GEOTECHNICAL REPORT
JONES PLAZA IMPROVEMENTS
DOWNTOWN HOUSTON, TEXAS

SUBMITTED TO

RIOS CLEMENTE HALES STUDIOS
3101 WEST EXPOSITION PLACE
LOS ANGELES, CA 90018

BY

HVJ ASSOCIATES, INC.

HOUSTON, TEXAS

APRIL 24, 2020

REPORT NO. HG1810092

HVJ ASSOCIATES

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April 24, 2020

Ms. Vicki Li
Project Director
Rios Clementi Hale Studios (RCH Studios)
3101 W. Exposition Place
Los Angeles, CA 90018

Re: Geotechnical Recommendations
Jones Plaza Improvements
Downtown Houston, Texas
Owner: Houston First
HVJ Report No. HG1810092

Dear Ms. Li:

Submitted herein is the final report of our geotechnical investigation for the above referenced project. The study was performed in accordance with proposal number HG1810092 dated March 8, 2018 and revised on January 22, 2020 and is subject to the limitations presented in this report.

It has been a pleasure to work for you on this project and we appreciate the opportunity to be of service. Please notify us if there are questions or if we may be of further assistance.

Sincerely,

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

SHARMI P. VEDANTAM
100218

SVedantam

K. Vijay

Sharmi P. Vedantam, PE
Branch Manager

4/24/2020

Vijay Kakara
Staff Engineer

Copies submitted: 1 electronic

SV/VK

The seal appearing on this document was authorized by Sharmi P. Vedantam, PE 100218 on April 24, 2020. Alteration of a sealed document without proper notification to the responsible engineer is an offense under the Texas Engineering Practice Act.

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APPENDICES

1 EXECUTIVE SUMMARY

HVJ Associates, Inc. (HVJ) was retained by Rios Clementi Hale Studios (RCH Studios) to provide recommendations for the sidewalk extension along Texas Avenue that takes up one of the existing traffic lane and estimating the foundation capacity of existing foundation. Based on the subsurface conditions revealed by the soil borings, the findings and recommendations of this report are summarized below.

1. Sidewalk Borings, B-1 and B-2: Fill material comprising of Lean Clay and Sandy lean clay and clayey sand with gravel, shells, ferrous and calcareous nodules is encountered. Boring B-1 was terminated at 5 feet due to obstruction (possible buried utility or tunnel) at the time of our field investigation. Details of the subsurface stratigraphy encountered in the borings are shown on the boring logs presented in Appendix A.

2. Borings B-3 and B-4: These borings are drilled to a depth of 60 feet to evaluate the capacity of existing foundation. The subsurface soils comprise of cohesive soil at the top 13 to 15 feet followed by clayey sands, silty clays, lean clays and sandy lean clays to the termination depth of the borings. The consistency of cohesive soils ranged from soft to hard and the cohesionless soils from medium dense to very dense with gravel and calcareous nodules.

3. A literature review of surface faults near the project area was conducted based on the Scientific Investigations Map 2874, Principal Faults in the Houston, Texas metropolitan area by Shah, S.D., and Lanning-Rush, J, 2005. Based on our review, the nearest mapped fault is the Pecore Fault, which is about 1.5 miles north of the project site, as shown on Plate 4. Faulting is not expected to impact the project site. A detailed fault study is not within the scope of this study.

4. Groundwater was not encountered during the drilling operations. However, it should be noted that groundwater conditions observed during drilling may not accurately reflect the groundwater conditions during construction, and therefore should only be considered as approximate. Groundwater levels may fluctuate seasonally and in response to rainfall.

5. Based on the existing foundation drawings, we understand that shallow spread footings, drilled and underreamed footings and driven piles are used as the foundation system for the existing structure.

6. Based on the information provided to us by RCH studios, the depth of the shallow spread footings varies between approximately 33 to 38 feet below the existing grade (approximately El. +7.0 to El. +2.0 feet). Based on the soil borings B-3 and B-4, the allowable net total load bearing pressure and net dead plus sustained live load bearing pressure values at a depth of 33 to 38 feet below the existing grade are presented in the table below. These bearing pressures contain a factor of safety 2 and 3, respectively.

Borings Used	Foundation Depth (ft)	Soil Description	Net Total Load Bearing Pressure (psf)	Net Dead plus Sustained Live Load Bearing Pressure (psf)
B-3 and B-4	33-38	Very stiff Silty Clay	5,000	3,300

7. Based on footing and pile cap details drawing (Drawing S-44) provided to us by RCH studios, the drilled and underreamed footings are founded at elevations +20 to +10 feet (approximately 20 to 30 feet deep from the existing grade). Allowable bearing capacity of subsurface soil at a depth of 20 to 30 feet estimated for drilled and underreamed footings is presented in the table below.

Foundation Capacity of Drilled and Underreamed Footings

Boring Number	Depth (feet)	Soil Description at Foundation Depth	Foundation Type and Depth	Allowable Bearing Capacity (psf)
B-3	20 to 25	Dense Clayey Sand	Drilled and Underreamed Footings	4,000
	25 to 30	Soft Silty Clay	Drilled and Underreamed Footings	650
B-4	20 to 30	Very stiff Silty Sandy Clay	Drilled and Underreamed Footings	4,000

The depth of 14-inch driven pile is about 50 feet below the bottom of the pile cap. The foundation capacity of driven piles is presented in Appendix C of the 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. (HVJ) was retained by Rios Clementi Hale Studios (RCH Studios) to provide recommendations for the proposed Jones Plaza improvements in Downtown Houston, Texas. The proposed improvements include central lawn, shade trees, access stairs, ramps, pathways, streetscape improvements, performance areas, gardens, restaurant and a water feature. We understand that all these structures will be constructed on the top of the existing lid of Jones Plaza and these structures will be supported on Geofoam fill that will be placed on the top of the lid. Our scope of work includes providing recommendations for the sidewalk extension along Texas Avenue that takes up one of the existing traffic lane, and estimating the foundation capacity of existing foundations.

2.2 Geotechnical Investigation Program

The major objectives of this study were to gather information on subsurface conditions at the site and to provide geotechnical recommendations for the proposed improvements. This study was performed in accordance with City of Houston Infrastructure Design Manual guidelines. The objectives were accomplished by:

- Drilling four (4) borings to depths varying between 5 and 60 feet below the existing grade 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 foundation recommendations for the proposed improvements.

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 Borings

The field exploration program undertaken at the project site was performed on March 6 and March 13, 2020. Boring B-1 was drilled only to 5 feet because of buried utilities at 5.5 feet below the existing grade. All boreholes were backfilled with soil cuttings. Approximate boring locations are presented on Plate 2 of the report.

3.2 Survey Data

Survey information was not available to us at the time of preparing this report. Approximate GPS coordinates obtained with a hand-held device at the boring locations are presented on the boring logs in Appendix A.

3.3 Sampling Methods

Soil samples were obtained continuously to the termination depths of the borings. Cohesive soil samples were obtained with a three-inch thin-walled (Shelby) tube sampler in general accordance with ASTM D1587 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 borings are given on the boring logs presented in Appendix A, which also includes a Key to Terms and Symbols for the soils classifications used on the boring logs.

3.4 Water Level Measurements

Groundwater was measured during drilling operations and presented in Section 5.4.

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, unconfined compression, unconsolidated undrained compression, and pocket penetrometer 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 –Laboratory Test Summary

Type of Test	Number of Tests
Moisture Content (ASTM D2216)	35
Atterberg Limits (ASTM D4318)	13
Percent Passing No. 200 Sieve (ASTM D1140)	19
Unconfined Compression (ASTM D2166)	5
Unconsolidated Undrained Compressive Strength (UU) (ASTM D2850)	3
Pocket Penetrometer	33

The laboratory test results are presented on the boring logs in Appendix A. The conversion between pocket penetrometer readings obtained in the field to the shear strength parameters presented in the borings logs 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 Gulf 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 an area where the Beaumont formation is typically encountered. A geology 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 over-consolidated to a large depth. In addition to pre-consolidating 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 Scientific Investigations Map 2874, Principal Faults in the Houston, Texas metropolitan area by Shah, S.D., and Lanning-Rush, J, 2005. Based on our review, the nearest mapped fault is the Pecore Fault, which is about 1.5 miles north of the project site, as shown on Plate 4. Faulting is not expected to impact 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 locations 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 re-evaluation of our findings and conclusions.

Sidewalk Borings, B-1 and B-2: Fill material comprising of Lean Clay and Sandy lean clay and clayey sand with gravel, shells, ferrous and calcareous nodules is encountered. Boring B-1 was terminated at 5 feet due to obstruction (possible buried utility or tunnel) at the time of our field investigation. Details of the subsurface stratigraphy encountered in the borings are shown on the boring logs presented in Appendix A.

Borings B-3 and B-4: These borings are drilled to a depth of 60 feet to evaluate the capacity of existing foundation. The subsurface soils comprise of cohesive soil at the top 13 to 15 feet followed by clayey sands, silty clays, lean clays and sandy lean clays. The consistency of cohesive soils ranged from soft to hard and the cohesionless soils from medium dense to very dense with gravel and calcareous nodules.

5.4 Groundwater Conditions

Groundwater was not encountered in any of the borings during drilling operations. It should be noted that groundwater levels determined during drilling may not accurately reflect the true groundwater conditions, and therefore should only be considered as approximate.

6 BEARING CAPACITY OF EXISTING FOUNDATION

6.1 General

The proposed improvements at Jones Plaza includes central lawn, shade trees, access stairs, ramps, pathways, streetscape improvements, performance areas, gardens, restaurant and a water feature. All these structures will be constructed on the top of the existing lid of Jones Plaza and these structures will be supported on Geofoam fill that will be placed on the top of the lid. HVJ was asked to evaluate the capacity of existing foundation to support this additional load based on the existing foundation drawings.

Based on the drawings provided to us by RCH studios, the existing slab is supported on shallow spread footings, drilled and underreamed footings and driven piles. The diameter of drilled and underreamed footings varied from 12 to 40 inches and the shafts are founded at El. +20 to +10 feet. The diameter of driven piles is 14 inches and the length of these piles is 50 feet below the bottom of the pile cap.

6.2 Shallow Spread Footings

Based on the information provided to us by RCH studios, the depth of the shallow spread footings varies between approximately 33 to 38 feet below the existing grade (approximately El. +7.0 to El. +2.0 feet). Based on the soil borings B-3 and B-4, the allowable net total load bearing pressure and net dead plus sustained live load bearing pressure values at a depth of 33 to 38 feet below the existing grade are presented in the table below. These bearing pressures contain a factor of safety 2 and 3, respectively.

Borings Used	Foundation Depth (ft)	Soil Description	Net Total Load Bearing Pressure (psf)	Net Dead plus Sustained Live Load Bearing Pressure (psf)
B-3 and B-4	33-38	Very stiff Silty Clay	5,000	3,300

6.3 Drilled and Underreamed Footings Capacity

Based on footing and pile cap details drawing (Drawing S-44) provided to us by RCH studios, the drilled and underreamed footings are founded at elevations +20 to +10 feet (approximately 20 to 30 feet deep from the existing grade). Allowable bearing capacity of subsurface soil at a depth of 20 to 30 feet below grade estimated for drilled and underreamed footings is presented in the table below.

Foundation Capacity of Drilled and Underreamed Footings

Boring Number	Depth (feet)	Soil Description at Foundation Depth	Foundation Type and Depth	Allowable Bearing Capacity (psf)
B-3	20 to 25	Dense Clayey Sand	Drilled and Underreamed Footings	4,000
	25 to 30	Soft Silty Clay	Drilled and Underreamed Footings	650
B-4	20 to 30	Very stiff Silty Sandy Clay	Drilled and Underreamed Footings	4,000

6.4 Uplift Capacity

There are several methods available to estimate the uplift capacity of drilled and underreamed shafts. HVJ recommends the following method to evaluate the uplift ultimate capacity of a belled shaft by the friction cylinder method (IEEE Guide for Transmission Structure Foundation Design and Testing, December 2001). This model assumes that, at failure, a vertical cylinder of soil is formed above the bell whose diameter is equal to the diameter of the bell. Using this model, the ultimate uplift capacity for a layered soil conditions can be expressed with the equation below.

$$Q_u = \pi B_b s_u D + W_s + W$$

Where:

Q_u is the ultimate uplift capacity
B_b is the diameter of the belled section of the shaft
S_u is the undrained shear strength of the soil
D is the length of the straight shaft below ground surface
W_s is effective weight of the soil enclosed in the cylinder
W is the effective weight of the concrete shaft

6.5 Driven Pile Analyses Criteria

For driven piles, the accumulative skin friction capacity curves were developed based on FHWA method with the use of APILE computer program by Ensoft. In order to determine the allowable capacity a factor of safety of 2 must be applied to the total capacity. The accumulative skin friction capacity curve for 14-inch circular driven pile is presented in Appendix C.

6.6 Lateral Capacity

Deep foundations often have to withstand some lateral loads due to wind and traffic loads in addition to axial loads. Lateral load analysis was beyond the scope of this study and should be performed using computer programs such as LPILE, etc. The input parameters for lateral load analysis are presented in Appendix D.

7 SIDE WALK DESIGN RECOMMENDATIONS

7.1 General

The project also includes sidewalk extension along Texas Avenue that takes up one of the existing traffic lane. We understand that the side walk will be at grade. Borings B-1 and B-2 are utilized to provide recommendations of subgrade for the sidewalk.

The sidewalk construction recommendations should follow Section 17.06 for Pedestrian Design Recommendations of City of Houston Design Manual dated July 2019. The subgrade below the pavement comprises of low to medium plasticity lean clay and sandy clay. Based on their plasticity index, we recommend stabilizing the subgrade with 5% lime for estimation purposes. The percentage is only an estimation based on test results of the subgrade material. The actual amount of lime percentage should be determined for subgrade soils by conducting laboratory tests on the exposed subgrade material during construction.

7.2 Preparation of subgrade

Stabilization of the subgrade will increase the modulus of subgrade reaction and provide subgrade stability for construction during inclement weather. Subgrade stabilization will enhance long-term sidewalk performance by reducing the tendency of the soil to displace from beneath the slab by pumping. We recommend the following procedures for subgrade preparation.

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

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

3. Surfaces exposed after excavation should be proof-rolled in accordance with TxDOT Standard Specification Item 216 or equivalent City of Houston specification. If rutting develops, tire pressures should be reduced. The purpose of the proof-rolling operation is to identify any underlying zones or pockets of soft soils and to remove such weak materials.

4. Before stabilizing the subgrade, scarify the upper eight inches of exposed surface as required, mix with lime and compact it to 95 percent of standard proctor maximum dry density (ASTM D698). Lime stabilization of the subgrade should conform to City of Houston Specification Section 02336.

7.3 Site Preparation and Select Fill

Select fill required to raise the grade or backfill grub holes should consist of lean silty or sandy clay with a Liquid Limit less than 40, and a Plasticity Index between 8 and 20. Fill material that is used should be placed in loose lifts not exceeding eight inches, and should be compacted to 95 percent of the maximum dry density at a moisture con tent between optimum and 3% wet of optimum as determined by ASTM D698. Water should not be allowed to accumulate within the excavations. Should water accumulate, then any wet or softened soils should be removed or reworked if appropriate, and subsequently re-compacted.

8 MONITORING

8.1 Construction Materials Testing

HVJ recommends that backfill be monitored by an accredited testing laboratory to verify that construction is performed in conformance with project specifications. HVJ routinely provides these services and would be pleased to do so for this project.

9 DESIGN REVIEW

HVJ should be retained to review the final design plans and specifications for this project. During all excavation, grading, and construction phases of this project, HVJ should provide the materials testing verification and observation services so our geotechnical recommendations may be interpreted and implemented correctly.

10 LIMITATIONS

This investigation was performed for the exclusive use of Jones Plaza improvements in Downtown 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.

PLATES

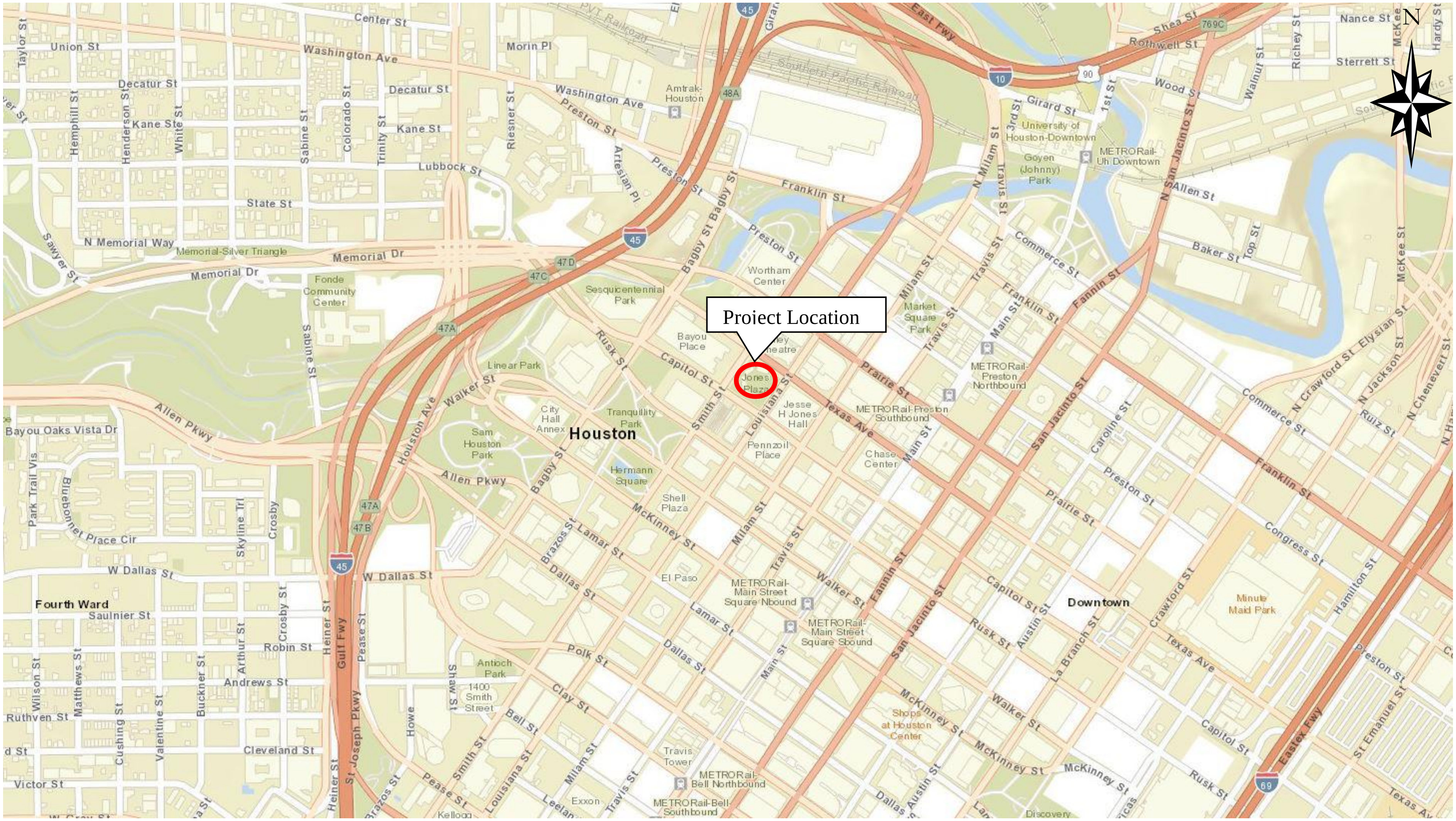

IMAGE SOURCE: Arc GIS

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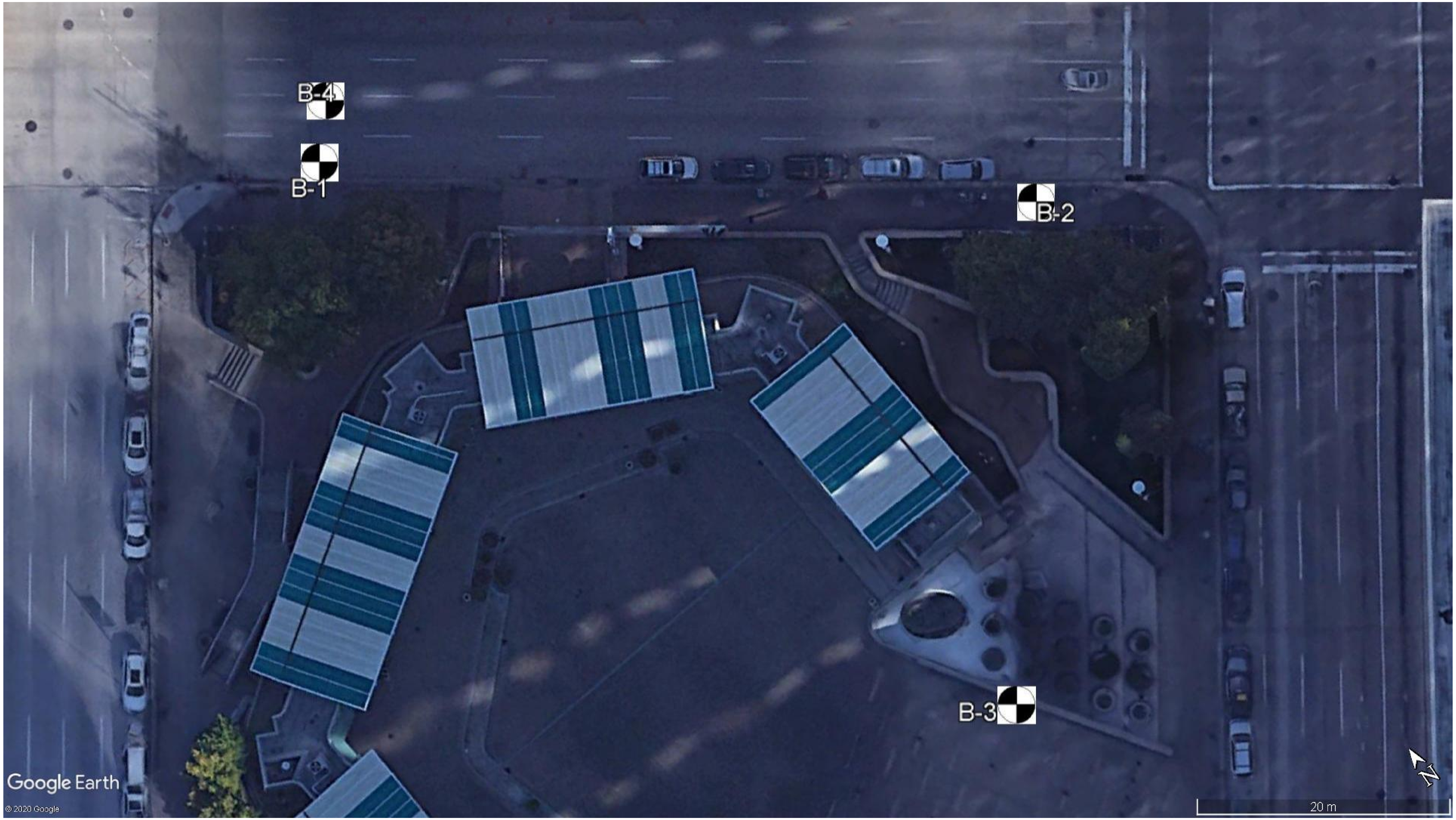
DATE: 04/06/2020	APPROVED BY: SV	PREPARED BY: VK

SITE VICINITY MAP
JONES PLAZA IMPROVEMENTS

PROJECT NO.: HG1810092	DRAWING NO.: PLATE 1



LEGEND:

◐ **APPROXIMATE BORING LOCATIONS**

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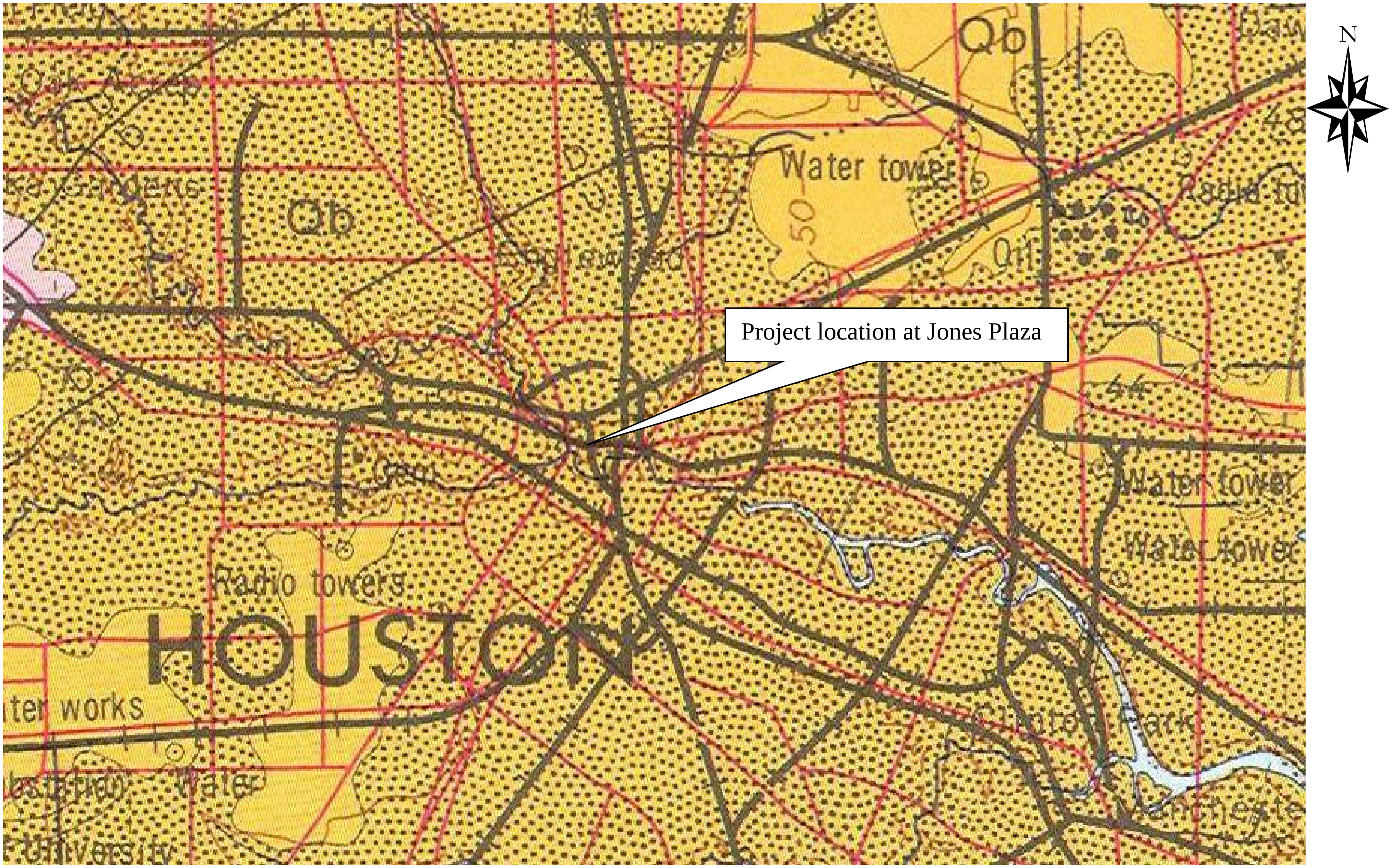
DATE: 04/06/2020	APPROVED BY: SV	PREPARED BY: VK

PLAN OF BORINGS
JONES PLAZA IMPROVEMENTS

PROJECT NO.: HG1810092	DRAWING NO.: PLATE 2



Project location at Jones Plaza

Qb	**Beaumont Formation – Mostly clay, silt, and sand; includes mainly stream channel, point-bar, natural levee, backswamp, and to a lesser extent coastal marsh and mud flat deposits; concretions of calcium carbonate, iron oxide, and iron-manganese oxides in zone of weathering; surface almost featureless, characterized by relict river channels shown by meander patterns and pimple mounds on meanderbelt ridges, separated by areas of flow, relatively smooth, featureless backswamp deposits without pimple mounds; thickness ± 100 ft.**
Qb-stipled	**Beaumont Formation -- Dominantly clay and mud of low permeability, high water-holding capacity, high compressibility, high to very high shrink-swell potential, poor drainage, level to depressed relief, low shear strength, and high plasticity; geologic units include interdistributary muds, abandoned channel-fill muds. and overbank fluvial muds**

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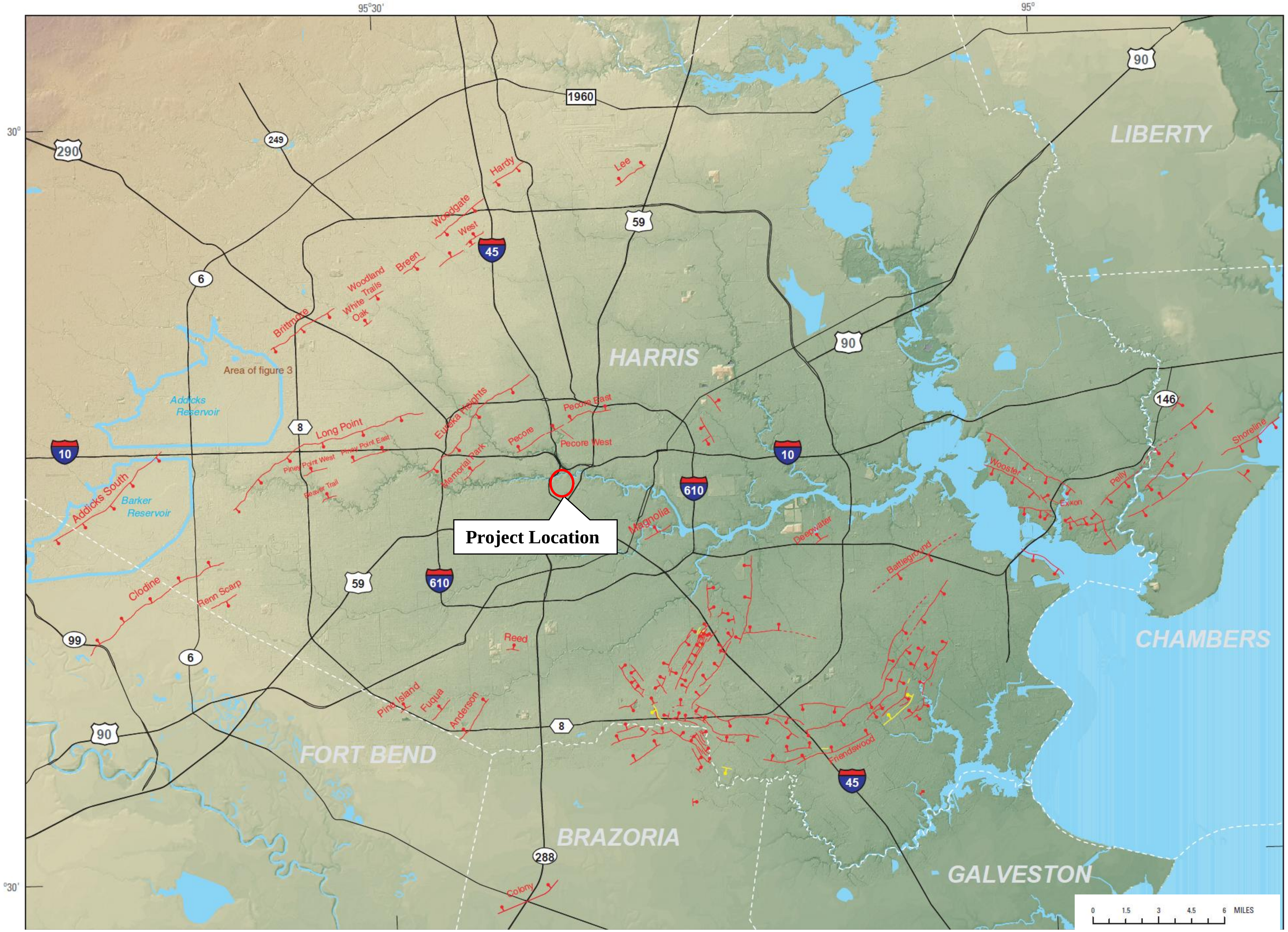
DATE: 04/06/2020	APPROVED BY: SV	PREPARED BY: VK

GEOLOGIC MAP
HOUSTON AVENUE & WHITE OAK DRIVE
INTERSECTION

PROJECT NO.: HG1810092	DRAWING NO.: PLATE 3



Source: Sachin D. Shah and Jennifer Lanning-Rush, 2005.

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FAULT MAP
JONES PLAZA IMPROVEMENTS

PROJECT NO.: HG1810092	DRAWING NO.: PLATE 4

APPENDIX A

BORING LOGS AND KEY TO TERMS AND SYMBOLS

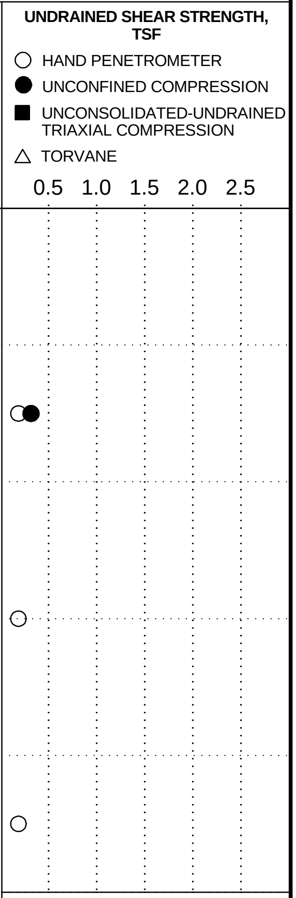
LOG OF BORING B-1

PROJECT: Jones Plaza
LOCATION: 29°45'42.78"N; 95°21'57.12"N
STATION: N/A
OFFSET: N/A
SURFACE ELEVATION: N/A

PROJECT NO.: HG1810092
COMPLETION DEPTH: 5 FT
DATE: 3/6/2020

SAMPLER: Shelby Tube/Split Spoon
DRY AUGER: TO FT
WET ROTARY: TO FT

ELEVATION, FT	DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
	0			Pavement: 5" Asphalt Concrete, 6.5" Lime Stabilized Base							
				Soft, gray, tan and reddish brown, LEAN CLAY w/ SAND (CL)			94	27			
				-w/ calcareous nodules at 3'-5' -w/ gravel at 3'-4'		79.8		30	46	19	27
								28			
	5										



DEPTH TO WATER IN BORING:
▽ FREE WATER DURING DRILLING: ---
▼ WATER DEPTH 24 HOURS AFTER DRILLING: ---

COH HG1810092.GPJ 4/5/20

Drilled By: Soltek Logged By: Majid

LOG OF BORING B-2

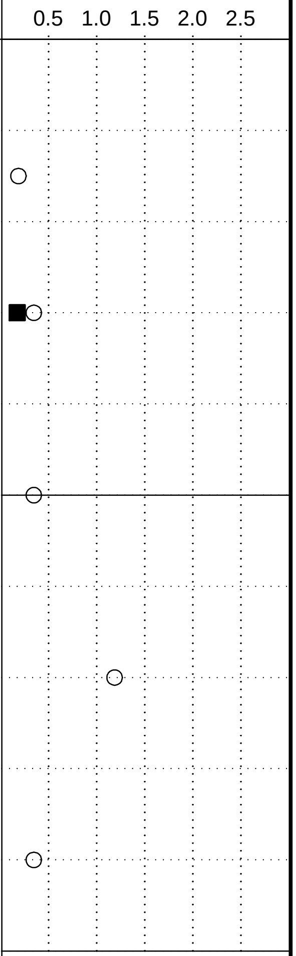
PROJECT: Jones Plaza
LOCATION: 29°45'41.64"N; 95°21'55.44"N
STATION: N/A
OFFSET: N/A
SURFACE ELEVATION: N/A

PROJECT NO.: HG1810092
COMPLETION DEPTH: 10 FT
DATE: 3/6/2020

SAMPLER: Shelby Tube/Split Spoon
DRY AUGER: TO FT
WET ROTARY: TO FT

ELEVATION, FT	DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
	0			Pavement: 6" Asphalt Concrete, 5.5" Lime Stabilized Base							
				Soft to firm, gray, brown and tan, possible fill material, SANDY LEAN CLAY (CL) -w/ gravel, ferrous stains and shell at 1'-4' -w/ calcareous nodules at 1'-2'		60.7		26	44	21	23
							116	15			
	5			Loose to dense, gray and tan, possible fill material, CLAYEY SAND (SC) -w/ shell at 5'-6' -w/ calcareous nodules at 5'-10' -w/ ferrous stains at 5'-8'		35.5		22	52	23	29
								19			
				-w/ gravel at 9'-10'		39.5		19			
	10										

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



DEPTH TO WATER IN BORING:
∇ FREE WATER DURING DRILLING: ---
▼ WATER DEPTH 24 HOURS AFTER DRILLING: ---

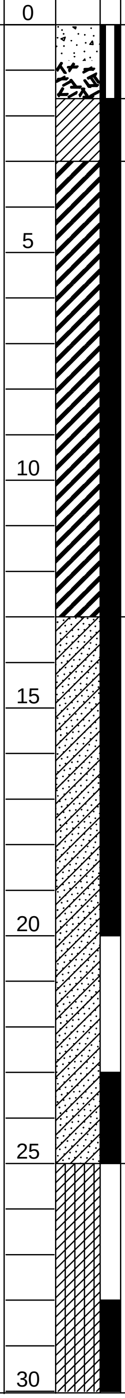
Drilled By: Soltek Logged By: Majid

LOG OF BORING B-3

PROJECT: Jones Plaza
LOCATION: 29°45'40.62"N; 95°21'56.34"N
STATION: N/A
OFFSET: N/A
SURFACE ELEVATION: N/A

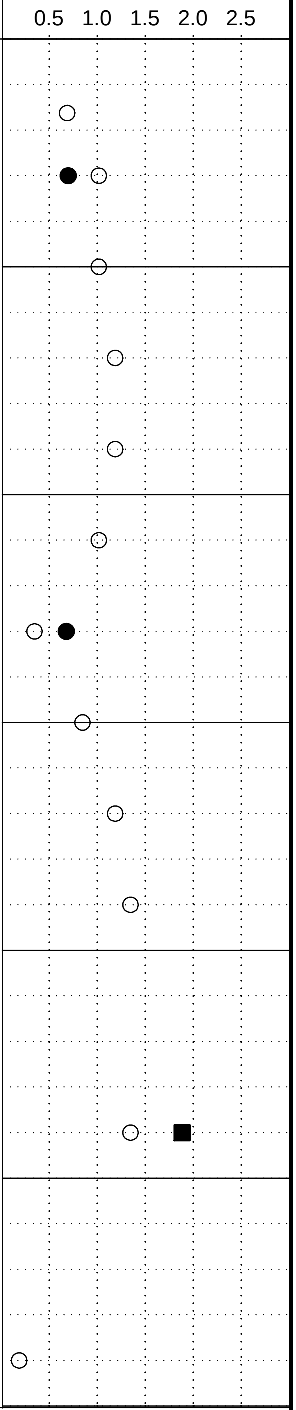
PROJECT NO.: HG1810092
COMPLETION DEPTH: 60 FT
DATE: 3/6/2020

SAMPLER: Shelby Tube/Split Spoon
DRY AUGER: TO FT
WET ROTARY: TO FT



DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
Pavement: 9.5" Concrete, 10" Crushed Concrete Lime Stabilized Base							
Stiff, brown and gray, LEAN CLAY w/ SAND (CL) -w/ calcareous nodules at 2'-3'		81.3		18	41	18	23
			101	23			
Firm to very stiff, reddish brown and gray, FAT CLAY w/ SAND (CH) -w/ calcareous nodules at 3'-6' and 11'-13' -w/ ferrous stains at 3'-10' -w/ silt seams at 8'-10'				27	51	23	28
				23			
		84.8		27	67	27	40
Medium dense to dense, gray and tan, CLAYEY SAND (SC) -w/ calcareous nodules, gravel and ferrous stains at 13'-25'			115	17			
		25.6		9	33	16	17
			116	21			
Soft , reddish brown and gray, SILTY CLAY (CL-ML)				12	21	17	4

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



DEPTH TO WATER IN BORING:
▽ FREE WATER DURING DRILLING: ---
▼ WATER DEPTH 24 HOURS AFTER DRILLING: ---

Drilled By: Soltek Logged By: Majid

LOG OF BORING B-3

PROJECT: Jones Plaza
LOCATION: 29°45'40.62"N; 95°21'56.34"N
STATION: N/A
OFFSET: N/A
SURFACE ELEVATION: N/A

PROJECT NO.: HG1810092

COMPLETION DEPTH: 60 FT

DATE: 3/6/2020

SAMPLER: Shelby Tube/Split Spoon
DRY AUGER: TO FT
WET ROTARY: TO FT

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

ELEVATION, FT	DEPTH, FT	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF (0.5 1.0 1.5 2.0 2.5)
	30	Soft , reddish brown and gray, SILTY CLAY (CL-ML) [Continued...]								
	35	Very stiff, reddish brown and gray, SILTY CLAY w/ SAND (CL-ML)	20	75.6		18				
	40	Very stiff, reddish brown and gray, LEAN CLAY (CL)	18	98.7						
	45	Stiff to hard, reddish brown, SILTY CLAY (CL-ML)				23				○
	50		50							
		-w/ calcareous nodules and gravel at 48'-50'								
	55	Very stiff, reddish brown, LEAN CLAY (CL)	18			23				
	60	VeryStiff, reddish brown, SILTY CLAY (CL-ML)	20			21				

DEPTH TO WATER IN BORING:
▽ FREE WATER DURING DRILLING: ---
▼ WATER DEPTH 24 HOURS AFTER DRILLING: ---

Drilled By: Soltek Logged By: Majid

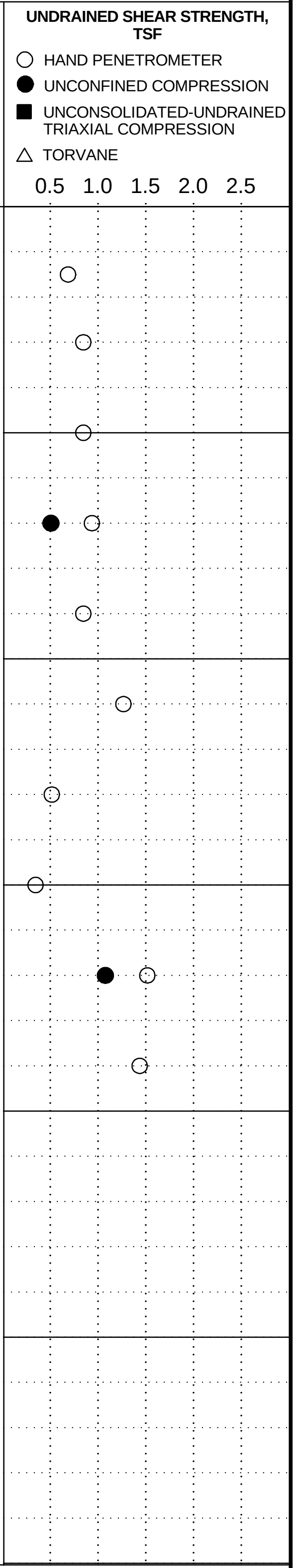
LOG OF BORING B-4

PROJECT: Jones Plaza
LOCATION: 29°45'42.9"N; 95°21'57.0"N
STATION: N/A
OFFSET: N/A
SURFACE ELEVATION: N/A

PROJECT NO.: HG1810092
COMPLETION DEPTH: 60 FT
DATE: 3/13/2020

SAMPLER: Shelby Tube/Split Spoon
DRY AUGER: TO FT
WET ROTARY: TO FT

ELEVATION, FT	DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
	0			Pavement: 10" Concrete, 10" Crushed Concrete Base							
				Stiff, dark brown and reddish brown, SANDY LEAN CLAY (CL)		55.7		14	24	17	7
	5			Stiff, reddish brown, FAT CLAY (CH)		98.7		23	54	31	23
							100	24			
	10			-w/ rocks at 10'		90.3		22			
				-w/ calcareous nodules at 13'							
	15			Dense, reddish brown and gray, SILTY CLAYEY SAND (SC-SM) -w/ calcareous nodules and sand pockets at 15'		47.9		19	21	17	4
				-w/ stones at 17'-18'			104	24			
	20			Reddish brown and gray, FAT CLAY (CH)		98.8		23	61	24	37
	25			Very stiff, reddish brown and gray, SANDY SILTY CLAY(CL-ML)		68.8		22	26	20	6
	30					50.8		22			



DEPTH TO WATER IN BORING:
∇ FREE WATER DURING DRILLING: ---
▼ WATER DEPTH 24 HOURS AFTER DRILLING: ---

Drilled By: Soltek Logged By: Edgar

LOG OF BORING B-4

PROJECT: Jones Plaza
LOCATION: 29°45'42.9"N; 95°21'57.0"N
STATION: N/A
OFFSET: N/A
SURFACE ELEVATION: N/A

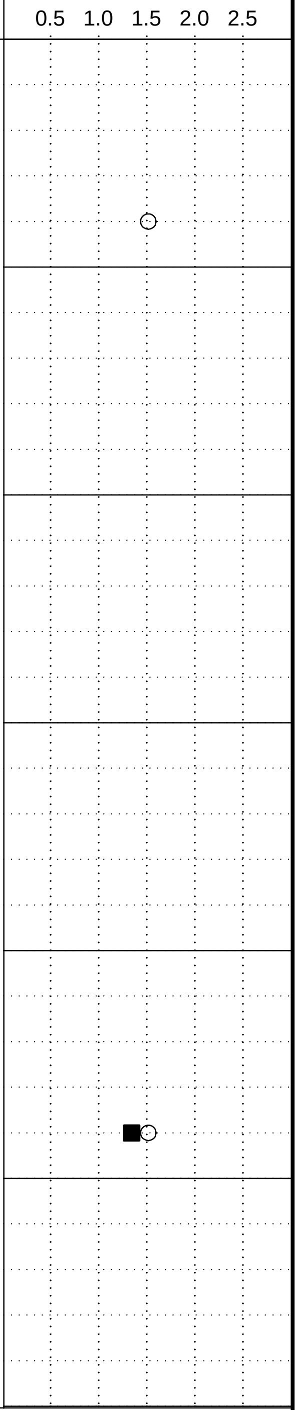
PROJECT NO.: HG1810092
COMPLETION DEPTH: 60 FT
DATE: 3/13/2020

SAMPLER: Shelby Tube/Split Spoon
DRY AUGER: TO FT
WET ROTARY: TO FT

ELEVATION, FT	DEPTH, FT	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
	30	Very stiff, reddish brown and gray, SANDY SILTY CLAY(CL-ML) [Continued...]							
		-w/ silt pockets at 33'-35'				15			
	35	-w/ sand stone at 35'							
				63.2		23			
	40								
		Very dense, brown, SILTY SAND (ML)	50			21			
	45								
		Stiff to hard, reddish brown, SILTY CLAY (CL-ML) -w/ calcareous nodules and gravel at 48'-50'	14	89.2					
	50								
		stiff to very stiff, reddish brown, LEAN CLAY (CL) -w/ silt seams at 53'-55'			102	22			
	55								
		Reddish brown, CLAYEY SAND (SC) -w/ silt seams below 58'		49.4		24			
	60								

UNDRAINED SHEAR STRENGTH, TSF

○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE



DEPTH TO WATER IN BORING:
▽ FREE WATER DURING DRILLING: ---
▼ WATER DEPTH 24 HOURS AFTER DRILLING: ---

Drilled By: Soltek Logged By: Edgar

APPENDIX B

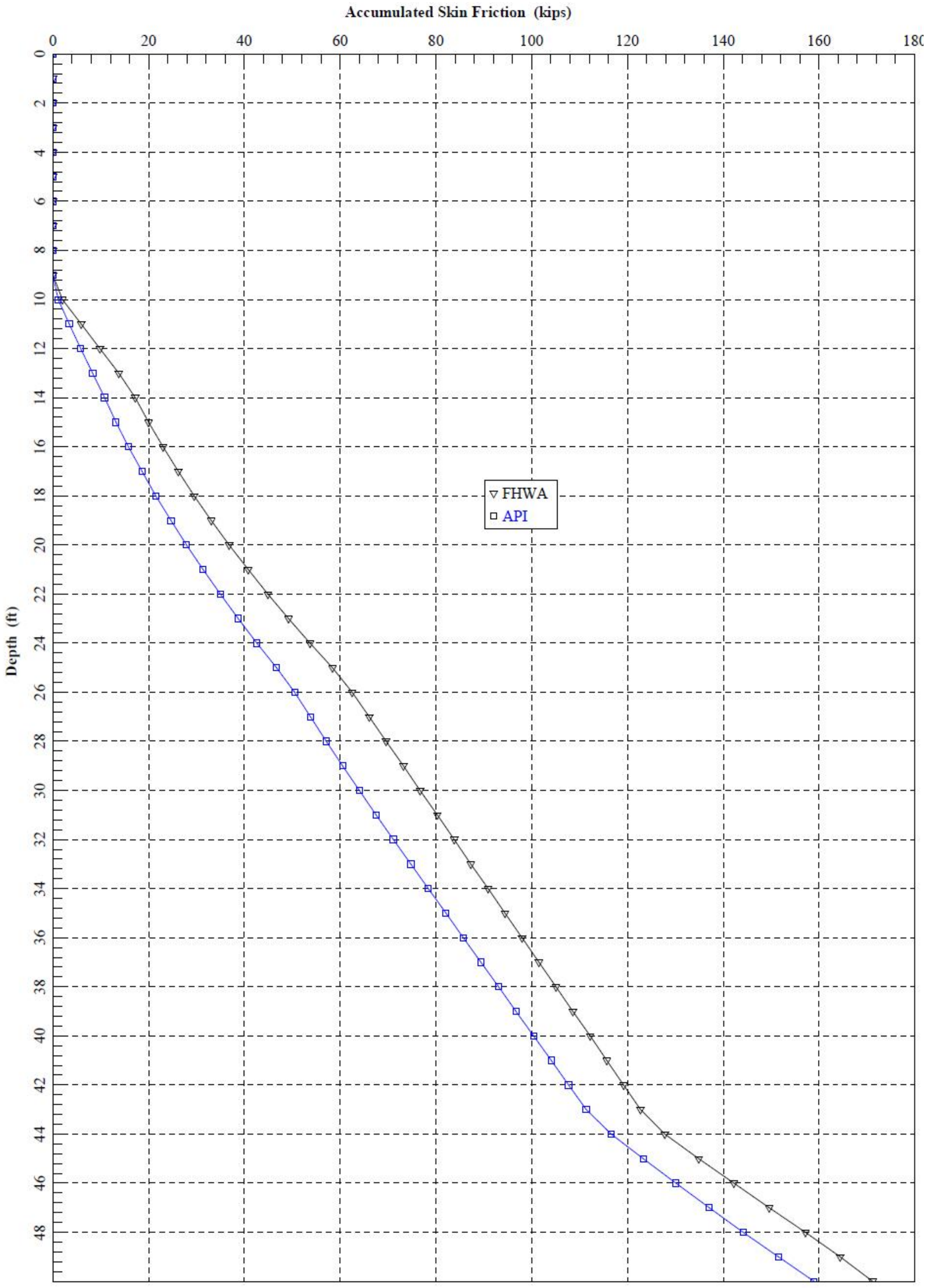
LAB SUMMARY

Company Name: HVJ Associates, Inc
Project: Jones Plaza Improvements
Location: Houston, Texas
Project Number: HG1810092

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	% Passing #200 Sieve	Moisture Content (%)	Shear Strength (UC) (tsf)	UU (tsf)	Pocket Pen (tsf)	Dry Density (pcf)
B-1	1.5					27	0.31		0.51	94
B-1	3	46	19	27	79.8	30			0.51	
B-1	4.5					28			0.51	
B-2	1.5	44	21	23	60.7	26			0.51	
B-2	3					15		0.16	1	116
B-2	5	52	23	29	35.5	22			1	
B-2	7					19			3.5	
B-2	9				39.5	19			1	
B-3	1.6	41	18	23	81.3	18			2	
B-3	3					23	0.69		3	101
B-3	5	51	23	28		27			3	
B-3	7					23			3.5	
B-3	9								3.5	
B-3	11	67	27	40	84.8	27			3	
B-3	13					17	0.67		1	115
B-3	15								2.5	
B-3	17	33	16	17	25.6	9			3.5	
B-3	19								4	
B-3	24					21		1.87	4	116
B-3	29	21	17	4		12			0.5	
B-3	34				75.6	18				
B-3	39				98.7					
B-3	44					23			1.5	
B-3	54					23				
B-3	59					21				
B-4	1.5	24	17	7	55.7	14			2	
B-4	3								2.5	
B-4	5	54	31	23	98.7	23			2.5	
B-4	7					24	0.5		2.75	100
B-4	9								2.5	
B-4	11				90.3	22			3.75	
B-4	13								1.5	
B-4	15	21	17	4	47.9	19			1	
B-4	17					24	1.07		4.5	104
B-4	19	61	24	37	98.8	23			4.25	
B-4	24	26	20	6	68.8	22				
B-4	29				50.8	22				
B-4	34					15			4.5	
B-4	39				63.2	23				
B-4	44					21				
B-4	49				89.2					
B-4	54					22		1.33	4.5	102
B-4	59				49.4	24				
Total		**13**	**13**	**13**	**19**	**35**	**5**	**3**	**33**	**8**

APPENDIX C

DRIVEN PILE CAPACITY CURVE



Note:

* Depth is from the existing ground level at the boring location.

HVJ ASSOCIATES

6120 S. Dairy Ashford Road
Houston, Texas 77072-1010
281.933.7388 Ph
281.933.7293 Fax

DATE: 04/06/2020	APPROVED BY: SV	PREPARED BY: VJ

ACCUMILATED SKIN FRICTION OF 14-INCH CIRCULAR DRIVEN PILE
JONES PLAZA IMPROVEMENTS

PROJECT NO.: HG1810092	DRAWING NO.: PLATE C-1

APPENDIX D

L-PILE PARAMETERS

Company Name: HVJ Associates, Inc.
Project Name: Jones Plaza Improvements
Project Location: Houston, Texas
Project Number: HG1810092

Project Description	Boring No.	LPILE Parameters							
		Depth (feet)	**P-Y Curve Model**	**Dry Unit Weight (pcf)**	**Undrained Cohesion, Su (psf)**	**Friction Angle, ø**	**Soil Modulus Parameter (psi)**	**Static Modulus of Subgrade Reaction (pci)**	**Strain Factor, ε_{50}**
Jones Plaza	B-3	0 to 13.0	Mod. Stiff Clay With Free Water	105	500	-	-	30	0.02
		13 to 25	Sand (Reese)	115	-	32	90	-	-
		25 to 33.0	Mod. Stiff Clay Without Free Water	95	250	-	-	-	-
		33.0 to 60.0	Mod. Stiff Clay Without Free Water	125	2000	-	-	500	0.007
	B-4	0 to 14.0	Mod. Stiff Clay Without Free Water	100	1000	-	-	100	0.01
		14.0 to 18.0	Sand (Reese)	104	-	34	225	-	-
		18.0 to 43.0	Mod. Stiff Clay Without Free Water	103	2000	-	-	500	0.007
		43.0 to 48.0	Sand (Reese)	105	-	34	225	-	-
		48.0 to 58.0	Mod. Stiff Clay Without Free Water	102	1000			100	0.01
		58.0 to 60.0	Sand (Reese)	105		34	225		