

# PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

104 Acre Fair Oaks Development  
Tulsa, Oklahoma

**Prepared for:**

PartnerTulsa

Tulsa, Oklahoma



November 2023

Olsson Project No. 023-04565

Oklahoma Certificate  
of Authorization #: 2483





November 27, 2023

PartnerTulsa  
Attn: Michelle Barnett  
100 S Cincinnati Avenue  
Tulsa, Oklahoma 74103

RE: Preliminary Geotechnical Engineering Report  
104 Acre Fair Oaks Development  
Tulsa, Oklahoma  
Olsson Project No. 023-04565

Dear Ms. Barnett

In general accordance with our "Joint Development Agreement" dated June 16, 2023, Olsson, Inc. has completed the authorized geotechnical exploration for the above referenced project. The preliminary geotechnical exploration was conducted to evaluate physical characteristics of subsurface conditions with respect to design and construction of the project. The enclosed report summarizes the project site characteristics as we understand them, presents the findings of the field exploration and laboratory testing, discusses the observed subsurface conditions, and provides our geotechnical engineering recommendations.

We appreciate the opportunity to provide our geotechnical engineering services for this project and are prepared to provide construction phase services as well. If you have any questions or need further assistance, please contact us at your convenience.

Respectfully submitted,  
Olsson, Inc.  
Oklahoma Certificate of Authority No. 2483

A handwritten signature in black ink that reads "Sydney Brinkley".

Sydney L. Brinkley  
Assistant Engineer  
[sbrinkley@olsson.com](mailto:sbrinkley@olsson.com)

A handwritten signature in black ink that reads "Shameem Dewan".

Shameem A. Dewan, PhD, PE  
Senior Geotechnical Engineer  
[sdewan@olsson.com](mailto:sdewan@olsson.com)

A handwritten signature in black ink that reads "Wyatt Grooms".

Wyat C. Grooms, EI  
Assistant Engineer  
[wgrooms@olsson.com](mailto:wgrooms@olsson.com)

# TABLE OF CONTENTS

- Executive Summary ..... 1
- 1. Project Understanding ..... 1
  - 1.1 Project Information..... 1
  - 1.2 Site Description..... 1
- 2. Subsurface Conditions ..... 3
  - 2.1 Site Geology ..... 3
  - 2.2 Subsurface Profile ..... 3
  - 2.3 Water Level Observations ..... 4
- 3. Geotechnical Considerations..... 5
- 4. Preliminary structure design ..... 6
  - 4.1 Preliminary Foundations ..... 6
  - 4.2 Seismic Site Classification..... 6
  - 4.3 Foundation Drainage ..... 6
- 5. Preliminary pavements ..... 7
- 6. Preliminary Earthwork Considerations ..... 8
  - 6.1 Site Preparation ..... 8
  - 6.2 Structural Fill..... 8
  - 6.3 Dewatering Considerations..... 9
- 7. Report Limitations..... 10

# LIST OF FIGURES

- Figure 1. 2022 Aerial Photograph/Project Site Outline..... 2

# APPENDICES

- Appendix A Exploration Maps, Logs, and Information
- Appendix B Laboratory Test Results

## **EXECUTIVE SUMMARY**

Olsson, Inc. (Olsson), under authorization and contract with TulsaPartner, completed a preliminary geotechnical exploration for the 104 Acre Fair Oaks Development site. Our subsurface exploration generally encountered low (lean) to high plasticity (fat) clays with varying sand contents. High plasticity clays were encountered within the upper 2.5 to 8 feet. The soils were generally underlain by shale, sandstone, and/or limestone.

Based on the findings of the preliminary geotechnical exploration and analyses, the soils encountered generally appear suitable for support of conventional shallow foundation systems. Due to the presence of high plasticity soils across the site, some additional earthwork of the existing soils may be required, depending on proposed final site grades. Additional testing during the final geotechnical exploration, as well as final design information will be required to determine whether certain on-site soils can be reused as structural fill.

Additionally, due to the presence of shallow bedrock in some areas and depending on proposed final site grades, the use of rock excavation equipment such as rock rippers, carbide tipped trenchers, or hydraulic breakers may be required.

This Executive Summary provides a limited overview of the report and is subject to any and all clarifications, conditions, contingencies, limitations and/or qualifications that may exist in the body of the report. The Client nor any other party may rely solely on this Executive Summary. Client and any other party using this report must review the entire report and interpret the information contained in this Executive Summary in conjunction with the remainder of the report.

# 1. PROJECT UNDERSTANDING

## 1.1 Project Information

We understand the purpose of this preliminary geotechnical exploration is to provide an evaluation of subsurface conditions and feasibility of the proposed 104-acre site for future planning and construction. At the time of this report, no specific structures or uses were planned for the site. However, we anticipate the future development will comprise light to medium industrial properties.

While acknowledging the recommended minimum number of borings in the project Request for Proposal (RFP) as one boring per 100 acres, we have reviewed USDA soil survey and geologic well logs data surrounding the project site and estimated up to four soil series/formations might be encountered. Based on our experience with similar developments and our evaluation of the expected conditions, the proposed boring numbers and depths will provide sufficient delineation of the subsurface strata to prepare our preliminary geotechnical recommendations.

## 1.2 Site Description

The project site is located approximately 0.5 miles east of the intersection of East 11<sup>th</sup> Street and County Line Road near Tulsa, Oklahoma. The site generally comprised dense wooded vegetation, and limited tree clearing was required prior to track-mounted drilling rig access. The northwest corner of the site appears to have a water channel present.

Based on available topographic information, existing site grades range from an elevation of approximately 610.0 to 675.0 feet. The site generally comprises a rolling terrain and associated wooded areas. The project site outline is shown in **Figure 1**.



Figure 1. 2022 Aerial Photograph/Project Site Outline.

## 2. SUBSURFACE CONDITIONS

### 2.1 Site Geology

The project site is located in the northeastern region of Oklahoma and is mapped as being underlain by the Pennsylvanian-Aged Senora Formation. Senora Formation generally consists mostly of shale with thin and lenticular sandstone, minor limestone, and coal seams. The total thickness of the formation generally ranges from 500 to 950 feet.

### 2.2 Subsurface Profile

The subsurface profile was determined based on our field exploration and laboratory testing. Our field exploration ([Appendix A](#)) included four exploratory borings and rock coring to depths up to 19.3 feet, and the field testing including standard penetration tests (SPT). Laboratory testing ([Appendix B](#)) included gradation, fines content (passing #200 sieve), Atterberg limits, moisture content, density, and unconfined compression tests.

The appended borehole reports represent subsurface conditions at the specific boring locations at the time of our field exploration; variations may occur between or beyond the borings. The stratification lines shown on the logs represent the approximate boundary between material types. However, the transition between layers may actually be gradual. The depths referenced in the following paragraphs are relative to the site grade at the time of our exploration.

The subsurface soils at this site comprised native low to high plasticity clays with varying sand contents and were underlain by sedimentary bedrock comprising limestone, sandstone, and shale. The general characteristics of each soil stratum are summarized below, with more detailed descriptions provided on the borehole reports in [Appendix A](#).

#### Surfacing and Topsoil

We encountered a topsoil layer, approximately 6 to 10 inches thick, in the borings. Varying topsoil thicknesses may be encountered at locations not explored.

#### Native Clays

We encountered native low to high plasticity clay soils in the borings, extending to depths ranging from 5.5 to 12 feet. The clay soils generally comprised lean clay (CL) and fat clay (CH) with varying sand contents. The clay soils were described as stiff to hard, grayish brown to reddish brown to dark brown, and slightly moist to moist.

#### Limestone

We encountered limestone in the borings at depths ranging from 2.5 to 19 feet. The limestone generally extended to the termination depth of the boring or transitioned to shale. At B-03,

residual silty gravel (GM) weathered from the limestone was encountered. The limestone was described as gray to brownish gray, hard, and dry.

## Shale

We encountered shale bedrock in borings B-01, B-03, and B-04, at depths ranging from 2.5 to 10 feet. The shale generally extended to the termination depth of the boring or transitioned to limestone. The shale was described as dark gray to light gray, hard, and dry.

## Sandstone

We encountered weathered sandstone in boring B-04 at a depth of 8 feet below existing grades. The sandstone was described as light brown, hard, and dry.

## 2.3 Water Level Observations

Subsurface water was not encountered in the soil test borings at the time of drilling operations. However, water levels will fluctuate over time with variations in precipitation, site grading, drainage, and adjacent land use. Perched subsurface water conditions can also develop in seams of loose or granular soil.

Long-term monitoring with piezometers generally provides a more representative indication of the potential range of subsurface water conditions. Such monitoring was not completed as part of this exploration. Olsson can provide additional monitoring upon written request of the Owner and/or Olsson's client. Recommendations for addressing effects of water in design and during construction are presented in earthwork considerations section of this report. Any retaining wall foundation design or global stability analysis must take into consideration changing water conditions.



### **3. GEOTECHNICAL CONSIDERATIONS**

High plasticity (fat) clay soils were observed across the site in the upper 8 feet. As such, depending on final site grades, some over-excavation or additional earthwork of the existing soils may be required if these materials are encountered during construction operations. depending on final site grades, additional laboratory testing may be required during the final geotechnical exploration to determine whether certain on-site soils can be reused as structural fill.

Additionally, bedrock was encountered as shallow as 2.5 feet in some areas and harder lenses of limestone and sandstone may be encountered during construction operations. Depending on final site grades, the use of rock excavation equipment such as rock rippers or hydraulic breakers may be required.

## **4. PRELIMINARY STRUCTURE DESIGN**

### **4.1 Preliminary Foundations**

Based on the results of our exploration and engineering evaluation, site structures may be supported on a conventional shallow foundation system. We estimate a maximum net allowable soil bearing pressure of 1,900 to 4,000 pounds per square foot (psf) may be used to design shallow foundations supported on approved native soils or properly placed and compacted structural fill. We estimate total post-construction settlements for foundations sized using the above bearing pressures will be less than 1 inch.

Please note that the above recommendations are intended only to provide a range of possible foundation design values. Final foundation type design values or required soil improvement programs must be based on site-specific geotechnical explorations, site grading, and proposed structure types.

### **4.2 Seismic Site Classification**

For this project site, the soil conditions encountered at the boring are consistent with Site Class "C" as defined by ASCE 7-16. Our review of the site class is based on the soil conditions encountered in the borings during the exploration and our assumption that the encountered soil conditions are underlain by similar native materials to those encountered which extend to a depth of 100 feet.

### **4.3 Foundation Drainage**

We did not encounter groundwater at the time of our exploration. However, depending on final site grades, groundwater may need to be addressed in facility design and during construction. Please note that variations in groundwater elevations can also be expected from seasonal changes in rainfall, temperature, snowmelt, runoff, localized irrigation demand, or other factors.

## **5. PRELIMINARY PAVEMENTS**

Based on the results of our exploration and engineering evaluation, some of the on-site lean clay soils appear suitable for support of future pavements. Potentially expansive soils were encountered across the site and some remediation may be required before use depending on final site grades and pavement locations.

We estimate a CBR value range of 3 to 5 and a modulus of subgrade reaction,  $k$ , ranging from 100 to 140 pci be used for pavement design. However, please note that the above recommendations are intended only to provide a range of possible design values. Final pavement design parameters or required soil improvement programs must be based on site-specific geotechnical explorations, site grading, and anticipated traffic uses.

## **6. PRELIMINARY EARTHWORK CONSIDERATIONS**

### **6.1 Site Preparation**

Vegetation, topsoil, roots, and other deleterious materials deemed unsuitable by an Olsson geotechnical engineer, or his/her authorized field representative should be removed from the proposed construction area and replaced with controlled fill. We recommend site clearing, grubbing, and stripping be performed during dry weather conditions. Operation of heavy equipment on the site during wet conditions could result in excessive rutting and mixing of organic debris with the underlying soils.

We estimate typical root zone depths on the order of 6 to 10 inches. All root zone materials, trees, or brush should be removed from the proposed construction area and replaced with structural fill. Additional over-excavation may be required in areas heavily disturbed by clearing activities, ditches, or other low-lying areas to remove organic materials and saturated soils.

We anticipate the weathered shale and sandstone bedrock in the project areas can be excavated with standard excavation equipment. However, lenses of harder sandstone or limestone may be present, requiring the use of rock excavation equipment such as rock rippers or hydraulic breakers.

### **6.2 Structural Fill**

We recommend that fill materials placed have a liquid limit less than 45 and a plasticity index less than 25. Soils with Atterberg limits greater than these values will require removal, blending with less plastic materials, or chemical stabilization. All structural fill soils should also be relatively free of organic materials (less than about 2 percent by weight), debris, and particles larger than 3 inches in nominal diameter.

Based on our site observations and laboratory testing performed as part of this preliminary exploration, some of the lean clay and granular on-site soils appear suitable for reuse as pavement and building slab-on-grade subgrade. However, as previously discussed, portions of the on-site soils (high plasticity clays) may present a risk of unacceptable differential movements. Depending on final site grades and subsurface conditions encountered at specific building pads, overexcavation of the soils may be required to provide structural fill beneath lightly loaded features such as floor slabs or pavements. Chemical stabilization methods such as lime, cement kiln dust (CKD), or Portland cement could also be considered with direction from the geotechnical engineer.

The suitability of the site soils should be based on additional laboratory testing completed as part of the final site-specific geotechnical exploration and at or prior to the time of construction.

## **6.3 Dewatering Considerations**

We did not encounter groundwater at the time of our exploration. However, variations in groundwater elevation could occur because of seasonal changes in rainfall, temperature, snowmelt, runoff, localized irrigation demand, or other factors. Saturated soils and higher groundwater elevations should be anticipated in areas near drainage channels and ditches.

The contractor should utilize their experience in this area and experience with similar projects to determine the most effective method of dewatering and the effects of such methods on nearby structures, utilities, or pavements.

## **7. REPORT LIMITATIONS**

The preliminary conclusions and recommendations presented in this preliminary report are based on the information available regarding the proposed construction, the results obtained from our soil test borings and sampling procedures, the results of the laboratory testing program, and our experience with similar projects. In addition, this report serves as a preliminary evaluation of the geotechnical considerations associated with the proposed project. Recommendations for specific structures within the development are beyond the scope of this preliminary exploration.

The soil test borings represent a limited statistical sampling of subsurface soils, and it is possible that conditions may be encountered during the final geotechnical exploration or construction that are substantially different from those indicated by the soil test borings. In these instances, adjustments to design and construction may be necessary.

The scope of this exploration did not include any environmental assessment for the presence of wetlands and/or hazardous or toxic materials in the soil or groundwater on or near the site. Any statements in this report regarding odors, discoloration, or suspicious conditions are strictly for the information of our client.

This preliminary report is prepared based on generally accepted professional geotechnical engineering practice at the time of this report, within this geographic area. No warranty, express or implied, is intended or made. This report has been prepared for the exclusive use of our client and client's authorized representatives for specific application to the discussed project.

We trust that this preliminary report will assist you in the planning of the proposed project. Olsson appreciates the opportunity to provide our services on this project and looks forward to working with you during full design and construction of this project. Should you have any questions, please do not hesitate to contact us.

# **APPENDIX A**

Exploration Maps, Logs, and Information

## **FIELD EXPLORATION**

Our drill crew advanced the borings for this exploration with a track-mounted drill rig using continuous-flight auger and rock coring drilling methods. Boring locations were located in the field by the drill crew using a hand-held GPS unit. The approximate locations of the borings are shown on the Boring Location Map.

Samples were obtained using the methods and at the depths shown on the logs. Recovered samples were sealed in containers, labeled, and protected for transportation to the laboratory for testing. The rock core samples were visually examined, and percent recovery (REC) and Rock Quality Designation (RQD) was calculated for each core run.

We interpolated the ground surface elevation at the boring locations using publicly available topographic information. The surface elevations at the boring locations, rounded to the nearest five-foot interval, are presented on the boring logs.

The drill crew prepared field boring logs during drilling operations. The field logs include drilling and sampling methods, sampling intervals, groundwater measurements, and general descriptions of the observed soil conditions. The final boring logs represent our engineering interpretation of the field logs based on visual classification and laboratory testing of the collected samples.





**olsson**

Drawn by: SLB  
Date: 10-08-2023

Appendix A - Boring Location Map

104 Acre Fair Oaks Development  
Tulsa, Oklahoma

# SYMBOLS AND NOMENCLATURE

## DRILLING NOTES

### DRILLING AND SAMPLING SYMBOLS

SS: Split-Spoon Sample (1.375" ID, 2.0" OD)	HSA: Hollow Stem Auger	NE: Not Encountered
U: Thin-Walled Tube Sample (3.0" OD)	CFA: Continuous Flight Auger	NP: Not Performed
CS: Continuous Sample	HA: Hand Auger	NA: Not Applicable
BS: Bulk Sample	CPT: Cone Penetration Test	% Rec: Percent Recovery
MC: Modified California Sampler	WB: Wash Bore	WD: While Drilling
GB: Grab Sample	RB: Rock Bit	IAD: Immediately After Drilling
SPT: Standard Penetration Test Blows per 6.0"	PP: Pocket Penetrometer	AD: After Drilling

### DRILLING PROCEDURES

Soil samples designated as "U" samples on the boring logs were obtained using thin-walled tube sampling techniques. Soil samples designated as "SS" samples were obtained using a split-spoon barrel sampler while performing Standard Penetration Tests (SPT). The standard penetration resistance 'N' value is the number of blows to drive the split-spoon sampler 1 foot using a 140-pound hammer falling 30 inches. Soil samples designated as "MC" were obtained in using thick-walled, ring-lined, split-barrel drive sampling techniques (Modified California sampler). Recovered samples were sealed in containers, labeled, and protected for transportation to the laboratory for testing.

### WATER LEVEL MEASUREMENTS

Water levels indicated on the boring logs are levels measured in the borings at the times indicated. In highly permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with only short-term observations.

## SOIL PROPERTIES & DESCRIPTIONS

Descriptions of the soils encountered in the soil test borings were prepared using Visual-Manual Procedures for Descriptions and Identification of Soils.

### PARTICLE SIZE

Boulders	12 in. +	Coarse Sand	4.75mm-2.0mm	Silt	0.075mm-0.002mm
Cobbles	12 in.-3 in.	Medium Sand	2.0mm-0.425mm	Clay	<0.002mm
Gravel	3 in.-4.75mm	Fine Sand	0.425mm-0.075mm		

### COHESIVE SOILS

#### Unconfined Compressive

<u>Consistency</u>	<u>Strength (Qu) (tsf)</u>
Very Soft	<0.25
Soft	0.25 – 0.5
Firm	0.5 – 1.0
Stiff	1.0 – 2.0
Very Stiff	2.0 – 4.0
Hard	> 4.0

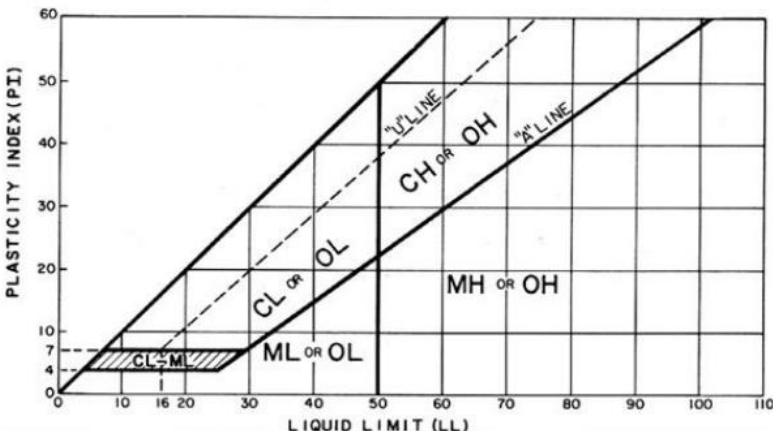
### COHESIONLESS SOILS

<u>Relative Density</u>	<u>'N' Value</u>
Very Loose	0 – 3
Loose	4 – 9
Medium Dense	10 – 29
Dense	30 – 49
Very Dense	≥ 50

### COMPONENT %

<u>Description</u>	<u>Percent (%)</u>
Trace	<5
Few	5 - 10
Little	15 - 25
Some	30 - 45
Mostly	50 - 100

### PLASTICITY CHART



### ROCK QUALITY DESIGNATION (RQD)

<u>Description</u>	<u>RQD (%)</u>
Very Poor	0 – 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 – 100

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PROJECT NAME: **104 Acre Fair Oaks Development** CLIENT: **PartnerTulsa**

PROJECT NUMBER: **023-04565** LOCATION: **Tulsa, Oklahoma**

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/REMARKS
640	<p><b>LAT: 36.145086 LONG: -95.752435</b>  <b>APPROX. SURFACE ELEV. (ft): 640</b></p> <p><b>ROOT ZONE</b>                      6-inches thick  <b>FAT CLAY</b>                      grayish brown; moist; stiff</p>		0								
		0.5'		SS 1		2-4-5 N=9		18.2			
635		5.5'	5	U 2	CH		1.0	21.0	98.7	57/35	P-200 = 88.9%
	<p><b>LIMESTONE</b>                      light gray; dry; hard</p>			RC 3							Recovery 27.1% RQD 0.0%
630		10.5'	10	RC 4			273.0	1.7	157.1		Recovery 100.0% RQD 27.5%
	<p><b>SHALE</b>                      dark gray; dry; hard</p>			RC 5							Recovery 94.4% RQD 81.0%
625		15.5'	15				398.0	1.8	155.2		

**BASE OF BORING AT 15.5 FEET**

WATER LEVEL OBSERVATIONS		<b>OLSSON, INC.</b> <b>9500 POLE ROAD</b> <b>OKLAHOMA CITY, OK 73160</b>	STARTED: 9/27/23	FINISHED: 9/27/23
WD	∇ Not Encountered		DRILL CO.: OLSSON	DRILL RIG: ATV
IAD	∇ Not Encountered		DRILLER: R. Melton	LOGGED BY: C. Baumann
AD	∇ Not Performed		METHOD: HOLLOW STEM AUGER	

PROJECT NAME: **104 Acre Fair Oaks Development** CLIENT: **PartnerTulsa**

PROJECT NUMBER: **023-04565** LOCATION: **Tulsa, Oklahoma**

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/REMARKS
655	LAT: 36.144558 LONG: -95.750112 APPROX. SURFACE ELEV. (ft) 655.0		0								
	<b>ROOT ZONE</b> 6-inches thick <b>LEAN CLAY</b> reddish brown; slightly moist to moist; stiff	0.5'		U 1	CL		1.3	14.2	97.6	39/19	P-200 = 93.8%
650			5	SS 2		3-5-5 N=10		15.6			
				SS 3		4-5-5 N=10		15.4			
645	<b>LEAN CLAY WITH SAND</b> reddish brown; moist; stiff	8.0'	10	SS 4		4-5-7 N=12		20.6			P-200 = 83.0%
				SS 5		50/0.3"					
640	<b>LIMESTONE</b> light gray to brownish gray; dry; hard	12.0'	15	SS 6		50/0.3"					
	<b>REFUSAL AT 15.3 FEET</b>	15.3'									

WATER LEVEL OBSERVATIONS		<b>OLSSON, INC.</b> <b>9500 POLE ROAD</b> <b>OKLAHOMA CITY, OK 73160</b>	STARTED: 9/27/23	FINISHED: 9/27/23
WD	∇ Not Encountered		DRILL CO.: OLSSON	DRILL RIG: ATV
IAD	∇ Not Encountered		DRILLER: R. Melton	LOGGED BY: C. Baumann
AD	∇ Not Performed		METHOD: HOLLOW STEM AUGER	

PROJECT NAME: **104 Acre Fair Oaks Development** CLIENT: **PartnerTulsa**

PROJECT NUMBER: **023-04565** LOCATION: **Tulsa, Oklahoma**

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/REMARKS
675	Split Spoon  LAT: 36.144418 LONG: -95.748662 APPROX. SURFACE ELEV. (ft): 675		0								
	<b>ROOT ZONE</b> 6-inches thick <b>SILTY GRAVEL</b>	0.5'		SS 1		8-22-50/1"		2.2			
	light to dark gray; dry; hard <b>WEATHERED SHALE</b> light brown to dark gray; mosit; hard	2.5'		SS 2		20-31-50/4"		18.3			
670			5								
	<b>LIMESTONE</b> gray; dry; hard <b>REFUSAL AT 8.2 FEET</b>	8.0' 8.2'		SS 4		50/0.1"					

WATER LEVEL OBSERVATIONS		<b>OLSSON, INC.</b> <b>9500 POLE ROAD</b> <b>OKLAHOMA CITY, OK 73160</b>	STARTED: 9/27/23	FINISHED: 9/27/23
WD	∇ Not Encountered		DRILL CO.: OLSSON	DRILL RIG: ATV
IAD	∇ Not Encountered		DRILLER: R. Melton	LOGGED BY: C. Baumann
AD	∇ Not Performed		METHOD: HOLLOW STEM AUGER	

PROJECT NAME: **104 Acre Fair Oaks Development** CLIENT: **PartnerTulsa**

PROJECT NUMBER: **023-04565** LOCATION: **Tulsa, Oklahoma**

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/REMARKS
650	LAT: 36.140753 LONG: -95.746516 APPROX. SURFACE ELEV. (ft): 650.0 Split Spoon Shelby Tube		0								
	<b>ROOT ZONE</b>		0.5'								
	6-inches thick <b>SANDY FAT CLAY</b> dark brown to brown; slightly moist; hard			SS 1		8-24-31 N=55		10.0			
645			5	U 2	CH		0.5	14.9	92.7	60/32	P-200 = 60.2%
				SS 3		14-21-21 N=42		6.7			P-200 = 63.0%
	<b>WEATHERED SANDSTONE</b> light brown; dry; hard		8.0'	SS 4		50/0.3"					
640	<b>WEATHERED SHALE</b> dark gray; dry; hard		10.0'								
				SS 5		50/5"					
635			15								
	<b>LIMESTONE</b> gray; dry; hard		19.0'	SS 6		50/3"					
			19.3'	SS 7		50/3"					
	<b>REFUSAL AT 19.3 FEET</b>										

WATER LEVEL OBSERVATIONS		<b>OLSSON, INC.</b> <b>9500 POLE ROAD</b> <b>OKLAHOMA CITY, OK 73160</b>	STARTED: 9/27/23	FINISHED: 9/27/23
WD	∇ Not Encountered		DRILL CO.: OLSSON	DRILL RIG: ATV
IAD	∇ Not Encountered		DRILLER: R. Melton	LOGGED BY: C. Baumann
AD	∇ Not Performed		METHOD: HOLLOW STEM AUGER	

Project Name: 104 Acre Fair Oaks Development  
 Site Location: Tulsa, Oklahoma



GEO-ID:	<u>B-01</u>	Core Run No.:	<u>1</u>	Core Run No.:	<u>2</u>	Core Run No.:	<u>3</u>
		Depth:	<u>5.5-7.5'</u>	Depth:	<u>7.5-12.5'</u>	Depth:	<u>12.5-15.5'</u>
GPS Location:	Latitude: <u>36.14509</u>	Recovery (%):	<u>27.1%</u>	Recovery (%):	<u>100.0%</u>	Recovery (%):	<u>94.4%</u>
	Longitude: <u>-95.75244</u>	RQD (%):	<u>0.0%</u>	RQD (%):	<u>27.5%</u>	RQD (%):	<u>81.0%</u>

## **APPENDIX B**

### Laboratory Test Results





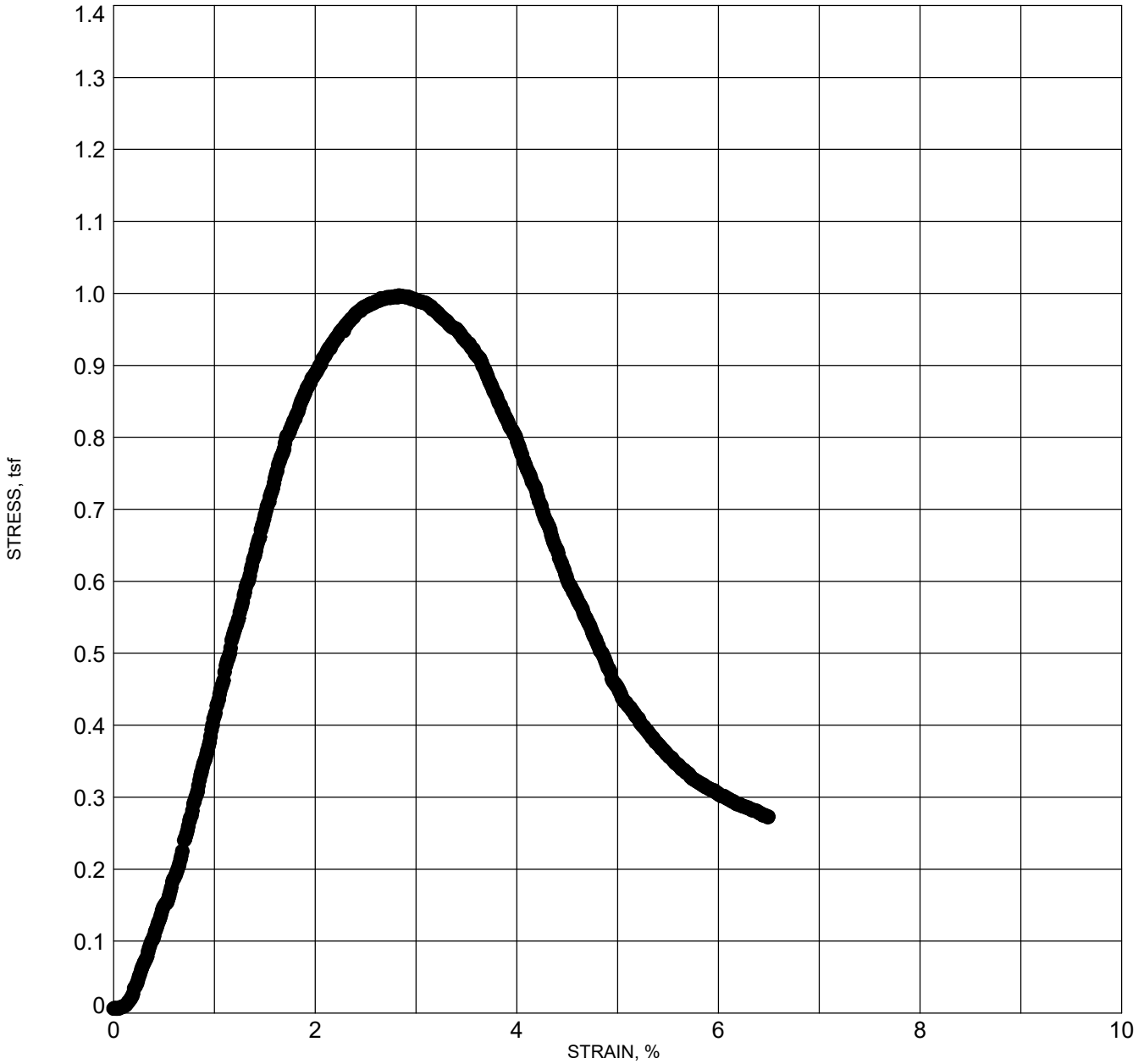


PROJECT NAME: 104 Acre Fair Oaks Development

CLIENT: PartnerTulsa

PROJECT NUMBER: 023-04565

PROJECT LOCATION: Tulsa, Oklahoma



Boring No: B-01

Sample Height (ft): 5.6

Unconfined Strength (tsf): 1.0

Sample ID: U-2

Sample Diameter (ft): 2.9

Strain at Failure (%): 2.8

Sample Depth (ft): 3.5 - 5.5' Height to Diameter Ratio: 1.9:1

Sample Break:

Initial Dry Density (pcf): 98.7 Degree of Saturation (%): 80.2



Initial Water Content (%): 21.0

Void Ratio: 0.708

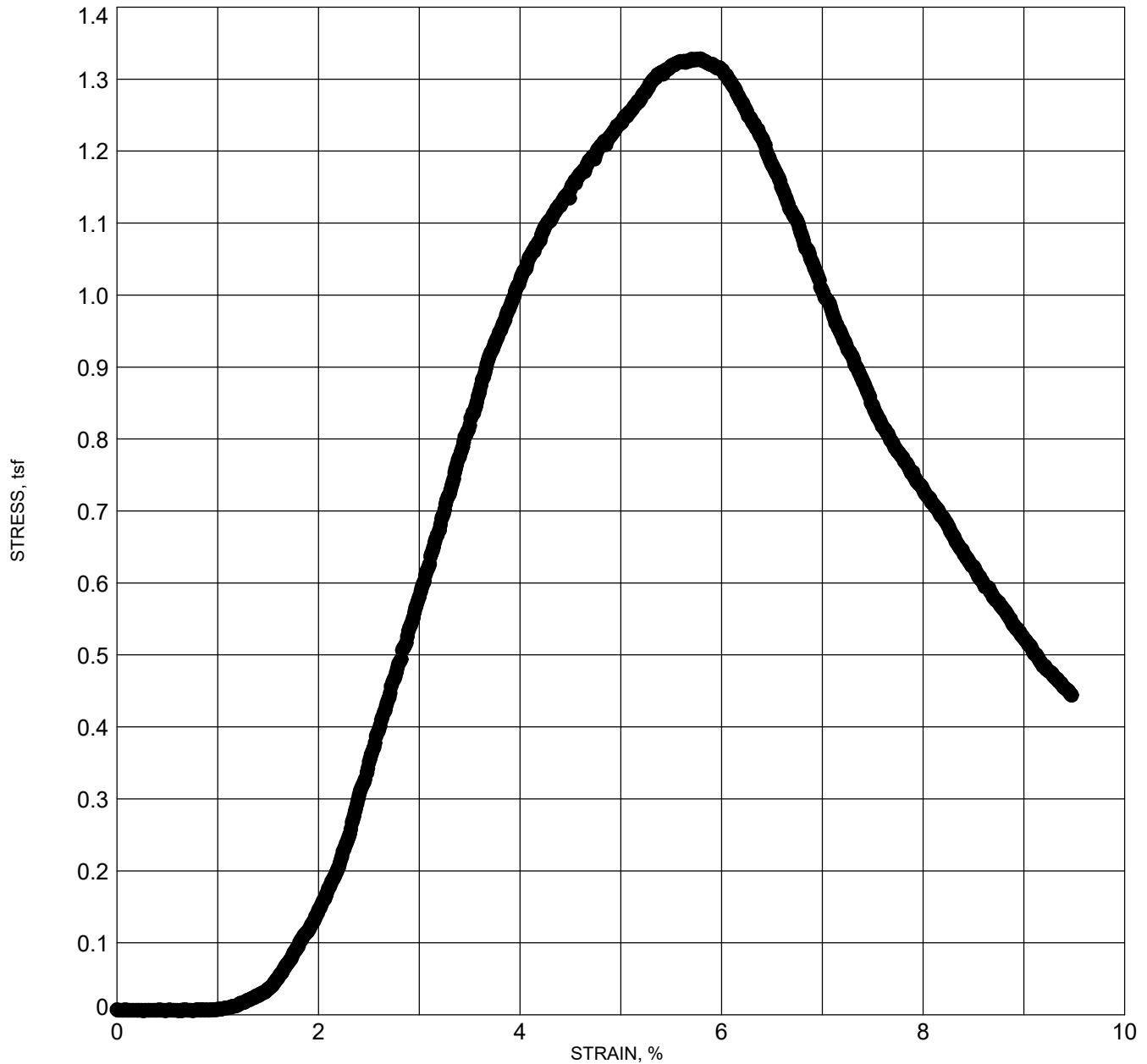
Sample Description: Grayish Brown, Fat Clay (CH)

PROJECT NAME: 104 Acre Fair Oaks Development

CLIENT: PartnerTulsa

PROJECT NUMBER: 023-04565

PROJECT LOCATION: Tulsa, Oklahoma



Boring No: B-02

Sample Height (ft): 5.6

Unconfined Strength (tsf): 1.3

Sample ID: U-1

Sample Diameter (ft): 2.9

Strain at Failure (%): 5.8

Sample Depth (ft): 1.0 - 3.0' Height to Diameter Ratio: 1.9:1

Sample Break:

Initial Dry Density (pcf): 97.6 Degree of Saturation (%): 52.7



Initial Water Content (%): 14.2

Void Ratio: 0.728

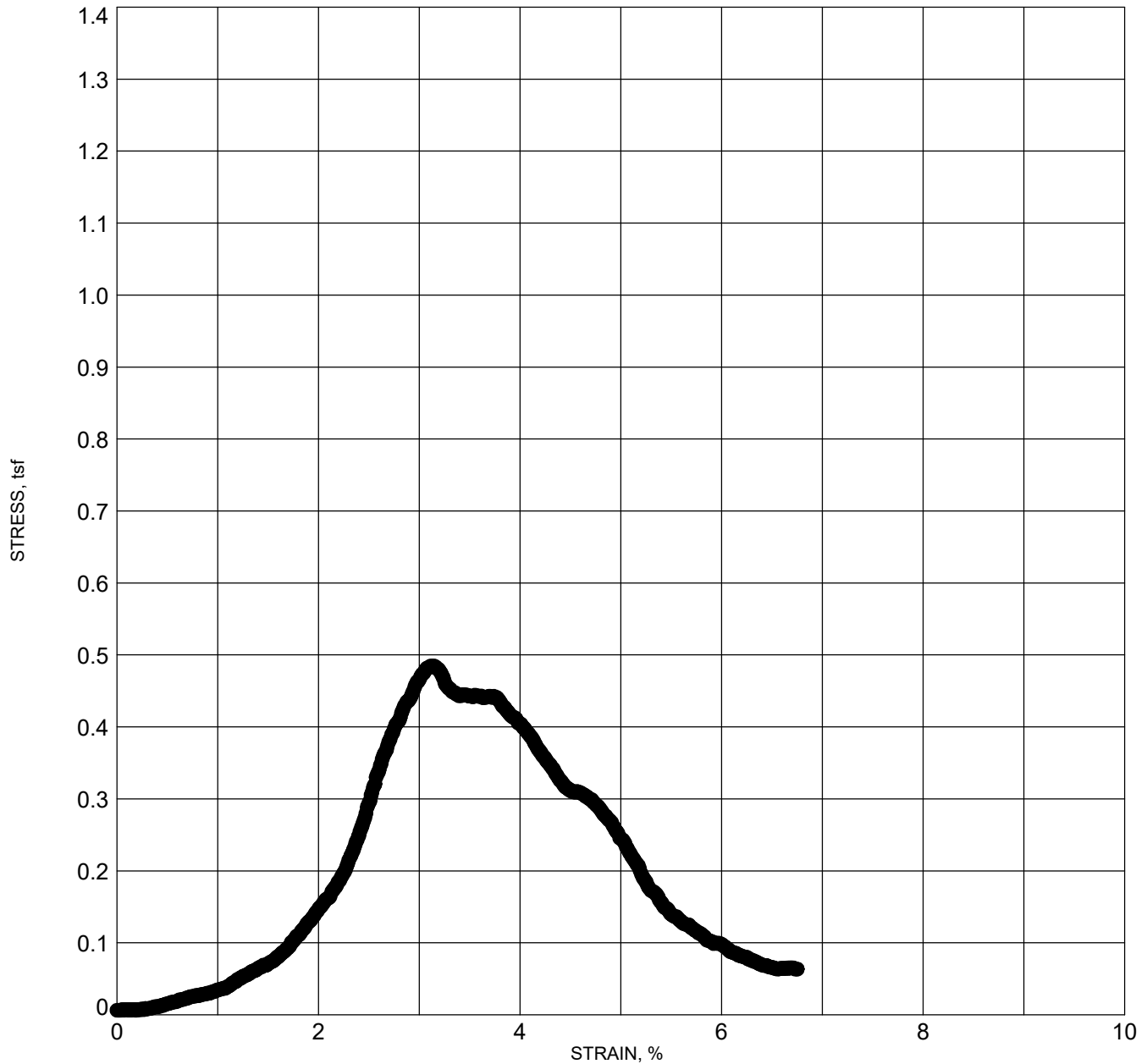
Sample Description: Reddish Brown, Lean Clay (CL)

PROJECT NAME: 104 Acre Fair Oaks Development

CLIENT: PartnerTulsa

PROJECT NUMBER: 023-04565

PROJECT LOCATION: Tulsa, Oklahoma



Boring No: B-04

Sample Height (ft): 5.6

Unconfined Strength (tsf): 0.5

Sample ID: U-2

Sample Diameter (ft): 2.9

Strain at Failure (%): 3.1

Sample Depth (ft): 3.5 - 5.5' Height to Diameter Ratio: 1.9:1

Sample Break:

Initial Dry Density (pcf): 92.7 Degree of Saturation (%): 49.1



Initial Water Content (%): 14.9

Void Ratio: 0.819

Sample Description: Dark Brown to Brown, Sandy Fat Clay (CH)

# Laboratory Analytical Report

11 October 2023  
Mr. Wyatt Grooms  
Olsson Associates  
9500 Pole Rd.  
Moore, OK 73160



WO: E3J0097  
RE: Tulsa, OK

Enclosed are the results of analyses for samples received by the laboratory on 10/4/2023. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Russell Britten  
President

Original (P)





Olsson Associates  
 9500 Pole Rd.  
 Moore OK, 73160

Project: Tulsa, OK  
 Project Number: 023-04565  
 Project Manager: Mr. Wyatt Grooms

Reported:  
 10/11/23 07:29

**B-02 SS-2 3.5-5.0'**

**E3J0097-01 (Solid) - Sampled: 09/27/23 00:00**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Analyst	Analyzed	Method	Qualifiers
<b>Conventional Chemistry Parameters by EPA Methods</b>									
pH	7.14		pH Units	1	ELJ0172	JRH	10/09/23 15:20	EPA 9045D 2004	H-03
<b>Conventional Chemistry Parameters by Standard Methods</b>									
x Resistivity	3120	1.00	ohms.cm	1	ELJ0169	JRH	10/09/23 13:45	SM 2510 B Mod	
x Temperature	20.1		°C	1	ELJ0169	JRH	10/09/23 13:45	SM 2550 B-2000	H-03
<b>Anions by EPA Method 300.0</b>									
Sulfate as SO4	29.9	3.00	mg/Kg	1	ELJ0202	LDH	10/09/23 17:16	EPA 300.0 1993	T-01

Environmental Testing, Inc.

Russell Britten, President

*The results in this report apply to the samples analyzed in accordance with the chain of custody document and meet all laboratory accreditation requirements unless noted otherwise. This analytical report must be reproduced in its entirety.*





Olsson Associates  
 9500 Pole Rd.  
 Moore OK, 73160

Project: Tulsa, OK  
 Project Number: 023-04565  
 Project Manager: Mr. Wyatt Grooms

Reported:  
 10/11/23 07:29

**B-04 SS-1 1.0-2.5'**

**E3J0097-02 (Solid) - Sampled: 09/27/23 00:00**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Analyst	Analyzed	Method	Qualifiers
<b>Conventional Chemistry Parameters by EPA Methods</b>									
pH	7.50		pH Units	1	ELJ0172	JRH	10/09/23 15:20	EPA 9045D 2004	H-03
<b>Conventional Chemistry Parameters by Standard Methods</b>									
x Resistivity	1340	1.00	ohms.cm	1	ELJ0169	JRH	10/09/23 13:45	SM 2510 B Mod	
x Temperature	20.1		°C	1	ELJ0169	JRH	10/09/23 13:45	SM 2550 B-2000	H-03
<b>Anions by EPA Method 300.0</b>									
Sulfate as SO4	19.7	3.00	mg/Kg	1	ELJ0202	LDH	10/09/23 17:35	EPA 300.0 1993	T-01

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Russell Britten, President

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 Project Number: 023-04565  
 Project Manager: Mr. Wyatt Grooms

Reported:  
 10/11/23 07:29

**B-01 SS-1 1.0-2.5'**

**E3J0097-03 (Solid) - Sampled: 09/27/23 00:00**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Analyst	Analyzed	Method	Qualifiers
<b>Conventional Chemistry Parameters by EPA Methods</b>									
pH	7.77		pH Units	1	ELJ0172	JRH	10/09/23 15:20	EPA 9045D 2004	H-03
<b>Conventional Chemistry Parameters by Standard Methods</b>									
x Resistivity	828	1.00	ohms.cm	1	ELJ0169	JRH	10/09/23 13:45	SM 2510 B Mod	
x Temperature	20.2		°C	1	ELJ0169	JRH	10/09/23 13:45	SM 2550 B-2000	H-03
<b>Anions by EPA Method 300.0</b>									
Sulfate as SO4	212	15.0	mg/Kg	5	ELJ0202	LDH	10/10/23 12:03	EPA 300.0 1993	T-01

Environmental Testing, Inc.

Russell Britten, President

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4619 N. Santa Fe Ave  
 Oklahoma City, OK 73118  
 405.488.2400 Phone  
 405.488.2404 Fax  
 www.etilab.com

Olsson Associates  
 9500 Pole Rd.  
 Moore OK, 73160

Project: Tulsa, OK  
 Project Number: 023-04565  
 Project Manager: Mr. Wyatt Grooms

Reported:  
 10/11/23 07:29

# QUALITY CONTROL

## Conventional Chemistry Parameters by EPA Methods Environmental Testing, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifiers
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**Batch ELJ0172 - General Prep - Wet Chem (Sd)**

**LCS (ELJ0172-BS1)**

Prepared & Analyzed: 10/09/23

pH	7.05		pH Units	7.000		101	99-101			
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**Duplicate (ELJ0172-DUP1)**

Source: E3J0098-01

Prepared & Analyzed: 10/09/23

pH	5.04		pH Units	5.18				3	20	
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Environmental Testing, Inc.

Russell Britten, President

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E3J0097  
 Original  
 ETI\_OKC\_RPT\_MRL\_rev43.0.rpt



Olsson Associates  
 9500 Pole Rd.  
 Moore OK, 73160

Project: Tulsa, OK  
 Project Number: 023-04565  
 Project Manager: Mr. Wyatt Grooms

Reported:  
 10/11/23 07:29

# QUALITY CONTROL

## Conventional Chemistry Parameters by Standard Methods Environmental Testing, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifiers
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**Batch ELJ0169 - General Prep - Wet Chem (Sd)**

**LCS (ELJ0169-BS1)**

Prepared & Analyzed: 10/09/23

Resistivity	7080	10.0	ohms.cm	7077		100	80-120			
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**Duplicate (ELJ0169-DUP1)**

Source: E3J0063-01

Prepared & Analyzed: 10/09/23

Resistivity	169000	10.0	ohms.cm		137000			21	20	R-01
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Environmental Testing, Inc.

Russell Britten, President

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Olsson Associates  
 9500 Pole Rd.  
 Moore OK, 73160

Project: Tulsa, OK  
 Project Number: 023-04565  
 Project Manager: Mr. Wyatt Grooms

Reported:  
 10/11/23 07:29

## QUALITY CONTROL

Anions by EPA Method 300.0  
 Environmental Testing, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifiers
<b>Batch ELJ0202 - General Prep - Wet Chem (Sd)</b>										
<b>Blank (ELJ0202-BLK1)</b>				<b>Prepared &amp; Analyzed: 10/09/23</b>						
Sulfate as SO4	<3.00	3.00	mg/Kg							
<b>LCS (ELJ0202-BS1)</b>				<b>Prepared &amp; Analyzed: 10/09/23</b>						
Sulfate as SO4	31.5	3.00	mg/Kg	30.00		105	90-110			
<b>Matrix Spike (ELJ0202-MS1)</b>				<b>Source: E3J0097-02</b>		<b>Prepared &amp; Analyzed: 10/09/23</b>				
Sulfate as SO4	45.5	3.00	mg/Kg	30.00	19.7	86	80-120			
<b>Matrix Spike Dup (ELJ0202-MSD1)</b>				<b>Source: E3J0097-02</b>		<b>Prepared &amp; Analyzed: 10/09/23</b>				
Sulfate as SO4	46.0	3.00	mg/Kg	30.00	19.7	88	80-120	1	20	

Environmental Testing, Inc.

Russell Britten, President

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Olsson Associates  
 9500 Pole Rd.  
 Moore OK, 73160

Project: Tulsa, OK  
 Project Number: 023-04565  
 Project Manager: Mr. Wyatt Grooms

Reported:  
 10/11/23 07:29

**Non-Certified Analytes included in this Report**

Analysis	Analyte
SM 2510 B Mod in Solid	Resistivity
SM 2550 B-2000 in Solid	Temperature

**Certifications**

Code	Description	Number	Expires
NELAP/OK	NELAP Accredited (ODEQ)	2023-028	08/31/2024
TCEQ	Texas Accredited (TCEQ)	T104704498-23-13	03/31/2024

**Qualifiers and Definitions**

Abbreviation	Description
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
x	Non-Certified analyte
NA	Not Applicable

Qualifier	Description
H-03	Sample was received and analyzed past the method holding time.
R-01	The RPD between sample duplicates exceeded the method or laboratory control limit. This may indicate the results are not as precise as expected.
T-01	The sample was received outside of the regulatory temperature for this analysis.

Environmental Testing, Inc.

Russell Britten, President

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# 104 ACRE FAIR OAKS DEVELOPMENT

Tulsa, Oklahoma

November 2023

Olsson Project No. 023-04565

