FINAL
GEOTECHNICAL INVESTIGATION
FOREST COVE III WELL PROJECT
HOUSTON, TEXAS
WBS NO. S-000100-0016-4

SUBMITTED TO
AEI ENGINEERING
616 FM 1960 WEST, SUITE 250
HOUSTON, TX 77090

BY
HVJ ASSOCIATES, INC.
HOUSTON, TEXAS
FEBRUARY 20, 2015

REPORT NO. HG1216881
KEY MAP NO. 336E

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February 20, 2015

Mr. J.T. (Tom) Matkin, P.E.
Vice President
AEI Engineering
616 FM 1960 West, Suite 250
Houston, TX 77090

Re: Geotechnical Investigation
City of Houston Forest Cove III Well Project
Owner: City of Houston
HVJ Project No. HG1216881
WBS No. S-000100-0016-4

Dear Mr. Matkin:

Submitted herein is the final report of our geotechnical investigation for the above referenced project. The study was conducted in general accordance with our proposal number HG1216881 dated October 23, 2012 (Revised April 28, 2014) and is subject to the limitations presented in this report. We appreciate the opportunity of working with you on this project. Please read the entire report and notify us if there are questions concerning this report or if we may be of further assistance.

Sincerely,

HVJ ASSOCIATES, INC.
Texas Firm Registration No. F-000646

STATE OF TEXAS
NISHANT DAYAL
109464
LICENSED
PROFESSIONAL ENGINEER

Nishant Dayal, PE
Project Manager

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ND/SS

Date: 2/20/2015

Copies submitted: 1 (electronic) 2 (hard copies)

The seal appearing on this document was authorized by Nishant Dayal, PE 109464 on February 20, 2014. Alteration of a sealed document without proper notification to the responsible engineer is an offense under the Texas Engineering Practice Act.

- Main Text – 13 pages
- Plates – 5 pages
- Appendix A – 3 pages
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1 EXECUTIVE SUMMARY

The project involves construction of a new water well for the Forest Cove Water System. This will involve construction of foundations for the well pump, and pavement for driveways and access roads. The purpose of our study is to perform a geotechnical investigation and provide design recommendations for the well pump foundation and driveways and access roads pavement. Based on the subsurface conditions obtained by the soil borings, the findings and recommendations of this report are summarized below:

1. Stiff to very stiff cohesive soils and medium dense to dense cohesionless soils were encountered in the boring drilled for this study. Cohesionless soils were encountered from 10 to 16 feet below the existing grade. Cohesive soils encountered at top 10 feet in this site are of low expansion potential. Details of the subsurface stratigraphy encountered in the borings are shown on the boring logs presented in Appendix A.

2. Based on our desktop fault study, faulting is not anticipated to impact the project site. However, unmapped faults may exist near the project site. A detailed fault study is not within the scope of this study.

3. Groundwater was not observed in the boring during drilling operations. The long term ground water study is not within the scope of this study.

4. The soil borings drilled at the site revealed the presence of stiff to very stiff clay layer at the foundation depth. We recommend an allowable bearing capacity of 2,300 psf. The foundation recommendations for the well pump is presented in Section 6 of this report.

5. We recommend using 7" Concrete Pavement over 6" Lime Stabilized Subgrade or 12" Crushed Stone Pavement over 6" Lime Stabilized Subgrade for the design of driveways and access roads. The detailed design is discussed in Section 7 of this report.

Please note that this executive summary does not fully relate our findings and opinions. Those findings and opinions are only presented through our full report.

2 INTRODUCTION

2.1 Project Description

HVJ Associates, Inc. was retained by AEI Engineering to provide geotechnical recommendations for the Forest Cove III Well Project located in northeastern Harris County approximately 2.5 miles northeast of the intersection of FM 1960 and US 59, in Houston, Texas. The project involves construction of a new water well for the Forest Cove Water System. This will involve construction of foundations for the well pump, and pavement for driveways and access roads. The purpose of our study is to perform a geotechnical investigation and provide design recommendations for the well pump foundation and driveways and access roads pavement.

2.2 Geotechnical Investigation Program

The major objectives of this study were to gather information on subsurface conditions at the site and to provide design and construction recommendations for the well pump foundation and driveways and access roads pavement. This investigation was performed in general accordance with the City of Houston Department of Public Works and Engineering Infrastructure Design Manual dated July 2012 and Section 3.2 of Exhibit A of the City of Houston contract. The objectives were accomplished by:

- Drilling one (1) soil boring at the location of proposed water well to determine soil stratigraphy and to obtain samples for laboratory testing.
- Performing laboratory tests to determine physical and engineering characteristics of the soils.
- Performing engineering analyses to develop design guidelines and construction recommendations for the proposed well pump foundation and driveways and access roads pavement.

Subsequent sections of this report contain descriptions of the field exploration, laboratory-testing program, general subsurface conditions, design recommendations, and construction considerations.

3 FIELD INVESTIGATION

3.1 Geotechnical Boring

The field exploration program undertaken at the project site was performed on October 31, 2014. Subsurface conditions were investigated by drilling one (1) soil boring to a depth of 20 feet below the existing grade at the location of proposed water well to determine soil stratigraphy and to obtain samples for laboratory testing.

Borehole was backfilled with cement grout by tremie method in accordance with the City of Houston Guidelines. Approximate boring location is presented on Plate 2 of the report.

3.2 Survey Data

The approximate GPS coordinates and elevation of the boring were provided to us by AEI Engineering and are presented in the boring log in Appendix A.

3.3 Sampling Methods

Soil samples were obtained continuously to the termination depth of the boring. Cohesive soil samples were obtained with a three-inch thin-walled (Shelby) tube sampler in general accordance

with ASTM D-1587 standard. Each sample was removed from the sampler in the field, carefully examined, and then classified. The shear strength of the cohesive soils was estimated by a hand penetrometer in the field. Cohesionless soils were sampled with the split spoon sampler in accordance with ASTM D 1586 standard. Suitable portions of each sample were sealed and packaged for transportation to our laboratory.

Detailed descriptions of the soils encountered in the boring are given on the boring log presented in Appendix A. A key to the soils classification and symbols used in the boring log is also presented in Appendix A.

3.4 Water Level Measurements

Groundwater was measured at the boring location during drilling operations. Groundwater conditions are presented in Section 5.4 of this report.

4 LABORATORY TESTING

Selected soil samples were tested in the laboratory to determine applicable physical and engineering properties. All tests were performed according to the relevant ASTM Standards. These tests consisted of moisture content measurement, percent passing no. 200 sieve, Atterberg limits, unconsolidated undrained compression and unit dry weight tests.

The Atterberg Limits and percent passing number 200 sieve tests were utilized to verify field classification by the Unified Soils Classification System, and the unconsolidated undrained compression tests was performed to obtain the undrained shear strength of the soil. The type and number of tests performed for this investigation are summarized below:

Table 4-1 Type and Number of Test Performed

Type of Test	Number of Tests
Moisture Content (ASTM D2216)	5
Atterberg Limits (ASTM D4318)	4
Percent Passing No. 200 Sieve (ASTM D1140)	4
Unconsolidated Undrained Triaxial (ASTM D2850)	4

The laboratory test results are presented on the boring log in Appendix A. The conversion between pocket penetrometer readings obtained in the field to the shear strength parameters presented in the borings log were obtained using a conversion factor of 1/3. A summary of laboratory test results is provided in Appendix B.

5 SITE CHARACTERIZATION

5.1 General Geology

There are two major surface geological formations that exist in the Greater Houston area: the Beaumont formation and the Lissie formation. The Beaumont formation is a relatively younger formation generally found to the southeast of the Lissie formation. The Beaumont formation dips southeastward and extends beneath beach sand and waters of the Gulf of Mexico as far as the continental shelf. The project site is located in the Beaumont formation. A geologic map is presented on Plate 3.

The Beaumont formation was deposited on land near sea level in flat river deltas and in inter-delta regions. Soil deposition occurred in fresh water streams and in flood plains (as backwater marsh and natural levees). The courses of major streams and deltaic tributaries changed frequently during the

period of deposition, generating within the Beaumont clay a complex stratification of sand, silt and clay deposits. Frequently, stream courses were diverted significant distances from a given point in a backwater marsh, and the water overlying the soil would evaporate since it was cut off from a drainage path. Such water, which would be highly alkaline, would precipitate large nodules of calcium carbonate (calcareous nodules) throughout the surface of evaporation. With the coming of the Second Wisconsin Ice Age, the nearby sea withdrew, leaving the formation several hundred feet above sea level and permitting the soil to desiccate. The process of desiccation compressed the clays in the formation such that they became significantly overconsolidated to a large depth. In addition to preconsolidating the soil, the process of desiccation, together with the later rewetting, produced a network of fissures and slickensides that are now closed but which represent potential planes of weakness in the soil.

5.2 Geologic Faulting

The tectonic history of the Texas Gulf Coast includes a relatively stable depositional cycle since the Cretaceous Period (about 65 million years). During this period the area was subjected to deposition of clays, silts, and sands resulting in over 30 thousand feet of sedimentary rocks. Underlying this clastic sequence are salt formations, which have migrated upwards to produce the typical salt dome features associated with the Texas Gulf Coast. In conjunction with salt movement, dewatering and compaction of some of the deeper sediments in the basin have resulted in the development of growth faults.

A literature review of surface faults near the project area was conducted based on the Bureau of Economic Geology, University of Texas at Austin, Geologic Atlas of Texas Houston Sheet, Paul Weaver Memorial Edition (revised in 1982). The primary objective of this review was to evaluate available information from published and open file reports. Based on our review, project site is located, approximately 8 miles north east of Lee Fault and approximately 6 miles north east of an unnamed fault. It should be noted that the project site is located within the boundary of the Humble Salt Dome. Unmapped faults may exist within the salt dome boundary. Faulting is not anticipated to impact the project site. However, unmapped faults may exist near the project site. A detailed fault study is not within the scope of this study.

5.3 Soil Stratigraphy

HVJ's interpretation of soil and groundwater conditions at the project site is based on information obtained at the boring location only. This information has been used as the basis for our conclusions and recommendations. Significant variations at areas not explored by the project boring may require reevaluation of our findings and conclusions.

Table 5-1 Generalized Soil Profile (Boring B-1)

Stratum	Approximate Elevation, (feet)		Material
	From	To	
I	Surface	10	Stiff to Very Stiff Sandy Lean Clay (CL)
II	10	16	Medium Dense to Dense Silty Sand (SM)
III	16	20	Stiff to Very Stiff Fat Clay (CH)

Details of the subsurface stratigraphy encountered in the boring are shown on the boring log presented in Appendix A.

The Casagrande's Plasticity Chart presented in Figure 5-1 illustrates the range of plasticity of the cohesive soils found during our investigation.

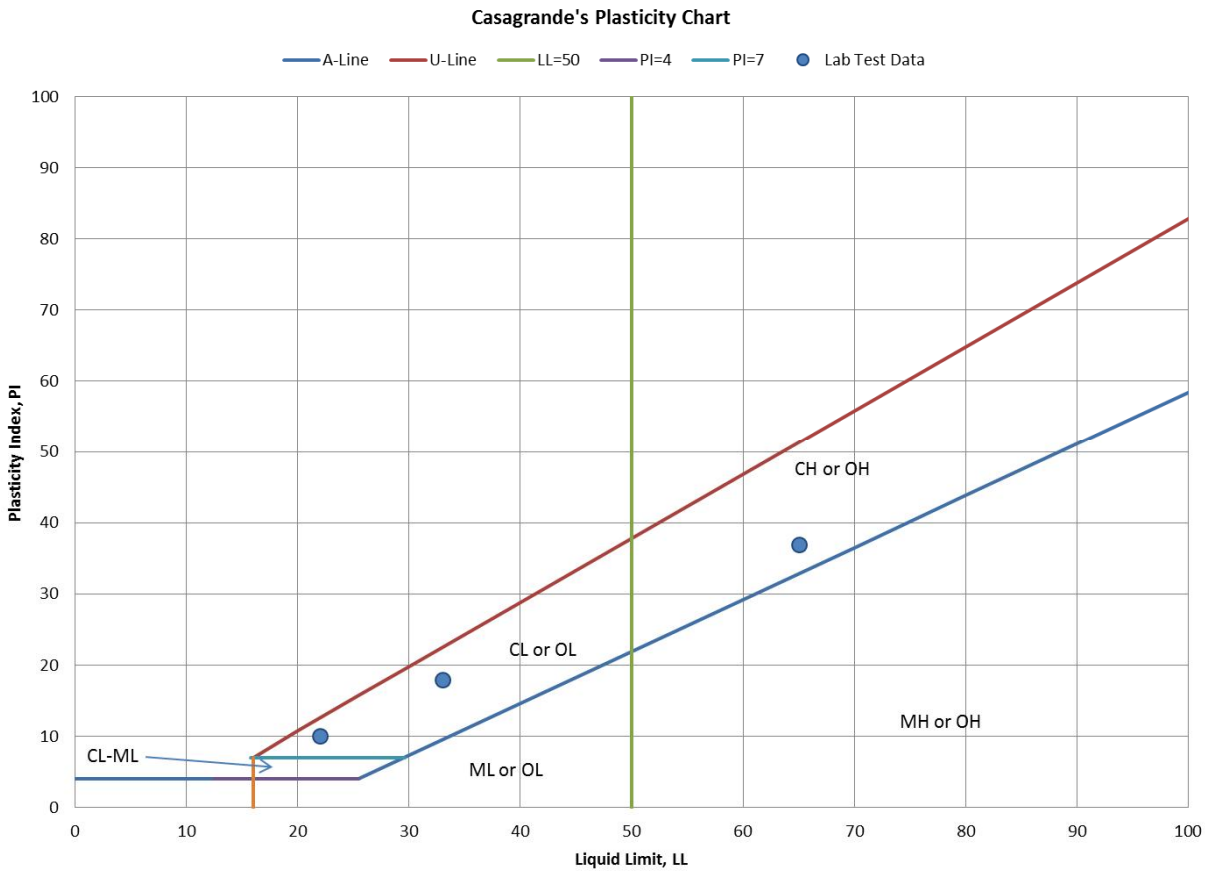


Figure 5-1 Casagrande's Plasticity Chart

5.4 Groundwater Conditions

Groundwater was not observed in boring B-1 during drilling operations.

6 WELL PUMP FOUNDATION RECOMMENDATIONS

6.1 General

This project will involve construction of foundations for the well pump. Based on the information provided by AEI Engineering, square footing placed approximately 1 foot below the existing grade will be used as the foundation system.

6.2 Foundation Recommendations

Foundations for the proposed structure must satisfy two basic design criteria. First, the bearing pressure transmitted by the foundation should not exceed the allowable bearing capacity computed with an adequate factor of safety. Second, foundation movement due to soil volume change must be within desirable limits.

One of the major design factors for lightly loaded structures in the general project area is the shrinking and swelling potential of fine-grained soils. The shrink/swell movements can be estimated

through the use of the Plasticity Index (PI). Generally, the higher the PI of a material, the greater the potential for soil movements during moisture changes. Based on the soil conditions encountered in the boring drilled for this this study, the cohesive soils at top 10 feet in this site are of low expansion potential.

The soil borings drilled at the site revealed the presence of stiff to very stiff sandy lean clay layer at the foundation depth. Based on the properties of this cohesive soil deposit, we recommend an allowable bearing capacity of 2,300 psf, which includes factor of safety of three. This bearing capacity recommendation assumes that the subgrade is relatively dry and undisturbed. The applied bearing pressure may be determined by the following criteria.

1. Summing the load applied to the foundation, the weight of the foundation, and the weight of any soil backfill placed directly above the foundation;
2. Subtracting the weight of soil excavated from above the foundation depth; and
3. Dividing the total by the base area of the foundation.

The subgrade reaction modulus (k) may be required for the structural design analysis. Based on the encountered subgrade material, a reaction modulus value of 125 pounds per cubic inch (Table 4-1, Technical Manual 5-809-12/AFM 88-3, Chapter 15, 1987, US Army) is recommended.

6.3 Settlement

With the indicated allowable bearing pressure and the use of a 2.5-foot thick pad prepared with properly compacted and moisture-conditioned structural fill or existing soil underneath the slab, settlement is expected to be less than one (1) inch.

6.4 Drainage

The owner must take care to maintain good drainage around the structure.

6.5 Subgrade Preparation and Structural Fill

The foundation area should be stripped of all vegetation, topsoil and all deleterious materials. Stripped areas should be appropriately graded and shaped to provide positive drainage. The site should be proof-rolled with heavy equipment to identify any weak spots in the subgrade. Any weak spot, if encountered, should be excavated to firm soil and the excavated soil replaced with select fill. The exposed subgrade should be compacted to 95 percent of the maximum dry density as determined by ASTM D698. In the event of existing grade to be raised, select fill required to raise the grade should consist of lean clay with a liquid limit less than 40 and a plasticity index between 8 and 20. Fill material should be placed in loose lifts not exceeding eight inches and should be compacted to 95 percent of the maximum dry density as determined by ASTM D698. Relatively uniform compaction should be provided.

6.6 Foundation Inspection

We recommend that any fill placed beneath the structures be inspected by an accredited construction materials laboratory to determine compliance with the plasticity and compaction requirements discussed above. HVJ Associates, Inc. would be pleased to provide this service.
It is recommended that slab area be inspected by a person knowledgeable in pad foundation construction to verify that the bearing soils are competent and the bearing area is properly prepared prior to concrete placement.

7 DRIVEWAYS AND ACCESS ROADS RECOMMENDATIONS

7.1 General

We understand that project will involve construction of pavement for driveways and access roads. We understand that existing site has a crushed stone roadway. Based on results of the field and laboratory investigation program for the boring drilled in the vicinity of the well pump (boring B-1) and our experience, the recommendations for rigid and crushed stone pavements are provided below.

7.2 Crushed Stone Roadway Recommendations

The crushed stone road is any paved roadway that is constructed of materials like gravel or crushed aggregate that does not create mud during rainfall. We understand that a crushed stone roadway is considered for the project. The following are discussed in relation to design of the driveways and access roads.

Traffic Load. The crushed stone road is required to support less than 10,000 vehicles during its life. The actual traffic expected on the roadway is not known at the time of writing this report. However, roadway is suitable for trucks weighing up to 72,000 pounds.

Recommended Thickness of Crushed Stone Roadway. The required thickness of the crushed stone roadway can be determined using the following equation derived from Boussinesq theory:

$$Z = \left(\frac{\frac{L}{\prod p}}{\frac{1}{\left(1 - \frac{\prod C}{p}\right)^{2/3}} - 1} \right)^{1/2} + I$$

Where:

Z = Thickness of crushed stone layer (inches)

L = Wheel load (lbs)

p = Average contact pressure from wheel load (psi)

C = Average shear strength of subgrade soil (psi)

I = Additional crushed stone thickness for intrusion into the subgrade layer (inches)

The estimated and/or assumed values for the above parameters are summarized in the following table.

Parameter	Value
Wheel Load, L	16,000 lbs
Average Contact Pressure, p	80 psi
Average Shear Strength of Subgrade, C	16 psi
Additional Aggregate Thickness for Intrusion, I	3 inches

Based on the above parameters, a minimum of 12 inches of crushed stone over 6 inches of lime stabilized subgrade is recommended that will support a 72,000 lbs truck. We recommend that an appropriate drainage system should be provided to drain the surface water as quickly as possible. Providing appropriate drainage system will reduce development of future pavement distress due to softened subgrade. The crushed stone material should meet the requirements of Section 02713 of City of Houston Standard Specifications and should be compacted to 95 percent of the maximum dry density as determined by ASTM D698.

7.3 Rigid Pavement Recommendations

We understand that concrete pavement is considered for the project. We understand that, roadway should be designed for trucks weighing up to 72,000 pounds. Based on the subgrade soils, expected traffic load and our experience, we recommend 7" Concrete Pavement over 6" Lime Stabilized Subgrade.

Reinforcement Steel Requirement. Longitudinal and transverse reinforcement steel is required to resist warping stresses in the rigid pavement section and to hold pavement cracks that develop tightly closed. In addition, reinforcement is required at pavement joints in order to prevent deflections across the joint. Recommendations for reinforcement at pavement joints are described in the AASHTO Pavement Design Manual. The amount of longitudinal and transverse reinforcement required depends on the distance between pavement joints.

7.4 Preparation of Subgrade

Subgrade preparation for the proposed pavement sections should consist of clearing, stripping, proof-rolling and lime stabilization. We recommend the following procedures for subgrade preparation:

- Clear the proposed pavement area. Grubbing operations should be performed to remove root systems of any trees cleared within the limits of the proposed construction.

- Strip the surface soil to suitable depths. In areas where soft, compressible or loose clay soils are encountered, additional stripping may be required. Stripping should extend a minimum of two feet beyond the edge of the proposed pavement.

- Surfaces exposed after stripping should be proof-rolled with heavy equipment, such as a loaded dump truck, to identify any underlying zones or pockets of soft soils and to remove such weak materials. If backfill is required, the fill material should be prepared as described earlier in this report.

Scarify the upper six inches of exposed surface as required, mix with 5% lime and compact it to 95 percent of standard Proctor (ASTM D698). These are preliminary estimates; actual percentage of lime should be confirmed by conducting lime series tests on the exposed subgrade material at the time of construction.

8 DESIGN REVIEW

HVJ should be retained to review the final design plans and specifications for this project to determine whether the geotechnical recommendations have been properly interpreted, and to

confirm that the assumptions made at the time this report was prepared are consistent with the project as finally design.

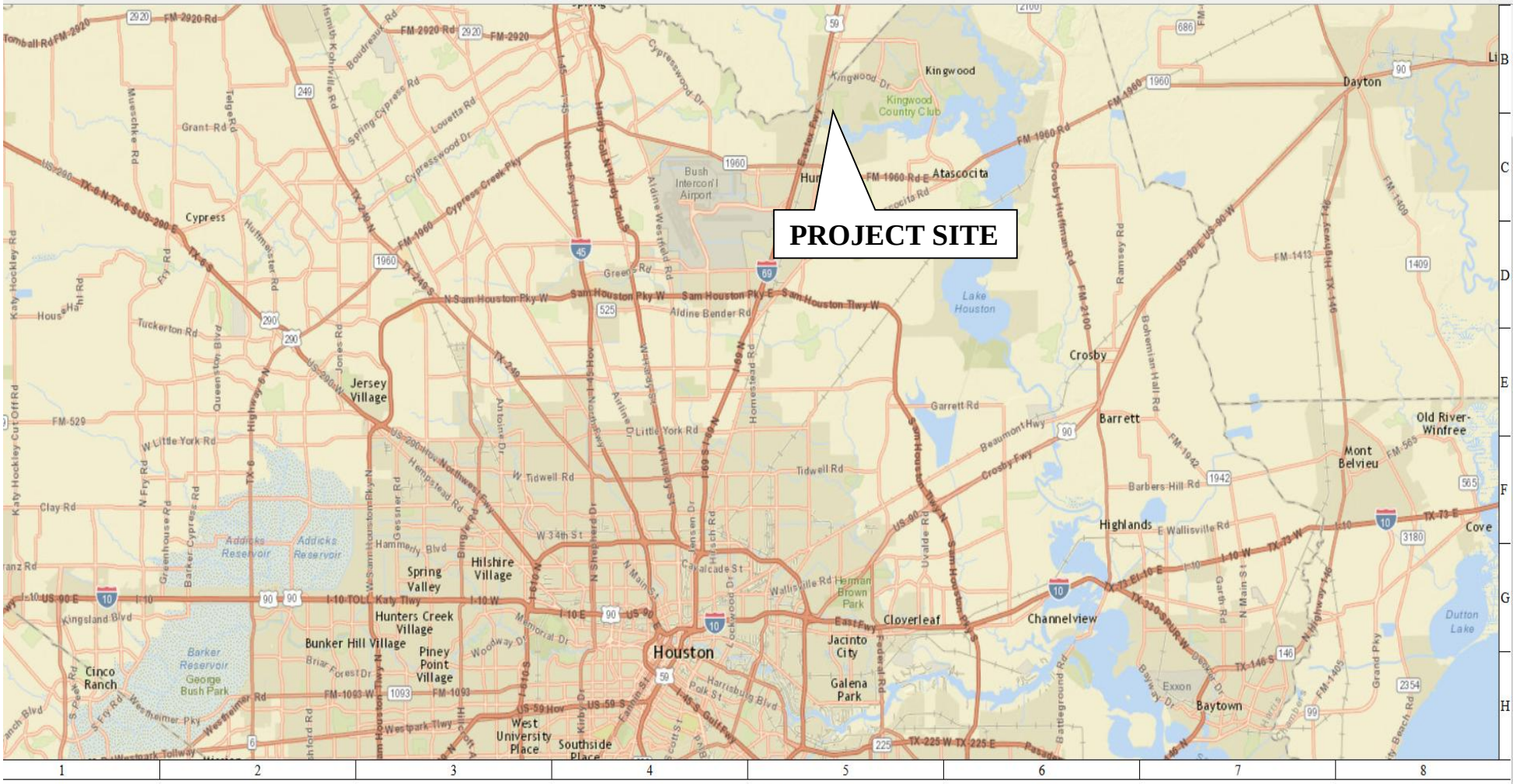
9 LIMITATIONS

This investigation was performed for the exclusive use of AEI Engineering to provide geotechnical recommendations for the Forest Cove III Well Project located in northeastern Harris County approximately 2.5 miles northeast of the intersection of FM 1960 and US 59, in Houston, Texas. HVJ has endeavored to comply with generally accepted geotechnical engineering practice common in the local area. HVJ makes no warranty, express or implied. The analyses and recommendations contained in this report are based on data obtained from subsurface exploration, laboratory testing, the project information provided to us and our experience with similar soils and area conditions. The methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. Should any subsurface conditions other than those described in our boring logs be encountered, HVJ should be immediately notified so that further investigation and supplemental recommendations can be provided.

10 REFERENCES

1. City of Houston Department of Public Works and Engineering (July 2012), "Infrastructure Design Manual".
2. Departments of the Army and the Air Force (August 1987), Technical Manual 5-809-12/AFM 88-3, Chapter 15.

PLATES



CITY OF HOUSTON
Department of Public Works and Engineering
Geographic Information & Management System (GIMS)

1 inch = 5578 feet

DISCLAIMER: THIS MAP REPRESENTS THE BEST INFORMATION AVAILABLE TO THE CITY. THE CITY DOES NOT WARRANT ITS ACCURACY OR COMPLETENESS. FIELD VERIFICATIONS SHOULD BE DONE AS NECESSARY.

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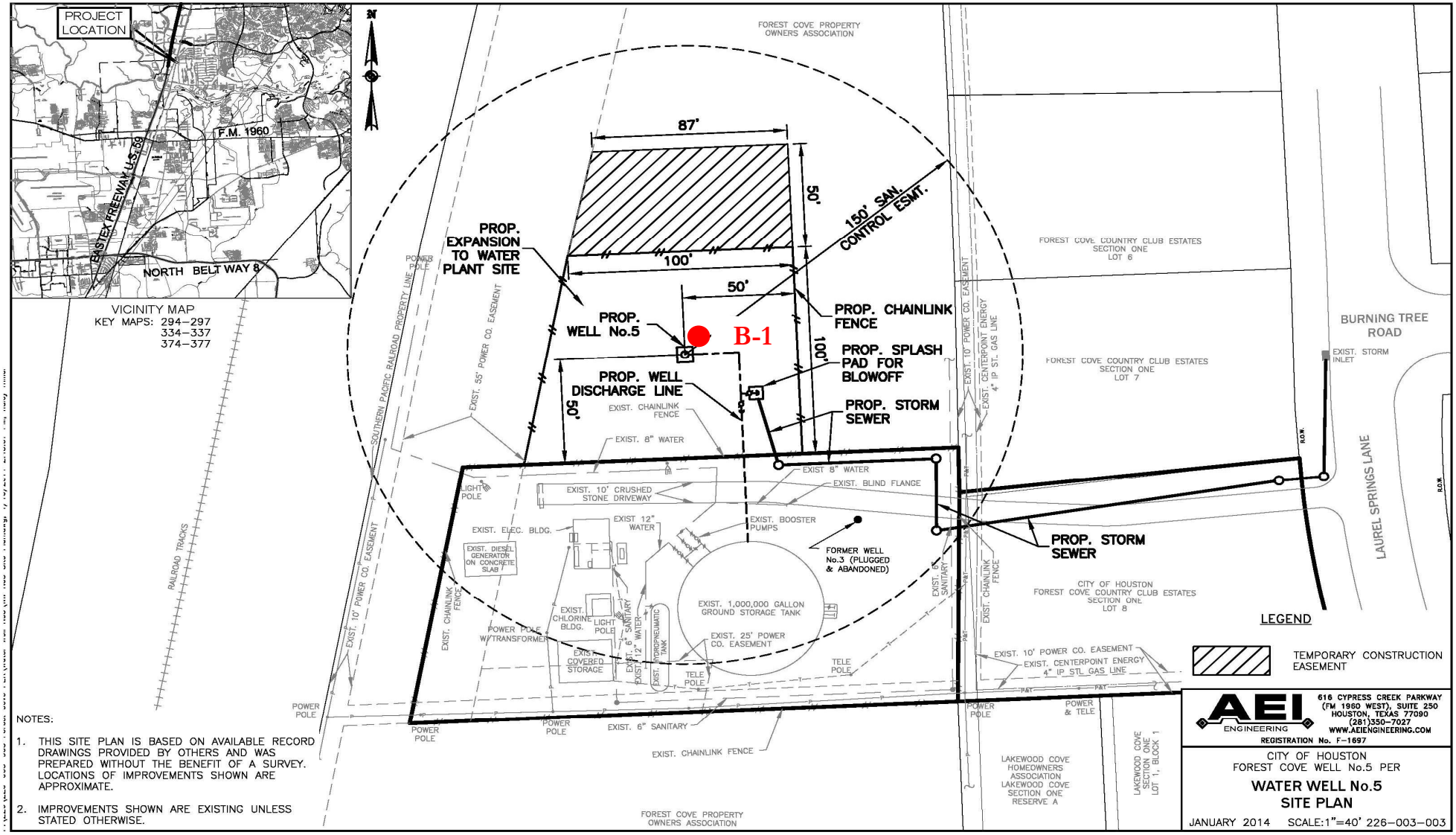
DATE: 11/24/2014	APPROVED BY: ND	PREPARED BY: SS

SITE VICINITY
FOREST COVE III WELL
WBS No.: S-000100-0016-4

PROJECT NO.: HG1216881	DRAWING NO.: PLATE 1



NOTES:

1. THIS SITE PLAN IS BASED ON AVAILABLE RECORD DRAWINGS PROVIDED BY OTHERS AND WAS PREPARED WITHOUT THE BENEFIT OF A SURVEY. LOCATIONS OF IMPROVEMENTS SHOWN ARE APPROXIMATE.
2. IMPROVEMENTS SHOWN ARE EXISTING UNLESS STATED OTHERWISE.

LEGEND:

● **APPROXIMATE BORING LOCATION**

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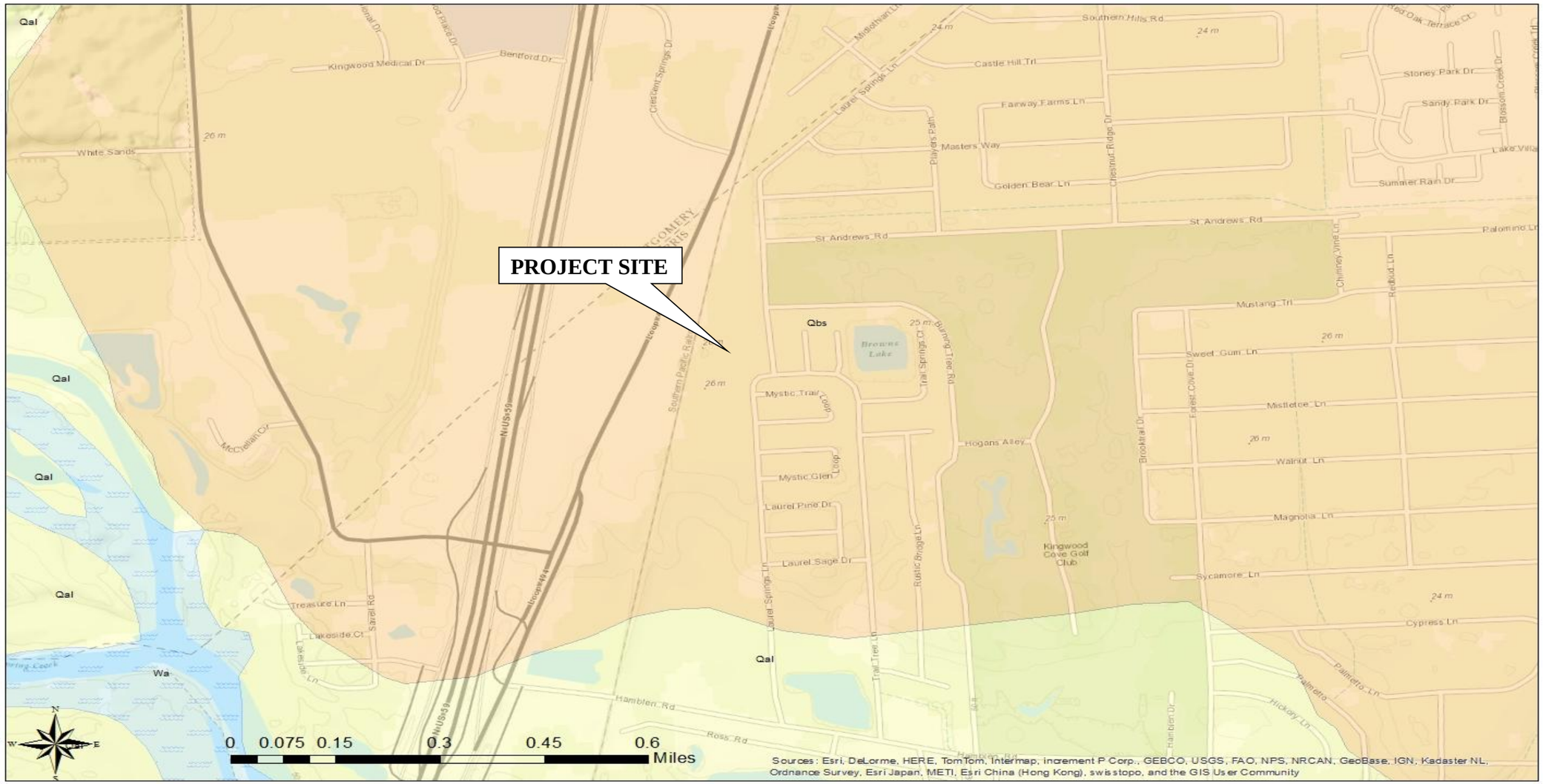
DATE: 04/29/2014	APPROVED BY: MM	PREPARED BY: AR

PLAN OF BORINGS
FOREST COVE III WELL
WBS No. S-000100-0016-4

PROJECT NO.: HG1216881	DRAWING NO.: PLATE 2



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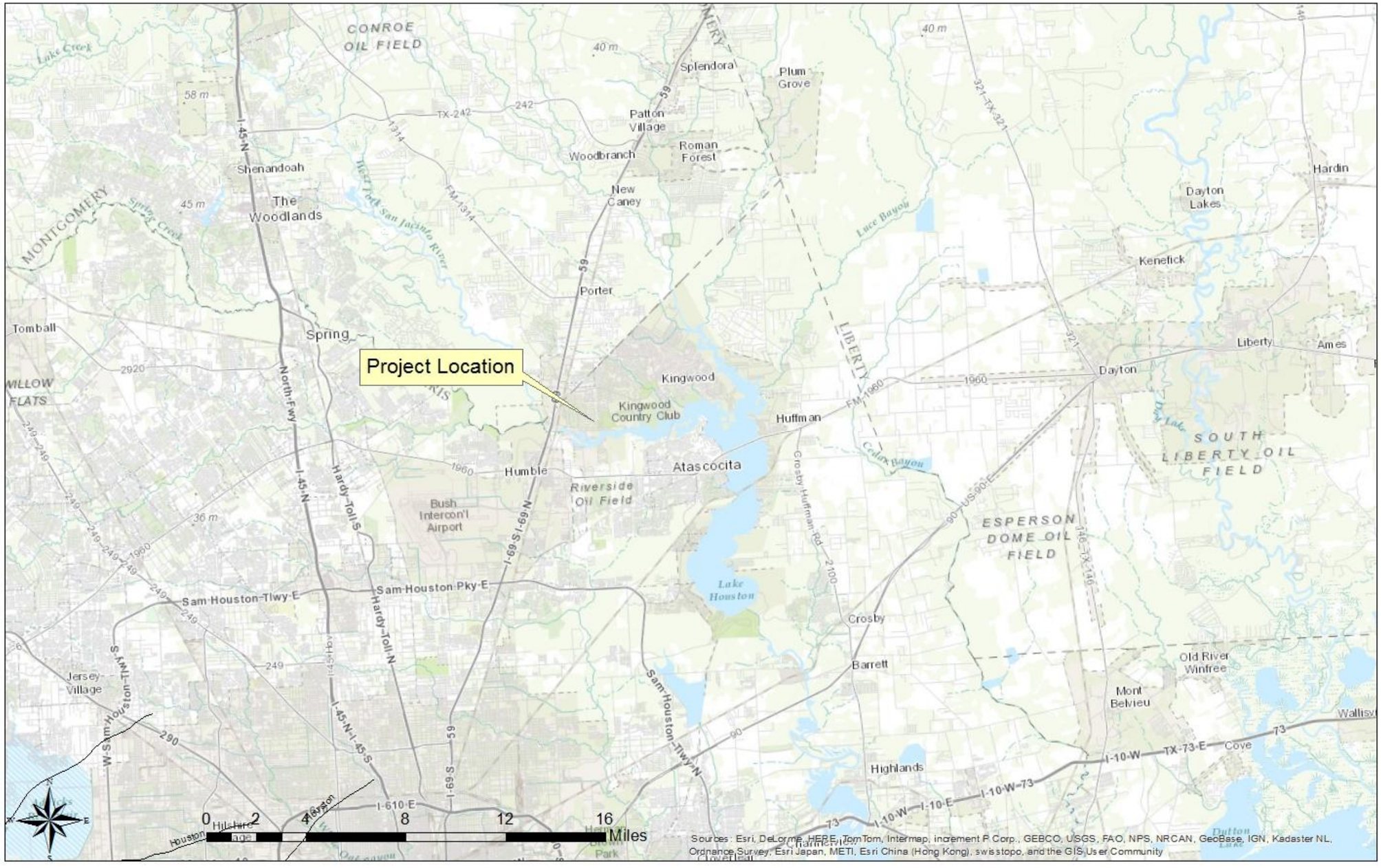
GEOLOGY MAP
FOREST COVE III WELL
WBS No.: S-000100-0016-4

PROJECT NO.: HG1216881	DRAWING NO.: PLATE 3



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FAULT MAP
FOREST COVE III WELL
WBS No.: S-000100-0016-4

PROJECT NO.: HG1216881	DRAWING NO.: PLATE 4

APPENDIX A

BORING LOGS AND KEY TO TERMS & SYMBOLS

LOG OF BORING

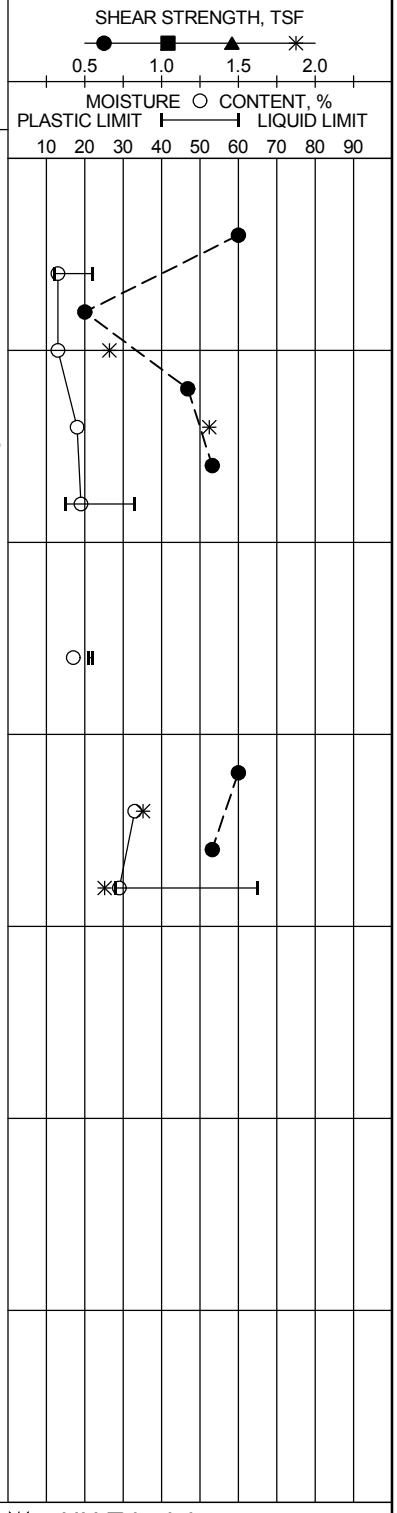
Project: Forest Cove Well | WBS No. S-000100-0016-4 | Project No.: HG1216881

Boring No.: B-1 | Date: 10/31/2014

Groundwater during drilling: --- | GPS Coordinates: 30˚ 2' 25.21" N, 95˚ 14' 59.64" W

Groundwater 24 hours after drilling: --- | Elevation: 87 feet

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF
0 / 85		Stiff to very stiff, brown and gray, SANDY LEAN CLAY (CL)	59.0	111
5 / 80		Very stiff, brown and gray, LEAN CLAY (CL)	85.6	113
10 / 75	10-18-20; 9-18-20; 5-10-12	Medium dense to dense, brown, SILTY SAND (SM)	41.4	
15 / 70		Stiff to very stiff, reddish brown, FAT CLAY (CH)	99.4	91; 91
20 / 65				
25 / 60				
30 / 55				
35				



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✳ = UU Triaxial

PLATE A-1

HVJ ASSOCIATES

LOG OF SOIL BORING HG-12-16881.GPJ HVJ.GDT 2/20/15

SOIL SYMBOLS

Soil Types

Clay | Silt | Sand | Gravel

Modifiers

Clayey | Silty | Sandy | Cemented

Construction Materials

Asphaltic Concrete | Stabilized Base | Fill or Debris | Portland Cement Concrete

SAMPLER TYPES

- Thin Walled Shelby Tube
- No Recovery
- Split Barrel
- Core
- Liner Tube
- Jar Sample

WATER LEVEL SYMBOLS

- Groundwater level after drilling in open borehole or piezometer
- Groundwater level determined during drilling operations

SOIL GRAIN SIZE

Classification	Particle Size	Particle Size or Sieve No. (U.S. Standard)
Clay	< 0.002 mm	< 0.002 mm
Silt	0.002 - 0.075 mm	0.002 mm - #200 sieve
Sand	0.075 - 4.75 mm	#200 sieve - #4 sieve
Gravel	4.75 - 75 mm	#4 sieve - 3 in.
Cobble	75 - 200 mm	3 in. - 8 in.
Boulder	> 200 mm	> 8 in.

DENSITY OF COHESIONLESS SOILS

Descriptive Term	Penetration Resistance "N" * Blows/Foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

CONSISTENCY OF COHESIVE SOILS

Consistency	Undrained Shear Strength (tsf)	Penetration Resistance "N" * Blows/Foot
Very Soft	0 - 0.125	0 - 2
Soft	0.125 - 0.25	2 - 4
Firm	0.25 - 0.5	4 - 8
Stiff	0.5 - 1.0	8 - 16
Very Stiff	1.0 - 2.0	16 - 32
Hard	> 2.0	> 32

PENETRATION RESISTANCE

3/6	Blows required to penetrate each of three consecutive 6-inch increments per ASTM D-1586 *
50/4"	If more than 50 blows are required, driving is discontinued and penetration at 50 blows is noted
0/18"	Sampler penetrated full depth under weight of drill rods and hammer

* The N value is taken as the blows required to penetrate the final 12 inches

TERMS DESCRIBING SOIL STRUCTURE

Slickensided	Fracture planes appear polished or glossy, sometimes striated
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Inclusion	Small pockets of different soils, such as small lenses of sand scattered through a mass of clay
Parting	Inclusion less than 1/4 inch thick extending through the sample
Seam	Inclusion 1/4 inch to 3 inches thick extending through the sample
Layer	Inclusion greater than 3 inches thick extending through the sample
Laminated	Soil sample composed of alternating partings of different soil type
Stratified	Soil sample composed of alternating seams or layers of different soil type
Intermixed	Soil sample composed of pockets of different soil type and laminated or stratified structure is not evident
Calcareous	Having appreciable quantities of calcium carbonate
Ferrous	Having appreciable quantities of iron
Nodule	A small mass of irregular shape

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KEY TO TERMS AND SYMBOLS
USED ON BORING LOGS
WBS NO. S-000100-0016-3

PROJECT NO.: HG1216881

DRAWING NO.: PLATE A-2

APPENDIX B

SUMMARY OF LABORATORY TEST RESULTS

Project: Forest Cove III Well
Location: Houston, Texas
Number: HG1216881
WBS No. S-000100-0016-4

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	% Pass #200 Sieve	Moisture Content (%)	Wet Density (pcf)	Shear Strength (UU) (tsf)
B-1	2							
	3.0	22.0	12.0	10.0	59.0	13.0		
	4.0							
	5.0					13.5	125.4	0.66
	6.0							
	7.0					18.0	133.1	1.31
	8.0							
	9.0	33.0	15.0	18.0	86.0	18.8		
	13.0	22.0	21.0	1.0	41.0	16.6		
	16.0							
	17.0					33.4	121.3	0.88
	18.0							
	19.0	65.0	28.0	37.0	99.0	29.4	118.1	0.63
Total		**4.0**	**4.0**	**4.0**	**4.0**	**7.0**	**4.0**	**4.0**