Exhibit Y. Hunter Industrial Park Preliminary Geotechnical Engineering Report

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Hunter Industrial Park Preliminary Geotechnical Engineering Report

December 8, 2017

North Louisiana Economic Partnership
1803 North 18th Street, Suite 501
Monroe, Louisiana 71201

Attn: Ms. Liz Pierre

Re: Preliminary Geotechnical Site Characterization Report
Hunter Industrial Park Site
Caddo Parish, Louisiana
PSI Project No.: 0257724

Dear Ms. Pierre:

Professional Service Industries, Inc. (PSI) is pleased to submit our Preliminary Geotechnical Site Characterization Study for the Hunter Industrial Park Site. This report includes the results of our field exploration and laboratory testing, as well as information regarding the compatibility of the subject site with industrial development, suitability of soils for building foundations and on-site roadways, requirements for soil augmentation for construction of a typical 100,000 square foot industrial manufacturing building, and depth of groundwater.

We appreciate the opportunity to perform this Preliminary Geotechnical Site Characterization Report. If you have any questions pertaining to this report, please contact our office at (318) 387-2327.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.

David F. Loyless
Project Manager

Reda M. Bakeer, PhD, PE
Chief Engineer

Name: Reda M. Bakeer, PhD, PE
Date: December 8, 2017
License No.: 27123
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PROJECT INFORMATION

Project Authorization

Table 1 summarizes the Project Authorization History for the services performed and represented in this report by Professional Service Industries, Inc. (PSI).

TABLE 1: Project Authorization History

Document and Reference No.	Date	Requested/Provided By
Request for Proposal	10/12/2017	Mr. Taylor M. Gravois of CSRS
PSI Proposal Number: 225800	10/19/2017	Mr. David F. Loyless of PSI
Notice to Proceed	10/30/2017	Ms. Liz Pierre of the NLEP

Project Description

The primary objectives for this preliminary report are to provide general information regarding the general compatibility of the approximately 135-acre subject site with an industrial type development, suitability of the soils for building foundations and on-site roadways, requirements for subsoil augmentation for construction of a typical 100,000 square foot industrial manufacturing building, and the depth of groundwater at the time of the investigation. This general geotechnical site characterization report provides an initial baseline of the site subsurface conditions that will likely be encountered during future site development. However, as with any geotechnical investigation, and particularly in this case given the size of the subject site, differences in grades across the site, and the limited number of exploration locations, variations in the subsurface conditions may exist and should be expected between and away from the exploration locations. Additionally, there remains a distinct possibility that other conditions may exist within the boundaries of the site that were not encountered during the field exploration.

PSI was provided with Google Earth location files and site maps depicting the boundaries of the subject site. It is understood that the site could be developed as a petrochemical plant, and that it may include structures such as tanks, pipe racks, warehouses, and manufacturing buildings. However, no site or project specific data with regard to the proposed development or structures was available at the time of this preliminary report. It was requested that PSI perform a limited, preliminary assessment of the site, as the specific sizes, locations, and structural loads of future facilities, equipment, and other features have not been determined at this time. It was further requested that PSI provide the approximate load bearing capacity of a 14-inch square concrete pile, 14-inch diameter steel pipe pile, or other similar commonly-used geotechnical support systems typically used for this type of construction.

Detailed loading information was not provided to PSI prior to the preparation of this report. Based on topographical information provided by the Client, as well as the approximate elevation data obtained from Google Earth, it appears that the present ground surface elevation is

relatively flat across the site. Therefore, it is not anticipated that substantial new cut or fill operations will be required to reach design grades.

The preliminary geotechnical discussion presented in this report is based on the available project information and the subsurface materials described herein. The opinions and information presented in this report are preliminary in nature, are based on a limited geotechnical exploration, and should not be used for design or construction. If any of the information noted above is incorrect, please inform PSI in writing so that we may amend the comments and discussion presented in this report if appropriate and if desired by the Client.

Purpose and Scope of Services

The purpose of this preliminary study was to explore the subsurface conditions at the site and prepare a geotechnical discussion for use in evaluation of the general suitability of the subject property for support of conventional spread footings and deep foundations elements. PSI's contracted scope of services included conducting one soil boring and two Cone Penetrometer Test (CPT) soundings, performing select laboratory testing on the samples obtained from the boring, and preparing this Preliminary Geotechnical Site Characterization Study Report. However, the exploration program was subsequently modified in the field by PSI to include two additional CPT soundings. This report briefly outlines the laboratory testing procedures, presents available project information, describes the site and subsurface conditions, and offers preliminary geotechnical discussions and commentary. It should be noted that results of the analyses included in this report are based on the limited number of borings and CPT soundings performed at random and accessible locations within the approximately 135-acre property and that these values may not be representative of the entire site. They are intended to be used only for feasibility studies, planning, and cost estimating purposes and should not be used in any formal designs unless they are confirmed with a more comprehensive and project-specific geotechnical investigation.

It should be noted that a limited number of borings and soundings were conducted to evaluate the general subsoil conditions within the subject property. In view of this, and considering the size of the project site, some variations in subsoil conditions likely exist between and away from the boring/sounding locations. The geotechnical discussion provided in this preliminary report is based on the limited number of borings and soundings performed and may not apply to all parts of the site or to a particular structure. Additional borings should be performed within the footprint of each structure prior to design and construction in order to verify the subsoil conditions and develop specific geotechnical recommendations.

The scope of services did not include an environmental assessment for determining the presence or absence of wetland, or hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or around this site. Any statements in this report or on the boring log regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes. Additionally, PSI's scope of services did not include environmental sampling or performing analytical testing of soil or groundwater samples.

PSI did not provide any service to investigate or detect the presence of moisture, mold, or other biological contaminants within the project area, or any service that was designed or intended to

prevent or lower the risk of the occurrence or amplification of the same. The Client should be aware that mold is ubiquitous to the environment, with mold amplification occurring when building materials are impacted by moisture. The Client should also be aware that site conditions are outside of PSI's control, and that mold amplification will likely occur or continue to occur in the presence of moisture. As such, PSI cannot and shall not be held responsible for the occurrence or recurrence of mold amplification.

FIELD AND LABORATORY PROCEDURES

PSI's contracted scope of services included drilling one traditional rotary boring to a depth of approximately 40 feet and performing two CPT soundings to a depth of about 100 feet each at random and accessible locations within the project site. However, practical refusal was encountered in a competent sand stratum in Sounding CPT-1 at a depth of approximately 55 feet and in Sounding CPT-2 at a depth of about 85 feet. Therefore, Boring B-1 was extended to a depth of approximately 50 feet, and two additional CPT soundings (Soundings CPT-1-2 and CPT-1-3) were conducted in the general area of Sounding CPT-1. The additional soundings were conducted in an effort to penetrate to the proposed depth of 100 feet and to confirm the presence, thickness, and density of the competent sand stratum. Despite these additional efforts, neither of the additional soundings in the area of Sounding CPT-1 were able to penetrate beyond a depth of approximately 55 feet. It should be noted that practical refusal is defined by both the subsoil conditions and rig specifications. CPT soundings are terminated when significant penetration resistance is encountered that could damage the electronic sensors of the cone tip or sleeve. Therefore, it is recommended that if future geotechnical investigations of the site require deeper borings or soundings, a heavier drilling rig should be utilized. The Boring/Sounding Location Plan included in the Appendix should be consulted for the approximate relative locations of the boring and soundings.

The boring and sounding locations and original depths were selected by PSI and were located in the field by PSI personnel using a furnished site plan and handheld GPS equipment. The boring and soundings were performed using a Geoprobe 7822DT ATV drilling rig. Hollow-stem auger drilling techniques were used to advance the borehole. Samples were generally obtained continuously from the ground surface to a depth of about 10 feet, and at maximum intervals of five feet thereafter.

The soil boring was sampled using the Standard Penetration Test (ASTM D1586) and Shelby Tube samplers (ASTM D1587). The samples were identified according to boring number and depth, placed in polyethylene plastic wrapping to reduce moisture loss, and transported to PSI's laboratory in West Monroe, Louisiana. The CPT soundings were performed in general accordance with ASTM D5778.

All samples obtained during the field exploration were visually classified and evaluated by experienced geotechnical personnel upon arrival at the laboratory. Selected soil samples were tested in the laboratory to determine material properties for our evaluation. The limited geotechnical laboratory testing program included water content, Atterberg limits, percent passing the U.S. Standard No. 200 sieve, and unconfined compressive strength testing.

Additional estimates of unconfined compressive strength were obtained through the use of a hand penetrometer.

The geotechnical laboratory testing was conducted in general accordance with applicable ASTM procedures. The results of the laboratory tests are presented in the boring log in the Appendix. The samples which were not altered by laboratory testing will be retained for 60 days from the date of this report and will then be discarded.

SITE AND SUBSURFACE CONDITIONS

Site Location and Description

The approximately 135-acre site is located on the west side of Corporate Drive in Caddo Parish, Louisiana. The Latitude and Longitude near the center of the site are approximately N 32.53817° and W 93.78266°, respectively. At the time of PSI's field exploration, the property was heavily-wooded with several cleared utility rights-of-way extending throughout the property. The property is generally bounded by Twelve-Mile Bayou to the north, south, and west, and by Corporate Drive and several existing businesses to the east.

Site Geology

The United States Geological Survey (USGS) maps the site as located within the Natural Levees Formation (Red River Region). The Natural Levees Formation is generally characterized by silts, silty clays, and some sands. It should be noted that due to the size of the site, practical refusal encountered at relatively shallow depths, variations in geological formations, and limited exploration locations, all of the characteristics of the above formations may not be reflected in the soil borings and CPT soundings of this limited investigation.

Subsurface Conditions

Based on the field observations and the results of the limited laboratory testing, the soils were classified and the boring log and CPT summary data reports were developed. The boring log and CPT summary data reports are included in the Appendix along with a key to the terms and symbols used on the log. Based on the boring and CPT soundings, the subsurface materials encountered appear to be fairly consistent across the site. A generalized soil profile is presented in Table 2.

TABLE 2: Generalized Soil Profile (Soundings CPT-1 through CPT-1-3)

Depth Range (feet)[1]	Approximate Elevation (feet)[2]	Generalized Soil Description
0 to 4	+165 to +161	Firm Lean Clay
4 to 28	+161 to +137	Firm to Stiff Fat Clay
28 to 50	+137 to +115	Loose to Medium Dense Sands
50 to 63	+115 to +102	Firm to Stiff Clays
63 to 85	+102 to +80	Medium Dense to Very Dense Sands

1. Depth is measured from the existing ground surface at the time of drilling.
2. Elevations are based on the provided topographic map compared with Google Earth elevation data.

As previously discussed, practical refusal was encountered at a relatively shallow depth (i.e., about 52 feet) in the area of Sounding CPT-1 due to encountering what appeared to be a very dense sand stratum. In addition, Sounding CPT-2 also encountered practical refusal in what appears to be a very dense sand stratum at a depth of approximately 85 feet. While no borings or soundings extended to the full planned penetration of 100 feet, the exploration indicates that competent sand strata are present within the subgrade. It also indicates that the near-surface fat clay soils below about four feet have a moderate shrink/swell potential which should be accounted for in the design of any shallow foundations. Otherwise, these soils are generally fair in bearing quality and suitable for support of lightly to moderately loaded structures. In addition, the CPT refusal encountered at the various locations indicates the presence of competent soil strata that would offer good shaft resistance and toe support for a deep foundation system.

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics at the presently accessible exploration locations. The boring logs and CPT summary data reports included in the Appendix should be reviewed for specific information at the individual exploration locations. These records include soil descriptions, stratifications, penetration resistances, and locations of the samples and laboratory test data. The stratifications shown on the logs represent the conditions only at the actual exploration locations. Variations may occur and should be expected between and away from the exploration locations. The stratifications represent the approximate boundary between subsurface materials, but the actual transition may be more gradual.

Water Level Measurements

Free groundwater was encountered in Boring B-1 at approximately 20 feet below the existing ground surface during drilling. A pore pressure dissipation test performed at the location of Sounding CPT-2 indicates the presence of groundwater as shallow as about 16 feet. However, it should be noted that the groundwater information presented in this report is based on site conditions that were present at the time of our relatively short field activities at the presently accessible areas of the site. Groundwater can fluctuate based on variations in rainfall, evaporation, surface runoff, stage of the adjacent Twelve-Mile Bayou and/or the nearby Red River, and other hydro-geologic factors. Considering the size of the site and the limited number of exploration locations, it is likely that the depth and/or elevation of groundwater could vary across the site. PSI recommends that the Contractor determine the actual groundwater depth at the time of construction activities.

GEOTECHNICAL DISCUSSION

The types and depth of foundations suitable for a given structure depend primarily on several factors including the subsurface conditions, the function of the structure, the loads it may carry, the cost of the foundation, the amount of fill or excavation needed, and the criteria set by the

Design Engineer with respect to vertical and differential movements which the structure can withstand without experiencing damage.

Based on the limited field exploration and the field and laboratory test results, the proposed site is generally considered compatible for industrial development, depending on the type, function, and anticipated loads of the proposed structure(s). In addition, the soils at the boring/sounding locations indicate that they are suitable for building foundations and/or construction of on-site roadways or railways following proper preparation and the required cut/fill in the areas of the specific structures. However, as stated previously, the information presented in this preliminary report is provided for planning purposes only; they are based on a very limited geotechnical exploration and are not intended for use in final design and construction. A detailed geotechnical investigation will be necessary prior to design of any proposed structures.

The choice of the type of foundation to be used for support of a specific structure should be based on the tolerance criteria for the performance of the structure and economics of construction. Ground-supported shallow foundations or surface improvements will likely be governed by the anticipated loads and settlement tolerances, particularly where a significant amount of new fill is placed. The preliminary allowable bearing capacities for shallow foundations provided in this report are based on the existing site grades at the exploration locations, and may not reflect the bearing capacities at the final design elevation(s) once site grading has been performed. Due to the presence of medium dense sands encountered at relatively shallow depths in the boring and soundings, it is believed that driven piles could be difficult to install without performing predrilling to avoid damaging the piles, and therefore, if deep foundations are to be used for support of a given structure, consideration could be given to the use of straight-sided drilled shafts, auger cast-in-place (ACIP) piles, open-ended steel pipe piles, or steel H-piles.

Potential Vertical Rise

The estimated amount of vertical movement of a foundation or floor slab constructed on swelling clays is referred to as Potential Vertical Rise (PVR). The PVR is affected by the physical characteristics of the foundation soils and their moisture contents. The near-surface fat clay soils identified in Boring B-1 have moderate moisture contents that are very close to their plastic limits, making them somewhat susceptible to shrink/swell cycles should the moisture content vary over time. Therefore, if shallow foundations are considered in the design, consideration should be given to the proximity of the foundations to the fat clay stratum, as remediation of the subgrade may be required in order to minimize the detrimental effects of the expansive clays.

Site Preparation

Prior to construction, positive drainage and collection of surface water should be established throughout the site and maintained throughout the duration of the construction period. Site preparation requirements will vary throughout the relatively large property and will depend on the structure type, foundation system, amount of cut/fill, etc., and should be established once a specific project features have been identified.

As previously discussed, at the time of PSI's field exploration, the site was heavily-wooded. It should be noted that the moisture demands of trees depend on their species and maturity, as well as the lateral and vertical extents of their root systems. Cutting existing trees in the vicinity of a foundation system could trigger volumetric changes in the surrounding soils within the influence zones of the tree root systems. In view of this, development plans should consider the impact of the trees on the long-term performance of any planned structures and their foundation systems. Mature trees which are to be removed should be cut as far in advance of construction as practical to allow for the groundwater at the site to stabilize prior to proceeding with construction of the foundations.

Shallow Foundations

Provided the site is properly prepared, it is believed that shallow foundation systems using spread and/or continuous footings bearing at least 24 inches below final grade could be designed for a minimum net allowable soil bearing capacity of approximately 1,500 psf. This assumes that the footings are supported on naturally occurring firm to stiff clay or compacted structural fill. However, as previously discussed, this value is based on the near-surface soils encountered at the exploration locations, and a detailed geotechnical investigation should be performed prior to the design or construction of any specific structure(s). If encountered, very soft or loose near-surface soils may require remediation or replacement prior to construction of shallow foundations.

Deep Foundations

As previously discussed, due to the presence of medium dense sands encountered at relatively shallow depths in the boring and soundings, it is believed that long driven piles could be difficult to install, and therefore, if deep foundations are to be used for support of a given structure, consideration could be given to the use of straight-sided drilled shafts, ACIP piles, open-ended steel pipe piles, or steel H-piles. As previously discussed, the CPT refusal encountered at various depths indicates the presence of competent soil strata that would offer good shaft resistance and toe support for a deep foundation system.

PSI has provided capacity recommendations in Table 3 for 14-inch diameter straight-sided drilled shafts or ACIP piles for use in feasibility studies, planning, and cost estimating purposes. These allowable capacity estimates are based on the results of our limited field and laboratory testing and assume proper design and installation. The allowable axial capacity in compression is the summation of the allowable friction resistance and the allowable toe resistance. The allowable axial capacity in tension (uplift) is the allowable frictional resistance and the effective weight of the shaft, neglecting the toe resistance component. The allowable capacities were estimated using factors of safety of 2.0 for compression and 3.0 for tension, which assumes that a static load test will be performed. If a field load test is not performed, PSI recommends using a factor of safety of 3.0 for compression to determine the allowable capacities.

TABLE 3: Estimated Allowable Capacities for Straight-Sided Drilled Shafts or ACIP Piles

Embedment Depth (feet)*	14-inch Diameter (tons)	
	Compression	Tension
30	15	12
35	25	15
40	40	25
45	50	30
50	60	35
55	62	40
60	65	42
65	70	45
70	80	50
75	90	55

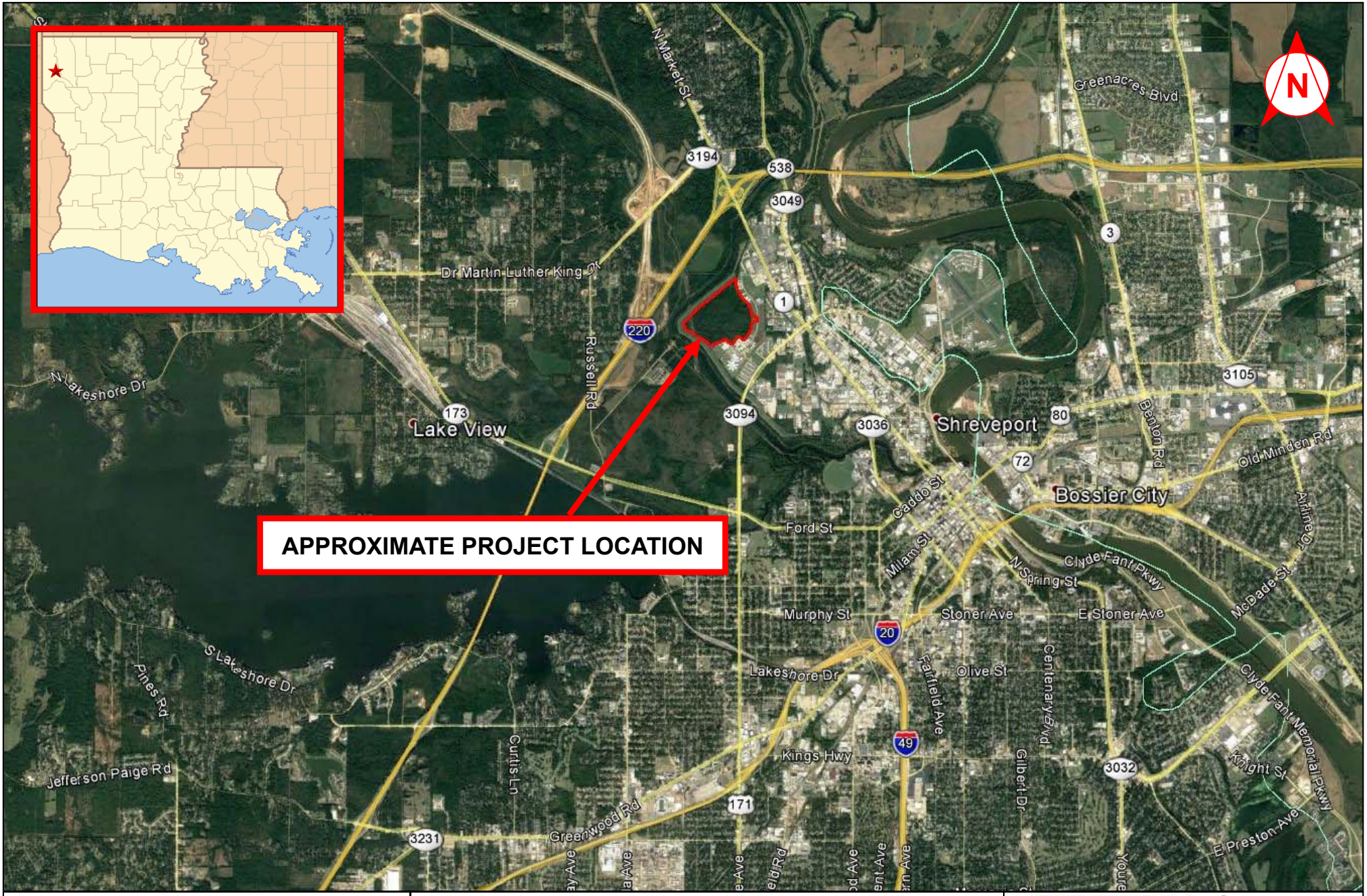
* Embedment depth is based on the existing grade at the time of the field exploration.

As previously discussed, detailed structural loads are not known at this time since no specific project or structures are being considered for construction. Based on topographical information provided by the Client, as well as elevation data obtained from Google Earth, it is not anticipated that significant cut or fill will be required to achieve design grades. However, it should be noted that when fill is placed on a site, any underlying compressible soils consolidate, resulting in areal settlement. As these compressible soils consolidate, downdrag (or "negative skin friction") loads may be imposed on the drilled shafts or ACIP piles, effectively increasing the total downward load. Therefore, if significant fill is to be placed on the site, additional provisions should be provided to account for downdrag loads, settlement, group effect, lateral loads, dynamic excitation, etc.

REPORT LIMITATIONS

The information and preliminary recommendations presented in this report are based on the available project information and the subsurface materials encountered at the specific exploration locations described in this report. The geotechnical investigation conducted for this report is preliminary in nature and is not to be used for construction. It is not intended to provide any opinions on the geotechnical performance of any specific structure or equipment, as such opinions would require further investigation and specific analyses. The actual conditions in specific areas of the site may vary from those encountered in the borings performed as part of this report. This preliminary report has been prepared for the exclusive use of CSRS and the North Louisiana Economic Partnership for the proposed Hunter Industrial Park site in Caddo Parish, Louisiana.

Appendix



PRELIMINARY GEOTECHNICAL SITE CHARACTERIZATION REPORT
HUNTER INDUSTRIAL PARK
CADDO PARISH, LOUISIANA

SITE VICINITY MAP

PSI PROJECT NO.: 0257724
GOOGLE EARTH IMAGERY DATE: 10/30/2016

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PRELIMINARY GEOTECHNICAL SITE CHARACTERIZATION REPORT
HUNTER INDUSTRIAL PARK
CADDO PARISH, LOUISIANA

BORING/SOUNDING LOCATION PLAN

PSI PROJECT NO.: 0257724
GOOGLE EARTH IMAGERY DATE: 10/30/2016

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LOG OF BORING B-1

Hunter Industrial Park
Caddo Parish, Louisiana

TYPE OF BORING: Hollow Stem Auger | LOCATION: See Boring Location Plan | PSI Project No.: 0257724

DEPTH, FT.	SOIL TYPE	USCS SYMBOL	SAMPLES	SOIL DESCRIPTION	N-BLOWS/FT.	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	% PASSING No. 200 SIEVE	SHEAR STRENGTH (tsf) ○ HP ● UC △ TV ▲ UU (0.0 1.0 2.0 3.0)	SHEAR STRENGTH (tsf) HAND PEN (tsf)	UC (tsf)	TORVANE (tsf)	UU (tsf)	UNIT DRY WEIGHT (pcf)
		CL		3 inches of Topsoil												
				Firm Brown **LEAN CLAY**	7	19				99						
2.5						20	47	21	26			0.75				
		CH		Firm to Stiff Brown **FAT CLAY**		25						0.75				
5.0																
						25	74	26	48	99		0.75				
7.5																
						29						0.75	0.53			91
10.0																
12.5																
						26	81	24	57			1.00	0.93			94
15.0																
17.5																
				▽		31				98		0.50	0.36			92
20.0																
22.5																
						33	76	26	50			0.50	0.43			93
25.0																
27.5																
		CL		Soft Tan **SANDY LEAN CLAY**	2	29				69						
30.0																
32.5																
		SC		Loose Tan **CLAYEY SAND**	4	30				47						
35.0																
37.5																
		SM		Very Loose Tan **SILTY SAND**	1	21				13						
40.0																
42.5																
		SP-SM		Medium Dense Brown **SAND with Silt**	17	20										
45.0																
47.5																
					11	21				9						
50.0				Boring Terminated at 50 Feet												

DEPTH OF BORING: 50 FEET
DATE DRILLED: 12/1/17
NOTE:

▽ GROUNDWATER DURING DRILLING: 20 Feet
▼ GROUNDWATER UPON COMPLETION: Not Measured
▼ DELAYED GROUNDWATER: N / A

BORINGLOG_WESTMONROE - PSIHOUSTON.GDT - 12/8/17 12:41 - 0257

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Engineering • Consulting • Testing
Professional Service Industries, Inc.
1853 New Natchitoches Road
West Monroe, Louisiana 71292
Telephone: (318) 387-2327

CPT: CPT-1

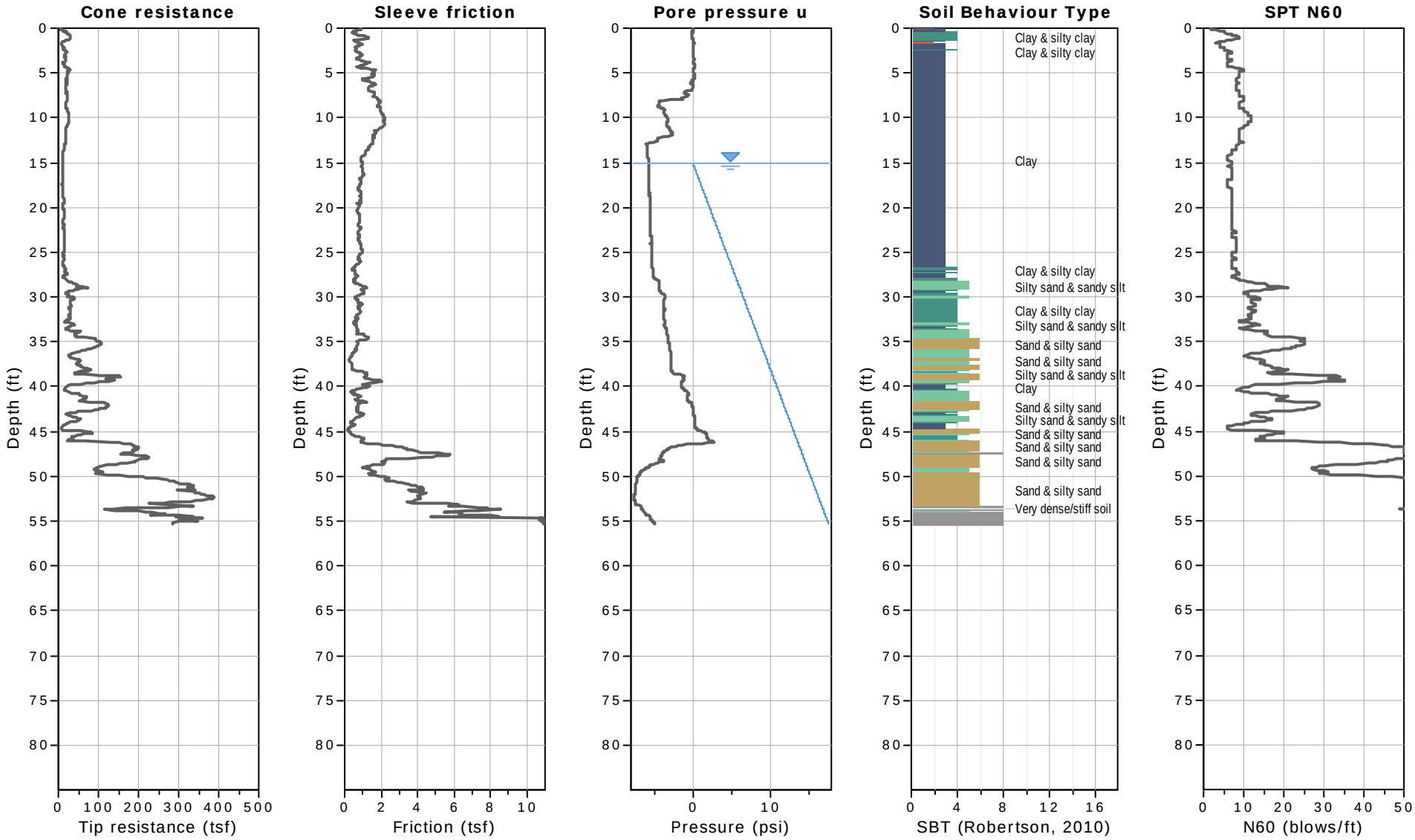
Total depth: 55.25 ft, Date: 11/30/2017

Cone Type: 60° 1.4" Diam. Type 2 Electric Cone Penetrometer

Cone Operator: Dee Keltner

Project: 0257728 - Poly Processing - New Building

Location: Monroe, Louisiana



CPT: CPT-1-2

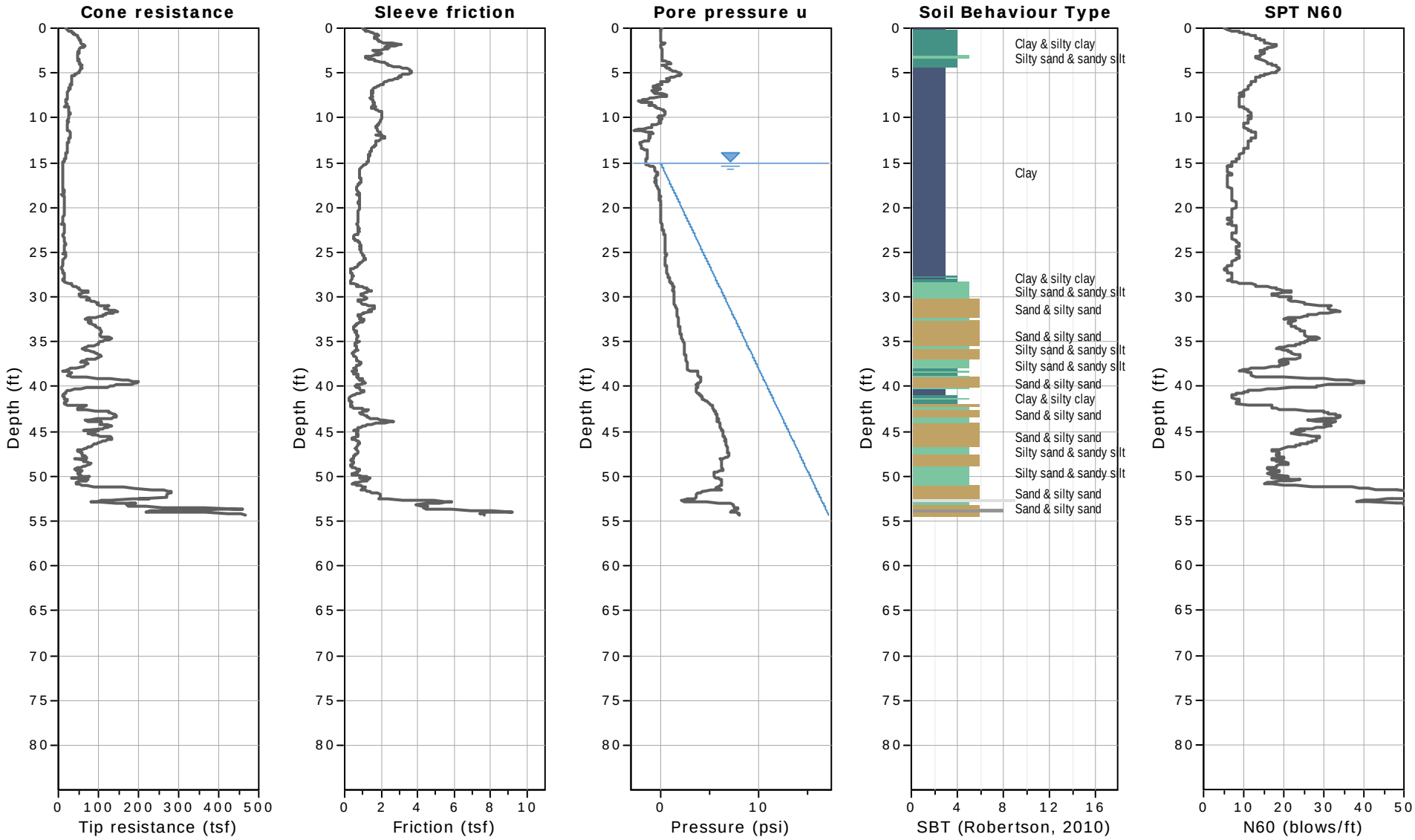
Total depth: 54.27 ft, Date: 11/30/2017

Cone Type: 60° 1.4" Diam. Type 2 Electric Cone Penetrometer

Cone Operator: Dee Keltner

Project: 0257728 - Poly Processing - New Building

Location: Monroe, Louisiana



CPT: CPT-1-3

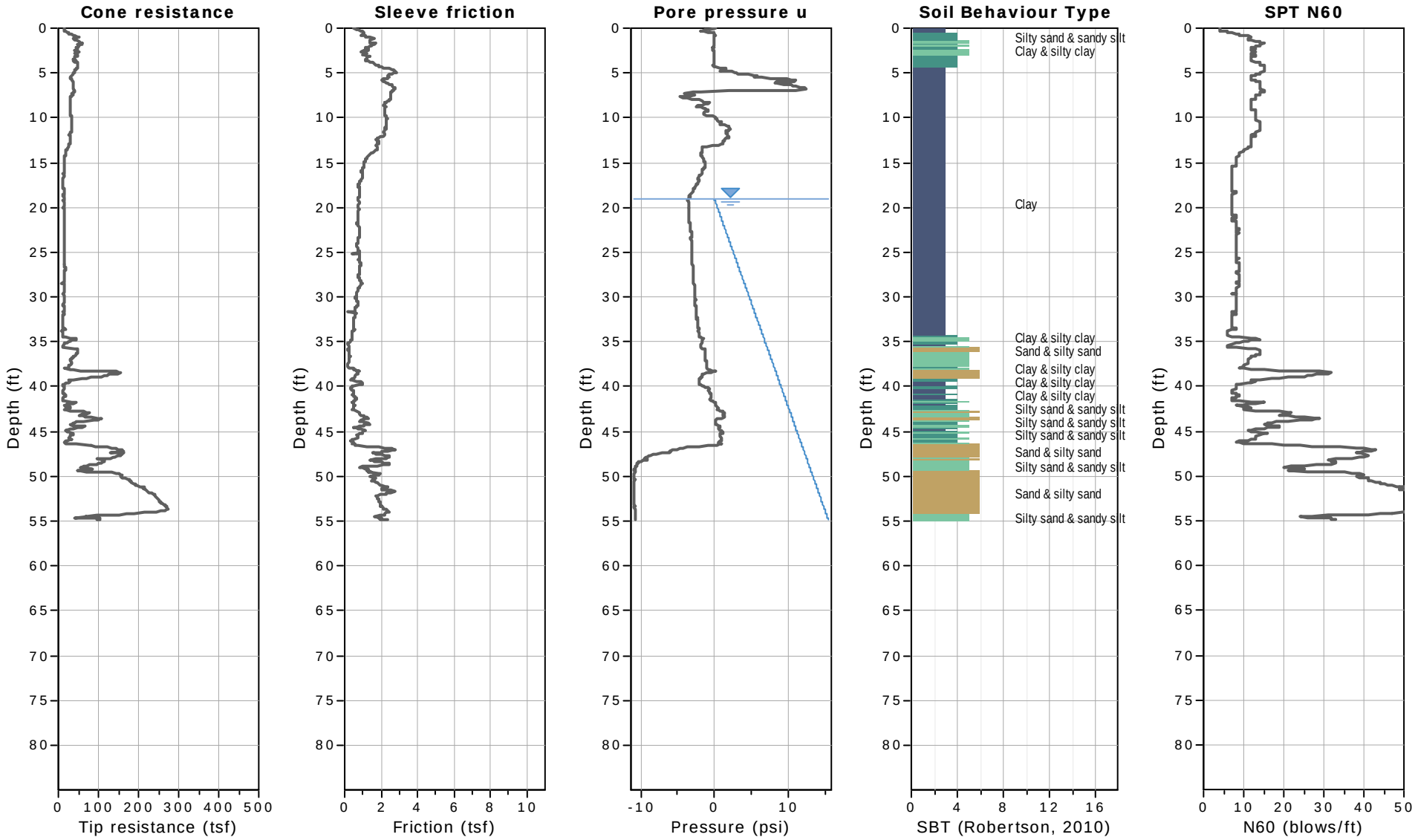
Total depth: 54.86 ft, Date: 12/1/2017

Cone Type: 60° 1.4" Diam. Type 2 Electric Cone Penetrometer

Cone Operator: Dee Keltner

Project: 0257728 - Poly Processing - New Building

Location: Monroe, Louisiana



CPT: CPT-2

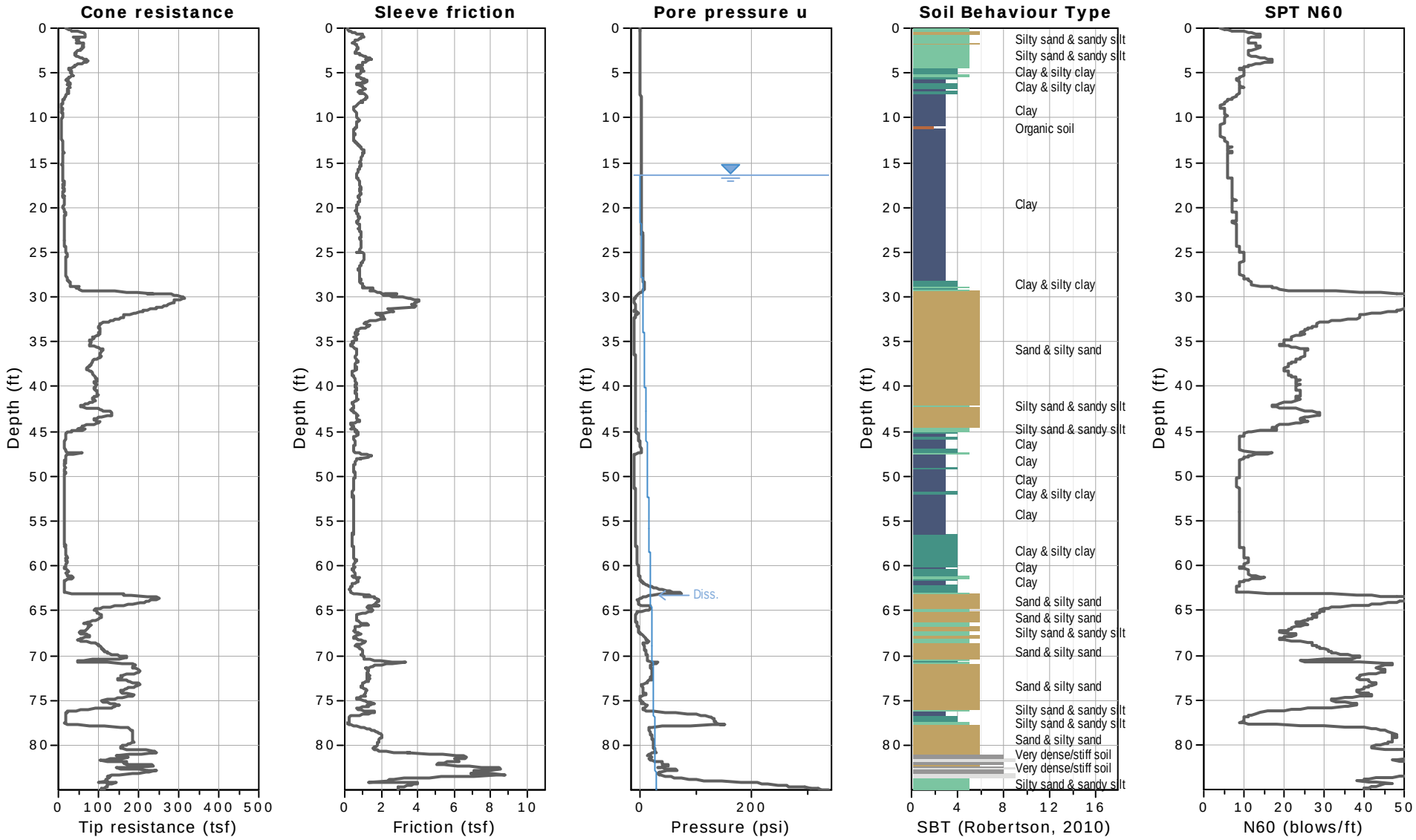
Total depth: 84.97 ft, Date: 11/30/2017

Cone Type: 60° 1.4" Diam. Type 2 Electric Cone Penetrometer

Cone Operator: Dee Keltner

Project: 0257728 - Poly Processing - New Building

Location: Monroe, Louisiana



GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
RC: Rock Core
TC: Texas Cone
BS: Bulk Sample
PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,⧩ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

Q_U - TSF	N - Blows/foot	Consistency
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

Description	Criteria
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term	% Dry Weight
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

Description	Criteria
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided:	Fracture planes appear polished or glossy, sometimes striated
Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed:	Inclusion of small pockets of different soils
Layer:	Inclusion greater than 3 inches thick (75 mm)
Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

Q_U - TSF	Consistency
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

Description	Criteria
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

Voids	Void Diameter
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

Component	Size Range
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

Rock Mass Description	RQD Value
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

DEGREE OF WEATHERING

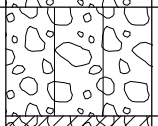
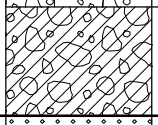
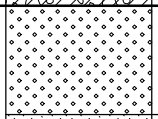
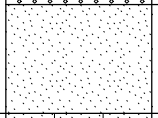
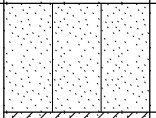
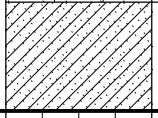
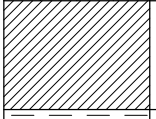
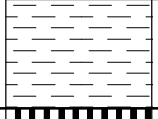
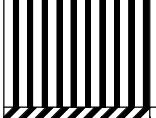
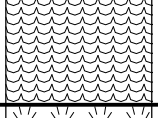
Slightly Weathered: Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.

Weathered: Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.

Highly Weathered: Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS: GRAPH	SYMBOLS: LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

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