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Engineering

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RE: GEOTECHNICAL REPORT TRANSMITTAL

The City of Tulsa provides the attached document(s) with the following conditions:

- A. The Geotechnical Report is not part of the construction documents. The Geotechnical Report is provided for informational purposes only, to assist the Contractor in understanding the general subsurface conditions at the site. The report presents the data and findings of the geotechnical engineer at the specific boring locations and times of the investigation.
- B. The Contractor is solely responsible for all interpretations, conclusions, and deductions drawn from the Geotechnical Report concerning the conditions at the site affecting the execution of the Work, including, but not limited to, the subsurface conditions, the scope of work, means, methods, sequencing, and pricing.
- C. The City makes no warranty or representation, express or implied, as to the accuracy, completeness, or interpretations of the data, information, and representations contained in the Geotechnical Report. The information provided is not a substitute for the Contractor's own independent investigation, judgment, and expertise.
- D. The Contractor shall visit the site and make their own investigations. This will include any borings, additional borings, and/or testing to determine actual subsurface conditions and the conditions under which the Bid is to be prepared, and the Work is to be performed.

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April 19, 2024
Kleinfelder Project No.: 24004482.001A

Mr. Jacob Brumbaugh, PE
Project Manager
RJN Group, Inc.
4150 S. 100th E. Avenue, Suite 106
Tulsa, Oklahoma 74146

**Subject: Report for Subsurface Investigation and Laboratory Testing Services
TMUA Spunky Creek MS South Phase 3
West Side of S. 193rd E. Ave. btw E. 31st St. & E. 41st St
Tulsa, Oklahoma**

Dear Mr. Brumbaugh:

Kleinfelder has completed the authorized subsurface exploration and laboratory testing services for the above referenced project. Kleinfelder conducted the fieldwork by drilling nine (9) soil test borings (B-1 through B-4 and B-6 through B-10) on April 8 and 9, 2024. Due to access restriction, the original planned boring B-5 was eliminated. The borings were located in the field by a Kleinfelder representative using a hand-held Global Positioning System (GPS) with an accuracy of approximately 15 feet. The general site location and the approximate boring locations are shown on Figure 1, Boring Location Map.

FIELD EXPLORATION PROGRAM

The soil test borings were advanced with a Geoprobe 7822DT rotary drill rig using hollow stem augers and rock coring techniques. Representative soil samples were obtained by split-barrel sampling procedures (ASTM D1586) at 5 feet intervals. The split-barrel sampling procedure utilizes a standard 2-inch O.D. split-barrel sampler that is driven into the bottom of the boring with a 140-pound auto-hammer (90% efficiency) falling 30 inches. Bedrock encountered in boring B-4 was cored to 23 feet below the existing grade. Recoveries and Rock Quality Designation (RQD) were recorded in the field and are presented in the boring log.

The collected soil and rock samples were sealed and returned to our laboratory for further examination, classification, and testing. All the borings were backfilled in accordance with the appropriate Oklahoma Water Resources Board (OWRB) regulations.

Field logs included visual classification of the materials encountered during drilling, as well as drilling characteristics. Stratification boundaries indicated on the boring logs are based on observations during our fieldwork, an extrapolation of information obtained by examining samples from the borings, and comparisons of soils with similar engineering characteristics. Locations of these boundaries are approximate, and the transitions between material types may be gradual rather than clearly defined. The boring logs are attached in Attachment A.

LABORATORY TESTING PROGRAM

Laboratory tests, including sieve gradations, Atterberg limits and moisture contents, were performed on selected samples for classification purposes in general accordance with applicable standards. In addition, rock unconfined compressive strength tests were also performed for rock core samples obtained from boring B-4. Soil samples were also visually classified in accordance with the Unified Soil Classification System (USCS). All the lab results are presented in Table B-1 in Attachment B, and also are presented on each respective log.

GROUNDWATER OBSERVATIONS

Groundwater depth observations were made and recorded during and after completion of drilling operations, where applicable. The borings were advanced using a combination of hollow stem augers and rock coring techniques.

Rock coring technique, which requires the introduction of water as a drilling fluid, was utilized to core the bedrock in boring B-4. Therefore, groundwater observations were not obtained below the depth where rock coring procedure was started or after completion of the drilling operations in boring B-4. The results of the groundwater observations are summarized in Table 1.

Table 1. Groundwater Summary			
Borings	Termination Depths (ft)	Groundwater Depth/Elevation During Drilling (ft)	Groundwater Depth/Elevation End of Drilling (ft)
B-1	19.0	18.5	7
B-2	15.0	8.5	NE
B-3	16.0	NE	NE
B-4	23.0	3.5	NA
B-5	Abandoned due to access issue		
B-6	16.0	NE	NE
B-7	14.5	NE	NE
B-8	10.0	8.5	7
B-9	14.0	NE	9.5
B-10	19.5	NE	NE

The materials encountered in the test borings have a wide range of permeabilities and observations over an extended period through the use of piezometers or cased borings would be required to better define current groundwater conditions. Piezometers were not installed at the site during this subsurface exploration. Fluctuations in groundwater levels can occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the borings were performed. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

SUBSURFACE CONDITIONS

Overburden Soil: Overburden soils, consisting of primarily lean and fat clay with varying amounts of sand and gravel, were encountered underneath the topsoil and continued to depths ranging from 1 to 8 feet below existing grade. The consistencies of the clay soils ranged from medium stiff to very stiff.

Bedrock: Shale and limestone bedrocks with varying degrees of weathering were encountered below the overburden soils at depths ranging from 1 to 8 feet below existing grade. The shale and limestone bedrocks were predominantly dark gray and gray in color. The hardnesses of both bedrocks ranged from extremely weak to strong. A summary of the subsurface materials is also presented in Table 2.

Table 2. Summary of Subsurface Materials				
Borings	Overburden Soil	Depth to Weathered Rock (ft)	Depth to Competent Bedrock (ft)	Boring Termination Depth (ft)
B-1*	Lean Clay	7.5	9.5	19.0
B-2*	Fat Clay	7	14.5	15.0
B-3*	Fat Clay	7	9.5	16.0
B-4	Lean Clay	1	4	23.0
B-5	Abandoned due to access issue			
B-6*	Lean Clay	8	9	16.0
B-7	Lean Clay	7	8.5	14.5
B-8*	Fat Clay	7	8.5	10.0
B-9*	Fat Clay	8	11	14.0
B-10	Fat Clay	7.5	14.5	19.5

*Borings were terminated at auger refusal on top of bedrock prior to planned termination depths.

EXCAVATION

Excavations of trenches for the proposed sewer line will encounter weak to strong shale and limestone bedrocks. Pneumatic hammer and/or blasting are likely to be required during construction. It is the contractor’s responsibility to carefully review our boring logs and rock unconfined compressive strength results and determine the appropriate excavation methods for the construction.

LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder’s profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

The report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two years from the date of this report. The work performed was based on project information provided by the Client.


CLOSING

We appreciate the opportunity to be of service to you on this project. Please call us if you have any questions concerning the information presented within this letter.

Sincerely,

KLEINFELDER, INC.

Certificate of Authorization #7292, Expires 6/30/25



Subásh Bhandari
Staff Professional II



Shiyun (Simon) Wang, PE
Senior Professional

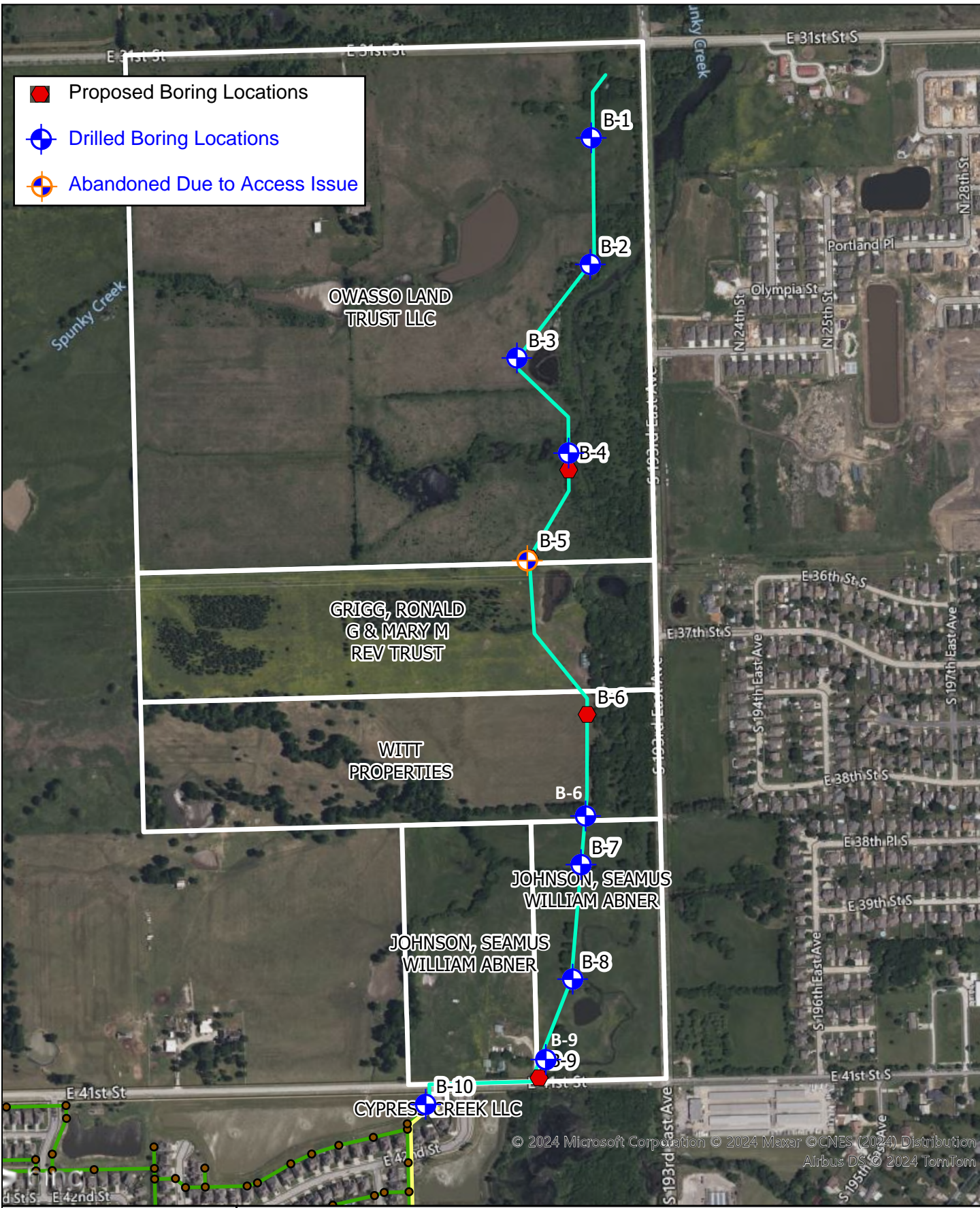
Attachments:

- Figure 1 Boring Location Map
- Attachment A Field Exploration Program
- Attachment B Laboratory Testing Program
- Attachment C GBA Documents



KLEINFELDER

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PROJECT NO.	24004482.001A
DRAWN:	4/18/2024
DRAWN BY:	SB
CHECKED BY:	SYB
FILE NAME:	FIGURE

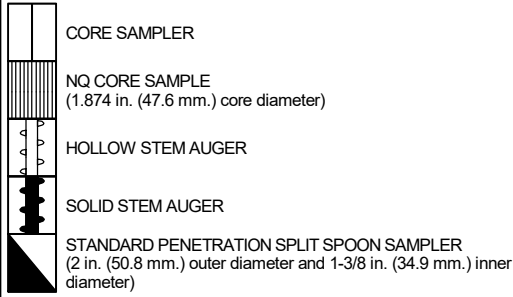
BORING LOCATIONS MAP

TMUA Spunky Creek MS South Phase 3
 West Side of S. 193rd E. Ave.
 Between E. 31st Street & E. 41st Street
 Tulsa, Oklahoma

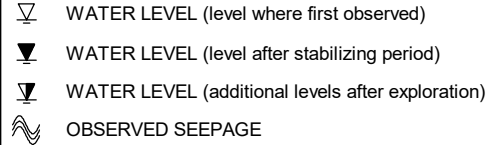
FIGURE:

1

DRILLING METHOD/SAMPLER TYPE GRAPHICS



GROUND WATER GRAPHICS



NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Solid lines separating strata on the logs represent approximate boundaries only, dashed lines are inferred or extrapolated boundaries. Actual transitions may be gradual or differ from those represented.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System (ASTM D2488/D2487) designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, i.e., CL-ML, GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

ABBREVIATIONS

- C_u - Coefficients of Uniformity
- C_c - Coefficients of Curvature
- WOH - Weight of Hammer
- WOR - Weight of Rod

REFERENCES

1. American Society for Materials and Testing (ASTM), 2011, ASTM D2487: Classification of Soils for Engineering Purposes (Unified Soil Classification System).

UNIFIED SOIL CLASSIFICATION SYSTEM¹

GRAVELS (More than 50% of coarse fraction retained on No. 4 Sieve)	CLEAN GRAVEL WITH <5% FINES	GW	WELL-GRADED GRAVEL, WELL-GRADED GRAVEL WITH SAND
		GP	POORLY GRADED GRAVEL, POORLY GRADED GRAVEL WITH SAND
	GRAVELS WITH 5% TO 12% FINES	GW-GM	WELL-GRADED GRAVEL WITH SILT, WELL-GRADED GRAVEL WITH SILT AND SAND
		GW-GC	WELL-GRADED GRAVEL WITH CLAY (OR SILTY CLAY), WELL-GRADED GRAVEL WITH CLAY AND SAND (OR SILT CLAY AND SAND)
		GP-GM	POORLY GRADED GRAVEL WITH SILT, POORLY GRADED GRAVEL WITH SILT AND SAND
		GP-GC	POORLY GRADED GRAVEL WITH CLAY (OR SILTY CLAY), POORLY GRADED GRAVEL WITH CLAY AND (OR SILTY CLAY AND SAND)
GRAVELS WITH > 12% FINES	GM	SILTY GRAVEL, SILTY GRAVEL WITH SAND	
	GC	CLAYEY GRAVEL, CLAYEY GRAVEL WITH SAND	
	GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL WITH SAND	
COARSE GRAINED SOILS (More than 50% retained on No. 200 Sieve)	CLEAN SANDS WITH <5% FINES	SW	WELL-GRADED SAND, WELL-GRADED SAND WITH GRAVEL
		SP	POORLY GRADED SAND, POORLY GRADED SAND WITH GRAVEL
	SANDS WITH 5% TO 12% FINES	SW-SM	WELL-GRADED SAND WITH SILT, WELL-GRADED SAND WITH SILT AND GRAVEL
		SW-SC	WELL-GRADED SAND WITH CLAY (OR SILTY CLAY), WELL-GRADED SAND WITH CLAY AND GRAVEL (OR SILTY CLAY AND GRAVEL)
		SP-SM	POORLY GRADED SAND WITH SILT, POORLY GRADED SAND WITH SILT AND GRAVEL
		SP-SC	POORLY GRADED SAND WITH CLAY, POORLY GRADED SAND WITH CLAY AND GRAVEL (OR SILTY CLAY AND GRAVEL)
	SANDS WITH > 12% FINES	SM	SILTY SAND, SILTY SAND WITH GRAVEL
		SC	CLAYEY SAND, CLAYEY SAND WITH GRAVEL
		SC-SM	SILTY, CLAYEY SAND, SILTY, CLAYEY SAND WITH GRAVEL
FINE GRAINED SOILS (50% or more passes the No. #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)	ML	SILT, SILT WITH SAND, SILT WITH GRAVEL
		CL	LEAN CLAY, LEAN CLAY WITH SAND, LEAN CLAY WITH GRAVEL
		CL-ML	SILTY CLAY, SILTY CLAY WITH SAND, SILTY CLAY WITH GRAVEL
	SILTS AND CLAYS (Liquid Limit 50 or greater)	OL	ORGANIC CLAY, ORGANIC CLAY WITH SAND, ORGANIC CLAY WITH GRAVEL, ORGANIC SILT, ORGANIC SILT WITH SAND, ORGANIC SILT WITH GRAVEL
		MH	ELASTIC SILT, ELASTIC SILT WITH SAND, ELASTIC SILT WITH GRAVEL
		CH	FAT CLAY, FAT CLAY WITH SAND, FAT CLAY WITH GRAVEL
	OH	ORGANIC CLAY, ORGANIC CLAY WITH SAND, ORGANIC CLAY WITH GRAVEL, ORGANIC SILT, ORGANIC SILT WITH SAND, ORGANIC SILT WITH GRAVEL	

NOTE: USE MATERIAL DESCRIPTION ON THE LOG TO DEFINE A GRAPHIC THAT MAY NOT BE PROVIDED ON THIS LEGEND.

	PROJECT NO.: 24004482.001A	GRAPHICS KEY TMUA Spunky Creek MS South Phase 3 West Side of S. 193rd E. Ave. Between E. 31st Street & E. 41st Street Tulsa, Oklahoma	FIGURE
	DRAWN BY: SB CHECKED BY: SYW DATE: 4/16/2024		A-1

GRAIN SIZE¹

DESCRIPTION	SIEVE SIZE	GRAIN SIZE
Boulders	>12 in.	>12 in. (304.8 mm.)
Cobbles	3 - 12 in.	3 - 12 in. (76.2 - 304.8 mm.)
Gravel	coarse	3/4 - 3 in. (19 - 76.2 mm.)
	fine	#4 - 3/4 in. (0.19 - 0.75 in. (4.8 - 19 mm.)
Sand	coarse	#10 - #4 (0.079 - 0.19 in. (2 - 4.9 mm.)
	medium	#40 - #10 (0.017 - 0.079 in. (0.43 - 2 mm.)
	fine	#200 - #40 (0.0029 - 0.017 in. (0.07 - 0.43 mm.)
Fines	Passing #200	<0.0029 in. (<0.07 mm.)

SECONDARY CONSTITUENT¹

Term of Use	AMOUNT	
	Secondary Constituent is Fine Grained	Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

PLASTICITY¹

DESCRIPTION	CRITERIA
Non-Plastic	A 1/8 in. (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

MOISTURE CONTENT¹

DESCRIPTION	FIELD TEST
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

CONSISTENCY - FINE-GRAINED SOIL^{2,3}

CONSISTENCY	SPT - N (# blows / ft)	Pocket Pen (tsf)	UNCONFINED COMPRESSIVE STRENGTH (Q _u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	PP < 0.25	<500	Easily penetrated several inches by fist
Soft	2 - 4	0.25 ≤ PP < 0.5	500 - 1,000	Easily penetrated several inches by thumb
Medium Stiff	4 - 8	0.5 ≤ PP < 1	1,000 - 2,000	Can be penetrated several inches by thumb with moderate effort
Stiff	8 - 15	1 ≤ PP < 2	2,000 - 4,000	Readily indented by thumb but penetrated only with great effort
Very Stiff	15 - 30	2 ≤ PP < 4	4,000 - 8,000	Readily indented by thumbnail
Hard	>30	4 ≤ PP	>8,000	Indented by thumbnail with difficulty

APPARENT DENSITY - COARSE-GRAINED SOIL²

APPARENT DENSITY	SPT-N (# blows / ft)
Very Loose	<4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	>50

STRUCTURE¹

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. (6mm) thick, note thickness.
Laminated	Alternating layers of varying material or color with the layers less than 1/4-in. (6 mm) thick, note thickness.
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, such as small lenses of sand scattered through a mass of clay; note thickness.
Homogeneous	Same color and appearance throughout

ANGULARITY¹

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.

REACTION WITH HYDROCHLORIC ACID¹


DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

CEMENTATION¹

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or little finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

REFERENCES

- American Society for Materials and Testing (ASTM), 2017, ASTM D2488: Standard Practice for Description and Identification of Soils (Visual Manual Procedures).
- Terzaghi, K and Peck, R., 1948, Soil Mechanics in Engineering Practice, John Wiley & Sons, New York.
- United States Department of the Interior Bureau of Reclamation (USBR), 1998, Earth Manual, Part I.

	PROJECT NO.: 24004482.001A	SOIL DESCRIPTION KEY (For additional tables, see ASTM D2488) TMUA Spunky Creek MS South Phase 3 West Side of S. 193rd E. Ave. Between E. 31st Street & E. 41st Street Tulsa, Oklahoma	FIGURE
	DRAWN BY: SB CHECKED BY: SYW DATE: 4/16/2024		A-2

INFILLING TYPE³

NAME	ABBR	NAME	ABBR
Albite	Al	Muscovite	Mus
Apatite	Ap	None	No
Biotite	Bi	Pyrite	Py
Clay	Cl	Quartz	Qz
Calcite	Ca	Sand	Sd
Chlorite	Ch	Sericite	Ser
Epidote	Ep	Silt	Si
Gypsum	Gy	Talc	Ta
Iron Oxide	Fe	Unknown	Uk
Manganese	Mn		

DENSITY/SPACING OF DISCONTINUITIES⁵

DESCRIPTION	SPACING CRITERIA
Unfractured	>6 ft. (>1.83 meters)
Slightly Fractured	2 - 6 ft. (0.061 - 1.83 meters)
Moderately Fractured	8 in - 2 ft. (203.20 - 609.60 mm)
Highly Fractured	2 - 8 in (50.80 - 203.30 mm)
Intensely Fractured	<2 in (<50.80 mm)

ADDITIONAL TEXTURAL ADJECTIVES⁵

DESCRIPTION	RECOGNITION
Pit (Pitted)	Pinhole to 0.03 ft. (3/8 in.) (>1 to 10 mm.) openings
Vug (Vuggy)	Small openings (usually lined with crystals) ranging in diameter from 0.03 ft. (3/8 in.) to 0.33 ft. (4 in.) (10 to 100 mm.)
Cavity	An opening larger than 0.33 ft. (4 in.) (100 mm.), size descriptions are required, and adjectives such as small, large, etc., may be used
Honeycombed	If numerous enough that only thin walls separate individual pits or vugs, this term further describes the preceding nomenclature to indicate cell-like form.
Vesicle (Vesicular)	Small openings in volcanic rocks of variable shape and size formed by entrapped gas bubbles during solidification.

WEATHERING⁵

DESCRIPTION	CRITERIA
Unweathered	No evidence of chemical / mechanical alteration; rings with hammer blow.
Slightly Weathered	Slight discoloration on surface; slight alteration along discontinuities; <10% rock volume altered.
Moderately Weathered	Discoloring evident; surface pitted and alteration penetration well below surface; Weathering "halos" evident; 10-50% rock altered.
Highly Weathered	Entire mass discolored; Alteration pervading most rock, some slight weathering pockets; some minerals may be leached out.
Decomposed	Rock reduced to soil with relic rock texture/structure; Generally molded and crumbled by hand.

RELATIVE HARDNESS / STRENGTH DESCRIPTIONS⁴

GRADE	UCS (MPa)	FIELD TEST	
R0	Extremely Weak	0.25 - 1.0	Indented by thumbnail
R1	Very Weak	1.0 - 5.0	Crumbles under firm blows of geological hammer, can be peeled by a pocket knife.
R2	Weak	5.0 - 25	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.
R3	Medium Strong	25 - 50	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single firm blow of a geological hammer.
R4	Strong	50 - 100	Specimen requires more than one blow of geological hammer to fracture it.
R5	Very Strong	100 - 250	Specimen requires many blows of geological hammer to fracture it.
R6	Extremely Strong	> 250	Specimen can only be chipped with a geological hammer.

ROCK QUALITY DESIGNATION (RQD)²

DESCRIPTION	RQD (%)
Very Poor	0 - 25
Poor	25 - 50
Fair	50 - 75
Good	75 - 90
Excellent	90 - 100

APERTURE¹

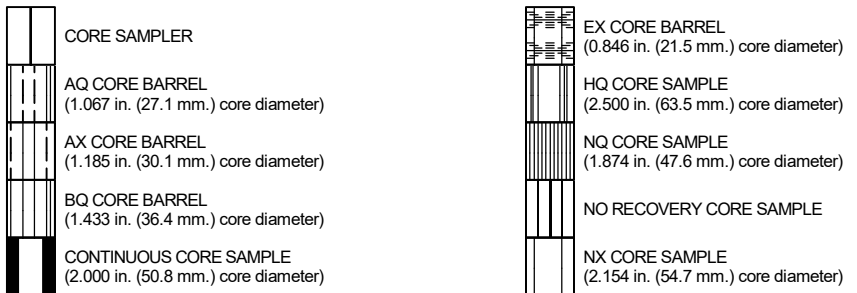
DESCRIPTION	CRITERIA [in (mm)]
Tight	<0.04 (<1)
Open	0.04 - 0.20 (1 - 5)
Wide	>0.20 (>5)

BEDDING CHARACTERISTICS⁶

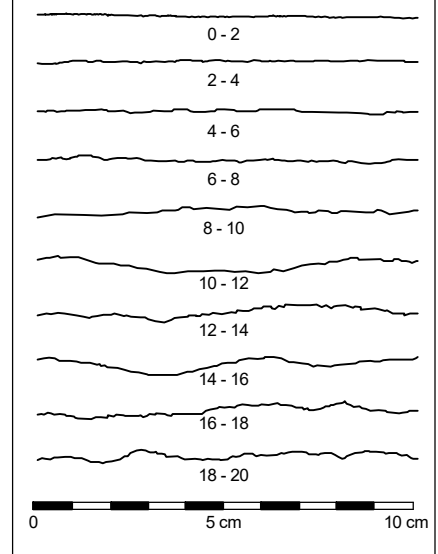
DESCRIPTION	Thickness [in (mm)]
Very Thick Bedded	>36 (>915)
Thick Bedded	12 - 36 (305 - 915)
Moderately Bedded	4 - 12 (102 - 305)
Thin Bedded	1 - 4 (25 - 102)
Very Thin Bedded	0.4 - 1 (10 - 25)
Laminated	0.1 - 0.4 (2.5 - 10)
Thinly Laminated	<0.1 (<2.5)

- Bedding Planes** Planes dividing the individual layers, beds, or stratigraphy of rocks.
- Joint** Fracture in rock, generally more or less vertical or traverse to bedding.
- Seam** Applies to bedding plane with unspecified degree of weather.

CORE SAMPLER TYPE GRAPHICS



JOINT ROUGHNESS COEFFICIENT (JRC)⁴



RQD Rock-quality designation (RQD) Rough measure of the degree of jointing or fracture in a rock mass, measured as a percentage of the drill core in lengths of 4 in. (10 cm.) or more.

REFERENCES

1. Bieniawski, Z.T., 1989, Engineering Rock Mass Classifications. John Wiley & Sons, New York. (Mod. by Kleinfelder).
2. Deere, D.U., and Deere, D.W., 1989, Rock Quality Designation (RQD) After Twenty Years, USACE Contract Report GL-89-1.
3. Federal Highway Administration (FHWA), 2002, Subsurface Investigations, FHWA-NHI-01-031. (Mod. by Kleinfelder).
4. International Society for Rock Mechanics (ISRM), 1978, "Suggested Methods for the Quantitative Description of Discontinuities in Rock Masses," International Joint Rock Mechanics and Mining Sciences & Geomechanics Abstracts, Vol. 15.
5. United States Army Corps of Engineers (USACE), 1994, Rock Foundations, EM 1110-1-2908, November 30, 1994.
6. United States Department of the Interior Bureau of Reclamation (USBR), 1998, Engineering Geology Field Manual, Volume 1.



PROJECT NO.:
24004482.001A

DRAWN BY: SB

CHECKED BY: SYW

DATE: 4/16/2024

ROCK DESCRIPTION KEY

TMUA Spunky Creek MS South Phase 3
 West Side of S. 193rd E. Ave.
 Between E. 31st Street & E. 41st Street
 Tulsa, Oklahoma

FIGURE

A-3

PLOTTED: 04/19/2024 12:55 PM BY: SBhandari

Date Begin - End: 4/09/2024	Drilling Company: Aimright	BORING LOG B-1
Logged By: S. Bhandari	Drill Crew: H. Wilson	
Hor.-Vert. Datum: NAD83 - Not Available	Drilling Equipment: Geoprobe 7822DT	
Plunge: -90 degrees	Drilling Method: Hollow Flight Auger	
Weather: 56° P. Cloudy	Auger Diameter: 6 in. O.D.	
	Hammer Type - Drop: 140 lb. Auto - 30 in.	
	Hammer Efficiency: 90%	
	Hammer Cal. Date: 2/11/2023	

Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS								
		Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. ROD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0		TOPSOIL: 4 inches Lean CLAY with Sand (CL): dark brown, moist, medium stiff, trace organics												
5		- gray and yellowish brown below 3.5 feet	SS-1		BC=2 3 4	18"	CL	20.1	92	73	44	23		
7		- wet below 7 feet												
10		Highly Weathered SHALE: gray, laminated, extremely weak, trace iron stains	SS-2		BC=14 30 50/4"	16"								
10		SHALE: gray, highly weathered, laminated, extremely weak, trace iron stains												
15		SHALE interbedded with limestone: dark gray, highly weathered, fissured, laminated, weak to medium strong	SS-3		BC=50/4"	4"								
18.5		The boring was terminated because of practical auger refusal (↑) at approximately 18.5 ft. below ground surface on limestone. The boring was backfilled with auger cuttings and bentonite on April 09, 2024.	SS-4		BC=50/2"	2"								

GROUNDWATER LEVEL INFORMATION:
 ▽ Groundwater was observed at approximately 18.5 ft. below ground surface during drilling.
 ▼ Groundwater was observed at approximately 7 ft. below ground surface at the end of drilling.
GENERAL NOTES:
 A handheld GPS unit was used to locate the exploration with an accuracy of 15 Feet.

PROJECT NUMBER: 24004482.001A OFFICE FILTER: TULSA
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2024.GLB [KLF_BORING/TEST PIT SOIL LOG]

	PROJECT NO.: 24004482.001A	BORING LOG B-1 TMUA Spunky Creek MS South Phase 3 West Side of S. 193rd E. Ave. Between E. 31st Street & E. 41st Street Tulsa, Oklahoma	BORING
	DRAWN BY: SB CHECKED BY: SYW DATE: 4/16/2024		B-1

PLOTTED: 04/19/2024 12:55 PM BY: SBhandari

PROJECT NUMBER: 24004482.001A OFFICE FILTER: TULSA
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2024.GLB [KLF_BORING/TEST PIT SOIL LOG]

Date Begin - End: 4/09/2024	Drilling Company: Aimright	BORING LOG B-2
Logged By: S. Bhandari	Drill Crew: H. Wilson	
Hor.-Vert. Datum: NAD83 - Not Available	Drilling Equipment: Geoprobe 7822DT	
Plunge: -90 degrees	Drilling Method: Hollow Flight Auger	
Weather: 60° Sunny	Auger Diameter: 6 in. O.D.	Hammer Type - Drop: 140 lb. Auto - 30 in.
		Hammer Efficiency: 90%
		Hammer Cal. Date: 2/11/2023

Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS								
		Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. ROD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0 - 4		TOPSOIL: 4 inches												
4 - 5.5		Fat CLAY (CH): dark brown, moist to wet, medium stiff - light brown with trace of gravel below 2.5 feet - olive and yellowish brown, trace iron stains below 3.5 feet	SS-1		BC=2 2 4	18"	CH	25.5	98	87	56	32		
5.5 - 9.5		Highly Weathered SHALE: olive, laminated, fissured, extremely weak, trace iron stains - dark gray, interbedded with limestone below 9.5 feet	SS-2		BC=6 11 43	18"								
9.5 - 15		SHALE interbedded with Limestone: dark gray, highly weathered, weak to medium strong	SS-3		BC=30 39 50/4.5"	16"								
15			SS-4		BC=50/1.5"	1"								

The boring was terminated because of practical auger refusal (↑) at approximately 15 ft. below ground surface on limestone. The boring was backfilled with auger cuttings and bentonite on April 09, 2024.

GROUNDWATER LEVEL INFORMATION:
 ∇ Groundwater was observed at approximately 8.5 ft. below ground surface during drilling.
GENERAL NOTES:
 A handheld GPS unit was used to locate the exploration with an accuracy of 15 Feet.

 KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 24004482.001A	BORING LOG B-2 TMUA Spunky Creek MS South Phase 3 West Side of S. 193rd E. Ave. Between E. 31st Street & E. 41st Street Tulsa, Oklahoma	BORING
	DRAWN BY: SB CHECKED BY: SYW DATE: 4/16/2024		B-2

PLOTTED: 04/19/2024 12:56 PM BY: SBhandari

PROJECT NUMBER: 24004482.001A OFFICE FILTER: TULSA
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2024.GLB [KLF_BORING/TEST PIT SOIL LOG]

Date Begin - End: 4/09/2024	Drilling Company: Aimright	BORING LOG B-3
Logged By: S. Bhandari	Drill Crew: H. Wilson	
Hor.-Vert. Datum: NAD83 - Not Available	Drilling Equipment: Geoprobe 7822DT	
Plunge: -90 degrees	Drilling Method: Hollow Flight Auger	
Weather: 63° Sunny	Auger Diameter: 6 in. O.D.	
Hammer Type - Drop: 140 lb. Auto - 30 in.		
Hammer Efficiency: 90%		
Hammer Cal. Date: 2/11/2023		

Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS								
		Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. ROD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0 - 4		TOPSOIL: 4 inches												
4 - 8.5		Fat CLAY (CH): olive, moist, medium stiff, with gravel and iron stains	SS-1	BC=1 2 4	12"	CH	28.6		100	94	60	34		
8.5 - 10		Highly Weathered SHALE: yellowish brown, laminated, extremely weak												
10 - 12		- dark gray and olive, interbedded with limestone below 8.5 feet	SS-2	BC=12 20 50/4"	16"									
12 - 16		SHALE interbedded with limestone: dark gray, laminated, fissured, weak to medium strong	SS-3	BC=50/4"	4"									
16 - 16.5		The boring was terminated because of practical auger refusal (↑) at approximately 16 ft. below ground surface on limestone. The boring was backfilled with auger cuttings and bentonite on April 09, 2024.	SS-4	BC=50/1.5"	NR									

GROUNDWATER LEVEL INFORMATION:
 Groundwater was not observed during drilling or after completion.
GENERAL NOTES:
 A handheld GPS unit was used to locate the exploration with an accuracy of 15 feet.

 KLEINFELDER <i>Bright People. Right Solutions.</i>	PROJECT NO.: 24004482.001A	BORING LOG B-3 TMUA Spunky Creek MS South Phase 3 West Side of S. 193rd E. Ave. Between E. 31st Street & E. 41st Street Tulsa, Oklahoma	BORING
	DRAWN BY: SB CHECKED BY: SYW DATE: 4/16/2024		B-3

PLOTTED: 04/19/2024 12:56 PM BY: SBhandari

Date Begin - End: 4/09/2024	Drilling Company: Aimright	BORING LOG B-4
Logged By: S. Bhandari	Drill Crew: H. Wilson	
Hor.-Vert. Datum: NAD83 - Not Available	Drilling Equipment: Geoprobe 7822DT	
Plunge: -90 degrees	Drilling Method: HSA / CORE	
Weather: 66° Sunny	Auger Diameter: 6 in. O.D.	
	Hammer Type - Drop: 140 lb. Auto - 30 in.	
	Hammer Efficiency: 90%	
	Hammer Cal. Date: 2/11/2023	

Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS								
		Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. RQD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0-4		TOPSOIL: 4 inches												
4-5		Lean CLAY (CL): dark brown, moist												
5-10		Highly Weathered SHALE: dark brown, laminated, fissured, extremely weak												
10-12		LIMESTONE: light gray, slightly weathered, intensely to highly fractured, strong	SS-1		BC=18 50/5.5"	8"								
12-15		SHALE interbedded with Limestone: dark gray, weathered, intensely to highly fractured, medium strong	NQ-2		RQD=83%	85%								
15-18		SHALE interbedded with Limestone: dark gray, weathered, intensely to highly fractured, medium strong	NQ-3		RQD=33%	89%								Unc. Comp. Str.= q _u : 7540 psi
18-20		LIMESTONE: gray, weathered, highly fractured, medium strong	NQ-4		RQD=83%	100%								Unc. Comp. Str.= q _u : 9560 psi
20-23		LIMESTONE: gray, weathered, highly fractured, medium strong	NQ-5		RQD=89%	100%								Unc. Comp. Str.= q _u : 4880 psi
23-25		The boring was terminated at approximately 23 ft. below ground surface. The boring was backfilled with auger cuttings and bentonite on April 09, 2024.												Unc. Comp. Str.= q _u : 6620 psi

GROUNDWATER LEVEL INFORMATION:
 ∇ Groundwater was observed at approximately 3.5 ft. below ground surface during drilling.
GENERAL NOTES:
 A handheld GPS unit was used to locate the exploration with an accuracy of 15 Feet.

PROJECT NUMBER: 24004482.001A OFFICE FILTER: TULSA
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2024.GLB [KLF_BORING/TEST PIT SOIL LOG]

	PROJECT NO.: 24004482.001A	BORING LOG B-4 TMUA Spunky Creek MS South Phase 3 West Side of S. 193rd E. Ave. Between E. 31st Street & E. 41st Street Tulsa, Oklahoma	BORING B-4
	DRAWN BY: SB CHECKED BY: SYW DATE: 4/16/2024		

PLOTTED: 04/19/2024 12:56 PM BY: SBhandari

PROJECT NUMBER: 24004482.001A OFFICE FILTER: TULSA
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2024.GLB [KLF_BORING/TEST PIT SOIL LOG]

Date Begin - End: 4/08/2024	Drilling Company: Aimright	BORING LOG B-6
Logged By: S. Bhandari	Drill Crew: H. Wilson	
Hor.-Vert. Datum: NAD83 - Not Available	Drilling Equipment: Geoprobe 7822DT	
Plunge: -90 degrees	Drilling Method: Hollow Flight Auger	
Weather: 67° P. Cloudy	Auger Diameter: 6 in. O.D.	Hammer Type - Drop: 140 lb. Auto - 30 in.
		Hammer Efficiency: 90%
		Hammer Cal. Date: 2/11/2023

Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS								
		Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. ROD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0 - 4		TOPSOIL: 4 inches												
4 - 6		Lean CLAY (CL): dark brown, moist, very stiff - light yellowish brown and olive below 2 feet - trace iron stains below 3.5 feet	SS-1		BC=5 8 9	14"	CL	13.5	100	89	44	23		
6 - 10		Highly Weathered SHALE: light gray and olive, laminated, extremely weak SHALE: light gray and olive, highly weathered, laminated, extremely weak - dark gray below 10 feet	SS-2		BC=21 50/5"	11"								
10 - 16		SHALE interbedded with Limestone: dark gray, laminated, weak to medium strong	SS-3		BC=50/3.25"	3"								
16 - 16.5			SS-4		BC=50/2"	2"								

The boring was terminated because of practical auger refusal (↑) at approximately 16 ft. below ground surface on limestone. The boring was backfilled with auger cuttings and bentonite on April 08, 2024.

GROUNDWATER LEVEL INFORMATION:
 Groundwater was not observed during drilling or after completion.
GENERAL NOTES:
 A handheld GPS unit was used to locate the exploration with an accuracy of 15 Feet.

 KLEINFELDER <i>Bright People. Right Solutions.</i>	PROJECT NO.: 24004482.001A	BORING LOG B-6 TMUA Spunky Creek MS South Phase 3 West Side of S. 193rd E. Ave. Between E. 31st Street & E. 41st Street Tulsa, Oklahoma	BORING
	DRAWN BY: SB CHECKED BY: SYW DATE: 4/16/2024		B-6

PLOTTED: 04/19/2024 12:56 PM BY: SBhandari

PROJECT NUMBER: 24004482.001A OFFICE FILTER: TULSA
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2024.GLB [KLF_BORING/TEST PIT SOIL LOG]

Date Begin - End: 4/08/2024	Drilling Company: Aimright	BORING LOG B-7
Logged By: S. Bhandari	Drill Crew: H. Wilson	
Hor.-Vert. Datum: NAD83 - Not Available	Drilling Equipment: Geoprobe 7822DT	
Plunge: -90 degrees	Drilling Method: Hollow Flight Auger	
Weather: 67° Sunny	Auger Diameter: 6 in. O.D.	Hammer Type - Drop: 140 lb. Auto - 30 in.
		Hammer Efficiency: 90%
		Hammer Cal. Date: 2/11/2023

Depth (feet)	Graphical Log	FIELD EXPLORATION					LABORATORY RESULTS							
		Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. ROD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0		TOPSOIL: 4 inches												
0-5		Lean CLAY with Sand (CL): dark brown and olive, moist, medium stiff - light gray and yellowish brown below 3.5 feet	SS-1	BC=2 2 3	18"	CL	20.3		96	75	46	26		
5-8		Highly Weathered SHALE: dark gray, extremely weak												
8-10		SHALE: dark gray, highly weathered, laminated, extremely weak	SS-2	BC=50/5.75"	6"									
10-15			SS-3	BC=23 50/4.75"	10"									
15	The boring was terminated at approximately 14.5 ft. below ground surface. The boring was backfilled with auger cuttings and bentonite on April 08, 2024.					GROUNDWATER LEVEL INFORMATION: Groundwater was not observed during drilling or after completion. GENERAL NOTES: A handheld GPS unit was used to locate the exploration with an accuracy of 15 Feet.								

 KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 24004482.001A	BORING LOG B-7 TMUA Spunky Creek MS South Phase 3 West Side of S. 193rd E. Ave. Between E. 31st Street & E. 41st Street Tulsa, Oklahoma	BORING
	DRAWN BY: SB CHECKED BY: SYW DATE: 4/16/2024		B-7

PLOTTED: 04/19/2024 12:56 PM BY: SBhandari

Date Begin - End: 4/08/2024	Drilling Company: Aimright	BORING LOG B-8
Logged By: S. Bhandari	Drill Crew: H. Wilson	
Hor.-Vert. Datum: NAD83 - Not Available	Drilling Equipment: Geoprobe 7822DT	
Plunge: -90 degrees	Drilling Method: Hollow Flight Auger	
Weather: 70° Sunny	Auger Diameter: 6 in. O.D.	Hammer Type - Drop: 140 lb. Auto - 30 in.
		Hammer Efficiency: 90%
		Hammer Cal. Date: 2/11/2023

Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS								
		Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. ROD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0		TOPSOIL: 4 inches												
0-5		Fat CLAY (CH): dark brown, moist, medium stiff - light brown, gray, and olive, trace iron strains below 3.5'	SS-1		BC=2 3 4	14"	CH	21.5	100	99	50	28		
5-7		Highly Weathered SHALE: gray and olive, laminated, extremely weak												
7-9		SHALE: gray and dark gray, laminated, highly weathered, extremely weak	SS-2		BC=50/6"	6"								
9-10		SHALE interbedded with limestone: dark gray, laminated, highly weathered, weak to medium strong	SS-3		BC=50/2.5"	2"								

The boring was terminated because of practical auger refusal (↑) at approximately 10 ft. below ground surface on limestone. The boring was backfilled with auger cuttings and bentonite on April 08, 2024.

GROUNDWATER LEVEL INFORMATION:
 ∇ Groundwater was observed at approximately 8.5 ft. below ground surface during drilling.
 ▼ Groundwater was observed at approximately 7 ft. below ground surface at the end of drilling.
GENERAL NOTES:
 A handheld GPS unit was used to locate the exploration with an accuracy of 15 Feet.

PROJECT NUMBER: 24004482.001A
 OFFICE FILTER: TULSA
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2024.GLB [KLF_BORING/TEST PIT SOIL LOG]

 KLEINFELDER <i>Bright People. Right Solutions.</i>	PROJECT NO.: 24004482.001A	BORING LOG B-8 TMUA Spunky Creek MS South Phase 3 West Side of S. 193rd E. Ave. Between E. 31st Street & E. 41st Street Tulsa, Oklahoma	BORING
	DRAWN BY: SB CHECKED BY: SYW DATE: 4/16/2024		B-8

PLOTTED: 04/19/2024 12:56 PM BY: SBhandari

BORING LOG B-9

Date Begin - End: 4/08/2024 **Drilling Company:** Aimright
Logged By: S. Bhandari **Drill Crew:** H. Wilson
Hor.-Vert. Datum: NAD83 - Not Available **Drilling Equipment:** Geoprobe 7822DT **Hammer Type - Drop:** 140 lb. Auto - 30 in.
Plunge: -90 degrees **Drilling Method:** Hollow Flight Auger **Hammer Efficiency:** 90%
Weather: 67° P. Cloudy **Auger Diameter:** 6 in. O.D. **Hammer Cal. Date:** 2/11/2023

Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. ROD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
		TOPSOIL Fat CLAY with Gravel (CH): dark brown, moist, medium stiff, traces of iron stains - olive, reddish brown, and gray below 3.5 feet	SS-1		BC=2 2 3	18"	CH	21.7	88	82	51	30	
		Highly Weathered SHALE: gray and olive, extremely weak, laminated	SS-1		BC=10 19 27	18"							
		SHALE interbedded with limestone: dark gray, laminated, weak to medium strong	SS-3		BC=50/6"	6"							
15		The boring was terminated because of practical auger refusal (↑) at approximately 14 ft. below ground surface on limestone. The boring was backfilled with auger cuttings and bentonite on April 08, 2024.				GROUNDWATER LEVEL INFORMATION: ▼ Groundwater was observed at approximately 9.5 ft. below ground surface at the end of drilling. GENERAL NOTES: A handheld GPS unit was used to locate the exploration with an accuracy of 15 Feet.							

OFFICE FILTER: TULSA

PROJECT NUMBER: 24004482.001A

gint FILE: KLF_gint_master_2024
 gint TEMPLATE: E:KLF_STANDARD_gint_LIBRARY_2024.GLB [KLF_BORING/TEST PIT SOIL LOG]



PROJECT NO.: 24004482.001A
 DRAWN BY: SB
 CHECKED BY: SYW
 DATE: 4/16/2024

BORING LOG B-9
 TMUA Spunky Creek MS South Phase 3
 West Side of S. 193rd E. Ave.
 Between E. 31st Street & E. 41st Street
 Tulsa, Oklahoma


BORING
B-9
 PAGE: 1 of 1

PLOTTED: 04/19/2024 12:56 PM BY: SBhandari

PROJECT NUMBER: 24004482.001A OFFICE FILTER: TULSA
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2024.GLB [KLF_BORING/TEST PIT SOIL LOG]


Date Begin - End: 4/08/2024	Drilling Company: Aimright	BORING LOG B-10
Logged By: S. Bhandari	Drill Crew: H. Wilson	
Hor.-Vert. Datum: NAD83 - Not Available	Drilling Equipment: Geoprobe 7822DT	
Plunge: -90 degrees	Drilling Method: Hollow Flight Auger	
Weather: 79° P. Cloudy	Auger Diameter: 6 in. O.D.	
Hammer Type - Drop: 140 lb. Auto - 30 in.		
Hammer Efficiency: 90%		
Hammer Cal. Date: 2/11/2023		

Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS								
		Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. ROD=%	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0 - 4	TOPSOIL: 4 inches													
4 - 3.5	Fat CLAY with Sand (CH): yellowish brown, moist, medium stiff													
3.5 - 5	- yellowish brown, gray, and olive below 3.5 feet	SS-1		BC=1 2 2	18"	CH	25.4		97	83	51	30		
5 - 10	Highly Weathered SHALE: olive, laminated, extremely weak, with iron strains	SS-2		BC=10 13 21	18"									
10 - 15	SHALE: olive and gray, laminated, fissured, extremely weak	SS-3		BC=21 44 50/4"	16"									
15 - 20		SS-4		BC=30 50/4.5"	10"									
20 - 19.5	The boring was terminated at approximately 19.5 ft. below ground surface. The boring was backfilled with auger cuttings and bentonite on April 08, 2024.				GROUNDWATER LEVEL INFORMATION: Groundwater was not observed during drilling or after completion. GENERAL NOTES: A handheld GPS unit was used to locate the exploration with an accuracy of 15 Feet.									

	PROJECT NO.: 24004482.001A	BORING LOG B-10 TMUA Spunky Creek MS South Phase 3 West Side of S. 193rd E. Ave. Between E. 31st Street & E. 41st Street Tulsa, Oklahoma	BORING
	DRAWN BY: SB CHECKED BY: SYW DATE: 4/16/2024		B-10

24004482-001A
 Spunky Creek phase 3
 4/9/24 5'-13'



 <p>KLEINFELDER Bright People. Right Solutions.</p>	PROJECT NO. 24004482	<p align="center">BORING B-4 (5' - 13') ROCK CORE PHOTOGRAPH</p>	<p align="center">FIGURE A-4</p>
	DRAWN: 4/16/2024		
	DRAWN BY: SB	<p>TMUA Spunky Creek MS South Phase 3 West of S. 193rd E. Ave. Between E. 31st St. & E. 41st St. Tulsa Oklahoma</p>	
	CHECKED BY: SYW		
FILE NAME: 24004482 Rock Cores			




PROJECT NO. 24004482
 DRAWN: 4/16/2024
 DRAWN BY: SB
 CHECKED BY: SYW
 FILE NAME:
 24004482 Rock Cores

BORING B-4 (13' - 18')
ROCK CORE PHOTOGRAPH
 TMUA Spunky Creek MS South Phase 3
 West of S. 193rd E. Ave.
 Between E. 31st St. & E. 41st St.
 Tulsa Oklahoma

FIGURE
A-5



 <p>KLEINFELDER Bright People. Right Solutions.</p>	PROJECT NO. 24004482	BORING B-4 (18' - 23') ROCK CORE PHOTOGRAPH	FIGURE A-6
	DRAWN: 4/16/2024		
	DRAWN BY: SB	TMUA Spunky Creek MS South Phase 3 West of S. 193rd E. Ave. Between E. 31st St. & E. 41st St. Tulsa Oklahoma	
	CHECKED BY: SYW		
	FILE NAME: 24004482 Rock Cores		

Exploration ID	Depth (ft.)	Sample No.	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
						Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
B-1	3.5 - 5.0	SS-1	LEAN CLAY WITH SAND (CL)	20.1		100	92	73	44	21	23	
B-2	3.5 - 5.0	SS-1	FAT CLAY (CH)	25.5		100	98	87	56	24	32	
B-3	3.5 - 5.0	SS-1	FAT CLAY (CH)	28.6		100	100	94	60	26	34	
B-4	7.5											Unconfined Compressive Strength=
												q _u : 7540 psi
B-4	11.0											Unconfined Compressive Strength=
												q _u : 9560 psi
B-4	16.0											Unconfined Compressive Strength=
												q _u : 4880 psi
B-4	21.5											Unconfined Compressive Strength=
												q _u : 6620 psi
B-6	3.5 - 5.0	SS-1	LEAN CLAY (CL)	13.5		100	100	89	44	21	23	
B-7	3.5 - 5.0	SS-1	LEAN CLAY WITH SAND (CL)	20.3		100	96	75	46	20	26	
B-8	3.5 - 5.0	SS-1	FAT CLAY (CH)	21.5		100	100	99	50	22	28	
B-9	3.5 - 5.0	SS-1	FAT CLAY WITH GRAVEL (CH)	21.7		100	88	82	51	21	30	
B-10	3.5 - 5.0	SS-1	FAT CLAY WITH SAND (CH)	25.4		100	97	83	51	21	30	

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
 NP = NonPlastic
 NA = Not Available



PROJECT NO.:
24004482.001A

DRAWN BY: SB

CHECKED BY: SYW

DATE: 4/16/2024

**LABORATORY TEST
RESULT SUMMARY**

TMUA Spunky Creek MS South Phase 3
 West Side of S. 193rd E. Ave.
 Between E. 31st Street & E. 41st Street
 Tulsa, Oklahoma

TABLE

B-1

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer

will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the “Findings” Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site’s subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report’s Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals’ misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals’ plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note*

conspicuously that you’ve included the material for information purposes only. To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a “phase-one” or “phase-two” environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer’s services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer’s recommendations will not of itself be sufficient to prevent moisture infiltration.* **Confront the risk of moisture infiltration** by including building-envelope or mold specialists on the design team. **Geotechnical engineers are not building-envelope or mold specialists.**



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