FINAL REPORT
GEOTECHNICAL INVESTIGATION
NEIGHBORHOOD STREET REHABILITATION–PROJECT 464
SPRINGDALE (SEC. 1&2) AND RESTRIDGE (SEC. 1&5)
WBS NO. N-000397-0001-3
FILE NO. 4600011023
HOUSTON, TEXAS

PREPARED BY

ASSOCIATED TESTING LABORATORIES, INC.

HOUSTON, TEXAS

ATL REPORT NO. G14-101

April 28, 2014

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April 28, 2014

ATL Job No: G14-101

Scientech Engineers, Inc.
701 Shepherd Drive, Suite 200
Houston, Texas 77077

Attention: Mr. David Sadeghpour, P.E.

Reference: Final Geotechnical Investigation Report
Proposed Neighborhood Street Rehabilitation – Project 464
Springdale (Sec. 1&2) and Restridge (Sec. 1&5)
WBS No. N-000397-0001-3
File No. 4600011023
Houston, Texas

Dear Mr. Sadeghpour:

We have completed the report for the geotechnical investigation for the above-referenced project. Our findings, geotechnical engineering analyses and recommendations are presented in this report.

It has been a pleasure working with you on this project. Should you have any questions concerning this project work, please call us at (713) 748-3717.

Sincerely,

ASSOCIATED TESTING LABORATORIES, INC.

STATE OF TEXAS
PENG SIA TANG
81150
REGISTERED
PROFESSIONAL ENGINEER
4/30/14

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GEOTECHNICAL INVESTIGATION

NEIGHBORHOOD STREET REHABILITATION–PROJECT 464

SPRINGDALE (SEC. 1&2) AND RESTRIDGE (SEC. 1&5)

HOUSTON, TEXAS

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HOUSTON, TEXAS

EXECUTIVE SUMMARY

Associated Testing Laboratories, Inc. (ATL) has completed the geotechnical study for the proposed replacement of existing storm sewer and waters for the Neighborhood Streets Rehabilitation-Project 464 in the Springdale and Restridge Subdivision Areas, as shown in Figure 1. The project entails street reconstruction and installation of storm sewer and water lines along the approximately 14,045 LF project alignments (see Figures 2a to 2e). Based on the project information, SEI estimated that the invert depths of the proposed utilities lines will be up to approximately 15 feet below the existing grade. The project alignment along Cedel Drive and Turquoise Lane crosses the HCFCD Ditch W140-04-00. ATL understands that the proposed utilities will underpass HCFCD Ditch W140-04-00 (estimated to be not more than 10 feet) using trenchless construction technique without disturbing the existing ditch slopes and structures. Thus, no slope stability analysis is required.

Both open cut/trenching and trenchless installation technique will be employed. The subsurface conditions, investigated by 29 soil borings to a depth of 25 feet below existing grade along the project alignments, consists predominantly of stiff to hard Lean Clays (CL) and Fat Clays (CH), with local areas with soft to firm consistency. A stratum of medium dense Silty Sand (SM) exists between depths of about 10 and 12 feet in Boring B-22. Medium dense Silty Sands (SM) were also found below a depth of about 20, 23 and 23 feet below existing grade to the bottom of the 25-ft deep Boring B-25, B-28 and B-29, respectively.

Detailed subsurface soils and stratigraphy are shown in the individual boring logs in Appendix 3 and in the Boring Log Profiles in Figures 4a through 4i.

Free water was encountered during drilling operation in Borings B-1, B-5, B-7, B-11 through B-13, B-16, B-17, B-25, B-28 and B-29 at a depth of about 25, 23, 23, 23, 23, 20, 22, 23, 23, 30 and 20 feet below existing grade, respectively, and at a depth of about 21, 18, 14.5, 17, 18, 18, 20.5, 19, 17, 17.5 and 18.5 feet, respectively at completion of drilling. Borings B-1, B-8, B-18 and B-27 were converted into Piezometer PZ-1 through PZ-4 after completion of drilling and soil sampling. Water level in PZ-1 through PZ-4 was measured after 24-hour at a depth of about 12, 13, 24 and 18 feet, respectively. Water level in PZ-1 through PZ-4 was measured after 7 days at a depth of about 12, 12.5, 23.5 and 18 feet, respectively. Water level in PZ-1 through PZ-4 was measured after 30 days at a depth of about 10.5, 11.5, 13.5 and 17.5 feet, respectively.

Our main geotechnical findings and recommendations are summarized below:

1. No unusual staining or hydrocarbon-like odor was noted in the soil samples recovered from the soil borings drilled in ATL's geotechnical investigation.
2. A preliminary fault evaluation based on review of available fault maps and literature review indicated that the Long Point Fault crosses near the southern end of the project alignments, most probably near the southern end of the Lynnview Drive alignment. Therefore, ATL recommends that a Phase I Fault Study be conducted by a Professional Geologist to further investigate and verify the possibility of the Long Point Fault zone impacting the Lynnview Drive project alignment.
3. Based on proposed flow line depths and the subsurface conditions (see Figures 4a through 4i), the storm sewer and water installation excavations will be advanced mostly in stiff to hard clays with local stratum of soft to firm clays. However, granular soils or soils with limited cohesion will likely or may be encountered at (but not limited to) locations identified in Table C in Section 5.2.
4. Based on the proposed invert elevation and the gathered groundwater information, the storm sewer and water construction excavations approaching or exceeds about 10 feet along project alignments near Hammerly Boulevard area, and the construction excavations

along alignments south of Hammerly Boulevard will have a high probability of encountering groundwater when the excavation depths approach or exceed the about 17 feet. However, it should be noted that groundwater level will fluctuate with the amount of precipitation prior to and during the construction.

5. Geotechnical parameters/information and construction recommendations for the proposed open cut/trenching and trenchless installation of the proposed storm sewer and waters are presented in Section 5.1.
6. Design and construction recommendations for portland cement concrete pavements for the reconstruction of streets along project alignments are presented in Section 5.2 of this report
7. Construction considerations are provided in Section 6 of this report.

GEOTECHNICAL INVESTIGATION
NEIGHBORHOOD STREET REHABILITATION–PROJECT 464
SPRINGDALE (SEC. 1&2) AND RESTRIDGE (SEC. 1&5)
HOUSTON, TEXAS

1.0 INTRODUCTION

1.1 General

The geotechnical investigation for the Neighborhood Streets Rehabilitation–Project 464 in the Sprindgdale and Restridge Subdivision was authorized via e-mail by Mr. David Sadeghpour, P.E. of **Scientech Engineers, Inc. (SEI)** on December 24, 2013, and with the acceptance of the **Associated Testing Laboratories, Inc., (ATL)** Proposal No. CP13-0704R1 (dated October 7, 2013). Project details were provided to ATL by Scientech Engineers, Inc. This report includes results of the field investigation, laboratory testing, geotechnical engineering analysis and recommendations for the proposed neighborhood street improvements for this project.

1.2 Location and Description of the Project

The project alignments are located in a mainly residential neighborhood, a Site Vicinity Map showing the project alignments is presented in Figure 1. ATL understands that as part of the City of Houston Neighborhood Street Rehabilitation (NSR) Program, select streets in Section 1 and 2 of the Springdale Subdivision and Section 1 and 5 in the Restridge Subdivision are proposed to be reconstructed, along with new utilities construction.

The proposed street improvements alignments total approximately 14,045 linear feet and traverse streets in the Key Map 451 N, P and S area, and are shown in Figures 2a to 2e. Photographs of the project sites were taken at the time of our site visit, and some are presented in Appendix 1.

In conjunction with the street reconstruction, 24- and 30-inch diameter storm sewers and water lines will be constructed using open cut and/or trenchless technique. Based on the preliminary project information, SEI estimated that the invert depths of the proposed utilities lines will be up to approximately 15 feet below the existing grade. The project alignment along Cedel Drive and Turquoise Lane crosses the HCFCD Ditch W140-04-00. ATL understands that the proposed utilities will underpass HCFCD Ditch W140-04-00 (estimated to be not more than 10 feet) using trenchless construction technique, and that the underpass invert will be about 5 feet below the ditch bottom and the construction will not disturb or involve modifications to the existing ditch slopes and structures. Thus, no slope stability analysis is required.

1.3 Scope of Work

A geotechnical investigation was conducted to determine subsurface soil conditions along the proposed project alignments and to develop geotechnical engineering recommendations for the construction of new underground utilities consisting of storm sewer and waters. **Associated Testing Laboratories, Inc. (ATL)** has completed a subsurface exploration program for this project consisted of the following scope:

- Coring through existing pavements at borings located within streets with portland cement concrete (PCC) pavements using a pavement coring machine, and augering through the existing asphaltic concrete (AC) pavements using the drill rig auger.
- Drilling and sampling a total of twenty-nine (29) borings (Borings B-1 through B-29), to a depth of 25 feet below existing grade, for a total of 725 linear feet of drilling, and converting four borings into piezometers (totaling 100 linear feet) after completion of drilling and sampling.
- Conducting laboratory tests on selected soil samples recovered from the soil borings.
- Developing boring logs and boring log profiles to present the general subsurface soil and groundwater conditions.

- Conducting a preliminary fault review of the project area based on review of available fault maps and literature.

Based on results from the field investigation, laboratory testing and gathered geological information, ATL performed geotechnical analyses to develop geotechnical recommendations for the proposed neighborhood street reconstruction and storm sewer and water lines construction.

2.0 SUBSURFACE INVESTIGATION PROGRAM

The field investigation for this project consisted of drilling and sampling a total of twenty-nine (29) soil borings and installing four (4) piezometers along the project alignments. The boring/piezometer locations and depths were approved during the proposal phase. The proposed borings and piezometers were selected based on criteria for borings and piezometers specified in City of Houston Department of Public Works and Engineering Design Manual, Chapter 11 "Geotechnical and Environmental Requirements".

All 29 borings were located within existing asphaltic concrete (AC) and portland cement concrete pavements (PCC) pavements. The existing PCC pavements and AC pavements with cement-treated base were cored through using a pavement coring machine; AC pavements with crushed stone base were drilled through using the drill rig auger. The information from our boring/piezometer and depths and the coordinates (northing and easting) are presented in the table below.

TABLE A: BORING AND PIEZOMETER INFORMATION

Boring		Piezometer		Location	Northing	Easting	Elevation, ft.
No.	Depth, ft.	No.	Depth, ft.				
B-1	25	PZ-1	25	Voque Drive	13,859,695.53	3,080,294.95	78.58
B-2	25	--	--	Voque Drive	13,859,717.46	3,080,853.65	78.06
B-3	25	--	--	Voque Drive	13,859,738.57	3,081,336.54	78.21
B-4	25	--	--	Cedel Drive	13,859,481.16	3,080,034.74	78.17
B-5	25	--	--	Cedel Drive	13,859,538.21	3,080,633.41	77.36

Boring		Piezometer		Location	Northing	Easting	Elevation, ft.
No.	Depth, ft.	No.	Depth, ft.				
B-6	25	--	--	Cedel Drive	13,859,571.97	3,081,145.83	77.77
B-7	25	--	--	Cedel Drive	13,859,585.59	3,081,761.44	77.13
B-8	25	PZ-2	25	Cedel Drive	13,859,606.52	3,082,235.09	76.34
B-9	25	--	--	Cedel Drive	13,859,625.18	3,082,683.34	77.37
B-10	25	--	--	Restridge Drive	13,859,285.68	3,080,321.86	77.09
B-11	25	--	--	Ridgecrest Drive	13,859,131.05	3,080,607.56	76.59
B-12	25	--	--	Turquoise Lane	13,859,282.61	3,081,163.21	76.46
B-13	25	--	--	Spenwick Drive	13,859,089.31	3,081,639.86	75.58
B-14	25	--	--	Turquoise Lane	13,859,312.41	3,081,884.27	76.74
B-15	25	--	--	Turquoise Lane	13,859,332.84	3,082,363.38	76.88
B-16	25	--	--	Delery Drive	13,859,084.42	3,082,763.47	75.76
B-17	25	--	--	Shortpoint Street	13,858,818.64	3,082,485.84	75.63
B-18	25	PZ-3	25	Glosridge Drive	13,857,956.42	3,078,971.80	78.08
B-19	25	--	--	Glosridge Drive	13,857,406.05	3,078,985.88	77.23
B-20	25	--	--	Glosridge Drive	13,856,843.28	3,079,000.42	76.26
B-21	25	--	--	Norcrest Drive	13,858,002.06	3,079,281.15	77.81
B-22	25	--	--	Norcrest Drive	13,857,381.12	3,079,296.45	77.21
B-23	25	--	--	Norcrest Drive	13,856,871.57	3,079,323.00	76.18
B-24	25	--	--	Lynnview Drive	13,858,054.77	3,080,813.61	76.68
B-25	25	--	--	Lynnview Drive	13,857,463.83	3,080,837.60	75.90
B-26	25	--	--	Lynnview Drive	13,856,953.99	3,080,860.18	75.75
B-27	25	PZ-4	25	Lynnview Drive	13,856,288.13	3,080,889.19	72.12
B-28	25	--	--	Waterbury Drive	13,854,888.74	3,079,861.58	68.03
B-29	25	--	--	Waterbury Drive	13,854,907.89	3,080,456.72	68.64

Boring locations drilled in this geotechnical exploration are shown on Figures 2a to 2e. The boreholes were drilled dry to the bottom of the boring or to a depth where a borehole started caving in, after which rotary wash boring technique was carried out. In cohesive soils, undisturbed soil samples were collected using a conventional 3-inch O.D. Shelby tube in accordance with ASTM D1587. Cohesionless soils were sampled using split spoon sampler in accordance with ASTM D1586. All soil samples were examined, classified and logged in the field. A representative portion of each sample was packed in containers to prevent moisture loss. All soil samples were properly labeled and subsequently transported to the ATL laboratory.

Boring B-1, B-8, B-18 and B-27 were converted into piezometer PZ-1 through PZ-4 after the completion of drilling and sampling. The groundwater level information encountered in the boreholes during and at completion of drilling, and the water level in the piezometer after 24 hours and 7 days are presented in Table 2. The piezometers were pulled and plugged with cement-bentonite grout after the 30-day water level reading. The piezometer installation and plugging reports are presented in Appendix 2.

Upon completion of drilling, the borings where no piezometer was to be installed were backfilled using cement-bentonite grout using a tremie. The cored PCC pavements were patched using portland cement concrete, and the augered AC pavements were patched using cold-mixed asphaltic concrete.

All soil samples were classified according to Unified Soil Classification System (ASTM D-2487). The soil and groundwater information found in each boring are shown on the individual boring logs presented in Appendix 3. A Key to Log Terms and Symbols is also presented in Appendix 3.

3.0 LABORATORY TESTING PROGRAM

Samples obtained from the field were again examined and classified in our laboratory by the geotechnical technician under the supervision of an engineer. Laboratory testing was performed on selected soil samples collected during the field investigation. The laboratory testing program included Atterberg Limits (ASTM D-4318), Density, Moisture Content (ASTM D-2216), Unconfined Compressive Strength (ASTM D-2166), Unconsolidated Undrained Triaxial (ASTM D-2850) and Percent Finer Than No. 200 Sieve (ASTM D-1140) tests. The results of laboratory tests are presented in the boring logs in Appendix 3 and summarized in Table 3. Overall numbers and types of tests performed for this study for this project are presented below:

TABLE B: SUMMARY OF LABORATORY SOIL TESTS

TYPE OF TEST	NUMBER OF TEST
Dry Density	58
Moisture Content	319
Atterberg Limits	91
Sieve Analysis thru #200	72
Unconsolidated Undrained Triaxial	30
Unconfined Compression	28

4.0 SUBSURFACE AND SITE CONDITIONS

4.1 Geology of Coastal Plain

The proposed project area is located within the Gulf Coast Structural Province, a huge sedimentary basin containing several thousand feet of sediments. In general, these sediments consist of loose sands, silts and clays which slope gently toward the Gulf of Mexico.

The site is underlain mostly by the Beaumont Formation of Pleistocene age. This formation consists of over consolidated clays, silts and sands with some shell calcium carbonate and iron oxides. These formations are quite strong and extend to an approximate depth of 100 feet.

The project alignment along Waterbury Drive is located near the boundary between the Beaumont and the Lissie Formation. The Lissie Formation is of Pleistocene age and consists of sand, silt, clay, and minor amount of gravel. Iron oxide and iron-manganese nodules common in zone of weathering and contains locally calcareous material. The surface is fairly flat and featureless except for many

shallow depressions and pimple mounds. The near surface materials are often weakened by the weathering process.

4.2 Geologic Faults

Among the geologic and geomorphological features in this region are sedimentary deposits broken by structure such as normal faults, salt domes, etc. The sedimentary deposits slope gently toward the Gulf of Mexico. They are broken by normal faults, most of which dip toward the Gulf and extend downward many thousands of feet. The earth movements that caused these faults took place within the last 50,000 years. In general, the regional faults in the Houston area trend parallel to the Gulf Coast. Only the local faults over the salt domes show a radial pattern associated with the upthrust of the salt mass. There are numerous faults and fault systems in the Greater Houston and surrounding area. The movements of many of these faults has been affected in recent history by area subsidence.

The subsidence is theorized to have been associated with the removal of oil and groundwater. As much as nine (9) feet of subsidence has occurred in the area east of Houston in the last 70 years. Conversion to surface water usage and the limiting of oil production has greatly reduced the subsidence rate in the area east of Houston.

Figure 3a shows the principal active faults in the Houston area. Figure 3b shows the active surface faults of the Houston area interpreted on LIDAR Imagery (Khan and Engelkemeir). Based on these maps, it appears that the Long Point Fault crosses near the southern end of the project alignments, most probably near the southern end of the Lynnview Drive alignment. Therefore, ATL recommends that a Phase I Fault Study be conducted by a Professional Geologist knowledgeable with Long Point Fault to further investigate and verify the possibility of the Long Point Fault zone impacting the Lynnview Drive project alignment.

4.3 Subsurface Soil Stratigraphy and Geotechnical Characterization

***Existing Pavement Material*:** All 29 boring were located within existing asphaltic concrete (AC) and portland cement concrete pavements (PCC) pavements. The existing PCC pavements and AC pavements with cement-treated base were cored through using a pavement coring machine; AC pavements with crushed stone base were drilled through using the drill rig auger. A summary of the existing pavement sections encountered at each boring location is presented in Table 1.

Based on the pavement information gathered from our field investigation, the existing AC pavements consist of between about 2 and 8 inches of AC surface over about 4 to 10 inches of base consisting of crushed shell and cement-treated crushed limestone. The existing PCC pavements at the boring locations have PCC thicknesses ranging from about 4 to 9 inches, some with about 2.5 to 10 inches of subbase including sand, crushed gravel and lime-stabilized soils; some of the PCC pavements were overlaid with between about 1.5 to 4 inches of AC. The actual pavement material and thicknesses in the field, at or near the boring locations, may differ from those described in the Table 1.

***Potentially Hazardous Materials*:** No unusual staining or hydrocarbon-like odor was noted in the soil samples recovered from the soil borings drilled in ATL's geotechnical investigation.

***Subsurface Soil Stratigraphy*:** Based on our soil borings, the subsurface soils along the project alignments consists generally of the following:

Along Vogue Drive (Profile 4a): The subsurface soils below the existing AC pavements, as found in Borings B-1 through B-3, consist of stiff to hard Lean Clays (CL) and Fat Clays (CH) to the bottom of borings at 25 feet below existing grade.

Along Cedel Drive (Profile 4b): The subsurface soils below the existing PCC pavements with AC overlay consist of soft to hard Lean Clays (CL) and Fat Clays (CH) to the bottom of Borings B-4 through B-9 at 25feet below the existing grade.

Along Restridge Drive (Profile 4c): The subsurface soils below the existing PCC pavements consist of soft t o very stiff Lean Clays (CL) and Fat Clays (CH) to the bottom of Boring B-5 and B-11at a depth of 25 feet below the existing grade.

Along Turquoise Lane (Profile 4d): The subsurface soils below the existing PCC pavements with AC overlay consist of firm to hard Lean Clays (CL) and Fat Clays (CH) to the bottom of Borings B-12, B-14 and B-15 at 25 feet below the existing grade.

Along Sue Delery Drive (Profile 4e): The subsurface soils below the existing PCC pavements consist of firm to hard Lean Clays (CL) and Fat Clays (CH) to the bottom of Borings B-9 and B-16 at 25 feet below the existing grade.

Along Glosridge Drive (Profile 4f): The subsurface soils below the existing AC and PCC pavements consist of stiff to hard Fat Clays (CH) and Lean Clays (CL) that exist to the bottom of Borings B-18, B-19 and B-20 at a depth of 25 feet below the existing grade.

Along Norcrest Drive (Profile 4g): The subsurface soils below the existing AC and PCC pavements consist predominantly of stiff to hard Fat Clays (CH) and Lean Clays (CL) to the bottom of Borings B-21 through B-23 at 25 feet below the existing grade. In Boring B-22, a stratum of medium dense Silty Sand (SM) exists within the clay stratum between depths of about 10 and 12 feet.

Along Lynnview Drive (Profile 4h): The subsurface soils below the existing AC and PCC pavements consist predominantly of stiff to hard Fat Clays (CH) and Lean Clays (CL) that exist to

the bottom of Borings B-24, B-26 and B-27 at 25 feet below the existing grade. In Boring B-25, the clay stratum exists to a depth of about 20 feet, below which a stratum of medium dense Silty Sand (SM) exists to the bottom of the boring at 25 feet.

Along Waterbury Drive (Profile 4i): The subsurface soils below the existing AC and PCC pavements consist predominantly of firm to very stiff Lean Clays (CL) and Fat Clays (CH) to a depth of about 23 feet below the existing grade in Borings B-28 and B-29. Below the clay stratum, medium dense Silt Sands (SM) exist to the the bottom of the borings at 25 feet below the existing grade.

The detailed subsurface soils and stratigraphy are shown in the individual boring logs in Appendix 3 and in the Boring Log Profiles in Figures 4a through 4i. "CL", "CH" and "SM" are classes of soils described in the Unified Soil Classification System.

The lean clays (CL) found in the soil borings have liquid limits ranging between about 23 and 49%, and plasticity indices (PI) ranging between about 8 and 30%. Clean non-expansive sandy lean clay soils (plasticity index between about 10 and 20) can be used as select fill in their present condition. The fat clay (CH) soils found in the soil borings have liquid limits ranging between about 50 and 76%, and plasticity indices ranging between about 31 and 53%. High plasticity fat and lean clays (PI>20) are not suitable for use as select fill in their present condition; however, these soils in their present conditions may be used as random fill. High plasticity clay soils, if clean, can be treated with appropriate amount of lime and used as select fill; a lime dosage of 6% by weight is recommended for preliminary estimate purposes, but lime vs. pH and/or lime vs. PI series tests should be conducted to determine the optimum lime dosage.

4.4 Groundwater

Free water was encountered during drilling operation in Borings B-1, B-5, B-7, B-11 through B-13, B-16, B-17, B-25, B-28 and B-29 at a depth of about 25, 23, 23, 23, 23, 20, 22, 23, 23, 30 and 20 feet

below existing grade, respectively, and at a depth of about 21, 18, 14.5, 17, 18, 18, 20.5, 19, 17, 17.5 and 18.5 feet, respectively at completion of drilling. Borings B-1, B-8, B-18 and B-27 were converted into Piezometer PZ-1 through PZ-4 after completion of drilling and soil sampling. Water level in PZ-1 through PZ-4 was measured after 24-hour at a depth of about 12, 13, 24 and 18 feet, respectively. Water level in PZ-1 through PZ-4 was measured after 7 days at a depth of about 12, 12.5, 23.5 and 18 feet, respectively. Water level in PZ-1 through PZ-4 was measured after 30 days at a depth of about 10.5, 11.5, 13.5 and 17.5 feet, respectively.

The groundwater information encountered during and at the end of drilling in the boreholes, and in the piezometer after 24 hours and 7 days are presented in Table 2. It should be noted that the groundwater conditions will fluctuate according to the amount of precipitation and the environments conditions at the site.

Perched water table may exist in permeable sand/silt lenses/seams/layers within clay stratum that can form pathways for percolated and infiltrated water. The rate of flow of groundwater produced by these layers will depend upon the weather conditions such as locations of size and continuity of the permeable layers/seams/lenses, and the amount of precipitation and ambient temperature etc., at the time of construction.

5.0 GEOTECHNICAL ANALYSES AND RECOMMENDATIONS

The proposed Neighborhood Street Rehabilitation project entails street improvements and storm sewer and water lines construction, along alignments traversing streets in the Key Map 451 N, P and S area totaling approximately 14,045 linear feet, as shown in Figures 2a to 2e.

5.1 Storm Sewer and Water Line Construction

The proposed storm sewer and water lines installation will likely involve both open cut/trenching

and augering, one of many trenchless construction technique. Construction of access pits (auger pits) will likely involve open cut/trench excavation. Based on the preliminary project information, the proposed 24- and 30-inch diameter storm sewer and water lines are proposed to be installed at a depth up to about 15 feet below existing grade.

ATL understands that the proposed storm sewer and water lines will underpass HCFCD Ditch W140-04-00 (estimated to be not more than 10 feet) using trenchless construction technique, and that the underpass invert will be about 5 feet below the ditch bottom and the construction will not disturb or involve modifications to the existing ditch slopes and structures. Thus, no slope stability analysis is required.

5.1.1 OSHA Soil Types

At the federal level, Occupational Safety and Health Act (OSHA) requires protective systems for all trenches exceeding 5 feet in depth. OSHA has developed a soil classification system to be used as a guideline in determining sloping and protective system requirements for trench excavations. This system has set forth a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing amounts of stability.

Stable Rock: Natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Type A: Cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) or greater.

However, no soil is Type A if:

- The soil is fissured; or
- The soil is subject to vibrations from heavy traffic, pile driving, or similar effects; or

- The soil has been previously disturbed; or
- The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four (4) horizontal to one (1) vertical or greater; or
- The material is subject to other factors that would require it to be classified as a less stable material.

Type B:

- Cohesive soil with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf; or
- Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or
- Dry rock that is not stable; or
- Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

Type C:

- Cohesive soil with an unconfined compressive strength of 0.5 tsf or less; or
- Granular, including gravel, sand, and loamy sand; or
- Submerged soil or soil from which water is freely seeping; or
- Submerged rock that is not stable;. or
- Material is a sloped, layered system where the layers dip into the excavation on a slope of four (4) horizontal to one (1) vertical or steeper.

Based on the soil conditions from the borings and groundwater information from the borings and piezometers, ATL recommends classifying the top 10 feet of the onsite clay soils (CL/CH) that are soft to firm as OSHA Soil Type "C", and those that are stiff to hard as OSHA Soil Type "B" for the determination of allowable maximum slope or selection and design of the protective system. All onsite clay soils below a depth of 10 feet shall be classified as OSHA Soil Type "C". Fill soils,

sands (SP/SM/SC), silts (ML), silty clays (CL-ML), clay soils containing a significant amount of sand/silt/gravel/calcareous nodules/other granular or low cohesion materials, and any soils subject to hydraulic pressure or vibrations shall be classified as OSHA Soil Type "C".

5.1.2 Open Cut/Trench Excavation

The proposed storm sewer and water lines installation will involve construction using both open cut/trenching and trenchless techniques. Construction of auger pits will also involve open cut/trench excavation.

The approximate flow line depths and the subsurface conditions found in the soil borings are shown in the Boring Log Profiles on Figures 4a through 4i. Accordingly, the storm sewer and water lines installation excavation will be advanced mostly in stiff to hard clays (CL/CH), with local soft to firm stratum. However, locations identified in Table C and D below (but not limited to) will likely or may encounter granular soils and/or soft clays during the construction excavation:

TABLE C: LOCATIONS WHERE STORM SWER AND WATER LINES INSTALLATION WILL LIKELY TO OR MAY ENCOUNTER SANDS

At/Near Boring	Approximate Storm Sewer and Water Invert Depth, ft.	Depth of Silty Sand Stratum	
		From	To
B-22	15	10	12**

** denotes sands exist above the proposed flow line, and may be encountered during open cut and/or pit excavation

TABLE D: LOCATIONS WHERE STORM SEWER AND WATER LINES INSTALLATION WILL LIKELY TO OR MAY ENCOUNTER SOFT CLAYS

At/Near Boring	Approximate Maximum Invert Depth, ft.	Depth of Soft Clay Stratum	
		From	To
B-4	15	10" (below pavement)	4**

** denotes soft clays exist above the proposed flow line, and may be encountered during open cut and/or auger pit excavation

The trench excavations can be made using cut slopes stepped back to stable slope, vertical cuts

supported with sheet piles or other suitably designed retaining system. The excavation should be performed in accordance with the current OSHA 29 CFR Part 1926 of OSHA (Trench Safety System) and City of Houston Standard Specification, Section 02317 – Excavation and Backfill for Utilities.

Trenches should be provided with a proper trench support system. For the trench supporting system, the lateral pressures exerted on trench walls by stiff clays and cohesionless soils are presented in Figure 5a. Where soft to firm cohesive soils are encountered, the lateral pressure may be computed as given in Figure 5b. Where cohesive soils are underlain by sandy soils, the lateral pressure may be computed as given in Figure 5c. Temporary earth retaining walls are sometimes designed assuming an equivalent fluid pressure, in such cases, a lateral earth pressure equivalent imposed by a 84 PCF and 102 PCF fluid is recommended for clay soils above and below the water table, respectively; in sandy soils, a lateral earth pressure equivalent imposed by a 48 PCF and 85 PCF fluid is recommended for soils above and below the water table, respectively. Timber shoring as outlined in 29 CFR Part 1926 of OSHA recommendation may be used in the construction of trench supporting system. Trench boxes are commonly used for trench safety without shoring or bracing in open-cut excavations with vertical walls. In all cases, excavations should conform to OSHA guidelines.

Vehicular and Other Surcharge Loadings: Under normal loading conditions, a surcharge magnitude of q psf can result in lateral earth pressure of about 0.5q in cohesive soils and about 0.4q in sandy soils. All surcharge loads to a distance of 0.5 times the wall height should be considered. Due to the likely presence of roadways along the proposed pipeline alignment, the effects of vehicular traffic should be considered while designing the lateral supporting systems. The highway loading imposed by a H20 truck on a pipe under various depths of soil cover is presented in Figure 6. Figure 7 presents Boussinesq's equation for computing both horizontal and vertical stresses imposed by a surface surcharge load.

Stockpiling of excavated material should not be allowed near the excavation. Generally, a distance of

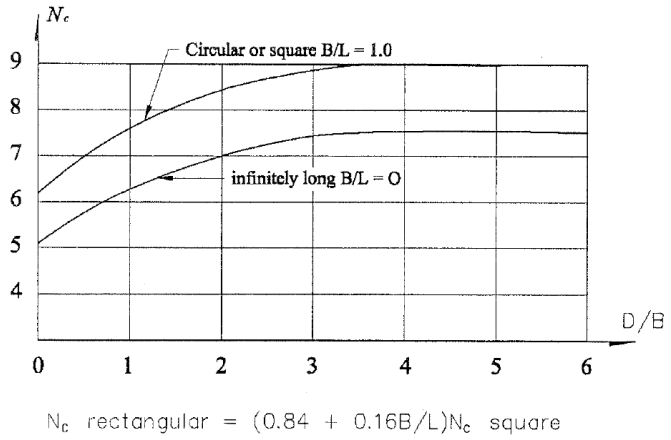
at least one-half the excavation depth on both sides of the trench should be kept clear of any excavated material and height of stockpile should be limited to no more than 3 feet. If this is not possible due to space limitations then the retaining system design should be designed to take into account the surcharge loads.

In stable cohesive soils and where groundwater is lowered at least 3 feet below the excavation bottom, and if the sheeting terminates at the base of cut, the trench bottom stability can be evaluated in the following manner:

$$\text{Factor of safety } (F_s) = \frac{(N_c)\,C}{(\Upsilon)\,D + q}$$

Where,

N_c = Bearing capacity factor that depends on dimensions of the excavation:



N_c rectangular = (0.84 + 0.16B/L)N_c square

C = Average undrained shear strength of clay in failure zone beneath and surrounding base of cut, psf.

Υ' = Average effective unit weight of soils above trench bottom, pcf.

q = Surface surcharge, psf.

D = Depth of trench, ft.

L = Length of trench, ft.

B = Width of trench, ft.

If the factor of safety is less than 1.5, sheeting should be extended below the base of the cut to insure stability. The extended sheeting depth should be at least 1.5 times the trench width.

5.1.3 Groundwater Control

Groundwater information gathered from the soil borings during and at completion of drilling, as well as the 24-hour and 7-day water level readings in the piezometers were presented in Section 4.4. It should also be noted that groundwater levels will fluctuate as a result of seasonal rainfall variations.

The approximate flow line depths and the subsurface conditions as found in the soil borings are shown in the Boring Log Profiles on Figures 4a through 4i. Based on the proposed invert elevation and the groundwater information gathered during our field investigation, the storm sewer and water lines construction excavations will have a high probability to encounter groundwater when the excavation depths approaches or exceeds about 10 feet along project alignments near Hammerly Boulevard area, and the construction excavations along alignments south of Hammerly Boulevard will have a high probability of encountering groundwater when the excavation depths approach or exceed the about 17 feet. It should be noted that groundwater level will fluctuate with the amount of precipitation and the prevailing environmental conditions prior to and during construction.

Seepage rate in clay soils, if exists, will likely be low, but seepage rate in sands (if exists) will be higher. Groundwater control for excavation in cohesive soils up to a depth of 15 feet, if required, can usually be accomplished by sump and pump arrangements because the seepage is relatively slow. For dewatering below the depth of about fifteen (15) feet multi-staged pumps will be required. When excavations extend into water-bearing sands/silts (not found in soil borings drilled in this investigation, but may be present away from the borings drilled or after heavy rainfalls), then dewatering using well points will be necessary. Criteria and requirements of City of Houston Standard Specification, Section 01578 – Control of Ground Water and Surface Water should be

followed.

Seams and pockets of sand, silt, ferrous nodules, and calcareous nodules that may exist in cohesive soil layers may form communicative drainage paths for the groundwater, leading to potential water-bearing/perched water condition, and as a result, accelerated the rate of seepage. If such unexpected phenomenon is observed during the trench excavation and construction, appropriate measures, such as proper dewatering and shoring methods, may have to be implemented under supervision of a Professional Civil/Geotechnical Engineer.

5.1.4 Bedding Criteria

For sewers and water lines, in areas where dry and stable subgrade is encountered, the trench bottom should be excavated to a minimum of 12 inches below the pipe placement depth. The trench bottom should be shaped to receive the pipe. The bedding details should be in accordance with the latest City of Houston Specifications. City of Houston Drawing No. 02317-03 should be used for the storm sewer bedding and backfill for dry stable trench conditions; in areas where wet subgrade is encountered, City of Houston Drawing No. 02317-02 crushed stone foundation should be provided for the storm sewer bedding. City of Houston Drawing No. 02317-04 should be used for the water main bedding and backfill. City of Houston Drawing No. 02317-01 should be used for the storm sewer bedding and backfill for both dry and wet stable trench conditions. Soft and/or wet soils, if encountered at trench bottom, should be handled according to requirements specified in City of Houston Standard Specifications Section 02317, Subsection 3.07, A and B.

The embedment material between the pipe and the trench (bedding, haunching and initial backfill) may consist of bank run sand or cement-stabilized sand placed in maximum six-inches compacted lift thickness and compacted to a minimum of 95 percent of the maximum dry density as determined by Standard Proctor test (ASTM D698) at –3 to +5 percent of the optimum moisture content. Cement stabilized sand shall be placed in maximum 6 inches compacted lifts and compacted to at

least 95 percent of the ASTM D 558 maximum dry density at a moisture content on the dry side of optimum.

5.1.5 Trench Backfill

The backfill should conform to standard City of Houston Specification, Section 02317 – Excavation and Backfill for Utilities. The backfill materials should conform to standard City of Houston Specification, Section 02320 – Utility Backfill Materials.

Trench zone backfill for storm sewers and water lines shall be in accordance with COHSS Section 02317, Section 3.09. Trench zone backfill under pavements or structures shall be placed to 12 inches below the bottom of the pavement structure, and compacted select fill shall be placed to the design pavement subgrade elevation.

Suitable onsite soils may consist of clean onsite soils (excluding ML, CL-ML, OH, OL type soils). Trench zone soils (including select fill) should be placed in maximum 12 inches loose lifts and compacted by vibratory equipment to a minimum of 95 percent of the maximum dry density at moisture content within zero and +5 percent of optimum as determined by ASTM D698. Cement stabilized sand shall be placed in maximum 12 inches compacted lifts and compacted to at least 95 percent of the ASTM D 558 maximum dry density at a moisture content on the dry side of optimum.

Trench zone backfill outside of pavements or other structures shall be placed in 9 inches maximum compacted lifts for clay soils and 12 inches maximum compacted lifts for granular soils, to a at least 90 percent of the maximum dry density as determined by Standard Proctor (ASTM D 698) method, at a moisture content that is conducive to achieving the required density.

5.1.6 Loads on Buried Conduits

The pipelines placed at depths under the ground will be subject to loads due to backfill (earth loads) and loads due to vehicular traffic (live loads).

Earth Load: The earth loads on a buried pipe can be calculated based on Marston's formulae (Ref: 1 through 3). The Marston's equation for buried conduits are generally given as:

$$W_d = C_d \Upsilon B_d^2 \qquad \text{- for rigid pipes}$$

$$W_d = C_d \Upsilon B_d B_c \qquad \text{- for flexible pipes}$$

Where, W_d = fill load, in pounds per linear foot of pipe

C_d = Marston's soil coefficient

Υ = Unit weight of fill material, pcf (use 120 pcf)

B_d = Width of trench at or slightly below top of pipe, in feet

B_c = Width of pipe, in feet

The above equation is valid when the conduit is placed in a trench not wider than 2.0 to 3.0 times its outside width. Marston's soil coefficient C_d can be obtained from Table 4. K is the active earth pressure coefficient and μ is the coefficient of sliding friction between the fill material and the sides of the trench. The height of fill and the horizontal width of trench should be considered from the top of the conduit. For the above equation for flexible pipes, an assumption of equal stiffness of soil and pipe has been used for its development and the equation generally gives a minimum load value. Hence, for flexible pipes including ones installed using trenchless construction, the earth loads may be conservatively calculated using the prism load theory. The prism load (Ref: 1 through 3) determines the weight of the soil column directly above the pipe and neglecting factors such as side wall friction and/or the cohesion of the soils. The prism load (in psf) may be calculated by multiplying the total unit weight of soil above the pipe (say 120 pcf) by the height, H (ft) of the soil fill. The prism load generally gives higher loading on the pipe and simulates the long term load

imposed on the pipe.

Vehicular Load: For calculation of live loads, the width of the loaded area should be taken as the outside horizontal width of the pipe. Loading due to H20 vehicle should be considered for vehicular traffic. The estimated highway loading on a buried conduit imposed by a H20 truck, under various soil cover, is presented on Figure 6.

Surcharge Load: The stresses imposed by a surcharge load can be estimated using Boussinesq's Equation presented on Figure 7.

5.1.7 Trenchless Construction

Segments of the proposed storm sewer and water lines will be installed using trenchless technique. In general, trenchless installation may involve dry auger or slurry auger method. In the dry auger method, the casing is advanced by jacking while soils are excavated at the advancing end of the casing. In the slurry auger method, a small diameter pilot hole is first drilled between the access shafts, followed by reaming the pilot hole to full diameter by augering with slurry and installing casing or pipe by pull-back or jacking techniques. Applicable requirements of City of Houston Standard Specification, Section 02447 "Augering Pipe and Conduit" and Section 02448 "Pipe and Casing Augering for Sewers", should be followed.

The proposed storm sewer and water lines will be installed mostly in stiff to very stiff clays, in which case the excavation face are anticipated to be stable. However, a stratum of silty sands may be present at Boring B-22 (but not limited to) as identified in Table C of Section 5.1.2, and soft clays may be present below existing pavement to a depth of about 4 feet at Boring B-4 (but not limited to) as identified in Table D. Groundwater conditions observed in open boreholes during the field investigation and in piezometers are presented in Section 4.4.

Excavation face in granular soils (sand/silt/gravel), soft clays and clay soils with slight/low plasticity or containing a significant amount of sands, and other caving soils, if encountered at/near the excavation face, will likely experience some degree of instability if the excavation face is unsupported, especially when these soils are saturated and/or subject to seepage pressure. In such cases, the following mitigating measures can be employed to improve the excavation stability:

1) Lower the groundwater table to at least 3 feet below the excavation bottom, and use colloidal drilling fluid (usually bentonite slurry) under controlled pressure to improve stability of the excavation.
2) In conditions where mitigation measures employed in Item 1 above cannot adequately provide the excavation stability, a casing can be installed at the same time of the slurry augering to provide stability of the excavation and reduce settlement at the surface.
3) In ground conditions where highly unstable soils and/or high inflow rate/pressure exist, microtunneling machine equipped with face shield and pressure-balancing colloidal drilling fluid may be used to maintain the stability of the excavation face.
4) Alternatively, open cut with shoring or other methods approved by City of Houston Department of Public Works and Engineering, along with groundwater control, and other stabilizing techniques such as chemical grouting, may be used at locations with difficult subsurface conditions or site constraints.

It is the responsibility of the Contractor to select a trenchless technique for the installation of the proposed storm sewer and water lines by taking into account the soil types and stratigraphy and the groundwater conditions as found in the soil borings; the Contractor should have a work crew with experience in working with the selected trenchless construction technique in subsurface conditions similar to those found along the project alignments. If necessary, the Contractor may conduct additional geotechnical investigation to provide more detailed subsurface conditions.

Shoring systems for the auger pits may be designed based on the lateral earth pressures and other

considerations discussed in Section 5.1.2.

5.1.8 Effects of Trenchless Construction on Surrounding Structures

A properly designed and controlled augering/trenchless construction operation can reduce immediate soil movement and subsidence to a tolerable level. Nevertheless, some ground loss should be expected during any augering/trenchless construction operations. With good construction techniques, ground loss can be mitigated to acceptable levels. Augering/trenchless construction below pavement and buried utilities may lead to some future settlement due to loosening of the subgrade or bedding condition. Large ground loss can result from uncontrolled flowing ground. Such conditions may occur if water-bearing sands or silts were encountered (not encountered in our soil borings, but may be present away from the borings drilled) in the excavations along the augering/trenchless construction alignment. Measures to mitigate ground loss and other impacts of trenchless construction were addressed in Section 5.1.7.

The zone of influence of the augering/tunnel roughly extends to a distance equal to the invert depth on each side of the centerline of the augering/trenchless construction alignment. The amounts of settlement due to augering/trenchless construction are difficult to estimate. We anticipate that if good construction practices and control are exercised, the amount of ground settlements should be small. Establishing monitoring points on existing roadways, buildings and other important structures along the augering/trenchless construction alignments, and record coordinates and elevations prior to, during and after construction to monitor the amount of settlements or lateral movements due to augering/trenchless construction, and adjust augering/trenchless construction technique accordingly to mitigate the movements as necessary. Existing damages to the surrounding structures should be documented prior to starting of the augering/trenchless construction operations.

5.1.9 Thrust Restraint

Unbalanced thrust forces result from changes in flow directions and/or velocity in a pressurized pipe system (see Figure 8). The unbalanced thrust force and magnitude of thrust block force T is defined as follows:

$$T = 2\ PA\ \text{Sin}\ (\theta/2)$$

Where, P = internal fluid pressure (psi);

A = cross-sectional area of pipe (in^2);

θ = deflection angle of bend; and,

T = thrust force (pounds)

Adequate restraint may be achieved by using thrust blocks, restraint joints, tie rods, or a combination of these systems. The unbalanced force acting on a pipe system is transmitted by a thrust block and resisted by the bearing area between the pipe and the foundation soils. The unbalanced force acting on a pipe system with restraint joints are resisted by the frictional forces between the pipe/soil interface across the pipe sections restrained to act integrally.

8hrust Blocks: Thrust blocks are commonly used to increase the bearing area to allow the fittings to resist movement. The procedures for thrust block design are given in detail in AWWA M9 (Ref. 1). The required thrust block bearing area is calculated based on the bearing capacity of the soil:

$$\text{Required Bearing Area of Thrust Block} = T/F$$

Where, T = thrust force (lb); and,

F = safe bearing value for soil (lb/sq.ft)

A safe bearing value of 1,500 psf can be used for thrust block design bearing on compacted soils. This value includes a factor of safety of 3. The blocks must be placed against undisturbed or compacted soils and the face of the block must be perpendicular to the direction of and centered on the line of action of the thrust. Proper care must be exercised after construction to prevent failure due to any future excavations behind the blocks.

Restrained Joints: Restrained joints are typically used to avoid the uncertainties of thrust blocking like future excavations, etc. A detailed procedure for designing restrained joints including example calculations is outlined in the AWWA design manual M9 (Ref. 1). The following soil parameters are recommended for the design of the restrained joint(s):

Average unit weight of soil, γ = 120 pcf

Cohesion of soils, C = 250/500/1000 psf (for soft/firm/stiff clays)

For coefficient of friction between pipe and granular soils, f, use 0.25 for smooth PVC and steel pipes, and use 0.3 for concrete pipes.

5.1.10 Flexible Pipe Deflection

The deflection of a flexible pipe may be determined using the modified Iowa formula of Watkins and Spangler (Ref. 2) as given below:

$$\Delta x = D_l \left[KWr^3 / (EI + 0.061\, E' r^3) \right]$$

Here EI is the pipe wall stiffness (in-lb.), r is the radius (in.) and W is the load per unit of pipe length (lb/in. in. of pipe). Where prism loads (i.e. weight of soil above the pipe) are used for pipe earth loads, a deflection lag factor, D_l of 1.0 may be used. Otherwise, deflection lag factor, D_l of 1.5 should be used. The bedding constant, K, may be taken as 0.1. The following typical soil parameters are recommended:

Soil Type	Soil Consistency	Unit Weight, pcf	Shear Strength (c), psf or SPT Blow Counts, blows/ft	Modulus of Soil Reaction, psi/in
Fat Clays and Lean Clays	Soft	120	$c \leq 250$	100
	Firm	124	$c \leq 500$	300
	Stiff	128	$c \leq 1{,}000$	600
	Very Stiff	130	$c \leq 2{,}000$	1,000
	Hard	132	$c > 2{,}000$	2,000
Granular Soils: Sands, Silts and Gravel	Loose	110	$2 \leq N_{SPT} \leq 7$	300
	Loose to Medium Dense	113	$8 \leq N_{SPT} \leq 15$	600
	Medium Dense	115	$16 \leq N_{SPT} \leq 30$	1,000
	Dense	118	$N_{SPT} > 30$	2,000

* Buoyant soil unit weight is computed by subtracting unit weight of water from the soil unit weight

5.1.11 Buoyant Uplift

Portion of a buried structure located below the water table is subject to an upward hydrostatic pressure, called the *buoyant uplift pressure*. Resistance to buoyant uplift pressure is provided by the following components:

- *Weight of the structure (W)*
- *Weight of the soil above the base extension beyond the wall(Ws)*
- *Frictional force between the soil and foundation (Fs).*

Buoyant Uplift Resistance = W + Ws + Fs

W and Ws are can be readily computed. The computation of the buoyant uplift, and the skin friction resistance are shown in Figure 9. If base extension option is used, we recommend using a buoyant unit weight of backfill soil above the base extension of 65 pcf when computing Ws.

5.1.12 Street Cut and Repair

Any street cut necessary for this project should be restored to its original condition using material similar in nature and thickness to the existing streets. Recommendations outlined in City of Houston Standard Specification, Section 02951 – Pavement Repair and Resurfacing should be followed. The top 6 and 8 inches of the subgrade soils in the pavement repair areas in local collectors/streets and major thoroughfares, respectively, should be stabilized. ATL recommends stabilizing the onsite subgrade soils that are clays with at least 6 percent lime on weight basis; optimum amount of stabilization shall be determined by conducting laboratory testing. The lime stabilization should be carried out in accordance with City of Houston Standard Specifications Section 02336.

5.2 Pavement Reconstruction

The existing streets along the project alignments will be reconstructed with portland cement concrete pavements. Our design recommendations for new concrete pavement are given in the following sections.

5.2.1 Traffic Information

Pavement reconstruction may be carried out on segments of the major thoroughfare Long Point Road, and along local collectors/streets along the project alignments in this project. Currently available City of Houston Traffic Counts information indicated average daily traffic (ADT) counts in 2009 and 2013 along major thoroughfares Hammerly Boulevard, Long Point Road, Bingle Road and Wirt Road in the vicinity of the project area range from about 12,000 to 18,300, while ADT counts of local collectors in the vicinity of the project area like Westview Drive and Campbell Drive range from about 6,200 to 8975. For Long Point Road that is a thoroughfare, assuming an average ADT of 8,975, an annual traffic growth rate of 4 percent, an average 18-k Equivalent Single Axle Load (ESAL) factor of 1.0 with 3 percent growth rate, and a directional and lane distribution factor of 0.5

and 0.7, we estimated the a 20- and 30-year design traffic loading of approximately 2.17 and 4.09 millions repetitions of 18-k ESAL, respectively. For future Lynnview Drive, Vogue Lane and Cedel Drive that are likely to be local collectors, assuming an average ADT of 8,975, an annual traffic growth rate of 4 percent, 4% truck traffic with an average 18-k Equivalent Single Axle Load (ESAL) factor of 1.0, and a directional and lane distribution factor of 0.5 and 0.7, we estimated the a 20- and 30-year design traffic loading of approximately 1.06 and 2.0 millions repetitions of 18-k ESAL, respectively. If the future traffic is projected to be significantly different from the above, we should be contacted. We will then revise our recommendations based on the actual anticipated traffic information.

5.2.2 Subgrade Preparation

The surface soils along project alignments consist mostly of fat and lean clays. These soils should provide an acceptable base for pavement construction when properly prepared as following:

- Remove existing pavements and structures per requirements of City of Houston Standard Specification Section 0222. Clear and grub existing vegetation and debris according to requirements of City of Houston Standard Specifications Section 02233. Excavate to grade and prepare and compact the pavement subgrade according to City of Houston Standard Specifications Section 02315 requirements. Proofroll the subgrade to detect any wet, soft, or pumping areas; remove and replace them with acceptable fill material. Compact the subgrade soils at a moisture content between 0 and +3 percent of optimum, to at least 95 and 90 percent of the maximum dry density at as determined by the Standard Proctor Compaction Test (ASTM D 698) for areas inside and outside the pavement and shoulder area, respectively.
- Good surface drainage should be provided away from the edges of paved areas to minimize lateral moisture transmission into the subgrade.

5.2.3 Subgrade Stabilization

Our field and laboratory exploration indicated that the subgrade soils below the existing pavement consisted of mostly of clay soils. After the pavement subgrade preparation as recommended in Section 5.2.2, scarify and treat the top 6 and 8 inches of the subgrade clay soils with at least 6 % lime by dry weight (optimum amount of stabilization shall be determined by conducting laboratory tests) for local collectors/streets and major thoroughfares, respectively, and compact the lime-stabilize soils at a moisture content between 0 and +3 percent of optimum, to at least 95 percent of the maximum dry density at as determined by the Standard Proctor Compaction Test (ASTM D 698). The lime stabilization should be in accordance with City of Houston Standard Specification, Section 02336.

5.2.4 Portland Cement Concrete Pavement

Major Thoroughfares: The concrete pavement for major thoroughfare in this project was designed based on the AASHTO procedure, and assuming an 8-inch stabilized soil subbase as recommended. The following design parameters were used in the concrete pavement design for the proposed pavement.

Reliability, R : 95 %

Overall Standard Deviation, So : 0.35

Load Transfer Coefficient, J : 3.2

Drainage Coefficient, Cd : 1.2

Design Serviceability Loss, ΔPSI : 2.0

Loss of Support : 1.0

Traffic : 2,172,000 18-k ESAL for a 20-year design life

4,090,000 18-k ESAL for a 30-year design life

Concrete Modulus of Rupture : 600 psi

Modulus of Elasticity of Concrete, Ec = 3.725×10^6 psi

Effective Modulus of Subgrade Reaction, k = 70 pci

Based on the above design parameters, the recommended concrete pavement section thicknesses for a thoroughfare in this project are as follows:

Design Life = 20 Year **(Design Traffic Loading = 2.17 x 10^6 18-k ESAL)**
8" Jointed Reinforced Concrete Pavement
8 "Stabilized Subgrade

Design Life = 30 Year **(Design Traffic Loading = 4.09 x 10^6 18-k ESAL)**
9" Jointed Reinforced Concrete Pavement
8 "Stabilized Subgrade

Local Collectors: The concrete pavement for future Lynnview Drive, Vogue Lane and Cedel Drive that are likely to be local collectors, was designed based on the AASHTO procedure, and assuming an 6-inch stabilized soil subbase as recommended. The following design parameters were used in the concrete pavement design for the proposed pavement.

Reliability, R : 90 %

Overall Standard Deviation, So : 0.35

Load Transfer Coefficient, J : 3.2

Drainage Coefficient, Cd : 1.2

Design Serviceability Loss, ΔPSI : 2.0

Loss of Support : 1.0

Traffic : 1,067,520 18-k ESAL for a 20-year design life

2,006,000 18-k ESAL for a 30-year design life

Concrete Modulus of Rupture : 600 psi

Modulus of Elasticity of Concrete, Ec = 3.725 x 10^6 psi

Effective Modulus of Subgrade Reaction, k = 60 pci

Based on the above design parameters, the recommended concrete pavement section thicknesses for a local collector in this project are as follows:

Design Life = 20 Year (Design Traffic Loading = 2.17 x 10^6 18-k ESAL)
7" Jointed Reinforced Concrete Pavement
6 "Stabilized Subgrade

Design Life = 30 Year (Design Traffic Loading = 4.09 x 10^6 18-k ESAL)
8" Jointed Reinforced Concrete Pavement
6" Stabilized Subgrade

If the projected traffic is going to be significantly different from that assumed, then we should be contacted for revised recommendation based on the actual traffic.

Local Streets: For local residential streets with PCC pavements, the following concrete pavement section thicknesses are recommended:

6" Jointed Reinforced Concrete Pavement
6 "Stabilized Subgrade

5.2.5 Pavement Construction and Reinforcement Design

Design and construction of the concrete pavements, including reinforcement and jointing details, should meet the COHDPWE Standard Specifications Section 02751 and 02752, as well as the standard details drawings No. 02751-1 and 02752-1, as applicable.

6.0 CONSTRUCTION CONSIDERATION

The proposed storm sewer and water installation will involve mostly trenchless construction techniques and some open cut/trenching construction. Accordingly, the storm sewer and water installation excavations will be installed mostly in stiff to very stiff clay soils with local areas of soft to firm stratum. However, granular soils or soils with limited cohesion, or soft clays, will likely or may be present at (but not limited to) locations identified in Table C and D of Section 5.1.2.

Excavation face in granular soils (sand/silt/gravel), soils with only slight plasticity and other caving soils (if encountered), will likely experience some degree of instability if the excavation face is unsupported, especially when these soils are saturated and/or subject to seepage pressure. In such cases, mitigating measures as discussed in Section 5.1.7 of this report can be employed to improve the excavation stability.

Based on the proposed invert elevation and the groundwater information gathered during our field investigation, the proposed storm sewer and water construction excavations approaching or exceeds about 10 feet along project alignments near Hammerly Boulevard area, and the construction excavations along alignments south of Hammerly Boulevard will have a high probability of encountering groundwater when the excavation depths approach or exceed the about 17 feet. However, it should be noted that groundwater level will fluctuate with the amount of precipitation and the amount of precipitations prior to and during construction. For storm sewer and water installation excavation advanced in clay soils, the seepage rates are usually low, and groundwater control can usually be controlled by sumping and pumping. However, for excavations advanced in water-bearing sands/silts stratum (not encountered in our soil borings, but may be present away from our soil borings and/or after heavy rainfalls), where water inflow rate is high, dewatering using well points will be required to provide a dry working platform and to prevent soil boiling.

It is the responsibility of the Contractor to select a trenchless technique for the installation of the proposed storm sewer and water by taking into account the soil types and stratigraphy and the groundwater conditions as found in the soil borings; the Contractor should have a work crew experienced at working with the selected trenchless construction technique in subsurface conditions similar to those found in along the project alignments. If necessary, the Contractor may conduct additional geotechnical investigation to provide more detailed subsurface conditions.

6.1 Quality Control

Associated Testing Laboratories, Inc. (ATL) recommends implementation of a comprehensive quality control program under the supervision of a Professional Engineer due to the fact that a considerable amount of excavation and back filling may be required in the proposed project area. Structural integrity and stability is particularly dependent on quality foundation installation, bedding and subgrade preparations. An independent testing laboratory should be assigned to test and inspect construction materials during the construction phase.

To ensure that excavation will remain stable, to provide sufficient headroom for working, to provide worker's safety and to protect adjacent structures, the excavations will have to be provided with sufficient side slopes or shored in accordance with OSHA "Trench Safety Systems" (29 CFR Part 1926), as published in the Federal Register, Vol. 52, No.72, Section 1926-650 through 1926-653. Excavation of the trenches and access pits should be carried out under the supervision of an experienced construction supervisor and necessary shoring and/or bracing of the trenches should be properly installed. In temporary braced or shored excavations and in access pits where the sheeting terminates at the base of the trench, lateral earth pressure, surcharge, and seepage pressure caused by a differential hydrostatic head moving upward to the bottom of the trench can cause trench bottom instability. Therefore, it is recommended that, if the bottom stability evaluation yields a factor of safety less than 1.5, the sheeting should be extended below the base of cut. Before filling operations take place, representative samples of the proposed fill material should be tested by an independent

laboratory to determine the compaction and classification characteristics.

6.2 Monitoring

Despite the thoroughness of this geotechnical exploration, there is always the possibility that actual subsurface conditions may differ from the predicted conditions because conditions between soil borings can be different from those at specific boring locations.

Any excessive ground movements like settlement and lateral movement should be monitored and controlled. This can be done by performing a preconstruction survey including photography and documentation of existing conditions like elevations, cracks, etc., and by installing ground movement monitoring devices such as inclinometers, crack monitors, and establishing elevation monitor stations along the proposed storm sewer and water line alignments to monitor the ground movement after commencement of the excavation.

Associated Testing Laboratory, Inc. (ATL) recommends a regular inspection and overall project monitoring by a geotechnical engineer during the construction phase. The purpose of inspection is to provide sound engineering and judgement alternatives during construction, if unanticipated conditions occur.

7.0 LIMITATIONS

The information, findings and recommendations contained in this report are based on data obtained from test borings at the locations shown in Figures 2a to 2e, a reasonable volume of laboratory tests, and professional interpretation and evaluation of the field and laboratory data, and consideration of the project information furnished. Should it become apparent during construction that soil conditions differ significantly from those discussed in this report, this office should be notified immediately so that further evaluation and any necessary adjustments can be made.

8.0 REFERENCES

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2. "Steel Pipe – A Guide for Design and Installation"; Manual of Water Supply Practices American Water Works Association (AWWA).
3. A. P. Moser (1990), Buried Pipe Design, McGraw-Hill, Inc.
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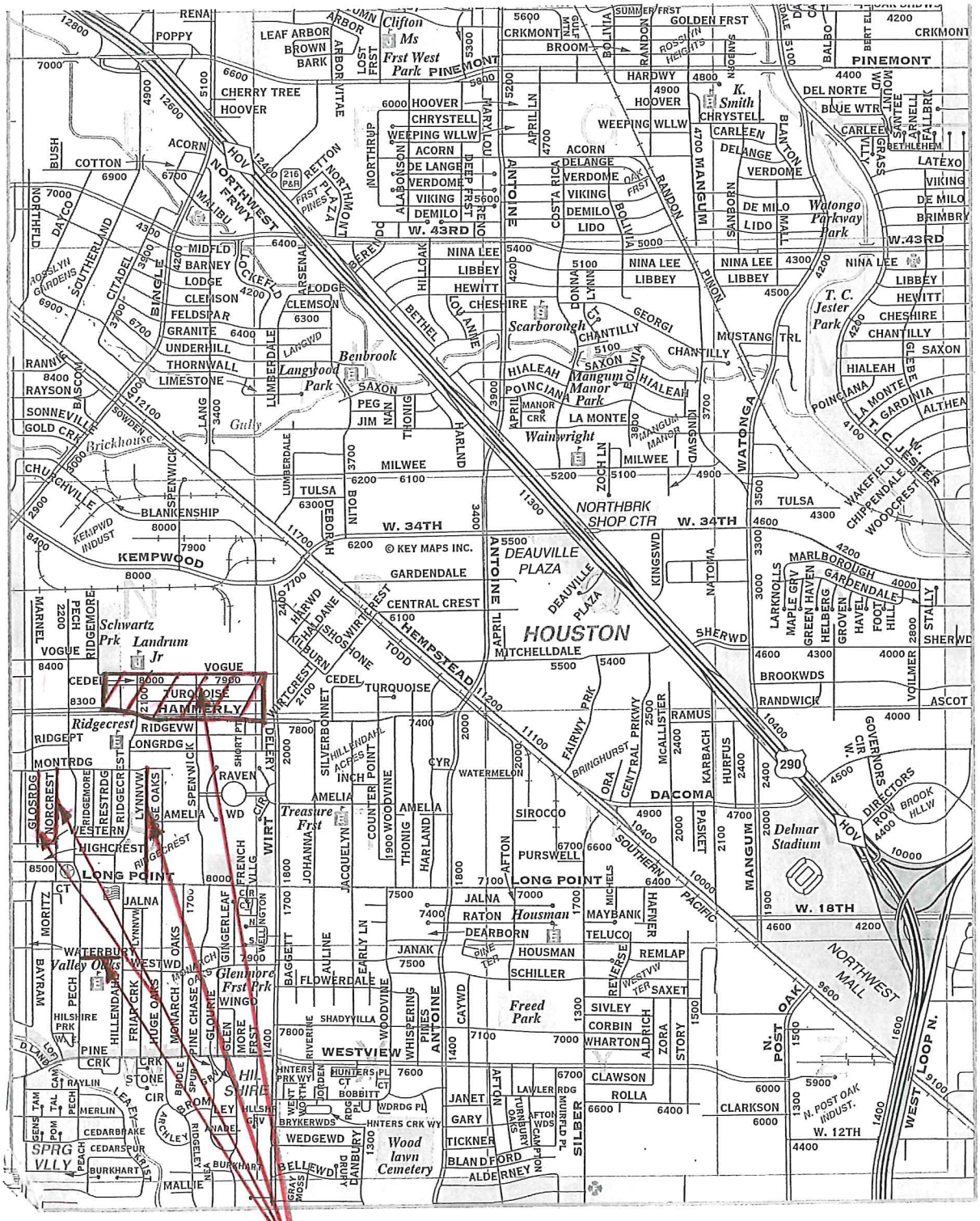
11. Geologic Atlas of Texas; Bureau of Economic Geology, The University of Texas.
12. Groundwater Quality in Texas; Texas Natural Resources Conservation Commission.
13. CFR PART 1926.

LIST OF FIGURES



SITE VICINITY MAP

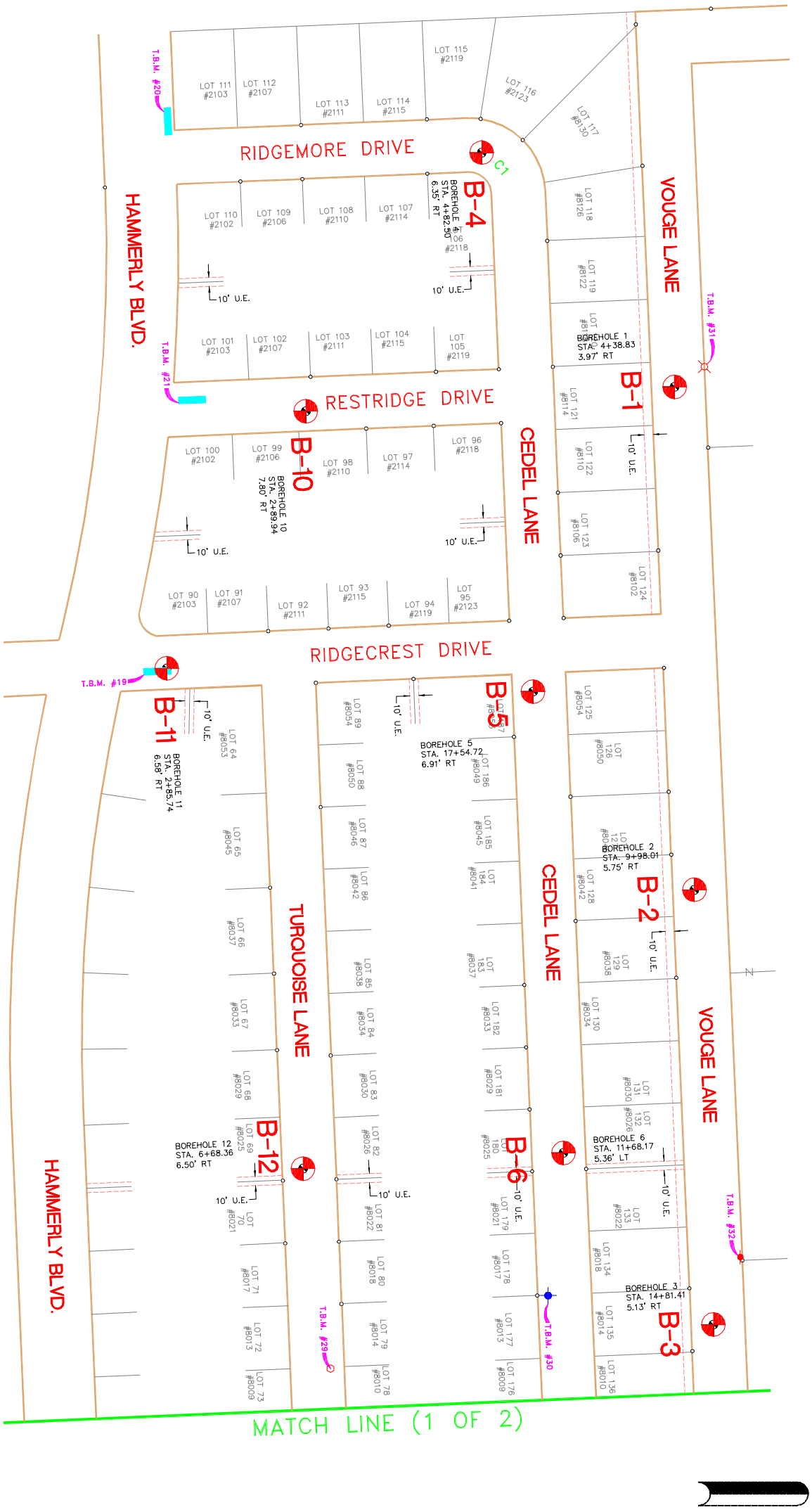
Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd. Houston, Texas
Tel: (713) 748-3717 Fax: (713) 748-3748

NSR 464-SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION

WBS No.: N-000397-0001-3

PROJECT NO. G14-101

FIGURE. 1



LOCATION OF BORINGS

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd. Houston, Texas
Tel: (713) 748-3717 Fax: (713) 748-3748

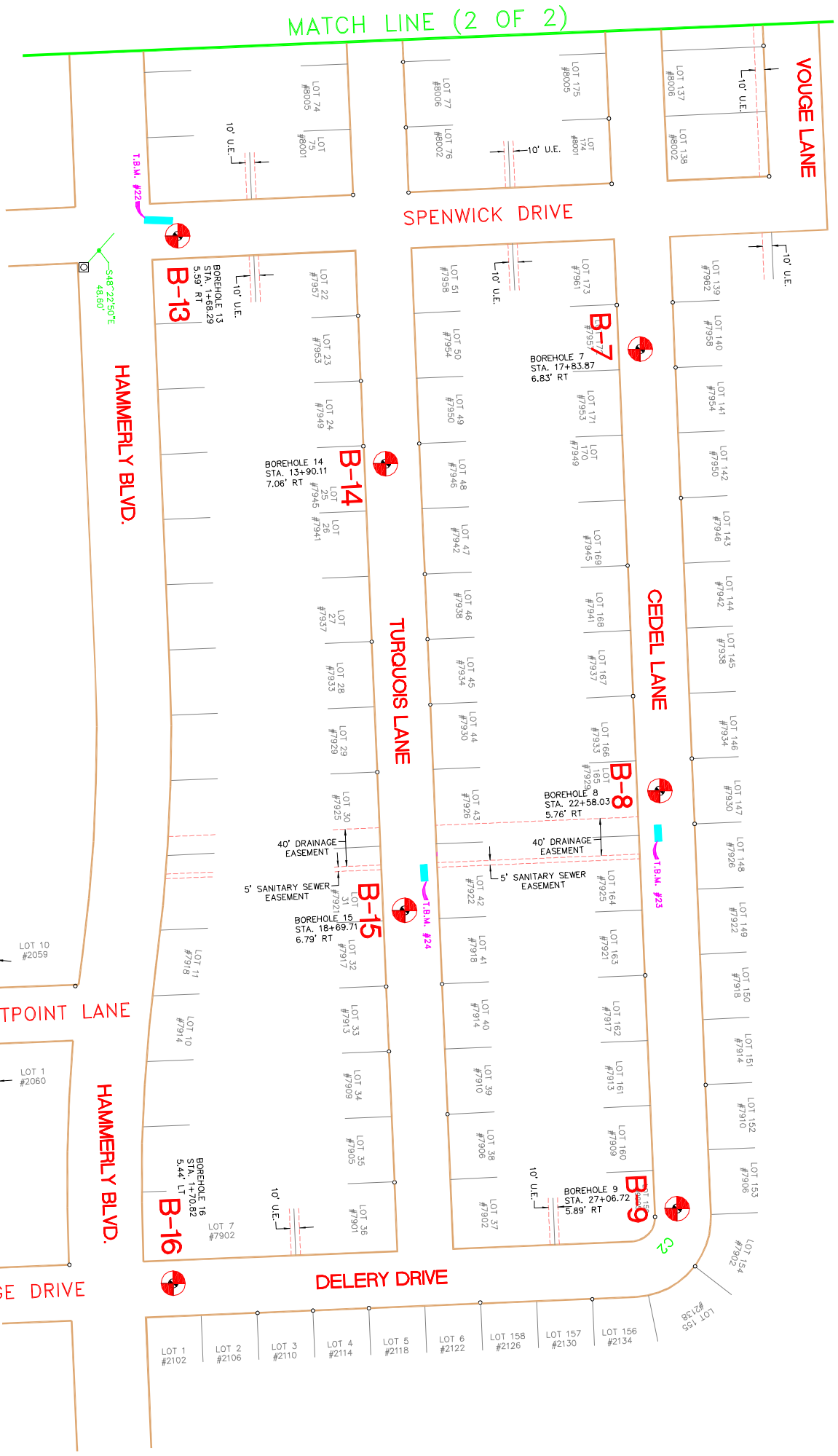
NSR 464-SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION

WBS No.: N-000397-0001-3

SCALE : 1"=150'

PROJECT NO. G14-101

FIGURE. 2a



LOCATION OF BORINGS

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3143 Yellowstone Blvd. Houston, Texas
Tel: (713) 748-3717 Fax: (713) 748-3748

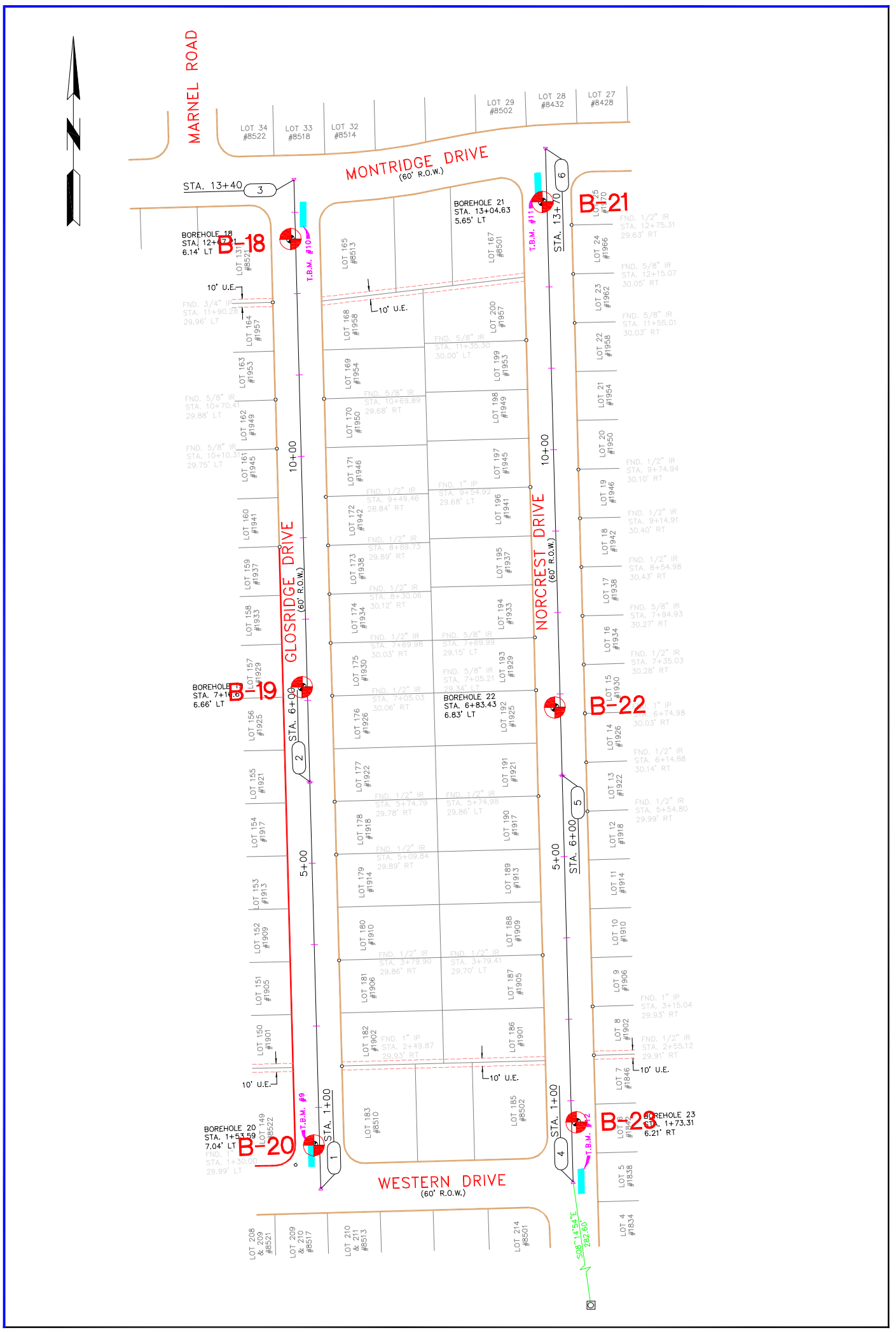
NSR 464-SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION

WBS No.: N-000397-0001-3

SCALE : 1"=150'

PROJECT NO. G14-101

FIGURE. 2b



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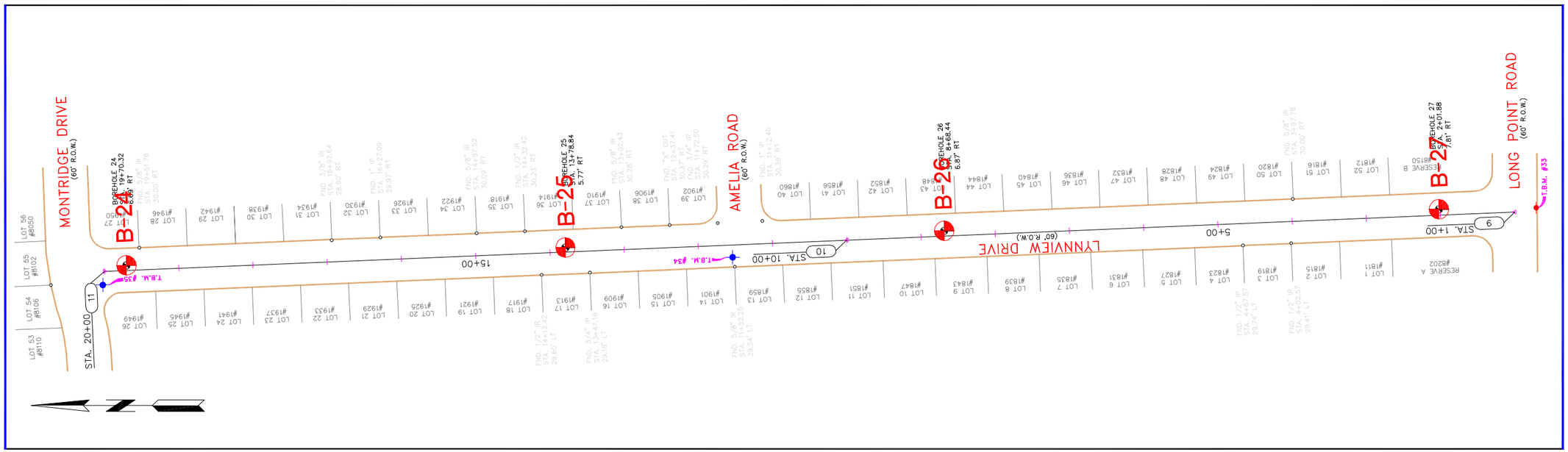
NSR 464-SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION

WBS No.: N-000397-0001-3

SCALE: 1"=150'

PROJECT NO. G14-101

FIGURE. 2c



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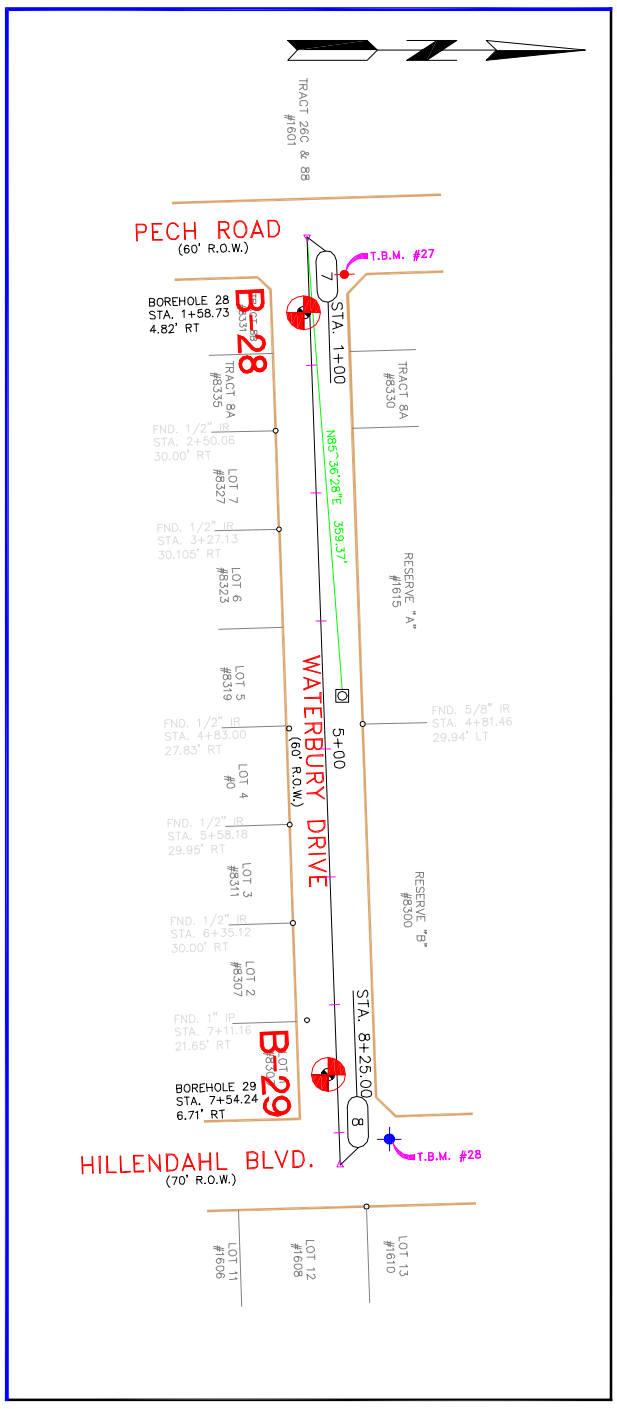
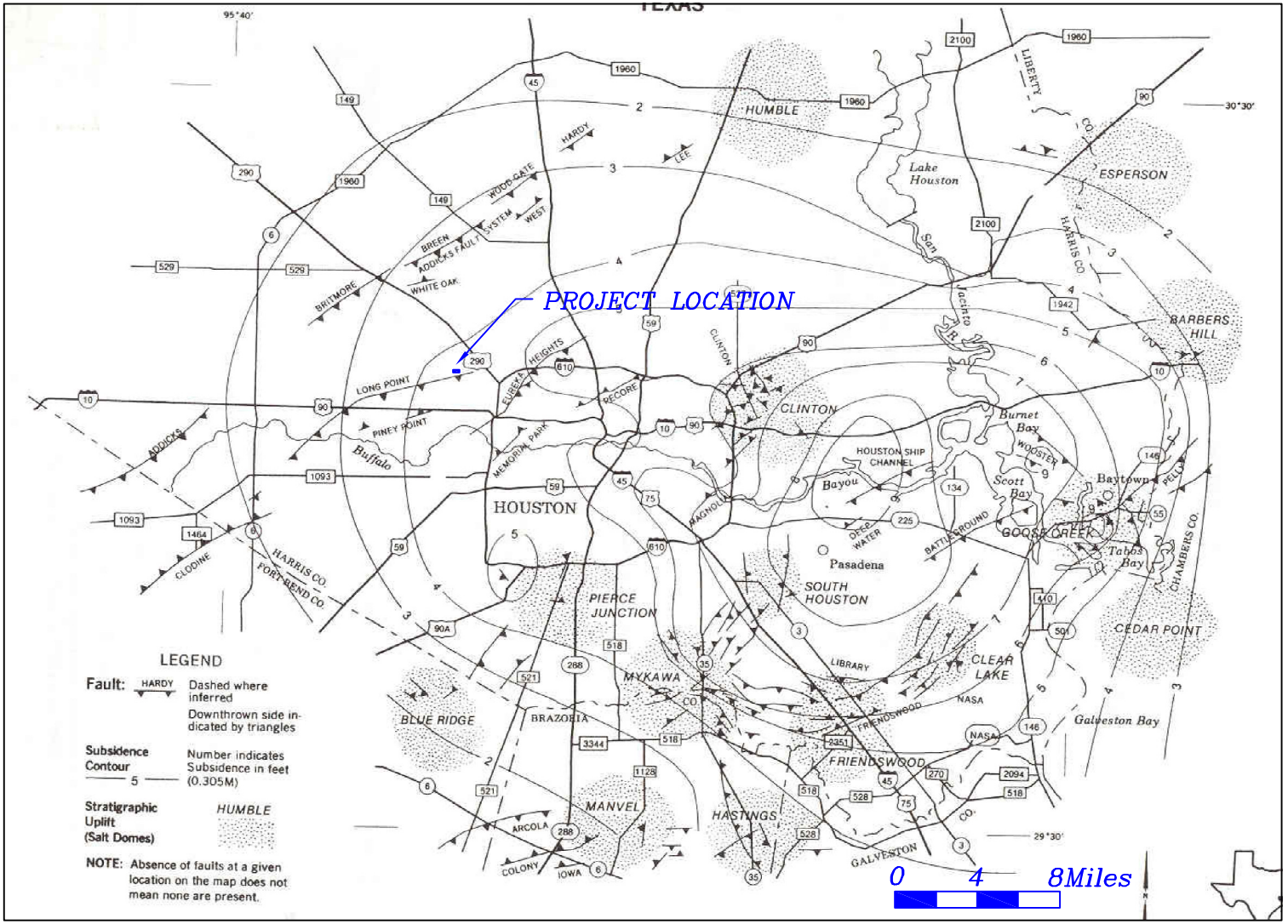
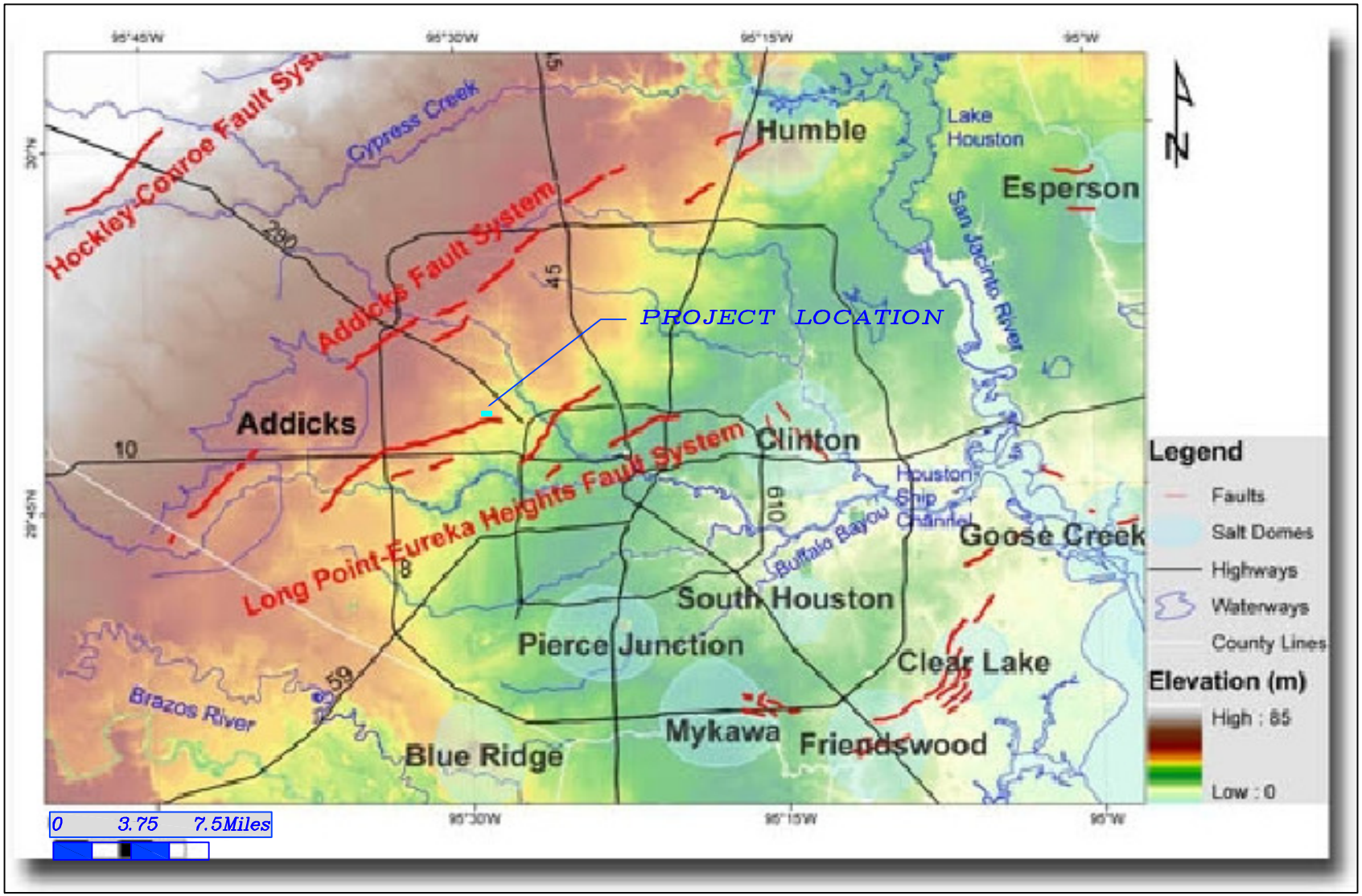
NSR 464-SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION	WBS No.: N-000397-0001-3	SCALE: 1"=150'
	PROJECT NO. G14-101	FIGURE. 2d



LOCATION OF BORINGS	*Associated Testing Laboratories, Inc.* *3143 Yellowstone Blvd. Houston, Texas* *Tel: (713) 748-3717 Fax: (713) 748-3748*	
NSR 464-SPRINGDALE (SEC.1&2) AND	*WBS No.: N-000397-0001-3*	*SCALE; 1" = 150'*
RESTRIDGE (SEC.1&5) SUBDIVISION	*PROJECT NO. G14-101*	*FIGURE. 2e*



PRINCIPAL ACTIVE FAULTS IN HOUSTON AREA	Associated Testing Laboratories, Inc. 3143 Yellowstone Blvd. Houston, Texas Tel: (713) 748-3717 Fax: (713) 748-3748
NSR 464-SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION	WBS No.: N-000397-0001-3
	PROJECT NO. G14-101 FIGURE. 3a



ACTIVE SURFACE FAULTS ON LIDAR IMAGERY	*Associated Testing Laboratories, Inc.* *3143 Yellowstone Blvd. Houston, Texas* *Tel: (713) 748-3717 Fax: (713) 748-3748*
NSR 464-SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION	*WBS No.: N-000397-0001-3*
	PROJECT NO. G14-101 — *FIGURE. 3b*

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: NSR 464- SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC. 1&5) SUBDIVISION — **PROJECT NO. G14-101**

WBS No. N-000397-0001-3

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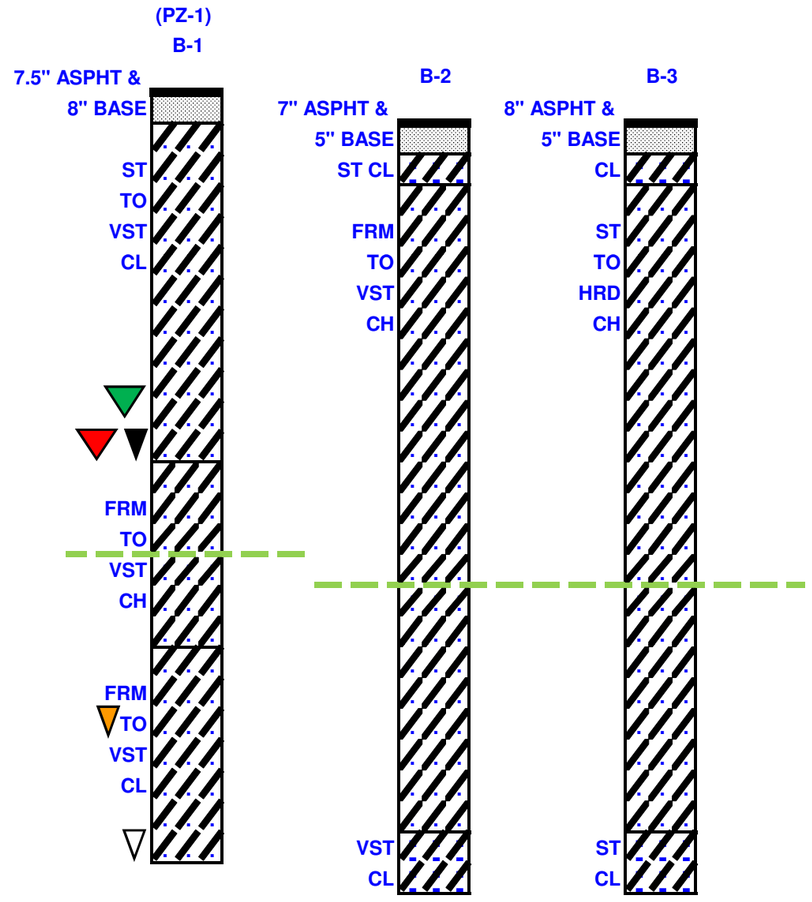

PROFILE ALONG VOGUE DRIVE

Water First Noticed
Depth To Water At Completion
24 hr. Water Level
PZ Water Level (1-31-14)
PZ Water Level (2-25-14)

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE
Horizontal: 1"= 500'
Vertical: 1"= 5'

Figure-4a

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: NSR 464- SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC. 1&5) SUBDIVISION

Elev. | **WBS No. N-000397-0001-3** | **PROJECT NO. G14-101**

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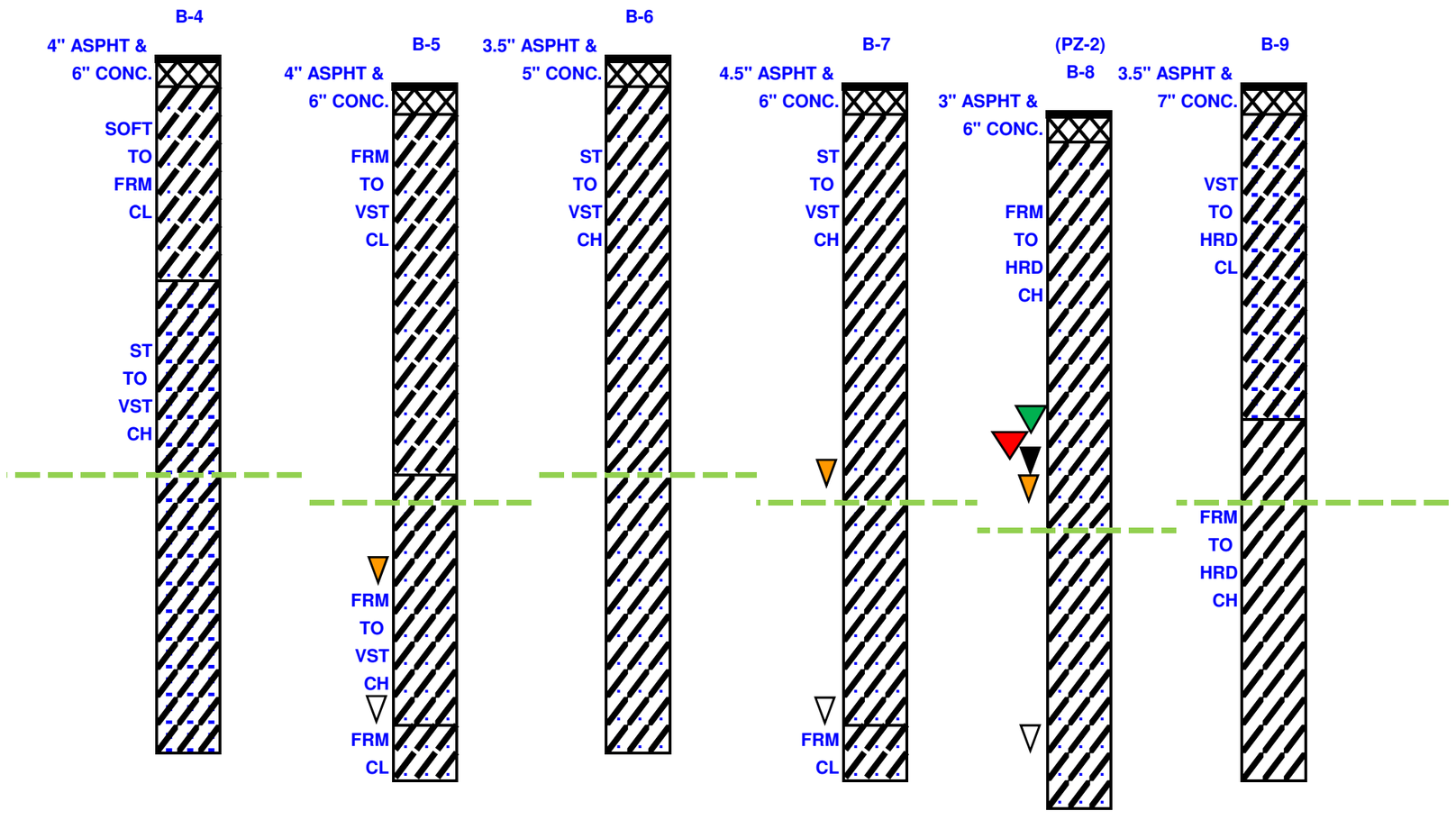

PROFILE ALONG CEDEL DRIVE

▽	Water First Noticed
▼	Depth To Water At Completion
▼	24 hr. Water Level
▼	PZ Water Level (1-31-14)
▼	PZ Water Level (2-25-14)

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE
Horizontal: 1"= 500'
Vertical: 1"= 5'

Figure-4b

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: NSR 464- SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC. 1&5) SUBDIVISION — **PROJECT NO. G14-101**

WBS No. N-000397-0001-3

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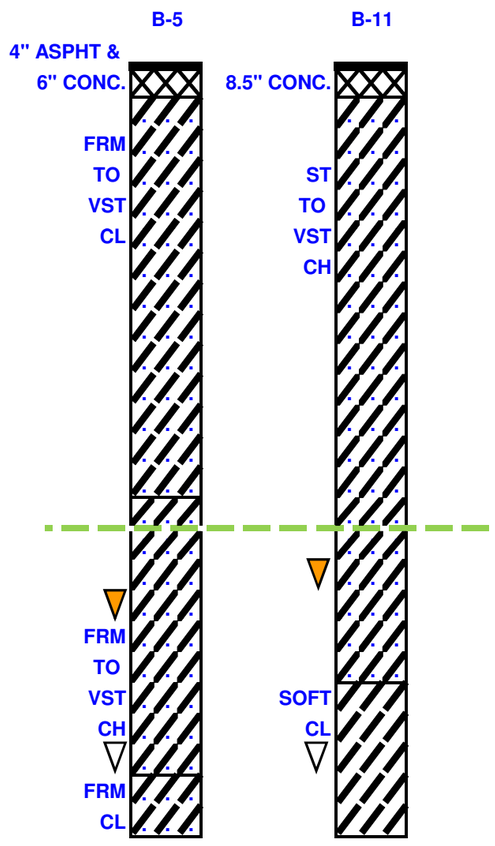

PROFILE ALONG RESTRIDGE DRIVE

▽	Water First Noticed
▼	Depth To Water At Completion

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE
Horizontal: 1"= 500'
Vertical: 1"= 5'

Figure-4c

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: NSR 464- SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC. 1&5) SUBDIVISION — **PROJECT NO. G14-101**

WBS No. N-000397-0001-3

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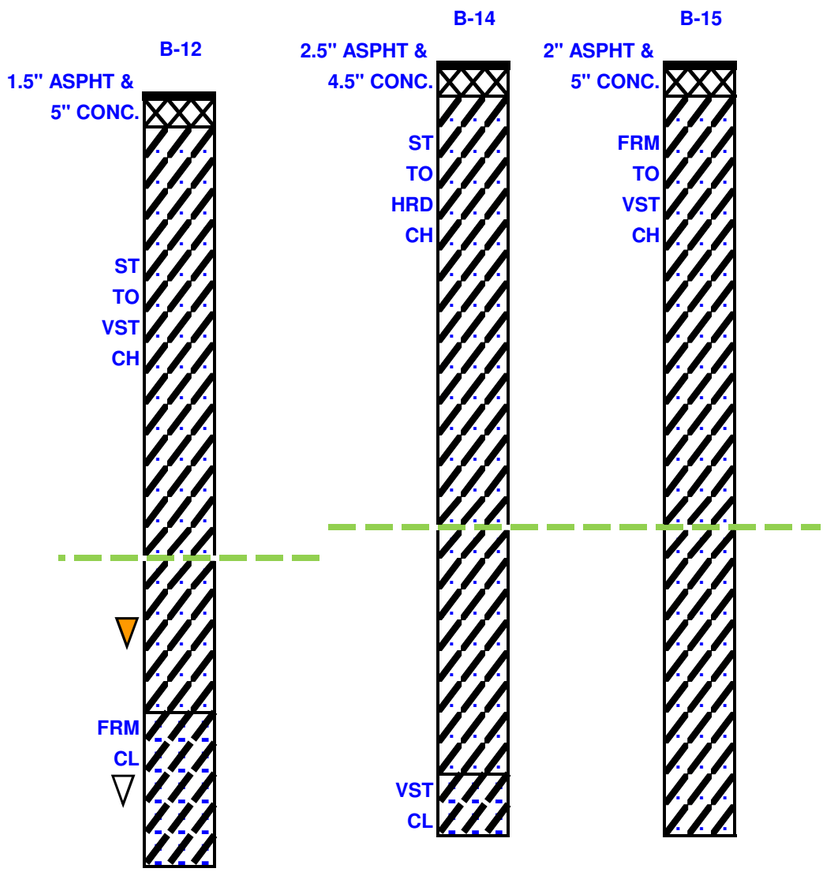

PROFILE ALONG TURQUOISE LANE

KEY

▽	Water First Noticed
▼	Depth To Water At Completion

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE
Horizontal: 1"= 500'
Vertical: 1"= 5'

Figure-4d

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: NSR 464- SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC. 1&5) SUBDIVISION — **PROJECT NO. G14-101**

WBS No. N-000397-0001-3

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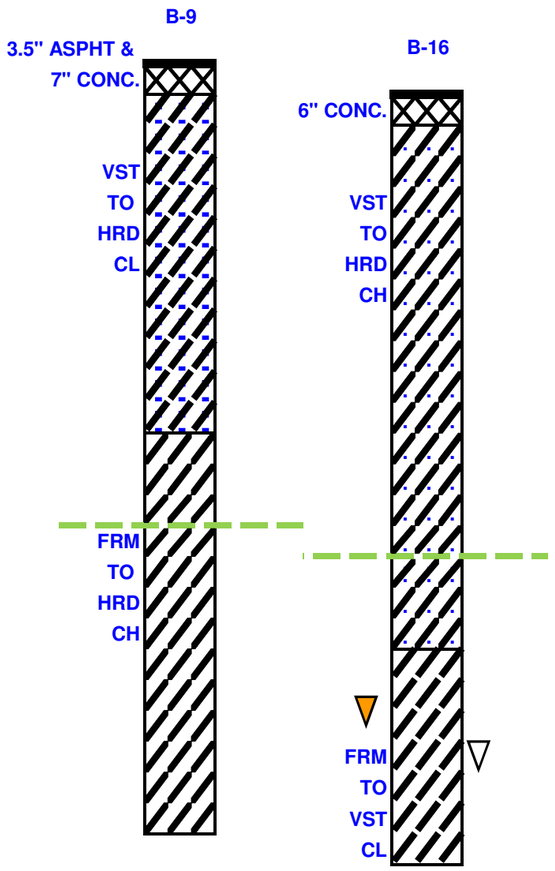

▽ Water First Noticed

▼ Depth To Water At Completion

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE
Horizontal: 1"= 500'
Vertical: 1"= 5'

Figure-4e

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: NSR 464- SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC. 1&5) SUBDIVISION — **PROJECT NO. G14-101**

WBS No. N-000397-0001-3

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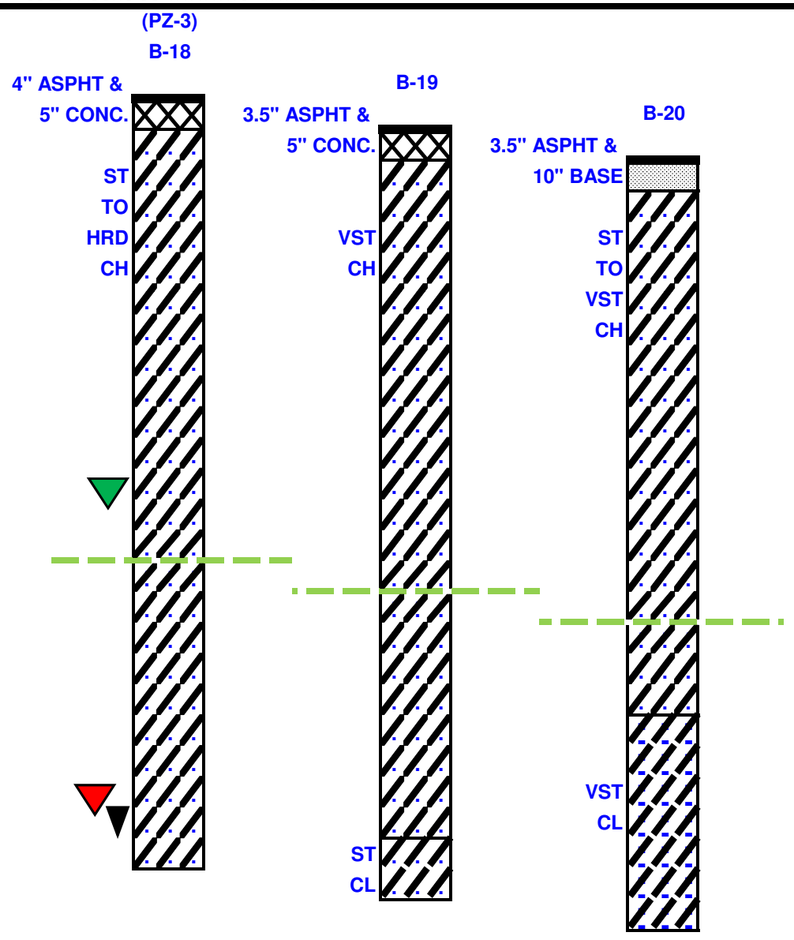

PROFILE ALONG GLOSRIDGE DRIVE

- Water First Noticed
- Depth To Water At Completion
- 24 hr. Water Level
- PZ Water Level (1-31-14)
- PZ Water Level (2-25-14)

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE
Horizontal: 1"= 500'
Vertical: 1"= 5'

Figure-4f

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: NSR 464- SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC. 1&5) SUBDIVISION — **PROJECT NO. G14-101**

WBS No. N-000397-0001-3

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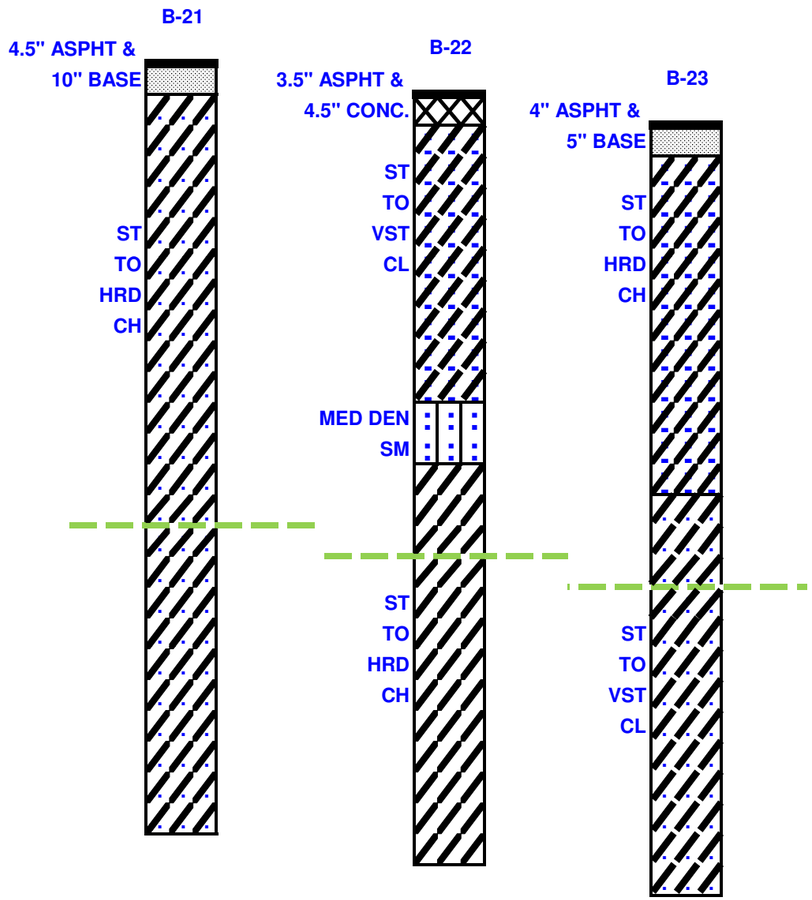

PROFILE ALONG NORCREST DRIVE

▽ Water First Noticed

▼ Depth To Water At Completion

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE
Horizontal: 1"= 500'
Vertical: 1"= 5'

Figure-4g

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: NSR 464- SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC. 1&5) SUBDIVISION — **PROJECT NO. G14-101**

WBS No. N-000397-0001-3

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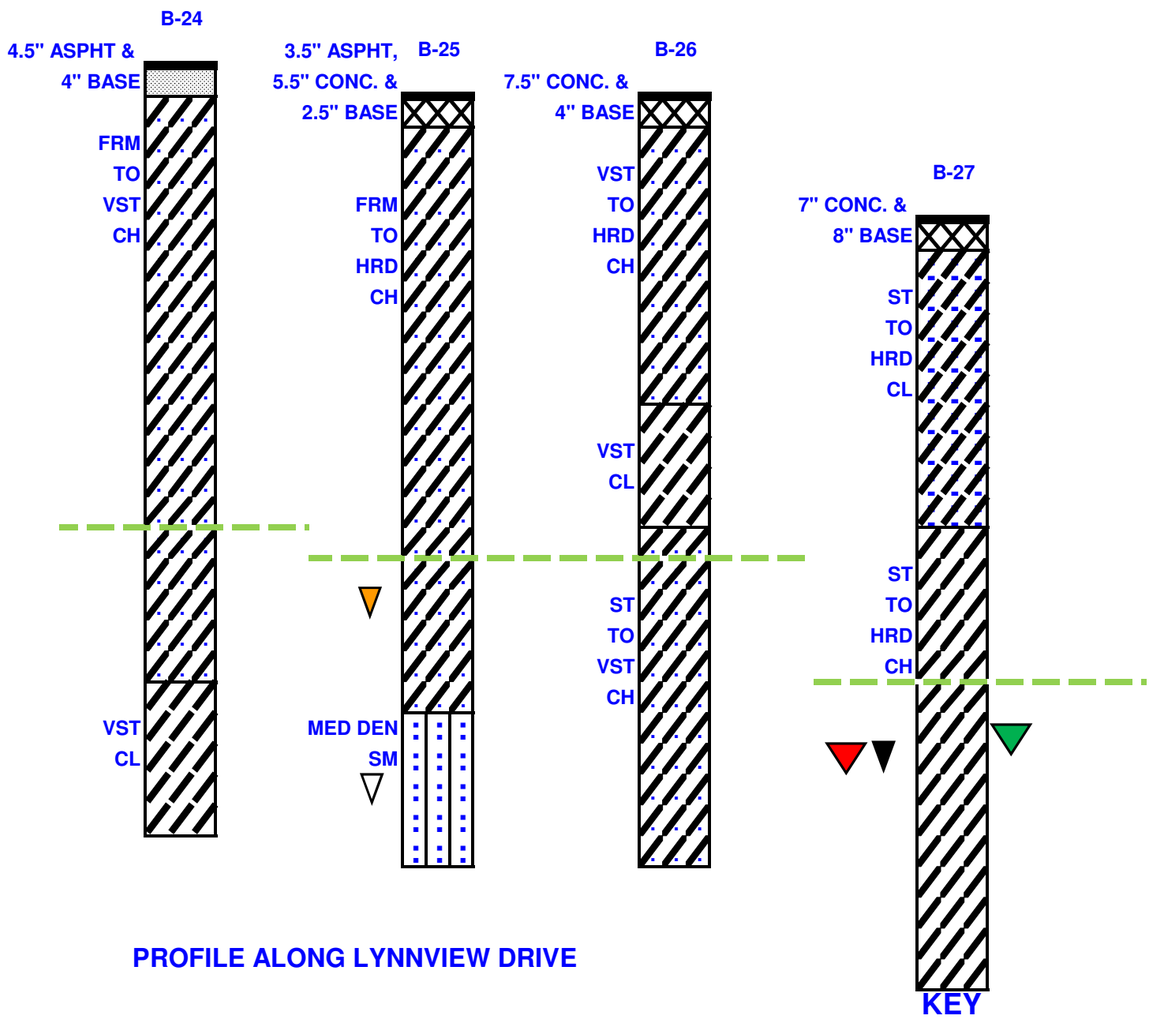

PROFILE ALONG LYNNVIEW DRIVE

- Water First Noticed
- Depth To Water At Completion
- 24 hr. Water Level
- PZ Water Level (1-31-14)
- PZ Water Level (2-25-14)

KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE
Horizontal: 1"= 500'
Vertical: 1"= 5'

Figure-4h

ASSOCIATED TESTING LABORATORIES, INC.

PROJECT NAME: NSR 464- SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC. 1&5) SUBDIVISION — **PROJECT NO. G14-101**

Elev. — **WBS No. N-000397-0001-3**

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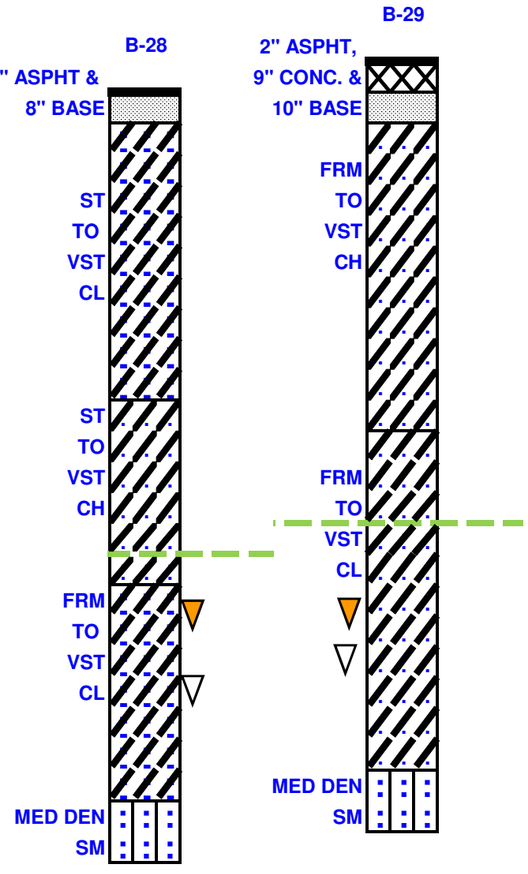


PROFILE ALONG WATERBURY DRIVE

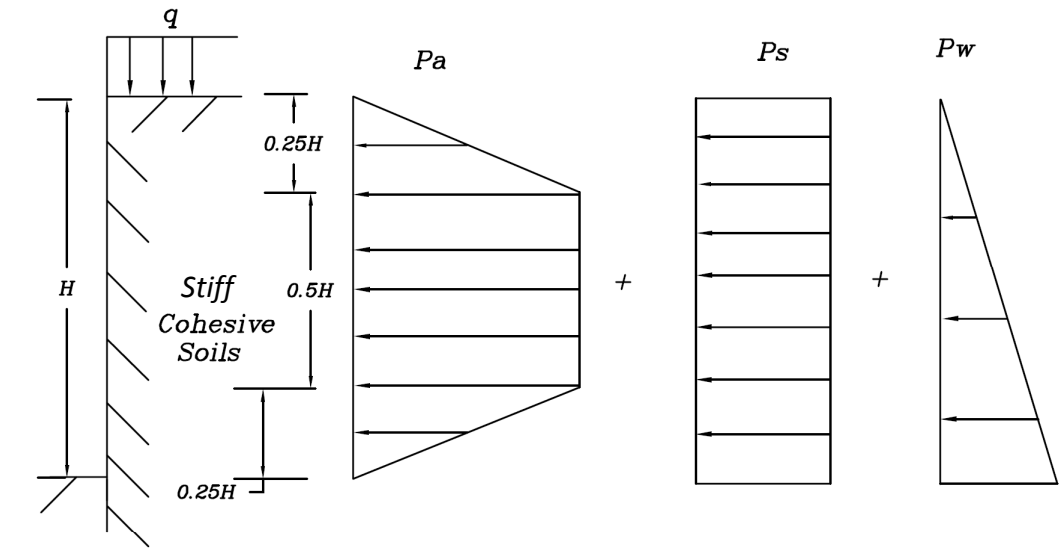
▽	Water First Noticed
▼	Depth To Water At Completion

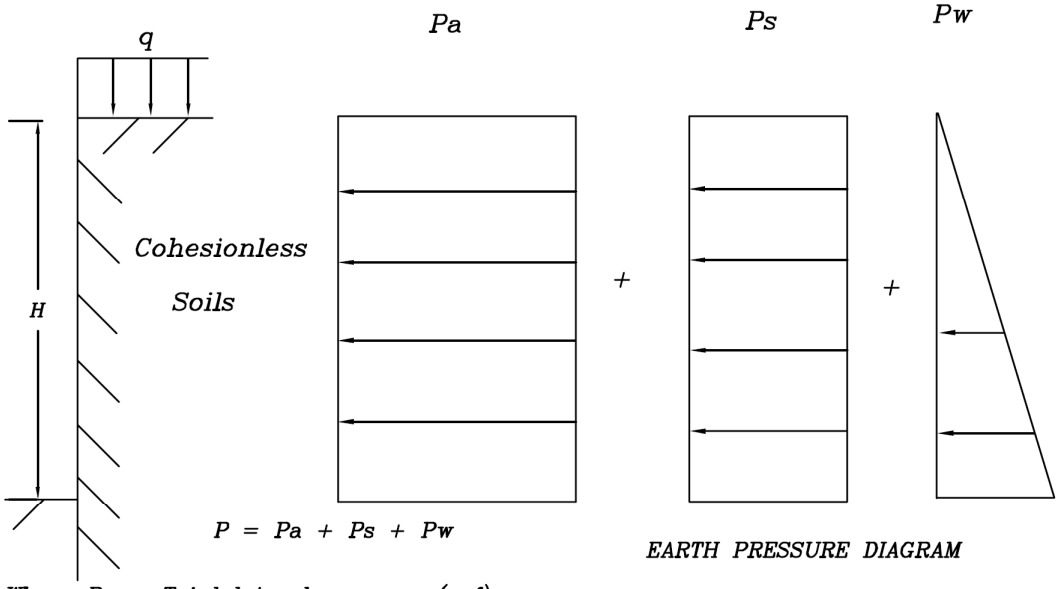
KEY

CH- Fat Clay		ST - Stiff
CH- Fat Clay With Sand		VST - Very Stiff
CL- Lean Clay With sand		FRM - Firm
CL- Sandy Lean Clay		HRD - Hard
SM- Silty Sand		MED DEN - Medium Dense

SCALE
Horizontal: 1"= 500'
Vertical: 1"= 5'

Figure-4i





$P = Pa + Ps + Pw$

EARTH PRESSURE DIAGRAM

Where P = Total lateral pressure (psf)

Pa = Active earth pressure(psf) = $K_A \gamma H = 0.4 \gamma H$ for Stiff Clays

= $0.65\ K_A \gamma H = 0.25 \gamma H$ for cohesionless Sands ($0.33 \gamma H$ – for loose sand)

Ps = Lateral pressure due to surcharge load (psf) = 0.5q for Clays

= 0.4q for Sands (0.5q for loose Sands)

Pw = Hydrostatic pressure (psf) = 62.4* water depth

H = Depth of braced excavation (ft)

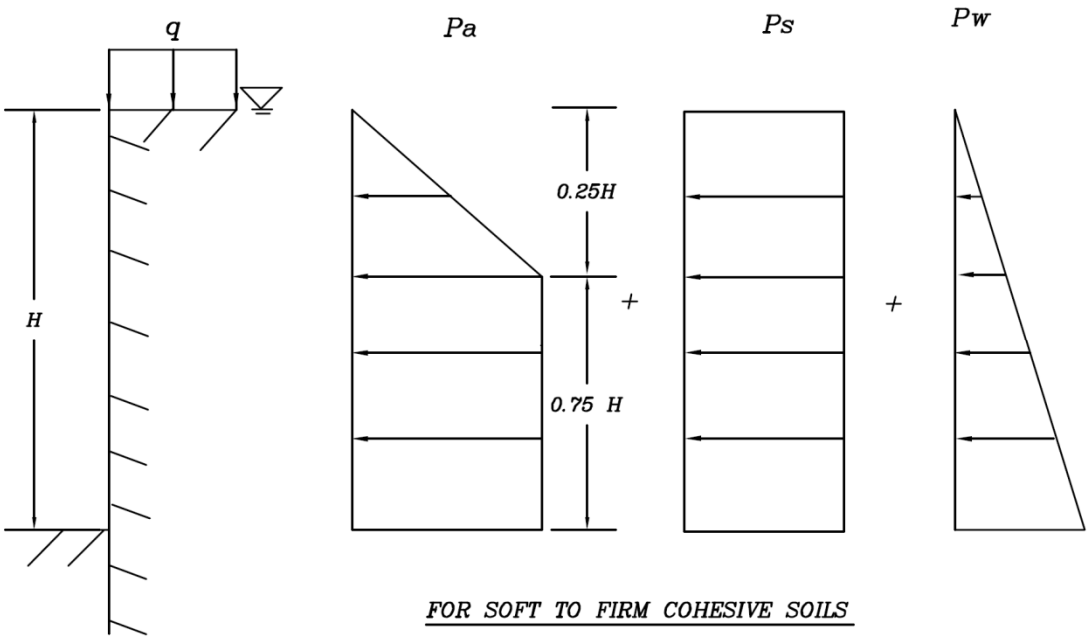
q = Surcharge load (psf) usually taken as 500 psf

γ = Submerged density of soils (pcf) = use 60 pcf (use 50 pcf for loose Sands)

Source: Peck, R.B. 1969. "Deep Excavations and Tunneling in Soft Ground".

EARTH PRESSURE DIAGRAM	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748
NEIGHBORHOOD STREET REHABILIATION–PROJECT 464 SPRINGDALE (SEC. 1&2) AND RESTRIDGE (SEC. 1&5)	WBS NO. N-000397-0001-3
	PROJECT NO. : G14-101 / FIGURE 5a

PST 8/28/12



FOR SOFT TO FIRM COHESIVE SOILS

Where P = Total lateral pressure (psf)

Pa = Active earth pressure(psf) = $1.0K_a\gamma H$ for soft clays

K_a = Active Earth pressure coefficient

$= 1-m\frac{2q_u}{\gamma H} = 1-m\frac{4C}{\gamma H}$ (taking $C=\frac{q_u}{2}$)

Here m=1 for N<4 and m=0.4 for N>5

N= Stability number $=\gamma H/C$

Ps = Lateral pressure due to surcharge load (psf) = K_a for clays

Pw = Hydrostatic pressure (psf) = 62.4* water depth

H = Depth of braced excavation (ft)

q = Surcharge load (psf) usually taken as 500 psf

γ = density of soils (pcf) = use 50 pcf below groundwater and 110 pcf above groundwater

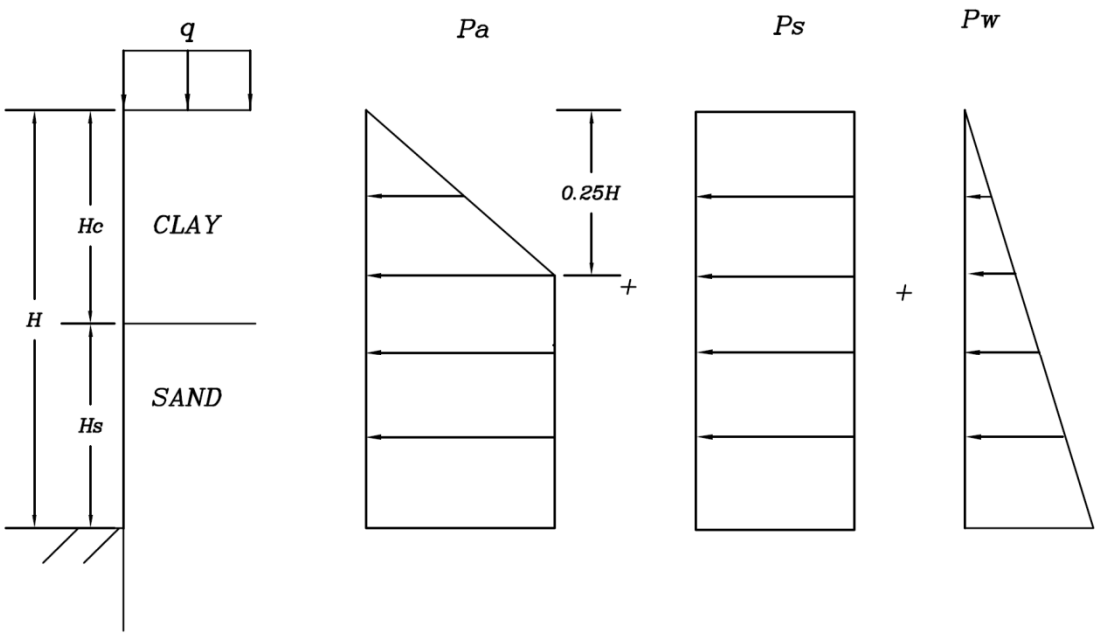
q_u = Unconfined compressive strength, psf

C = Undrained shear strength, psf

Note: Neglect hydrostatic pressure above groundwater level

Source: Peck, R.B. 1969. "Deep Excavations and Tunneling in Soft Ground".

EARTH PRESSURE DIAGRAM	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748	
NEIGHBORHOOD STREET REHABILIATION–PROJECT 464 SPRINGDALE (SEC. 1&2) AND RESTRIDGE (SEC. 1&5)	WBS NO. N-000397-0001-3	
	PROJECT NO. : G14-101	FIGURE 5b



$$P = Pa + Ps + Pw$$

Where P = Total lateral pressure (psf)

Pa = Active earth pressure(psf) = $K_A \gamma H = 0.4 \gamma H$

Ps = Lateral pressure due to surcharge load (psf) = $0.5q$

Pw = Hydrostatic pressure (psf) = 62.4* water depth

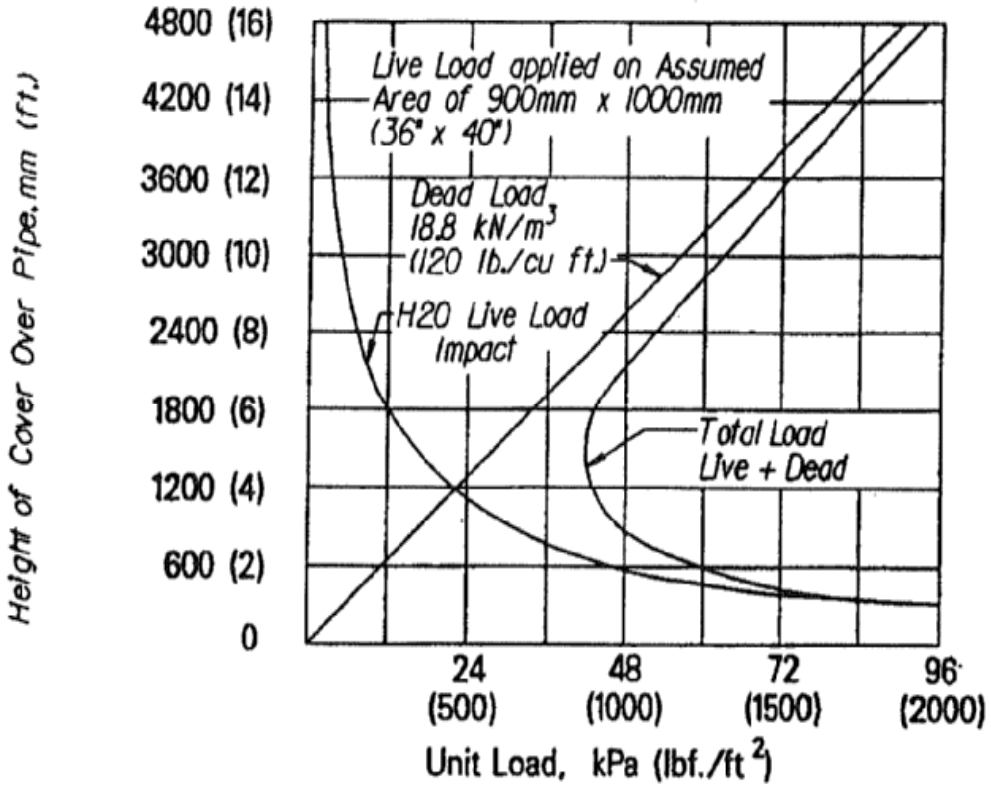
H = Depth of braced excavation (ft)

q = Surcharge load (psf) usually taken as 500 psf

γ = Submerged density of soils (pcf) = use 60 pcf

Source: Peck, R.B. 1969. "Deep Excavations and Tunneling in Soft Ground".

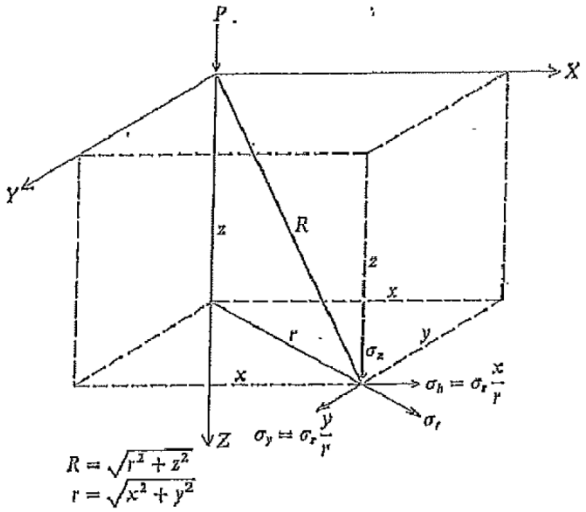
EARTH PRESSURE DIAGRAM	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748
NEIGHBORHOOD STREET REHABILIATION–PROJECT 464 SPRINGDALE (SEC. 1&2) AND RESTRIDGE (SEC. 1&5)	WBS NO. N-000397-0001-3
	PROJECT NO. : G14-101 / FIGURE 5c



Combined H20 highway live load and dead load is a minimum at about 1500mm (5 ft.) of cover, applied through a pavement 300mm (1 ft.) thick.

HIGHWAY LOADING ON A PIPE UNDER VARIOUS SOIL COVER	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748
NEIGHBORHOOD STREET REHABILIATION–PROJECT 464 SPRINGDALE (SEC. 1&2) AND RESTRIDGE (SEC. 1&5)	WBS NO. N-000397-0001-3
	PROJECT NO. : G14-101 / FIGURE 6

PST 8/28/12



Later Pressure, σ_r:

$\sigma_r = (P/2\pi) \{3r^2Z/R^5) - ([1-2\mu]/R[R+z]\}$

For $\mu = 0.5$,

$\sigma_r = P/2\pi\ (2r^2z/R^5)$

Vertical Pressure, σ_z :

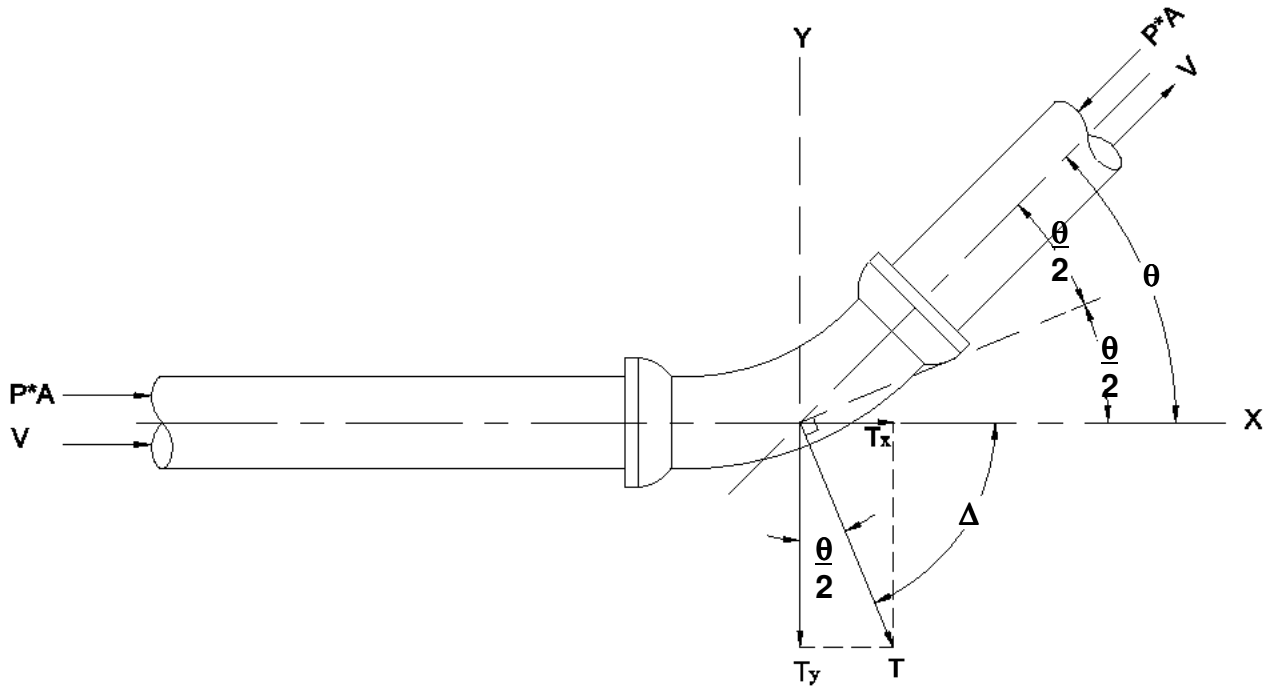
$\sigma_z = 3\ P\ z^3 / 2\pi R^5$

P = Point load surcharge

μ = Poisson's ratio if soils, use 0.5

X, y, z = distance in x, y and z direction, respectively

BOUSSINESQ'S EQUATION FOR POINT LOAD SURCHARGE	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748
NEIGHBORHOOD STREET REHABILIATION–PROJECT 464 SPRINGDALE (SEC. 1&2) AND RESTRIDGE (SEC. 1&5)	WBS NO. N-000397-0001-3
	PROJECT NO. : G14-101 / FIGURE 7



$$T = 2\,P\,A \sin\frac{\theta}{2}$$

$$T_x = P\,A\,(1 - \cos\theta)$$

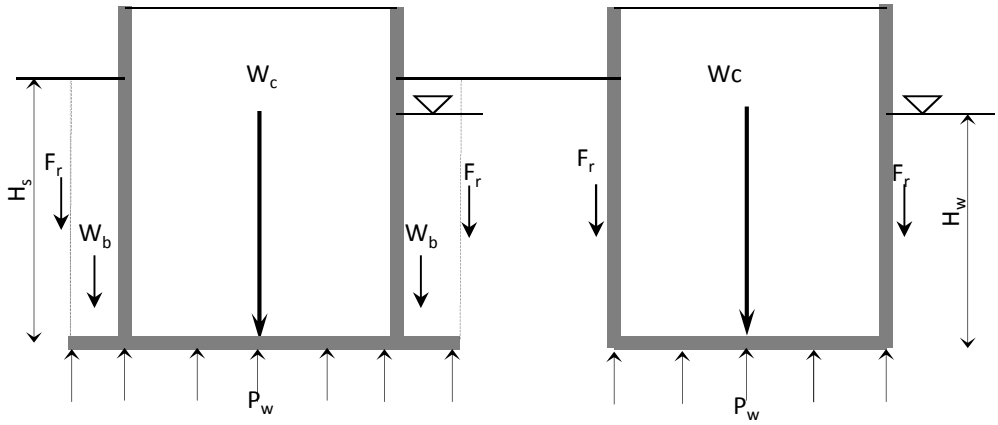
$$T_y = P\,A \sin\theta$$

Where:

T	=	Resultant thrust force, lbs
T_x	=	Resultant thrust force component along x-axis, lbs
T_y	=	Resultant thrust force component along y-axis, lbs
P	=	Maximum sustain pressure of fluid in pipe, psi
A	=	Cross-section area of pipe, square inches
D	=	Inside diameter of pipe, inches
θ	=	Angle of the pipe bend, degrees
Δ	=	Angle between x-axis and resultant force
	=	$\tan^{-1}(T_y/T_x)$, degrees
V	=	Fluid velocity

Source: American Water Works Association, "Concrete Pressure Pipes", AWWA Manual M9.

THRUST FORCE AT A PIPE BEND	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748	
NEIGHBORHOOD STREET REHABILIATION–PROJECT 464 SPRINGDALE (SEC. 1&2) AND RESTRIDGE (SEC. 1&5)	WBS NO. N-000397-0001-3	
	PROJECT NO. : G13-211	FIGURE 8



Dead Weight of Structure + Dead Weight of Backfill Above Base Extension + Frictional Resistance

$P_w = H_w\gamma_w$
$F_u = A_bP_w$
$W_c/S_{fa}+W_b/S_{fb}+ F_r/S_{fc} \geq F_u$
(S_{fa} = 1.1; S_{fb} = 1.5; S_{fc} = 3.0)

Dead Weight of Structure + Frictional Resistance

$P_w = H_w\gamma_w$
$F_u = A_bP_w$
$W_c/S_{fa}+F_r/S_{fc} \geq F_u$
(S_{fa} = 1.1; S_{fc} = 3.0)

For cohesive soils:
$F_r = \alpha c_n A_n$

For cohesionless soils,
$Fr = p_nK\tan\delta_nA_n$

Where,

H_s	=	Buried depth of wall, ft
H_w	=	Height of water table above base of structure, ft
P_w	=	Total uplift pressure = 62.4 x Hw, psf
F_u	=	Total uplift force exerted on base of structure = Pw x A_b
W_c	=	Dead weight of structure, lbs
W_b	=	Weight of backfill above base of structure, lbs
A_b	=	Area of base, ft^2
F_r	=	Friction resistance developed at the soil/wall interface, lbs
A_n	=	Contact area between the soil/wall interface in layer"n"
c_n	=	Undrained shear strength of cohesive soils at layer "n" at soil/wall interface. See individual boring logs. c_n for the top 8 ft of clays with PI higher than 20 percent should be discounted because of the shrink-swell characteristics of high plasticity clays.
α	=	Adhesion factor, to be multiplied with c_n to obtain the adhesion between the soil/wall interface. Use 0.75 if c_n is less than 0.25 tsf, use 0.67 if c_n is between 0.25 and 0.5 tsf, use 0.5 if c_n is greater than 0.5 tsf but limit the adhesion to 1.5 ksf.
K	=	Coefficient of lateral earth pressure of cohesionless soils. Use 0.4.
p_n	=	Average overburden stress at the mid-depth of cohesionless soil layer "n", psf
δ_n	=	Average frictional angle between cohesionless soil layer "n" and the walls of the structure, use 0.75 of the angle of internal friction (ϕ) of the cohesionless soil. A ϕ of 28 degrees may be used if no specific value is given.
$S_{fa,b,c}$	=	Factors of safety against buoyant uplift force.

BUOYANT UPLIFT RESISTANCE OF A BURIED STRUCTURE	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748
NEIGHBORHOOD STREET REHABILIATION–PROJECT 464 SPRINGDALE (SEC. 1&2) AND RESTRIDGE (SEC. 1&5)	WBS NO. N-000397-0001-3 PROJECT NO. : G14-101 | FIGURE 9

LIST OF TABLES

TABLE 1

SUMMARY OF PAVEMENT MEASUREMENTS
NEIGHBORHOOD STREET REHABILITATION – PROJECT 464
SPRINGDALE (Sec. 1 & 2) & RESTRIDGE (Sec. 1 & 5) SUBDIVISION
WBS NO. N-000397-0001-3

ATL PROJECT NO. G14-101

Boring Number	Boring Depth (ft)	Piezometer		Asphalt Paving (inch)	Concrete Paving (inch)	Base Material (inch)
		No.	Depth (ft)			
B-1	25	PZ-1	25	7.5	--	8” crushed shell base
B-2	25	--	--	7	--	5” crushed shell base
B-3	25	--	--	8	--	5” crushed shell base
B-4	25	--	--	4	6	--
B-5	25	--	--	4	6	--
B-6	25	--	--	3.5	5	--
B-7	25	--	--	4.5	6	--
B-8	25	PZ-2	25	3	6	--
B-9	25	--	--	3.5	7	--
B-10	25	--	--	2	6	--
B-11	25	--	--	--	8.5	--
B-12	25	--	--	1.5	5	--
B-13	25	--	--	2	4.5	--
B-14	25	--	--	2.5	4.5	--
B-15	25	--	--	2	5	--
B-16	25	--	--	--	6	--
B-17	25	--	--	2	4	--
B-18	25	PZ-3	25	4	5	--
B-19	25	--	--	3.5	5	--
B-20	25	--	--	3.5	--	10” Cement treated crushed limestone base
B-21	25	--	--	4.5	--	10” Cement treated crushed limestone base
B-22	25	--	--	3.5	4.5	--
B-23	25	--	--	4	--	5” Cement treated crushed limestone base
B-24	25	--	--	4.5	--	4” Cement treated crushed limestone base
B-25	25	--	--	3.5	5.5	2.5” Sand base
B-26	25	--	--	--	7.5	4” Crushed gravel base

TABLE 1

SUMMARY OF PAVEMENT MEASUREMENTS
NEIGHBORHOOD STREET REHABILITATION – PROJECT 464
SPRINGDALE (Sec. 1 & 2) & RESTRIDGE (Sec. 1 & 5) SUBDIVISION
WBS NO. N-000397-0001-3

ATL PROJECT NO. G14-101

Boring Number	Boring Depth (ft)	Piezometer		Asphalt Paving (inch)	Concrete Paving (inch)	Base Material (inch)
		No.	Depth (ft)			
B-27	25	PZ-4	25	--	7	8” Lime stabilized soil base
B-28	25	--	--	2	--	8” Cement treated crushed limestone base
B-29	25	--	--	2	9	10” Lime stabilized soil base

TABLE 2

SUMMARY OF GROUNDWATER MEASUREMENTS
NEIGHBORHOOD STREET REHABILITATION – PROJECT 464
SPRINGDALE (SEC. 1 & 2) & RESTRIDGE (SEC. 1 & 5) SUBDIVISION
WBS NO. N-000397-0001-3

ATL PROJECT NO. G14-101

Boring Number	Location	Groundwater in Boreholes		Groundwater Level in Piezometers		
		During Drilling	At Completion of Drilling	After 24 Hours	After 7 Days	After 30 Days
B-1 (PZ-1)	Voque Drive	25’	21’	(01/22/2014) 12’	(01/31/2014) 12’	(02/25/2014) 10.5’
B-2	Voque Drive	Dry	Dry	--	--	--
B-3	Voque Drive	Dry	Dry	--	--	--
B-4	Cedel Drive	Dry	Dry	--	--	--
B-5	Cedel Drive	23’	18’	--	--	--
B-6	Cedel Drive	Dry	Dry	--	--	--
B-7	Cedel Drive	23’	14.5’	--	--	--
B-8 (PZ-2)	Cedel Drive	23’	14’	(01/28/2014) 13’	(02/03/2014) 12.5’	(02/25/2014) 11.5’
B-9	Cedel Drive	Dry	Dry	--	--	--
B-10	Restridge Drive	Dry	Dry	--	--	--
B-11	Ridgecrest Drive	23’	17’	--	--	--
B-12	Turquoise Lane	23’	18’	--	--	--
B-13	Spenwick Drive	20’	18’	--	--	--
B-14	Turquoise Lane	Dry	Dry	--	--	--
B-15	Turquoise Lane	Dry	Dry	--	--	--
B-16	Delery Drive	22’	20.5’	--	--	--
B-17	Shortpoint Street	23’	19’	--	--	--
B-18 (PZ-3)	Glosridge Drive	Dry	Dry	(01/24/2014) 24’	(01/31/2014) 23.5’	(02/24/2014) 13.5’
B-19	Glosridge Drive	Dry	Dry	--	--	--
B-20	Glosridge Drive	Dry	Dry	--	--	--
B-21	Norcrest Drive	Dry	Dry	--	--	--
B-22	Norcrest Drive	Dry	Dry	--	--	--
B-23	Norcrest Drive	Dry	Dry	--	--	--
B-24	Lynnview Drive	Dry	Dry	--	--	--
B-25	Lynnview Drive	23’	17’	--	--	--
B-26	Lynnview Drive	Dry	Dry	--	--	--

TABLE 2

SUMMARY OF GROUNDWATER MEASUREMENTS
NEIGHBORHOOD STREET REHABILITATION – PROJECT 464
SPRINGDALE (SEC. 1 & 2) & RESTRIDGE (SEC. 1 & 5) SUBDIVISION
WBS NO. N-000397-0001-3

ATL PROJECT NO. G14-101

Boring Number	Location	Groundwater in Boreholes		Groundwater Level in Piezometers		
		During Drilling	At Completion of Drilling	After 24 Hours	After 7 Days	After 30 Days
B-27 (PZ-4)	Lynnview Drive	Dry	Dry	(01/24/2014) 18’	(01/31/2014) 18’	(02/24/2014) 17.5’
B-28	Waterbury Drive	20’	17.5’	--	--	--
B-29	Waterbury Drive	20’	18.5’	--	--	--

TABLE 3

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023

CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-1	1	0-2	UD		19									1.50	Lean Clay with Sand (CL)
	2	2-4	UD		20		49	19	30	73				1.50	Lean Clay with Sand (CL)
	3	4-6	UD		22									2.00	Lean Clay with Sand (CL)
	4	6-8	UD		18									2.00	Lean Clay with Sand (CL)
	5	8-10	UD		18		49	19	30	78				2.50	Lean Clay with Sand (CL)
	6	10-12	UD		18									2.75	Lean Clay with Sand (CL)
	7	12-14	UD		35	89	76	23	53		0.70			2.00	Fat Clay with Sand (CH)
	8	14-16	UD		19	112						2.05 (0.72)		4.50	Fat Clay with Sand (CH)
	9	16-18	UD		21									3.75	Fat Clay with Sand (CH)
	10	18-20	UD		18		40	17	23					4.00	Lean Clay with Sand (CL)
	11	23-25	UD		22									1.50	Lean Clay with Sand (CL)
B-2	1	0-2	UD		18		30	16	14	65				2.00	Sandy Lean Clay (CL)
	2	2-4	UD		20									1.50	Fat Clay with Sand (CH)
	3	4-6	UD		18									2.50	Fat Clay with Sand (CH)
	4	6-8	UD		17									3.50	Fat Clay with Sand (CH)
	5	8-10	UD		17	113					0.60			2.00	Fat Clay with Sand (CH)
	6	10-12	UD		20		62	21	41	78				3.50	Fat Clay with Sand (CH)
	7	12-14	UD		24									3.75	Fat Clay with Sand (CH)
	8	14-16	UD		20									3.00	Fat Clay with Sand (CH)
	9	16-18	UD		23	105						1.07(0.79)		4.00	Fat Clay with Sand (CH)
	10	18-20	UD		23									3.75	Fat Clay with Sand (CH)
	11	23-25	UD		20		45	18	27					3.50	Sandy Lean Clay (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023

CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-3	1	0-2	AU		13		41	17	24						Sandy Lean Clay (CL)
	2	2-4	UD		18		50	19	31	71				1.75	Fat Clay with Sand (CH)
	3	4-6	UD		14									2.50	Fat Clay with Sand (CH)
	4	6-8	UD		16									3.00	Fat Clay with Sand (CH)
	5	8-10	UD		15									3.50	Fat Clay with Sand (CH)
	6	10-12	UD		18	113					1.35			3.50	Fat Clay with Sand (CH)
	7	12-14	UD		18		54	19	35	81				4.00	Fat Clay with Sand (CH)
	8	14-16	UD		18									3.50	Fat Clay with Sand (CH)
	9	16-18	UD		20	106						0.90(0.79)		2.50	Fat Clay with Sand (CH)
	10	18-20	UD		21		65	21	44					4.50	Fat Clay with Sand (CH)
	11	23-25	UD		22									2.00	Sandy Lean Clay (CL)
B-4	1	0-2	UD		22									0.50	Lean Clay with Sand (CL)
	2	2-4	UD		22		46	18	28	72				0.50	Lean Clay with Sand (CL)
	3	4-6	UD		22									1.00	Lean Clay with Sand (CL)
	4	6-8	UD		20									1.00	Lean Clay with Sand (CL)
	5	8-10	UD		24		56	20	36	70				1.75	Sandy Fat Clay (CH)
	6	10-12	UD		20									2.75	Sandy Fat Clay (CH)
	7	12-14	UD		18									4.00	Sandy Fat Clay (CH)
	8	14-16	UD		19	107						1.36 (0.72)		3.50	Sandy Fat Clay (CH)
	9	16-18	UD		18	113					1.65			4.00	Sandy Fat Clay (CH)
	10	18-20	UD		23		63	21	42					4.00	Sandy Fat Clay (CH)
	11	23-25	UD		28									2.75	Sandy Fat Clay (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023
CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-5	1	0-2	UD		20									1.50	Lean Clay with Sand (CL)
	2	2-4	UD		17									1.50	Lean Clay with Sand (CL)
	3	4-6	UD		16		47	18	29	74				3.75	Lean Clay with Sand (CL)
	4	6-8	UD		22									2.00	Lean Clay with Sand (CL)
	5	8-10	UD		29									2.75	Lean Clay with Sand (CL)
	6	10-12	UD		18									3.00	Lean Clay with Sand (CL)
	7	12-14	UD		18		48	20	30	78				3.00	Lean Clay with Sand (CL)
	8	14-16	UD		22	106	58	20	38		0.90			2.00	Fat Clay with Sand (CH)
	9	16-18	UD		25									4.00	Fat Clay with Sand (CH)
	10	18-20	UD		23	105						1.64(0.94)		4.00	Fat Clay with Sand (CH)
	11	23-25	UD		26		32	16	16					1.00	Fat Clay with Sand (CH)
B-6	1	0-2	UD		20		54	19	35	71				2.00	Fat Clay with Sand (CH)
	2	2-4	UD		20									1.75	Fat Clay with Sand (CH)
	3	4-6	UD		18									2.00	Fat Clay with Sand (CH)
	4	6-8	UD		19									3.00	Fat Clay with Sand (CH)
	5	8-10	UD		21									3.50	Fat Clay with Sand (CH)
	6	10-12	UD		19		55	20	35	74				4.00	Fat Clay with Sand (CH)
	7	12-14	UD		17									4.00	Fat Clay with Sand (CH)
	8	14-16	UD		21	101					1.85			4.00	Fat Clay with Sand (CH)
	9	16-18	UD		25	95						0.88(0.79)		2.00	Fat Clay with Sand (CH)
	10	18-20	UD		21		68	22	46					3.50	Fat Clay with Sand (CH)
	11	23-25	UD		26									2.50	Fat Clay with Sand (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023

CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-7	1	0-2	UD		18									2.00	Fat Clay with Sand (CH)
	2	2-4	UD		19		53	19	34	74				3.50	Fat Clay with Sand (CH)
	3	4-6	UD		15									4.00	Fat Clay with Sand (CH)
	4	6-8	UD		17									3.50	Fat Clay with Sand (CH)
	5	8-10	UD		21									3.25	Fat Clay with Sand (CH)
	6	10-12	UD		20		55	20	35	78				3.75	Fat Clay with Sand (CH)
	7	12-14	UD		19									4.00	Fat Clay with Sand (CH)
	8	14-16	UD		23	103						1.07(0.72)		3.00	Fat Clay with Sand (CH)
	9	16-18	UD		21	107					1.55			4.00	Fat Clay with Sand (CH)
	10	18-20	UD		20									4.00	Fat Clay with Sand (CH)
	11	23-25	UD		21		23	15	8	78				1.00	Lean Clay with Sand (CL)
B-8	1	0-2	UD		20		61	21	40	72				1.50	Fat Clay with Sand (CH)
	2	2-4	UD		16									3.75	Fat Clay with Sand (CH)
	3	4-6	UD		17									3.25	Fat Clay with Sand (CH)
	4	6-8	UD		28									3.00	Fat Clay with Sand (CH)
	5	8-10	UD		18		50	19	31	75				4.50	Fat Clay with Sand (CH)
	6	10-12	UD		17									4.00	Fat Clay with Sand (CH)
	7	12-14	UD		19	111					1.60			4.00	Fat Clay with Sand (CH)
	8	14-16	UD		24									3.75	Fat Clay with Sand (CH)
	9	16-18	UD		25	107						1.33 (0.74)		2.50	Fat Clay with Sand (CH)
	10	18-20	UD		22		58	20	38	84				4.00	Fat Clay with Sand (CH)
	11	23-25	UD		25									4.50	Fat Clay with Sand (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023

CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-9	1	0-2	UD		16									3.75	Sandy Lean Clay (CL)
	2	2-4	UD		16									3.00	Sandy Lean Clay (CL)
	3	4-6	UD		14		49	19	30	70				4.00	Sandy Lean Clay (CL)
	4	6-8	UD		15									3.25	Sandy Lean Clay (CL)
	5	8-10	UD		17									4.00	Sandy Lean Clay (CL)
	6	10-12	UD		16									4.50	Sandy Lean Clay (CL)
	7	12-14	UD		22		65	21	44	88				4.50	Fat Clay (CH)
	8	14-16	UD		21	108					1.85			4.00	Fat Clay (CH)
	9	16-18	UD		21	103						0.95(0.79)		2.00	Fat Clay (CH)
	10	18-20	UD		22									4.50	Fat Clay (CH)
	11	23-25	UD		24		75	23	52					3.50	Fat Clay (CH)
B-10	1	0-2	UD		17		48	18	30	68				3.00	Sandy Lean Clay (CL)
	2	2-4	UD		15									4.00	Sandy Lean Clay (CL)
	3	4-6	UD		13									3.50	Sandy Lean Clay (CL)
	4	6-8	UD		14									4.00	Sandy Lean Clay (CL)
	5	8-10	UD		17									4.50	Sandy Lean Clay (CL)
	6	10-12	UD		18		52	19	33	69				4.50	Sandy Fat Clay (CH)
	7	12-14	UD		22									4.50	Sandy Fat Clay (CH)
	8	14-16	UD		26	104						0.94(0.72)		2.00	Sandy Fat Clay (CH)
	9	16-18	UD		22	106					1.00			3.50	Sandy Fat Clay (CH)
	10	18-20	UD		24									2.50	Sandy Fat Clay (CH)
	11	23-25	UD		23		30	16	14	69				1.00	Sandy Lean Clay (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023

CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-11	1	0-2	UD		18									3.25	Fat Clay with sand (CH)
	2	2-4	UD		15		54	19	35	71				4.00	Fat Clay with sand (CH)
	3	4-6	UD		15									4.00	Fat Clay with sand (CH)
	4	6-8	UD		18									3.50	Fat Clay with sand (CH)
	5	8-10	UD		19									2.75	Fat Clay with sand (CH)
	6	10-12	UD		16									4.00	Fat Clay with sand (CH)
	7	12-14	UD		17		51	19	32	76				3.50	Fat Clay with sand (CH)
	8	14-16	UD		21	104					1.20			3.50	Fat Clay with sand (CH)
	9	16-18	UD		25	102						0.78 (0.74)		2.00	Fat Clay with sand (CH)
	10	18-20	UD		21									2.00	Fat Clay with sand (CH)
	11	23-25	UD		24		27	15	12	91				0.50	Lean Clay (CL)
B-12	1	0-2	UD		22		55	20	35	71				1.75	Fat Clay with Sand (CH)
	2	2-4	UD		19									2.50	Fat Clay with Sand (CH)
	3	4-6	UD		16									3.00	Fat Clay with Sand (CH)
	4	6-8	UD		27									4.00	Fat Clay with Sand (CH)
	5	8-10	UD		24									2.75	Fat Clay with Sand (CH)
	6	10-12	UD		20		54	19	35	78				3.25	Fat Clay with Sand (CH)
	7	12-14	UD		21									3.50	Fat Clay with Sand (CH)
	8	14-16	UD		18									4.00	Fat Clay with Sand (CH)
	9	16-18	UD		23	106						1.65(0.79)		4.00	Fat Clay with Sand (CH)
	10	18-20	UD		21	110	59	20	39		1.65			4.00	Fat Clay with Sand (CH)
	11	23-25	UD		23		25	15	10					1.00	Sandy Lean Clay (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023

CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-13	1	0-2	UD		24									1.50	Fat Clay with Sand (CH)
	2	2-4	UD		14		51	19	32	73				3.50	Fat Clay with Sand (CH)
	3	4-6	UD		11									4.50	Fat Clay with Sand (CH)
	4	6-8	UD		25									4.50	Fat Clay with Sand (CH)
	5	8-10	UD		15									4.50	Fat Clay with Sand (CH)
	6	10-12	UD		17									4.50	Fat Clay with Sand (CH)
	7	12-14	UD		23		63	21	42	85				3.75	Fat Clay with Sand (CH)
	8	14-16	UD		21	107					1.05			3.50	Fat Clay with Sand (CH)
	9	16-18	UD		18									4.00	Fat Clay with Sand (CH)
	10	18-20	UD		20	107						1.36(0.86)		2.00	Fat Clay with Sand (CH)
	11	23-25	UD		21		34	16	18	77				1.00	Lean Clay with Sand (CL)
B-14	1	0-2	UD		19		51	19	32	74				2.00	Fat Clay with Sand (CH)
	2	2-4	UD		19									1.50	Fat Clay with Sand (CH)
	3	4-6	UD		24									1.50	Fat Clay with Sand (CH)
	4	6-8	UD		28									1.50	Fat Clay with Sand (CH)
	5	8-10	UD		17									3.50	Fat Clay with Sand (CH)
	6	10-12	UD		17		52	19	33	71				4.00	Fat Clay with Sand (CH)
	7	12-14	UD		18									4.00	Fat Clay with Sand (CH)
	8	14-16	UD		19	110					1.45			4.00	Fat Clay with Sand (CH)
	9	16-18	UD		21	107						1.05(0.79)		3.75	Fat Clay with Sand (CH)
	10	18-20	UD		24		66	21	45					4.50	Fat Clay with Sand (CH)
	11	23-25	UD		23		37	17	20					3.00	Sandy Lean Clay (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023

CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-15	1	0-2	UD		19									2.00	Fat Clay with Sand (CH)
	2	2-4	UD		20									1.75	Fat Clay with Sand (CH)
	3	4-6	UD		18		50	19	31	73				1.75	Fat Clay with Sand (CH)
	4	6-8	UD		26									2.00	Fat Clay with Sand (CH)
	5	8-10	UD		20									3.50	Fat Clay with Sand (CH)
	6	10-12	UD		19									3.50	Fat Clay with Sand (CH)
	7	12-14	UD		19		59	20	39	80				4.00	Fat Clay with Sand (CH)
	8	14-16	UD		21	108					0.90			2.00	Fat Clay with Sand (CH)
	9	16-18	UD		22	107						2.03(0.79)		4.50	Fat Clay with Sand (CH)
	10	18-20	UD		22									4.00	Fat Clay with Sand (CH)
	11	23-25	UD		21		65	21	44					3.00	Fat Clay with Sand (CH)
B-16	1	0-2	UD		16									3.75	Fat Clay with Sand (CH)
	2	2-4	UD		14		50	19	31	71				4.50	Fat Clay with Sand (CH)
	3	4-6	UD		15									4.50	Fat Clay with Sand (CH)
	4	6-8	UD		22									4.50	Fat Clay with Sand (CH)
	5	8-10	UD		14									4.50	Fat Clay with Sand (CH)
	6	10-12	UD		14		63	21	42	77				4.50	Fat Clay with Sand (CH)
	7	12-14	UD		18	113					2.15			4.50	Fat Clay with Sand (CH)
	8	14-16	UD		23									3.25	Fat Clay with Sand (CH)
	9	16-18	UD		16	113						1.38(0.79)		3.00	Fat Clay with Sand (CH)
	10	18-20	UD		20		49	19	30	87				2.50	Lean Clay (CL)
	11	23-25	UD		23									1.00	Lean Clay (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023

CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-17	1	0-2	UD		24									1.75	Fat Clay with Sand (CH)
	2	2-4	UD		19									2.50	Fat Clay with Sand (CH)
	3	4-6	UD		15		51	19	32	72				3.75	Fat Clay with Sand (CH)
	4	6-8	UD		28									3.50	Fat Clay with Sand (CH)
	5	8-10	UD		22									2.00	Fat Clay with Sand (CH)
	6	10-12	UD		16									2.00	Fat Clay with Sand (CH)
	7	12-14	UD		17									4.50	Fat Clay with Sand (CH)
	8	14-16	UD		20		51	19	32	83				4.50	Fat Clay with Sand (CH)
	9	16-18	UD		23	104					1.50			4.00	Fat Clay with Sand (CH)
	10	18-20	UD		24	103						1.34(0.86)		3.00	Fat Clay with Sand (CH)
	11	23-25	UD		25		60	20	40					2.75	Fat Clay with Sand (CH)
B-18	1	0-2	UD		20									3.00	Fat Clay with Sand (CH)
	2	2-4	UD		19		60	20	40	71				4.00	Fat Clay with Sand (CH)
	3	4-6	UD		19									3.00	Fat Clay with Sand (CH)
	4	6-8	UD		30									4.00	Fat Clay with Sand (CH)
	5	8-10	UD		30									4.00	Fat Clay with Sand (CH)
	6	10-12	UD		19		55	20	35	83				3.50	Fat Clay with Sand (CH)
	7	12-14	UD		17	118					1.50			4.00	Fat Clay with Sand (CH)
	8	14-16	UD		16									4.50	Fat Clay with Sand (CH)
	9	16-18	UD		18	110						1.73(0.79)		4.00	Fat Clay with Sand (CH)
	10	18-20	UD		21		59	20	39					4.00	Fat Clay with Sand (CH)
	11	23-25	UD		20									3.50	Fat Clay with Sand (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023

CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-19	1	0-2	AU		17		50	19	31	72					Fat Clay with Sand (CH)
	2	2-4	UD		16									4.00	Fat Clay with Sand (CH)
	3	4-6	UD		20									3.75	Fat Clay with Sand (CH)
	4	6-8	UD		21									3.25	Fat Clay with Sand (CH)
	5	8-10	UD		29									4.00	Fat Clay with Sand (CH)
	6	10-12	UD		26		78	23	55	84				3.50	Fat Clay with Sand (CH)
	7	12-14	UD		26									3.00	Fat Clay with Sand (CH)
	8	14-16	UD		16	116					2.25			4.50	Fat Clay with Sand (CH)
	9	16-18	UD		22									4.00	Fat Clay with Sand (CH)
	10	18-20	UD		17	113						1.43(0.86)		3.50	Fat Clay with Sand (CH)
	11	23-25	UD		20		29	15	14	74				2.00	Lean Clay with Sand (CL)
B-20	1	0-2	AU		33										Fat Clay with Sand (CH)
	2	2-4	UD		17									3.00	Fat Clay with Sand (CH)
	3	4-6	UD		20		57	20	37	71				1.75	Fat Clay with Sand (CH)
	4	6-8	UD		27									2.00	Fat Clay with Sand (CH)
	5	8-10	UD		33									1.75	Fat Clay with Sand (CH)
	6	10-12	UD		20	110					1.45			3.50	Fat Clay with Sand (CH)
	7	12-14	UD		16		50	19	31	82				3.75	Fat Clay with Sand (CH)
	8	14-16	UD		24	103						1.24(0.72)		3.50	Fat Clay with Sand (CH)
	9	16-18	UD		22									4.00	Fat Clay with Sand (CH)
	10	18-20	UD		19		33	16	17	67				3.75	Sandy Lean Clay (CL)
	11	23-25	UD		20									4.00	Sandy Lean Clay (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023

CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample NO.	Sample DEPTH (ft)	Sample TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF) UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	TYPE OF MATERIAL
B-21	1	0-2	UD		17		50	19	31	72				3.75	Fat Clay with Sand (CH)
	2	2-4	UD		16									4.50	Fat Clay with Sand (CH)
	3	4-6	UD		14									4.50	Fat Clay with Sand (CH)
	4	6-8	UD		14									4.50	Fat Clay with Sand (CH)
	5	8-10	UD		23									4.50	Fat Clay with Sand (CH)
	6	10-12	UD		23		99	27	72	83				4.50	Fat Clay with Sand (CH)
	7	12-14	UD		21	110					1.55			4.00	Fat Clay with Sand (CH)
	8	14-16	UD		16									4.50	Fat Clay with Sand (CH)
	9	16-18	UD		17	113	60	20	40	84		1.47(0.79)		4.00	Fat Clay with Sand (CH)
	10	18-20	UD		19									4.50	Fat Clay with Sand (CH)
	11	23-25	UD		22									4.00	Fat Clay with Sand (CH)
B-22	1	0-2	UD		22									2.00	Sandy Lean Clay (CL)
	2	2-4	UD		17		46	18	28	63				1.75	Sandy Lean Clay (CL)
	3	4-6	UD		18									2.00	Sandy Lean Clay (CL)
	4	6-8	UD		16									3.00	Sandy Lean Clay (CL)
	5	8-10	UD		15									2.00	Sandy Lean Clay (CL)
	6	10-12	SS	17	8										Silty Sand (SM)
	7	12-14	UD		21		67	21	46	87				4.00	Fat Clay (CH)
	8	14-16	UD		17	114					1.50			4.00	Fat Clay (CH)
	9	16-18	UD		30	96						1.13(0.79)		3.75	Fat Clay (CH)
	10	18-20	UD		23									4.00	Fat Clay (CH)
	11	23-25	UD		20		62	21	41	99				4.50	Fat Clay (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023

CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-23	1	0-2	AU		21										Sandy Fat Clay (CH)
	2	2-4	UD		20									4.00	Sandy Fat Clay (CH)
	3	4-6	UD		13		56	20	36	66				4.50	Sandy Fat Clay (CH)
	4	6-8	UD		14									4.50	Sandy Fat Clay (CH)
	5	8-10	UD		23									4.50	Sandy Fat Clay (CH)
	6	10-12	UD		24	103					0.95			2.00	Sandy Fat Clay (CH)
	7	12-14	UD		17		37	17	20	76				4.00	Lean Clay with Sand (CL)
	8	14-16	UD		17	114						1.45(0.72)		3.00	Lean Clay with Sand (CL)
	9	16-18	UD		18									2.75	Lean Clay with Sand (CL)
	10	18-20	UD		18		48	18	30					4.00	Lean Clay with Sand (CL)
	11	23-25	UD		24									3.50	Lean Clay with Sand (CL)
B-24	1	0-2	UD		18		56	20	36	71				3.00	Fat Clay with Sand (CH)
	2	2-4	UD		17									2.50	Fat Clay with Sand (CH)
	3	4-6	UD		15									3.00	Fat Clay with Sand (CH)
	4	6-8	UD		18									3.50	Fat Clay with Sand (CH)
	5	8-10	UD		27		70	22	48	84				2.75	Fat Clay with Sand (CH)
	6	10-12	UD		15									4.50	Fat Clay with Sand (CH)
	7	12-14	UD		15	118						2.50(0.58)		4.50	Fat Clay with Sand (CH)
	8	14-16	UD		15									4.50	Fat Clay with Sand (CH)
	9	16-18	UD		24	102					0.90			2.00	Fat Clay with Sand (CH)
	10	18-20	UD		29									3.50	Fat Clay with Sand (CH)
	11	23-25	UD		21		34	16	18	95				4.00	Lean Clay (CL)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023

CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-25	1	0-2	UD		14									3.00	Fat Clay with Sand (CH)
	2	2-4	UD		15		51	19	32	71				4.50	Fat Clay with Sand (CH)
	3	4-6	UD		14									4.50	Fat Clay with Sand (CH)
	4	6-8	UD		20									4.50	Fat Clay with Sand (CH)
	5	8-10	UD		25									4.50	Fat Clay with Sand (CH)
	6	10-12	UD		19		52	19	33	81				4.50	Fat Clay with Sand (CH)
	7	12-14	UD		15									4.50	Fat Clay with Sand (CH)
	8	14-16	UD		16	115						1.60(0.72)		4.00	Fat Clay with Sand (CH)
	9	16-18	UD		22	105					0.90			2.00	Fat Clay with Sand (CH)
	10	18-20	UD		24		54	19	35					2.00	Fat Clay with Sand (CH)
	11	23-25	SS	27	20					27					Silty Sand (SM)
B-26	1	0-2	UD		16									4.00	Fat Clay with Sand (CH)
	2	2-4	UD		13									4.50	Fat Clay with Sand (CH)
	3	4-6	UD		15		58	20	38	73				4.50	Fat Clay with Sand (CH)
	4	6-8	UD		14									4.50	Fat Clay with Sand (CH)
	5	8-10	UD		28									4.50	Fat Clay with Sand (CH)
	6	10-12	UD		12									4.00	Fat Clay with Sand (CH)
	7	12-14	UD		13		40	17	23	86				4.00	Lean Clay (CL)
	8	14-16	UD		22	106					1.05			3.50	Lean Clay (CL)
	9	16-18	UD		25									4.00	Fat Clay with Sand (CH)
	10	18-20	UD		21	107						1.35 (0.86)		4.00	Fat Clay with Sand (CH)
	11	23-25	UD		28		84	24	60					3.50	Fat Clay with Sand (CH)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023
CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-27	1	0-2	UD		16		47	18	29	63				4.00	Sandy Lean Clay (CL)
	2	2-4	UD		17									2.75	Sandy Lean Clay (CL)
	3	4-6	UD		19									3.25	Sandy Lean Clay (CL)
	4	6-8	UD		20									3.75	Sandy Lean Clay (CL)
	5	8-10	UD		17									4.50	Sandy Lean Clay (CL)
	6	10-12	UD		20		61	21	40	92				4.50	Fat Clay (CH)
	7	12-14	UD		21									4.50	Fat Clay (CH)
	8	14-16	UD		24	105					2.05			4.50	Fat Clay (CH)
	9	16-18	UD		32	93						1.13(0.79)		3.00	Fat Clay (CH)
	10	18-20	UD		34		92	25	67					3.75	Fat Clay (CH)
	11	23-25	UD		27									4.00	Fat Clay (CH)
B-28	1	0-2	UD		14									4.00	Sandy Lean Clay (CL)
	2	2-4	UD		13		34	16	18	66				3.25	Sandy Lean Clay (CL)
	3	4-6	UD		15									4.00	Sandy Lean Clay (CL)
	4	6-8	UD		21									1.75	Sandy Lean Clay (CL)
	5	8-10	UD		22									2.00	Sandy Lean Clay (CL)
	6	10-12	UD		19		52	19	33	73				3.00	Fat Clay with Sand (CH)
	7	12-14	UD		15									4.00	Fat Clay with Sand (CH)
	8	14-16	UD		19	113					1.15			3.50	Fat Clay with Sand (CH)
	9	16-18	UD		17	115	48	18	30			1.03(0.79)		2.50	Sandy Lean Clay (CL)
	10	18-20	UD		19									1.00	Sandy Lean Clay (CL)
	11	23-25	SS	12	20					15					Silty Sand (SM)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 3 (cont'd)

ASSOCIATED TESTING LABORATORIES, INC.
3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052
TEL: (713) 748-3717 FAX: (713) 748-3748

PROJECT NAME : PROJECT 464-SPRINGDALE (SEC 1 & 2) AND RESTRIDGE (SEC 1 & 5) SUBDIVISION, WBS NO. N-000397-0001-3, FILE NO: 4600011023

CONSULTANT PROJECT NUMBER: G14-101

BORING NO.	Sample			SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	Atterberg Limits			PERCENT PASSING SIEVE 200 (%)	UNDRAINED SHEAR STRENGTH (TSF)				TYPE OF MATERIAL
	NO.	DEPTH (ft)	TYPE				LL	PL	PI		UNCONFINED COMPRESSION TEST (TSF)	UU TEST (CONFINING PRESSURE) (TSF)	TORVANE	POCKET PENETRO-METER	
B-29	1	0-2	UD		12									4.00	Fat Clay with Sand (CH)
	2	2-4	UD		14									3.75	Fat Clay with Sand (CH)
	3	4-6	UD		17		53	19	34	76				3.00	Fat Clay with Sand (CH)
	4	6-8	UD		27									2.00	Fat Clay with Sand (CH)
	5	8-10	UD		21									1.50	Fat Clay with Sand (CH)
	6	10-12	UD		22									3.50	Fat Clay with Sand (CH)
	7	12-14	UD		13		38	17	21	74				3.50	Lean Clay with Sand (CL)
	8	14-16	UD		16	115					0.90			2.00	Lean Clay with Sand (CL)
	9	16-18	UD		17		46	18	28					4.00	Lean Clay with Sand (CL)
	10	18-20	UD		18	110						0.46(0.86)		1.00	Lean Clay with Sand (CL)
	11	23-25	SS	12	18					15					Silty Sand (SM)

Legend:
UD - Undisturbed Sample Extruded in Field
UL - Undisturbed Sample Extruded in Lab
Designates consolidation test Performed
AG - Auger Cutting in Field
SS - Split Spoon Sample
SPT - Standard Penetration Test

TABLE 4
MARSTON SOIL COEFFICIENTS (Cd) FOR TRENCH CONDUITS

A = K_u' = 0.1924 Granular materials without cohesion
B = K_u' = 0.165 Maximum for sand and gravel
C = K_u' = 0.150 Maximum for saturated top soil
D = Ku' = 0.130 Ordinary maximum for clay
E = K_u' = 0.110 Maximum for saturated clay

H/B_d	A	B	C	D	E
0.05	0.050	0.050	0.050	0.050	0.050
0.10	0.098	0.098	0.099	0.099	0.099
0.15	0.146	0.146	0.147	0.147	0.148
0.20	0.192	0.194	0.194	0.195	0.196
0.25	0.238	0.240	0.241	0.242	0.243
0.30	0.283	0.286	0.287	0.289	0.290
0.35	0.327	0.331	0.332	0.335	0.337
0.40	0.371	0.375	0.377	0.380	0.383
0.45	0.413	0.418	0.421	0.425	0.428
0.50	0.455	0.461	0.464	0.469	0.473
0.55	0.496	0.503	0.507	0.512	0.518
0.60	0.536	0.544	0.549	0.555	0.562
0.65	0.575	0.585	0.591	0.598	0.606
0.70	0.614	0.625	0.631	0.640	0.649
0.75	0.651	0.664	0.672	0.681	0.691
0.80	0.689	0.703	0.711	0.722	0.734
0.85	0.725	0.741	0.750	0.763	0.775
0.90	0.761	0.779	0.789	0.802	0.817
0.95	0.796	0.816	0.827	0.842	0.857
1.00	0.830	0.852	0.864	0.881	0.898
1.05	0.864	0.887	0.901	0.919	0.938
1.10	0.897	0.922	0.937	0.957	0.977
1.15	0.929	0.957	0.973	0.994	1.016
1.20	0.961	0.991	1.008	1.031	1.055
1.25	0.992	1.024	1.042	1.067	1.093
1.30	1.023	1.057	1.076	1.103	1.131
1.35	1.053	1.089	1.110	1.139	1.168
1.40	1.082	1.121	1.143	1.173	1.205
1.45	1.111	1.152	1.176	1.208	1.241
1.50	1.140	1.183	1.208	1.242	1.278
1.55	1.167	1.213	1.240	1.276	1.313
1.60	1.195	1.243	1.271	1.309	1.349
1.65	1.221	1.272	1.301	1.342	1.384
1.70	1.248	1.301	1.332	1.374	1.418
1.75	1.273	1.329	1.361	1.406	1.452
1.80	1.299	1.357	1.391	1.437	1.486
1.85	1.323	1.385	1.420	1.469	1.520
1.90	1.348	1.412	1.448	1.499	1.553
1.95	1.372	1.438	1.476	1.530	1.586
2.00	1.395	1.464	1.504	1.560	1.618
2.10	1.440	1.515	1.558	1.618	1.682
2.20	1.484	1.564	1.610	1.675	1.744
2.30	1.526	1.612	1.661	1.731	1.805
2.40	1.567	1.658	1.711	1.785	1.865
2.50	1.606	1.702	1.759	1.838	1.923
2.60	1.643	1.745	1.805	1.890	1.980
2.70	1.679	1.787	1.850	1.940	2.036
2.80	1.714	1.827	1.894	1.989	2.090
2.90	1.747	1.867	1.937	2.037	2.144

H/B_d	A	B	C	D	E
3.00	1.780	1.904	1.978	2.083	2.196
3.10	1.810	1.941	2.018	2.128	2.247
3.20	1.840	1.976	2.057	2.172	2.297
3.30	1.869	2.010	2.095	2.215	2.346
3.40	1.896	2.044	2.131	2.257	2.394
3.50	1.923	2.076	2.167	2.298	2.441
3.60	1.948	2.107	2.201	2.338	2.487
3.70	1.973	2.137	2.235	2.376	2.531
3.80	1.997	2.166	2.267	2.414	2.575
3.90	2.019	2.194	2.299	2.451	2.618
4.00	2.041	2.221	2.329	2.487	2.660
4.10	2.062	2.247	2.359	2.522	2.701
4.20	2.082	2.273	2.388	2.556	2.741
4.30	2.102	2.297	2.416	2.589	2.780
4.40	2.121	2.321	2.443	2.621	2.819
4.50	2.139	2.344	2.469	2.652	2.856
4.60	2.156	2.366	2.495	2.683	2.893
4.70	2.173	2.388	2.520	2.713	2.929
4.80	2.189	2.409	2.543	2.742	2.964
4.90	2.204	2.429	2.567	2.770	2.999
5.00	2.219	2.448	2.590	2.798	3.032
5.10	2.234	2.467	2.612	2.825	3.065
5.20	2.247	2.486	2.633	2.851	3.098
5.30	2.261	2.503	2.654	2.877	3.129
5.40	2.273	2.520	2.674	2.901	3.160
5.50	2.286	2.537	2.693	2.926	3.190
5.60	2.298	2.553	2.712	2.949	3.220
5.70	2.309	2.568	2.730	2.972	3.248
5.80	2.320	2.583	2.748	2.995	3.277
5.90	2.330	2.598	2.766	3.017	3.304
6.00	2.340	2.612	2.782	3.038	3.331
6.20	2.360	2.639	2.814	3.079	3.383
6.40	2.377	2.664	2.845	3.118	3.433
6.60	2.394	2.687	2.873	3.155	3.481
6.80	2.409	2.709	2.900	3.190	3.527
7.00	2.423	2.730	2.925	3.223	3.571
7.20	2.436	2.749	2.949	3.255	3.613
7.40	2.448	2.767	2.971	3.285	6.653
7.60	2.459	2.784	2.992	3.313	3.691
7.80	2.470	2.799	3.012	3.340	3.728
8.00	2.479	2.814	3.031	3.366	3.763
8.50	2.500	2.847	3.073	3.424	3.845
9.00	2.517	2.875	3.109	3.476	3.918
9.50	2.532	2.898	3.141	3.521	3.983
10.00	2.543	2.919	3.167	3.560	4.042
15.00	2.591	3.009	3.296	3.768	4.378
20.00	2.598	3.026	3.325	3.825	4.490
30.00	2.599	3.030	3.333	3.845	4.539
40.00	2.599	3.030	3.333	3.846	4.545

Source: American Water Works Association, Manual of Water Supply Practices, "Concrete Pressure Pipe, AMMA M9

MARSTON SOIL COEFFICIENTS (C_d) FOR TRENCH CONDUITS	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748
NEIGHBORHOOD STREET REHABILIATION–PROJECT 464 SPRINGDALE (SEC. 1&2) AND RESTRIDGE (SEC. 1&5)	WBS NO. N-000397-0001-3 PROJECT NO. : G14-101 | TABLE 4

PST 8/28/12

APPENDIX 1

PHOTOGRAPHS OF THE PROJECT SITE

PHOTOGRAPHS OF THE PROJECT SITE
ATL PROJECT No.: G14-101 WBS No: N-000397-0001-3
NSR 464-SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION

Looking West On Turquoise Lane From Delery Drive

Looking North On Ridgecrest Drive From Turquoise Lane

PHOTOGRAPHS OF THE PROJECT SITE
ATL PROJECT No.: G14-101 WBS No: N-000397-0001-3
NSR 464-SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION

Looking East On Vogue Drive From Ridgecrest Drive

Looking North On Norcrest Drive From Western Drive

PHOTOGRAPHS OF THE PROJECT SITE
ATL PROJECT No.: G14-101 WBS No: N-000397-0001-3
NSR 464-SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION

Looking North On Lynnview Drive From Long Point

Looking East On Waterbury Drive From Pech Road

APPENDIX 2

PIEZOMETER INSTALLATION AND PLUGGING REPORTS

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: NSR 464–SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION WBS No.: N–000397–0001–3

PIEZOMETER NO.: B–1 (PZ–1)

GEOTECHNICAL CONSULTANT
ASSOCIATED TESTING LABORATORIES, INC.

DESIGN CONSULTANT
SCIENTECH ENGINEERS, INC.

CITY OF HOUSTON

COMPLETION DATE: 1–21–14

DRY AUGERED 0 TO 25 FT

WASH BORED _____ TO _____ FT

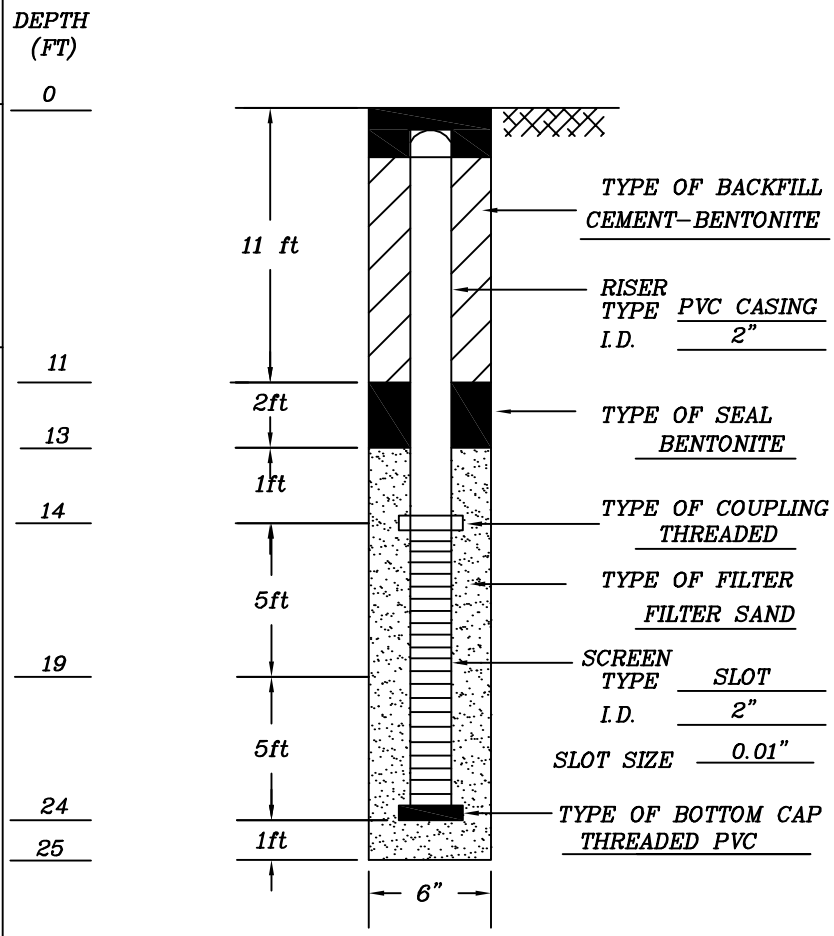
DRILING FLUID: _____

DEVELOPMENT DATE: 1–21–14

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READING:

DATE	READING
1–22–14	12'
1–31–14	12'
2–25–14	10.5'



(NOT TO SCALE)

REMARKS:

NOTES:

DRILLED BY: Soltek,LLC	STARTED: 1–21–14
LOGGED BY: PV	COMPLETED: 1–21–14
CHECKED BY: JITU	APPROVED BY: PST

ATL job No. G14–101

SHEET 1 OF 4

ASSOCIATED TESTING LABORATORIES, INC.

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: NSR 464–SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION WBS No.: N–000397–0001–3	PIEZOMETER NO.: B–8 (PZ–2)

GEOTECHNICAL CONSULTANT ASSOCIATED TESTING LABORATORIES, INC.	DESIGN CONSULTANT SCIENTECH ENGINEERS, INC.	CITY OF HOUSTON

COMPLETION DATE: 1–27–14

DRY AUGERED 0 TO 25 FT

WASH BORED _____ TO _____ FT

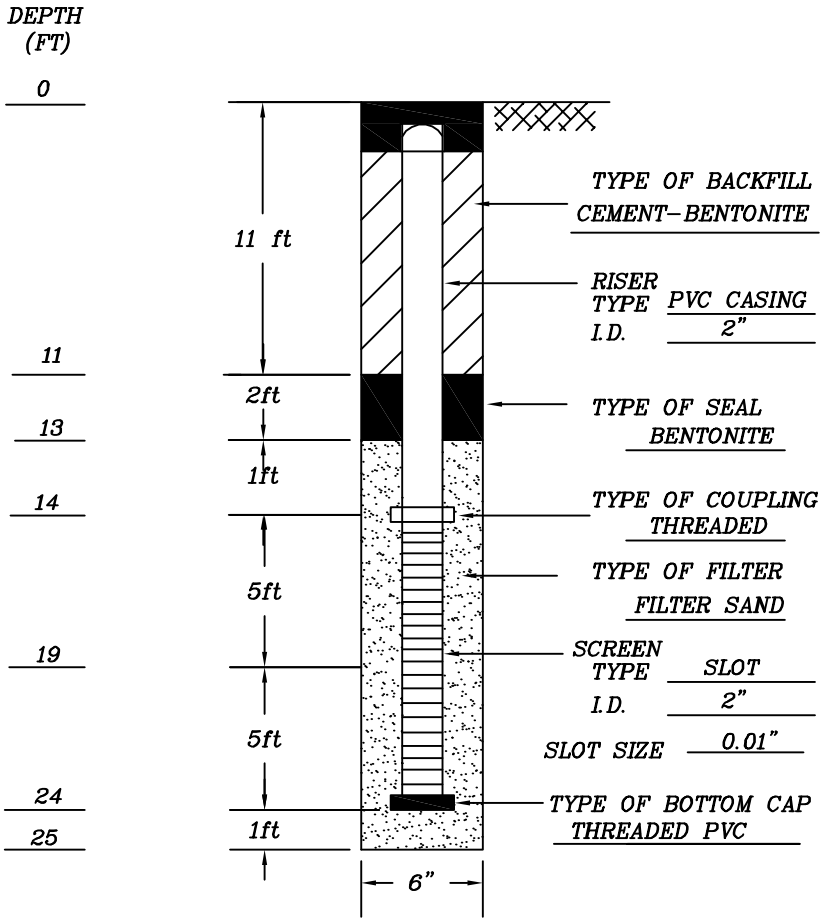
DRILING FLUID: _____

DEVELOPMENT DATE: 1–27–14

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READING:

DATE	READING
1–28–14	13'
1–31–14	12.5'
2–25–14	11.5'



(NOT TO SCALE)

REMARKS:

NOTES:

DRILLED BY: Soltek,LLC	STARTED: 1–27–14
LOGGED BY: PV	COMPLETED: 1–27–14
CHECKED BY: JITU	APPROVED BY: PST

ATL job No. G14–101

ASSOCIATED TESTING LABORATORIES, INC.

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: NSR 464–SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION WBS No.: N–000397–0001–3	PIEZOMETER NO.: B–18 (PZ–3)
GEOTECHNICAL CONSULTANT ASSOCIATED TESTING LABORATORIES, INC.	DESIGN CONSULTANT SCIENTECH ENGINEERS, INC.
	CITY OF HOUSTON

COMPLETION DATE: 1–23–14

DRY AUGERED 0 TO 25 FT

WASH BORED _____ TO _____ FT

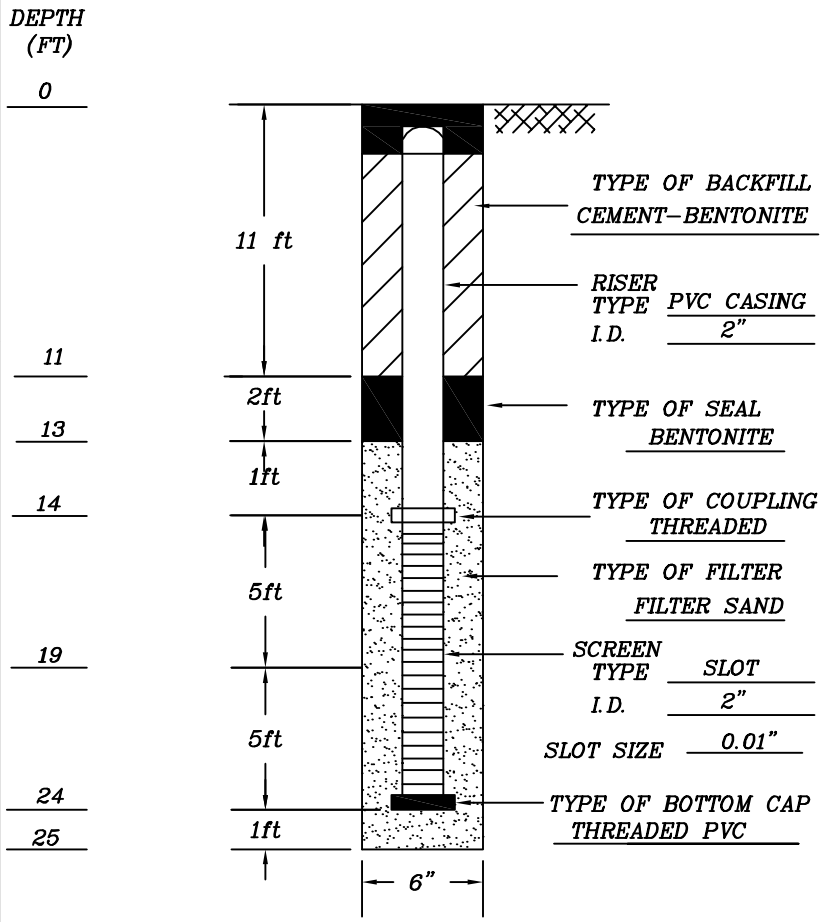
DRILING FLUID: _____

DEVELOPMENT DATE: 1–23–14

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READING:

DATE	READING
1–24–14	24'
1–31–14	23.5'
2–25–14	13.5'



(NOT TO SCALE)

REMARKS:

NOTES:

DRILLED BY: Soltek,LLC	STARTED: 1–23–14
LOGGED BY: PV	COMPLETED: 1–23–14
CHECKED BY: JITU	APPROVED BY: PST

ATL job No. G14–101

SHEET 3 OF 4

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: NSR 464–SPRINGDALE (SEC.1&2) AND RESTRIDGE (SEC.1&5) SUBDIVISION WBS No.: N–000397–0001–3	PIEZOMETER NO.: B–27(PZ–4)

GEOTECHNICAL CONSULTANT ASSOCIATED TESTING LABORATORIES, INC.	DESIGN CONSULTANT SCIENTECH ENGINEERS, INC.	CITY OF HOUSTON

COMPLETION DATE: 1–23–14

DRY AUGERED 0 TO 25 FT

WASH BORED _____ TO _____ FT

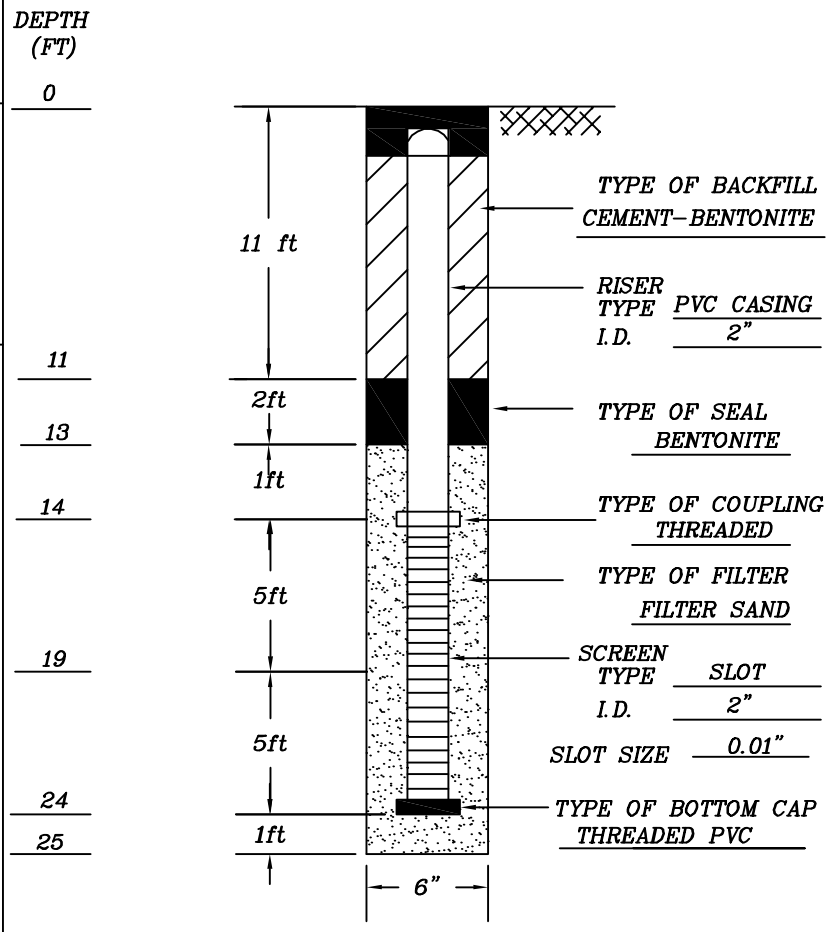
DRILING FLUID: _____

DEVELOPMENT DATE: 1–23–14

METHOD OF DEVELOPMENT: BAILING

WATER LEVEL READING:

DATE	READING
1–24–14	18'
1–31–14	18'
2–25–14	17.5'



(NOT TO SCALE)

REMARKS:

NOTES:

DRILLED BY: Soltek,LLC	STARTED: 1–21–14	ATL job No. G14–101
LOGGED BY: PV	COMPLETED: 1–21–14	
CHECKED BY: JITU	APPROVED BY: PST	SHEET 4 OF 4

ASSOCIATED TESTING LABORATORIES, INC.

 G14-101

STATE OF TEXAS WELL REPORT for Tracking #357119

Owner:	**City of Houston Geo Dept.**	Owner Well #:	**B-1**
Address:	**611 Walker Houston , TX 77002**	Grid #:	**65-13-4**
Well Location:	**Vogue Ln Houston , TX 77027**	Latitude:	**29° 48' 27" N**
Well County:	**Harris**	Longitude:	**095° 29' 22" W**
Elevation:	**No Data**	GPS Brand Used:	**Magellan**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **1/21/2014**
Completed: **1/21/2014**

Diameter of Hole: Diameter: **4 in From Surface To 25 ft**

Drilling Method: Other: **Auger**

Borehole Completion: Other: **(No Data)**

Annular Seal Data: 1st Interval: **From 0 ft to 13 ft with 1 bentonite (#sacks and material)**
2nd Interval: **No Data**
3rd Interval: **No Data**
Method Used: **No Data**
Cemented By: **No Data**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **20/40 13-25**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for

completion and resubmittal.

Company Information:	**Envirotech Drilling Services 2718 South Brompton Drive Pearland , TX 77584**
Driller License Number:	**58171**
Licensed Well Driller Signature:	**Jaime Vasquez**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#357119**) on your written request.

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

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-12 Brown sa/cl
12-25 Br cl

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2" New PVC Riser 0-15 Sch. 40
2" New PVC Screen 15-25 0.010

STATE OF TEXAS WELL REPORT for Tracking #357121

Owner:	**City of Houston Geo Dept.**	Owner Well #:	**B-8**
Address:	**611 Walker Houston , TX 77002**	Grid #:	**65-13-4**
Well Location:	**Cedel Dr. Houston , TX 77027**	Latitude:	**29° 48' 26" N**
Well County:	**Harris**	Longitude:	**095° 29' 09" W**
Elevation:	**No Data**	GPS Brand Used:	**Magellan**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **1/27/2014** Completed: **1/27/2014**
Diameter of Hole:	Diameter: **4 in From Surface To 25 ft**
Drilling Method:	Other: **Auger**
Borehole Completion:	Other: **(No Data)**
Annular Seal Data:	1st Interval: **From 0 ft to 13 ft with 1 bentonite (#sacks and material)** 2nd Jnterval: **No Data** 3rd Interval: **No Data** Method Used: **No Data** Cemented By: **No Data** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Surface Sleeve Installed**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**20/40 13-25**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for

completion and resubmittal.

Company Information:	**Envirotech Drilling Services 2718 South Brompton Drive Pearland , TX 77584**
Driller License Number:	**58171**
Licensed Well Driller Signature:	**Jaime Vasquez**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #**357121**) on your written request.

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

DESC. & COLOR OF FORMATION MATERIAL

From (ft)	To (ft)	Description
0	**16**	**Tan l grey Sa/cl**
16	**25**	**Red-grey Sa/cl**

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2"	**New**	**PVC Riser**	**0-15 Sch. 40**
2"	**New**	**PVC Screen**	**15-25 0.010**

STATE OF TEXAS WELL REPORT for Tracking #357122

Owner:	**City of Houston Geo Dept.**	Owner Well #:	**B-18**
Address:	**611 Walker Houston , TX 77002**	Grid #:	**65-13-4**
Well Location:	**Glosridge Dr. Houston , TX 77027**	Latitude:	**29° 48' 18" N**
Well County:	**Harris**	Longitude:	**095° 29' 19" W**
Elevation:	**No Data**	GPS Brand Used:	**Magellan**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **1/23/2014** Completed: **1/23/2014**
Diameter of Hole:	Diameter: **4 in From Surface To 25 ft**
Drilling Method:	Other: **Auger**
Borehole Completion:	Other: **(No Data)**
Annular Seal Data:	1st Interval: **From 0 ft to 13 ft with 1 bentonite (#sacks and material)** 2nd Interval: **No Data** 3rd Interval: **No Data** Method Used: **No Data** Cemented By: **No Data** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Surface Sleeve Installed**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**20/40 13-25**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for

completion and resubmittal.

Company Information:	**Envirotech Drilling Services 2718 South Brompton Drive Pearland , TX 77584**
Driller License Number:	**58171**
Licensed Well Driller Signature:	**Jaime Vasquez**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #**357122**) on your written request.

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

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-6 Grey tan sandy clay
6-25 Red, tan, light grey sandy clay

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2" New PVC Riser 0-15 Sch. 40
2" New PVC Screen 15-25 0.010

STATE OF TEXAS WELL REPORT for Tracking #357124

Owner:	**City of Houston Geo Dept.**	Owner Well #:	**B-27**
Address:	**611 Walker Houston , TX 77002**	Grid #:	**65-13-4**
Well Location:	**Roadway Lynnview Dr. Houston , TX 77027**	Latitude:	**29° 48' 07" N**
Well County:	**Harris**	Longitude:	**095° 29' 19" W**
Elevation:	**No Data**	GPS Brand Used:	**Magellan**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **1/23/2014** Completed: **1/23/2014**
Diameter of Hole:	Diameter: **4 in From Surface To 25 ft**
Drilling Method:	Other: **Auger**
Borehole Completion:	Other: **(No Data)**
Annular Seal Data:	1st Interval: **From 0 ft to 13 ft with 1 bentonite (#sacks and material)** 2nd Interval: **No Data** 3rd Interval: **No Data** Method Used: **No Data** Cemented By: **No Data** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Surface Sleeve Installed**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**20/40 13-25**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for

completion and resubmittal.

Company Information:	**Envirotech Drilling Services 2718 South Brompton Drive Pearland , TX 77584**
Driller License Number:	**58171**
Licensed Well Driller Signature:	**Jaime Vasquez**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#357124**) on your written request.

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

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-16 Grey sandy clay
16-25 Red tan sandy clay

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2" New PVC Riser 0-15 Sch. 40
2" New PVC Screen 15-25 0.010

G14-101

STATE OF TEXAS PLUGGING REPORT for Tracking #94065

Owner:	**City Of Houston Geo Dept**	Owner Well #:	**B-1**
Address:	**611 Walker** **Houston , TX 77002**	Grid #:	**65-13-4**
Well Location:	**Vogue Ln** **Houston , TX**	Latitude:	**29° 48' 27" N**
Well County:	**Harris**	Longitude:	**095° 29' 22" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Jaime Vasquez**
Driller's License Number of Original Well Driller:	**58171**
Date Well Drilled:	**1/21/2014**
Well Report Tracking Number:	**357119**
Diameter of Borehole:	**4 inches**
Total Depth of Borehole:	**25' feet**

Date Well Plugged:	**4/14/2014**
Person Actually Performing Plugging Operation:	**Jaime Vasquez**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **2 inches diameter, From 0 ft to 2 ft** 2nd Interval: **(No Data) inches diameter, From 2 ft to 25 ft** 3rd Interval: **No Data**
Cement/Bentonite	1st Interval: **From 0 ft to 25 ft; Sack(s)/type of cement used: 1-cement**

Plugs Placed in Well:	2nd Interval: **No Data** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**

Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking #**94065**) 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 #94066

Owner:	**City Of Houston Geo Dept**	Owner Well #:	**B-8**
Address:	**611 Walker Houston , TX 77002**	Grid #:	**65-13-4**
Well Location:	**Cedel Dr Houston , TX**	Latitude:	**29° 48' 26" N**
Well County:	**Harris**	Longitude:	**095° 29' 09" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Jaime Vasquez**
Driller's License Number of Original Well Driller:	**58171**
Date Well Drilled:	**1/27/2014**
Well Report Tracking Number:	**357121**
Diameter of Borehole:	**4 inches**
Total Depth of Borehole:	**25' feet**

Date Well Plugged:	**4/14/2014**
Person Actually Performing Plugging Operation:	**Jaime Vasquez**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **2 inches diameter, From 0 ft to 2 ft** 2nd Interval: **(No Data) inches diameter, From 2 ft to 25 ft** 3rd Interval: **No Data**
Cement/Bentonite	1st Interval: **From 0 ft to 25 ft; Sack(s)/type of cement used: 1-cement**

Plugs Placed in Well:	2nd Interval: **No Data** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**

Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking #**94066**) 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 #94067

Owner:	**City Of Houston Geo Dept**	Owner Well #:	**B-18**
Address:	**611 Walker** **Houston , TX 77002**	Grid #:	**65-13-4**
Well Location:	**Roadw way** **Houston , TX**	Latitude:	**29° 48' 18" N**
Well County:	**Harris**	Longitude:	**095° 29' 19" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Jaime Vasquez**
Driller's License Number of Original Well Driller:	**58171**
Date Well Drilled:	**1/23/2014**
Well Report Tracking Number:	**357122**
Diameter of Borehole:	**4 inches**
Total Depth of Borehole:	**25' feet**

Date Well Plugged:	**4/14/2014**
Person Actually Performing Plugging Operation:	**Jaime Vasquez**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **2 inches diameter, From 0 ft to 2 ft** 2nd Interval: **(No Data) inches diameter, From 2 ft to 25 ft** 3rd Interval: **No Data**
Cement/Bentonite	1st Interval: **From 0 ft to 25 ft; Sack(s)/type of cement used: 1-cement**

Plugs Placed in Well:	2nd Interval: **No Data** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**

Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking #**94067**) 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 #94068

Owner:	**City Of Houston Geo Dept**	Owner Well #:	**B-27**
Address:	**611 Walker Houston , TX 77002**	Grid #:	**65-13-4**
Well Location:	**Roadw way Lynnview Dr Houston , TX**	Latitude:	**29° 48' 18" N**
Well County:	**Harris**	Longitude:	**095° 29' 19" W**
		GPS Brand Used:	**Magellan**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Jaime Vasquez**
Driller's License Number of Original Well Driller:	**58171**
Date Well Drilled:	**1/23/2014**
Well Report Tracking Number:	**357124**
Diameter of Borehole:	**4 inches**
Total Depth of Borehole:	**25' feet**

Date Well Plugged:	**4/14/2014**
Person Actually Performing Plugging Operation:	**Jaime Vasquez**
License Number of Plugging Operator:	**58171**
Plugging Method:	**Pour in 3/8 bentonite chips when standing water in well is less than 100 feet in depth, cement top 2 feet.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **2 inches diameter, From 0 ft to 2 ft** 2nd Interval: **(No Data) inches diameter, From 2 ft to 25 ft** 3rd Interval: **No Data**
Cement/Bentonite	1st Interval: **From 0 ft to 25 ft; Sack(s)/type of cement used: 1-cement**

Plugs Placed in Well:	2nd Interval: **No Data** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**

Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Envirotech Drilling Services** **2718 South Brompton Drive** **Pearland , TX 77584**
Plug Installer License Number:	**58171**
Licensed Plug Installer Signature:	**Jaime Vasquez**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking #**94068**) on your written request.

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

APPENDIX 3

BORING LOGS AND KEY TO LOG TERMS AND SYMBOLS

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-1 (PZ-1)

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/21/2014

SURFACE ELEVATION: 78.58

LOCATION

Voque Dr

Northing: 13859695.53
Easting: 3080294.95

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LL	PL	PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0		7.5" Asphalt												
		8" Crushed shell base												
		Lean Clay with Sand (CL), stiff, high plasticity, light gray and tan	1.5						19					
			1.5						20	49	19	30	73	
5			2.0						22					
	CL	..with calcareous nodules below 6'	2.0						18					
		..very stiff with ferrous nodules below 8'	2.5						18	49	19	30	78	
10			2.75						18					
		Fat Clay with Sand (CH), firm, very high plasticity, light gray and tan (slickensided)	2.0		89	0.7		0	35	76	23	53		
15	CH	..very stiff with ferrous nodules below 14'	4.5		112	2.05		10	19					
			3.75						21					
		Lean Clay with Sand (CL), very stiff, high plasticity, light gray and tan	4.0						18	40	17	23		
20	CL													
		..firm below 23'	1.5						22					
25														

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: 25', After Drilling Water Level: 21', 24 hrs Water Level: 12', 7 days Water Level: 12', 30 days Water Level: 10.5'

Sample Key: ☒ SPT ☒ Shelby Tube ☒ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25'; PZ water level: 12' (01/22/2014); PZ water level: 12' (01/31/2014); PZ water level: 10.5' (02/25/2014) Drilled By: Soltek,LLC , Logged By: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-2

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/16/2014

SURFACE ELEVATION: 78.06

LOCATION

Voque Dr

Northing: 13859717.46
Easting: 3080853.65

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LL	PL	PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0		7" Asphalt												
		5" Crushed shell base												
	CL	Sandy Lean Clay (CL), stiff, medium plasticity, light gray and tan	2.0						18	30	16	14	65	
			1.5						20					
		Fat Clay with Sand (CH), firm, high plasticity, light gray and tan	2.5						18					
5		..very stiff below 4'												
		..with calcareous nodules below 6'	3.5						17					
		..firm to stiff with ferrous nodules below 8'	2.0		113	0.6		0	17					
10		..stiff to very stiff, very high plasticity below 10'	3.5						20	62	21	41	78	
	CH		3.75						24					
			3.0						20					
15			4.0		105	1.07		11	23					
		..reddish brown below 18'	3.75						23					
20														
	CL	Sandy Lean Clay (CL), very stiff, high plasticity, reddish brown and light gray with calcareous nodules	3.5						20	45	18	27		
25														

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☐ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-3

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/16/2014

SURFACE ELEVATION: 78.21

LOCATION

Voque Dr

Northing: 13859738.57
Easting: 3081336.54

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)
0		8" Asphalt										
		5" Crushed shell base										
	CL	Sandy Lean Clay (CL), medium plasticity, light gray and tan	1.75					13	41	17	24	
								18	50	19	31	71
		Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	2.5									
5		..with calcareous nodules below 4'						14				
			3.0					16				
		..with ferrous nodules below 6'										
			3.5					15				
10			3.5	113	1.35		0	18				
	CH		4.0					18	54	19	35	81
			3.5					18				
15												
		..stiff, reddish brown below 16' (slickensided)	2.5	106	0.9		11	20				
		..hard, very high plasticity below 18'	4.5					21	65	21	44	
20												
		Sandy Lean Clay (CL), stiff, high plasticity, light gray and tan	2.0					22				
	CL											
25												

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☒ Shelby Tube ☒ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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Houston, Texas-77054

LOG OF BORING B-4

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/17/2014

SURFACE ELEVATION: 78.17

LOCATION

Cedel Dr

Northing: 13859481.16
Easting: 3080034.74

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LL	PL	PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0		4" Asphalt												
		6" Concrete												
		Lean Clay with Sand (CL), soft, high plasticity, light gray and tan	0.5						22					
			0.5						22	46	18	28	72	
5	CL	..firm with ferrous nodules below 4'	1.0						22					
		..with sand seams below 6'	1.0						20					
		Sandy Fat Clay (CH), stiff, high plasticity, light gray and tan	1.75						24	56	20	36	70	
10		..very stiff below 10'	2.75						20					
		..with ferrrous nodules below 12'	4.0						18					
			3.5		107	1.36		10	19					
15	CH	..with slickensided layers below 16'	4.0		113	1.65		0	18					
		..very high plasticity, reddish brown below 18'	4.0						23	63	21	42		
20														
		..light gray and tan below 23'	2.75						28					
25														

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☐ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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Houston, Texas-77054

LOG OF BORING B-5

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/20/2014

SURFACE ELEVATION: 77.36

LOCATION

Cedel Dr

Northing: 13859538.21
Easting: 3080633.41

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		4" Asphalt											
		6" Concrete											
	CL	Lean Clay with Sand (CL), firm, high plasticity, light gray and tan	1.5						20				
			1.5						17				
		..very stiff with calcareous nodules below 4'	3.75						16	47	18	29	74
5		..stiff with sand seams below 6'	2.0						22				
		..with ferrous nodules below 8'	2.75						29				
10			3.0						18				
			3.0						18	48	18	30	78
	CH	Fat Clay with Sand (CH), firm, high plasticity, light gray and tan (slickensided)	2.0		106	0.9		0	22	58	20	38	
15		..very stiff, reddish brown below 16'	4.0						25				
		..stiff to very stiff with calcareous nodules below 18'	4.0		105	1.64		13	23				
20													
	CL	Lean Clay with Sand (CL), firm, medium plasticity, light gray and tan	1.0						26	32	16	16	
25													

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: 23', After Drilling Water Level: 18'

Sample Key: ☒ SPT ☒ Shelby Tube ☒ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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Houston, Texas-77054

LOG OF BORING B-6

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/20/2014

SURFACE ELEVATION: 77.77

LOCATION

Cedel Dr

Northing: 13859571.97
Easting: 3081145.83

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		3.5" Asphalt 5" Concrete											
	CH	Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	2.0						20	54	19	35	71
			1.75						20				
5		..with ferrous nodules below 4'	2.0						18				
		..very stiff below 6'	3.0						19				
			3.5						21				
10		..with calcareous nodules below 10'	4.0						19	55	20	35	74
			4.0						17				
		..stiff to very stiff below 13'											
		..with slickensided layers below 14'	4.0		101	1.85		0	21				
15		..reddish brown below 16'	2.0		95	0.88		11	25				
		..very high plasticity below 18'	3.5						21	68	22	46	
20													
			2.5						26				
25													

N (blows/ft) 20 40 60 80
Q_u (tsf) 1.0 2.0 3.0 4.0
DD (pcf) 90 100 110 120
P (tsf) 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
20 40 60 80

ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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LOG OF BORING B-7

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/20/2014

SURFACE ELEVATION: 77.13

LOCATION

Cedel Dr

Northing: 13859585.59
Easting: 3081761.44

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		4.5" Asphalt											
		6" Concrete											
		Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	2.0						18				
		..very stiff below 2'	3.5						19	53	19	34	74
		..with calcareous nodules below 4'	4.0						15				
5		..with ferrous nodules below 6'	3.5						17				
			3.25						21				
10	CH		3.75						20	55	20	35	78
			4.0						19				
15		..stiff to very stiff, reddish brown below 14' (slickensided)	3.0		103	1.07		10	23				
			4.0		107	1.55		0	21				
			4.0						20				
20													
	CL	Lean Clay with Sand (CL), firm, slight plasticity, reddish brown	1.0						21	23	15	8	78
25													

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: 23', After Drilling Water Level: 14.5'

Sample Key: ☒ SPT ☒ Shelby Tube ☒ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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LOG OF BORING B-8 (PZ-2)

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/27/2014

SURFACE ELEVATION: 76.34

LOCATION

Cedel Dr

Northing: 13859606.52
Easting: 3082235.09

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0													
													3" Asphalt
													6" Concrete
		1.5						20	61	21	40	72	Fat Clay with Sand (CH), firm, high plasticity, light gray and tan
		3.75						16					..very stiff with ferrous nodules below 2'
		3.25						17					
5													
		3.0						28					
		4.5						18	50	19	31	75	..hard below 8'
10													
		4.0						17					..stiff to very stiff below 10'
	CH	4.0		111	1.6		0	19					
		3.75						24					..reddish brown below 14'
15													
		2.5		107	1.33		11	25					..with slickensided layers below 16'
		4.0						22	58	20	38	84	..with calcareous nodules below 18'
20													
													..hard below 23'
		4.5						25					
25													

N (blows/ft) 20 40 60 80
Q_u (tsf) 1.0 2.0 3.0 4.0
DD (pcf) 90 100 110 120
P (tsf) 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
20 40 60 80

ATTERBERG LIMITS(%)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: 23', After Drilling Water Level: 14', 24 hrs Water Level: 13', 7 days Water Level: 12.5', 30 days Water Level: 11.5'

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25'; PZ water level: 13' (01/28/2014); PZ water level: 12.5' (02/03/2014); PZ water level: 11.5' (02/25/2014) Drilled By: Soltek,LLC , Logged By: PV, Checked By: Jitu/John, QC/QA By: PST

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Houston, Texas-77054

LOG OF BORING B-9

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/20/2014

SURFACE ELEVATION: 77.37

LOCATION

Cedel Dr

Northing: 13859625.18
Easting: 3082683.34

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0		3.5" Asphalt												
		7" Concrete												
		Sandy Lean Clay (CL), very stiff, high plasticity, light gray and tan	3.75						16					
			3.0						16					
			4.0						14	49	19	30	70	
5	CL	..with calcareous nodules below 6'	3.25						15					
		..with ferrous nodules below 8'	4.0						17					
10		..hard below 10'	4.5						16					
		Fat Clay (CH), hard, very high plasticity, light gray and tan	4.5						22	65	21	44	88	
		..stiff to very stiff with ferrous nodules below 14'	4.0		108	1.85		0	21					
15		..firm to stiff, reddish brown with calcareous nodules below 16' (slickensided)	2.0		103	0.95		11	21					
	CH	..hard below 18'	4.5						22					
20														
		..very stiff below 23'	3.5						24	75	23	52		
25														

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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Houston, Texas-77054

LOG OF BORING B-10

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/17/2014

SURFACE ELEVATION: 77.09

LOCATION

Restridge Dr

Northing: 13859285.68
Easting: 3080321.86

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				2" Asphalt												
				6" Concrete												
				Sandy Lean Clay (CL), very stiff, high plasticity, light gray and tan	3.0						17	48	18	30	68	
				..with calcareous nodules below 2'	4.0						15					
				..with ferrous nodules below 4'	3.5						13					
5		CL			4.0						14					
				..hard below 8'	4.5						17					
10				Sandy Fat Clay (CH), hard, high plasticity, light gray and tan	4.5						18	52	19	33	69	
				..reddish brown below 12'	4.5						22					
				..stiff to very stiff below 14' (slickensided)	2.0		104	0.94		10	26					
15		CH			3.5		106	1		0	22					
					2.5						24					
20																
				Sandy Lean Clay (CL), firm, medium plasticity, reddish brown	1.0						23	30	16	14	69	
25		CL														

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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Houston, Texas-77054

LOG OF BORING B-11

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/21/2014

SURFACE ELEVATION: 76.59

LOCATION

Ridgecrest Dr

Northing: 13859131.05
Easting: 3080607.56

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		8.5" Concrete											
	CH	Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan	3.25						18				
			4.0						15	54	19	35	71
		..with calcareous nodules below 4'	4.0						15				
5			3.5						18				
			2.75						19				
10		..with ferrous nodules below 10'	4.0						16				
			3.5						17	51	19	32	76
15		..stiff to very stiff below 14'	3.5		104	1.2		0	21				
		..stiff below 16'	2.0		102	0.78		11	25				
		..reddish brown below 18'	2.0						21				
20	CL	Lean Clay (CL), soft, medium plasticity, reddish brown (wet)											
			0.5						24	27	15	12	91
25													

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

ATTERBERG LIMITS(%)

ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: 23', After Drilling Water Level: 17'

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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Houston, Texas-77054

LOG OF BORING B-12

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/22/2014

SURFACE ELEVATION: 76.46

LOCATION

Turquoise Ln

Northing: 13859282.61
Easting: 3081163.21

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	PASSING #200 SIEVE (%)
0		1.5" Asphalt; 5" Concrete											
		Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	1.75						22	55	20	35	71
		..stiff to very stiff below 2'	2.5						19				
5			3.0						16				
		..reddish brown with calcareous nodules below 6'	4.0						27				
			2.75						24				
10	CH	..light gray and tan below 10'	3.25						20	54	19	35	78
		..with ferrous nodules below 12'	3.5						21				
		..reddish brown below 14'	4.0						18				
15		..with slickensided layers below 16'	4.0		106	1.65		11	23				
			4.0		110	1.65		0	21	59	20	39	
20	CL	Sandy Lean Clay (CL), firm, slight plasticity, reddish brown	1.0						23	25	15	10	
25													

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: 23', After Drilling Water Level: 18'

Sample Key: ☒ SPT ☐ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-13

DATE: 01/21/2014

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

SURFACE ELEVATION: 75.58

LOCATION

Spenwick Dr

Northing: 13859089.31
Easting: 3081639.86

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		2" Asphalt 4.5" Concrete	1.5						24				
		Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	3.5						14	51	19	32	73
		..very stiff with ferrous nodules below 2'											
		..hard below 4'	4.5						11				
5		..light gray and tan below 6'	4.5						25				
			4.5						15				
10	CH		4.5						17				
		..stiff to very stiff, very high plasticity with calcareous nodules below 12'	3.75						23	63	21	42	85
15			3.5		107	1.05		0	21				
			4.0						18				
			2.0		107	1.36		12	20				
20													
	CL	Lean Clay with Sand (CL), firm, medium plasticity, light gray and tan	1.0						21	34	16	18	77
25													

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: 20', After Drilling Water Level: 18'

Sample Key: ☒ SPT ☒ Shelby Tube ☒ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-14

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/20/2014

SURFACE ELEVATION: 76.74

LOCATION

Turquoise Ln

Northing: 13859312.41
Easting: 3081884.27

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LL	PL	PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				2.5" Asphalt 4.5" Concrete	2.0						19	51	19	32	74	
				Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan ..with ferrous nodules below 2'	1.5						19					
				..with calcareous nodules below 4'	1.5						24					
5					1.5						28					
				..stiff to very stiff below 8'	3.5						17					
10		CH			4.0						17	52	19	33	71	
					4.0						18					
					4.0		110	1.45		0	19					
15				..with slickensided layers below 16'	3.75		107	1.05		11	21					
				..hard, very high plasticity, reddish brown below 18'	4.5						24	66	21	45		
20																
		CL		Sandy Lean Clay (CL), very stiff, medium plasticity, reddish brown	3.0						23	37	17	20		
25																

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☒ Shelby Tube ☒ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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Houston, Texas-77054

LOG OF BORING B-15

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/20/2014

SURFACE ELEVATION: 76.88

LOCATION

Turquoise Ln

Northing: 13859332.84
Easting: 3082363.38

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LL	PL	PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0		2" Asphalt 5" Concrete	2.0						19					
		Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	1.75						20					
5		..with ferrous nodules below 4'	1.75						18	50	19	31	73	
			2.0						26					
		..very stiff below 8'	3.5						20					
10		..with calcareous nodules below 10'	3.5						19					
	CH		4.0						19	59	20	39	80	
15		..firm to stiff below 14' (slickensided)	2.0		108	0.9		0	21					
		..stiff to very stiff, reddish brown below 16'	4.5		107	2.03		11	22					
			4.0						22					
20														
		..very high plasticity below 23'	3.0						21	65	21	44		
25														

N (blows/ft) 20 40 60 80
Q_u (tsf) 1.0 2.0 3.0 4.0
DD (pcf) 90 100 110 120
P (tsf) 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
20 40 60 80

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☐ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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Houston, Texas-77054

LOG OF BORING B-16

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/22/2014

SURFACE ELEVATION: 75.76

LOCATION

Delery Dr

Northing: 13859084.42
Easting: 3082763.47

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	Material Description	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		6" Concrete											
	CH	Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan	3.75						16				
		..hard below 2'	4.5						14	50	19	31	71
5		..with ferrous nodules below 4'	4.5						15				
			4.5						22				
			4.5						14				
10		..very high plasticity below 10'	4.5						14	63	21	42	77
			4.5		113	2.15		0	18				
15		..stiff to very stiff with calcareous nodules below 14'	3.25						23				
		..reddish brown below 16'	3.0		113	1.38		11	16				
		Lean Clay (CL), stiff, high plasticity, light gray and tan	2.5						20	49	19	30	87
20	CL												
		..firm below 23'	1.0						23				
25													

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: 22', After Drilling Water Level: 20.5'

Sample Key: ☒ SPT ☐ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-17

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/22/2014

SURFACE ELEVATION: 75.63

LOCATION

Shortpoint St

Northing: 13858818.64
Easting: 3082485.84

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		2" Asphalt 4" Concrete											
	CH	Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan ..very stiff below 2'	1.75 2.5						24 19				
5		..with calcareous nodules below 6'	3.75 3.5						15 28	51	19	32	72
		..stiff with ferrous nodules below 8'	2.0						22				
10		..hard below 12'	2.0 4.5						16 17				
15		..stiff to very stiff below 16' (slickensided)	4.5 4.0		104	1.5		0	20 23	51	19	32	83
		..stiff, reddish brown below 18'	3.0		103	1.34		12	24				
20													
			2.75						25	60	20	40	
25													

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: 23', After Drilling Water Level: 19'

Sample Key: ☒ SPT ▨ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-18 (PZ-3)

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/23/2014

SURFACE ELEVATION: 78.08

LOCATION

Glosridge Dr

Northing: 13857956.42
Easting: 3078971.8

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	Material Description	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		4" Asphalt											
		5" Concrete											
		Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan	3.0						20				
		..with calcareous nodules below 2'	4.0						19	60	20	40	71
		..with ferrous nodules below 4'	3.0						19				
5			4.0						30				
		..reddish brown below 8'	4.0						30				
10		..stiff to very stiff, light gray and tan below 10'	3.5						19	55	20	35	83
	CH		4.0		118	1.5		0	17				
		..hard below 14'	4.5						16				
15		..stiff to very stiff below 16'	4.0		110	1.73		11	18				
		..reddish brown below 18'	4.0						21	59	20	39	
20													
			3.5						20				
25													

N (blows/ft): 20 40 60 80
Q_u (tsf): 1.0 2.0 3.0 4.0
DD (pcf): 90 100 110 120
P (tsf): 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit; 20 40 60 80

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry, 24 hrs Water Level: 24', 7 days Water Level: 23.5', 30 days Water Level: 13.5'

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25'; PZ water level: 24' (01/24/2014); PZ water level: 23.5' (01/31/2014); PZ water level: 13.5' (02/25/2014) Drilled By: Soltek,LLC , Logged By: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-19

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/16/2014

SURFACE ELEVATION: 77.23

LOCATION

Glosridge Dr

Northing: 13857406.05
Easting: 3078985.88

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		3.5" Asphalt											
		5" Concrete											
		Fat Clay with Sand (CH), high plasticity, light gray and tan	4.0						17	50	19	31	72
		..very stiff with ferrous nodules below 2'							16				
		..with calcareous nodules below 4'	3.75						20				
5		..light gray and tan below 6'	3.25						21				
		..reddish brown below 8'	4.0						29				
10	CH	..very high plasticity below 10'	3.5						26	78	23	55	84
			3.0						26				
		..light gray and tan below 14'	4.5		116	2.25		0	16				
15			4.0						22				
			3.5		113	1.43		12	17				
20													
	CL	Lean Clay with Sand (CL), stiff, medium plasticity, light gray and tan	2.0						20	29	15	14	74
25													

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☒ Shelby Tube ☒ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-20

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/16/2014

SURFACE ELEVATION: 76.26

LOCATION

Glosridge Dr

Northing: 13856843.28
Easting: 3079000.42

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	Material Description	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		3.5" Asphalt											
		10" Cement treated crushed limestone											
		Fat Clay with Sand (CH), stiff to very stiff, high plasticity, light gray and tan	3.0						33				
									17				
5		..with calcareous nodules below 4'	1.75						20	57	20	37	71
		..reddish brown below 6'	2.0						27				
			1.75						33				
10	CH	..light gray and tan below 10'	3.5		110	1.45		0	20				
		..with ferrous nodules below 12'	3.75						16	50	19	31	82
		..reddish brown below 14'	3.5		103	1.24		10	24				
15			4.0						22				
		Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	3.75						19	33	16	17	67
20	CL												
		..reddish brown below 23'	4.0						20				
25													

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-21

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/16/2014

SURFACE ELEVATION: 77.81

LOCATION

Norcrest Dr

Northing: 13858002.06
Easting: 3079281.15

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	Material Description	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		4.5" Asphalt											
		10" Cement treated crushed limestone											
	CH	Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan	3.75						17	50	19	31	72
		..hard below 2'	4.5						16				
5		..with calcareous nodules below 4'	4.5						14				
		..with ferrous nodules below 6'	4.5						14				
		..very high plasticity below 8'	4.5						23	99	27	72	83
10		..redddish brown below 10'	4.5						23				
		..stiff to very stiff below 12' (slickensided)	4.0		110	1.55		0	21				
		..hard below 14'	4.5						16				
15		..stiff to very stiff, high plasticity below 16' (slickensided)	4.0		113	1.47		11	17	60	20	40	84
		..hard below 18'	4.5						19				
20													
		..very stiff below 23'	4.0						22				
25													

N (blows/ft) 20 40 60 80
Q_u (tsf) 1.0 2.0 3.0 4.0
DD (pcf) 90 100 110 120
P (tsf) 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
20 40 60 80

ATTERBERG LIMITS(%): LL, PL, PI

ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-22

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/16/2014

SURFACE ELEVATION: 77.21

LOCATION

Norcrest Dr

Northing: 13857381.12
Easting: 3079296.45

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	Material Description	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		3.5" Asphalt											
		4.5" Concrete											
	CL	Sandy Lean Clay (CL), stiff, high plasticity, light gray and tan	2.0						22				
		..with ferrous nodules below 2'	1.75						17	46	18	28	63
5			2.0						18				
		..very stiff with calcareous nodules below 6'	3.0						16				
		..stiff below 8'	2.0						15				
10	SM	Silty Sand (SM), medium dense, non plastic, light gray and tan		17					8				
	CH	Fat Clay (CH), very stiff, very high plasticity, light gray and tan	4.0						21	67	21	46	87
		..stiff to very stiff with ferrous nodules below 14'	4.0		114	1.5		0	17				
15		..with slickensided layers below 16'	3.75		96	1.13		11	30				
		..reddish brown below 18'	4.0						23				
20													
		..hard below 23'	4.5						20	62	21	41	99
25													

N (blows/ft) 20 40 60 80
Q_u (tsf) 1.0 2.0 3.0 4.0
DD (pcf) 90 100 110 120
P (tsf) 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
20 40 60 80

ATTERBERG LIMITS(%)

ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☐ Shelby Tube ☐ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-23

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/16/2014

SURFACE ELEVATION: 76.18

LOCATION

Norcrest Dr

Northing: 13856871.57
Easting: 3079323

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		4" Asphalt										
		5" Cement treated crushed limestone										
		Sandy Fat Clay (CH), high plasticity, light gray and tan	4.0					21				
		..very stiff below 2'						20				
		..hard with calcareous nodules below 4'	4.5					13	56	20	36	66
5	CH		4.5					14				
			4.5					23				
10		..stiff below 10' (slickensided)	2.0	103	0.95		0	24				
		Lean Clay with Sand (CL), stiff to very stiff, medium plasticity, light gray and tan	4.0					17	37	17	20	76
15			3.0	114	1.45		10	17				
			2.75					18				
	CL	..very stiff, high plasticity with ferrous nodules below 18'	4.0					18	48	18	30	
20												
		..with calcareous nodules below 23'	3.5					24				
25												

N (blows/ft) 20 40 60 80
Q_u (tsf) 1.0 2.0 3.0 4.0
DD (pcf) 90 100 110 120
P (tsf) 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
20 40 60 80

ATTERBERG LIMITS(%)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼
Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☐ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-24

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/16/2014

SURFACE ELEVATION: 76.68

LOCATION

Lynnview Dr

Northing: 13858054.77
Easting: 3080813.61

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0		4.5" Asphalt												
		4" Cement treated crushed limestone												
	CH	Fat Clay with Sand (CH), stiff to very stiff, high plasticity, light gray and tan	3.0						18	56	20	36	71	
			2.5						17					
5		..with ferrous nodules below 4'	3.0						15					
		..with calcareous nodules below 6'	3.5						18					
		..very high plasticity below 8'	2.75						27	70	22	48	84	
10		..very stiff below 10'	4.5						15					
			4.5		118	2.5		8	15					
			4.5						15					
15														
		..firm to stiff, reddish brown below 16' (slickensided)	2.0		102	0.9		0	24					
		..very stiff below 18'	3.5						29					
20		Lean Clay (CL), very stiff, medium plasticity, light gray and tan												
	CL		4.0						21	34	16	18	95	
25														

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☐ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

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Houston, Texas-77054

LOG OF BORING B-25

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/17/2014

SURFACE ELEVATION: 75.90

LOCATION

Lynnview Dr

Northing: 13857463.83
Easting: 3080837.6

MATERIAL DESCRIPTION

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)
0		3.5" Asphalt											
		5.5" Concrete											
		2.5" Sand base											
	CH	Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan	3.0						14				
		..hard below 2'	4.5						15	51	19	32	71
5		..with calcareous nodules below 4'	4.5						14				
			4.5						20				
			4.5						25				
10		..with ferrous nodules below 10'	4.5						19	52	19	33	81
			4.5						15				
		..stiff to very stiff below 14'	4.0		115	1.6		10	16				
15		..firm to stiff below 16'	2.0		105	0.9		0	22				
			2.0						24	54	19	35	
20	SM	Silty Sand (SM), medium dense, non plastic, light gray and tan		27					20				27
25													

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: 23', After Drilling Water Level: 17'

Sample Key: ☒ SPT ☐ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-26

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/17/2014

SURFACE ELEVATION: 75.75

LOCATION

Lynnview Dr

Northing: 13856953.99
Easting: 3080860.18

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0		7.5" Concrete												
		4" Crushed gravel base	4.0						16					
		Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan	4.5						13					
		..hard with calcareous nodules below 2'												
		..with ferrous nodules below 4'	4.5						15	58	20	38	73	
5	CH													
			4.5						14					
		..reddish brown below 8'	4.5						28					
10		Lean Clay (CL), very stiff, high plasticity, light gray and tan	4.0						12					
	CL		4.0						13	40	17	23	86	
		Fat Clay with Sand (CH), stiff to very stiff, very high plasticity, light gray and tan (slickensided)	3.5		106	1.05		0	22					
15			4.0						25					
		..with ferrous nodules below 18'	4.0		107	1.35		12	21					
20	CH													
			3.5						28	84	24	60		
25														

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry

Sample Key: ☒ SPT ☒ Shelby Tube ☒ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-27 (PZ-4)

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/23/2014

SURFACE ELEVATION: 72.12

LOCATION

Lynnview Dr

Northing: 13856288.13
Easting: 3080889.19

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0		7" Concrete												
		8" Lime stabilized soil base												
		Sandy Lean Clay (CL), stiff to very stiff, high plasticity, light gray and tan	4.0						16	47	18	29	63	
			2.75						17					
		..with ferrous nodules below 4'	3.25						19					
5	CL	..with calcareous nodules below 6'	3.75						20					
		..hard below 8'	4.5						17					
10		Fat Clay (CH), very stiff to hard, high plasticity, light gray and tan	4.5						20	61	21	40	92	
		..reddish brown below 12'	4.5						21					
			4.5		105	2.05		0	24					
15		..stiff to very stiff with ferrous nodules below 16' (slickensided)	3.0		93	1.13		11	32					
	CH	..very high plasticity below 18'	3.75						34	92	25	67		
20														
		..with calcareous nodules below 23'	4.0						27					
25														

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: Dry, After Drilling Water Level: Dry, 24 hrs Water Level: 18', 7 days Water Level: 18', 30 days Water Level: 17.5'

Sample Key: ☒ SPT ☒ Shelby Tube ☒ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25'; PZ water level: 18' (01/24/2014); PZ water level: 18' (01/31/2014); PZ water level: 17.5' (02/25/2014) Drilled By: Soltek,LLC , Logged By: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-28

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/22/2014

SURFACE ELEVATION: 68.03

LOCATION

Waterbury Dr

Northing: 13854888.74
Easting: 3079861.58

DEPTH (ft.)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0				2" Asphalt												
				8" Cement treated crushed limestone	4.0						14					
				Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	3.25						13	34	16	18	66	
				..with calcareous nodules below 2'												
				..with ferrous nodules below 4'	4.0						15					
5		CL														
				..stiff below 6'	1.75						21					
					2.0						22					
10				Fat Clay with Sand (CH), stiff to very stiff, high plasticity, light gray and tan	3.0						19	52	19	33	73	
				..with calcareous nodules below 12'	4.0						15					
		CH														
15					3.5		113	1.15		0	19					
				Sandy Lean Clay (CL), stiff to very stiff, high plasticity, light gray and tan	2.5		115	1.03		11	17	48	18	30		
				..firm below 18'	1.0						19					
20		CL														
				Silty Sand (SM), medium dense, non plastic, light gray and tan (wet)		12					20				15	
25		SM														

Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: 20', After Drilling Water Level: 17.5'

Sample Key: ☒ SPT ☐ Shelby Tube ▤ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

Associated Testing Laboratories, Inc.
3143 Yellowstone Blvd
Houston, Texas-77054

LOG OF BORING B-29

PROJECT: Neighborhood Street Rehabilitation-Project 464 Springdale (Sec.1&2) & Restridge (Sec.1&5) Subdivision WBS No. N-000397-0001-3

PROJECT NO.: G14-101 BORING TYPE: Auger

DATE: 01/22/2014

SURFACE ELEVATION: 68.64

LOCATION

Waterbury Dr

Northing: 13854907.89
Easting: 3080456.72

DEPTH (ft.)	USC	MATERIAL DESCRIPTION	POCKET PENETROMETER(P,tsf)	BLOW COUNT (N, Blows/Foot)	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
0		2" Asphalt												
		9" Concrete												
		10" Lime stabilized soil base	4.0						12					
		Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan	3.75						14					
		..with calcareous nodules below 2'	3.0						17	53	19	34	76	
5		..with ferrous nodules below 4'												
	CH	..stiff below 6'	2.0						27					
		..firm below 8'	1.5						21					
10		..very stiff below 10'	3.5						22					
		Lean Clay with Sand (CL), very stiff, high plasticity, light gray and tan	3.5						13	38	17	21	74	
		..stiff below 14'	2.0		115	0.9		0	16					
15		..very stiff below 16'	4.0						17	46	18	28		
	CL	..firm below 18'	1.0		110	0.46		12	18					
20														
	SM	Silty Sand (SM), medium dense, non plastic, light gray and tan		12					18				15	
25														

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20 40 60 80)

Water Level Intial: ▽ After Drilling: ▼ 24 Hrs: ▼

Water Observations: Initial Water Level: 20', After Drilling Water Level: 18.5'

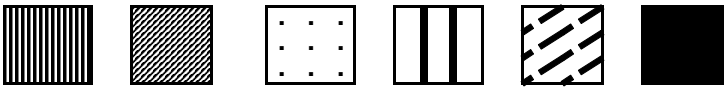
Sample Key: ☒ SPT ☒ Shelby Tube ☒ Disturbed

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (psf)
Q_u - Unconfined Comp. Strength (tsf)
DD - Dry Density (pcf)

Notes:
Augered Dry to 25', Hole Grouted after Drilling. Drilled By: Soltek,LLC , Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST

KEY TO LOG TERMS AND SYMBOLS

SOIL TYPE

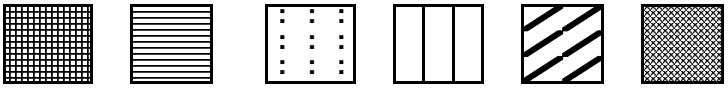


ROCK | GRAVEL | SAND | SILT | CLAY | PEAT

SAMPLER TYPE

NO SAMPLE | AUGER SAMPLE | SHELBY TUBE | SPLIT SPOON

MODIFIER



STONE | GRAVELY | SANDY | SILTY | CLAYEY | FILL

NO RECOVERY | ROCK CORE | 2" SHELBY TUBE | TXDOT CONE

UNIFIED SOIL CLASSIFICATION SYSTEM - ASTM D 2487

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS LESS THAN 50% PASSING No. 200 SIEVE	GRAVEL & GRAVELY SOILS LESS THAN 50% PASSING No.4 SIEVE	CLEAN GRAVELS LITTLE OR NO FINES	GW	WELL GRADEED GRAVELS,GRAVELSAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS,GRAVEL SAND MIXTURES WITH LITTLE OR NO FINES
		W/ APPRECIATEBLE FINES	GM	SILTY GRAVELS,GRAVEL SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS,GRAVEL SAND-CLAY MIXTURES
	SANDS MORE **THAN 50%** PASSING No.4 SIEVE	CLEAN SANDS LITTLE FINES	SW	WELL GRADED SAND,GRAVELY SAND (LITTLE FINES)
			SP	POORLY GRADED SANDS,GRAVELY SAND(L. FINES)
		SANDS WITH APPREA. FINES	SM	SILTY SANDS,SAND-SILT MIXTURES
			SC	CLAYEY SANDS,SAND-CLAY MIXTURES
FINE GRAINED SOILS LESS THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS & VERY FINE SANDS,ROCK FLOUR SILTY OR CLAYEY FINE SANDS OR CLAYEY SILT W/PI
			CL	INORGANIC CLAY OF LOW TO MEDIUM PI LEAN CLAY, GRAVELY CLAYS,SANDY CLAYS,SILTY CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PI
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS,MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY FAT CLAYS
			OH	ORGANIC CLAYS OF MED TO HIGH PI, ORGANIC SILT
HIGHLY ORGANIC SOIL			FT	PEAT AND OTHER HIGHLY ORGANIC SOILS
UNCLASSIFIED FILL MATERIALS			ARTIFICIALLY DEPOSITED AND OTHER UNCLASSIFIED SOILS FILL MATERIALS	

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	UNCONFINED COMP. STRENGTH IN TSF
VERY SOFT	LESS THAN 0.25
SOFT	0.25 TO 0.5
FIRM	0.5 TO 1.0
STIFF	1.0 TO 2.0
VERY STIFF	2.0 TO 4.0
HARD	GREATER THAN 4.0

CONSISTENCY	UNCORR. POCKET PENTROMETER READ.
VERY SOFT	LESS THAN 0.25
SOFT	0.25 TO 0.5
FIRM	> 0.50 TO 1.50
STIFF	> 1.50 TO 3.00
VERY STIFF	> 3.0 TO 4.50
HARD	4.5+

RELATIVE DENSITY - GRANULAR SOILS

CONSISTENCY	N-VALUE (BLOWS PER FT)
VERY LOOSE	<4
LOOSE	5-10
MEDIUM DENSE	11-30
DENSE	31-50
VERY DENSE	>50 OR 50+

CLASSIFICATION OF GRANULAR SOILS

U.S.STANDARD SIEVE SIZE(S)

6"	3"	3/4"	4	10	40	200		
BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		
152	76.2	19.1	4.76	2.0	0.42	0.074	0.002	

GRAIN SIZE IN MM