# RED ROCK CONSULTING

## Report of Geotechnical Investigation

OF THE

SH 29 Bridge over Black Bear Creek STEPHENS COUNTY, OKLAHOMA

29657(04)

#### Prepared For:

SRB 100 Northeast 5th Street Oklahoma City, Oklahoma 73104 Attention: Mr. Greg Allen, PE

#### Prepared By:

Red Rock Consulting, LLC PO Box 30591 Edmond, Oklahoma 73003 (405) 562-3328

> July 19, 2018 Project No. 18026



July 19, 2018

SRB

100 Northeast 5<sup>th</sup> Street Oklahoma City, Oklahoma 73104

Attention:

Mr. Greg Allen, PE

Re:

Report of Geotechnical Investigation

SH 29 Bridge over Black Bear Creek

Stephens County, Oklahoma 29657(04)

Project No. 18026

Dear Mr. Allen:

I am pleased to submit herewith this report entitled "Geotechnical Investigation, SH 29 Bridge over Black Bear Creek, Stephens County, Oklahoma, 29657(04)".

In an effort to provide a more environmentally friendly service, this report has been printed double sided on 100% recycled paper.

It has been our pleasure to assist you with this project. Should you have any questions regarding the contents of this report, please contact Red Rock Consulting.

Yours very truly,

RED ROCK CONSULTING, LLC

il Bul.

CA No. 5707 Exp. 06/30/19

Daniel Bolin, El

**Project Specialist** 

Jeremy Basler, PE

Geotechnical Manager Oklahoma PE No. 20233

#### REPORT OF GEOTECHNICAL INVESTIGATION

#### SH 29 BRIDGE OVER BLACK BEAR CREEK STEPHENS COUNTY, OKLAHOMA

#### 29657(04)

#### PROJECT NO. 18026

| INTRODUCTION                            | 1 |
|---|---|
| GENERAL                                 | 1 |
| PROPOSED CONSTRUCTION                   | 1 |
| SCOPE OF WORK                           |   |
| FIELD AND LABORATORY INVESTIGATIONS     | 2 |
| FIELD EXPLORATION                       | 2 |
| LABORATORY TESTING                      | 4 |
| SITE DESCRIPTION                        | 5 |
| SURFACE CONDITIONS                      |   |
| SITE GEOLOGY                            | 6 |
| SUBSURFACE CONDITIONS                   | 8 |
| GROUNDWATER CONDITIONS                  | 9 |
| INTERNATIONAL BUILDING CODE SITE CLASS1 | 0 |
| CLOSURE1                                | 1 |

#### **APPENDICES**

APPENDIX A – Field Investigation

APPENDIX B – Laboratory Results
APPENDIX C – Rock Core Photographs
APPENDIX D – General Notes

#### REPORT OF GEOTECHNICAL INVESTIGATION

### SH 29 BRIDGE OVER BLACK BEAR CREEK STEPHENS COUNTY, OKLAHOMA

29657(04)

#### PROJECT NO. 18026

#### INTRODUCTION

#### General

This report presents the results of the geotechnical investigation performed for the proposed construction of an 8-span bridge along SH 29 over Black Bear Creek, located 8.6 miles west of the Garvin County line in Stephens County, Oklahoma. The new bridge is anticipated to be 8 spans along a new alignment of SH 29 located approximately 60 feet north of the existing alignment. The purpose of this investigation is to evaluate the subsurface conditions at the site and to provide information pertaining to the geotechnical aspects of the proposed project.

#### **Proposed Construction**

The project will include the replacement of the existing single-span bridge with a new 8-span bridge along a new alignment of SH 29. The new alignment is located approximately 60 feet north of the existing alignment.

#### Scope of Work

The scope of this investigation includes the following:

- 1. Review of previous geotechnical and geological information of sites near this site. This was augmented with data obtained during the field investigation phase of the project.
- 2. Investigation of the subsurface soils by drilling and testing a total of 10 boreholes within the planned project area
- 3. A laboratory testing program consisting of moisture content, Atterberg limits, and full sieve analysis on the overburden soils encountered. Also included were unconfined compressive strength tests on select rock core samples.
- 4. Provide an International Building Code (IBC) site classification for seismic design

#### FIELD AND LABORATORY INVESTIGATIONS

#### Field Exploration

Subsurface exploration was performed from May 18 to June 5, 2018. The borings were located in the field by a representative of Red Rock Consulting by measuring distances from known site reference points as depicted on the plans that were provided by SRB. The locations of the borings should be considered accurate only to the degree implied by the methods used to define them.

The subsurface exploration program consisted of drilling 10 borings under the full-time supervision of a geologist or engineer. One boring was drilled at each of the abutment and pier locations of the bridge. Two borings were drilled at pier No. 1 (B-2 and B-2A). Boring B-2A was a constructability boring that was drilled to obtain bedrock samples to test for unconfined compressive strength. The borings ranged between 88.5 and 99.5 feet. The borings are shown on the boring location diagram, which is included in Appendix A.

The borings were advanced using wet rotary drilling methods from an all-terrain vehicle (ATV) mounted CME 750 drill rig or a truck mounted CME 55 drill rig both equipped with an automatic hammer. The overburden in both abutment borings and select pier borings was tested and sampled as per Oklahoma Department of Transportation (ODOT) specifications as modified by Bridge Division. The overburden materials were tested with Texas Cone Penetrometer (TCP) immediately followed by standard penetration test (SPT) at 5-foot intervals. In boring B-2A, SPT was only performed at the surface of bedrock. Following SPT refusal, the hardness of bedrock in all borings, except boring B-2A, was evaluated using a TCP in 5-foot intervals for a total depth of 30 feet. After SPT refusal was attained in boring B-2A, a 3-inch diameter continuous sampler was used to obtain bedrock samples. The bedrock was cored in 5-foot sections for a total depth of 20 feet. The sampling procedures are presented on the boring logs in Appendix A and the rock core photographs are included in Appendix C.

The SPT test uses a standard, 2-inch outside diameter, split-barrel sampling spoon that is driven into the bottom of the boring with a 140-pound automatic drive hammer that falls 30 inches. The blows per foot, N, is the number of hammer blows required to advance the sampling spoon the last 12 inches, or less, of an 18-inch sampling interval. The N value is used to estimate the in-situ relative density of granular soils, the consistency of cohesive soils, and the hardness of weathered bedrock.

Drilling equipment and methods have evolved considerably over the past 65 years following the development of the first SPT empirical design correlations. As a result, the automatic drive hammers on modern geotechnical drilling rigs must be calibrated for efficiency. The efficiency of an automatic drive hammer is specific to each hammer and is expressed by an energy efficiency ratio. The energy efficiency ratio is calculated by dividing the actual measured energy delivered to the drill rod by the theoretical energy delivered by a 140-pound automatic drive hammer that falls 30 inches. The hammer efficiency can be used to convert a SPT value into an N value with a nominal 60 percent efficiency, the  $N_{60}$  value. The  $N_{60}$  value is rarely used in engineering practice but is widely considered to be more accurate and more representative of the N values used to develop the original SPT empirical design correlations. Both the N and  $N_{60}$  values are presented on the boring logs in Appendix A.

The TCP test was developed by the Texas Highway Department in accordance with the AASHTO Manual on Subsurface Investigation and was modified by the Oklahoma Department Transportation. The TCP test is a dynamic penetration test performed to determine the in-situ properties of subsurface soils and to evaluate the consistency or hardness of the bedrock material. The TCP test drives a penetrometer cone into the undisturbed cohesive overburden soil or bedrock material with a 140-pound automatic drive hammer that falls 30 inches. The cone is seated into the undisturbed cohesive soil or bedrock material by driving the cone 10 blows or 12 inches, whichever is achieved first, into the soil/bedrock. The cone is then driven an additional 12 inches or 100 blows, whichever is reached first. If the cone is driven the full 12 inches, the number of blows required to drive each 6 inches of penetration up to 12 inches is recorded. The total number of blows required for the two 6-inch increments are then recorded as the TCP blow count. If the cone is unable to be driven the full 12 inches, the penetration is recorded after every 50 blows up to 100 blows.

After performing SPT and TCP tests, as well as collecting rock cores, the holes were backfilled with grout and cuttings as required by the Oklahoma State Statutes for Geotechnical drilling.

Samples were collected and transported back to the lab for further classification and testing. The final boring logs were developed from the draft logs, observations and test results of the samples returned to the laboratory. The stratigraphic contacts indicated are only for the specific dates and locations reported, and therefore, are not necessarily representative of other locations and times. The boring logs, presenting conditions encountered at each location explored, are included in Appendix A.

#### **Laboratory Testing**

Representative soil samples were tested to refine the field classifications and evaluate physical properties of the soils which may affect the geotechnical aspects of project design and construction. The laboratory testing program included the following:

- Moisture content (ASTM D2216)
- Liquid limit and plastic limit (ASTM D4318)
- Full sieve (ASTM D422)
- Uniaxial compressive strength of intact rock core (ASTM D7012 Method C)

The results of the physical laboratory tests conducted are shown on the boring logs in Appendix A and are included in Appendix B.

The above laboratory tests were performed in general accordance with applicable ASTM procedures, or generally accepted practice. It should be noted that reference to ASTM procedures does not imply that all cross-referenced procedures in ASTM standards have been used, or that all ASTM procedures used have been followed exactly. Only those ASTM procedures and/or portions of procedures, which, in the professional judgment of the geotechnical engineer of record for this report, are applicable, appropriate, and necessary for this project, have been used or followed.

#### SITE DESCRIPTION

#### **Surface Conditions**

At the time of this investigation, one reinforced concrete bridge was present along State Highway 29 over Black Bear Creek. The bridge had two lanes, one running east and one running west. The traffic on State Highway 29 was moderate to high and consisted of mostly large trucks.

There is a large cattle grazing field to the north of the boring locations, which is where the proposed bridge will be located. To the southwest there is a crop field across the existing highway. To the southeast a large uncultivated area was in place. This area was very dense with large trees and undergrowth. Nearer to the project site many large trees and brush lined the existing fence. Black Bear Creek was approximately 20 feet across and had flowing water in it during drilling activities. There was two days during drilling activities when the creek was approximately 40 feet across due to the buildup of timber underneath the bridge. The timber had to be cleared by ODOT to allow the water to flow away and allow drilling to proceed. This is known to occur after every significant rain storm. All the borings were easily accessible.

All the borings were drilled on the south side of the proposed bridge in the right-of-way due to the lack of permission from the landowner to the north. The borings were drilling in a line that staggered by approximately 3 to 18 feet as approved by the client. The locations of the borings are shown on the Boring Location Diagram in Appendix A.

The surface elevations at the boring locations were determined using differential leveling procedures. Benchmark 23, which was a set cut 'X' on the northeast wingwall of the existing bridge, was used as a benchmark. The benchmark was located at station 746+82.2, 13.3 feet left of the center line of survey and had an elevation of 1087.07 feet. The location and elevation of the benchmark were shown on the plans provided by the client. Based on this benchmark, the elevations of the borings ranged from 1083.4 to 1086.1 feet. The approximate elevation at each boring location is shown on the Boring Location Diagram in Appendix A.

#### Site Geology

The geology of the project site was researched using the "Division seven Engineering Classification of Geological Materials", published by the Oklahoma Department of Transportation (ODOT) and the Geologic Map of the "Hydrologic Atlas 3 of Oklahoma, Reconnaissance of the Water Resources of the Ardmore and Sherman quadrangle, southern Oklahoma," by Donald L Hart, Jr., U.S. Geological Survey, 1974.

#### ODOT PUBLLICATION

The ODOT publication indicates the project site is underlain by the El Reno Unit (Per).

The El Reno unit consists of a heterogeneous mixture of sandstones, shale, siltstone, and siltstone conglomerate. In northeastern Stephens County, the lowermost 40 to 100 feet of the unit consists dominantly of sandstones which are coarse-grained, nearly white to buff, and moderately soft; but a few hard massive sandstone beds up to six feet thick occur near the base of the unit. Northward, across Grady County, the sandstones of this lower section become red, progressively finer grained, and moderately hard to hard.

The upper portion of the unit is known as "The Purple Series" in Stephens and Grady Counties. Here, some 80 feet of soft purple sandstone, 50 feet of soft pink sandstones, and 50 feet of moderately soft purple mudstone conglomerate are present in descending order. Westward, in Comanche and southern Caddo counties, the sandstones grade into red shales with minor amounts of gypsum and siltstones. Locally, in southeastern Grady County, near Cox City, a few sandstone beds in the upper portion are hard, limy, and occur in beds up to seven feet thick.

The unit thickens northward from 420 feet in Stephens County to 460 feet in Western Caddo County to 660 feet in northern Grady County.

The El Reno unit outcrops in a four to eight mile wide northwest-southeast band across southern Caddo, northeastern Comanche, and northwestern Stephens Counties. The outcrop then circles the southeastern end of the Anadarko basin in northern Stephens County and covers a broad area up to eighteen miles wide across northeastern Stephens and Grady Counties of Division 7. In Grady and eastern Caddo Counties, north of T4N, the upper 0 to 230 feet is mapped separately as the Dog Creek-Blaine subunits undifferentiated. Northward, in Division 4, and westward from Caddo County, in Division 5, the rock strata of the El Reno unit are separable and are mapped as the Flowerpot, Blaine, and Dog Creek units.

Topographically, the unit generally forms rolling hills with a pronounced escarpment at the base in Stephens and southern Grady Counties where the sandstones are thickest.

Northwestward, the topography is rolling with gently rolling topography dominant in western Caddo County where the shales are thickest. The sandstone ridges are usually marked by oak vegetation and erosional gullies in the sandy soils. The shales generally form the valleys and gently rolling hills and support the growth of short grass. Some mesquite and prickly pear are evident in the salty or gypsiferous areas.

#### **USGS MAP**

According to the USGS geologic map, the project site is underlain by the Duncan Sandstone Member (Pd) of the El Reno Group.

Sandstone, white to buff, fine- to coarse-grained, moderately indurated, with interbedded mudstone conglomerates and siltstones; thickness, 100 to 400 feet, decreasing southeastward. Yields small to moderate amounts of water of fair quality.

#### **Subsurface Conditions**

Information collected during the field investigation indicates that the overburden material consisted of primarily of lean clay with varying amounts of sand and various combinations of sand and silt. These materials extended from the surface to the top of bedrock. The overburden encountered in the borings appeared to be native to the site.

The depth to bedrock ranged between 57 and 61 feet in the borings. The bedrock in the borings consisted of poorly cemented to very well cemented sandstone.

The unconfined compressive strength of the bedrock cores recovered from boring B-2 ranged between 744 and 1,161 psi. The rock coring had a relatively low recovery rate in all of the runs. These results are shown on the boring logs in Appendix A and in the lab results in Appendix B.

The approximate depths to bedrock and conditions are summarized in Table 1.

Table 1 – Depth to Bedrock and Conditions

|        |                                  | 14510 1             | Dopui to D         | ediock and Conditions                      |                            |
|--------|----------------------------------|---------------------|--------------------|--|----------------------------|
| Boring | Depth<br>to<br>Bedrock<br>(feet) | Elevation<br>(feet) | Type of<br>Bedrock | Hardness                                   | UC Compressive<br>Strength |
| B-1    | 57.5                             | 1027                | sandstone          | poorly cemented to very well cemented      |                            |
| B-2    | 57                               | 1027.2              | sandstone          | cemented to very well cemented             | 744 – 1,161 psi            |
| B-3    | 60.5                             | 1023.7              | sandstone          | poorly cemented to very well cemented      |                            |
| B-4    | 61                               | 1024.7              | sandstone          | poorly cemented to very well cemented      |                            |
| B-5    | 61                               | 1024.2              | sandstone          | poorly cemented to very well cemented      |                            |
| B-6    | 61                               | 1025.1              | sandstone          | poorly cemented to very well cemented      |                            |
| B-7    | 59.5                             | 1025.8              | sandstone          | well cemented to very well cemented        |                            |
| B-8    | 59                               | 1024.4              | sandstone          | poorly well cemented to very well cemented |                            |
| B-9    | 59                               | 1025                | sandstone          | well cemented to very well cemented        |                            |

Subsurface conditions are described in greater detail on the boring logs in Appendix A. Photographs of the rock cores collected are presented in Appendix C.

#### **Groundwater Conditions**

Groundwater conditions were monitored in all borings immediately following completion of drilling operations in borings B-1, B-2, B-8 and B-9 and after a period of delay in borings B-1, B-2, B-3, B-6, B-7 and B-8. All borings remained open following drilling activities except borings B-4 and B-5 that collapsed at 2 feet and 3 feet, respectively. The approximate groundwater levels are summarized in Table 2. It should be noted that the groundwater levels measured immediately following drilling may not be precise due to the nature of wet rotary drilling. The groundwater levels measured after a period of delay may not be precise due to the location of the borings being near a creek that gathers large amounts of water and the rainfall events experienced during drilling activities.

Table 2 – Groundwater Levels

|        |                 | Approximate              | e Groundwa     | Groundwater Levels      |                  |  |  |  |  |  |  |  |
|--------|-----------------|--------------------------|----------------|-------------------------|------------------|--|--|--|--|--|--|--|
| Boring |                 | ediately<br>ing Drilling |                | Hours<br>After Drilling |                  |  |  |  |  |  |  |  |
|        | Depth<br>(feet) | Elevation<br>(feet)      | Hours          | Depth<br>(feet)         | Elevation (feet) |  |  |  |  |  |  |  |
| B-1    | 2.5             | 1082                     | 168 3 1081.5   |                         |                  |  |  |  |  |  |  |  |
| B-2    | 3               | 1081.2                   | 192            | 192 12 1072.2           |                  |  |  |  |  |  |  |  |
| B2-A   | 3               | 1081.2                   | 192            | 192 12 1072.2           |                  |  |  |  |  |  |  |  |
| B-3    | NA              |                          | 192            | 2.5                     | 1081.7           |  |  |  |  |  |  |  |
| B-4    |                 | Colla                    | apsed at 2 fe  | eet                     |                  |  |  |  |  |  |  |  |
| B-5    |                 | Colla                    | apsed at 3 fe  | eet                     |                  |  |  |  |  |  |  |  |
| B-6    | NA              |                          | 456            | 6                       | 1080.1           |  |  |  |  |  |  |  |
| B-7    | NA              |                          | 168 2.5 1082.8 |                         |                  |  |  |  |  |  |  |  |
| B-8    | 4.5             | 1078.9                   | 24             | 8                       | 1075.4           |  |  |  |  |  |  |  |
| B-9    | 2.5             | 1081.5                   |                |                         |                  |  |  |  |  |  |  |  |

To obtain more accurate groundwater level information, long-term observations in a well or piezometer that is sealed from the influence of surface water would be needed. Fluctuations in groundwater levels can occur due to seasonal variations in the amount of rainfall, runoff, altered drainage paths, and other factors not evident at the time borings were advanced. Consequently, the contractor should be aware of this possibility while constructing this project.

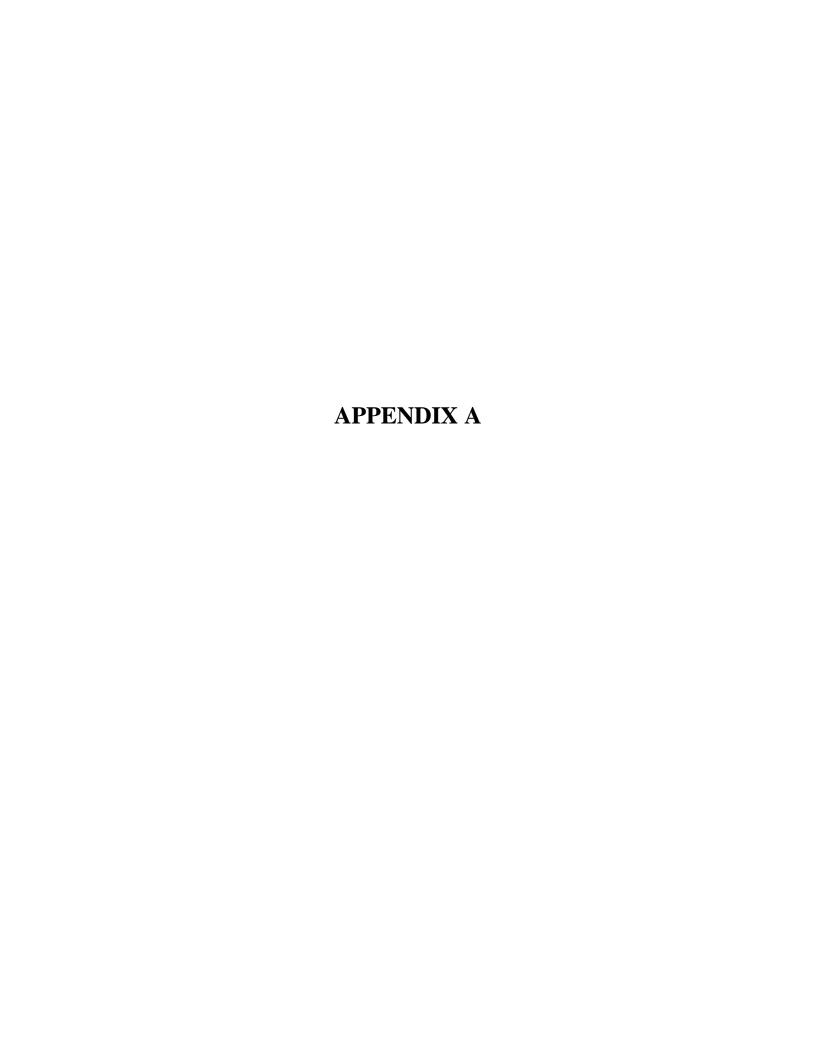
#### **International Building Code Site Class**

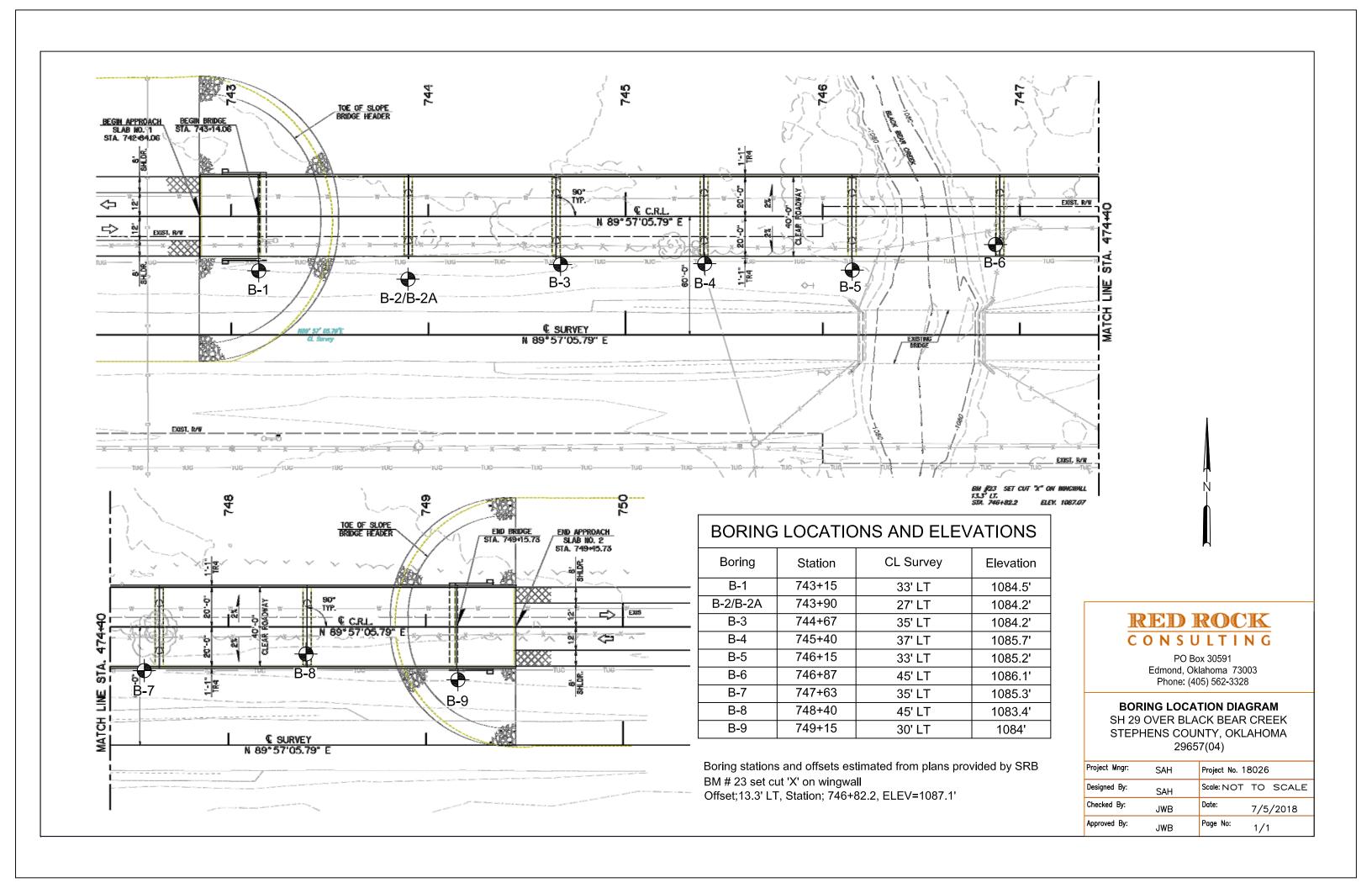
From the geotechnical investigation and subsequent laboratory tests, the onsite soils yield an **International Building Code (IBC) Site Class "D"**. This site class is based on the average standard penetration resistance (SPT) procedure, and a maximum boring depth of 99.5 feet. **This site class does not account for induced earth movement, such as the recent earthquakes due to injection wells.** To obtain a more accurate site class, more extensive testing must be used to evaluate the subsurface conditions.

#### **CLOSURE**

The data presented in this report are based on the negotiated scope for this project and site conditions as they existed at the time of the field exploration. The conditions encountered in the exploratory borings are assumed to be representative subsurface conditions within the study area.

This report was prepared for the exclusive use of SRB, ODOT and their agents and consultants. It should be made available to prospective contractors for information and factual data only and not as a warranty of subsurface conditions similar to those interpreted from the boring logs or discussions presented herein.





PAGE 1 OF 2



**CLIENT** SRB PROJECT NAME SH 29 Bridge over Black Bear Creek PROJECT NUMBER 18026 PROJECT LOCATION Stephens County, Oklahoma DATE STARTED 5/30/18 **COMPLETED** 5/30/18 GROUND ELEVATION 1084.5 ft STATION 743+15 OFFSET 33' LT **DRILLING CONTRACTOR** DSO - Drilling Services of Oklahoma **GROUND WATER LEVELS:** DURING DRILLING NA DRILLING METHOD wet rotary - CME 750 ATV **▼168 hrs AFTER DRILLING** 3.0 ft / Elev 1081.5 ft LOGGED BY SAH **CHECKED BY** JWB **NOTES** 29657(04) Cave In Depth open **ATTERBERG** BLOW COUNTS N BLOW COUNTS N60 PASSING #200 SIEVE (%) SAMPLE TYPE MOISTURE CONTENT (%) LIMITS GRAPHIC LOG DEPTH (ft) ELEVATION PLASTICITY INDEX PLASTIC LIMIT LIQUID MATERIAL DESCRIPTION SANDY LEAN CLAY, brown, medium stiff 22 10 1084.5' 5 27 17 60.1  $\nabla$ 7080 SILTY, CLAYEY SAND, brown, very loose 1079.5' XSPT 0 0 22 21 16 5 39.2 LEAN CLAY with SAND, reddish brown, soft 1074.5' 1 25 30 15 15 79.3 7<u>0</u>-107 TC 8 SILTY CLAY with SAND, reddish brown, medium stiff 1067.5' 8 11 17 7 72.8 SPT 26 24 SILTY SAND, reddish brown to brown, very soft to stiff 7 1064.5'  $\times$ SPT 5 24 0 0 NP 34.7 1060 **LEAN CLAY with SAND**, reddish brown to brown, very soft 1059.5' SPT 10 13 40 73.9 21 14 26 TC 12 SPT 1 1 27 35 22 78.1 13 1050 LEAN CLAY, brown, medium stiff to very stiff 1049.5'  $\times$ SPT 7 9 23 34 14 20 85.9 TC 15 19 SILTY SAND, brown, medium dense 1042.5' 14 21 0 0 NP 30.0 SANDY LEAN CLAY, brown, very soft to stiff 1039.5' 21 24  $|\times|$ SPT 0 0 12 12 61.3 50 14 ▼ TC **LEAN CLAY with SAND**, dark gray, stiff to very stiff 1032.5' imesSPT 9 12 27 39 12 27 80.9 <u> 1</u>030 TC 13 23 30 45 18 27 90.2 1027' **SANDSTONE**, gray, poorly cemented to very well cemented SPT 50/5.5" TC 50/2.3" 50/0.5" 31 15 86.5 19 16 1020 TC 50/0.4 TC 50/0.8 <del>-</del>70 50/0.4

PAGE 2 OF 2

RED ROCK PO Box 30591 Edmond, OK 73003 C O N S U L T I N G 405-562-3328

CLIENT SRB

1 DURING AFTER CAVE IN WITH N60 18026 LOGS.GPJ DATA TEMPLATE.GDT 7/19/18

PROJECT NAME SH 29 Bridge over Black Bear Creek

| PROJECT NUM                           | BER 18026 PROJECT LOCATIO   | N Step      | hens Co  | unty, Ok           | lahoma                  |        |                        |                          |                           |
|---------------------------------------|---|-------------|--|--------------------|-------------------------|--------|------------------------|--------------------------|---------------------------|
| ELEVATION (ft) DEPTH (ft) GRAPHIC LOG |   | SAMPLE TYPE | BLOW COUNTS<br>N   | BLOW COUNTS<br>N60 | MOISTURE<br>CONTENT (%) | LIQUID | PLASTIC IT LIMIT LIMIT | PLASTICITY W ZI<br>INDEX | PASSING #200<br>SIEVE (%) |
| 1010                                  | SANDSTONE, gray, poorly cemented to very well cemented (continued)  Boring Termination Depth = 88 feet 996.5' Boring Completed on 5/30/18 and Grouted on 6/9/18 | ▼ TC        | 50/0.8"<br>50/0.4"<br>50/0.3"<br>50/0.1"<br>50/0.5"<br>50/0.5" |                    |                         |        |                        | <u>d</u>                 |                           |
| 980<br>                               |   |             |  |                    |                         |        |                        |                          |                           |

PAGE 1 OF 2



**CLIENT** SRB PROJECT NAME SH 29 Bridge over Black Bear Creek PROJECT NUMBER 18026 PROJECT LOCATION Stephens County, Oklahoma DATE STARTED 5/29/18 COMPLETED 5/29/18 GROUND ELEVATION 1084.2 ft STATION 743+90 OFFSET 27' LT **DRILLING CONTRACTOR** DSO - Drilling Services of Oklahoma **GROUND WATER LEVELS: DURING DRILLING** NA DRILLING METHOD wet rotary - CME 750 ATV **▼192 hrs AFTER DRILLING** 12.0 ft / Elev 1072.2 ft LOGGED BY SAH **CHECKED BY** JWB **NOTES** 29657(04) Cave In Depth open **ATTERBERG** BLOW COUNTS N BLOW COUNTS N60 PASSING #200 SIEVE (%) MOISTURE CONTENT (%) SAMPLE TYPE LIMITS GRAPHIC LOG **ELEVATION** ( DEPTH (ft) PLASTICITY INDEX PLASTIC LIMIT LIQUID MATERIAL DESCRIPTION 1084.2' 1083.2'  $\times$ SPT 9 **CLAYEY SAND**, brown, loose 11 25 16 9 48.0 SILTY, CLAYEY SAND, reddish brown, very loose imesSPT 1 1 19 23 17 6 45.3 TC 9 0 **LEAN CLAY with SAND**, brown, very soft 1072.2' SPT 0 28 32 15 17 81.8 <u> 1</u>07 TC 6 SILTY, CLAYEY SAND, reddish brown, loose 1067.2' 7 9 35.0 SPT 21 22 16 6 7 TC ✓ SPT LEAN CLAY, dark brown, very soft 1062.2' 0 0 27 30 16 14 86.5 1060 TC 6 SANDY LEAN CLAY, dark brown, medium stiff 1057.2' 5 7 19 25 15 10 64.8 TC 15 **LEAN CLAY with SAND**, dark brown, very soft to stiff 1052.2' SPT 11 15 20 34 21 72.0 13 1050 TC 7 SPT 1 33 74.3 1 26 15 18 TC 13 15 SANDY LEAN CLAY, brown, stiff 1042.2' SPT 11 28 31 13 18 65.8 1039.2' SPT 15 24 SILTY SAND, brown, loose to medium dense 11 0 0 NP 24.2 <del>-</del>50 SPT 19 25 22 NP 25.7 0 0 1030 imesSPT 10 13 17 19 15 34.0 4 25 23 17 6 59.9 **SANDSTONE**, light gray, cemented to very well cemented 1027.2' 50/1" TC 50/0.4 TC 50/0.5 1020 50/1" TC 50/0.4" 50/0.4 70

PAGE 2 OF 2

RED ROCK PO Box 30591 Edmond, OK 73003 C O N S U L T I N G 405-562-3328

CLIENT SRB

PROJECT NAME SH 29 Bridge over Black Bear Creek

| PROJECT NUMBER 1                      | 8026 PROJECT   | LOCATIO | ON Stept    | nens Cou  | unty, Ok           | lahoma                  |        |                     |        |                           |
|---------------------------------------|--|---------|-------------|---|--------------------|-------------------------|--------|---------------------|--------|---------------------------|
| ELEVATION (ft) DEPTH (ft) GRAPHIC LOG | MATERIAL DESCRIPTION   |         | SAMPLE TYPE | BLOW COUNTS<br>N  | BLOW COUNTS<br>N60 | MOISTURE<br>CONTENT (%) | LIQUID | PLASTIC LIMIT LIMIT | S<br>~ | PASSING #200<br>SIEVE (%) |
| 1010                                  | SANDSTONE, light gray, cemented to very well cemented (continued)                    | 1027.2' | ▼ TC        | 50/1.5"<br>50/0.5"/<br>50/0.3"/<br>50/0.3"/<br>50/0.3"/ |                    |                         |        |                     |        |                           |
| 980     -   -                         | Boring Termination Depth = 88 feet Boring Completed on 5/29/18 and Grouted on 6/9/18 | 996.2'  | TC          | 50/0.4"   |                    |                         |        |                     |        |                           |

## BORING NUMBER B 2-A PAGE 1 OF 2



| CLIE             | NT _           | SRB            |  | PROJECT NAME S     | H 29 Brid   | lge over      | Black B            | ear Cre                 | ek          |                  |                     |                           |
|------------------|----------------|----------------|--|--------------------|-------------|---------------|--------------------|-------------------------|-------------|------------------|---------------------|---------------------------|
| PRO              | JEC1           | NUN            | IBER 18026                                       | PROJECT LOCATIO    | N Steph     | ens Cou       | unty, Okl          | ahoma                   |             |                  |                     |                           |
| DAT              | E ST           | ARTE           | <b>ED</b> 5/29/18 <b>COMPLETED</b> 5/29/18       | GROUND ELEVATION   | N 1084      | .2 ft S       | TATION             | <b>I</b> _743+          | 90 <b>o</b> | FFSE             | Γ <u>27'</u> Ι      | LΤ                        |
| DRIL             | LING           | CON            | ITRACTOR DSO - Drilling Services of Oklahoma     | GROUND WATER LI    | EVELS:      |               |                    |                         |             |                  |                     |                           |
| DRIL             | LING           | MET            | THOD wet rotary - CME 750 ATV                    | DURING DRIL        | LING N      | Ą             |                    |                         |             |                  |                     |                           |
| LOG              | GED            | BY             | SAH CHECKED BY JWB                               | ₹192 hrs AFTEI     | R DRILLI    | NG 12         | .0 ft / Ele        | ev 1072                 | .2 ft       |                  |                     |                           |
| NOT              | ES _           | 29657          | 7(04)  | Cave In Depth      | open_       |               |                    |                         |             |                  |                     |                           |
| <u> </u>         |                |                |  |                    |             | m             | m                  |                         | AT          | TERBI            | ERG                 | _                         |
| ELEVATION (ft)   | ( <del>L</del> | ೨              |  |                    | SAMPLE TYPE | COUNTS        | BLOW COUNTS<br>N60 | MOISTURE<br>CONTENT (%) |             | LIMIT            |                     | PASSING #200<br>SIEVE (%) |
| TIO              | DEРТН (ft)     | GRAPHIC<br>LOG | MATERIAL DESCRIPTION                             |                    | LEJ         | 00<br>N       | CO1                | ENI                     | ∟           | PLASTIC<br>LIMIT | Ę×.                 | NG<br>Æ (                 |
| EV₽              | DEF            | GR/<br>L       |  |                    | MP          | BLOW          | WC                 | NO.                     | LIQUID      | ASI              | STI<br>NDE          | SSI                       |
| Е                | 0              |                |  |                    | SA          | BL(           | BL(                | 20                      |             | 립_               | PLASTICITY<br>INDEX | Ь                         |
|                  |                |                | <u>CLAYEY SAND</u> , brown, loose                | 1084.2'            | -           |               |                    |                         |             |                  |                     |                           |
|                  |                |                | SILTY, CLAYEY SAND, reddish brown, very          | loose 1083.2'      |             |               |                    |                         |             |                  |                     |                           |
| 108 <u>0</u>     |                |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
|                  |                |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
|                  | <br>-10        |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
| <br><br>         | - 10 -<br>     |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
|                  |                |                | LEAN CLAY with SAND, brown, very so              | oft 1072.2'        | -           |               |                    |                         |             |                  |                     |                           |
| 107 <u>0</u><br> |                |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
|                  | _ =            |                | OILTY OLANTY CAND and the brown to               | 4007.01            | -           |               |                    |                         |             |                  |                     |                           |
| <br><br>         | <br>20         |                | SILTY, CLAYEY SAND, reddish brown, lo            | ose 1067.2'        |             |               |                    |                         |             |                  |                     |                           |
|                  | - <b>-</b>     |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
| <br>1060         | _ =            |                | <b>LEAN CLAY</b> , dark brown, very soft         | 1062.2'            | -           |               |                    |                         |             |                  |                     |                           |
|                  |                |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
|                  |                |                | CANDY I FAN CLAY deals busy in the discourse     | -+:FF 4057.0L      | -           |               |                    |                         |             |                  |                     |                           |
| <br>             | <br>-30        |                | SANDY LEAN CLAY, dark brown, medium              | stiff 1057.2'      |             |               |                    |                         |             |                  |                     |                           |
|                  | _              |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
| <br>105 <u>0</u> |                |                | <b>LEAN CLAY with SAND</b> , dark brown, very so | t to stiff 1052.2' | -           |               |                    |                         |             |                  |                     |                           |
|                  |                |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
|                  |                |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
|                  | <br>-40-       |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
|                  | - '°-          |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
| <br>104 <u>0</u> |                |                | SANDY LEAN CLAY, brown, stiff                    | 1042.2'            | -           |               |                    |                         |             |                  |                     |                           |
|                  |                |                | SILTY SAND, brown, loose to medium de            | nse 1039.2'        | -           |               |                    |                         |             |                  |                     |                           |
|                  |                |                | SILTY SAND, DIOWII, 1005e to medium dei          | 1039.2             |             |               |                    |                         |             |                  |                     |                           |
| <br>             | <br>50         |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
|                  |                |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
| <br>1030         |                |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
|                  |                |                |  |                    |             |               |                    |                         |             |                  |                     |                           |
|                  |                |                | SANDSTONE light gray, comented to you well       | 20monted 1027 21   | ≥¥ерт       | 50/3.4"/      |                    |                         |             |                  |                     |                           |
|                  | <br>-60        |                | SANDSTONE, light gray, cemented to very well     | cemented 1027.2'   | RC          | Total=        |                    |                         |             |                  |                     |                           |
|                  |                |                |  |                    | RC          | 5<br>Rec=     |                    |                         |             |                  |                     |                           |
| <br>1020         |                |                | *62.5 feet - Compressive Strength = 744 p        | si * 1021.7'       |             | 8%<br>RQD=    |                    |                         |             |                  |                     |                           |
|                  | = =            |                |  |                    | RC          | 0%            |                    |                         |             |                  |                     |                           |
|                  | = =            |                |  |                    | H           | Total=<br>_23 |                    |                         |             |                  |                     |                           |
|                  | <br>-70        |                | *67.5 feet - Compressive Strength = 1,161        | psi * 1016.7'      | RC          | Rec= 38%      |                    |                         |             |                  |                     |                           |
|                  |                |                |  |                    |             | RQD=          |                    |                         |             |                  |                     |                           |
|                  |                |                |  |                    |             |               |                    |                         | _           |                  |                     |                           |

PAGE 2 OF 2

RED ROCK PO Box 30591 Edmond, OK 73003 C O N S U L T I N G 405-562-3328

CLIENT SRB

1 DURING AFTER CAVE IN WITH N60 18026 LOGS.GPJ DATA TEMPLATE.GDT 7/19/18

PROJECT NAME SH 29 Bridge over Black Bear Creek

| PRC                            | JEC          | I NUIVI        | BER 18026 PROJECT LOCATION   | <u> 516</u> | epnens C            | ounty, O                                     | kianoma                 | 1      |                  |                     |                           |
|--------------------------------|--------------|----------------|--|-------------|---------------------|--|-------------------------|--------|------------------|---------------------|---------------------------|
| (#)                            |              |                |  | 뮙           | TS                  | TS   | <br>   %                | ΑT     | TERB<br>LIMIT    | S                   | 000                       |
| NOL                            | DEPTH (ft)   | GRAPHIC<br>LOG | MATERIAL DESCRIPTION   | E TY        | NOO N               | NO02   | TURE                    | ٥٢     |                  | Ε×                  | NG #2<br>'E (%)           |
| ELEVATION (ft)                 | DEP          | GRA            | , 2 2200 1101.   | SAMPLE TYPE | BLOW COUNTS<br>N    | BLOW COUNTS<br>N60                           | MOISTURE<br>CONTENT (%) | LIQUID | PLASTIC<br>LIMIT | PLASTICITY<br>INDEX | PASSING #200<br>SIEVE (%) |
| Ш -                            |              |                | <b>SANDSTONE</b> , light gray, cemented to very well cemented 1027.2'                        | S           | 15%                 |  |                         |        | ш                | 귑                   | <u>Ф</u>                  |
| 1010                           |              |                | SANDSTONE, light gray, cemented to very well cemented 1027.2' (continued)                    | R           | Total               | =  |                         |        |                  |                     |                           |
|                                |              |                | Boring Termination Depth = 77 feet 1007.2' Boring Completed on 5/29/18 and Grouted on 6/9/18 |             | Rec:                | =  |                         |        |                  |                     |                           |
|                                |              |                | Boring Completed on 5/29/18 and Grouted on 6/9/18  |             | RQD<br>12%<br>Total | <u>.                                    </u> |                         |        |                  |                     |                           |
| 1000                           | <u> </u><br> |                |  |             | 11<br>  Rec:        | _  |                         |        |                  |                     |                           |
|                                |              |                |  |             | 18%<br>RQD<br>0%    | -  |                         |        |                  |                     |                           |
| _ =                            |              |                |  |             |                     |  |                         |        |                  |                     |                           |
|                                |              |                |  |             |                     |  |                         |        |                  |                     |                           |
| 990                            |              |                |  |             |                     |  |                         |        |                  |                     |                           |
|                                |              |                |  |             |                     |  |                         |        |                  |                     |                           |
|                                |              |                |  |             |                     |  |                         |        |                  |                     |                           |
| 980                            |              |                |  |             |                     |  |                         |        |                  |                     |                           |
|                                |              |                |  |             |                     |  |                         |        |                  |                     |                           |
|                                |              |                |  |             |                     |  |                         |        |                  |                     |                           |
| 970                            |              |                |  |             |                     |  |                         |        |                  |                     |                           |
| = =                            |              |                |  |             |                     |  |                         |        |                  |                     |                           |
| -<br> -<br> -<br> -            |              |                |  |             |                     |  |                         |        |                  |                     |                           |
|                                |              |                |  |             |                     |  |                         |        |                  |                     |                           |
| 960                            | <u> </u><br> |                |  |             |                     |  |                         |        |                  |                     |                           |
|                                |              |                |  |             |                     |  |                         |        |                  |                     |                           |
|                                |              |                |  |             |                     |  |                         |        |                  |                     |                           |
| 950                            |              |                |  |             |                     |  |                         |        |                  |                     |                           |
|                                |              |                |  |             |                     |  |                         |        |                  |                     |                           |
| 2  <br>2  <br>2                |              |                |  |             |                     |  |                         |        |                  |                     |                           |
| 940                            | 1            |                |  |             |                     |  |                         |        |                  |                     |                           |
| =  _ <del>]4</del> 0_<br> <br> |              |                |  |             |                     |  |                         |        |                  |                     |                           |
| <br> <br>                      |              |                |  |             |                     |  |                         |        |                  |                     |                           |
| 930                            | 1            |                |  |             |                     |  |                         |        |                  |                     |                           |
| 930                            |              |                |  |             |                     |  |                         |        |                  |                     |                           |

PAGE 1 OF 2



| CLIE                 | ENT               | SRB      |   | PROJECT NAME _S                                     | SH 29 Brid  | lge over         | Black B            | ear Cre                 | ek     |                  |                     |                           |
|----------------------|-------------------|----------|---|---|-------------|------------------|--------------------|-------------------------|--------|------------------|---------------------|---------------------------|
| PRO                  | JEC.              | T NUN    | IBER _18026                                   | PROJECT LOCATIO                                     | N Steph     | ens Cou          | unty, Ok           | lahoma                  |        |                  |                     |                           |
| DAT                  | E ST              | ARTE     | <b>ED</b> 5/29/18 <b>COMPLETED</b> 5/29/18    | GROUND ELEVATION                                    | N 1084      | .2 ft S          | MOITAT             | 744+                    | -67 C  | FFSE             | Г <u>35</u> '       | LT                        |
| DRIL                 | LIN               | G CON    | ITRACTOR DSO - Drilling Services of Oklahoma  | GROUND WATER L                                      | EVELS:      |                  |                    |                         |        |                  |                     |                           |
|                      |                   |          | HOD wet rotary - CME 750 ATV                  | DURING DRIL   |             |                  |                    |                         |        |                  |                     |                           |
| LOG                  | GED               | BY _     | SAH CHECKED BY JWB                            | ▼192 hrs AFTE                                       | R DRILLI    | NG _2.5          | ft / Elev          | / 1081.                 | 7 ft   |                  |                     |                           |
| NOT                  | ES _              | 2965     | 7(04)   | Cave In Depth                                       | open_       |                  |                    |                         |        |                  |                     |                           |
| ft)                  |                   |          |   |   | Щ           | LS               | LS                 | (9)                     | AT     | TERBE            |                     | 0                         |
| )<br>NC              | (£)               | ₽ ,,     |   |   | TYF         | COUNTS           | S                  | JRE<br>T (%             |        | LIMIT            |                     | (%)                       |
| ATIC                 | DЕРТН (ft)        | GRAPHIC  | MATERIAL DESCRIPTION                          |   | ٦LE         | 0<br>0<br>Z      | S S S              | STL                     | 윽늘     | STIC             | 들跖                  | ING<br>IVE                |
| ELEVATION (ft)       | DE                | <u> </u> |   |   | SAMPLE TYPE | BLOW             | BLOW COUNTS<br>N60 | MOISTURE<br>CONTENT (%) | LIQUID | PLASTIC<br>LIMIT | PLASTICITY<br>INDEX | PASSING #200<br>SIEVE (%) |
| Ш                    | 0                 | ļ , , ,  |   |   | S           | BI               | B                  | 0                       |        | ш                | П                   | Δ.                        |
|                      | <u> </u>          |          | SILTY, CLAYEY SAND, brown                     | 1084.2'   |             |                  |                    |                         |        |                  |                     |                           |
| 108 <u>0</u>         | :                 |          | <del>*</del><br>                              |   |             |                  |                    |                         |        |                  |                     |                           |
|                      |                   |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
|                      |                   |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
| <br><br>             | 10                |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
|                      |                   |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
| <u>1070</u>          |                   |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
|                      | L :               |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
| <br>                 | <br>20            |          | SILTY SAND, brown                             | 1066.2'   | -           |                  |                    |                         |        |                  |                     |                           |
|                      | - <del>-</del> 0- |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
| <br>1060             | -                 |          | LEAN CLAY with SAND, brown                    | 1061.7'   | -           |                  |                    |                         |        |                  |                     |                           |
|                      | - :               |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
|                      |                   |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
| <br><br>             | _30               |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
|                      | _ :               |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
| <u>1050</u>          | - :               |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
|                      |                   |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
|                      |                   |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
|                      | _40]              |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
| = =                  |                   |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
| <u>1</u> 04 <u>0</u> |                   |          | SILTY, CLAYEY SAND, brown                     | 1041.2'   |             |                  |                    |                         |        |                  |                     |                           |
|                      | <u> </u>          |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
| <br><br><br>         | -<br>50           |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
|                      | _ 50 _            |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
| <br>103 <u>0</u>     | - :               |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
|                      |                   |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
|                      | Γ:                |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
| <br><br>             |                   |          |   |   |             |                  |                    |                         |        |                  |                     |                           |
|                      | <u> </u>          |          | SILTY SAND with GRAVEL, brown                 | 1024.2 <sup>+</sup><br>cemented 1023.7 <sup>+</sup> | SPT<br>TC   | 35<br>50/5"      |                    | 17                      | _ 0    | 0                | NP                  | 33.8                      |
|                      | <u> </u>          |          | SANDSTONE, gray, poorly cemented to very well | cernented 1020.7                                    | , , ,       | 50/1.8"<br>50/1" |                    |                         |        |                  |                     |                           |
|                      | <u> </u>          | ::::     |   |   | T0          | 50/0.8"          |                    |                         |        |                  |                     |                           |
|                      |                   |          |   |   | TC          | 50/0.8           |                    |                         |        |                  |                     |                           |
|                      | 70                | 1::::    |   |   |             |                  |                    |                         |        |                  |                     |                           |
|                      | Γ                 | ]::::    |   |   | V           | 50/1"            |                    |                         |        |                  |                     |                           |

PAGE 2 OF 2

RED ROCK PO Box 30591 Edmond, OK 73003 C O N S U L T I N G 405-562-3328

CLIENT SRB

PROJECT NAME SH 29 Bridge over Black Bear Creek

| PROJEC                    | T NUMBER _     | 18026 PROJECT  | LOCATIO | N Steph     | nens Co                                  | unty, Ok           | lahoma                  | 1      |                           |                     |                           |
|---------------------------|----------------|--|---------|-------------|--|--------------------|-------------------------|--------|---------------------------|---------------------|---------------------------|
| ELEVATION (ft) DEPTH (ft) | GRAPHIC<br>LOG | MATERIAL DESCRIPTION   |         | SAMPLE TYPE | BLOW COUNTS<br>N                         | BLOW COUNTS<br>N60 | MOISTURE<br>CONTENT (%) | LIQUID | PLASTIC<br>LIMIT<br>LIMIT | PLASTICITY S BINDEX | PASSING #200<br>SIEVE (%) |
| 010                       |                | SANDSTONE, gray, poorly cemented to very well cemented (continued)                   | 1023.7' | ▼ TC        | 50/0.4"<br>50/0.5"<br>50/0.5"            |                    |                         |        |                           |                     |                           |
| 000                       |                |  |         |             | 50/0.4"<br>50/0.3"<br>50/0.5"<br>50/0.4" |                    |                         |        |                           |                     |                           |
| 990                       |                | Boring Termination Depth = 91 feet Boring Completed on 5/29/18 and Grouted on 6/9/18 | 993.2'  |             | 50/0.4",<br>50/0.3",<br>50/0.3",         |                    |                         |        |                           |                     |                           |
| -                         |                |  |         |             |  |                    |                         |        |                           |                     |                           |
| 980                       |                |  |         |             |  |                    |                         |        |                           |                     |                           |
| 970_                      |                |  |         |             |  |                    |                         |        |                           |                     |                           |
| -                         |                |  |         |             |  |                    |                         |        |                           |                     |                           |
| 960                       |                |  |         |             |  |                    |                         |        |                           |                     |                           |
| 950                       |                |  |         |             |  |                    |                         |        |                           |                     |                           |
| -<br>-<br>-<br>940_       |                |  |         |             |  |                    |                         |        |                           |                     |                           |
| 950]                      |                |  |         |             |  |                    |                         |        |                           |                     |                           |
| 930                       |                |  |         |             |  |                    |                         |        |                           |                     |                           |

PAGE 1 OF 2



PROJECT NAME SH 29 Bridge over Black Bear Creek **CLIENT** SRB PROJECT NUMBER 18026 PROJECT LOCATION Stephens County, Oklahoma DATE STARTED 5/18/18 COMPLETED 5/18/18 GROUND ELEVATION 1085.7 ft STATION 745+40 OFFSET 37' LT **DRILLING CONTRACTOR** DSO - Drilling Services of Oklahoma **GROUND WATER LEVELS:** DRILLING METHOD wet rotary - CME 55 Truck DURING DRILLING NA LOGGED BY SMA **CHECKED BY** JWB hrs AFTER DRILLING NA **T** Cave In Depth 2.0 ft / Elev 1083.7 ft **NOTES** 29657(04) **ATTERBERG** BLOW COUNTS N BLOW COUNTS N60 SAMPLE TYPE MOISTURE CONTENT (%) PASSING #200 SIEVE (%) LIMITS GRAPHIC LOG DEPTH (ft) ELEVATION PLASTICITY PLASTIC LIMIT LIQUID MATERIAL DESCRIPTION **CLAYEY SAND with GRAVEL**, light brown, loose 1085.7 lacksquare5 7 SPT 11 33 13 20 46.2 SANDY LEAN CLAY, dark brown with reddish brown, medium stiff1081.7 5 7 17 33 14 19 60.2 1080 LEAN CLAY, brown, soft 1078.7 4 5 24 37 15 22 88.6 LEAN CLAY with SAND, brown, soft 1075.7' 3 4 18 35 13 22 71.9 107 SANDY SILTY CLAY, brown, soft 1070.7' XSPT 2 3 62.2 23 21 14 7 LEAN CLAY, brown, soft 5 1065.7' XSPT 4 25 34 16 18 86.2 1060 SANDY LEAN CLAY, brown, very soft to soft 1060.7' SPT 0 67.3 0 24 23 14 9 imesSPT 3 4 20 23 15 8 65.1 1050 LEAN CLAY, brown, soft 1050.7' XSPT 3 4 25 33 15 18 96 **LEAN CLAY with SAND**, brown and light gray, stiff 1045.7' SPT 10 13 19 41 15 26 73.9 13 1040.7' XSPT 10 23 45.6 SILTY SAND, light brown, loose to medium dense 0 0 NP ±50 SPT 21 28 23 24.9 0 0 NP 1030 X SPT 17 23 23 18 13 5 44.1 SILTY, CLAYEY SAND, light brown, medium dense 1028.7 19 **CLAYEY SAND**, light brown, dense 1025.7'- SPT 22 13 9 42 1020 29 1024.7 **SANDSTONE**, gray, poorly cemented to very well cemented 50/5.5" 50/0.8' 50/0.4' TC 50/0.5" 50/0.3 **-**70

PAGE 2 OF 2

**RED ROCK** PO Box 30591 Edmond, OK 73003 C O N S U L T I N G 405-562-3328

CLIENT SRB

PROJECT NAME SH 29 Bridge over Black Bear Creek

| PRO.                        | JECT                   | NUMBE          | ER 18026 PROJECT   | LOCATIO | N Steph     | ens Cou              | unty, Ok           | lahoma                  | 1      |                  |                     |                           |
|-----------------------------|------------------------|----------------|--|---------|-------------|----------------------|--------------------|-------------------------|--------|------------------|---------------------|---------------------------|
| ON (ft)                     | (#)                    | 일              |  |         | TYPE        | UNTS                 | UNTS               | JRE<br>T (%)            | ΓA     | TERB<br>LIMIT    | S                   | #200                      |
| ELEVATION (ft)              | DEPTH (ft)             | GRAPHIC<br>LOG | MATERIAL DESCRIPTION   |         | SAMPLE TYPE | BLOW COUNTS<br>N     | BLOW COUNTS<br>N60 | MOISTURE<br>CONTENT (%) | LIQUID | PLASTIC<br>LIMIT | PLASTICITY<br>INDEX | PASSING #200<br>SIEVE (%) |
| 1010                        |                        |                | SANDSTONE, gray, poorly cemented to very well cemented (continued)                   | 1024.7' | TC          | 50/0.9"<br>50/0.4"/  |                    |                         |        |                  |                     |                           |
| :                           | -<br>-<br>-<br>-<br>80 |                |  |         | TC          | 50/0.3"<br>50/0.3"   |                    |                         |        |                  |                     |                           |
| · - <br>· - <br>· - <br>· - | <br>                   |                |  |         | TC          | 50/0.4"<br>50/0.1"/  |                    |                         |        |                  |                     |                           |
| 000                         |                        |                |  |         | TC          | 50/0.4"<br>(50/0.1") |                    |                         |        |                  |                     |                           |
|                             | 90 _                   |                | Boring Termination Depth = 92 feet Boring Completed on 5/18/18 and Grouted on 6/9/18 | 993.7'  |             | 50/0.3"<br>(50/0.3") |                    |                         |        |                  |                     |                           |
| 990                         |                        |                | Boring Completed on 5/18/18 and Grouted on 6/9/18                                    |         |             | <u>(50/0.3"</u> )    |                    |                         |        |                  |                     |                           |
| -                           |                        |                |  |         |             |                      |                    |                         |        |                  |                     |                           |
| 080                         |                        |                |  |         |             |                      |                    |                         |        |                  |                     |                           |
| -                           |                        |                |  |         |             |                      |                    |                         |        |                  |                     |                           |
| 970                         |                        |                |  |         |             |                      |                    |                         |        |                  |                     |                           |
| -                           |                        |                |  |         |             |                      |                    |                         |        |                  |                     |                           |
| -                           |                        |                |  |         |             |                      |                    |                         |        |                  |                     |                           |
| 960                         |                        |                |  |         |             |                      |                    |                         |        |                  |                     |                           |
| -                           |                        |                |  |         |             |                      |                    |                         |        |                  |                     |                           |
| 50                          |                        |                |  |         |             |                      |                    |                         |        |                  |                     |                           |
| -                           |                        |                |  |         |             |                      |                    |                         |        |                  |                     |                           |
| 9960                        |                        |                |  |         |             |                      |                    |                         |        |                  |                     |                           |
| -                           |                        |                |  |         |             |                      |                    |                         |        |                  |                     |                           |
|                             |                        |                |  |         |             |                      |                    |                         |        |                  |                     |                           |

PAGE 1 OF 2



**CLIENT** SRB PROJECT NAME SH 29 Bridge over Black Bear Creek PROJECT NUMBER 18026 PROJECT LOCATION Stephens County, Oklahoma DATE STARTED 5/21/18 COMPLETED 5/21/18 GROUND ELEVATION 1085.2 ft STATION 746+15 OFFSET 33' LT **DRILLING CONTRACTOR** DSO - Drilling Services of Oklahoma **GROUND WATER LEVELS:** DRILLING METHOD wet rotary - CME 55 Truck DURING DRILLING NA LOGGED BY SAH **CHECKED BY** JWB hrs AFTER DRILLING NA **Y** Cave In Depth 3.0 ft / Elev 1082.2 ft **NOTES** 29657(04) **ATTERBERG** BLOW COUNTS N BLOW COUNTS N60 SAMPLE TYPE MOISTURE CONTENT (%) **ELEVATION** (ft) PASSING #200 SIEVE (%) LIMITS GRAPHIC LOG DEPTH (ft) PLASTICITY INDEX PLASTIC LIMIT LIQUID MATERIAL DESCRIPTION 1085.2 SILTY SAND, brown and reddish brown, very loose  $\mathbf{V}$ 1080 imesSPT 4 5 3 0 0 NP 16 SPT 3 107 1070.2' XSPT 22 SANDY LEAN CLAY, reddish brown, very soft 1 23 13 10 59.6 1065.2' SPT 2 3 **LEAN CLAY with SAND**, reddish brown, very soft 23 24 14 10 81.1 TC 4 1060 SANDY LEAN CLAY, reddish brown, very soft to soft 1060.2' SPT 0 23 22 0 14 8 64.5 TC 0 imesSPT 3 4 21 24 13 11 62.4 TC 4 LEAN CLAY, brown, soft 1050.2' SPT 4 5 24 33 16 17 95.6 DURING AFTER CAVE IN WITH N60 18026 LOGS.GPJ DATA TEMPLATE.GDT 7/19/18 TC 13 LEAN CLAY with SAND, dark brown and dark gray, stiff 1045.2' SPT 12 16 16 26 81.6 38 12 ▼ TC 10 11 19 23 45.2 8 15 8 1039.7' **CLAYEY SAND**, reddish brown, loose <u>+</u>50 SILTY SAND, brown, loose 1035.2' XSPT 6 8 23 17 46.1 19 2 SANDY SILT, dark brown, very stiff 1030.2' SPT 19 25 26 0 0 NΡ 55.6 1025.2' SPT 19 NP SILTY SAND, light gray, dense to very dense 0 0 29.3 37 1024.2' **SANDSTONE**, gray, poorly cemented to very well cemented 50/3.5" 50/2.8' 50/1.1' TC 50/0.8" 50/0.4" **1**70

PAGE 2 OF 2

RED ROCK PO Box 30591 Edmond, OK 73003 C O N S U L T I N G 405-562-3328

CLIENT SRB

1 DURING AFTER CAVE IN WITH N60 18026 LOGS.GPJ DATA TEMPLATE.GDT 7/19/18

PROJECT NAME SH 29 Bridge over Black Bear Creek

| PRC            | JEC1       | T NUM          | BER 18026 PROJECT LOCATI   | ON | Steph       | ens Cou              | unty, Ok           | lahoma                  |        |                  |                     |                           |
|----------------|------------|----------------|--|----|-------------|----------------------|--------------------|-------------------------|--------|------------------|---------------------|---------------------------|
| ELEVATION (ft) | DEPTH (ft) | GRAPHIC<br>LOG | MATERIAL DESCRIPTION   |    | SAMPLE TYPE | BLOW COUNTS<br>N     | BLOW COUNTS<br>N60 | MOISTURE<br>CONTENT (%) |        | TERBI<br>LIMIT   | S                   | PASSING #200<br>SIEVE (%) |
| ELEVA          | DEP        | GR/<br>L       |  |    |             |                      | BLOW               | CONT                    | LIQUID | PLASTIC<br>LIMIT | PLASTICITY<br>INDEX | PASSI<br>SIE\             |
| 101 <u>0</u>   | <br><br>   |                | SANDSTONE, gray, poorly cemented to very well cemented (continued)                         |    |             | 50/0.8"<br>50/0.3"/  |                    |                         |        |                  |                     |                           |
|                | <br>80     |                |  |    |             | 50/0.6"<br>50/0.4"/  |                    |                         |        |                  |                     |                           |
| 1000           | <br><br>   |                |  |    |             | 50/0.4"<br>(50/0.3"/ |                    |                         |        |                  |                     |                           |
|                | 90         |                |  |    |             | 50/0.3"<br>50/0.1"/  |                    |                         |        |                  |                     |                           |
| 990            | <br>       | -              | Boring Termination Depth = 92 feet 993.2 Boring Completed on 5/21/18 and Grouted on 6/9/18 |    | TC          | 50/0.3"<br>50/0.1"/  |                    |                         |        |                  |                     |                           |
|                |            |                |  |    |             |                      |                    |                         |        |                  |                     |                           |
| 980            |            |                |  |    |             |                      |                    |                         |        |                  |                     |                           |
|                |            |                |  |    |             |                      |                    |                         |        |                  |                     |                           |
| 970            |            |                |  |    |             |                      |                    |                         |        |                  |                     |                           |
|                |            |                |  |    |             |                      |                    |                         |        |                  |                     |                           |
| <br>           |            |                |  |    |             |                      |                    |                         |        |                  |                     |                           |
|                |            |                |  |    |             |                      |                    |                         |        |                  |                     |                           |
| 950            |            |                |  |    |             |                      |                    |                         |        |                  |                     |                           |
|                |            |                |  |    |             |                      |                    |                         |        |                  |                     |                           |
| 940            |            |                |  |    |             |                      |                    |                         |        |                  |                     |                           |
| 9940           |            |                |  |    |             |                      |                    |                         |        |                  |                     |                           |
|                |            |                |  |    |             |                      |                    |                         |        |                  |                     |                           |

PAGE 1 OF 2



**CLIENT** SRB PROJECT NAME SH 29 Bridge over Black Bear Creek PROJECT NUMBER 18026 PROJECT LOCATION Stephens County, Oklahoma DATE STARTED 5/18/18 COMPLETED 5/18/18 GROUND ELEVATION 1086.1 ft STATION 746+87 OFFSET 45' LT **DRILLING CONTRACTOR** DSO - Drilling Services of Oklahoma **GROUND WATER LEVELS:** DURING DRILLING NA DRILLING METHOD wet rotary - CME 750 ATV **▼456 hrs AFTER DRILLING** 6.0 ft / Elev 1080.1 ft LOGGED BY SAH **CHECKED BY** JWB NOTES 29657(04) Cave In Depth open **ATTERBERG** BLOW COUNTS N BLOW COUNTS N60 MOISTURE CONTENT (%) ELEVATION (ft) SAMPLE TYPE PASSING #200 SIEVE (%) LIMITS GRAPHIC LOG DEPTH (ft) PLASTICITY INDEX PLASTIC LIMIT LIQUID MATERIAL DESCRIPTION 0 SILTY SAND, reddish brown 1086.1 1080  $\nabla$ **CLAYEY SAND**, reddish brown 1081.1' 1074.1' **LEAN CLAY with SAND**, reddish brown 70 107 SILTY SAND, brown 1064.1 1050 **LEAN CLAY with SAND**, brown 1054.1 40. 50 SILTY SAND, brown 1038.6' 1020 imesSPT 15 0 0 NP 28.8 **SANDSTONE**, gray, poorly cemented to very well cemented 1025.1 18 50/5" 50/1.3 50/1" TC 50/0.5 50/0.3 70

PAGE 2 OF 2

RED ROCK PO Box 30591 Edmond, OK 73003 C O N S U L T I N G 405-562-3328

CLIENT SRB

PROJECT NAME SH 29 Bridge over Black Bear Creek

| PROJECT NUMBER 18  | 3026 PROJECT  | LOCATIO | ON Steph    | nens Cou                        | unty, Ok           | lahoma                  | 1      |                     |              |                           |
|--|---|---------|-------------|---------------------------------|--------------------|-------------------------|--------|---------------------|--------------|---------------------------|
| ELEVATION (ft) DEPTH (ft) GRAPHIC LOG  | MATERIAL DESCRIPTION  |         | SAMPLE TYPE | BLOW COUNTS<br>N                | BLOW COUNTS<br>N60 | MOISTURE<br>CONTENT (%) |        | PLASTIC TIMIT LIMIT | S<br>        | PASSING #200<br>SIEVE (%) |
| G G C C C C C C C C C C C C C C C C C C  | SANDSTONE, gray, poorly cemented to very well cemented (continued)                      | 1025.1' |             | MO B 50/0.8" (50/0.3")          | ВГОМ               | CON                     | LIQUID | PLA8                | PLAST<br>IND | PASS                      |
| _  | (continued)   |         |             | 50/0.3"/<br>50/0.5"<br>50/0.4"/ |                    |                         |        |                     |              |                           |
| 80 - 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6   |   |         |             | 50/0.5"<br>(50/0.5")            |                    |                         |        |                     |              |                           |
| 1000   |   |         |             | 50/0.3"<br>\50/0.1"/            |                    |                         |        |                     |              |                           |
| 990  | Boring Termination Depth = 92 feet<br>Boring Completed on 5/18/18 and Grouted on 6/9/18 | 994.1'  | ▼ TC        | 50/0.5"<br> 50/0.4"/            |                    |                         |        |                     |              |                           |
|  |   |         |             |                                 |                    |                         |        |                     |              |                           |
| 980  |   |         |             |                                 |                    |                         |        |                     |              |                           |
|  |   |         |             |                                 |                    |                         |        |                     |              |                           |
| -<br>  |   |         |             |                                 |                    |                         |        |                     |              |                           |
|  |   |         |             |                                 |                    |                         |        |                     |              |                           |
| 960]   |   |         |             |                                 |                    |                         |        |                     |              |                           |
| 960<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>- |   |         |             |                                 |                    |                         |        |                     |              |                           |
| 950]<br>-<br>-<br>-<br>-   |   |         |             |                                 |                    |                         |        |                     |              |                           |
|  |   |         |             |                                 |                    |                         |        |                     |              |                           |
| <br> <br> <br>   |   |         |             |                                 |                    |                         |        |                     |              |                           |
|  |   |         |             |                                 |                    |                         |        |                     |              |                           |

## BORING NUMBER B-7 PAGE 1 OF 2

| RED ROCK   | PO Box 30591<br>Edmond OK 73003 |
|------------|---------------------------------|
| CONSULTING |                                 |

| CLIE                 | ENT      | SRB            |   | PROJECT NAME SH 29 Bridge over Black Bear Creek |             |                     |                    |                         |                      |                     |              |                           |  |
|----------------------|----------|----------------|---|---|-------------|---------------------|--------------------|-------------------------|----------------------|---------------------|--------------|---------------------------|--|
|                      | _        |                |   | PROJECT LOCATIO                                 |             |                     |                    |                         |                      |                     |              |                           |  |
| DAT                  | E ST     | ARTE           | D 5/30/18 COMPLETED 5/30/18                   |   |             |                     |                    |                         |                      | FFSE                | <b>T</b> 35' | LT                        |  |
|                      |          |                | TRACTOR DSO - Drilling Services of Oklahoma   |   |             |                     |                    |                         |                      |                     |              |                           |  |
| DRIL                 | LING     | S MET          | HOD wet rotary - CME 750 ATV                  | DURING DRIL                                     | LING        | -                   |                    |                         |                      |                     |              |                           |  |
| LOG                  | GED      | BY _           | SAH CHECKED BY JWB                            | ▼168 hrs AFTE                                   | R DRILLI    | NG _2.5             | ft / Ele           | v 1082.                 | 8 ft                 |                     |              |                           |  |
| NOT                  | ES _     | 2965           | (04)  | Cave In Depth                                   | າ           |                     |                    |                         |                      |                     |              |                           |  |
| ELEVATION (ft)       |          | GRAPHIC<br>LOG | MATERIAL DESCRIPTION                          |   | SAMPLE TYPE | BLOW COUNTS<br>N    | BLOW COUNTS<br>N60 | MOISTURE<br>CONTENT (%) | TA<br>LIMIT<br>LIMIT | PLASTIC TIMIT LIMIT |              | PASSING #200<br>SIEVE (%) |  |
|                      | 0        |                | <b>LEAN CLAY with SAND</b> , brown to reddish | brown 1085.3'                                   |             |                     |                    |                         |                      |                     |              |                           |  |
|                      |          |                | $\bar{\Sigma}$                                |   |             |                     |                    |                         |                      |                     |              |                           |  |
| <u>1080</u>          | -        |                | SILTY SAND, brown                             | 1080.3'   | Ī           |                     |                    |                         |                      |                     |              |                           |  |
|                      |          |                | SILIT SAND, DIOWIT                            | 1000.3  |             |                     |                    |                         |                      |                     |              |                           |  |
|                      | _10_     |                |   |   |             |                     |                    |                         |                      |                     |              |                           |  |
| <br><br>             |          |                | <b>LEAN CLAY with SAND</b> , reddish brow     | /n 1075.3'                                      |             |                     |                    |                         |                      |                     |              |                           |  |
| <br>1070             |          |                |   |   |             |                     |                    |                         |                      |                     |              |                           |  |
|                      |          |                |   |   |             |                     |                    |                         |                      |                     |              |                           |  |
| <br><br>             |          | <i>(////</i>   | SILTY SAND with GRAVEL, brown                 | 1067.8'   |             |                     |                    |                         |                      |                     |              |                           |  |
| 106 <u>0</u>         | 30       |                |   |   |             |                     |                    |                         |                      |                     |              |                           |  |
| 1050                 | -        | /////          | SANDY LEAN CLAY, brown                        | 1050.3'   | Ī           |                     |                    |                         |                      |                     |              |                           |  |
|                      | 40       |                | <u>OAIDT ELANGLAT,</u> BIOWII                 | 1050.5  |             |                     |                    |                         |                      |                     |              |                           |  |
| 104 <u>0</u><br>     | -        | ////           | SILTY SAND with GRAVEL, brown                 | 1040.3'   |             |                     |                    |                         |                      |                     |              |                           |  |
| <br><br><br>         | 50       |                |   |   |             |                     |                    |                         |                      |                     |              |                           |  |
| <u>1</u> 03 <u>0</u> | <u> </u> |                |   |   |             |                     |                    |                         |                      |                     |              |                           |  |
| _ =                  | <u> </u> |                |   |   |             |                     |                    |                         |                      |                     |              |                           |  |
|                      | 60       |                | SANDSTONE, gray, well cemented to very well   | cemented 1025.8'                                | SPT.        | 50/4"<br>50/0.8"    |                    | 15                      | 0                    | 0 /                 | NP /         | 23.2                      |  |
| <br><br>             | <u> </u> |                |   | <del>-</del>                                    | ▼ TC        | 50/0.8"<br>50/0.5"  |                    |                         |                      |                     |              |                           |  |
| <br>1020             | E =      |                |   |   |             |                     |                    |                         |                      |                     |              |                           |  |
|                      | <u> </u> |                |   |   | ▼ TC        | 50/0.4"<br>50/0.4"/ |                    |                         |                      |                     |              |                           |  |
|                      | -<br>70  |                |   |   |             |                     |                    |                         |                      |                     |              |                           |  |
|                      | - '      | ::::           |   |   | TC          | 50/0.8"             |                    |                         |                      |                     |              |                           |  |

PAGE 2 OF 2

RED ROCK PO Box 30591 Edmond, OK 73003 C O N S U L T I N G 405-562-3328

CLIENT SRB

PROJECT NAME SH 29 Bridge over Black Bear Creek

| PRO   | ROJECT NUMBER 18026 PROJECT LOCATION |                |   |             |  | Stephens County, Oklahoma |                         |                 |                     |                                |                           |  |  |  |
|---|--------------------------------------|----------------|---|-------------|--|---------------------------|-------------------------|-----------------|---------------------|--------------------------------|---------------------------|--|--|--|
| ELEVATION (ft)  | DEPTH (ft)                           | GRAPHIC<br>LOG | MATERIAL DESCRIPTION  | SAMPLE TYPE | BLOW COUNTS<br>N   | BLOW COUNTS<br>N60        | MOISTURE<br>CONTENT (%) | LIQUID<br>LIMIT | PLASTIC LIMIT LIMIT | PLASTICITY <sup>©</sup> HINDEX | PASSING #200<br>SIEVE (%) |  |  |  |
| 101 <u>0</u>  | 80                                   |                | SANDSTONE. gray, well cemented to very well cemented 1025.8' (continued)                    | ТС          | 50/0.5"<br>50/0.8"<br>50/0.4"<br>50/0.3"<br>50/0.4"<br>50/0.4" |                           |                         |                 |                     |                                |                           |  |  |  |
| 980<br>   |                                      |                | Boring Termination Depth = 90 feet 995.3' Boring Completed on 5/30/18 and Grouted on 6/9/18 | TC          | 50/0.3"<br>50/0.3"   |                           |                         |                 |                     |                                |                           |  |  |  |
| 1 DURING AFTER CAVE IN WITH N60 18026 LOGS.GPJ DATA TEMPLATE.GDT 7/19/18  1 |                                      |                |   |             |  |                           |                         |                 |                     |                                |                           |  |  |  |

## BORING NUMBER B-8 PAGE 1 OF 2

| RI | ED | R | 0( |  | PO Box 30591<br>Edmond, OK 73003 |
|----|----|---|----|--|----------------------------------|
|    |    |   |    |  | 405-562-3328                     |

| CLIENT SRB  |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
|---|---|--|--------------|-------------------|--------------------|-------------------------|------------|------------------|---------------------|---------------------------|--|--|
| PROJECT NUMBER 180  |   | PROJECT LOCATION Stephens County, Oklahoma |              |                   |                    |                         |            |                  |                     |                           |  |  |
| DATE STARTED 6/5/18   |   |  |              | 8.4 ft S          | OITAT              | <b>1</b> 748            | +40_C      | OFFSE            | <b>T</b> 45'        | LT                        |  |  |
|   | R DSO - Drilling Services of Oklahoma       |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
| DRILLING METHOD wet   |   | DURING DRIL                                |              |                   |                    |                         |            |                  |                     |                           |  |  |
|   | CHECKED BY JWB                              |  |              |                   | ft / Elev          | 1075.4                  | ft         |                  |                     |                           |  |  |
| NOTES 29657(04)   |   | Cave In Depth                              |              | 1                 |                    |                         |            |                  |                     |                           |  |  |
| (£) _   |   |  | Щ            | COUNTS            | TS T               | @                       | A7         | TERB<br>LIMIT    |                     | 8                         |  |  |
| DEPTH (ft)<br>GRAPHIC<br>LOG  |   |  | Σ            | ) N               | 5                  | NA<br>PR                |            |                  | Γ                   | (%)<br>(%)                |  |  |
| ATI ATI PER I   | MATERIAL DESCRIPTION                        |  | PLE          | ŏz<br>>           | S S                | TSE<br>TE               | LIQUID     | STE              | ASTICI              | SIN                       |  |  |
| ELEVATION (ft) DEPTH (ft) GRAPHIC LOG   |   |  | SAMPLE TYPE  | BLOW              | BLOW COUNTS<br>N60 | MOISTURE<br>CONTENT (%) | 25         | PLASTIC<br>LIMIT | PLASTICITY<br>INDEX | PASSING #200<br>SIEVE (%) |  |  |
| 0   |   |  | 0)           | В                 | В                  |                         |            |                  | П                   | Ш.                        |  |  |
|   | <u>SILTY SAND</u> , brown                   | 1083.4'                                    |              |                   |                    |                         |            |                  |                     |                           |  |  |
| 1080  |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
|   | <b>LEAN CLAY with SAND</b> , brown          | 1078.4'                                    | =            |                   |                    |                         |            |                  |                     |                           |  |  |
|   |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
| - +10   |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
| 1070  |   |  | -            |                   |                    |                         |            |                  |                     |                           |  |  |
|   | <u>SILTY SAND</u> , brown                   | 1070.9'                                    |              |                   |                    |                         |            |                  |                     |                           |  |  |
|   |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
|   |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
| [ <del>-</del>   |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
| 1060  | SANDY LEAN CLAY, brown                      | 1061.4'                                    | -            |                   |                    |                         |            |                  |                     |                           |  |  |
|   | <u> </u>                                    |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
|   |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
|   |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
| 30  |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
| 1050  | SILTY, CLAYEY SAND, brown                   | 1051.4'                                    | -            |                   |                    |                         |            |                  |                     |                           |  |  |
|   |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
| <u>e</u> [ ]  |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
| \$\begin{align*} \begin{align*} \begi |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
|   |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
| Ë 1040  |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
|   |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
|   | SILTY SAND with GRAVEL, reddish brown a     | nd brown 1036.4'                           | -            |                   |                    |                         |            |                  |                     |                           |  |  |
| 5 50  | SILTY SAND WITH GRAVEE, TEGUISH BIOWH A     | 1030.4                                     |              |                   |                    |                         |            |                  |                     |                           |  |  |
|   |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
| S 1030 = -  |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
| 88056   | SILTY SAND with GRAVEL, reddish brown a     | nd brown 1028.4'                           | -            |                   |                    |                         |            |                  |                     |                           |  |  |
|   | ,   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
| € 60 ] · · · · · · · · · · · · · · · · · ·  | SANDSTONE, gray, poorly cemented to very we | I cemented 1024.4'                         | <b>SPT</b>   | 50/5"             |                    | 18                      | <b>√</b> 0 | 0                | NP /                | 21.7                      |  |  |
| ≶   | 3 371 3                                     |  | TC           | 50/1"<br>50/0.4"  |                    |                         |            |                  |                     |                           |  |  |
| ₩ <u>1020</u>   |   |  |              |                   |                    |                         |            |                  |                     |                           |  |  |
|   |   |  | TC           | 50/1"<br>\50/0.4" |                    |                         |            |                  |                     |                           |  |  |
| 40  |   |  |              | 30/0.4            |                    |                         |            |                  |                     |                           |  |  |
| 100081 0908 COD 3718 COD 1 1008 C  |   | -  | TC           | 50/0.8"           |                    |                         |            |                  |                     |                           |  |  |
| <del></del>   |   |  | <b>V</b> 1.0 | 50/0.5"           |                    |                         |            |                  |                     |                           |  |  |

PAGE 2 OF 2

RED ROCK PO Box 30591 Edmond, OK 73003 C O N S U L T I N G 405-562-3328

CLIENT SRB

PROJECT NAME SH 29 Bridge over Black Bear Creek

| But   But | PRO            | )JEC       | T NUN          | MBER 18026 PROJECT LOCATION | ON Stephens County, Oklahoma |              |  |                    |                         |  |       |   |                           |
|---|----------------|------------|----------------|-----------------------------|------------------------------|--------------|--|--------------------|-------------------------|--|-------|---|---------------------------|
| TC   S0/0.4"  | ELEVATION (ft) | DEPTH (ft) | GRAPHIC<br>LOG |                             | T (1)                        | SAMPLE I YPE | BLOW COUNTS<br>N   | BLOW COUNTS<br>N60 | MOISTURE<br>CONTENT (%) |  | LIMIT | S | PASSING #200<br>SIEVE (%) |
|   | 3000<br>       |            |                |                             |                              | TC TC TC     | 50/1"<br>50/0.6"<br>50/0.8"<br>50/0.5"<br>50/0.4"<br>50/0.4" |                    |                         |  |       |   |                           |

PAGE 1 OF 2

PO Box 30591 Edmond, OK 73003 C O N S U L T I N G 405-562-3328

| CLI                 | ENI.       | SKB            |   | _ PROJECT NA         | VIVIE 3 | оп 29 bii      | ige over            | DIACK D            | ear Cre                 | eĸ           |                  |                     |                           |
|---------------------|------------|----------------|---|----------------------|---------|----------------|---------------------|--------------------|-------------------------|--------------|------------------|---------------------|---------------------------|
| PRC                 | JEC        | T NUN          | BER 18026   | _ PROJECT LO         | CATIC   | N Steph        | ens Cou             | ınty, Ok           | lahoma                  |              |                  |                     |                           |
| DAT                 | E ST       | ARTE           | O 6/5/18 COMPLETED 6/6/18                             | _ GROUND ELE         | EVATIO  | <b>DN</b> 1084 | ft S                | TATION             | <b>1</b> 749+           | ·15 <b>C</b> | FFSE             | <b>T</b> 30'        | LT                        |
| DRII                | LLING      | G CON          | FRACTOR DSO - Drilling Services of Oklahoma           |                      |         |                |                     |                    |                         |              |                  |                     |                           |
|                     |            |                | HOD wet rotary - CME 750 ATV                          |                      |         | LING           |                     |                    |                         |              |                  |                     |                           |
|                     |            |                | SAH CHECKED BY JWB                                    | 0 hrs A              |         |                |                     |                    |                         |              |                  |                     |                           |
|                     |            | _              |   |                      |         |                | 2.5 II              | / Elev 1           | 081.5 Π                 |              |                  |                     |                           |
| NOI                 | ES _       | 29657          | 04)   | _ Cave In            | Depti   | 1              |                     |                    |                         |              |                  |                     |                           |
| €                   |            |                |   |                      |         | Щ              | LS                  | Z                  | (9)                     | AT           | TERBI<br>LIMIT   |                     | 0                         |
| ELEVATION (ft)      | DEPTH (ft) | GRAPHIC<br>LOG |   |                      |         | SAMPLE TYPE    | COUNTS              | BLOW COUNTS<br>N60 | MOISTURE<br>CONTENT (%) |              |                  |                     | PASSING #200<br>SIEVE (%) |
| \                   | 돈          | A 66           | MATERIAL DESCRIPTION                                  |                      |         | <u> </u>       | Sz                  | 88                 | STL                     | ₽⊨           | TIC              | 등┈                  | N<br>N<br>N               |
| EV/                 | H          | 9.<br>1        |   |                      |         | MP             | BLOW                | »C                 | ON L                    | LIQUID       | PLASTIC<br>LIMIT | ST                  | SS                        |
| 🗇                   | 0          |                |   |                      |         | \S \           | BL                  | BL                 | 20                      | _            | Ы                | PLASTICITY<br>INDEX | Ą                         |
|                     |            |                | SANDY SILT, brown, loose                              |                      | 1084'   | SPT            | 7                   | 9                  | 13                      | 0            | 0                | NP                  | 61.9                      |
|                     | <u> </u>   |                | ⊻   |                      |         |                |                     |                    |                         |              |                  |                     |                           |
| 1080                |            |                |   |                      |         |                |                     |                    |                         |              |                  |                     |                           |
| -                   | F -        |                | <b>LEAN CLAY with SAND</b> , brown, soft to           | o stiff              | 1079'   | SPT            | 2                   | 3                  |                         | 0            | 0                | NP                  |                           |
| _ =                 | ‡ =        |                |   |                      |         |                |                     |                    |                         |              |                  |                     |                           |
| -                   | 10         |                |   |                      |         | <b>V T</b> O   | 4                   |                    |                         |              |                  |                     |                           |
|                     | ‡ :        |                |   |                      |         | TC             | 1                   |                    |                         |              |                  |                     |                           |
| 1070                | _ :        |                |   |                      |         | SPT            | 9                   | 12                 | 23                      | _28          | 13               | 15                  | 70.3                      |
| <u> </u>            | <u> </u>   |                |   |                      |         | ▼ TC           | 10                  |                    |                         |              |                  |                     |                           |
|                     |            |                | SANDY SILTY CLAY, brown, medium                       | etiff                | 1067'   | SPT            | 7                   | 9                  | 26                      | 22           | 15               | 7                   | 68.9                      |
| F =                 | 20         |                | <u>GANDI GILII GLAI</u> , BIOWII, MEGIGIII            | 3011                 | 1007    | 31 1           | ,                   |                    | 20                      |              | 10               |                     | 00.5                      |
| = =                 | ļ - ī      |                |   |                      |         | TC             | 3                   |                    |                         |              |                  |                     |                           |
| 1060                | ‡ =        |                | <b>LEAN CLAY</b> , brown, soft                        |                      | 1062'   | SPT            | 4                   | 5                  | 26                      | 30           | 14               | 16                  | 88.0                      |
| 1000                | -          |                |   |                      |         |                |                     |                    |                         |              |                  |                     |                           |
|                     | <u> </u>   |                |   |                      |         | TC             | 5                   |                    |                         |              |                  |                     |                           |
| L :                 |            |                | <b>LEAN CLAY with SAND</b> , brown, so                | oft                  | 1057'   | SPT            | 3                   | 4                  | 23                      | 24           | 13               | 11                  | 70.1                      |
|                     | _30_       |                | SANDY LEAN CLAY, brown, medium                        | etiff                | 1054'   | SPT            | 6                   | 8                  | 19                      | 27           | 11               | 16                  | 67.4                      |
| -                   | -          |                | <u>57.115 ; 227.17,</u> , 57.6111, 111.611.111        |                      | 1001    | Jo. 1          |                     |                    |                         |              |                  |                     | 01.1                      |
| 1050                | Ψ -        |                |   |                      |         |                |                     |                    |                         |              |                  |                     |                           |
| <u>_</u>            | ‡ =        |                |   |                      |         | TC             | 14                  |                    |                         |              |                  |                     |                           |
| <u> </u>            | ‡ =        |                | <b>LEAN CLAY with SAND</b> , brown and light gray, me | edium stiff to stiff | 1047'   | SPT            | 8                   | 11                 | 21                      | 36           | 13               | 23                  | 81.5                      |
| \$ <br><del>-</del> | 40         |                |   |                      |         |                |                     |                    |                         |              |                  |                     |                           |
| ]<br>               | ‡ :        |                |   |                      |         | TC             | 10                  |                    |                         |              |                  |                     |                           |
| <u>1040</u>         | <u> </u>   |                |   |                      |         | SPT            | 9                   | 12                 | 20                      | 27           | 16               | 11                  | 78.7                      |
| <u> </u>            | <u> </u>   |                | SILTY SAND, brown, medium dens                        | <br>e                | 1039'   | SPT            | 11                  | 15                 | 21                      | 0            | 0                | NP                  | 42.0                      |
| ≰                   |            |                | ,,,,  |                      |         |                |                     |                    |                         |              | ,                |                     |                           |
|                     | 50         |                |   |                      |         |                |                     |                    |                         |              |                  |                     |                           |
|                     | Ι.         |                |   |                      |         | SPT            | 15                  | 20                 | 21                      | 0            | 0                | NP                  | 12.1                      |
| 3<br>2 <b>1030</b>  | ‡ =        |                |   |                      |         |                |                     |                    |                         |              |                  |                     |                           |
|                     | ‡ :        |                |   |                      |         | <b></b>        |                     |                    |                         |              |                  |                     |                           |
| º <br>              | ‡ :        |                |   |                      |         | SPT            | 27                  | 36                 | 22                      | 0            | 0                | NP                  | 32.0                      |
| 2<br>E              | -          |                |   |                      |         |                |                     |                    |                         |              |                  |                     |                           |
|                     | 60         |                | <b>SANDSTONE</b> , gray, well cemented to very we     | II cemented          | 1025'   | SPT/<br>TC     | 50/3.5"/<br>50/0.4" |                    |                         |              |                  |                     |                           |
| ≧                   | -          |                |   |                      |         |                | 50/1"               |                    |                         |              |                  |                     |                           |
| 3 1020              | _          |                |   |                      |         | 1              | E0/0.0"             |                    |                         |              |                  |                     |                           |
| <u> </u>            | F =        |                |   |                      |         | ▼ TC           | 50/0.6"<br>50/0.4"/ |                    |                         |              |                  |                     |                           |
| <u> </u>            | Ε:         |                |   |                      |         |                |                     |                    |                         |              |                  |                     |                           |
| 10040               | 70         |                |   |                      |         | TC TC          | 50/0.8"             |                    |                         |              |                  |                     |                           |
| <u> </u>            | <u> </u>   |                |   |                      |         | <b>V</b> 10    | 50/0.8"<br>50/0.4"/ |                    |                         |              |                  |                     |                           |

PAGE 2 OF 2

RED ROCK PO Box 30591 Edmond, OK 73003 C O N S U L T I N G 405-562-3328

CLIENT SRB

PROJECT NAME SH 29 Bridge over Black Bear Creek

| PROJECT NUMBER _1                     | 8026 PROJECT  | LOCATIO | ION Stephens County, Oklahoma |   |                    |                         |        |                           |   |                           |  |  |
|---------------------------------------|---|---------|-------------------------------|---|--------------------|-------------------------|--------|---------------------------|---|---------------------------|--|--|
| ELEVATION (ft) DEPTH (ft) GRAPHIC LOG | MATERIAL DESCRIPTION  |         | SAMPLE TYPE                   | BLOW COUNTS<br>N                                    | BLOW COUNTS<br>N60 | MOISTURE<br>CONTENT (%) | LIQUID | PLASTIC<br>LIMIT<br>LIMIT | S | PASSING #200<br>SIEVE (%) |  |  |
| 1010                                  | SANDSTONE, gray, well cemented to very well cemented (continued)                      | 1025'   | ▼ TC                          | 50/0.5"<br>50/0.3"<br>50/0.5"<br>50/0.5"<br>50/0.4" |                    |                         |        |                           |   |                           |  |  |
| 990                                   | Boring Termination Depth = 89.5 feet Boring Completed on 6/6/18 and Grouted on 6/9/18 | 994.5'  | ▼ TC                          | 50/0.4"<br>50/0.3"/                                 |                    |                         |        |                           |   |                           |  |  |

B- 1 APPROX. OFFSET: 33' LT APPROX. STATION: 743+15 1,090 APPROX. SURFACE ELEV.: 1084.5 FT 1084.5 FT. – SPT; N=5 MC=22 1084.5 FT. – SANDY LEAN CLAY, BROWN, MEDIUM STIFF P200=60.1% LL=27 PL=17  $\blacksquare$ 1,080 1079.5 FT. - SPT; N=0 MC=22 1079.5 FT. - SILTY, CLAYEY SAND, BROWN, VERY LOOSE P200=39.2% LL=21 PL=16 1074.5 FT. - SPT; N=1 MC=25 PZ:00=79.3% LL=30 PL=15 1074.5 FT. - LEAN CLAY WITH SAND. REDDISH BROWN, SOFT 1,070 1069.5 ft. - TCP = 8 1067.5 FT. - SPT; N=8 MC=26
P200=72.8% LL=24 PL=17

1064.5 FT. - SPT; N=5 MC=24
P200=34.7% LL=0 PL=0

1064.5 FT. - SILTY CLAY WITH SAND, REDDISH BROWN, MEDIUM STIFF
P200=34.7% LL=0 PL=0 1,060 1059.5 FT. - SPT; N=10 MC=21 1059.5 FT. - <u>LEAN CLAY WITH SAND</u>, REDDISH BROWN TO BROWN, VERY SOFT P200=73.9% LL=40 PL=14 1054.5 ft. - TCP = 121052.5 FT. - SPT; N=1 MC=27 P200=78.1% LL=35 PL=13 1,050 1049.5 FT. - SPT; N=7 MC=23 1049.5 FT. - LEAN CLAY, BROWN, MEDIUM STIFF TO VERY STIFF P200=85.9% LL=34 PL=14 1044.5 ft. - TCP = 15 1042.5 FT. - SPT; N=14 MC=21 P200=30.0% LL=0 PL=0 1042.5 FT. - SILTY SAND, BROWN, MEDIUM DENSE 1.040 1039.5 FT. - SPT; N=0 MC=21 1039.5 FT. - SANDY LEAN CLAY, BROWN, VERY SOFT TO STIFF P200=61.3% LL=24 PL=12 1034.5 ft. - TCP = 14 1032.5 FT. - SPT; N=9 MC=27 1032.5 FT. - LEAN CLAY WITH SAND, DARK GRAY, STIFF TO VERY STIFF P200=80.9% LL=39 PL=12 1,030 1029.5 ft. - TCP = 13 1027ft = TOP OF ROCK 1027.5 FT. - SPT; N=23 MC=30 P200=90.2% LL=45 PL=18 P200=86.5% LL=31 PL=16 P200=86.5% LL=31 PL=16 1027 FT. - SANDSTONE, GRAY, POORLY CEMENTED TO VERY WELL CEMENTED 1026.5 ft. - TCP = 50/2.3" 50/0.5" 1021.5 ft. - TCP = 50/0.5" 50/0.4" 1,020 1016.5 ft. - TCP = 50/0.8" 50/0.4"1011.5 ft. - TCP = 50/0.8" 50/0.4"1,010 1006.5 ft. - TCP = 50/0.8" 50/0.3"1001.5 ft. - TCP = 50/0.4" 50/0.1"1,000 996.5 ft. - TCP = 50/0.5" 50/0.3" J996.5 FT. - BORING TERMINATION DEPTH = 88 FEET BORING COMPLETED ON 5/30/18 AND GROUTED ON 6/9/18

B- 2
APPROX. OFFSET: 27' LT
APPROX. STATION: 743+90
APPROX. SURFACE ELEV.: 1084.2 FT

1084.2 FT. - SPT; N=7 MC=11 7 1084.2 FT. - <u>CLAYEY SAND</u>, BROWN, LOOSE P200=48.0% LL=25 PL=16 7 11083.2 FT. - <u>SILTY, CLAYEY SAND</u>, REDDISH BROWN, VERY LOOSE 1,080 1079.2 FT. - SPT; N=1 MC=19 P200=45.3% LL=23 PL=17 1074.2 ft. - TCP = 91072.2 FT. - SPT; N=0 MC=28 P200=81.8% LL=32 PL=15 71072.2 FT. — <u>LEAN CLAY WITH SAND</u>, BROWN, VERY SOFT 1,070 1069.2 ft. - TCP = 61067.2 FT. - SPT; N=7 MC=21 1067.2 FT. - SILTY, CLAYEY SAND, REDDISH BROWN, LOOSE P200=35.0% LL=22 PL=16 1064.2 ft. - TCP = 7 1062.2 FT. - SPT; N=0 MC=27 1062.2 FT. - LEAN CLAY, DARK BROWN, VERY SOFT P200=86.5% LL=30 PL=16 1,060 1059.2 ft. - TCP = 6 1057.2 FT. - SPT; N=5 MC=19 P200=64.8% LL=25 PL=15 1057.2 FT. - SANDY LEAN CLAY, DARK BROWN, MEDIUM STIFF 1054.2 ft. - TCP = 151052.2 FT. - SPT; N=11 MC=20 1052.2 FT. - LEAN CLAY WITH SAND, DARK BROWN, VERY SOFT TO STIFF P200=72.0% LL=34 PL=13 1,050 1049.2 ft. - TCP = 71047.2 FT. - SPT; N=1 MC=26 P200=74.3% LL=33 PL=15 1044.2 ft. - TCP = 131042.2 FT. - SPT; N=11 MC=28 1042.2 FT. - SANDY LEAN CLAY, BROWN, STIFF P200=65.8% LL=31 PL=13 1,040 1039.2 FT. - SPT; N=11 MC=24 1039.2 FT. - SILTY SAND, BROWN, LOOSE TO MEDIUM DENSE P200=24.2% LL=0 PL=0 1034.2 FT. - SPT; N=19 MC=22 P200=25.7% LL=0 PL=0 1029.2 FT. - SPT; N=10 MC=17 P200=34.0% LL=19 PL=15 1,030 1027.2ft = TOP OF ROCK 1027.2 FT. - SPT: N=50/4.5 MC=25 P200=59.9% LL=23 PL=17 1026.7 ft. - TCP = 50/1" 50/0.4" 1027.2 FT. - SANDSTONE, LIGHT GRAY, CEMENTED TO VERY WELL CEMENTED 1021.7 ft. - TCP = 50/0.5" 50/1"1,020 1016.7 ft. - TCP = 50/0.4" 50/0.4"1011.7 ft. - TCP = 50/1.5" 50/0.5"1.010 1006.7 ft. - TCP = 50/0.4" 50/0.3"1001.7 ft. - TCP = 50/0.4" 50/0.3"1,000

> 996.2 FT. — BORING TERMINATION DEPTH = 88 FEET BORING COMPLETED ON 5/29/18 AND GROUTED ON 6/9/18

LEGEND

996.7 ft. - TCP = 50/0.4" 50/0.1"

SPT DENOTES STANDARD PENETRATION TEST, ASTM D1586
N DENOTES NUMBER OF BLOW COUNTS PER 12 INCHES
TOP DENOTES TEXAS CONE PENETRATION TESTS
REC DENOTES RECOVERY IN ROCK CORING
RQD DENOTES ROCK QUALITY DESIGNATION
MC DENOTES MOSTURE CONTENT TESTS
P200 DENOTES PERCENT PASSING NO 200 SIEVE
LL DENOTES LIQUID LIMIT TESTS (IN=NO VALUE)
PL DENOTES PLASTIC LIMIT TESTS (IN=NO PLASTICITY)

MC DENOTES MOISTURE CONTENT TESTS
P200 DENOTES PERCENT PASSING NO 200 SIEVE
LL DENOTES LIQUID LIMIT TESTS (NV=NO VALUE)
PL DENOTES PLASTIC LIMIT TESTS (NP=NO PLASTICITY)
DENOTES WATER ELEVATION IMPEDIATELY AFTER DRILLING
DENOTES WATER ELEVATION HOURS AFTER DRILLING
DENOTES TOP OF ROCK

■ NOTE: WATER ELEVATIONS SHOWN WERE OBTAINED AT THE TIME BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR.

- \*\*\* NOTE: TOP OF ROCK LINE SHOWN FOR ESTIMATING PURPOSE ONLY
- \*\*\*\* NOTE: ROCK CLASSIFICATION IS BASED ON DRILLING CHARACTERISTICS AND VISUAL OBSERVATION, PTEROGRAPHIC ANALYSIS OF THIN SECTIONS OF THE ROCK CORE SAMPLES MAY REVEAL OTHER TYPES.

#### GEOTECHNICAL REPORT

ALL GEOTECHNICAL INFORMATION CONTAINED ON THIS SHEET IS COVERED BY THE ENGINEERING SEAL AFFIXED TO AN ORIGINAL GEOTECHINCAL ENGINEERING REPORT THAT HAS BEEN STAMPED AND SEALED BY A PROFESSIONAL ENGINEER LICENSED IN OKLAHOMA. TO OBTAIN A COPY OF THE COMPLETE REPORT, CONTACT THE ODDT OFFICE ENGINEER AT (405) 521-2625. THE CONTRACTOR SHOULD BE FULLY AWARE OF THE SITE CONDITIONS PRIOR TO BEGINING WORK, ANY ADDITIONAL GEOTECHNICAL INFORMATION WHICH MAY BE DESIRED IS THE RESPONSIBILITY OF THE CONTRACTOR.

RED ROCK
CONSULTING

SH 29 Bridge over Stephens County, Oklahoma Black Bear Creek

SUBSURFACE PROFILE SHEET 1 OF 5

Detail | DMB | 7/1:

REVISIONS

1,090

STATE OF OKLAHOMA JOB PIECE NO. 29657(04) SHEET NO.

The ODOT publication indicates the project site is underlain by the El Reno Unit (Per).

The LI Nerio unit consists of a heterogeneous mixture of sandstones, shale, sitistone, and sitistone conglomerate. In northeastern Stephens County, the lowermost 40 to 100 feet of the unit consists dominantly of sandstones which are coarse-grained, nee white to buff, and moderately soft; but a few hard massive sandstone beds up to six feet thick occur near the base of the unit. Northward, across Grady County, the sandstones of this lower section become red, progressively finer grained, and moderately hard hard.

The upper portion of the until is known as "The Purple Series" in Stephens and Grady Countles. Here, some 80 feet of soft purple sandstone, 50 feet of soft pink sandstones, and 50 feet of moderately soft purple mudstone conglomerate are present in descending order. Westward, in Comanche and southern Caddo countles, the sandstones grade into red shales with minor amounts of gypsum and siltstones. Locally, in southeastern Grady County, near Cox City, a few sandstone beds in the upper portion are hard, limit, and occur in beds up to seven feet thick.

The unit thickens northward from 420 feet in Stephens County to 460 feet in Western Caddo County to 660 feet in northern Grady County.

The El Reno unit outcrops in a four to eight mile wide northwest-southeast band across southern Caddo, northeastern Comanche, and northwestern Stephens Counties. The outcrop then circles the southeastern end of the Anadarko basin in northern Stephens County and covers a broad area up to eighteen miles wide across northeastern Stephens and Grady Counties of Division 7. In Grady and eastern Caddo Counties, northo if TAN, the upper 0 to 230 feet is mapped separately as the Dog Creek-Blaine subunits undifferentiated. Northward, in Division 4, and westward from Caddo County, in Division 5, the rock strate of the El Reno unit are separately and are mapped as the Flowerpot. Blaine, and Dog Creek units.

Topographically, the unit generally forms rolling hills with a pronounced escarpment at the base in Stephens and southern Grady Countles where the sandstones are thickest. Northwestward, the topography is rolling with gently rolling topography dominan western Caddo Countly where the shales are thickest. The sandstoner didges are usually marked by oak vegetation and erosional guilles in the sandy soils. The shales generally form the valleys and gently rolling hills and support the growth of short grass. So mesquile and prickly pear are evident in the sally or gypsiferous areas.

USGS MA

ODOT PUBLLICATION

According to the USGS geologic map, the project site is underlain by the Duncan Sandstone Member (Pd) of the El Reno Group

Sandstone, white to buff, fine- to coarse-grained, moderately indurated, with interbedded mudstone conglomerates and siltstones; thickness, 100 to 400 feet, decreasing southeastward. Yields small to moderate amounts of water of fair quality.

B 2-A APPROX. OFFSET: 27' LT APPROX. STATION: 743+90 1,090 APPROX. SURFACE ELEV.: 1084.2 FT 1084.2 FT. - <u>CLAYEY SAND</u>, BROWN, LOOSE 1083.2 FT. - <u>SILTY, CLAYEY SAND</u>, REDDISH BROWN, VERY LOOSE 1.08 71072.2 FT. - LEAN CLAY WITH SAND, BROWN, VERY SOFT 1,070 11111067.2 FT. - SILTY, CLAYEY SAND, REDDISH BROWN, LOOSE 1062.2 FT. - LEAN CLAY, DARK BROWN, VERY SOFT 1,06 1057.2 FT. - SANDY LEAN CLAY, DARK BROWN, MEDIUM STIFF 1052.2 FT. - LEAN CLAY WITH SAND, DARK BROWN, VERY SOFT TO STIFF 1,050 1042.2 FT. - SANDY LEAN CLAY, BROWN, STIFF 1.04 1039.2 FT. - SILTY SAND, BROWN, LOOSE TO MEDIUM DENSE 1,030 1027.2ft = TOP OF ROCK SPT; N=50/3.4" 1027.2 FT. - SANDSTONE, LIGHT GRAY, CEMENTED TO VERY WELL CEMENTED RC; Total= 5 Rec= 8% RQD= 0% RC; Total= 23 Rec= 38% RQD= 15% 1021.7 FT. - \*62.5 FEET - COMPRESSIVE STRENGTH = 744 PSI \* 1,020 RC; Total= 15 Rec= 25% RQD= 12% 1016.7 FT. - \*67.5 FEET - COMPRESSIVE STRENGTH = 1,161 PSI \* RC; Total= 11 Rec= 18% RQD= 0% 1,01 1007.2 FT. — BORING TERMINATION DEPTH = 77 FEET BORING COMPLETED ON 5/29/18 AND GROUTED ON 6/9/18 1,00

B- 3 APPROX. OFFSET: 35' LT APPROX. STATION: 744+67 APPROX. SURFACE ELEV.: 1084.2 FT 1084.2 FT. - SILTY, CLAYEY SAND, BROWN 1,080 1,070 1066.2 FT. - SILTY SAND, BROWN 1061.7 FT. - LEAN CLAY WITH SAND, BROWN 1,060 1,050 1041.2 FT. - SILTY, CLAYEY SAND, BROWN 1,040 1,030 1024.2 FT. - SPT; N=35 50/5" MC=17 FT. - SPI; N=35 30/3 mC-17
P200=33.8% LL=0 PL=0
1023.7ft = TOP OF ROCK
1023.7 FT. - SILTY SAND WITH GRAVEL, BROWN
1023.7 FT. - SANDSTONE, GRAY, POORLY CEMENTED TO VERY WELL CEMENTED 1023.2 ft. - TCP = 50/1.8" 50/1"1,020 1018.2 ft. - TCP = 50/0.8" 50/0.5"1013.2 ft. - TCP = 50/1" 50/0.4"1,010 1008.2 ft. - TCP = 50/0.5" 50/0.5"1003.2 ft. - TCP = 50/0.4" 50/0.3"1,000 998.2 ft. - TCP = 50/0.5" 50/0.4"

993.2 FT. — BORING TERMINATION DEPTH = 91 FEET BORING COMPLETED ON 5/29/18 AND GROUTED ON 6/9/18

The ODOT publication indicates the project site is underlain by the El Reno Unit (Per).

The upper portion of the unit is known as "The Purple Series" in Stephens and Grady Countles. Here, some 80 feet of soft purple sandstone, 50 feet of soft pink sandstones, and 50 feet of moderately soft purple mudstone conglomerate are present in escending order. Westward, in Comanche and southern Caddo countiles, the sandstones grade into red shales with minor amounts of gypsum and siltstones. Locally, in southeastern Grady County, near Cox City, a few sandstone beds in the upper portion are hard, Ilmy, and occur in beds up to seven feet thick.

County and covers a broad area up to eighteen miles wide across northeastern Stephens and Grady Counties of Division 7. In Grady and eastern Caddo Counties, north of T4N, the upper 0 to 230 feet is mapped separately as the Dog Creek-Blaine subunits undifferentiated. Northward, In Division 4, and westward from Caddo County, In Division 5, the rock strata of the El Reno unit are separable and are mapped as the Flowerpot, Blaine, and Dog Creek units.

Topographically, the unit generally forms rolling hills with a pronounced escarpment at the base in Stephens and southern Grady Countles where the sandstones are thickest. Northwestward, the topography is rolling with gently rolling topography dominant in western Caddo County where the shales are thickest. The sandstone ridges are usually marked by oak vegetation and erosional guilles in the sandy soils. The shales generally form the valleys and gently rolling hills and support the growth of short grass. Some mesquite and prickly pear are evident in the salty or gypsiferous areas.

SITE GEOLOGY

According to the USGS geologic map, the project site is underlain by the Duncan Sandstone Member (Pd) of the El Reno Group.

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LEGEND

993.2 ft. - TCP = 50/0.3" 50/0.3"

SPT DENOTES STANDARD PENETRATION TEST, ASTM D1586
N DENOTES NUMBER OF BLOW COUNTS PER 12 INCHES DENOTES TEXAS CONE PENETRATION TESTS

DENOTES RECOVERY IN ROCK CORING RQD DENOTES ROCK QUALITY DESIGNATION

DENOTES MOISTURE CONTENT TESTS

P200 DENOTES PERCENT PASSING NO 200 SIEVE

DENOTES LIQUID LIMIT TESTS (NY=NO VALUE)
DENOTES PLASTIC LIMIT TESTS (NP=NO PLASTICITY) DENOTES WATER ELEVATION IMMEDIATELY AFTER DRILLING

DENOTES WATER ELEVATION HOURS AFTER DRILLING DENOTES TOP OF ROCK

\* NOTE: WATER ELEVATIONS SHOWN WERE OBTAINED AT THE TIME BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR.

- \*\*\* NOTE: TOP OF ROCK LINE SHOWN FOR ESTIMATING PURPOSE ONLY
- \*\*\*\* NOTE: ROCK CLASSIFICATION IS BASED ON DRILLING CHARACTERISTICS AND VISUAL OBSERVATION. PTEROGRAPHIC ANALYSIS OF THIN SECTIONS OF THE ROCK CORE SAMPLES MAY REVEAL OTHER TYPES.

#### GEOTECHNICAL REPORT

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SH 29 Bridge over Stephens County, Oklah Black Bear Creek

> SUBSURFACE PROFILE SHEET 2 OF 5

Check DMB

Detail DMB

REVISIONS

1,090

STATE OF **DEPARTMENT OF TRANSPORTATION** OKLAHOMA JOB PIECE NO. 29657(04)

REVISIONS APPROX. OFFSET: 33' LT APPROX. STATION: 746+15 1,090 APPROX. SURFACE ELEV.: 1085.2 FT 1085.2 FT. - SILTY SAND, BROWN AND REDDISH BROWN, VERY LOOSE 1080.2 FT. - SPT; N=4 MC=3 1,080 P200=16% LL=0 PL=0 FT. - SPT; N=2 1070.2 FT. - SANDY LEAN CLAY, REDDISH BROWN, VERY SOFT 1070.2 FT. - SPT; N=1 MC=22 P200=59.6% LL=23 PL=13 1,070 1065.2 FT. - SPT; N=2 MC=23 P200=81.1% LL=24 PL=14 1065.2 FT. - LEAN CLAY WITH SAND, REDDISH BROWN, VERY SOFT 1063.2 ft. - TCP = 41060.2 FT. - SPT; N=0 MC=23 P200=64.5% LL=22 PL=14 1058.2 ft. - TCP = 0 1060.2 FT. - SANDY LEAN CLAY, REDDISH BROWN, VERY SOFT TO SOFT 1,060 1055.2 FT. - SPT; N=3 MC=21 P200=62.4% LL=24 PL=13 1050.2 FT. - SPT; N=4 MC=24 1,050 1050.2 FT. - LEAN CLAY, BROWN, SOFT P200=95.6% LL=33 PL=16 1048.2 ft. - TCP = 13 1045.2 FT. - SPT; N=12 MC=16 P200=81.6% LL=38 PL=12 1045.2 FT. - LEAN CLAY WITH SAND, DARK BROWN AND DARK GRAY, STIFF 1043.2 ft. - TCP = 101040.2 FT. - SPT; N=8 MC=19 1,040 1039.7 FT. - CLAYEY SAND, REDDISH BROWN, LOOSE P200=45.2% LL=23 PL=15 1035.2 FT. - SPT; N=6 MC=23 P200=46.1% LL=19 PL=17 1035.2 FT. - SILTY SAND, BROWN, LOOSE 1030.2 FT. - SPT; N=19 MC=26 P200=55.6% LL=0 PL=0 1,030 1030.2 FT. - <u>SANDY SILT</u>, DARK BROWN, VERY STIFF 1025.2 FT. - SPT; N=9 37 50/3.5" MC=19 P200=29.3% L1=0 PL=0 1024.2ft = TOP OF ROCK 11 1025.2 FT. — <u>SILTY SAND</u>, LIGHT GRAY, DENSE TO VERY DENSE 1 1024.2 FT. — <u>SANDSTONE</u>, GRAY, POORLY CEMENTED TO VERY WELL CEMENTED 1023.2 ft. - TCP = 50/2.8" 50/1.1"1,020 1018.2 ft. - TCP = 50/0.8" 50/0.4"1013.2 ft. - TCP = 50/0.8" 50/0.3"1.010 1008.2 ft. - TCP = 50/0.6" 50/0.4"1003.2 ft. - TCP = 50/0.4" 50/0.3"1,000

SITE GEOLOGY 990
ODOT PUBLLICATION

The ODOT publication indicates the project site is underlain by the El Reno Unit (Per).

1,090

1,080

1.070

1,060

1,050

1,040

1.030

1,020

1,010

1,000

The EI Reno unit consists of a heterogeneous mixture of sandstones, shale, sitistone, and sitistone conglomerate. In northeastern Stephens County, the lowermost 40 to 100 feet of the unit consists dominantly of sandstones which are coarse-grained, ne whitle to buff, and moderately soft; but a few hard massive sandstone beds up to six feet thick occur near the base of the unit. Northward, across Grady County, the sandstones of this lower section become red, progressively finer grained, and moderately han hard.

APPROX. OFFSET: 37' LT APPROX. STATION: 745+40

APPROX. SURFACE ELEV.: 1085.7 FT

1083.7 FT. - SPT; N=5 MC=11 P200=46.2% LL=33 PL=13 1081.7 FT. - SPT; N=5 MC=17

1078.7 FT. - SPT; N=4 MC=24 P200=88.6% LL=37 PL=15 1075.7 FT. - SPT; N=3 MC=18 P200=71.9% LL=35 PL=13

1070.7 FT. - SPT; N=2 MC=23 P200=62.2% LL=21 PL=14

1065.7 FT. - SPT; N=4 MC=25 P200=86.2% LL=34 PL=16

1060.7 FT. - SPT; N=0 MC=24 P200=67.3% LL=23 PL=14

1055.7 FT. - SPT; N=3 MC=20 P200=65.1% LL=23 PL=15

1050.7 FT. - SPT; N=3 MC=25 P200=96% LL=33 PL=15

1045.7 FT. - SPT; N=10 MC=19 P200=73.9% LL=41 PL=15

1040.7 FT. - SPT; N=10 MC=23 P200=45.6% LL=0 PL=0

1035.7 FT. - SPT; N=21 MC=23 P200=24.9% LL=0 PL=0

1030.7 FT. - SPT; N=17 MC=23

1025.7 FT. - SPT; N=8 29 50/5.5" MC=19 P200=42% LL=22 PL=13 1024.7ft = TOP OF ROCK

1023.7 ft. - TCP = 50/0.8" 50/0.4"

1018.7 ft. - TCP = 50/0.5" 50/0.3"

1013.7 ft. - TCP = 50/0.9" 50/0.4"

1008.7 ft. - TCP = 50/0.3" 50/0.3"

1003.7 ft. - TCP = 50/0.4" 50/0.1"

998.7 ft. - TCP = 50/0.4" 50/0.1"

993.7 ft. - TCP = 50/0.3" 50/0.3"

P200=44.1% LL=18 PL=13

1085.7 FT. — <u>CLAYEY SAND WITH GRAVEL</u>, LIGHT BROWN, LOOSE

1060.7 FT. - SANDY LEAN CLAY, BROWN, VERY SOFT TO SOFT

1045.7 FT. - LEAN CLAY WITH SAND, BROWN AND LIGHT GRAY, STIFF

1040.7 FT. - SILTY SAND, LIGHT BROWN, LOOSE TO MEDIUM DENSE

1028.7 FT. - SILTY, CLAYEY SAND, LIGHT BROWN, MEDIUM DENSE

993.7 FT. — BORING TERMINATION DEPTH = 92 FEET BORING COMPLETED ON 5/18/18 AND GROUTED ON 6/9/18

1025.7 FT. — <u>CLAYEY SAND</u>, LIGHT BROWN, DENSE 1024.7 FT. — <u>SANDSTONE</u>, GRAY, POORLY CEMENTED TO VERY WELL CEMENTED

1078.7 FT. - LEAN CLAY, BROWN, SOFT

1070.7 FT. - SANDY SILTY CLAY, BROWN, SOFT

1065.7 FT. - LEAN CLAY, BROWN, SOFT

1050.7 FT. - <u>LEAN CLAY</u>, BROWN, SOFT

1075.7 FT. - LEAN CLAY WITH SAND, BROWN, SOFT

1081.7 FT. - SANDY LEAN CLAY, DARK BROWN WITH REDDISH BROWN, MEDIUM STIFF

The upper portion of the unit is known as "The Purple Series" in Stephens and Grady Countles. Here, some 80 feet of soft purple andstone, 50 feet of soft pink sandstones, and 50 feet of moderately soft purple mudistone conglomerate are present in descending order. Westward, in Comanche and southern Caddo countles, the sandstones grade into red shales with minor amounts of gypsum and siltstones. Locally, in southeastern Grady County, near Cox City, a few sandstone beds in the upper portion are hard, limy, and occur in beds up to seven feet thick.

The unit thickens northward from 420 feet in Stephens County to 460 feet in Western Caddo County to 660 feet in northern Grady Count

The EI Reno unit outcrops in a four to eight mile wide northwest-southeast band across southern Caddo, northeastern Comanche, and northwestern Stephens Countles. The outcrop then chrides the southeastern end of the Anadarko basin in northern Stephens Countly and covers a broad area up to eighteen miles wide across northeastern Stephens and Grady Countles of Division 7. In Grady and eastern Caddo Countles, north of T4N, the upper 0 to 230 feet is mapped separately as the Dog Creek-Blaine subunits undifferentiated. Northward, in Division 4, and westward from Caddo County, in Division 5, the rock strata of the EI Reno unit are separately as the Flowerpot, Blaine, and Dog Creek units.

Topographically, the unit generally forms rolling hills with a pronounced escarpment at the base in Stephens and southern Grady Countles where the sandstones are thickest. Northwestward, the topography is rolling with gently rolling topography dominant western Caddo County where the shales are thickest. The sandstone ridges are usually marked by oak vegetation and erosional guilles in the sandy soils. The shales generally form the valleys and gently rolling hills and support the growth of short grass. So messquile and prickly pear are evident in the satily or gypsiferous areas.

USGS MA

ording to the USGS geologic map, the project site is underlain by the Duncan Sandstone Member (Pd) of the El Reno Gro

Sandstone, white to buff, fine- to coarse-grained, moderately indurated, with interbedded mudstone conglomerates and siltstones; thickness, 100 to 400 feet, decreasing southeastward. Yields small to moderate amounts of water of fair quality.

SPT DENOTES STANDARD PENETRATION TEST, ASTM D1586
N DENOTES NUMBER OF BLOW COUNTS PER 12 INCHES
TCP DENOTES TEXAS CONE PENETRATION TESTS
REC DENOTES RECOVERY IN ROCK CORING
RQD DENOTES ROCK QUALITY DESIGNATION
MC DENOTES MOISTURE CONTENT TESTS
P200 DENOTES PERCENT PASSING NO 200 SIEVE

998.2 ft. - TCP = 50/0.3" 50/0.1"

993.2 ft. - TCP = 50/0.3" 50/0.1"

LL DENOTES LIQUID LIMIT TESTS (NY=NO VALUE)
PL DENOTES PLASTIC LIMIT TESTS (NP=NO PLASTICITY)
DENOTES WATER ELEVATION IMMEDIATELY AFTER DRILLING
DENOTES WATER ELEVATION HOURS AFTER DRILLING
DENOTES TOP OF ROCK

- \* NOTE: WATER ELEVATIONS SHOWN WERE OBTAINED AT THE TIME BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR.
- ■■ NOTE: TOP OF ROCK LINE SHOWN FOR ESTIMATING PURPOSE ONLY
- NOTE: ROCK CLASSIFICATION IS BASED ON DRILLING CHARACTERISTICS AND VISUAL OBSERVATION, PTEROGRAPHIC ANALYSIS OF THIN SECTIONS OF THE ROCK CORE SAMPLES MAY REVEAL OTHER TYPES.

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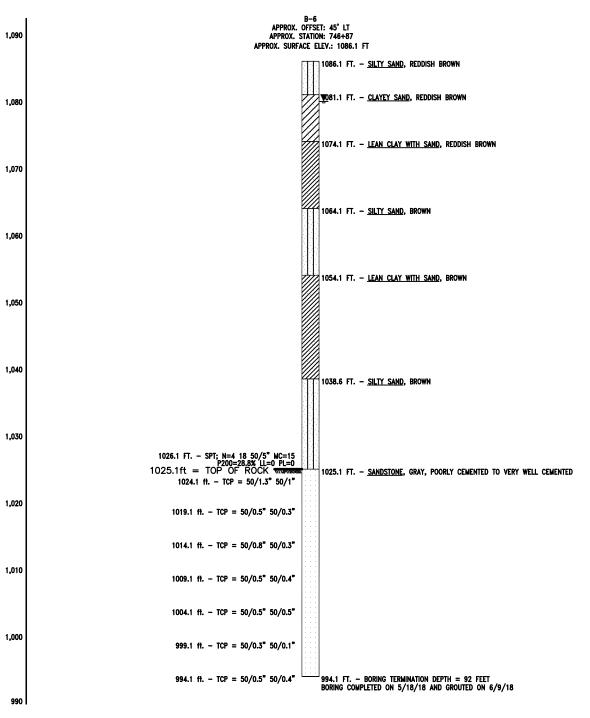
993.2 FT. — BORING TERMINATION DEPTH = 92 FEET BORING COMPLETED ON 5/21/18 AND GROUTED ON 6/9/18

> SH 29 Bridge over Stephens County, Oklahoma Black Bear Creek

> > SUBSURFACE PROFILE SHEET 3 OF 5

Detail DMB 7/19
Check DMB 7/19
Squod:
Engr:

STATE OF OKLAHOMA OB PECE NO. 29657(04) SHEET NO.



995.3 ff. – TCP = 50/0.3" 50/0.3"

P995.3 ff. – TCP = 50/0.3" 50/0.3"

| DENOTES STANDARD PENETRATION TEST, ASTM D1586 | DENOTES NUMBER OF BLOW COUNTS PER 12 INCHES | DENOTES NUMBER OF BLOW COUNTS PER 12 INCHES | DENOTES RECOVERY IN ROCK CORING | DENOTES RECOVERY IN ROCK CORING | DENOTES ROCK QUALITY DESIGNATION | DENOTES ROCK QUALITY DESIGNATION | DENOTES PROCK DIVINE CONTENT TESTS | DENOTES PROCK DIVINE CONTENT TESTS | DENOTES PLASTIC LIMIT TESTS | DENOTES PLASTIC LIMIT TESTS (INP=NO VALUE) | DENOTES PLASTIC LIMIT TESTS (INP=NO VALUE) | DENOTES PLASTIC LIMIT TESTS (INP=NO PLASTICITY)

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DENOTES WATER ELEVATION IMMEDIATELY AFTER DRILLING DENOTES WATER ELEVATION HOURS AFTER DRILLING DENOTES TOP OF ROCK

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RED ROCK CONSULTING

SH 29 Bridge over Stephens County, Oklahoma Black Bear Creek

> SUBSURFACE PROFILE SHEET 4 OF 5

Detail DMB 7/19
Check DMB 7/19
Squod:
Engr:

REVISIONS

1,070

1,030

STATE OF OKLAHOMA JOB PIECE NO. 29657(04) SHEET NO.

The ODOT publication indicates the project site is underlain by the El Reno Unit (Per).

The EI Reno unit consists of a heterogeneous mixture of sandstones, shale, siltstone, and siltstone conglomerate. In northeastern Stephens County, the lowermost 40 to 100 feet of the unit consists dominantly of sandstones which are coarse-grained, nearly white to buff, and moderately soft; but a few hard massive sandstone beds up to six feet thick occur near the base of the unit. Northward, across Grady County, the sandstones of this lower section become red, progressively finer grained, and moderately hard to hard.

The upper portion of the unit is known as "The Purple Series" in Stephens and Grady Countles. Here, some 80 feet of soft purple sandstone, 50 feet of soft plnk sandstones, and 50 feet of moderately soft purple mudstone conglomerate are present in descending order. Westward, in Comanche and southern Caddo countles, the sandstones grade into red shales with minor amounts of gypsum and siltstones. Locally, in southeastern Grady County, near Cox City, a few sandstone beds in the upper portion are hard, limy, and occur in beds up to seven feet thick.

The unit thickens northward from 420 feet in Stephens County to 460 feet in Western Caddo County to 660 feet in northern Grady Count

The El Reno unit outcrops in a four to eight mile wide northwest-southeast band across southern Caddo, northeastern Comanche, and northwestern Stephens Countles. The outcrop then circles the southeastern end of the Anadarko basin in northern Stephens County and covers a broad area up to eighteen miles wide across northeastern Stephens and Grady Counties of Division 7. In Grady and eastern Caddo Counties, north of TAN, the upper 10 to 20 feet is mapped separately as the Dog Creek-Blaine subunits undifferentiated. Northward, in Division 4, and westward from Caddo County, In Division 6, the rock strate of the El Reno unit are separatel end are mapped as the Flowerpot, Blaine, and Dog Creek units.

Topographically, the unit generally forms rolling hills with a pronounced escarpment at the base in Stephens and southern Grady Counties where the sandstones are thickest. Northwestward, the topography is rolling with gently rolling topography dominant in western Caddo County where the shales are thickest. The sandstone ridges are usually marked by oak vegetation and erosional guillies in the sandy soils. The shales generally form the valleys and gently rolling hills and support the growth of short grass. Some mesquite and pricity pear are evident in the sally or gypisferous areas.

USGS MA

SITE GEOLOGY

According to the USGS geologic map, the project site is underlain by the Duncan Sandstone Member (Pd) of the El Reno Group.

Sandstone, while to buff, fine- to coarse-grained, moderately indurated, with interbedded mudstone conglomerates and sittstones; thickness, 100 to 400 feet, decreasing southeastward. Yields small to moderate amounts of water of fair quality.

1085.3 FT. — LEAN CLAY WITH SAND, BROWN TO REDDISH BROWN

1080.3 FT. — SILTY SAND, BROWN

1075.3 FT. — LEAN CLAY WITH SAND, REDDISH BROWN

1067.8 FT. — SILTY SAND WITH GRAYEL, BROWN

1050.3 FT. — SANDY LEAN CLAY, BROWN

B-7 APPROX. OFFSET: 35' LT

APPROX. STATION: 747+63

APPROX. SURFACE ELEV.: 1085.3 FT

1025.8 FT. - SPT; N=50/4" MC=15 P200=23.2% LL=0 PL=0 1025.8 FT. - SANDSTONE, GRAY, WELL CEMENTED TO VERY WELL CEMENTED 1025.3 ft. - TCP = 50/0.8" 50/0.5" 1020.3 ft. - TCP = 50/0.4" 50/0.4"

1010.3 ft. - TCP = 50/0.8" 50/0.4"

1005.3 ft. - TCP = 50/0.4" 50/0.3"

1015.3 ft. - TCP = 50/0.8" 50/0.5"

1000.3 ft. - TCP = 50/0.4" 50/0.4"

/0.3" 995.3 FT. - BORING TERMINATION DEPTH = 90 FEET BORING COMPLETED ON 5/30/18 AND GROUTED ON 6/9/18

1,090 1,090 APPROX. OFFSET: 30' LT APPROX. STATION: 749+15 APPROX. OFFSET: 45' LT APPROX. STATION: 748+40 APPROX. SURFACE ELEV.: 1084 FT APPROX. SURFACE ELEV.: 1083.4 FT 1084 FT. - SPT; N=7 MC=13 TTT 1084 FT. - <u>SANDY SILT</u>, BROWN, LOOSE P200=61.9% LL=0 PL=0 71083.4 FT. - SILTY SAND, BROWN 1.080 1.080 1079 FT. SPT; - N=2 1079 FT. - LEAN CLAY WITH SAND, BROWN, SOFT TO STIFF 1078.4 FT. - LEAN CLAY WITH SAND, BROWN LL=0 PL=0 1074 ft. - TCP = 1072 FT. - SPT; N=9 MC=23 P200=70.3% LL=28 PL=13 1070.9 FT. – <u>SILTY SAND</u>, BROWN 1,070 1.070 1069 ft. - TCP = 101067 FT. - SPT; N=7 MC=26 1067 FT. - SANDY SILTY CLAY, BROWN, MEDIUM STIFF P200=68.9% LL=22 PL=15 1064 ft. - TCP = 3 1062 FT. - SPT; N=4 MC=26 1062 FT. - <u>LEAN CLAY</u>, BROWN, SOFT P200=88.0% LL=30 PL=14 1061.4 FT. - SANDY LEAN CLAY, BROWN 1,060 1,060 1059 ft. - TCP = 51057 FT. - SPT; N=3 MC=23 1057 FT. - LEAN CLAY WITH SAND, BROWN, SOFT P200=70.1% LL=24 PL=13 1054 FT. - SPT; N=6 MC=19 P200=67.4% LL=27 PL=11 1054 FT. - SANDY LEAN CLAY, BROWN, MEDIUM STIFF 1051.4 FT. - SILTY, CLAYEY SAND, BROWN 1,050 1,050 1049 ft. - TCP = 141047 FT. - SPT; N=8 MC=21 1047 FT. - LEAN CLAY WITH SAND, BROWN AND LIGHT GRAY, MEDIUM STIFF TO STIFF P200=81.5% LL=36 PL=13 1044 ft. - TCP = 101042 FT. - SPT; N=9 MC=20 P200=78.7% LL=27 PL=16 1039 FT. - SPT; N=11 MC=21 1039 FT. - <u>SILTY SAND</u>, BROWN, MEDIUM DENSE P200=42.0% LL=0 PL=0 1.040 1.040 1036.4 FT. - SILTY SAND WITH GRAVEL, REDDISH BROWN AND BROWN 1034 FT. - SPT; N=15 MC=21 P200=12.1% LL=0 PL=0 1,030 1.030 1029 FT. - SPT; N=27 MC=22 P200=32.0% LL=0 PL=0 1028.4 FT. - SILTY SAND WITH GRAVEL, REDDISH BROWN AND BROWN 1025ft = TOP OF ROCK 1025 FT. - SANDSTONE, GRAY, WELL CEMENTED TO VERY WELL CEMENTED 1024.4ft = TOP OF ROCK 1024.4 FT. - SPT; N=50/5" MC=18 1024.4 FT. - SANDSTONE, GRAY, POORLY CEMENTED TO VERY WELL CEMENTED FT. - SPT; N=50/3.5" 1024.5 ft. - TCP = 50/0.4" 50/1" P200=21.7% LL=0 PL=0 1023.9 ft. - TCP = 50/1" 50/0.4" 1,020 1,020 1019.5 ft. - TCP = 50/0.6" 50/0.41018.9 ft. - TCP = 50/1" 50/0.4"1014.5 ft. - TCP = 50/0.8" 50/0.4"1013.9 ft. - TCP = 50/0.8" 50/0.5"1,010 1.010 1009.5 ft. - TCP = 50/0.5" 50/0.4"1008.9 ft. - TCP = 50/0.8" 50/0.4"1004.5 ft. - TCP = 50/0.5" 50/0.3"1003.9 ft. - TCP = 50/1" 50/0.6"1,000 1.000 999.5 ft. - TCP = 50/0.5" 50/0.4998.9 ft. - TCP = 50/0.8" 50/0.5" 994.5 FT. — BORING TERMINATION DEPTH = 89.5 FEET BORING COMPLETED ON 6/6/18 AND GROUTED ON 6/9/18 994.5 ft. - TCP = 50/0.4" 50/0.3" 993.9 ft. - TCP = 50/0.8" 50/0.4" 990 988.9 ft. - TCP = 50/1" 50/0.4" 983.9 FT. — BORING TERMINATION DEPTH = 99.5 FEET BORING COMPLETED ON 6/5/18 AND GROUTED ON 6/9/18 983.9 ft. - TCP = 50/0.5" 50/0.4" GEOTECHNICAL REPORT SPT DENOTES STANDARD PENETRATION TEST, ASTM D1586
N DENOTES NUMBER OF BLOW COUNTS PER 12 INCHES ALL GEOTECHNICAL INFORMATION CONTAINED ON THIS SHEET IS

The ODOT publication indicates the project site is underlain by the El Reno Unit (Per).

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County and covers a broad area up to eighteen miles wide across northeastern Stephens and Grady Counties of Division 7. In Grady and eastern Caddo Counties, north of T4N, the upper 0 to 230 feet is mapped separately as the Dog Creek-Blaine subunits undifferentiated. Northward, In Division 4, and westward from Caddo County, In Division 5, the rock strata of the El Reno unit are separable and are mapped as the Flowerpot, Blaine, and Dog Creek units.

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SITE GEOLOGY

According to the USGS geologic map, the project site is underlain by the Duncan Sandstone Member (Pd) of the El Reno Group

Sandstone, white to buff, fine- to coarse-grained, moderately indurated, with interbedded mudstone conglomerates and sittstones; thickness, 100 to 400 feet, decreasing southeastward. Yields small to moderate amounts of water of fair quality.

DENOTES TEXAS CONE PENETRATION TESTS DENOTES RECOVERY IN ROCK CORING

RQD DENOTES ROCK QUALITY DESIGNATION DENOTES MOISTURE CONTENT TESTS P200 DENOTES PERCENT PASSING NO 200 SIEVE

DENOTES PLASTIC LIMIT TESTS (NP=NO PLASTICITY) DENOTES WATER ELEVATION IMMEDIATELY AFTER DRILLING DENOTES WATER ELEVATION HOURS AFTER DRILLING DENOTES TOP OF ROCK

#### \* NOTE: WATER ELEVATIONS SHOWN WERE OBTAINED AT THE TIME BORINGS WERE DRILLED AND MAY FLUCTUATE THROUGHOUT THE YEAR.

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SH 29 Bridge over Stephens County, Oklahoma

SUBSURFACE PROFILE

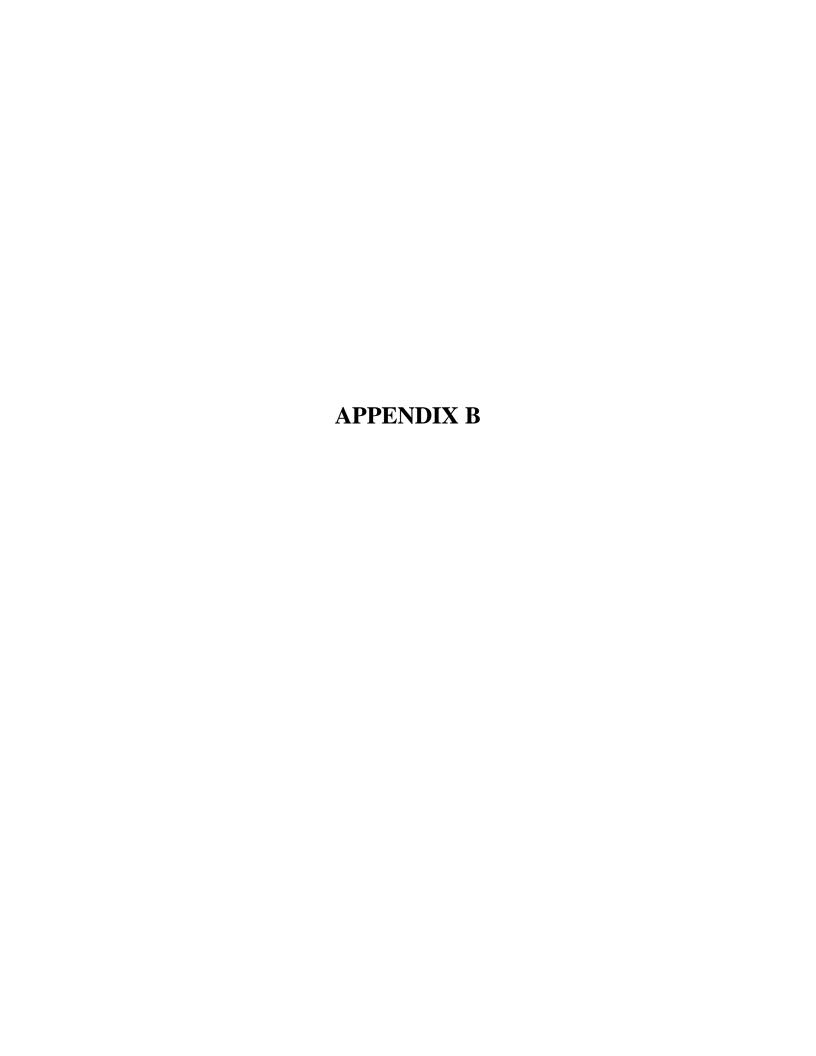
SHEET 5 OF 5

Check DMB 7/19

Detail | DMB | 7/1:

REVISIONS

STATE OF DEPARTMENT OF TRANSPORTATION OKLAHOMA JOB PIECE NO. 29657(04)



# **SUMMARY OF LABORATORY RESULTS**



PO Box 30591 Edmond, OK 73003 405-562-3328

Project Name: SH 29 Bridge over Black Bear Creek
CLIENT: SRB Project No: 18026

| Borehole | Depth<br>(ft) | % Moist. | Liquid<br>Limit | Plastic<br>Limit | Plastic<br>Index | -3" Sieve | -3/4"<br>Sieve | -1/2"<br>Sieve | -4 Sieve | -10<br>Sieve | -40<br>Sieve | -200<br>Sieve |
|----------|---------------|----------|-----------------|------------------|------------------|-----------|----------------|----------------|----------|--------------|--------------|---------------|
| B-1      | 0             | 21.5     | 27              | 17               | 10               | 100       | 100            | 100            | 100      | 100          | 99           | 60.1          |
| B-1      | 5             | 22.1     | 21              | 16               | 5                | 100       | 100            | 100            | 100      | 100          | 98           | 39.2          |
| B-1      | 10            | 24.5     | 30              | 15               | 15               | 100       | 100            | 100            | 100      | 99           | 97           | 79.3          |
| B-1      | 17            | 25.8     | 24              | 17               | 7                | 100       | 100            | 100            | 100      | 98           | 96           | 72.8          |
| B-1      | 20            | 24.3     | NV              | NP               | NP               | 100       | 100            | 100            | 99       | 98           | 97           | 34.7          |
| B-1      | 25            | 20.8     | 40              | 14               | 26               | 100       | 100            | 100            | 100      | 100          | 99           | 73.9          |
| B-1      | 32            | 26.9     | 35              | 13               | 22               | 100       | 100            | 100            | 100      | 100          | 99           | 78.1          |
| B-1      | 35            | 22.8     | 34              | 14               | 20               | 100       | 100            | 100            | 99       | 98           | 97           | 85.9          |
| B-1      | 42            | 20.8     | NV              | NP               | NP               | 100       | 100            | 100            | 100      | 100          | 99           | 30.0          |
| B-1      | 45            | 21.2     | 24              | 12               | 12               | 100       | 100            | 100            | 100      | 100          | 98           | 61.3          |
| B-1      | 52            | 26.9     | 39              | 12               | 27               | 100       | 100            | 100            | 100      | 99           | 99           | 80.9          |
| B-1      | 57            | 29.7     | 45              | 18               | 27               | 100       | 100            | 100            | 100      | 100          | 100          | 90.2          |
| B-1      | 57.5          | 18.8     | 31              | 16               | 15               | 100       | 100            | 100            | 100      | 100          | 99           | 86.5          |
| B-2      | 0             | 10.6     | 25              | 16               | 9                | 100       | 100            | 100            | 99       | 98           | 96           | 48.0          |
| B-2      | 5             | 18.7     | 23              | 17               | 6                | 100       | 100            | 100            | 100      | 100          | 100          | 45.3          |
| B-2      | 12            | 28.2     | 32              | 15               | 17               | 100       | 100            | 100            | 100      | 99           | 96           | 81.8          |
| B-2      | 17            | 20.9     | 22              | 16               | 6                | 100       | 100            | 100            | 100      | 100          | 100          | 35.0          |
| B-2      | 22            | 26.9     | 30              | 16               | 14               | 100       | 100            | 100            | 100      | 100          | 100          | 86.5          |
| B-2      | 27            | 19.3     | 25              | 15               | 10               | 100       | 100            | 100            | 100      | 100          | 98           | 64.8          |
| B-2      | 32            | 19.5     | 34              | 13               | 21               | 100       | 100            | 100            | 100      | 100          | 99           | 72.0          |
| B-2      | 37            | 26.0     | 33              | 15               | 18               | 100       | 100            | 100            | 100      | 99           | 95           | 74.3          |
| B-2      | 42            | 28.2     | 31              | 13               | 18               | 100       | 100            | 100            | 99       | 99           | 97           | 65.8          |
| B-2      | 45            | 23.7     | NV              | NP               | NP               | 100       | 100            | 100            | 100      | 100          | 95           | 24.2          |
| B-2      | 50            | 21.9     | NV              | NP               | NP               | 100       | 100            | 100            | 100      | 98           | 95           | 25.7          |
| B-2      | 55            | 17.2     | 19              | 15               | 4                | 100       | 100            | 100            | 91       | 82           | 67           | 34.0          |
| B-2      | 57            | 24.6     | 23              | 17               | 6                | 100       | 100            | 100            | 98       | 93           | 79           | 59.9          |
| B-3      | 60            | 16.5     | NV              | NP               | NP               | 100       | 100            | 96             | 81       | 76           | 73           | 33.8          |
| B-4      | 2             | 10.7     | 33              | 13               | 20               | 100       | 88             | 83             | 70       | 66           | 63           | 46.2          |
| B-4      | 4             | 16.6     | 33              | 14               | 19               | 100       | 100            | 100            | 97       | 95           | 93           | 60.2          |
| B-4      | 7             | 23.6     | 37              | 15               | 22               | 100       | 100            | 100            | 100      | 100          | 99           | 88.6          |
| B-4      | 10            | 17.5     | 35              | 13               | 22               | 100       | 100            | 100            | 98       | 96           | 93           | 71.9          |
| B-4      | 15            | 23.2     | 21              | 14               | 7                | 100       | 100            | 100            | 100      | 100          | 97           | 62.2          |
| B-4      | 20            | 25.1     | 34              | 16               | 18               | 100       | 100            | 100            | 100      | 100          | 97           | 86.2          |
| B-4      | 25            | 24.0     | 23              | 14               | 9                | 100       | 100            | 100            | 100      | 100          | 98           | 67.3          |
| B-4      | 30            | 20.2     | 23              | 15               | 8                | 100       | 100            | 100            | 100      | 100          | 97           | 65.1          |
| B-4      | 35            | 25.2     | 33              | 15               | 18               | 100       | 100            | 100            | 100      | 99           | 98           | 96.0          |
| B-4      | 40            | 19.2     | 41              | 15               | 26               | 100       | 100            | 100            | 100      | 99           | 98           | 73.9          |
| B-4      | 45            | 23.2     | NV              | NP               | NP               | 100       | 100            | 100            | 96       | 95           | 94           | 45.6          |
|          | _             | +        |                 |                  |                  | -         |                |                |          |              |              |               |
| B-4      | 50            | 23.0     | NV              | NP               | NP               | 100       | 100            | 100            | 100      | 100          | 100          | 24.9          |

# **SUMMARY OF LABORATORY RESULTS**



PO Box 30591 Edmond, OK 73003 405-562-3328

Project Name: SH 29 Bridge over Black Bear Creek
CLIENT: SRB Project No: 18026

| Borehole | Depth<br>(ft) | % Moist. | Liquid<br>Limit | Plastic<br>Limit | Plastic<br>Index | -3" Sieve | -3/4"<br>Sieve | -1/2"<br>Sieve | -4 Sieve | -10<br>Sieve | -40<br>Sieve | -200<br>Sieve |
|----------|---------------|----------|-----------------|------------------|------------------|-----------|----------------|----------------|----------|--------------|--------------|---------------|
| B-4      | 55            | 23.0     | 18              | 13               | 5                | 100       | 100            | 100            | 99       | 98           | 80           | 44.1          |
| B-4      | 60            | 19.4     | 22              | 13               | 9                | 100       | 100            | 92             | 89       | 88           | 84           | 42.0          |
| B-5      | 5             | 3.3      | NV              | NP               | NP               | 100       | 74             | 65             | 45       | 36           | 29           | 15.8          |
| B-5      | 15            | 22.1     | 23              | 13               | 10               | 100       | 100            | 100            | 100      | 100          | 98           | 59.6          |
| B-5      | 20            | 23.2     | 24              | 14               | 10               | 100       | 100            | 100            | 100      | 98           | 95           | 81.1          |
| B-5      | 25            | 23.1     | 22              | 14               | 8                | 100       | 100            | 100            | 100      | 100          | 99           | 64.5          |
| B-5      | 30            | 20.6     | 24              | 13               | 11               | 100       | 100            | 100            | 100      | 100          | 97           | 62.4          |
| B-5      | 35            | 24.3     | 33              | 16               | 17               | 100       | 100            | 100            | 100      | 98           | 97           | 95.6          |
| B-5      | 40            | 16.0     | 38              | 12               | 26               | 100       | 100            | 100            | 100      | 100          | 99           | 81.6          |
| B-5      | 45            | 19.4     | 23              | 15               | 8                | 100       | 100            | 100            | 100      | 99           | 99           | 45.2          |
| B-5      | 50            | 22.5     | 19              | 17               | 2                | 100       | 100            | 100            | 100      | 100          | 99           | 46.1          |
| B-5      | 55            | 26.4     | NV              | NP               | NP               | 100       | 100            | 100            | 95       | 93           | 88           | 55.6          |
| B-5      | 60            | 18.9     | NV              | NP               | NP               | 100       | 100            | 100            | 99       | 98           | 95           | 29.3          |
| B-6      | 60            | 14.7     | NV              | NP               | NP               | 100       | 100            | 100            | 87       | 80           | 73           | 28.8          |
| B-7      | 59.5          | 15.1     | NV              | NP               | NP               | 100       | 100            | 100            | 77       | 65           | 48           | 23.2          |
| B-8      | 59            | 18.3     | NV              | NP               | NP               | 100       | 100            | 96             | 83       | 74           | 63           | 21.7          |
| B-9      | 0             | 13.2     | NV              | NP               | NP               | 100       | 100            | 100            | 100      | 100          | 100          | 61.9          |
| B-9      | 5             |          | NV              | NP               | NP               |           |                |                |          |              |              |               |
| B-9      | 12            | 22.8     | 28              | 13               | 15               | 100       | 100            | 100            | 100      | 98           | 95           | 70.3          |
| B-9      | 17            | 26.4     | 22              | 15               | 7                | 100       | 100            | 100            | 97       | 96           | 93           | 68.9          |
| B-9      | 22            | 25.6     | 30              | 14               | 16               | 100       | 100            | 100            | 100      | 100          | 99           | 88.0          |
| B-9      | 27            | 22.5     | 24              | 13               | 11               | 100       | 100            | 100            | 100      | 100          | 98           | 70.1          |
| B-9      | 30            | 19.2     | 27              | 11               | 16               | 100       | 100            | 100            | 100      | 100          | 98           | 67.4          |
| B-9      | 37            | 21.1     | 36              | 13               | 23               | 100       | 100            | 100            | 100      | 100          | 97           | 81.5          |
| B-9      | 42            | 20.4     | 27              | 16               | 11               | 100       | 100            | 100            | 98       | 96           | 95           | 78.7          |
| B-9      | 45            | 21.4     | NV              | NP               | NP               | 100       | 100            | 100            | 100      | 100          | 100          | 42.0          |
| B-9      | 50            | 21.4     | NV              | NP               | NP               | 100       | 100            | 100            | 100      | 100          | 98           | 12.1          |
| B-9      | 55            | 21.8     | NV              | NP               | NP               | 100       | 100            | 100            | 98       | 96           | 88           | 32.0          |

#### SUMMARY OF UNIAXIAL COMPRESSIVE STRENGTH TEST RESULTS



PO Box 30591 Edmond, OK 73003 405-562-3328

RRC PROJECT NO 18026

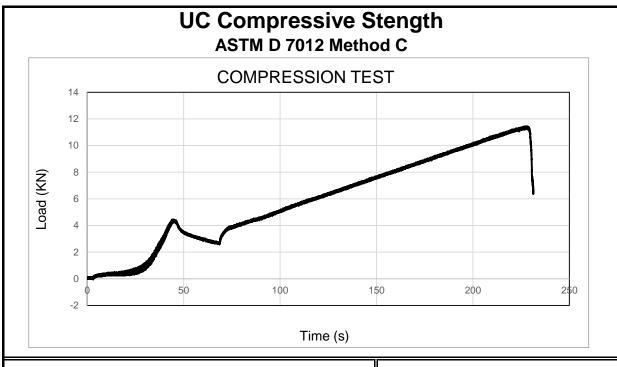
PROJECT NAME

SH 29 Bridge over Black Bear Creek

CLIENT

SRB

| Boring | Depth | Length | Diameter | L/D | Moisture | Unit<br>Weight | Loading<br>Rate | Un Comp<br>Strength | Un Comp<br>Strength | Correction<br>Factor<br>Applied | Straight | Flat   | Perpend |
|--------|-------|--------|----------|-----|----------|----------------|-----------------|---------------------|---------------------|---------------------------------|----------|--------|---------|
|        | (ft)  | (in)   | (in)     |     | %        | (pcf)          | (KN/sec)        | (Mpa)               | (psi)               |                                 |          | Pass / | Fail    |
| B2-A   | 62.5  | 3.96   | 2.1      | 2   | 1.4%     | 135.7          | 0.05            | 5.1                 | 744                 | 1                               | Pass     | Pass   | Pass    |
|        | 67.5  | 4      | 1.97     | 2   | 1.1%     | 150.0          | 0.01            | 8.0                 | 1,161               | 1                               | Pass     | Pass   | Pass    |



# Compressive Strength =

#### 744

#### psi

#### **Photo After Test**

#### **Test Conditions**

Procedure S1 - Side Staightness = **Pass** Procedure FP2 - Flatness = Pass Procedure P2 - Perpendicularity = Pass Load Direction = Vericaĺ Loading Rate = 0.05 KN/sec

Time of Failure = 231 seconds Temperature at Testing = 25 °C

#### **ASTM Tolerance Limits**

Prcedures: S1, FP2, P2

Side Tolerance (Straightness): Not to exceed 0.020 inch Perpendicularity Deviation: Not to exceed 0.250° Deviation from Flatness: Not to exceed 0.001 inch Parallelism Deviation: Not to exceed 0.25°

Equipment Used Cut Saw - Chicago Electric 46225 Caliper - General No. 143

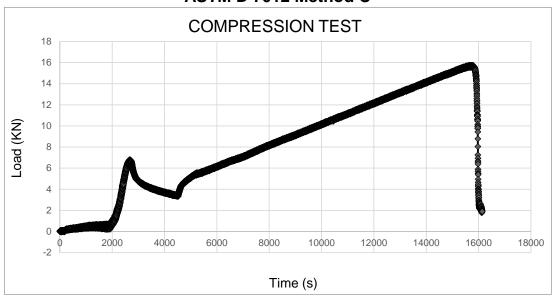
Feeler Gauge

Compression Machine - Humboldt 1348



| SAM                 | PLE DATA          | PR           | OJECT INFORMATION                  |
|---------------------|-------------------|--------------|------------------------------------|
| SAMPLE LOCATION:    | B2-A at 62.5 feet | PROJECT:     | SH 29 Bridge over Black Bear Creek |
| SAMPLE DESCRIPTION: | Crov Condatona    | LOCATION:    | Stephens County, OK                |
| SAMPLE DESCRIPTION: | Gray Sandstone    | PROJECT NO.: | 18026                              |
| MOISTURE CONTENT:   | 1.4%              | CLIENT:      | SRB                                |
| UNIT WEIGHT (PCF):  | 135.7             | TESTED BY:   | SAH                                |
| DIAMETER (IN):      | 2.1               | DATE:        | 7/19/2018                          |
| LENGTH (IN):        | 3.96              | Tal          |                                    |
| L/D RATIO:          | 2                 |              | ED ROCK<br>DISULTING               |

# UC Compressive Stength ASTM D 7012 Method C



#### 1,161 psi

#### **Photo After Test**

#### **Test Conditions**

Procedure S1 - Side Staightness = Pass
Procedure FP2 - Flatness = Pass
Procedure P2 - Perpendicularity = Pass
Load Direction = Verical

Loading Rate = 0.1 KN/sec Time of Failure = 161 seconds Temperature at Testing = 25 °C

#### **ASTM Tolerance Limits**

Prcedures: S1, FP2, P2

Side Tolerance (Straightness): Not to exceed 0.020 inch Perpendicularity Deviation: Not to exceed 0.250° Deviation from Flatness: Not to exceed 0.001 inch Parallelism Deviation: Not to exceed 0.25°

#### **Equipment Used**

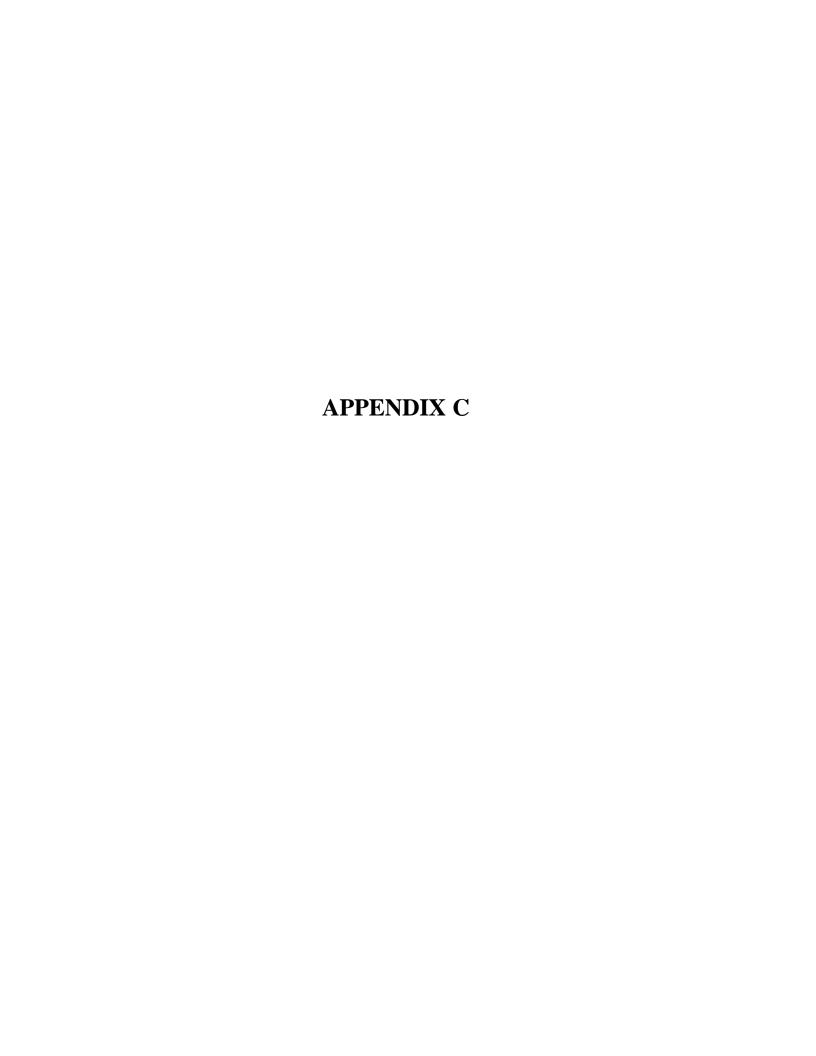
Cut Saw - Chicago Electric 46225 Caliper - General No. 143

Feeler Gauge

Compression Machine - Humboldt 1348



| SAMI                | PLE DATA                           | PF           | PROJECT INFORMATION                |  |  |  |
|---------------------|------------------------------------|--------------|------------------------------------|--|--|--|
| SAMPLE LOCATION:    | SAMPLE LOCATION: B2-A at 67.5 feet |              | SH 29 Bridge over Black Bear Creek |  |  |  |
| SAMPLE DESCRIPTION: | Cray Candatana                     | LOCATION:    | Stephens County, OK                |  |  |  |
| SAMPLE DESCRIPTION. | Gray Sandstone                     | PROJECT NO.: | 18026                              |  |  |  |
| MOISTURE CONTENT:   | 1.1%                               | CLIENT:      | SRB                                |  |  |  |
| UNIT WEIGHT (PCF):  | 150.0                              | TESTED BY:   | SAH                                |  |  |  |
| DIAMETER (IN):      | 1.97                               | DATE:        | 7/19/2018                          |  |  |  |
| LENGTH (IN):        | 4                                  | RE           | DROCK                              |  |  |  |
| L/D RATIO:          | 2                                  |              | NSULTING                           |  |  |  |





#### **Rock Core Photographs**



Photo #1 Run 1 of boring B2-A was from 57 to 62 feet. Run 1 had a recovery of 8% and a RQD 0%.



Photo # 2 Run 2 of boring B2-A was from 62 to 67 feet. Run 2 had a recovery of 38% and a RQD of 15%.



Photo #3 Run 3 of boring B2-A was from 67 to 72 feet. Run 3 had a recovery of 25% and a RQD of 12%.

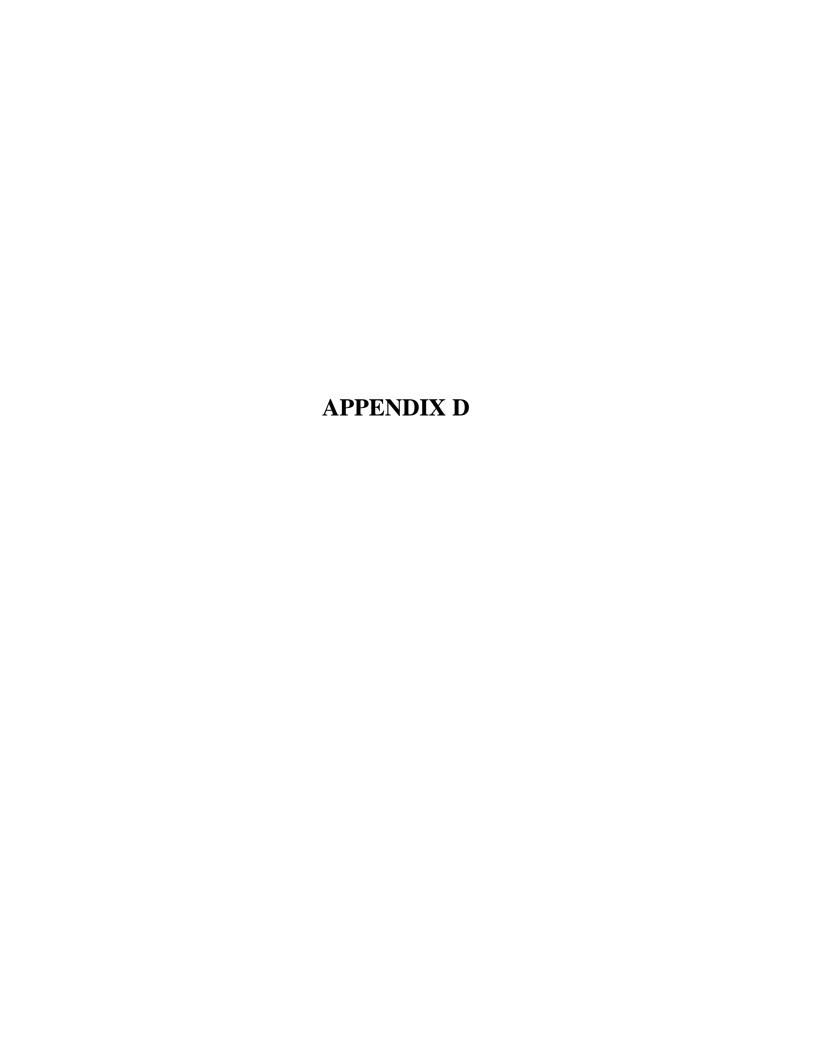
SH 29 Bridge over Black Bear Creek, Stephens County, OK 29657(04)
RRC Project No. 18026
July 19, 2018



### **Rock Core Photographs**



Photo # 4 Run 4 of boring B2-A was from 72 to 77 feet. Run 4 had a recovery of 18% and a RQD of 0%.





#### **GENERAL NOTES**

#### **SOIL PROPERTY ABBREVIATIONS**

 $\begin{array}{ll} N & & \text{Uncorrected SPT Penetration, blows per foot} \\ N_{60} & & \text{Corrected SPT Penetration, blows per foot} \\ Q_u & & \text{Unconfined Compressive Strength, psf} \\ Mc & & \text{Moisture Content, \%} \end{array}$ 

LL Liquid Limit, %
PL Plastic Limit, %
PI Plasticity Index, %

#### **DRILLING & SAMPLING ABBREVIATIONS**

BS Bag Sample
SPT Split Spoon Sample
ST Shelby Tube Sample

AU Auger Sample
TC Texas Cone Penetrometer

DCP Dynamic Cone Penetrometer

# UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487) -- used to classify all soils unless otherwise noted --

| M                           | ajor Divisions                                 | -                  | Group  | T   |
|-----------------------------|--|--------------------|--------|---|
|                             |  |                    | Symbol | Typical Names   |
| Course-Grained Soils        | Gravels  |                    | GW     | Well-graded gravels and gravel-sand mixtures, little or no fines              |
| >50% retained on #200 sieve | 50% + of course fraction retained on           | Clean Gravels      | GP     | Poorly graded gravels and gravel-sand mixtures, little or no fines            |
|                             | #4 sieve                                       | Gravels            | GM     | Silty gravels, gravel-sand-silt mixtures                                      |
|                             |  | with Fines         | GC     | Clayey gravels, gravel-sand-clay mixtures                                     |
|                             | Sands  |                    | SW     | Well-graded sands and gravelly sands, little or no fines                      |
|                             | 50% + of course<br>fraction passes #4<br>sieve | Clean Sands        | SP     | Poorly graded sands and gravelly sands, little or no fines                    |
|                             |  | Sands              | SM     | Silty sands, sand-silt mixtures   |
|                             |  | with Fines         | SC     | Clayey sands, sand-clay mixtures  |
| Fine-Grained Soils          | Silts and C                                    | lays               | ML     | Inorganic silts, very fine sands, rock four, silty or clayey fine sands       |
| <50% passes #200 sieve      | Liquid Limit ≤                                 | 50%                | CL     | Inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays  |
|                             |  |                    | OL     | Organic silts and organic silty clays of low plasticity                       |
|                             | Silts and Clays                                |                    | МН     | Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts |
|                             | Liquid Limit >                                 | Liquid Limit > 50% |        | Inorganic clays or high plasticity, fat clays                                 |
|                             |  |                    | ОН     | Organic clays of medium to high plasticity                                    |
| Highly Organic Soils        |  |                    |        | Peat, muck, and other highly organic soils                                    |

Prefix: G = Gravel, S = Sand, M = Silt, C = Clay, O = Organic

Suffix: W = Well Graded, P = Poorly Graded, M = Silty, L = Clay, LL < 50%, H = Clay, LL > 50%

#### PLASTICITY OF COHESIVE SOIL

| Degree of<br>Plasticity | Plasticity<br>Index | Swell Potential |  |  |  |  |  |
|-------------------------|---------------------|-----------------|--|--|--|--|--|
| None                    | 0 to 4              | Very Low        |  |  |  |  |  |
| Slight                  | 5 to 9              | Low             |  |  |  |  |  |
| Medium                  | 10 to 19            | Low to Medium   |  |  |  |  |  |
| High                    | 20 to 39            | Medium to High  |  |  |  |  |  |
| Very High               | 40+                 | Very High       |  |  |  |  |  |

#### MOISTURE OF COHESIVE SOIL

| Description | Condition | Moisture<br>Content |  |  |
|-------------|-----------|---------------------|--|--|
| Dry, Dusty  | Dry       | 0 to 10%            |  |  |
| Damp        | Moist     | 10 to 30%           |  |  |
| Free Water  | Wet       | 30 to 70%           |  |  |

#### **CONSISTENCY - COHESIVE SOILS**

| Consistency  | SPT      |
|--------------|----------|
| Very Soft    | <2       |
| Soft         | 2 to 4   |
| Medium Stiff | 5 to 8   |
| Stiff        | 9 to 14  |
| Very Stiff   | 15 to 30 |
| Hard         | 31+      |

#### **DENSITY - COHESIONLESS SOILS**

| Relative Density | SPT      |
|------------------|----------|
| Very Loose       | <4       |
| Loose            | 4 to 10  |
| Medium Dense     | 11 to 30 |
| Dense            | 31 to 50 |
| Very Dense       | 51+      |

#### **ROCK HARDNESS**

| SPT<br>(in/50) | TCP<br>(in/100) | Rock Description                 |
|----------------|-----------------|----------------------------------|
| 6+             | 6+              | Very Soft / Very Poorly Cemented |
| 5 - 6          | 3 - 6           | Soft / Poorly Cemented           |
| 4 - 5          | 2 - 3           | Moderately Hard / Cemented       |
| 3 - 4          | 1 - 2           | Hard / Well Cemented             |
| <3             | <1              | Very Hard / Very Well Cemented   |

#### **ROCK CORE QUALITY**

| Core Quality      | RQD       |
|-------------------|-----------|
| Excellent Quality | 90 – 100% |
| Good Quality      | 75 – 90%  |
| Fair Quality      | 50 – 75%  |
| Poor Quality      | 25 – 50%  |
| Very Poor Quality | <25%      |