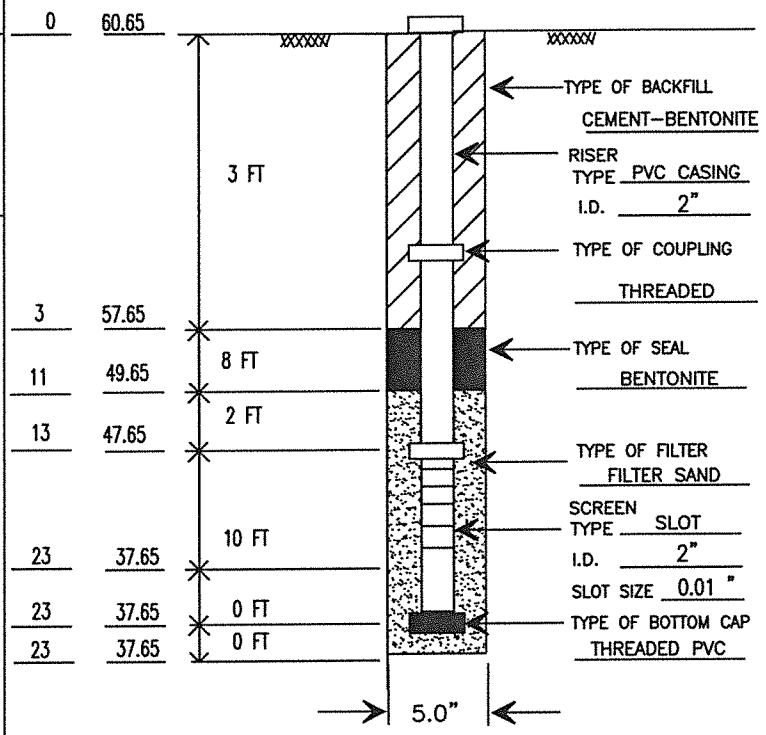
DEVELOPMENT DATE: 08-07-13

METHOD OF DEVELOPMENT:

BAILING

WATER LEVEL READINGS:

DATE	DEPTH (TOG)	ELEVATION
08-08-13	16.2	44.45
9-8-13	16.2	44.45



(NOT TO SCALE)

REMARKS:

NOTES:

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

DRILLED BY: MG	STARTED: 08-07-13	NORTHING: 13811401.17 EASTING: 3072770.19
LOGGED BY: TM	COMPLETED: 08-07-13	GROUND LEVEL (MSL): 60.65 FT
CHECKED BY: NK	APPROVED BY: MB	SHEET 1 OF 1

Job No. 1140196001

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN SHARPSTOWN II AREA WBS NO. S-000035-0194-4	PIEZOMETER NUMBER: GB-25P

GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT AMANI ENGINEERING, INC.	HOUSTON, TEXAS

COMPLETION DATE 07-31-13

DRY AUGERED 0 TO 16 FT

WASH BORED 16 TO 24 FT

DRILLING FLUID: WATER

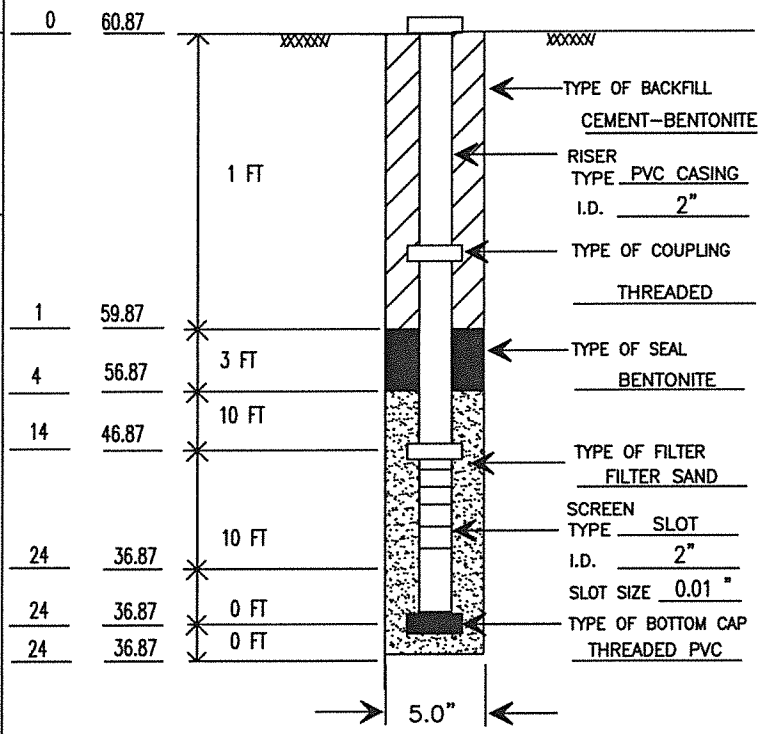
DEVELOPMENT DATE: 07-31-13

METHOD OF DEVELOPMENT:

BAILING

WATER LEVEL READINGS:

DATE	DEPTH (TOG)	ELEVATION
08-01-13	15.5	45.37
9-8-13	15.7	45.17



(NOT TO SCALE)

REMARKS:

NOTES:

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

DRILLED BY: MG	STARTED: 07-31-13	NORTHING: 13814544.55 EASTING: 3073969.15
LOGGED BY: TM	COMPLETED: 07-31-13	GROUND LEVEL (MSL): 60.87 FT
CHECKED BY: NK	APPROVED BY: MB	SHEET 1 OF 1

Job No. 1140196001

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN SHARPSTOWN II AREA WBS NO. S-000035-0194-4	PIEZOMETER NUMBER: GB-41P

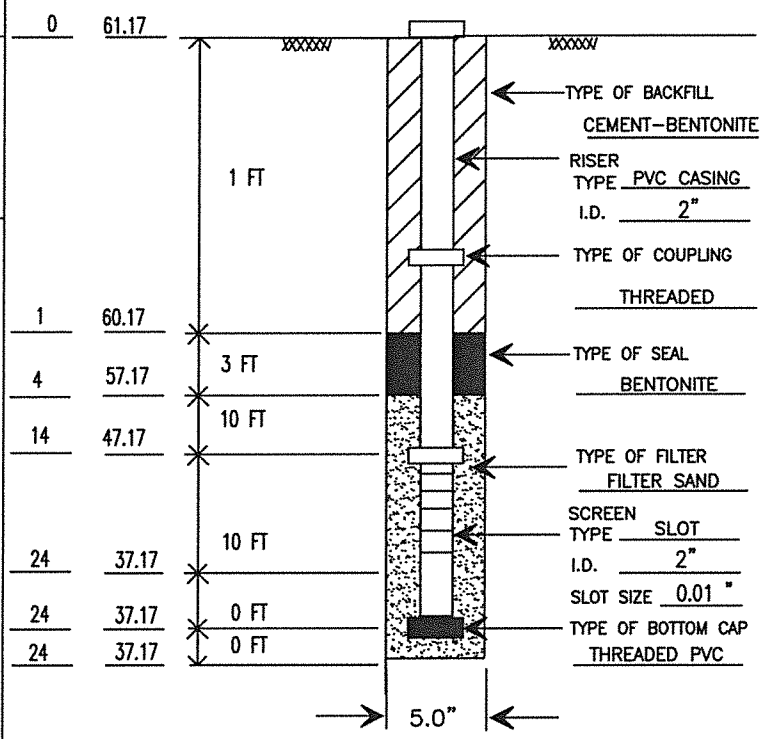
GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT AMANI ENGINEERING, INC.	HOUSTON, TEXAS

COMPLETION DATE 07-31-13
DRY AUGERED 0 TO 24 FT
WASH BORED -- TO -- FT
DRILLING FLUID: WATER

DEVELOPMENT DATE: 07-31-13
METHOD OF DEVELOPMENT:
BAILING

WATER LEVEL READINGS:

DATE	DEPTH (TOG)	ELEVATION
08-01-13	DRY	
9-8-13	9.8	51.37



(NOT TO SCALE)

REMARKS:

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

DRILLED BY: MG	STARTED: 07-31-13	NORTHING: 13814458.18 EASTING: 3075203.48
LOGGED BY: TM	COMPLETED: 07-31-13	GROUND LEVEL (MSL): 61.17 FT
CHECKED BY: NK	APPROVED BY: MB	SHEET 1 OF 1

Job No. 1140196001

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: WATER LINE REPLACEMENT IN SHARPSTOWN II AREA WBS NO. S-000035-0194-4	PIEZOMETER NUMBER: GB-56P

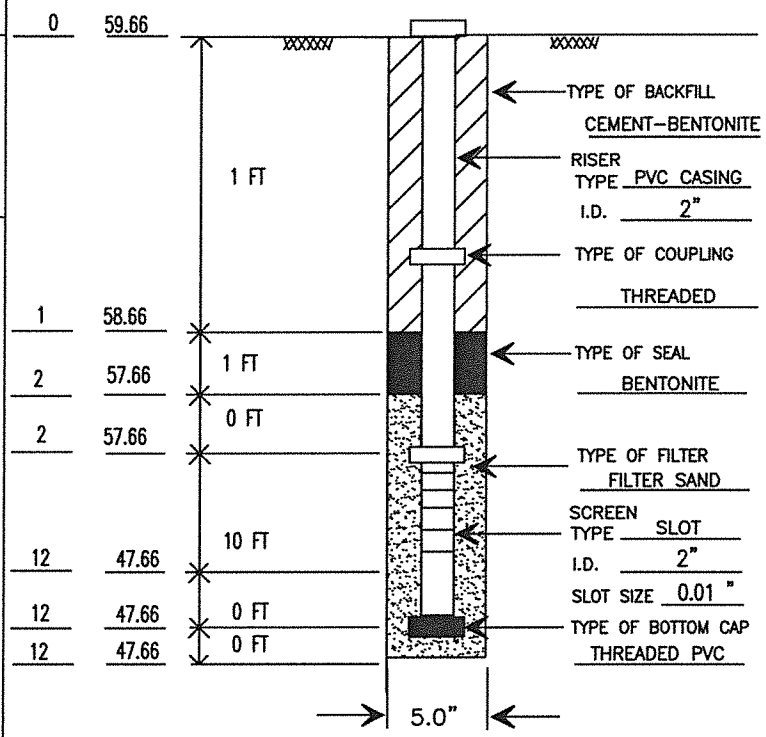
GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT AMANI ENGINEERING, INC.	HOUSTON, TEXAS

COMPLETION DATE 07-31-13
DRY AUGERED 0 TO 12 FT
WASH BORED -- TO -- FT
DRILLING FLUID: WATER

DEVELOPMENT DATE: 07-31-13
METHOD OF DEVELOPMENT:
BAILING

WATER LEVEL READINGS:

DATE	DEPTH (TOG)	ELEVATION
08-01-13	DRY	
9-8-13	DRY	



(NOT TO SCALE)

REMARKS:

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

DRILLED BY: MG	STARTED: 07-31-13	NORTHING: 13814919.85 EASTING: 3077307.54
LOGGED BY: TM	COMPLETED: 07-31-13	GROUND LEVEL (MSL): 59.66 FT
CHECKED BY: NK	APPROVED BY: MB	SHEET 1 OF 1

APPENDIX B

Figure

Summary of Laboratory Test Results ..... B-1 thru B-56

Grain Size Distribution Curves ..... B-57 thru B-58

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.8	2.0	UD		22									1.25	1.38	Fat Clay
	3	2.0	4.0	UD		20									1.75	1.50	Fat Clay
	4	4.0	6.0	UD		19	108	54	22	32	85		0.99	0.43	1.50	1.88	Fat Clay
	5	6.0	8.0	UD		22									1.50	1.88	Fat Clay
	6	8.0	10.0	UD		16									0.50	0.75	Sandy Lean Clay
	7	10.0	12.0	UD		17	114	35	15	20	70		1.03	0.86	1.50	1.88	Sandy Lean Clay
	8	12.0	14.0	UD		16									1.50	1.75	Sandy Lean Clay
	9	14.0	16.0	UD		14									1.00	1.38	Sandy Lean Clay
	10	16.0	18.0	UD		19									0.60	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-1

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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 (GB-2P)	2	0.7	2.0	UD		11									2.25	2.25	Fat Clay
	3	2.0	4.0	UD		13									2.25	2.25	Fat Clay
	4	4.0	6.0	UD		15									2.25	2.25	Fat Clay
	5	6.0	8.0	UD		15	116	50	21	29	83		2.94	0.58	2.25	2.25	Fat Clay
	6	8.0	10.0	UD		12									2.13	2.25	Fat Clay
	7	10.0	12.0	UD		15									2.25	2.25	Fat Clay
	8	12.0	14.0	UD		19									1.25	1.00	Fat Clay
	9	14.0	15.0	UD		18									1.25	1.13	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-2

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-3	2	0.5	2.0	UD		20									1.00	1.00	Fat Clay
	3	2.0	4.0	UD		22									0.80	1.00	Fat Clay
	4	4.0	6.0	UD		25	98	63	24	39	87		0.51	0.43	0.75	0.63	Fat Clay
	5	6.0	8.0	UD		25									1.00	1.00	Fat Clay
	6	8.0	10.0	UD		19									0.50	1.00	Lean Clay
	7	10.0	12.0	UD		20	109	32	18	14	81		0.44	0.86	0.30	0.25	Lean Clay
	8	12.0	14.0	UD		15									1.00	1.75	Lean Clay
	9	14.0	16.0	UD		15									0.75	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

FIGURE B-3

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-4	2	0.6	2.0	UD		18									1.63	0.88	Fat Clay
	3	2.0	4.0	UD		20									1.13	0.75	Fat Clay
	4	4.0	6.0	UD		21	106	58	23	35	86		0.78	0.43	1.13	0.50	Fat Clay
	5	6.0	8.0	UD		20									1.88	1.38	Fat Clay
	6	8.0	10.0	UD		20									1.50	1.13	Fat Clay
	7	10.0	12.0	UD		24									1.00	0.25	Fat Clay
	8	12.0	14.0	UD		19									1.13	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-4

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-5	2	1.1	2.0	UD		20									1.50	1.13	Fat Clay
	3	2.0	4.0	UD		19									1.63	1.00	Fat Clay
	4	4.0	6.0	UD		20									1.38	1.13	Fat Clay
	5	6.0	8.0	UD		21	107	57	20	37	86		1.06	0.58	1.50	1.63	Fat Clay
	6	8.0	10.0	UD		20									1.38	2.25	Fat Clay
	7	10.0	12.0	UD		25		68	26	42	98				1.63	1.63	Fat Clay
	8	12.0	14.0	UD		27									1.25	1.38	Fat Clay
	9	14.0	16.0	UD		19									0.88	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

FIGURE B-5

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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		23									1.38	1.13	Fat Clay
	3	2.0	4.0	UD		20									1.75	1.25	Fat Clay
	4	4.0	6.0	UD		19	108	55	20	35	83		1.00	0.43	1.75	1.13	Fat Clay
	5	6.0	8.0	UD		22									1.13	1.13	Fat Clay
	6	8.0	10.0	UD		25									1.25	1.13	Fat Clay
	7	10.0	12.0	UD		20	114	66	22	44	84		1.44	0.86	1.63	2.25	Fat Clay
	8	12.0	14.0	UD		19									2.00	2.25	Fat Clay
	9	14.0	16.0	UD		23									2.00	2.25	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-6

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	4	1.0	2.0	UD		23									1.25	1.25	Fat Clay
	5	2.0	4.0	UD		27									1.25	1.00	Fat Clay
	6	4.0	6.0	UD		20									1.00	1.00	Fat Clay
	7	6.0	8.0	UD		20	105	56	20	36	84		1.22	0.58	1.00	1.38	Fat Clay
	8	8.0	10.0	UD		16		44	25	19	80				1.25	1.63	Lean Clay
	9	10.0	12.0	UD		16									0.88	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-7

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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 (GB-8P)	3	0.9	2.0	UD		24									1.13	1.00	Sandy Fat Clay
	4	2.0	4.0	UD		23									1.13	1.25	Sandy Fat Clay
	5	4.0	6.0	UD		17									1.88	0.75	Sandy Fat Clay
	6	6.0	8.0	UD		22	103	53	19	34	68		0.73	0.58	1.13	0.88	Sandy Fat Clay
	7	8.0	10.0	UD		20									0.63	1.00	Sandy Fat Clay
	8	10.0	12.0	UD		18									0.63	1.00	Sandy Fat Clay
	9	12.5	14.0	SS	10	8											Silty Sand
	10	14.5	16.0	SS	10	25					22						Silty Sand
	11	16.5	18.0	SS	11	22											Silty Sand
	12	18.5	20.0	SS	26	23					12						Silty Sand
	13	21.5	23.0	SS	57	22											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-8

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	3	0.7	2.0	UD		16									1.88	1.63	Fat Clay
	4	2.0	4.0	UD		22									1.00	0.88	Fat Clay
	5	4.0	6.0	UD		22	106	58	23	35	84		0.78	0.43	1.13	0.75	Fat Clay
	6	6.0	8.0	UD		21									1.38	1.50	Fat Clay
	7	8.0	10.0	UD		17									1.25	1.25	Lean Clay
	8	10.0	12.0	UD		16									1.25	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-9

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.7	2.0	UD		19									1.00	1.00	Lean Clay
	3	2.0	4.0	UD		17									1.38	1.25	Lean Clay
	4	4.0	6.0	UD		21									1.25	1.13	Lean Clay
	5	6.0	8.0	UD		21	107	43	17	26	73		0.53	0.58	1.13	1.13	Lean Clay
	6	8.0	10.0	UD		18									1.50	1.38	Lean Clay
	7	10.0	12.0	UD		18									1.38	1.50	Lean Clay
	8	12.0	13.0	UD		17									1.38	1.25	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 Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.8	2.0	UD		16									1.25	1.25	Sandy Lean Clay
	3	2.0	4.0	UD		17									1.25	1.38	Sandy Lean Clay
	4	4.0	6.0	UD		18	114	42	16	26	66		1.27	0.43	1.00	1.38	Sandy Lean Clay
	5	6.0	8.0	UD		19									1.00	1.50	Sandy Lean Clay
	6	8.0	10.0	UD		20									0.38	0.88	Sandy Lean Clay
	7	10.0	12.0	UD		15					23						Silty Sand
	8	15.5	17.0	SS	6												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-11

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.5	2.0	UD		24									0.60	0.50	Fat Clay
	3	2.0	4.0	UD		22									1.00	0.88	Fat Clay
	4	4.0	6.0	UD		25	97	50	21	29	82		0.40	0.43	0.60	0.38	Fat Clay
	5	6.0	8.0	UD		21									1.50	1.25	Fat Clay
	6	8.0	10.0	UD		15											Fat Clay
	7	10.5	12.0	SS	6	6					18						Silty Sand
	8	12.5	14.0	SS	13	22											Silty Sand
	9	14.5	16.0	SS	9	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-12

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-13	2	0.5	2.0	UD		17									1.13	1.25	Sandy Lean Clay
	3	2.0	4.0	UD		18									1.75	1.13	Sandy Lean Clay
	4	4.0	6.0	UD		18									1.38	1.50	Sandy Lean Clay
	5	6.0	8.0	UD		22									1.75	1.50	Sandy Lean Clay
	6	8.0	10.0	UD		19	110	32	16	16	70		0.37	0.72	0.45	0.63	Sandy Lean Clay
	7	10.0	12.0	UD		18									1.25	0.88	Sandy Lean Clay
	8	12.0	14.0	UD		18									0.65	0.88	Sandy Lean Clay
	9	13.0	15.0	UD		18									0.65	0.88	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-13

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	3	1.0	2.0	UD		12									2.25	2.25	Sandy Lean Clay
	4	2.0	4.0	UD		14									2.25	2.25	Sandy Lean Clay
	5	4.0	6.0	UD		15									2.25	2.25	Sandy Lean Clay
	6	6.0	8.0	UD		13	116	34	18	16	56		1.64	0.58	1.13	2.25	Sandy Lean Clay
	7	8.0	10.0	UD		14									1.00	2.00	Silty Sand
	8	10.5	12.0	SS	12	11					31						Silty Sand
	9	15.5	17.0	SS	16												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-14

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-15	2	0.8	2.0	UD		20									1.00	1.25	Fat Clay
	3	2.0	4.0	UD		22									1.13	1.38	Fat Clay
	4	4.0	6.0	UD		24	102	61	24	37	84		0.71	0.43	0.70	0.75	Fat Clay
	5	6.0	8.0	UD		19									0.88	1.00	Fat Clay
	6	8.0	10.0	UD		23									0.50	0.25	Fat Clay
	7	10.0	12.0	UD		9									0.75	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

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-16	2	0.7	2.0	UD		18									2.13	1.13	Lean Clay
	3	2.0	4.0	UD		25									1.25	0.75	Lean Clay
	4	4.0	6.0	UD		27									1.38	1.38	Lean Clay
	5	6.0	8.0	UD		22	106	49	19	30	89		1.36	0.58	1.63	1.50	Lean Clay
	6	8.0	10.0	UD		20									1.63	2.13	Lean Clay
	7	10.0	12.0	UD		16									1.25	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-16

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.8	2.0	UD		21									0.75	0.88	Fat Clay
	3	2.0	4.0	UD		20	108	56	21	35	85		1.12	0.29	1.00	0.88	Fat Clay
	4	4.0	6.0	UD		25									0.88	1.00	Fat Clay
	5	6.0	8.0	UD		21									1.13	1.38	Fat Clay
	6	8.0	10.0	UD		19									0.88	1.38	Fat Clay
	7	10.0	12.0	UD		24									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-17

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.7	2.0	UD		25									0.80	0.50	Fat Clay
	3	2.0	4.0	UD		25									1.00	0.88	Fat Clay
	4	4.0	6.0	UD		29									1.00	1.00	Fat Clay
	5	6.0	8.0	UD		34									0.70	0.50	Fat Clay
	6	8.0	10.0	UD		26	101	56	22	34	93		1.17	0.72	1.38	1.38	Fat Clay
	7	10.0	12.0	UD		23									1.25	1.38	Fat Clay
	8	12.0	14.0	UD		18									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-18

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-19	2	0.6	2.0	UD		25									0.75	0.75	Fat Clay
	3	2.0	4.0	UD		21									0.85	0.88	Fat Clay
	4	4.0	6.0	UD		25	103	62	24	38	91		0.92	0.43	1.00	1.00	Fat Clay
	5	6.0	8.0	UD		27									1.25	1.38	Fat Clay
	6	8.0	10.0	UD		26									1.63	1.88	Fat Clay
	7	10.0	12.0	UD		24									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-19

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-20	2	0.7	2.0	UD		27									0.60	0.25	Fat Clay
	3	2.0	4.0	UD		26									0.60	0.38	Fat Clay
	4	4.0	6.0	UD		25	98	70	26	44	89		0.75	0.43	0.80	0.63	Fat Clay
	5	6.0	8.0	UD		28									1.13	1.25	Fat Clay
	6	8.0	10.0	UD		27									1.50	1.38	Fat Clay
	7	10.0	12.0	UD		26									1.00	1.25	Fat Clay
	8	12.0	14.0	UD		17									0.60	0.63	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-20

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.8	2.0	UD		24									0.80	0.50	Fat Clay
	3	2.0	4.0	UD		27									0.70	0.38	Fat Clay
	4	4.0	6.0	UD		28									0.75	0.75	Fat Clay
	5	6.0	8.0	UD		31	91	75	28	47	93		0.40	0.58	1.00	1.00	Fat Clay
	6	8.0	10.0	UD		22									2.00	1.88	Fat Clay
	7	10.0	12.0	UD		34									0.60	0.50	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-21

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-22	2	0.7	2.0	UD		24									0.75	0.75	Fat Clay
	3	2.0	4.0	UD		21									1.25	1.25	Fat Clay
	4	4.0	6.0	UD		21									1.50	1.38	Fat Clay
	5	6.0	8.0	UD		26									1.00	0.63	Fat Clay
	6	8.0	10.0	UD		26	97	77	28	49	91		0.71	0.72	1.00	0.75	Fat Clay
	7	10.0	12.0	UD		22									0.35	0.25	Fat Clay
	8	12.0	14.0	UD		22		64	25	39	99				2.00	2.25	Fat Clay
	9	14.0	16.0	UD		16									1.00	1.00	Lean Clay
	10	16.0	18.0	UD		19									0.50	0.75	Lean Clay
	11	18.0	19.0	UD		18									0.88	1.25	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

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	1	0.0	2.0	UD		15										2.25	Fat Clay
	2	2.0	4.0	UD		19									2.00	2.25	Fat Clay
	3	4.0	6.0	UD		20	106	62	24	38	92		2.84	0.43	2.00	2.25	Fat Clay
	4	6.0	8.0	UD		25									2.00	1.00	Fat Clay
	5	8.0	10.0	UD		29									1.13	1.25	Fat Clay
	6	10.0	12.0	UD		24									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-23

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.7	2.0	UD		15									1.38	1.88	Fat Clay
	3	2.0	4.0	UD		19									1.00	1.13	Fat Clay
	4	4.0	6.0	UD		20									1.00	0.88	Fat Clay
	5	6.0	8.0	UD		23		50	21	29	90				1.50	1.50	Fat Clay
	6	8.0	10.0	UD		16									0.75	1.13	Sandy Lean Clay
	7	10.0	12.0	UD		19	113	40	18	22	70		0.91	0.86	0.60	0.50	Sandy Lean Clay
	8	12.0	14.0	UD		14									1.00	1.88	Sandy Lean Clay
	9	14.0	16.0	UD		13									1.50	2.25	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-24

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-25 (GB-25P)	2	0.5	2.0	UD		18									0.88	0.88	Fat Clay
	3	2.0	4.0	UD		16									1.00	1.25	Fat Clay
	4	4.0	6.0	UD		18	113	50	22	28	81		1.75	0.43	1.00	1.25	Fat Clay
	5	6.0	8.0	UD		18									1.38	1.75	Fat Clay
	6	8.0	10.0	UD		20									1.38	0.63	Fat Clay
	7	10.0	12.0	UD		17									0.35	0.63	Sandy Lean Clay
	8	12.5	14.0	SS	11	11											Silty Sand
	9	14.5	16.0	SS	10	22					15						Silty Sand
	10	16.5	18.0	SS	12	24											Silty Sand
	11	18.5	20.0	SS	23	20											Silty Sand
	12	22.0	24.0	UD		19		52	24	28	86				1.88	2.13	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-25

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.5	2.0	UD		19									1.00	0.75	Fat Clay
	3	2.0	4.0	UD		15									1.88	1.50	Fat Clay
	4	4.0	6.0	UD		20	111	54	22	32	80		0.72	0.43	1.38	1.25	Fat Clay
	5	6.0	8.0	UD		19									1.25	1.50	Fat Clay
	6	8.0	10.0	UD		18	112						1.22	0.72	1.25	1.25	Fat Clay
	7	10.0	12.0	UD		15									0.50	0.25	Sandy Lean Clay
	8	12.5	14.0	SS	14	6					13						Silty Sand
	9	14.5	16.0	SS	14	20											Silty Sand
	10	16.5	18.0	SS	10	23											Silty Sand
	11	18.5	20.0	SS	37	21											Silty Sand
	12	22.0	24.0	UD		27		70	26	44	89				1.13	1.38	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 Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.5	2.0	UD		20									1.00	1.00	Fat Clay
	3	2.0	4.0	UD		20									0.88	0.75	Fat Clay
	4	4.0	6.0	UD		20									1.00	1.25	Fat Clay
	5	6.0	8.0	UD		22	105	52	20	32	82		0.84	0.58	1.13	1.38	Fat Clay
	6	8.0	10.0	UD		19									1.25	1.50	Fat Clay
	7	10.0	12.0	UD		20									1.38	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-27

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-28	2	0.6	2.0	UD		16									2.25	2.25	Fat Clay
	3	2.0	4.0	UD		18									2.25	2.25	Fat Clay
	4	4.0	6.0	UD		19									2.25	2.25	Fat Clay
	5	6.0	8.0	UD		20	107	73	27	46	92		1.83	0.58	2.25	2.25	Fat Clay
	6	8.0	10.0	UD		18									2.25	2.25	Fat Clay
	7	10.0	12.0	UD		16									2.00	2.25	Fat Clay
	8	12.0	14.0	UD		16									1.50	2.13	Fat Clay
	9	14.0	15.0	UD		18									1.63	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-28

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.7	2.0	UD		23									1.75	1.88	Fat Clay
	3	2.0	4.0	UD		19									2.25	2.25	Fat Clay
	4	4.0	6.0	UD		18	106	68	26	42	86		2.15	0.43	2.25	2.25	Fat Clay
	5	6.0	8.0	UD		16									2.25	2.00	Fat Clay
	6	8.0	10.0	UD		30									1.13	0.75	Fat Clay
	7	10.0	12.0	UD		27									1.38	1.25	Fat Clay
	8	12.0	14.0	UD		16	116	26	13	13	72		0.61	1.01	1.00	0.75	Lean Clay
	9	14.0	16.0	UD		17									0.63	1.00	Lean Clay
	10	16.0	18.0	UD		16									1.75	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-29

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.0	2.0	UD		25									0.60	0.63	Fat Clay
	3	2.0	4.0	UD		22									1.25	1.25	Fat Clay
	4	4.0	6.0	UD		21									2.25	2.25	Fat Clay
	5	6.0	8.0	UD		21									2.25	2.25	Fat Clay
	6	8.0	10.0	UD		27	99	73	27	46	93		1.02	0.72	1.13	0.75	Fat Clay
	7	10.0	12.0	UD		25									1.00	1.00	Fat Clay
	8	12.0	14.0	UD		19	112	36	15	21	72		0.66	1.01	0.50	0.63	Lean Clay
	9	14.0	16.0	UD		19									1.00	1.38	Lean Clay
	10	16.0	18.0	UD		19									1.13	1.38	Lean Clay
	11	18.0	20.0	UD		24									1.75	1.75	Lean Clay
	12	21.0	23.0	UD		28									1.75	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

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.8	2.0	UD		20									1.25	1.13	Lean Clay
	3	2.0	4.0	UD		20									1.00	1.00	Lean Clay
	4	4.0	6.0	UD		21									1.25	1.13	Lean Clay
	5	6.0	8.0	UD		20	105	44	20	24	79		0.86	0.58	1.00	0.63	Lean Clay
	6	8.0	10.0	UD		20									0.60	1.00	Lean Clay
	7	10.0	11.0	UD		16									0.60	0.75	Lean Clay
	8	11.0	12.0	UD		19									0.75	0.63	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

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-32	2	0.7	2.0	UD		19									1.63	1.00	Lean Clay
	3	2.0	4.0	UD		19									1.50	1.13	Lean Clay
	4	4.0	6.0	UD		19	108	48	17	31	79		1.06	0.43	1.50	1.50	Lean Clay
	5	6.0	8.0	UD		19									1.50	1.88	Lean Clay
	6	8.0	10.0	UD		17									2.00	1.38	Lean Clay
	7	10.0	12.0	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

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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									1.13	0.88	Sandy Lean Clay
	3	2.0	4.0	UD		18									1.00	0.63	Sandy Lean Clay
	4	4.0	6.0	UD		19									1.38	1.13	Sandy Lean Clay
	5	6.0	8.0	UD		16	116	45	19	26	55		2.22	0.58	2.25	2.25	Sandy Lean Clay
	6	8.0	10.0	UD		20									1.25	1.38	Sandy Lean Clay
	7	10.0	12.0	UD		18									1.50	0.88	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-33

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	2	0.6	2.0	UD		18									1.13	1.38	Fat Clay
	3	2.0	4.0	UD		17									1.50	2.00	Fat Clay
	4	4.0	6.0	UD		17									2.00	1.50	Fat Clay
	5	6.0	8.0	UD		18	114	62	21	41	81		1.20	0.58	1.50	1.38	Fat Clay
	6	8.0	10.0	UD		18									1.75	1.38	Fat Clay
	7	10.0	12.0	UD		17									1.13	1.38	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-34

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	2	0.5	2.0	UD												1.13	Sandy Lean Clay
	3	2.0	4.0	UD		22									0.70	0.88	Sandy Lean Clay
	4	4.0	6.0	UD		19	108	49	17	32	68		0.82	0.43	1.00	0.88	Sandy Lean Clay
	5	6.0	8.0	UD		18									1.50	1.75	Sandy Lean Clay
	6	8.0	10.0	UD		21									1.50	2.25	Sandy Lean Clay
	7	10.0	12.0	UD		17									1.00	2.00	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

SUMMARY OF LABORATORY TEST RESULTS

CEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.6	2.0	UD		19									0.90	0.88	Fat Clay
	3	2.0	4.0	UD		23									1.00	1.00	Fat Clay
	4	4.0	6.0	UD		22	108	52	21	31	81		0.71	0.43	1.00	1.00	Fat Clay
	5	6.0	8.0	UD		18									1.25	1.88	Lean Clay
	6	8.0	10.0	UD		19		44	16	28	92				1.25	1.75	Lean Clay
	7	10.0	12.0	UD		16									1.25	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-36

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-37	2	0.7	2.0	UD		15									1.50	2.25	Fat Clay
	3	2.0	4.0	UD		17									1.75	2.25	Fat Clay
	4	4.0	6.0	UD		24	103	65	25	40	90		1.79	0.43	1.50	1.50	Fat Clay
	5	6.0	8.0	UD		16									1.00	1.13	Fat Clay
	6	8.0	10.0	UD		21									0.70	0.50	Fat Clay
	7	10.0	12.0	UD		15									0.50	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 Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-38	2	0.5	2.0	UD		17									1.50	2.25	Sandy Fat Clay
	3	2.0	4.0	UD		17									1.63	2.25	Sandy Fat Clay
	4	4.0	6.0	UD		13									1.50	2.25	Sandy Fat Clay
	5	6.0	8.0	UD		17	112	51	21	30	69		2.32	0.58	1.50	2.13	Sandy Fat Clay
	6	8.0	10.0	UD		17									1.75	2.25	Sandy Fat Clay
	7	10.0	12.0	UD		6					33						Silty Sand
	8	15.5	17.0	SS	12												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-38

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-39	2	0.5	2.0	UD		18									2.00	2.13	Fat Clay
	3	2.0	4.0	UD		16									1.50	1.75	Fat Clay
	4	4.0	6.0	UD		18									1.38	1.50	Fat Clay
	5	6.0	8.0	UD		17	111	50	14	36	76		1.76	0.58	1.25	1.63	Fat Clay
	6	8.0	10.0	UD		15									1.63	2.00	Fat Clay
	7	10.0	12.0	UD		15									1.75	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

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.5	2.0	UD		14									2.25	2.25	Fat Clay
	3	2.0	4.0	UD		14									2.25	2.25	Fat Clay
	4	4.0	6.0	UD		15									2.25	2.25	Fat Clay
	5	6.0	8.0	UD		16									2.25	1.88	Fat Clay
	6	8.0	10.0	UD		18	113	52	21	31	78		1.66	0.72	1.63	1.50	Fat Clay
	7	10.0	12.0	UD		15									1.88	2.25	Fat Clay
	8	12.0	14.0	UD		14									1.75	1.63	Fat Clay
	9	14.0	16.0	UD		16									1.75	2.00	Fat Clay
	10	16.0	18.0	UD		20									1.25	1.50	Fat Clay
	11	18.0	20.0	UD		26	100	60	24	36	97		1.03	1.44	1.38	1.50	Fat Clay
	12	22.0	24.0	UD		30									1.50	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-40

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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 (GB-41P)	2	0.5	2.0	UD		16									2.00	0.88	Lean Clay
	3	2.0	4.0	UD		17									1.13	0.75	Lean Clay
	4	4.0	6.0	UD		19									1.38	1.00	Lean Clay
	5	6.0	8.0	UD		20									1.63	1.13	Lean Clay
	6	8.0	10.0	UD		24	101	47	18	29	83		0.55	0.72	0.50	0.50	Lean Clay
	7	10.0	12.0	UD		21									2.13	2.00	Lean Clay
	8	12.0	14.0	UD		16									2.00	1.63	Lean Clay
	9	14.0	16.0	UD		16									1.50	1.25	Lean Clay
	10	16.0	18.0	UD		18	113	50	20	30	57		0.96	1.30	1.00	1.38	Sandy Fat Clay
	11	18.0	20.0	UD		26									2.00	2.25	Sandy Fat Clay
	12	22.0	24.0	UD		29									1.75	1.75	Sandy 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 Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-42	2	0.6	2.0	UD		22									0.90	0.88	Fat Clay
	3	2.0	4.0	UD		20									0.85	0.88	Fat Clay
	4	4.0	6.0	UD		22	107	51	21	30	84		0.94	0.43	1.25	1.25	Fat Clay
	5	6.0	8.0	UD		20									1.00	1.00	Fat Clay
	6	8.0	10.0	UD		19									1.00	1.38	Fat Clay
	7	10.0	12.0	UD		21									1.13	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-42

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-43	2	0.6	2.0	UD		20									1.13	1.25	Fat Clay
	3	2.0	4.0	UD		22									1.00	1.00	Fat Clay
	4	4.0	6.0	UD		22									1.00	1.00	Fat Clay
	5	6.0	8.0	UD		23	104	57	23	34	84		0.81	0.58	0.90	0.88	Fat Clay
	6	8.0	10.0	UD		29									0.60	0.63	Fat Clay
	7	10.0	12.0	UD		28									0.75	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-43

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.6	2.0	UD		22									1.00	1.00	Fat Clay
	3	2.0	4.0	UD		19									1.25	1.38	Fat Clay
	4	4.0	6.0	UD		20	110	59	23	36	80		1.15	0.43	1.00	0.75	Fat Clay
	5	6.0	8.0	UD		16									1.50	1.88	Sandy Lean Clay
	6	8.0	10.0	UD		14									1.50	2.25	Sandy Lean Clay
	7	10.0	12.0	UD		13									1.50	2.25	Sandy Lean Clay
	8	12.0	14.0	UD		13									1.13	2.25	Sandy Lean Clay
	9	14.0	16.0	UD		13	120	32	13	19	57		0.98	1.15	1.13	2.25	Sandy Lean Clay
	10	16.0	18.0	UD		13									1.25	2.25	Sandy Lean Clay
	11	18.0	20.0	UD		14									0.50	0.75	Sandy Lean Clay
	12	20.5	22.0	SS	26	18					55						Sandy Lean Clay
	13	22.0	23.0	UD		23									2.00	2.25	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-44

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-45	2	0.7	2.0	UD		21									1.00	1.00	Fat Clay
	3	2.0	4.0	UD		17									1.25	1.13	Fat Clay
	4	4.0	6.0	UD		20	109	55	22	33	83		1.01	0.43	1.50	0.63	Fat Clay
	5	6.0	8.0	UD		22									0.75	1.00	Fat Clay
	6	8.0	10.0	UD		13		32	12	20	58				1.00	1.75	Sandy Lean Clay
	7	10.0	12.0	UD		15									1.25	2.00	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-45

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-46	2	0.6	2.0	UD		15									1.50	2.00	Fat Clay
	3	2.0	4.0	UD		15									1.50	2.00	Fat Clay
	4	4.0	6.0	UD		19	110	50	22	28	77		1.39	0.43	1.00	0.75	Fat Clay
	5	6.0	8.0	UD		18									1.00	0.75	Fat Clay
	6	8.0	10.0	UD		16									1.00	1.50	Lean Clay
	7	10.0	12.0	UD		15									0.88	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-46

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.6	2.0	UD		20									1.00	1.00	Fat Clay
	3	2.0	4.0	UD		19									1.25	1.38	Fat Clay
	4	4.0	6.0	UD		21									1.00	1.00	Fat Clay
	5	6.0	8.0	UD		23	104	56	22	34	84		0.94	0.58	1.25	1.25	Fat Clay
	6	8.0	10.0	UD		21		56	22	34	80				1.00	1.00	Fat Clay
	7	10.0	12.0	UD		19									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

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.6	2.0	UD		23									0.50	0.25	Fat Clay
	3	2.0	4.0	UD		19									1.25	1.00	Fat Clay
	4	4.0	6.0	UD		21									1.50	1.13	Fat Clay
	5	6.0	8.0	UD		19									1.50	0.75	Fat Clay
	6	8.0	10.0	UD		19	109	52	20	32	81		1.23	0.72	1.50	1.38	Fat Clay
	7	10.0	12.0	UD		17									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-48

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-49	2	0.5	2.0	UD		22									0.90	0.63	Fat Clay
	3	2.0	4.0	UD		19									1.25	1.00	Fat Clay
	4	4.0	6.0	UD		21	105	56	22	34	81		0.88	0.43	0.85	0.50	Fat Clay
	5	6.0	8.0	UD		22									0.90	0.75	Fat Clay
	6	8.0	10.0	UD		24									1.00	0.75	Fat Clay
	7	10.0	12.0	UD		24									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-49

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-50	2	0.7	2.0	UD		17									1.25	1.13	Fat Clay
	3	2.0	4.0	UD		20									1.00	0.75	Fat Clay
	4	4.0	6.0	UD		23	103	59	23	36	81		1.25	0.43	1.25	0.88	Fat Clay
	5	6.0	8.0	UD		26									1.00	1.00	Fat Clay
	6	8.0	10.0	UD		23									1.25	1.25	Fat Clay
	7	10.0	12.0	UD		18									1.25	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-50

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-51B	2	0.8	2.0	UD		26		55	22	33	82				0.60	0.25	Fat Clay
	3	2.0	4.0	UD		25									0.65	0.50	Fat Clay
	4	4.0	6.0	UD		26									0.40	0.13	Fat Clay
	5	6.0	8.0	UD		31	96	64	25	39	84				1.00	1.00	Fat Clay
	6	8.0	10.0	UD		28									1.25	1.38	Fat Clay
	7	10.0	12.0	UD		18									0.88	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

FIGURE B-51

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-52	2	0.8	2.0	UD		19									0.75	0.50	Fat Clay
	3	2.0	4.0	UD		24									0.65	0.75	Fat Clay
	4	4.0	6.0	UD		23	101	53	21	32	78		0.48	0.43	0.65	0.38	Fat Clay
	5	6.0	8.0	UD		23									1.25	1.25	Fat Clay
	6	8.0	10.0	UD		21									1.75	1.63	Fat Clay
	7	10.0	12.0	UD		20									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-52

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-53	2	0.7	2.0	UD		20									2.00	2.13	Fat Clay
	3	2.0	4.0	UD		22									1.00	0.25	Fat Clay
	4	4.0	6.0	UD		21	105	56	22	34	82		1.13	0.43	1.00	0.88	Fat Clay
	5	6.0	8.0	UD		25									0.85	0.88	Fat Clay
	6	8.0	10.0	UD		26									0.90	0.88	Fat Clay
	7	10.0	12.0	UD		29									1.13	1.13	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-53

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-54	2	0.7	2.0	UD		21									1.25	0.88	Fat Clay
	3	2.0	4.0	UD		21									0.40	1.00	Fat Clay
	4	4.0	6.0	UD		24	101	68	26	42	82		0.47	0.43	1.00	0.75	Fat Clay
	5	6.0	8.0	UD		25									1.25	1.13	Fat Clay
	6	8.0	10.0	UD		19									1.50	1.13	Sandy Lean Clay
	7	10.0	12.0	UD		14		36	14	22	60				1.75	1.75	Sandy Lean Clay
	8	12.0	14.0	UD		16									0.35	0.75	Sandy Lean Clay
	9	14.5	16.0	SS	18	15					11						Sand
	10	16.5	18.0	SS	27	21											Sand
	11	18.5	20.0	SS	29	21											Sand
	12	22.5	24.0	SS	30	21											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 Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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	0.6	2.0	UD		14									1.50	2.13	Fat Clay
	3	2.0	4.0	UD		13									2.50	2.25	Fat Clay
	4	4.0	6.0	UD		13									2.50	2.25	Fat Clay
	5	6.0	8.0	UD		15	111	50	21	29	84		2.26	0.58	2.00	2.25	Fat Clay
	6	8.0	10.0	UD		19									1.75	2.25	Fat Clay
	7	10.0	12.0	UD		18									1.50	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-55

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

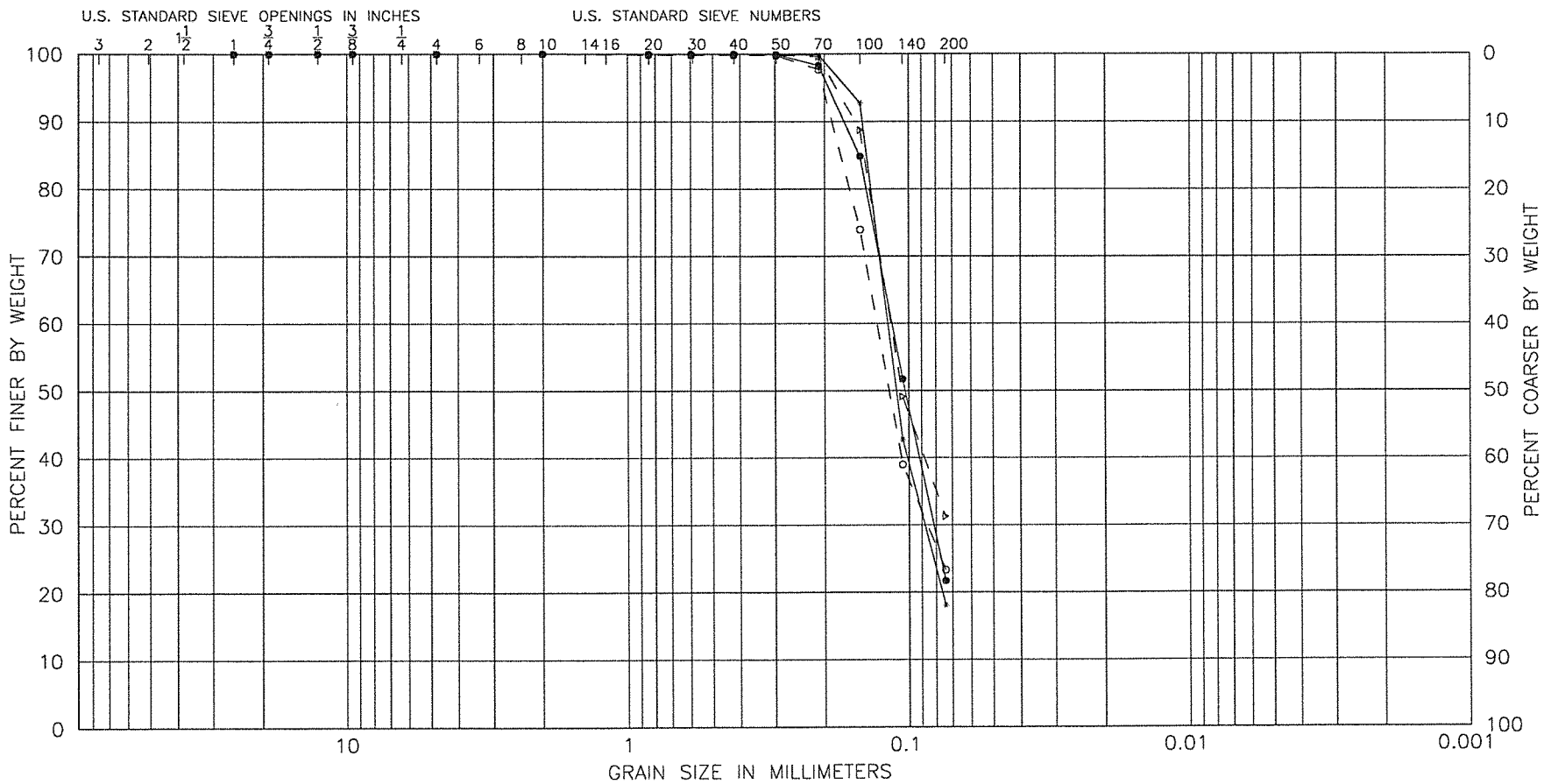
PROJECT NAME: Water Line Replacement in Sharpstown II Area
WBS No. S-000035-0194-4
Houston, Texas
PROJECT NUMBER: 1140196001

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-56 (GB-56P)	2	0.5	2.0	UD		18									1.25	1.00	Fat Clay
	3	2.0	4.0	UD		21									0.85	0.88	Fat Clay
	4	4.0	6.0	UD		20	107	58	20	38	81		1.01	0.43	0.88	1.00	Fat Clay
	5	6.0	8.0	UD		20									1.38	1.25	Fat Clay
	6	8.0	10.0	UD		24									1.38	1.75	Fat Clay
	7	10.0	12.0	UD		16									1.50	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

Job No. 1140196001



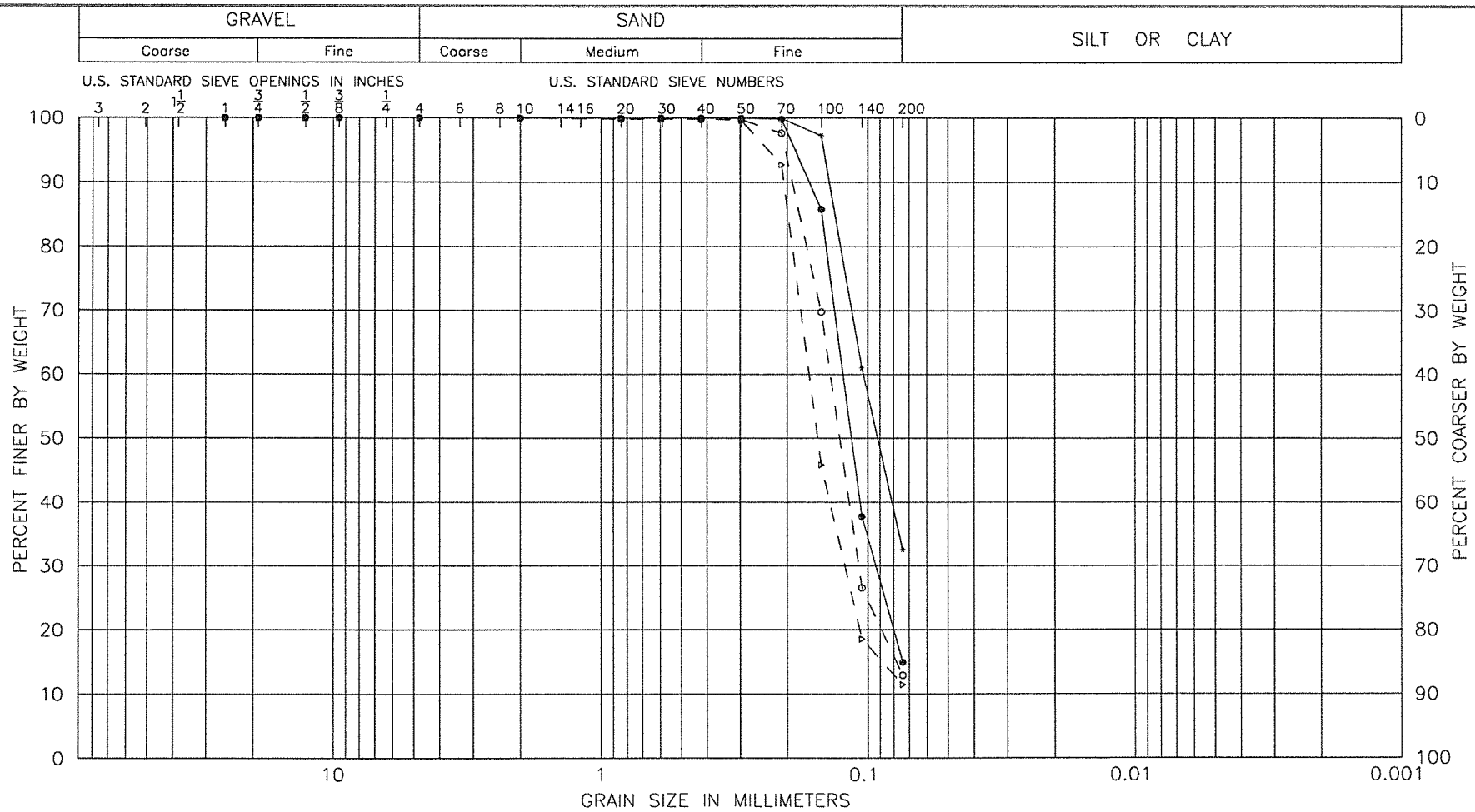
LEGEND	BORING NO.	SAMPLE NO.	DEPTH FT.	SAMPLE DESCRIPTION
●—●—●—●	GB-8	S-9	14.5-16.0	Brown silty sand
○—○—○—○	GB-11	S-7	10.0-12.0	Brown silty sand
×—×—×—×	GB-12	S-6	10.5-12.0	Brown silty sand
▷—▷—▷—▷	GB-14	S-16	10.5-12.0	Yellow and gray silty sand

GRAIN SIZE DISTRIBUTION CURVES

Geotest Engineering, Inc.

FIGURE B-57

Job No. 1140196001



LEGEND	BORING NO.	SAMPLE NO.	DEPTH FT.	SAMPLE DESCRIPTION
●—●—●—●	GB–25P	S–8	14.5–16.0	Gray silty sand
○—○—○—○	GB–26	S–7	12.5–14.0	Brown and gray silty sand
×—×—×—×	GB–38	S–7	10.0–12.0	Brown and gray silty sand
▷—▷—▷—▷	GB–54	S–9	14.5–16.0	Yellowish brown and gray fine sand w/silt

GRAIN SIZE DISTRIBUTION CURVES

Geotest Engineering, Inc.

FIGURE B–58

APPENDIX C

Laboratory Corrosivity Test Report

Analytical Report 469654

for

Geotest Engineering, Inc.

Project Manager: Mohan Ballagere

COH Waterline Replacement Sharpstown

1140196001

12-SEP-13

Collected By: Client

4143 Greenbriar Dr., Stafford, TX 77477

Xenco-Houston (EPA Lab code: TX00122):
Texas (T104704215-13-14-TX), Arizona (AZ0765), Arkansas (08-039-0), Connecticut (PH-0102), Florida (E871002)
Illinois (002082), Indiana (C-TX-02), Iowa (392), Kansas (E-10380), Kentucky (45), Louisiana (03054)
New Hampshire (297408), New Jersey (TX007), New York (11763), Oklahoma (9218), Pennsylvania (68-03610)
Rhode Island (LAO00312), USDA (S-44102), DoD (L11-54)

Xenco-Atlanta (EPA Lab Code: GA00046):
Florida (E87429), North Carolina (483), South Carolina (98015), Kentucky (85), DoD (L10-135)
Louisiana (04176), USDA (P330-07-00105)

Xenco-Tampa Mobile (EPA Lab code: FL01212): Florida (E84900)
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)

12-SEP-13

Project Manager: **Mohan Ballagere**
Geotest Engineering, Inc.
5600 Bintliff
Houston, TX 77036

Reference: XENCO Report No(s): **469654**
COH Waterline Replacement Sharpstown
Project Address:

Mohan Ballagere:

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) 469654. 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. 469654 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
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 469654

Geotest Engineering, Inc., Houston, TX

COH Waterline Replacement Sharpstown

Sample Id	Matrix	Date Collected	Sample Depth	Lab Sample Id
GB-40-S#10	S	07-31-13 00:00	16 - 18 ft	469654-001
GB-26-S#6	S	08-01-13 00:00	10 - 12 ft	469654-002
GB-1-S#6	S	08-07-13 00:00	12 - 14 ft	469654-003
GB-3-S#5	S	08-07-13 00:00	8 - 10 ft	469654-004
GB-24-S#6	S	08-08-13 00:00	8 - 10 ft	469654-005
GB-20-S#6	S	08-09-13 00:00	8 - 10 ft	469654-006
GB-6-S#6	S	08-07-13 00:00	8 - 10 ft	469654-007
GB-44-S#8	S	08-08-13 00:00	16 - 18 ft	469654-008
GB-8-S#7	S	08-07-13 00:00	10 - 12 ft	469654-009
GB-28-S#6	S	08-08-13 00:00	8 - 10 ft	469654-010
GB-30-S#8	S	08-08-13 00:00	14 - 16 ft	469654-011
GB-12-S#4	S	08-08-13 00:00	6 - 8 ft	469654-012
GB-5-S#6	S	08-07-13 00:00	8 - 10 ft	469654-013
GB-13-S#5	S	08-08-13 00:00	8 - 10 ft	469654-014
GB-26-S#6	S	08-01-13 00:00	10 - 12 ft	469654-015
GB-54-S#8	S	08-09-13 00:00	12 - 14 ft	469654-016
GB-18-S#6	S	08-08-13 00:00	8 - 10 ft	469654-017

Sample receipt non conformances and comments:

Sample 469654-015 (GB-26 S#6) was not received at the lab 9/3/13. Client was contacted and sample for GB-26 S#6 was delivered to lab on 9/6/13.

Sample receipt non conformances and comments per sample:

None

Certificate of Analysis Summary 469654

Geotest Engineering, Inc., Houston, TX

Project Name: COH Waterline Replacement Sharpstown

Project Id: 1140196001
Contact: Mohan Ballagere
Project Location:

Date Received in Lab: Tue Sep-03-13 10:47 am
Report Date: 12-SEP-13
Project Manager: Debbie Simmons

Analysis Requested													
	Lab Id:	469654-001		469654-002		469654-003		469654-004		469654-005		469654-006	
	Field Id:	GB-40-S#10		GB-26-S#6		GB-1-S#6		GB-3-S#5		GB-24-S#6		GB-20-S#6	
	Depth:	16-18 ft		10-12 ft		12-14 ft		8-10 ft		8-10 ft		8-10 ft	
	Matrix:	SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
	Sampled:	Jul-31-13 00:00		Aug-01-13 00:00		Aug-07-13 00:00		Aug-07-13 00:00		Aug-08-13 00:00		Aug-09-13 00:00	
Inorganic Anions by SW 9056	***Extracted:***	Sep-05-13 11:38		Sep-05-13 11:38		Sep-05-13 11:38		Sep-05-13 11:38		Sep-05-13 11:38		Sep-05-13 11:38	
	Analyzed:	Sep-05-13 19:10		Sep-05-13 20:06		Sep-05-13 20:25		Sep-05-13 20:43		Sep-05-13 21:02		Sep-05-13 21:21	
	Units/RL:	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL
Chloride		BRL	9.38	BRL	9.52	BRL	9.49	BRL	9.84	BRL	10.0	BRL	9.09
Sulfate		BRL	9.38	BRL	9.52	BRL	9.49	BRL	9.84	BRL	10.0	BRL	9.09
Soil pH by EPA 9045C	***Extracted:***												
	Analyzed:	Sep-09-13 16:45		Sep-09-13 16:45		Sep-09-13 16:45		Sep-09-13 16:45		Sep-09-13 16:45		Sep-09-13 16:45	
	Units/RL:	SU	RL	SU	RL	SU	RL	SU	RL	SU	RL	SU	RL
pH		8.98 K		8.46 K		8.94 K		8.96 K		8.82 K		9.10 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

Certificate of Analysis Summary 469654

Geotest Engineering, Inc., Houston, TX

Project Name: COH Waterline Replacement Sharpstown

Project Id: 1140196001
Contact: Mohan Ballagere
Project Location:

Date Received in Lab: Tue Sep-03-13 10:47 am
Report Date: 12-SEP-13
Project Manager: Debbie Simmons

Analysis Requested							
	Lab Id:	469654-001	469654-002	469654-003	469654-004	469654-005	469654-006
	Field Id:	GB-40-S#10	GB-26-S#6	GB-1-S#6	GB-3-S#5	GB-24-S#6	GB-20-S#6
	Depth:	16-18 ft	10-12 ft	12-14 ft	8-10 ft	8-10 ft	8-10 ft
	Matrix:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampled:	Jul-31-13 00:00	Aug-01-13 00:00	Aug-07-13 00:00	Aug-07-13 00:00	Aug-08-13 00:00	Aug-09-13 00:00
Soil Resistivity (As Received) by NACE	***Extracted:***						
	Analyzed:	Sep-04-13 14:16	Sep-04-13 14:16	Sep-04-13 14:16	Sep-04-13 14:16	Sep-04-13 14:16	Sep-04-13 14:16
	Units/RL:	Ohm-cm RL	Ohm-cm RL	Ohm-cm RL	Ohm-cm RL	Ohm-cm RL	Ohm-cm RL
Soil Resistivity		692	4440	1270	1530	1420	844

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 469654

Geotest Engineering, Inc., Houston, TX

Project Name: COH Waterline Replacement Sharpstown

Project Id: 1140196001
Contact: Mohan Ballagere
Project Location:

Date Received in Lab: Tue Sep-03-13 10:47 am
Report Date: 12-SEP-13
Project Manager: Debbie Simmons

Analysis Requested													
	Lab Id:	469654-007		469654-008		469654-009		469654-010		469654-011		469654-012	
	Field Id:	GB-6-S#6		GB-44-S#8		GB-8-S#7		GB-28-S#6		GB-30-S#8		GB-12-S#4	
	Depth:	8-10 ft		16-18 ft		10-12 ft		8-10 ft		14-16 ft		6-8 ft	
	Matrix:	SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
	Sampled:	Aug-07-13 00:00		Aug-08-13 00:00		Aug-07-13 00:00		Aug-08-13 00:00		Aug-08-13 00:00		Aug-08-13 00:00	
Inorganic Anions by SW 9056	***Extracted:***	Sep-05-13 11:38		Sep-05-13 11:38		Sep-05-13 11:38		Sep-05-13 11:38		Sep-05-13 11:38		Sep-05-13 11:38	
	Analyzed:	Sep-05-13 22:16		Sep-05-13 22:35		Sep-05-13 22:54		Sep-05-13 23:12		Sep-05-13 23:31		Sep-06-13 00:27	
	Units/RL:	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL
Chloride		27.9	9.46	16.7	9.58	13.5	9.38	BRL	9.52	11.5	9.09	BRL	9.46
Sulfate		BRL	9.46	BRL	9.58	BRL	9.38	BRL	9.52	BRL	9.09	BRL	9.46
Soil Resistivity (As Received) by NACE	***Extracted:***												
	Analyzed:	Sep-04-13 14:16		Sep-04-13 14:16		Sep-04-13 14:16		Sep-04-13 14:16		Sep-04-13 14:16		Sep-04-13 14:16	
	Units/RL:	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL	Ohm-cm	RL
Soil Resistivity		700		1540		2070		1270		934		813	
Soil pH by EPA 9045C	***Extracted:***												
	Analyzed:	Sep-09-13 16:45		Sep-09-13 16:45		Sep-09-13 16:45		Sep-09-13 16:45		Sep-09-13 16:45		Sep-09-13 16:45	
	Units/RL:	SU	RL	SU	RL	SU	RL	SU	RL	SU	RL	SU	RL
pH		8.51 K		8.43 K		8.67 K		8.83 K		8.92 K		8.96 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 469654

Geotest Engineering, Inc., Houston, TX

Project Name: COH Waterline Replacement Sharpstown

Project Id: 1140196001
Contact: Mohan Ballagere
Project Location:

Date Received in Lab: Tue Sep-03-13 10:47 am
Report Date: 12-SEP-13
Project Manager: Debbie Simmons

Analysis Requested												
	Lab Id:	469654-013		469654-014		469654-015		469654-016		469654-017		
	Field Id:	GB-5-S#6		GB-13-S#5		GB-26-S#6		GB-54-S#8		GB-18-S#6		
	Depth:	8-10 ft		8-10 ft		10-12 ft		12-14 ft		8-10 ft		
	Matrix:	SOIL		SOIL		SOIL		SOIL		SOIL		
	Sampled:	Aug-07-13 00:00		Aug-08-13 00:00		Aug-01-13 00:00		Aug-09-13 00:00		Aug-08-13 00:00		
Inorganic Anions by SW 9056	***Extracted:***	Sep-05-13 11:38		Sep-05-13 11:38		Sep-10-13 18:22		Sep-05-13 11:38		Sep-05-13 11:38		
	Analyzed:	Sep-06-13 00:45		Sep-06-13 01:41		Sep-11-13 00:14		Sep-06-13 02:00		Sep-06-13 02:18		
	Units/RL:	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL	mg/kg	RL	
Chloride		16.7	9.09	BRL	8.82	BRL	9.58	15.0	9.74	BRL	8.82	
Sulfate		BRL	9.09	BRL	8.82	BRL	9.58	BRL	9.74	BRL	8.82	
Soil pH by EPA 9045C	***Extracted:***											
	Analyzed:	Sep-09-13 16:45		Sep-09-13 16:45		Sep-09-13 16:45		Sep-09-13 16:45		Sep-09-13 16:45		
	Units/RL:	SU	RL	SU	RL	SU	RL	SU	RL	SU	RL	
pH		8.72 K		8.93 K		8.44 K		8.92 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

Certificate of Analysis Summary 469654

Geotest Engineering, Inc., Houston, TX

Project Name: COH Waterline Replacement Sharpstown

Project Id: 1140196001
Contact: Mohan Ballagere
Project Location:

Date Received in Lab: Tue Sep-03-13 10:47 am
Report Date: 12-SEP-13
Project Manager: Debbie Simmons

Analysis Requested							
	Lab Id:	469654-013	469654-014	469654-015	469654-016	469654-017	
	Field Id:	GB-5-S#6	GB-13-S#5	GB-26-S#6	GB-54-S#8	GB-18-S#6	
	Depth:	8-10 ft	8-10 ft	10-12 ft	12-14 ft	8-10 ft	
	Matrix:	SOIL	SOIL	SOIL	SOIL	SOIL	
	Sampled:	Aug-07-13 00:00	Aug-08-13 00:00	Aug-01-13 00:00	Aug-09-13 00:00	Aug-08-13 00:00	
Soil Resistivity (As Received) by NACE	***Extracted:***						
	Analyzed:	Sep-04-13 14:16	Sep-04-13 14:16	Sep-10-13 11:38	Sep-04-13 14:16	Sep-04-13 14:16	
	Units/RL:	Ohm-cm RL	Ohm-cm RL	Ohm-cm RL	Ohm-cm RL	Ohm-cm RL	
Soil Resistivity		800	1640	5060 K	853	885	

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

XENCO Laboratories
CHRONOLOGY OF HOLDING TIMES

Analytical Method : Soil pH by EPA 9045C

Client : Geotest Engineering, Inc.

Work Order #: **469654**

Project ID: 1140196001

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-24-S#6	Aug. 8, 2013	Sep. 3, 2013				Sep.9, 2013	28	32	F
GB-1-S#6	Aug. 7, 2013	Sep. 3, 2013				Sep.9, 2013	28	33	F
GB-12-S#4	Aug. 8, 2013	Sep. 3, 2013				Sep.9, 2013	28	32	F
GB-54-S#8	Aug. 9, 2013	Sep. 3, 2013				Sep.9, 2013	28	31	F
GB-40-S#10	Jul. 31, 2013	Sep. 3, 2013				Sep.9, 2013	28	40	F
GB-20-S#6	Aug. 9, 2013	Sep. 3, 2013				Sep.9, 2013	28	31	F
GB-44-S#8	Aug. 8, 2013	Sep. 3, 2013				Sep.9, 2013	28	32	F
GB-26-S#6	Aug. 1, 2013	Sep. 3, 2013				Sep.9, 2013	28	39	F
GB-18-S#6	Aug. 8, 2013	Sep. 3, 2013				Sep.9, 2013	28	32	F
GB-5-S#6	Aug. 7, 2013	Sep. 3, 2013				Sep.9, 2013	28	33	F
GB-3-S#5	Aug. 7, 2013	Sep. 3, 2013				Sep.9, 2013	28	33	F
GB-28-S#6	Aug. 8, 2013	Sep. 3, 2013				Sep.9, 2013	28	32	F
GB-26-S#6	Aug. 1, 2013	Sep. 3, 2013				Sep.9, 2013	28	39	F
GB-6-S#6	Aug. 7, 2013	Sep. 3, 2013				Sep.9, 2013	28	33	F
GB-8-S#7	Aug. 7, 2013	Sep. 3, 2013				Sep.9, 2013	28	33	F
GB-30-S#8	Aug. 8, 2013	Sep. 3, 2013				Sep.9, 2013	28	32	F
GB-13-S#5	Aug. 8, 2013	Sep. 3, 2013				Sep.9, 2013	28	32	F

XENCO Laboratories
CHRONOLOGY OF HOLDING TIMES

Analytical Method : Inorganic Anions by SW 9056

Client : Geotest Engineering, Inc.

Work Order #: **469654**

Project ID: 1140196001

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-30-S#8	Aug. 8, 2013	Sep. 3, 2013	Sep. 5, 2013	28	28	Sep.5, 2013	28	0	P
GB-3-S#5	Aug. 7, 2013	Sep. 3, 2013	Sep. 5, 2013	28	29	Sep.5, 2013	28	0	F
GB-20-S#6	Aug. 9, 2013	Sep. 3, 2013	Sep. 5, 2013	28	27	Sep.5, 2013	28	0	P
GB-26-S#6	Aug. 1, 2013	Sep. 3, 2013	Sep. 10, 2013	28	40	Sep.11, 2013	28	1	F
GB-26-S#6	Aug. 1, 2013	Sep. 3, 2013	Sep. 5, 2013	28	35	Sep.5, 2013	28	0	F
GB-6-S#6	Aug. 7, 2013	Sep. 3, 2013	Sep. 5, 2013	28	29	Sep.5, 2013	28	0	F
GB-28-S#6	Aug. 8, 2013	Sep. 3, 2013	Sep. 5, 2013	28	28	Sep.5, 2013	28	0	P
GB-13-S#5	Aug. 8, 2013	Sep. 3, 2013	Sep. 5, 2013	28	28	Sep.6, 2013	28	1	P
GB-44-S#8	Aug. 8, 2013	Sep. 3, 2013	Sep. 5, 2013	28	28	Sep.5, 2013	28	0	P
GB-54-S#8	Aug. 9, 2013	Sep. 3, 2013	Sep. 5, 2013	28	27	Sep.6, 2013	28	1	P
GB-1-S#6	Aug. 7, 2013	Sep. 3, 2013	Sep. 5, 2013	28	29	Sep.5, 2013	28	0	F
GB-5-S#6	Aug. 7, 2013	Sep. 3, 2013	Sep. 5, 2013	28	29	Sep.6, 2013	28	1	F
GB-18-S#6	Aug. 8, 2013	Sep. 3, 2013	Sep. 5, 2013	28	28	Sep.6, 2013	28	1	P
GB-40-S#10	Jul. 31, 2013	Sep. 3, 2013	Sep. 5, 2013	28	36	Sep.5, 2013	28	0	F
GB-24-S#6	Aug. 8, 2013	Sep. 3, 2013	Sep. 5, 2013	28	28	Sep.5, 2013	28	0	P
GB-8-S#7	Aug. 7, 2013	Sep. 3, 2013	Sep. 5, 2013	28	29	Sep.5, 2013	28	0	F
GB-12-S#4	Aug. 8, 2013	Sep. 3, 2013	Sep. 5, 2013	28	28	Sep.6, 2013	28	1	P

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 quantiation 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: COH Waterline Replacement Sharpstown

Work Order #: 469654 **Project ID:** 1140196001

Lab Batch #: 922260 **Sample:** 643408-1-BKS **Matrix:** Solid
Date Analyzed: 09/05/2013 **Date Prepared:** 09/05/2013 **Analyst:** RKO
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	1000	970	97	80-120	
Sulfate	<10.0	1000	978	98	80-120	

Lab Batch #: 922452 **Sample:** 643657-1-BKS **Matrix:** Solid
Date Analyzed: 09/10/2013 **Date Prepared:** 09/10/2013 **Analyst:** RKO
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	<2.00	200	194	97	80-120	
Sulfate	<2.00	200	195	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: COH Waterline Replacement Sharpstown

Work Order # : 469654 **Project ID:** 1140196001

Lab Batch ID: 922260 **QC- Sample ID:** 469654-001 S **Batch #:** 1 **Matrix:** Soil

Date Analyzed: 09/05/2013 **Date Prepared:** 09/05/2013 **Analyst:** RKO

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	<9.38	938	914	97	938	926	99	1	80-120	20	
Sulfate	<9.38	938	923	98	938	935	100	1	80-120	20	

Lab Batch ID: 922260 **QC- Sample ID:** 469654-011 S **Batch #:** 1 **Matrix:** Soil

Date Analyzed: 09/05/2013 **Date Prepared:** 09/05/2013 **Analyst:** RKO

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	11.5	909	906	98	909	906	98	0	80-120	20	
Sulfate	<9.09	909	912	100	909	912	100	0	80-120	20	

Lab Batch ID: 922452 **QC- Sample ID:** 469889-001 S **Batch #:** 1 **Matrix:** Soil

Date Analyzed: 09/10/2013 **Date Prepared:** 09/10/2013 **Analyst:** RKO

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	<10.8	1080	1060	98	1080	1050	97	1	80-120	20	
Sulfate	<10.8	1080	1070	99	1080	1060	98	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.

Form 3 - MS / MSD Recoveries

Project Name: COH Waterline Replacement Sharpstown

Work Order # : 469654 **Project ID:** 1140196001

Lab Batch ID: 922452 **QC- Sample ID:** 469922-001 S **Batch #:** 1 **Matrix:** Soil

Date Analyzed: 09/11/2013 **Date Prepared:** 09/10/2013 **Analyst:** RKO

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	32.8	940	935	96	940	931	96	0	80-120	20	
Sulfate	<9.40	940	927	99	940	924	98	0	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: COH Waterline Replacement Sharpstown

Work Order #: 469654

Lab Batch #: 921970 **Project ID:** 1140196001
Date Analyzed: 09/04/2013 14:16 **Date Prepared:** 09/04/2013 **Analyst:** DHE
QC- Sample ID: 469487-003 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	662	661	0	20	

Lab Batch #: 921970
Date Analyzed: 09/04/2013 14:16 **Date Prepared:** 09/04/2013 **Analyst:** DHE
QC- Sample ID: 469654-010 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	1270	1270	0	20	

Lab Batch #: 922367
Date Analyzed: 09/10/2013 11:39 **Date Prepared:** 09/10/2013 **Analyst:** ANS
QC- Sample ID: 469654-015 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	5060	5000	1	20	

Lab Batch #: 922331
Date Analyzed: 09/09/2013 16:45 **Date Prepared:** 09/09/2013 **Analyst:** DHE
QC- Sample ID: 469654-010 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	8.83	8.84	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

Sample Duplicate Recovery

Project Name: COH Waterline Replacement Sharpstown

Work Order #: 469654

Lab Batch #: 922331 **Project ID:** 1140196001

Date Analyzed: 09/09/2013 16:45 **Date Prepared:** 09/09/2013 **Analyst:** DHE

QC- Sample ID: 469654-017 D **Batch #:** 1 **Matrix:** Soil

Reporting Units: SU

Soil pH by EPA 9045C Analyte	SAMPLE / SAMPLE DUPLICATE RECOVERY Parent Sample Result [A]	Sample Duplicate Result [B]	RPD	Control Limits %RPD	Flag
pH	9.01	9.00	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

XENCO Laboratories

☐ 4143 Greenbriar Drive, Stafford, TX 77477 **281-240-4200**
☐ 5332, Blackberry Drive, San Antonio, TX 78238 **210-509-3334**
☐ 9701 Harry Hines Blvd., Dallas, TX 75220 **214-902-0300**
☐ 12600 West I-20 East, Odessa, TX 79765 **432-563-1800**

Serial #: 325257 Page 1 of 2

Company-City: Geotest
Phone: 713 266 0588
Lab Only: 4/19/54-11

Project Name-Location: Cont Waterline Replacement Sharpstown ☐ Previously done at XENCO
Project ID: 114019600

TAT: ASAP 5h 12h 24h 48h 3d 5d 7d 10d 21d Standard TAT is project specific.
It is typically 5-7 Working Days for level II and 10+ Working days for level III and IV data.

Proj. State: TX, AL, FL, GA, LA, MS, NC, NJ, PA, SC, TN, UT Other
Proj. Manager (PM): Mohan Ballagere.
Fax No:
E-mail Results to ☐ PM and nkolli@geotesteng.com
Invoice to: ☑ Accounting ☐ Inc. Invoice with Final Report ☐ Invoice must have a P.O.
Bill to:
Quote/Pricing: **P.O. No:** ☐ Call for P.O.
Reg Program: UST DRY-CLEAN Land-Fill Waste-Disp NPDES DW **TRRP**
QAPP Per-Contract CLP AGCEE NAVY DOE DOD USACE OTHER:
Special DLs (GW DW QAPP MDLs RLs See Lab PM Included Call PM)
Sampler Name: Tiffany Murray **Signature:** T Murray

Remarks

	Sample ID	Sampling Date	Time	Depth ft' in" m	Matrix	Composite	Grab	# Containers	Container Size	Container Type	Preservatives	VOA: Full-List BTEX-MTBE EtOH Oxyg VOHs VOAs	VOA: PP TCL DW Appdx-1 Appdx-2 CALL Other:	PAHs SIM 8310 8270	TX-1005 DRO GRO MA EPH MA VPH	SVOCs: Full-List DW BN&AE TCLP PP Appdx-2 CALL	OC Pesticides PCBs Herbicides OP Pesticides	Metals: RCRA-8 RCRA-4 Pb 13PP 23TAL Appdx 1 Appdx2	SPLP - TCLP (Metals VOCs SVOCs Pest. Herb. PCBs)	EDB / DBCP	Sulphate	ph	Chloride	Resistivity	TATASAP 5h 12h 24h 48h 3d 5d 7d 10d 21d	Addn: PAH above mg/L W, mg/Kg S Highest Hit	Hold Samples (Surcharges will apply and are pre-approved)	Sample Clean-ups are pre-approved as needed	Addn: Date Rcv. by: From:
1	BB-40 - S#10	7-31-13		18-18	S			1													/	/	/	/					
2	GB-26 - S#6	8-1-13		10-12	S			1													/	/	/	/					
3	GB-1 S#6	8-7-13		12-14	S			1													/	/	/	/					
4	GB-3 S#5	8-7-13		8-10	S			1													/	/	/	/					
5	BB-24 S#6	8-8-13		8-10	S			1													/	/	/	/					
6	GB-20 S#6	8-9-13		8-10	S			1													/	/	/	/					
7	BB-6 S#6	8-7-13		8-10	S			1													/	/	/	/					
8	GB-44 S#8	8-8-13		16-18	S			1													/	/	/	/					
9	GB-8 S#7	8-7-13		10-12	S			1													/	/	/	/					
10	GB-28 S#6	8-8-13		8-10	S			1													/	/	/	/					

Relinquished by (Initials and Sign)	Date & Time	Relinquished to (Initials and Sign)	Date & Time
1)		2)	
3) T Murray	9-3-13 10:47	4)	9-3-15 10:47
5)			

Total Containers per COC: Cooler Temp: 3.7 °C

Otherwise agreed on writing. Reports are the Intellectual Property of XENCO until paid. Samples will be held 30 days after final report is e-mailed unless hereby requested. Rush Charges and Collection Fees are pre-approved if needed.

Preservatives: Various (**V**), HCl pH<2 (**H**), H2SO4 pH<2 (**S**), HNO3 pH<2 (**N**), Asbc Acid&NaOH (**A**), ZnAc&NaOH (**Z**), (Cool, <4C) (**C**), None (**NA**),See Label (**L**), Other (**O**) _____
Cont. Size: 4oz (**4**), 8oz (**8**), 32oz (**32**), 40ml VOA (**40**), 1L (**1**), 500ml (**5**), Tedlar Bag (**B**), Various (**V**), Other _____ **Cont. Type:** Glass Amb (**A**), Glass Clear (**C**), Plastic (**P**), Various (**V**)
Matrix: Air (**A**), Product (**P**), Solid (**S**), Water (**W**), Liquid (**L**)

Committed to Excellence in Service and Quality *www.xenco.com*

Notice: Signature of this document and relinquishment of these samples constitutes a valid purchase order from client company to Xenco Laboratories and its affiliates, subcontractors and assigns under Xenco's standard terms and conditions of service unless previously negotiated under a fully executed client contract.

XENCO Laboratories

☐ 4143 Greenbriar Drive, Stafford, TX 77477 **281-240-4200**
☐ 5332, Blackberry Drive, San Antonio, TX 78238 **210-509-3334**
☐ 9701 Harry Hines Blvd., Dallas, TX 75220 **214-902-0300**
☐ 12600 West I-20 East, Odessa, TX 79765 **432-563-1800**

Serial #: 325258 Page 2 of 2

Company-City Geotest **Phone** 713-266-0588

Lab Only: 419654-11

Project Name-Location ☐ Previously done at XENCO SHMBJOB **Project ID** City of Houston Waterline Replacement 1140196001

TAT: ASAP 5h 12h 24h 48h 3d 5d 7d 10d 21d Standard TAT is project specific.
It is typically 5-7 Working Days for level II and 10+ Working days for level III and IV data.

Proj. State TX, AL, FL, GA, LA, MS, NC, NJ, PA, SC, TN, UT Other

Proj. Manager (PM) Mohan Ballagere

E-mail Results to ☐ PM and ntalli@geotesting.com **Fax No:**

Invoice to ☐ Accounting ☐ Inc. Invoice with Final Report ☐ Invoice must have a P.O.
Bill to:

Quote/Pricing: **P.O. No:** ☐ Call for P.O.

Reg Program: UST DRY-CLEAN Land-Fill Waste-Disp NPDES DW **TRRP**
QAPP Per-Contract CLP AGCEE NAVY DOE DOD USACE OTHER:

Special DLs (GW DW QAPP MDLs RLs See Lab PM Included Call PM)

Sampler Name Tiffany Murray **Signature** T Murray

	Sample ID	Sampling Date	Time	Depth ft' in" m	Matrix	Composite	Grab	# Containers	Container Size	Container Type	Preservatives	VOA: Full-List BTEX-MTBE EtOH Oxyg VOHs VOAs	VOA: PP TCL DW Appdx-1 Appdx-2 CALL Other:	PAHs SIM 8310 8270	TX-1005 DRO GRO MA EPH MA VPH	SVOCs: Full-List DW BN&AE TCLP PP Appdx-2 CALL	OC Pesticides PCBs Herbicides OP Pesticides	Metals: RCRA-8 RCRA-4 Pb 13PP 23TAL Appdx 1 Appdx2	SPLP - TCLP (Metals VOCs SVOCs Pest. Herb. PCBs)	EDB / DBCP	Sulphate	Ph	Chloride	Resistivity						TATASAP 5h 12h 24h 48h 3d 5d 7d 10d 21d	Addn: PAH above mg/L W, mg/Kg S Highest Hit	Hold Samples (Surcharges will apply and are pre-approved)	Remarks: Sample Clean-ups are pre-approved as needed			Addn: Date Rcv. by: From:	
1	GB-30 S# 8	8-8-13		14-16	S			1													/	/	/	/												1
2	GB-12 S# 4	8-8-13		8-8	S			1													/	/	/	/												2
3	GB-5 S# 6	8-7-13		8-10	S			1													/	/	/	/												3
4	GB-13 S# 5	8-8-13		8-10	S			1													/	/	/	/												4
5	GB-26 S# 6	8-1-13		10-12	S			1													/	/	/	/												5
6	GB 54 S# 8	8-9-13		12-14	S			1													/	/	/	/												6
7	GB-18 S# 6	8-8-13		8-10	S			1													/	/	/	/												7
8																																				8
9																																				9
10																																				10

	Relinquished by (Initials and Sign)	Date & Time	Relinquished to (Initials and Sign)	Date & Time
1	1)		2)	
2	3) T Murray	9-3-13 12:47	4)	9-
3	5)		6)	9-3-13 16:47

Total Containers per COC: Cooler Temp: 5.7 °C

Otherwise agreed on writing. Reports are the Intellectual Property of XENCO until paid. Samples will be held 30 days after final report is e-mailed unless hereby requested. Rush Charges and Collection Fees are pre-approved if needed.

Preservatives: Various (**V**), HCl pH<2 (**H**), H2SO4 pH<2 (**S**), HNO3 pH<2 (**N**), Asbc Acid&NaOH (**A**), ZnAc&NaOH (**Z**), (Cool, <4C) (**C**), None (**NA**),See Label (**L**), Other (**O**) _____
Cont. Size: 4oz (**4**), 8oz (**8**), 32oz (**32**), 40ml VOA (**40**), 1L (**1**), 500ml (**5**), Tedlar Bag (**B**), Various (**V**),. Other _____ **Cont. Type:** Glass Amb (**A**), Glass Clear (**C**), Plastic (**P**), Various (**V**)

Matrix: Air (**A**), Product (**P**), Solid (**S**), Water (**W**), Liquid (**L**)

Committed to Excellence in Service and Quality *www.xenco.com*

Notice: Signature of this document and relinquishment of these samples constitutes a valid purchase order from client company to Xenco Laboratories and its affiliates, subcontractors and assigns under Xenco's standard terms and conditions of service unless previously negotiated under a fully executed client contract.

XENCO Laboratories

Prelogin/Nonconformance Report- Sample Log-In

Client: Geotest Engineering, Inc.

Date/ Time Received: 09/03/2013 10:47:00 AM

Work Order #: 469654

Acceptable Temperature Range: 0 - 6 degC
Air and Metal samples Acceptable Range: Ambient

Temperature Measuring device used : R-31

Sample Receipt Checklist		Comments
#1 *Temperature of cooler(s)?	20	
#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?	**No**	
#6 *Custody Seals Signed and dated?	**No**	
#7 *Chain of Custody present?	**Yes**	
#8 Sample instructions complete on Chain of Custody?	**Yes**	
#9 Any missing/extra samples?	**Yes**	Sample # 015 missing 9/3/13.
#10 Chain of Custody signed when relinquished/ received?	**Yes**	
#11 Chain of Custody agrees with sample label(s)?	**No**	No labels on sample
#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?	**Yes**	
#16 Sample container(s) intact?	**Yes**	
#17 Sufficient sample amount for indicated test(s)?	**Yes**	
#18 All samples received within hold time?	**Yes**	
#19 Subcontract of sample(s)?	**No**	
#20 VOC samples have zero headspace (less than 1/4 inch bubble)?	**N/A**	
#21 <2 for all samples preserved with HNO3,HCL, H2SO4?	**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: AM	PH Device/Lot#:

NonConformance:
Sample # 015 missing 9/3/13.
Corrective Action Taken:
client delivered sample 015 (GB-26) 9/6

Nonconformance Documentation

Contact: _____ **Contacted by :** _____ **DateTime :** _____

Checklist completed by: Angel Morales — Date: 09/04/2013

Checklist reviewed by: Georgia Jones — Date: 09/04/2013

APPENDIX D

Piezometer Abandonment Reports

STATE OF TEXAS PLUGGING REPORT for Tracking #90484

Owner:	**COH Waterline Replacement**	Owner Well #:	**GB-2**
Address:	**8703 Brae Acres Road Houston , TX 77074**	Grid #:	**65-05-8**
Well Location:	**Brae Acres @ Bissonet Houston , TX 77074**	Latitude:	**29° 53' 29" N**
Well County:	**Harris**	Longitude:	**095° 25' 31" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Mario Gonzalez**
Driller's License Number of Original Well Driller:	**No Data**
Date Well Drilled:	**8/7/2013**
Well Report Tracking Number:	**338219**
Diameter of Borehole:	**5 inches**
Total Depth of Borehole:	**15' feet**

Date Well Plugged:	**10/14/2013**
Person Actually Performing Plugging Operation:	**Mario Gonzalez**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Tremmie pipe cement from bottom to top.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **No Data** 2nd Interval: **No Data** 3rd Interval: **No Data**
Cement/Bentonite Plugs Placed in	1st Interval: **From 0 ft to 2 ft; Sack(s)/type of cement used: Concrete** 2nd Interval: **From 2 ft to 15 ft; Sack(s)/type of cement used: Grout/Cement**

Well:	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 S. Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**Mario Gonzalez**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking #**90484**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS PLUGGING REPORT for Tracking #90483

Owner:	Geotest Engineering Inc.	Owner Well #:	GB-8
Address:	5600 Bintliff Houston , TX 77036	Grid #:	65-20-6
Well Location:	Brae Acres Road Houston , TX 77074	Latitude:	29° 40' 50" N
Well County:	Harris	Longitude:	095° 31' 18" W
		GPS Brand Used:	Magellan

Well Type: Monitor

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	Mario Gonzalez
Driller's License Number of Original Well Driller:	No Data
Date Well Drilled:	8/7/2013
Well Report Tracking Number:	338219
Diameter of Borehole:	5" inches
Total Depth of Borehole:	23' feet

Date Well Plugged:	10/14/2013
Person Actually Performing Plugging Operation:	Mario Gonzalez
License Number of Plugging Operator:	58171
Plugging Method:	Tremmie pipe cement from bottom to top.
Plugging Variance #:	No Data
Casing Left Data:	1st Interval: No Data 2nd Interval: No Data 3rd Interval: No Data

Cement/Bentonite Plugs Placed in Well:	1st Interval: From 0 ft to 2 ft; Sack(s)/type of cement used: Concrete 2nd Interval: From 2 ft to 23 ft; Sack(s)/type of cement used: Grout/Cement 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 S. Brompton Drive Pearland , TX 77584
Plug Installer License Number:	58171
Licensed Plug Installer Signature:	Jaime Vasquez
Registered Plug Installer Apprentice Signature:	Mario Gonzalez
Apprentice Registration Number:	No Data
Plugging Method Comments:	No Data

Please include the plugging report's tracking number (Tracking #90483) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS PLUGGING REPORT for Tracking #90505

Owner:	**Geotest Engineering Inc.**	Owner Well #:	**GB-25P**
Address:	**5600 Bintliff Houston , TX 77036**	Grid #:	**65-20-6**
Well Location:	**Brae Acres Road Houston , TX 77036**	Latitude:	**29° 41' 12" N**
Well County:	**Harris**	Longitude:	**095° 31' 22" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Mario Gonzalez**
Driller's License Number of Original Well Driller:	**No Data**
Date Well Drilled:	**7/31/2013**
Well Report Tracking Number:	**343882**
Diameter of Borehole:	**5" inches**
Total Depth of Borehole:	**24' feet**

Date Well Plugged:	**10/14/2013**
Person Actually Performing Plugging Operation:	**Mario Gonzalez**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Tremmie pipe cement from bottom to top.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **No Data** 2nd Interval: **No Data** 3rd Interval: **No Data**
Cement/Bentonite Plugs Placed in	1st Interval: **From 0 ft to 1 ft; Sack(s)/type of cement used: Grout** 2nd Interval: **From 1 ft to 3 ft; Sack(s)/type of cement used: Bentonite**

Well:	3rd Interval: **From 3 ft to 20 ft; Sack(s)/type of cement used: Filter Sand** 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 S. Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**Mario Gonzalez**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#90505**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS PLUGGING REPORT for Tracking #90504

Owner:	**Geotest Engineering Inc.**	Owner Well #:	**GB-41P**
Address:	**5600 Bintliff** **Houston , TX 77036**	Grid #:	**65-20-6**
Well Location:	**Brae Acres Road** **Houston , TX 77036**	Latitude:	**29° 41' 14" N**
Well County:	**Harris**	Longitude:	**095° 30' 30" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Mario Gonzalez**
Driller's License Number of Original Well Driller:	**No Data**
Date Well Drilled:	**7/31/2013**
Well Report Tracking Number:	**343881**
Diameter of Borehole:	**5" inches**
Total Depth of Borehole:	**24' feet**

Date Well Plugged:	**10/14/2013**
Person Actually Performing Plugging Operation:	**Mario Gonzalez**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Tremmie pipe cement from bottom to top.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **No Data** 2nd Interval: **No Data** 3rd Interval: **No Data**
Cement/Bentonite Plugs Placed in	1st Interval: **From 0 ft to 1 ft; Sack(s)/type of cement used: Grout** 2nd Interval: **From 1 ft to 3 ft; Sack(s)/type of cement used: Bentonite**

Well:	3rd Interval: **From 3 ft to 24 ft; Sack(s)/type of cement used: Filter Sand** 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 S. Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**Mario Gonzalez**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#90504**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS PLUGGING REPORT for Tracking #90503

Owner:	**Geotest Engineering Inc.**	Owner Well #:	**GB-56P**
Address:	**5600 Bintliff** **Houston , TX 77036**	Grid #:	**65-20-6**
Well Location:	**Brae Acres Road** **Houston , TX 77036**	Latitude:	**29° 41' 14" N**
Well County:	**Harris**	Longitude:	**095° 30' 15" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Mario Gonzalez**
Driller's License Number of Original Well Driller:	**No Data**
Date Well Drilled:	**7/31/2013**
Well Report Tracking Number:	**343880**
Diameter of Borehole:	**5 inches**
Total Depth of Borehole:	**12' feet**

Date Well Plugged:	**10/14/2013**
Person Actually Performing Plugging Operation:	**Mario Gonzalez**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Tremmie pipe cement from bottom to top.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **No Data** 2nd Interval: **No Data** 3rd Interval: **No Data**
Cement/Bentonite Plugs Placed in	1st Interval: **From 0 ft to 1 ft; Sack(s)/type of cement used: Grout/Bentonite** 2nd Interval: **From 1 ft to 12 ft; Sack(s)/type of cement used: Filter Sand**

Well:	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 S. Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**Mario Gonzalez**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#90503**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880