May 20, 2015

Rogers State University
1701 W Will Rogers Boulevard
Claremore, Oklahoma 74017

Attn: Mr. Leonard Szopinski
lszopinski@rsu.edu

Re: Geotechnical Engineering Report
Parking Lot Evaluation & Physical Plant Additions
Rogers State University
Claremore, Oklahoma
Terracon Project Number: 04155080

Dear Mr. Szopinski:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. This report presents the findings of the subsurface exploration and provides geotechnical recommendations regarding earthwork and the design and construction of building foundations, floor slabs, and pavements.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.
Cert. of Auth. #CA-4531 exp. 6/30/15

[Signatures]
Vaughn Rupnow, P.E.
Oklahoma No. 25692

Michael H. Homan, P.E.
Regional Manager

Enclosures
cc: 1 – Client (1 via mail, 1 via email)
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1.0 INTRODUCTION

A geotechnical engineering report has been completed for the Parking Lot Evaluation & Physical Plant Additions at Rogers State University in Claremore, Oklahoma. Three borings, designated B-1 to B-3, were drilled to depths of approximately 15 feet for the physical plant additions; and two borings, designated P-1, and P-2, were performed to depths of approximately 5 feet for the parking lot. Boring logs along with a location map and a boring location plan are included in Appendix A of this report.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- earthwork
- foundation design and construction
- floor slab subgrade preparation
- pavement thickness

2.0 PROJECT INFORMATION

2.1 Project Description

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site layout</td>
<td>See Appendix A, Exhibit A-2: Boring Location Plan</td>
</tr>
</tbody>
</table>
| Proposed development  | ■ Parking Lot Evaluation: The existing asphalt concrete pavement will be replaced with a concrete pavement.  
                                ■ Physical Plant Additions: we understand that recent earthwork activities have been performed and that RSU is interested in updating Terracon Geotechnical Report No. 04135238 dated January 29, 2014 for the construction of a building and a paved parking lot. |
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
</table>
| Maximum building addition loads | Columns: 50 kips (assumed)  
Walls: 2 kips/ft. (assumed)  
Floor slabs: 150 psf uniform (assumed)  
Final grading plans have not been provided at this time. However, we anticipate that maximum cut and fill depths on the order of 1 to 3 feet, relatively to the existing grades, will be required to develop the final building and pavement subgrade elevations. |

### 2.2 Site Location and Description

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
</table>
| Location                    | Rogers State University in Claremore, OK. Our geotechnical services were performed at two locations, as follows:  
- Parking Lot Evaluation: The parking lot is located on the west side of the RSU Student Services Center.  
- Physical Plant Additions: The site is located on the south side of the RSU Physical Plant, near the intersection of W Blue Starr Drive (County Road E 480) and Holly Creek Road.  
- Parking Lot Evaluation: Asphalt parking lot.  
- Physical Plant Additions: Small metal buildings, paved and gravel parking and drive areas.  
- Relatively level |

### 3.0 SUBSURFACE CONDITIONS

#### 3.1 Typical Profile

Based on the results of the borings, subsurface conditions on the project site consisted of lean clay fill soils to depths of 5 to 6.5 feet in the Physical Plant Addition area and to a depth of 2 feet in the Parking Lot area. Beneath the fill soils we encountered medium stiff to very stiff lean clay and shaley lean clay soils to boring termination depths of approximately 5 to 15 feet. The upper soils consist of relatively low plasticity clays. We have been told that the existing fill soils were removed and recompacted since our original report. The soil samples tested had the following measured liquid limits, plastic limits, and plasticity indices:

<table>
<thead>
<tr>
<th>Sample Location, Depth</th>
<th>Liquid Limit, (%)</th>
<th>Plastic Limit, (%)</th>
<th>Plasticity Index, (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boring B-1, 0.5 – 2.0 ft.</td>
<td>32</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>Boring B-3, 2.0 – 3.5 ft.</td>
<td>32</td>
<td>20</td>
<td>12</td>
</tr>
</tbody>
</table>
Conditions encountered at each boring location are indicated on the individual boring logs included in Appendix A. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual.

3.2 Groundwater

The boreholes were observed while drilling and immediately after completion for the presence and level of groundwater. No groundwater was observed at these times. Longer monitoring in piezometers or cased holes, sealed from the influence of surface water, would be required to evaluate longer-term groundwater conditions. During some periods of the year, perched water could be present. Fluctuations in groundwater levels should be expected throughout the year depending upon variations in the amount of rainfall, runoff, evaporation, and other hydrological factors not apparent at the time the borings were performed.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

We encountered existing fill materials to depths of about 5 to 6.5 feet at borings B-1 to B-3, which were drilled for the proposed physical plant additions. We have been told that these soils were removed and recompacted since our original report. We were told that observation and testing was not performed to evaluate the quality of fill construction. The soils encountered at the boring locations appear to consist of suitable material types for construction.

Because of the potential for variation in the composition and quality of existing fill away from the borings, there is an inherent risk of unpredictable settlement of floor slabs, footings, and pavements constructed over existing fills. This risk cannot be eliminated unless the full-depth of the existing fill is removed and replaced with tested and approved, new engineered fill. However, the risk can be reduced with thorough observation and testing by a representative of the geotechnical engineer during construction. Close observation and testing will be required during construction to evaluate the presence and extent of unsuitable fill materials and verify that the proposed structure is supported by suitable materials. Any unsuitable fill materials will require removal and replacement with engineered fill.
The proposed building can be supported on shallow foundations bearing in properly constructed new engineered fill or further verified existing fill. Recommendations and design parameters for shallow foundations are presented in section 4.3 Foundations. Recommendations regarding earthwork, design and construction of foundations, and support of floor slabs and pavements are presented below.

4.2 Earthwork

4.2.1 Site Preparation

Areas within the limits of construction should be stripped and cleared of all surface vegetation, topsoil, loose material, and debris. After stripping and completing any required cuts and overexcavations, the subgrade should be proofrolled to aid in locating soft and unstable areas. Proofrolling should be performed with a loaded tandem axle dump truck weighing at least 25 tons. Areas too small to proofroll should be evaluated by the geotechnical engineer. Soft, unstable soil should be removed and replaced with tested and approved, engineered fill, if they cannot be adequately stabilized in-place.

After completing the proofrolling, and before placing any fill, the exposed subgrade should be scarified to a minimum depth of 9 inches, moisture conditioned, and compacted as recommended in section 4.2.3 Compaction Requirements.

4.2.2 Fill Material Types

Engineered fill should meet the following material property requirements:

<table>
<thead>
<tr>
<th>Fill Type</th>
<th>USCS Classification</th>
<th>Acceptable Location for Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Volume Change (LVC) Material</td>
<td>CL or SC with PI ≤ 18</td>
<td>All locations and elevations</td>
</tr>
<tr>
<td>On-Site Clay Soils</td>
<td>CL</td>
<td>All locations and elevations</td>
</tr>
</tbody>
</table>

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris and contain maximum rock size of 3 inches. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.

2. Low plasticity cohesive soil having a plasticity index (PI) of 18 or less and containing at least 15% fines (material passing the No. 200 sieve, based on dry weight).
4.2.3 Compaction Requirements

The scarified and compacted subgrade and fill should be moisture conditioned and compacted using recommendations in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgrade Scarification Depth</td>
<td>9 inches</td>
</tr>
<tr>
<td>Fill Lift Thickness</td>
<td>9-inches or less in loose thickness</td>
</tr>
<tr>
<td>Compaction Requirements</td>
<td>At least 95% of the material’s maximum standard Proctor dry density (ASTM D-698)</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>-1 to +3% of the optimum moisture content</td>
</tr>
</tbody>
</table>

1. We recommend that engineered fills (including scarified and compacted subgrade) be tested for moisture content and compaction. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

The recommended moisture content should be maintained in the scarified and compacted subgrade and new fills, until fills are completed and on-grade floor slabs and pavements are constructed.

4.2.4 Utility Trench Backfill

Utility trenches are a common source of water infiltration and migration. All utility trenches that penetrate beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the building. We recommend constructing an effective clay “trench plug” that extends at least 5 feet out from the face of the building exterior. The plug material should consist of clay compacted at a water content at or above the soils optimum water content. The clay fill should be placed to completely surround the utility line and be compacted in accordance with recommendations in this report.

4.2.5 Grading and Drainage

All grades must provide effective drainage away from the building during and after construction. Water permitted to pond next to the building can result in greater soil movements than those discussed in this report. These greater movements can result in unacceptable differential floor slab movements, cracked slabs and walls, and roof leaks. Estimated movements described in this report are based on effective drainage for the life of the structure and cannot be relied upon if effective drainage is not maintained.

Exposed ground should be sloped at a minimum 5 percent away from the building for at least 10 feet beyond the perimeter of the building. After building construction and landscaping, we recommend verifying final grades to document that effective drainage has been achieved.
Grades around the structure should also be periodically inspected and adjusted as necessary, as part of the structure’s maintenance program.

Planters located within 10 feet of the structures should be self-contained to prevent water accessing the building subgrade soils. Sprinkler mains and spray heads should be located a minimum of 5 feet away from the building lines. Low-volume, drip style landscaped irrigation should not be used near the building. Roof runoff should be collected in drains or gutters. Roof drains and downspouts should be discharged onto pavements which slope away from the building or down spouts should be extended a minimum of 10 feet away from structures.

4.2.6 Earthwork Construction Considerations

Upon completion of filling and grading, care should be taken to maintain the recommended subgrade moisture content prior to construction of floor slabs and pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, excessively wetted or dried, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab and pavement construction.

Temporary excavations may be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

Terracon should be retained during the construction phase of the project to provide observation and testing during earthwork.

4.3 Foundations

4.3.1 Footing Foundation Design Recommendations

<table>
<thead>
<tr>
<th>Description</th>
<th>Design Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net allowable bearing pressure (^1)</td>
<td>2,000 psf</td>
</tr>
<tr>
<td>Bearing material</td>
<td>Newly placed engineered fill or further verified existing fill</td>
</tr>
<tr>
<td>Minimum width</td>
<td>Columns: 30 inches</td>
</tr>
<tr>
<td></td>
<td>Walls: 16 inches</td>
</tr>
<tr>
<td>Minimum depth (below lowest finished exterior grade)(^2)</td>
<td>24 inches</td>
</tr>
<tr>
<td>Estimated total settlement</td>
<td>(\frac{3}{4}) inch</td>
</tr>
</tbody>
</table>
### 4.3.2 Construction Considerations for Footings

The bottom of the footing overexcavations should be free of loose and disturbed material, debris, and water when backfill is placed. The foundation bearing surface should be free of loose and disturbed material, debris, and water when concrete is placed. Concrete should be placed as soon as possible after excavation is completed to reduce the potential for wetting, drying, or disturbance of the bearing materials. It is recommended that the geotechnical engineer be retained to observe and test the soil foundation bearing materials.

If unsuitable bearing soils are encountered in footing excavations, the excavations should be extended deeper to suitable soils and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations as shown in Figure 1 below. The footings could also bear on properly compacted engineered fill extending down to the suitable soils. Overexcavation for compacted backfill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation. The overexcavation should then be backfilled up to the footing base elevation with approved engineered fill material. The overexcavation and backfill procedure is shown in Figure 2 below.
4.4 Floor Slabs

4.4.1 Floor Slab Design Recommendations
We recommend construction of at least 12 inches of low volume change engineered fill beneath the floor slab of the building. The recommended fill material type and compaction requirements are presented in sections 4.2.2 Fill Material Types and 4.2.3 Compaction Requirements. Based on preparing the floor slab subgrade and constructing engineered fills beneath the floor slab as recommended, the floor slab should be adequately supported.

The use of a vapor retarder should be considered beneath concrete slabs on grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

4.4.2 Floor Slab Construction Considerations
Upon completion of grading operations in the building area, care should be taken to maintain the recommended subgrade moisture content and density prior to construction of the building floor slab. If the subgrade should become excessively wetted or dried, or otherwise disturbed prior to construction of the floor slab, the affected material should be removed or the materials scarified, moisture conditioned, and recompacted.

4.5 Pavements

4.5.1 Typical Pavement Sections
It has been our experience that soft, wet soils are often encountered beneath existing pavements. The contractor should anticipate encountering soft, wet soils as they remove the
existing pavements at borings P-1 and P-2. We recommend that subgrade improvement be accomplished by constructing a minimum 10-inch thick layer of select fill beneath the pavement section. Some on-site subgrade soils may require overexcavation to construct the 10-inch thick layer of select fill below the pavement section. The select fill should meet the criteria for Low Volume Change (LVC) material stated in section 4.2.2 Material Types. The 10-inch select fill layer beneath the pavements should have a Unified Soil Classification System group symbol of CL or SC. Soils classifying as ML, CL-ML, SM, or SC-SM per the Unified Soil Classification System should not be used as select fill. An approved crushed aggregate base, crushed limestone screenings, or broken shale may be considered as an alternative to the select fill material and, if used, may warrant a slight reduction in the thickness of select fill required.

Minimum alternative pavement sections are outlined below. The sections assume that automobile parking pavements will be traveled only by automobiles and drive lane pavements will be traveled by no more than 5 trucks per day having a gross weight of 50,000 pounds or equivalent trafficking. If heavier or more frequent truck traffic is expected, Terracon should be contacted to review the pavements sections and, if necessary, to modify the section thickness. Periodic maintenance should be planned to extend the pavement life. Other pavement sections could be considered.

<table>
<thead>
<tr>
<th>Minimum Pavement Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pavement Section</strong></td>
</tr>
<tr>
<td>3,500 psi Air Entrained Portland Cement Concrete Over Select Fill</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

NOTE: We recommend that 7-inch thick reinforced concrete pads be provided in front of and beneath trash receptacles. The dumpster trucks should be parked on the rigid concrete pavement when the trash receptacles are lifted. The concrete pads should be supported on at least 4 inches of ODOT Type “A” aggregate base over 10 inches of Select Fill or 8 inches of chemically treated subgrade.

### 4.5.2 Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration.

### 4.5.3 Pavement Maintenance

The pavement sections provided in this report represent minimum recommended thicknesses and, as such, periodic maintenance including crack and joint sealing, patching, and surface sealing should be performed. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventive maintenance.
5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.
APPENDIX A
FIELD EXPLORATION
LEGEND

BORING LOCATION

APPROXIMATE SCALE IN FEET
LEGEND

BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

BENCHMARK: FINISH FLOOR OF EXISTING BUILDING AT DOORWAY, ELEVATION 100 FEET

BORING LOCATION PLAN
GEOTECHNICAL EXPLORATION
RSU PHYSICAL PLANT ADDITIONS
CLAREMORE, OKLAHOMA

© 2015 GOOGLE
Field Exploration Description
The boring locations were established in the field by Terracon personnel by taping from existing reference features. Terracon determined the approximate ground surface elevations at borings B-1 to B-3 using an engineer’s level. The finish floor of the existing building immediately north of the borehole locations was used as a benchmark. The approximate ground surface elevations at the borings are shown on the logs based on an elevation of 100.0 feet for the benchmark. The elevations shown on the logs have been rounded to the nearest 0.5 feet. The boring locations and elevations should be considered accurate only to the degree implied by the methods used to define them. We did not collect elevation data at borings P-1 and P-2.

We drilled the borings with an ATV-mounted rotary drill rig using continuous flight solid-stem augers to advance the boreholes. Representative samples were obtained by the split-barrel sampling procedure. The split-barrel sampling procedure uses a standard 2-inch, O.D. split-barrel sampling spoon that is driven into the bottom of the boring with a 140-pound drive hammer falling 30 inches. The number of blows required to advance the sampling spoon the last 12 inches, or less, of an 18-inch sampling interval or portion thereof, is recorded as the standard penetration resistance value, N. The N value is used to estimate the in-situ relative density of granular soils and, to a lesser degree of accuracy, the consistency of cohesive soils and the hardness of bedrock.

The sampling depths, penetration distances, and N values are reported on the boring logs. The samples were tagged for identification, sealed to reduce moisture loss and returned to the laboratory for further examination, testing and classification.

An automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. Generally, a greater efficiency is achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. The effect of the automatic hammer’s efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

A field log of each boring was prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller’s interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer’s interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.
### BORING LOG NO. B-1

**PROJECT:** Parking Lot Evaluation & Physical Plant Additions  
**CLIENT:** Rogers State University  
**SITE:** Claremore, Oklahoma

---

**LOCATION**  
See Exhibit A-2  
Latitude: 36.32099°  
Longitude: -95.64149°  
Surface Elev.: 99.5 (Ft.)

---

**GRAPHIC LOG**  
Depth (Fl.)  
Elevation (Fl.)

#### 6" Crushed Rock
- **FILL - LEAN CLAY**, with sand, brown and gray
  - Depth: 6.0  
  - Elevation: 94.5

#### LEAN CLAY (CL)
- gray and reddish-brown, stiff  
  - Depth: 13.5  
  - Elevation: 86

#### SHALEY LEAN CLAY (CL)
- olive-gray, very stiff  
  - Depth: 15.0  
  - Elevation: 84.5

---

**Boring Terminated at 15 Feet**

Stratification lines are approximate. In-situ, the transition may be gradual.

---

**Water Level Observations**

<table>
<thead>
<tr>
<th>Depth (Ft.)</th>
<th>Recovery (In.)</th>
<th>Water Content (%)</th>
<th>Atterberg Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3-5-9 N=14</td>
<td>15</td>
<td>32-18-14</td>
</tr>
<tr>
<td>5</td>
<td>3-4-5 N=9</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>10</td>
<td>2-3-5 N=8</td>
<td>26</td>
<td>19</td>
</tr>
<tr>
<td>15</td>
<td>14-7-42 N=69</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

---

**Notes:**  
Hammer Type: Automatic  
+ Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

---

**Advancement Method:**  
Power Auger

**Abandonment Method:**  
See Exhibit A-3 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

---

**WATER LEVEL OBSERVATIONS**

- 12 ft While Drilling
- 12 ft After Boring

---

**Location: 9522 East 47th Place, Unit D  
Tulsa, Oklahoma**

**Drill Rig: ATV 380E  
Driller: TS**

**Project No.: 04155080  
Exhibit: A-4**

**Boring Started: 5/12/2015  
Boring Completed: 5/12/2015**
6" Crushed Rock
**FILL - LEAN CLAY**, with sand, brown and dark brown

8.5

**LEAN CLAY (CL)**, reddish-brown and light gray, stiff

13.5

**SHALEY LEAN CLAY (CL)**, light gray and yellowish-brown, very stiff

15.0

Boring Terminated at 15 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic
+Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.

Notes:

**WATER LEVEL OBSERVATIONS**

- 11 ft While Drilling
- 11 ft After Boring
BORING LOG NO. B-3

PROJECT: Parking Lot Evaluation & Physical Plant Additions

SITE: Claremore, Oklahoma

CLIENT: Rogers State University

LOCATION
See Exhibit A-2
Latitude: 36.32097° Longitude: -95.64198°

Surface Elev.: 99 (Ft.)

DEPTHD ELEVATION (Fl.)

6" Crushed Rock
FILL - LEAN CLAY, with sand, brown, dark brown and gray
- with gravel below 2 feet

LEAN CLAY (CL), with sand, gray and reddish-brown, stiff

SHALEY LEAN CLAY (CL), olive-gray, very stiff

Boring Terminated at 15 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic
-Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Advancement Method:
Power Auger

Abandonment Method:

WATER LEVEL OBSERVATIONS

DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | RECOVERY (ft.) | FIELD TEST RESULTS | UNCONFINED COMPRESSIVE STRENGTH (psi) | WATER CONTENT (%) | ATTERBERG LIMITS | PERCENT FINES
--- | --- | --- | --- | --- | --- | --- | ---
11 | 11 ft While Drilling | | | | | | |
15 | 11 ft After Boring | | | | | | |

Notes:

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Boring Started: 5/12/2015
Boring Completed: 5/12/2015
Drill Rig: ATV 380E
Driller: TS
Project No.: 04155080
Exhibit: A-6
**BORING LOG NO. P-1**

**PROJECT:** Parking Lot Evaluation & Physical Plant Additions  
**SITE:** Claremore, Oklahoma  
**CLIENT:** Rogers State University

| LOCATION | See Exhibit A-2  
| Latitude: 36.31878° Longitude: -95.63598° |

| DEPTH (FL) | ELEVATION (FL) | 4" Ashphalt  
| FILL - SANDY LEAN CLAY, gray and brown |
| 2.5 |  |

| DEPTH (FL) | ELEVATION (FL) | SHALEY LEAN CLAY (CL), with sandstone fragments, yellowish-brown and light gray, very stiff |
| 5.0 | 5 |

**Boring Terminated at 5 Feet**

<table>
<thead>
<tr>
<th>WATER LEVEL OBSERVATIONS</th>
<th>FIELD TEST RESULTS</th>
<th>UNCONFINED COMPRESSIVE STRENGTH (psi)</th>
<th>WATER CONTENT (%)</th>
<th>ATTERBERG LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-5-7 N=12</td>
<td></td>
<td></td>
<td>13</td>
<td>33-17-16</td>
</tr>
<tr>
<td>4-5-15 N=20</td>
<td></td>
<td></td>
<td>22</td>
<td></td>
</tr>
</tbody>
</table>

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic  
+Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

**Advancement Method:** Power Auger  
**Abandonment Method:**

See Exhibit A-3 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

**Notes:**

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**WATER LEVEL OBSERVATIONS**

Not Encountered While Drilling  
Not Encountered After Boring

**Terracon**

9522 East 47th Place, Unit D  
Tulsa, Oklahoma

**Project No.: 04155080**  
**Exhibit:** A-7
**BORING LOG NO. P-2**

**PROJECT:** Parking Lot Evaluation & Physical Plant Additions  
**SITE:** Claremore, Oklahoma  
**CLIENT:** Rogers State University

| LOCATION | See Exhibit A-2  
|----------|-----------------  
| Latitude: 36.31853°, Longitude: -95.63617° |

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>ELEVATION (FL)</th>
<th>SAMPLE TYPE</th>
<th>RECOVERY</th>
<th>FIELD TEST RESULTS</th>
<th>UNCONFINED COMPRESSIVE STRENGTH (psi)</th>
<th>WATER CONTENT (%)</th>
<th>ATTERBERG LIMITS</th>
<th>LL-PL-PI</th>
<th>PERCENT FINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**6" Asphalt Fill - Sandy Lean Clay**, gray and dark brown

**Shale Lean Clay (CL)**, with sandstone fragments, yellowish-brown and light gray, very stiff

**Boring Terminated at 5 Feet**

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic  
Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

**ADVANCEMENT METHOD:** Power Auger  
**ABANDONMENT METHOD:**

---

**WATER LEVEL OBSERVATIONS**

- Not Encountered While Drilling
- Not Encountered After Boring

---

**BUILDING SMART LOGS WHILE WELL 04155080.GPJ**

---

**NOTES:**

See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

---

**Terracon**

9522 East 47th Place, Unit D  
Tulsa, Oklahoma

Project No.: 04155080  
Exhibit: A-8

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Boring Started: 5/12/2015  
Boring Completed: 5/12/2015

Drill Rig: ATV 380E  
Driller: TS
Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in Appendix A. After the testing was completed, the field descriptions were confirmed or modified as necessary.

Selected soil and bedrock samples obtained from the site were tested for the following engineering properties:

- Water content
- Atterberg limits
- Sieve analysis
APPENDIX C
SUPPORTING DOCUMENTS
### DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

### LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

### RELATIVE DENSITY OF COARSE-GRAINED SOILS

(50% or more passing the No. 200 sieve.) Density determined by Standard Penetration Resistance

<table>
<thead>
<tr>
<th>Descriptive Term (Density)</th>
<th>Standard Penetration or N-Value Blows/Ft.</th>
<th>Ring Sampler Blows/Ft.</th>
<th>Descriptive Term (Consistency)</th>
<th>Unconfined Compressive Strength, Qu, psf</th>
<th>Standard Penetration or N-Value Blows/Ft.</th>
<th>Ring Sampler Blows/Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Loose</td>
<td>0 - 3</td>
<td>0 - 6</td>
<td>Very Soft</td>
<td>less than 500</td>
<td>0 - 1</td>
<td>&lt; 3</td>
</tr>
<tr>
<td>Loose</td>
<td>4 - 9</td>
<td>7 - 18</td>
<td>Soft</td>
<td>500 to 1,000</td>
<td>2 - 4</td>
<td>3 - 4</td>
</tr>
<tr>
<td>Medium Dense</td>
<td>10 - 29</td>
<td>19 - 58</td>
<td>Medium-Stiff</td>
<td>1,000 to 2,000</td>
<td>4 - 8</td>
<td>5 - 9</td>
</tr>
<tr>
<td>Dense</td>
<td>30 - 50</td>
<td>59 - 98</td>
<td>Stiff</td>
<td>2,000 to 4,000</td>
<td>8 - 15</td>
<td>10 - 18</td>
</tr>
<tr>
<td>Very Dense</td>
<td>&gt; 50</td>
<td>&gt; 99</td>
<td>Very Stiff</td>
<td>4,000 to 8,000</td>
<td>15 - 30</td>
<td>19 - 42</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hard</td>
<td>&gt; 8,000</td>
<td>&gt; 30</td>
<td>&gt; 42</td>
</tr>
</tbody>
</table>

### RELATIVE DENSITY OF FINE-GRAINED SOILS

(50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance

<table>
<thead>
<tr>
<th>Consistency of Fine-Grained Soils</th>
<th>Descriptive Term(s) of other constituents</th>
<th>Percent of Dry Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Loose</td>
<td>&lt; 15</td>
<td></td>
</tr>
<tr>
<td>Loose</td>
<td>15 - 29</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>&gt; 30</td>
<td></td>
</tr>
</tbody>
</table>

### GRAIN SIZE TERMINOLOGY

<table>
<thead>
<tr>
<th>Particle Size</th>
<th>Major Component of Sample</th>
<th>Term</th>
<th>Plasticity Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 12 in. (300mm)</td>
<td>Boulders</td>
<td>Non-plastic</td>
<td>0</td>
</tr>
<tr>
<td>12 in. to 3 in. (300mm to 75mm)</td>
<td>Cobble</td>
<td>Low</td>
<td>1 - 10</td>
</tr>
<tr>
<td>3 in. to #4 sieve (75mm to 4.75 mm)</td>
<td>Gravel</td>
<td>Medium</td>
<td>11 - 30</td>
</tr>
<tr>
<td>#4 to #200 sieve (4.75mm to 0.075mm)</td>
<td>Sand</td>
<td>High</td>
<td>&gt; 30</td>
</tr>
<tr>
<td>#200 sieve (0.075mm)</td>
<td>Silt or Clay</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

### PLASTICITY DESCRIPTION

<table>
<thead>
<tr>
<th>Plasticity Index</th>
<th>Descriptive Term(s) of other constituents</th>
<th>Percent of Dry Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Trace</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>1 - 10</td>
<td>With</td>
<td>5 - 12</td>
</tr>
<tr>
<td>11 - 30</td>
<td>Modifier</td>
<td>&gt; 12</td>
</tr>
</tbody>
</table>
# UNIFIED SOIL CLASSIFICATION SYSTEM

### Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests

<table>
<thead>
<tr>
<th>Group</th>
<th>Symbol</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Cu = D_{60}/D_{10}</td>
<td>$C_e = \frac{(D_{60})^2}{D_{10} \times D_{40}}$</td>
</tr>
<tr>
<td>B</td>
<td>If field sample contained cobbles or boulders, or both, add &quot;with cobbles or boulders, or both&quot; to group name.</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>$C_u = D_{60}/D_{10}$</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>If soil contains $\geq 15$% sand, add &quot;with sand&quot; to group name.</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.</td>
<td></td>
</tr>
</tbody>
</table>

## Gravels:

More than 50% of coarse fraction retained on No. 4 sieve

### Clean Gravels:

- Less than 5% fines
- Fines classify as ML or MH
- Fines classify as CL or CH

| Cu $\geq$ 4 and or/1 $\leq$ Cc $\leq$ Cc $\geq$ 3 $^{e}$ | GW | Well-graded gravel |
| Cu $\leq$ 1 $\leq$ Cc $\leq$ 3 $^{e}$ | GP | Poorly graded gravel |

### Gravels with Fines:

More than 12% fines

| Fines classify as ML or MH | GM | Silty gravel |
| Fines classify as CL or CH | GC | Clayey gravel |

## Sands:

50% or more of coarse fraction passes No. 4 sieve

### Clean Sands:

Less than 5% fines

| Fines classify as ML or MH | SM | Silty sand |
| Fines classify as CL or CH | SC | Clayey sand |

## Silts and Clays:

Liquid limit less than 50

### Inorganic:

- PI $\geq$ 7 and plots on or above "A" line
- PI $\leq$ 4 or plots below "A" line

| PI $\geq$ 7 and plots on or above "A" line | CL | Lean clay |
| PI $\leq$ 4 or plots below "A" line | ML | Silt |

### Organic:

Liquid limit - oven dried

| Liquid limit - oven dried $< 0.75$ | OL | Organic clay |

Liquid limit - not dried

| Liquid limit - not dried $< 0.75$ | OH | Organic silt |

## Fine-Grained Soils:

50% or more passes the No. 200 sieve

### Silts and Clays:

Liquid limit 50 or more

### Inorganic:

- PI plots on or above "A" line
- PI plots below "A" line

| PI plots on or above "A" line | CH | Fat clay |
| PI plots below "A" line | MH | Elastic Silt |

### Organic:

Liquid limit - oven dried

| Liquid limit - oven dried $< 0.75$ | OL | Organic clay |
| Liquid limit - not dried $< 0.75$ | OH | Organic silt |

Highly organic soils:

- Primarily organic matter, dark in color, and organic odor

| PT | Peat |

---

For classification of fine-grained soils and fine-grained fraction of coarse-grained soils:

- Equation of "A" - line: $P_{sc}=0.73 \times LL_{25.5}$
- Equation of "U" - line: $P_{sc}=0.9 \times LL_{8}$

- If fines are organic, add "with organic fines" to group name.
- If soil contains $\geq 15$% gravel, add "with gravel" to group name.
- If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
- If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
- If soil contains $\geq 30$% predominantly sand, add "sandy" to group name.
- If soil contains $\geq 30$% predominantly gravel, add "gravely" to group name.
- If PI $\geq 4$ and plots on or above "A" line.
- If PI $< 4$ or plots below "A" line.
- If PI plots on or above "A" line.
- If PI plots below "A" line.