RED ROCK
CONSULTING

Report of Geotechnical Investigation

In-Place Soils Survey
SH 29 - WEST
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 17, 2018
Project No. 18027

RED ROCK
CONSULTING

July 17, 2018

SRB
100 Northeast 5th Street
Oklahoma City, Oklahoma 73104

Attention: Mr. Greg Allen, PE

Re: Report of Geotechnical Investigation
In-Place Soils Survey
SH 29 - West
Stephens County, Oklahoma
29657(04)
Project No. 18027

Dear Mr. Allen:

I am pleased to submit herewith this report entitled "Geotechnical Investigation, In-Place Soils Survey – West, SH 29, 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
CA No. 5707 Exp. 06/30/19

Daniel Bolin, EI
Project Specialist

Jeremy Basler, PE
Geotechnical Manager
Oklahoma PE No. 20233

REGISTERED PROFESSIONAL ENGINEER
JEREMY BASLER
7-17-18
20233
OKLAHOMA

REPORT OF GEOTECHNICAL INVESTIGATION

IN-PLACE SOILS SURVEY
SH 29 - WEST
STEPHENS COUNTY, OKLAHOMA
29657(04)

PROJECT NO. 18027

APPENDICES

REPORT OF GEOTECHNICAL INVESTIGATION

IN-PLACE SOILS SURVEY
SH 29 - WEST
STEPHENS COUNTY, OKLAHOMA
29657(04)

PROJECT NO. 18027

INTRODUCTION

General

This report presents the results of the geotechnical investigation performed for the construction of the pavement along the new alignment of SH 29 in Stephens County, Oklahoma.

Proposed Construction

The project includes the full depth construction of new pavement where the offset alignments crossover SH 29 near station 840+00.

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.

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 sampling a total of 1 borehole within the planned project area.

3. A laboratory testing program consisting of moisture content, Atterberg limits, and full sieve tests on the soils encountered.

4. Presentation of laboratory data.

FIELD AND LABORATORY INVESTIGATIONS

Field Exploration

Subsurface exploration was performed on April 10, 2018. The boring was located in the field by a representative of Red Rock Consulting by measuring distances from known site reference points as depicted on the project plans. The location of the boring should be considered accurate only to the degree implied by the methods used to define it.

The subsurface exploration program consisted of drilling and sampling 1 boring under the full-time supervision of an engineer. The boring was advanced within the roadway. The boring IPW-1 was placed approximately at station 839+50 where the offset alignments crossover SH 29. The boring's location is shown on the boring location diagram, which is included in Appendix A.

The pavement and subgrade soils at the boring was drilled using a trailer mounted coring machine to cut through the existing pavement and then advanced to its termination depth using a hand auger. The boring was advanced to 36 inches below the existing pavement. The thickness of the pavement at the boring location was measured with a tape measure. Representative samples of the boring were obtained from the auger cuttings. Measured pavement thicknesses and the depths at which the soil samples were obtained are shown on the Pavement and In-Place Soils Survey chart in Appendix B.

Samples were collected and transported back to the lab for further classification and testing. The final Pavement and In-Place Soils Survey chart was developed from the draft log, observations and test results of the samples returned to the laboratory. The stratigraphic contacts indicated are only for the specific date and location reported, and therefore, are not necessarily representative of other locations and times. The Pavement and In-Place Soils Survey chart, presenting conditions encountered at the location explored, is included in Appendix B.

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 (AASHTO T265)
- Particle size analysis of soils (AASHTO T88)
- Liquid limit (AASHTO T 89)
- Plastic limit (AASHTO T90)
- Standard Proctor (AASHTO T99) – in Pedological Survey report
- Resilient modulus tests (AASHTO T307) – in Pedological Survey report

The results of the physical laboratory tests conducted are shown on the Pavement and In-Place Soils Survey chart in Appendix B and are included in Appendix C. **Standard Proctor and resilient modulus test results were done as part of the pedological survey and are include in that report.**

SITE DESCRIPTION

Surface Conditions

At the time of the field investigation, SH 29 was a two-lane highway with no existing shoulders. The surface pavement of SH 29 was asphalt. The roadway was visibly worn but did not show heavy rutting or cracking.

The in-place survey was performed approximately 2,300 feet west of North 2960 Road near Bray. The surrounding area was largely rural farmland and uncultivated pastures Some natural gas drilling pads and associated pipelines were located along the project scope. These operations did not hinder the subsurface exploration in any way.

Traffic control was utilized to drill the boring. There was a small amount of traffic during most of the day.

The approximate station of the boring is shown on the Pavement and In-Place Soils Survey chart in Appendix B.

Site Geology

Division Seven of the "Engineering Classification of Geological Materials", published by the Oklahoma Department of Transportation (ODOT) 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.

Subsurface Conditions

Information collected during the field investigation indicates that the existing pavement of SH 29 at the location of boring consisted of 9 inches of asphalt concrete. The asphalt concrete was underlain by 3 inches of aggregate base.

Beneath the pavement section, the subgrade materials consisted of clayey sand. The subgrade materials encountered in the borings consisted of A-2-6 and A-6 soils. The subgrade material in the boring appeared to be native to the project site and extended to the full termination depth of 36 inches.

Bulk samples representative of the project site were obtained from a pedological soils survey investigation. The most dominant soils series encountered along the project length during the pedological soil survey were the Little Axe, Pulaski, and Stephenville soils. Bulk samples of these soil series were obtained from the project site.

All of the conditions summarized above can be found on the Pavement and In-Place Soils Survey chart in Appendix B. Laboratory results can be found in Appendix C.

Groundwater Conditions

Groundwater conditions were monitored in the boring during and immediately after drilling operations. Groundwater was not encountered in the boring during these times.

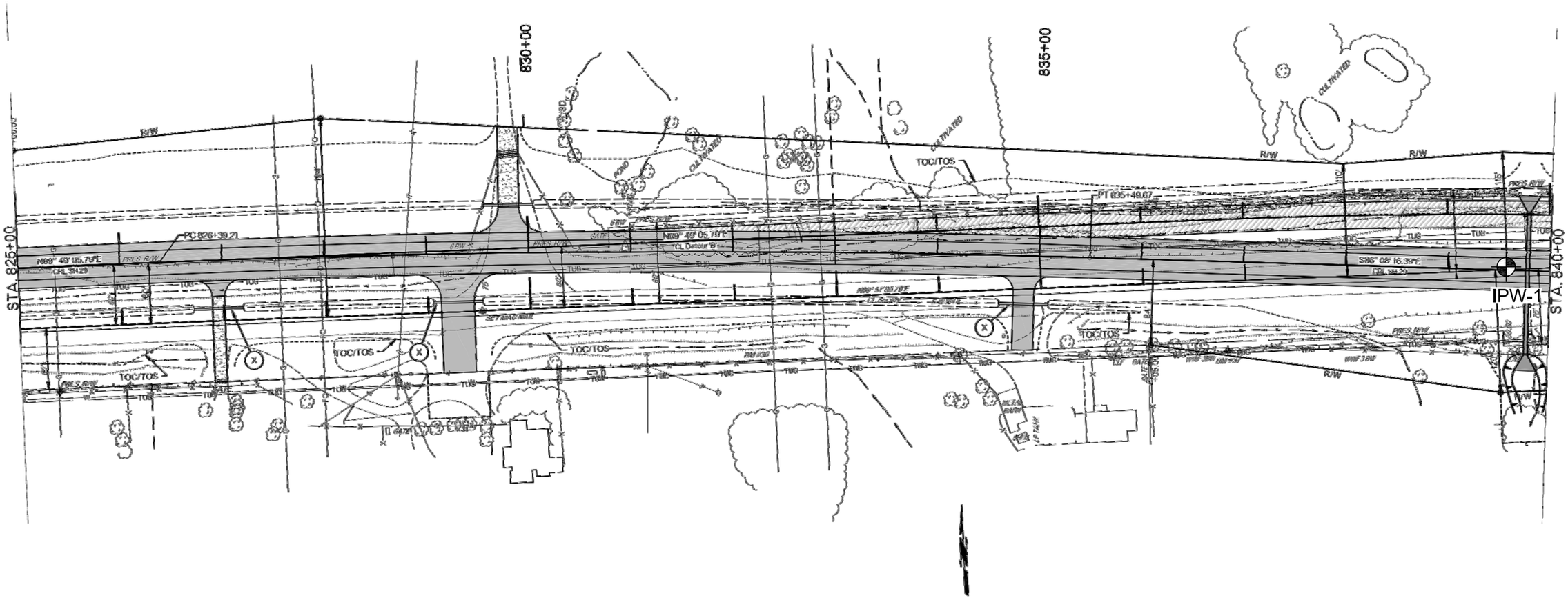
To obtain more accurate groundwater level information, long-term observations in a well or piezometer that is sealed from the influence of surface water would be needed. Fluctuations in groundwater levels can occur due to seasonal variations in the amount of rainfall, runoff, altered drainage paths,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

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 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 pavement and in-place soils survey chart or discussions presented herein.

APPENDIX A



RED ROCK CONSULTING

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BORING LOCATION DIAGRAM
SH 29 IN-PLACE SURVEY - WEST
STEPHENS COUNTY, OKLAHOMA
29657(04)

Project Mngr:	DMB	Project No.	18027
Designed By:	DMB	Scale:	NOT TO SCALE
Checked By:	JWB	Date:	7/5/2018
Approved By:	JWB	Page No:	1/1

APPENDIX B

Surveyed By: Shawn Alred
Date Surveyed: April 10, 2018

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RRC Project No: 18027
State Job No: 29657(04)
Location: SH 29 - West

Pavement and In-Place Soils Survey

Boring	Field No.	Soil Group	Approximate Station	Description	Depth (in)	LL	PI	Percent Passing						OSI	MC %
								3 in.	3/4 in	#4	#10	#40	#200		
IPW-1			840+00	**9" ASPHALT CONCRETE**	0"-9"										
			SH 29 Alignment	**3" AGGREGATE BASE**	9"-12"										
	1A	A-6(2)		**6" CLAYEY SAND,** yellowish brown	12"-18"	29	15	100	100	100	99	96	40.0	6	23
	1B	A-2-6(0)		**30" CLAYEY SAND,** reddish brown	18"-48"	27	12	100	100	87	86	83	28.6	4	20

APPENDIX C

SUMMARY OF LABORATORY RESULTS

RED ROCK CONSULTING
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Project No: 18027

Project Name: SH 29 In Place Survey-West
Client: SRB

Borehole	Depth (in)	% Moist.	Liquid Limit	Plastic Limit	Plastic Index	-3" Sieve	-3/4" Sieve	-1/2" Sieve	-4 Sieve	-10 Sieve	-40 Sieve	-200 Sieve
IPW-1	0-6"	22.7	29	14	15			100	100	99	96	40.0
IPW-1	6-36"	20.2	27	15	12		100	87	87	86	83	28.6

APPENDIX C

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GENERAL NOTES

SOIL PROPERTY ABBREVIATIONS

N	Uncorrected SPT Penetration, blows per foot
N_{60}	Corrected SPT Penetration, blows per foot
Q_u	Unconfined Compressive Strength, psf
Mc	Moisture Content, %
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 --

Major Divisions			Group Symbol	Typical Names
Course-Grained Soils >50% retained on #200 sieve	**Gravels** 50% + of course fraction retained on #4 sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands 50% + of course fraction passes #4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils <50% passes #200 sieve	**Silts and Clays** Liquid Limit ≤ 50%		ML	Inorganic silts, very fine sands, rock four, silty or clayey fine sands
			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 Liquid Limit > 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	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 Plasticity	Plasticity 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 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 (in/50)	TCP (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%