



ECS Southwest, LLP

Geotechnical Engineering Report

Brakes Plus

4900 N May Avenue
Oklahoma City, Oklahoma

ECS Project Number 58:1830

May 8, 2024





ECS SOUTHWEST, LLP

Geotechnical • Construction Materials • Environmental • Facilities

"One Firm. One Mission."

May 8, 2024

Ms. Ashley Bernatski
Express Oil Change & Tire Engineers
1880 Southpark Drive
Birmingham, AL 35244

ECS Project No. 58:1830

Reference: Geotechnical Engineering Report
Brakes Plus
4900 N May Avenue
Oklahoma City, Oklahoma

Dear Ms. Bernatski:

ECS Southwest (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our agreed to scope of work. This report presents our understanding of the geotechnical aspects of the project along with the results of the field exploration and laboratory testing conducted, and our design and construction recommendations.

It has been our pleasure to be of service to Express Oil Change and Tire Engineers during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify subsurface conditions assumed for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Southwest, LLP


Andy Wilshire, P.E.
Office Manager
awilshire@ecslimited.com




Ethan Pollard, E.I.
Geotechnical Project Manager
epollard@ecslimited.com


Garrett Klingensmith, P.E.
Subsidiary Regional Manager / Principal
gklingensmith@ecslimited.com

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1.0 INTRODUCTION	2
2.0 PROJECT INFORMATION	2
2.1 Project Location/Current Site Use.....	2
2.2 Proposed Construction.....	3
3.0 FIELD EXPLORATION AND LABORATORY TESTING	4
3.1 Subsurface Characterization	4
3.2 Groundwater Observations.....	4
3.3 Laboratory Testing	5
4.0 DESIGN RECOMMENDATIONS	5
4.1 Potential Vertical Movements	5
4.2 Subgrade Improvements.....	5
4.3 Foundations.....	6
4.4 Slab on Grade	7
4.5 Building Perimeter Conditions	8
4.6 Seismic Design Considerations.....	8
4.7 Pavements.....	9
4.8 Corrosion Potential	11
5.0 SITE CONSTRUCTION RECOMMENDATIONS	11
5.1 Subgrade Preparation	11
5.1.1 Stripping and Grubbing.....	11
5.1.2 Proofrolling	12
5.2 Earthwork Operations	12
5.2.1 Fill Placement.....	12
5.2.2 Earthwork Testing.....	13
5.3 Material Specifications.....	13
5.3.1 Select Fill	13
5.3.2 Moisture Conditioning.....	13
5.4 Foundation and Slab Observations	14
5.5 Utility Installations	14
6.0 CLOSING.....	15

APPENDICES

Appendix A – Drawings & Reports

- Site Location Diagram
- Boring Location Diagram
- Generalized Subsurface Soil Profile A-A'
- Clay Plug Detail at Trench

Appendix B – Field Operations

- Reference Notes for Boring Logs
- Subsurface Exploration Procedures: Standard Penetration Testing (SPT)
- Boring Logs B-01 to B-05

Appendix C – Laboratory Testing

- Laboratory Testing Summary

EXECUTIVE SUMMARY

This Executive Summary is intended as a very brief overview of the primary geotechnical conditions that are expected to affect design and construction. The following summarizes the main findings of the exploration, particularly those that may have a cost impact on the planned development. Further, our principal foundation recommendations are summarized. Information gleaned from the executive summary should not be utilized in lieu of reading the entire geotechnical report.

- The planned structure is understood to be an automotive services building and is assumed be no more than 7,500 square feet, single-story, entirely above grade, and consist of structural steel, masonry, and/or wood frame construction. Anticipated maximum structural loads are assumed to be column and wall loading of 60 kips and 4 kips/foot, respectively. We have also assumed the structure will have a finished floor elevation at or near the existing grade.
- The planned structure may be supported on a shallow foundation system consisting of spread footings with conventional slab on grade, provided the subgrade is improved and prepared as outlined in this report. A reinforced slab with grade beams (monolithic slab/BRAB) or post-tensioned slab on grade may also be used to support the structure on existing subgrade soils.
- Subgrade improvements of the moderately to highly plastic clay soils are necessary below the planned structure to reduce the potential for vertical movements. Specific details on addressing these highly plastic clay soils are presented in the body of the report.
- Due to the high soluble sulfate levels of the onsite soils, stabilization with calcium-based additives, such as lime, is not recommended for this site. Pavements should be supported directly on a layer of ODOT Type A Aggregate Base that is placed and compacted as outlined in this report.
- Sulfate test results indicate the soil sulfate exposure to be moderate. Type II Portland cement concrete should be used for this site.
- Pavements should be supported directly on stabilized subgrades or a layer of aggregate base upon subgrades that are evaluated and prepared as outlined in this report.
- It is recommended that ECS conduct a geotechnical review of the project plans (prior to issuance for construction) to check to see that ECS' geotechnical recommendations have been properly interpreted and implemented.
- To prevent misinterpretation of ECS recommendations, ECS should be retained to perform quality control testing and documentation during construction of the earthwork and foundations for the project.

1.0 INTRODUCTION

The purpose of this study was to provide geotechnical information for the design and construction of the foundations, floor slabs, and pavements for the planned Brakes Plus project located at 4900 N May Avenue in Oklahoma City, Oklahoma. The recommendations developed for this report are based on project information provided by the client.

Our services were provided in accordance with our Proposal No. 58:3320-GP, dated February 26, 2024, and authorized by the client by providing the signed contract that same date, which includes our Terms and Conditions of Service. The field exploration was unable to be performed until April 19, 2024 due to inaccessible site conditions from substantial rain events and site drainage features.

This report contains the procedures and results of our subsurface exploration and laboratory testing programs, review of existing site conditions, engineering analyses, and recommendations for the design and construction of the project.

The report includes the following items.

- A brief review and description of our field and laboratory test procedures and the results of testing conducted.
- A review of surface topographical features and site conditions.
- A review of area and site geologic conditions.
- A review of subsurface soil stratigraphy with pertinent available physical properties.
- A final copy of our soil test borings.
- Recommendations for site preparation and construction of compacted fills, including an evaluation of on-site soils for use as compacted fills.
- Recommended foundation types.
- General recommendations for pavement design.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION/CURRENT SITE USE

The project is located at 4900 N May Avenue in Oklahoma City, Oklahoma. The location is depicted in Figure 2.1.1 as shown below.



Figure 2.1.1. Site Location

ECS reviewed aerial photographs of the subject site dated 1990 to 2023. Since April 1990, the site consisted of a building structure along the east side of the property and its associated parking/drive areas. At some time between January 2022 and July 2022, it appears the building structure and its associated parking/drive areas were removed from the site. At some time between May 2023 and the time of our drilling operations, it appears the construction of two restaurant buildings have been constructed and/or are currently under construction directly north of the site. Since that time, the site has remained relatively unchanged.

Currently the site consists of an undeveloped, stripped and lightly grassed property used for stormwater detention. The topography of the site generally slopes down from west to east with maximum and minimum boring elevations of approximately EL 1213 feet and EL 1211 feet, respectively. The ground surface elevations noted in this report were obtained from the USGS National Map and have been rounded to the nearest foot.

2.2 PROPOSED CONSTRUCTION

The following information explains our understanding of the planned development including the proposed building and related infrastructure.

SUBJECT	DESIGN INFORMATION / ASSUMPTIONS
Building Footprint (assumed)	No more than 7,500 square feet in plan view
# of Stories (assumed)	Single-story above grade
Usage	Automotive services
Framing (assumed)	Structural steel, masonry, and/or wood frame
Column Loads (assumed)	60 kips (Full Dead and Live Load) maximum
Wall Loads (assumed)	4 kips per linear foot (klf) maximum

SUBJECT	DESIGN INFORMATION / ASSUMPTIONS
Lowest Finish Floor Elevation	Unknown, assumed no more than 2 feet below or above existing grades

We also understand that associated parking/drive areas will be constructed. *If ECS' understanding of the project is not correct, especially if the structural loads are different, please contact ECS so that we may review these changes and revise our recommendations, as appropriate.*

3.0 FIELD EXPLORATION AND LABORATORY TESTING

Our exploration procedures are explained in greater detail in Appendix B including the insert titled Subsurface Exploration Procedures. Our scope of work included drilling five (5) borings. The boring locations were selected by ECS based on information provided by the client and identified in the field by the drill crew using boring GPS coordinates generated by ECS. The approximate as-drilled boring locations are shown on the Boring Location Diagram in Appendix A.

3.1 SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered were generally consistent with published geological mapping. The following sections provide generalized characterizations of the soil strata encountered during our subsurface exploration. For specific subsurface information refer to the boring logs in Appendix B.

Approximate Depth of Bottom of Strata Below Grade	Elevation ⁽¹⁾ (ft)	Stratum	Material Description	Consistency / Density
9.5 to 10 feet	Elevation 1202 to 1201.5	I	(CL) LEAN CLAY and LEAN CLAY WITH SAND, various shades of red, brown, and gray	Firm to Very Hard
18.75 feet ⁽²⁾	Elevation 1193	II ⁽³⁾	(WR) WEATHERED SHALE, red	Very Hard

Notes:

- (1) Elevations are approximate.
- (2) Depth to deepest boring termination depth.
- (3) Stratum II was encountered in the building borings only.

Please refer to the attached boring logs and laboratory data summary for this field exploration for a more detailed description of the subsurface conditions encountered in the borings as the stratification descriptions above are generalized for presentation purposes.

3.2 GROUNDWATER OBSERVATIONS

Water levels were measured in our boring logs in Appendix B. Groundwater was not observed in the borings at the time of our exploration and is indicated on the boring logs as "dry".

Variations in the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, construction activities, and other factors.

3.3 LABORATORY TESTING

The laboratory testing consisted of selected tests performed on samples obtained during our field exploration operations. Classification and index property tests were performed on representative soil samples. Testing performed include moisture content, Atterberg Limits, percent passing the No. 200 sieve, and soluble sulfate.

Samples were visually classified based on texture and plasticity in accordance with ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures) and including USCS classification symbols, and ASTM D2487 Standard Practice for Classification for Engineering Purposes (Unified Soil Classification System (USCS)). After classification, the samples were grouped in the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses along with the soil descriptions. The stratification lines between strata on the logs are approximate; in situ, the transitions may be gradual.

4.0 DESIGN RECOMMENDATIONS

4.1 POTENTIAL VERTICAL MOVEMENTS

The intent of recommendations contained in this report are provided in order to reduce the potential risk associated with the shrink/swell tendencies of the on-site expansive soil, should a conventional shallow footing foundation and slab on grade be used.

The majority of clay soils encountered in the borings have a high expansion potential. Based on our Atterberg limits laboratory test results and experience with similar soils, we estimate potential vertical soil movements (PVM) of the highly expansive soils encountered in the borings of up to about 2 ½ inches, based on dry conditions. These potential movements reflect moisture changes in the soil that can occur over the life of the structure and after construction is complete. The actual movements could be greater if poor drainage, ponded water, and/or other unusual sources of moisture are allowed to saturate the soils beneath the structure after construction.

4.2 SUBGRADE IMPROVEMENTS

In order to reduce the risk associated with future movements, we recommend the following general building pad subgrade improvements to reduce the PVM to approximately 1 inch. Please note, these recommendations are the minimum requirements to reduce potential movements due to expansion potential. If a monolithic slab/BRAB or post-tensioned slab is used, subgrade improvements are not required.

Options	Depth of Select Fill (feet)	Depth of Moisture Conditioning (feet)	Total Depth of Improved Zone (feet)	Estimated PVM (inch)
Option 1	3	---	3	1
Option 2	2	2	4	1
Option 2	---	5	5	1

The subgrade improvements should extend at least 5 feet beyond the edge of the building pads and include any flatwork sensitive to movements such as sidewalks or pavements. Exterior perimeter footing/grade beam backfill should consist of moisture conditioned clay soil. Please refer to the “Material Specifications” section of this report for more details.

These design parameters assume that positive drainage will be provided away from the structures and with moderate irrigation of surrounding lawn and planter areas with no excessive wetting or drying of soils adjacent to the foundations. Greater potential movements could occur with extreme wetting or drying of the soils due to ponding of water, plumbing leaks or lack of irrigation. Recommendations for earthwork operations are found in the “Site Construction Recommendations” portion of this report.

4.3 FOUNDATIONS

Provided the subgrades are improved and structural fills are prepared as recommended in this report, the proposed structure can be supported by conventional shallow foundations including column footings and continuous wall footings. We recommend the foundation design use the following parameters:

Design Parameter	Column Footing	Wall Footing
Net Allowable Bearing Pressure ⁽¹⁾	3,000 psf	3,000 psf
Bearing Soil Material	Improved Subgrades	Improved Subgrades
Minimum Width	24 inches	24 inches
Minimum Footing/Grade Beam Embedment Depth (below slab or finished grade) ⁽²⁾	24 inches	24 inches
Estimated Total Settlement ⁽³⁾	Less than 1- inch	Less than 1- inch
Estimated Differential Settlement ⁽⁴⁾	Less than ¾ inches between columns	Less than ¾ inches per 30 linear feet

Notes:

- (1) Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.
- (2) For bearing considerations and frost penetration requirements.
- (3) Based on our assumed structural loads. If final loads are different, ECS must be contacted to update foundation recommendations and settlement calculations.
- (4) Based on maximum loads and variability in borings. Differential settlement can be re-evaluated once the foundation plans are more complete.

Monolithic Slab/BRAB: Should improving the subgrade in order to use conventional shallow foundations and slab on grade be cost prohibitive, foundations consisting of a reinforced slab with grade beams (monolithic slab/BRAB) under load bearing walls could also be used to support the proposed structures.

The reinforced slab may be designed using a soil modulus of subgrade reaction of 125 pci and the grade beams or spread footings may be design for a net allowable soil bearing pressure of 3,000 psf bearing on newly placed and compacted select fill or natural soils that were encountered in the borings.

If a monolithic slab is used this system may be designed with conventional reinforcing. The slab should be designed in accordance with WRI/CRSI "Design Slab-On-Ground Foundations". The structure can be supported on a monolithic/waffle slab and grade beam foundation system designed in accordance with the following information:

Design Parameter	BRAB/WRI Slab
Allowable Bearing Pressure	3,000 psf
Design PI	30
Climatic Rating (Cw)	20
Soil-Climate Support Index (1-C)	0.15

Post-Tensioned Slab: In lieu of a BRAB/WRI slab, a post-tensioned slab on grade could be used. The following design parameters are recommended for the Post-Tensioning Institute's slab-on-grade design method (3rd Edition) should that method be chosen:

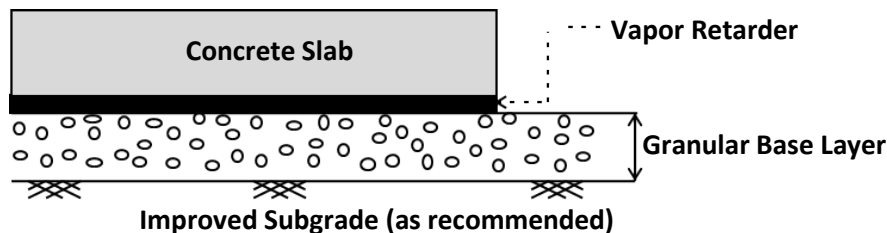
Center Lift		Edge Lift	
e_m (feet)	Y_m (inches)	e_m (feet)	Y_m (inches)
9.0	1.5	5.0	2.0

Potential Undercuts: DCP testing of the bearing soils by ECS representatives should be incorporated during construction to verify their suitability for supporting shallow foundations. If soft or inadequate soils are observed at the footing bearing elevations, these soils should be undercut and removed. Any undercut should be backfilled with lean concrete ($f'_c \geq 1,000$ psi at 28 days) up to the original design bottom of footing elevation; the original footing shall be constructed on top of the hardened lean concrete.

4.4 SLAB ON GRADE

A conventional slab on grade may be used provided it is supported on subgrades improved as presented in this report.

The following graphic depicts our soil-supported slab recommendations:



1. Concrete Slab Thickness: 4 inches minimum
2. Concrete Slab Strength: 3,000 psi minimum
3. Drainage Layer Thickness: 4 inches minimum
4. Drainage Layer Material: GRAVEL (GP, GW)
5. Subgrade compacted per the earthwork recommendations provided.

Subgrade Modulus: Provided subgrades are improved and prepared as discussed herein, the slab may be designed assuming a modulus of subgrade reaction, k_1 of 125 pci (lbs/cu. inch).

Vapor Retarder: Before the placement of concrete, a vapor retarder may be placed on top of the granular drainage layer to provide additional protection against moisture penetration through the floor slab. When a vapor retarder is used, special attention should be given to surface curing of the slab to reduce the potential for uneven drying, curling and/or cracking of the slab. Depending on proposed flooring material types, the structural engineer and/or the architect may choose to eliminate the vapor retarder.

Slab Isolation: Soil-supported slabs should be isolated from the foundations and foundation-supported elements of the structure so that differential movement between the foundations and slab will not induce excessive shear and bending stresses in the floor slab. Where the structural configuration prevents the use of a free-floating slab such as in a drop-down footing/monolithic slab configuration, the slab should be designed with suitable reinforcement and load transfer devices to reduce the risk of overstressing of the slab.

4.5 BUILDING PERIMETER CONDITIONS

Soils placed along the exterior of the foundations should consist of fine-grained soils encountered on site, placed and compacted in accordance with the "Fill Placement" section of this report. The purpose of this clay backfill is to reduce the opportunity for surface or subsurface water infiltration beneath the structure. Additionally, where lateral penetrations (for utilities) into or below the structure occur, a clay plug (or suitable synthetic alternative) should be placed at the building line to reduce the opportunity for infiltrating water, regardless of the backfill material. A clay plug detail is included in Appendix A.

Positive drainage away from the structure should also be provided. Additionally, irrigation of lawn and landscaped areas should be moderate, with no excessive wetting or drying of soils around the perimeter of the structures allowed. Trees and bushes/shrubs planted near the perimeter of the structures can withdraw large amounts of water from the soils and should be planted at least their anticipated mature height away from the building.

Where flatwork is placed against or near the structure, a positive seal must be installed and adequately maintained to limit water intrusion. Down spouts and gutters should be used to collect and distribute water at least 10 feet away from the structure.

Routine maintenance of the building perimeter condition is necessary so that the recommendations contained in this report are followed and maintained. Greater potential vertical movements could occur with extreme wetting or drying of the soils due to poor drainage, ponding of water, plumbing leaks, lack of irrigation, and/or lack of routine maintenance, etc.

4.6 SEISMIC DESIGN CONSIDERATIONS

Seismic Site Classification: The International Building Code (IBC) 2015/2018 requires site classification for seismic design based on the upper 100 feet of a soil profile. At least two methods are utilized in classifying sites, namely the shear wave velocity (v_s) method and the Standard Penetration Resistance (N-value) method. The Standard Penetration Resistance (N-value) method was used in classifying this site.

SEISMIC SITE CLASSIFICATION			
Site Class	Soil Profile Name	Shear Wave Velocity, V_s , (ft./s)	N value (bpf)
A	Hard Rock	$V_s > 5,000$ fps	N/A
B	Rock	$2,500 < V_s \leq 5,000$ fps	N/A
C	Very dense soil and soft rock	$1,200 < V_s \leq 2,500$ fps	> 50
D	Stiff Soil Profile	$600 \leq V_s \leq 1,200$ fps	15 to 60
E	Soft Soil Profile	$V_s < 600$ fps	< 15

Based upon our interpretation of the subsurface conditions, the appropriate Seismic Site Classification is "C" as shown in the preceding table.

Ground Motion Parameters: In addition to the seismic site classification, ECS has determined the design spectral response acceleration parameters following the IBC methodology. The Mapped Responses were estimated from the U.S. Seismic Design Maps website <https://seismicmaps.org/>. The design responses for the short (0.2 sec, S_{DS}) and 1-second period (S_{D1}) are noted in bold at the far right end of the following table.

GROUND MOTION PARAMETERS [IBC 2015/2018 Method]								
Period (sec)	Mapped Spectral Response Accelerations (g)		Values of Site Coefficient for Site Class		Maximum Spectral Response Acceleration Adjusted for Site Class (g)		Design Spectral Response Acceleration (g)	
Reference	Figures 1613.3.1 (1) & (2)		Tables 1613.3.3 (1) & (2)		Eqs. 16-37 & 16-38		Eqs. 16-39 & 16-40	
0.2	S_s	0.266	F_a	1.2	$S_{MS}=F_a S_s$	0.319	$S_{DS}=2/3 S_{MS}$	0.213
1.0	S_1	0.077	F_v	1.7	$S_{M1}=F_v S_1$	0.131	$S_{D1}=2/3 S_{M1}$	0.087

The Site Class definition should not be confused with the Seismic Design Category designation which the Structural Engineer typically assesses. If a higher site classification is beneficial to the project, we can provide additional testing methods that may yield more favorable results.

4.7 PAVEMENTS

Subgrade Characteristics: Based on the results of our borings, it appears that the pavement subgrades will consist of existing moderate to high plasticity soils. The subgrade should be prepared in accordance with the recommendations in the Site Construction Recommendations section of this report.

We were not provided traffic loading information so we have assumed heavy duty pavements will experience a maximum traffic loading of 300,000 ESALs.

The preliminary pavement sections below are guidelines that may or may not comply with local jurisdictional minimums.

PROPOSED PAVEMENT SECTIONS				
MATERIAL	FLEXIBLE PAVEMENT		RIGID PAVEMENT	
	Heavy Duty	Light Duty	Heavy Duty	Light Duty
Portland Cement Concrete ⁽¹⁾	-	-	6 in.	5 in.
Asphaltic Concrete Surface Course	2 in.	2 in.	-	-
Asphaltic Concrete Binder Course ⁽²⁾	4 ½ in.	3 in.	-	-
ODOT Type A Aggregate Base	8 in.	8 in.	8 in.	8 in.

Notes:

- (1) Due to the excessive surface wear and subsequent deterioration of asphalt pavement caused by turning truck traffic, we recommend that any areas where trucks will be turning or backing up be constructed of Portland cement concrete only.
- (2) ODOT Type A aggregate base material may be substituted for the asphalt binder using a substitute ratio of three inches of aggregate base for each inch of asphalt binder.

ECS should be allowed to review these recommendations and make appropriate revisions based upon the formulation of the final traffic design criteria for the project. It is important to note that the design sections do not account for construction traffic loading. It should also be noted that these design recommendations may not satisfy the local jurisdictional traffic guidelines. Any roadways constructed for public use and to be dedicated to the local or state jurisdiction for repair and maintenance must be designed in accordance with those jurisdictional requirements.

In general, heavy duty sections are areas that will be subjected to trucks, buses, or other similar vehicles including main drive lanes of the development. Light duty sections are appropriate for vehicular traffic and parking areas.

An important consideration with the design and construction of pavements is surface and subsurface drainage. Where standing water develops, either on the pavement surface or within the base course layer, softening of the subgrade and other problems related to the deterioration of the pavement and crushed aggregate surface can be expected. Furthermore, good drainage should reduce the possibility of the subgrade materials becoming saturated during the normal service period of the pavement.

Large, front loading trash dumpsters frequently impose concentrated front wheel loads on pavements during loading. This type of loading typically results in rutting of asphalt pavement and ultimately pavement failures. For preliminary design purposes, we recommend that the pavement in trash pickup areas consist of an 8 inch thick Portland Cement Concrete (PCC) pavement section. Appropriate jointing should also be incorporated into the design of the PCC pavement. When traffic loading becomes available ECS or the Civil Engineer can design the pavements.

Pavements should be specified, constructed and tested to meet the ODOT Standard Specifications for Highway Construction and the following requirements:

1. Reinforcing steel may consist of #3 reinforcing steel bars placed at 18 inches on center each way.
2. Hot Mix Asphaltic Concrete: In accordance with Oklahoma Department of Transportation (ODOT) Standard Specifications.

3. Portland Cement Concrete: Minimum compressive strength of 3,500 psi (28 Days). Concrete should be designed with 3 to 6 percent entrained air.
4. Crushed Limestone Base Material: ODOT Type A Aggregate Base. The material should be compacted to a minimum 95 percent of Standard Proctor maximum dry density (ASTM D 698) and within three percentage points of the material's optimum moisture.

4.8 CORROSION POTENTIAL

Total soluble sulfate testing was performed on one composite sample to provide an estimation of the materials' corrosion potential. The test results are presented in the following table:

Sample	Location / Depth	Soluble Sulfate (mg/KG)
Composite 1	B-01, B-02, B-04 0 to 5 ft.	1320

Sulfate test results indicate the soil sulfate exposure to concrete to be moderate. Type II Portland cement concrete should be used for this site. Cathodic protection or a polyethylene coating or wrap should be used to protect ferrous metal pipes and the manufacturer's corrosion specifications should be followed. These test results should be used to determine the corrosion potential of on-site soils when in contact with various underground materials to be used in construction.

5.0 SITE CONSTRUCTION RECOMMENDATIONS

5.1 SUBGRADE PREPARATION

In a dry and undisturbed state, the upper 1-foot of the majority of the soil at the site should provide good subgrade support for fill placement and construction operations. However, when wet, this soil will degrade quickly with disturbance from contractor operations. Therefore, good site drainage should be maintained during earthwork operations, which should help maintain the integrity of the soil.

The surface of the site should be kept properly graded in order to enhance drainage of the surface water away from the proposed structures during the construction phase. We recommend that an attempt be made to enhance the natural drainage without interrupting its pattern, where possible.

The soils at the site are moisture and disturbance sensitive, and contain fines which are considered moderately erodible. Therefore, the contractor should carefully plan his operation to limit exposure of the subgrade to weather and construction equipment traffic, and provide and maintain good site drainage during earthwork operations. All erosion and sedimentation shall be controlled in accordance with sound engineering practice and current jurisdictional requirements.

5.1.1 Stripping and Grubbing

The subgrade preparation should consist of stripping all vegetation, topsoil, existing gravels/pavements, loose, poorly compacted or deleterious existing soils, existing fill (as defined in this report), and any soft or yielding materials from the 5-foot expanded building area, and any

areas receiving new fill. Deeper topsoil or organic laden soils may be present in wet, low-lying, and poorly drained areas. ECS should be retained to verify that topsoil and yielding surficial materials have been removed prior to the placement of structural fill or construction of structures.

5.1.2 Proofrolling

Prior to fill placement or other construction on subgrades, the subgrades should be evaluated by an ECS field technician. The exposed subgrade should be comprehensively proofrolled with construction equipment having a minimum axle load of 10 tons [e.g. fully loaded tandem-axle dump truck]. Proofrolling should be traversed in two perpendicular directions with overlapping passes of the vehicle under the observation of an ECS technician. This procedure is intended to assist in identifying any localized yielding materials.

Where proofrolling identifies areas that are yielding or “pumping” subgrade those areas should be repaired prior to the placement of any subsequent Structural Fill or other construction materials. Methods of stabilization include undercutting, moisture conditioning, or chemical stabilization. The situation should be discussed with ECS to determine the appropriate procedure. Test pits may be excavated to explore the shallow subsurface materials to help in determining the cause of the observed yielding materials, and to assist in the evaluation of appropriate remedial actions to repair the subgrade.

5.2 EARTHWORK OPERATIONS

The following sections describe requirements for fill placement and earthwork testing.

5.2.1 Fill Placement

Prior to placement of any new fill or other construction material, subgrades should be scarified to a minimum depth of 8 inches, moisture conditioned to a workable moisture content at or above the optimum value and compacted to at least 95% of Maximum Dry Density as obtained by the Standard Proctor Method (ASTM D-698).

Fill material in the building pad areas should consist of select fill or meet the requirements of the chosen subgrade improvement option. Details regarding select fill and the subgrade improvement options are presented in the “Materials Specifications” section of this report. Fill material outside the building pad area, which includes pavement areas, should consist of materials similar to or less plastic than those encountered in our borings. Fill material should be moisture conditioned at or above the optimum moisture content and compacted to at least 95% of the Maximum Dry Density as obtained by the Standard Proctor Method (ASTM D-698).

Soil moisture levels should be preserved (by various methods that can include covering with plastic, watering, etc.) until new fill, pavements, or slabs are placed. Fill soils should be placed in maximum 8 inch loose lifts for mass grading operations and maximum 4 inches for trench type excavations where walk behind or “jumping jack” compaction equipment is used.

Upon completion of the filling operations, care should be taken to maintain the soil moisture content prior to construction of floor slabs and/or pavements. If the soil becomes desiccated, the affected material should be removed and replaced, or these materials should be scarified, moisture conditioned and recompacted.

5.2.2 Earthwork Testing

Field density and moisture tests should be performed by ECS on each lift as necessary to verify that adequate compaction is achieved. One test per 2,500 square feet per lift is recommended in the future building and pavement areas (two tests minimum per lift). Utility trench backfill should be tested at a rate of one test per lift per each 150 linear feet of trench (two tests minimum per lift). Certain jurisdictional requirements may require testing in addition to that noted previously. Therefore, these recommendations should be reviewed and the more stringent specifications should be followed.

5.3 MATERIAL SPECIFICATIONS

The recommendations provided in the "Subgrade Improvements" portion of this report outline the subgrade improvement options required in order to achieve the desired PVM. This section is intended to outline the material requirements of those recommendations.

5.3.1 Select Fill

For the purposes of this report, select fill may consist of imported material that is free of debris and organic matter, has a Plasticity Index (PI) less than 15, greater than 50% passing the No. 200 sieve, and a maximum particle size of 2 inches. The PI and gradation of this material should be evaluated by ECS at the time of construction. This material should be placed and compacted at workable moisture contents at or above the optimum moisture content and compacted to at least 95% of the Maximum Dry Density as obtained using the Standard Proctor Method (ASTM D-698).

5.3.2 Moisture Conditioning

Within the planned pads and flatwork sensitive to movements, moisture conditioning should be performed as outlined in this report. Reworking of the existing clays, and new clayey fill, is performed to increase the moisture of the clays to a level that reduces their ability to absorb additional water that could result in post-construction heave in these soils.

The moisture conditioning should consist of undercutting, scarifying and/or reworking, as required to achieve the required subgrade improvement. During this process, the clay should receive adequate amounts of water to attain an even moisture content of at least +2% or higher above the optimum moisture content. During the addition of water, the soils should be adequately mixed, and re-mixed, to achieve an even distribution of the moisture throughout the soil mass. Once appropriately mixed, the material should be compacted to at least 95% of the Maximum Dry Density as obtained using the Standard Proctor Method (ASTM D-698).

Outside of the moisture conditioned zone and where clay is used to establish site grades, we recommend that this material be placed and compacted to at least 95% of the Maximum Dry Density as obtained using the Standard Proctor Method (ASTM D-698). These soils should be free of deleterious materials, and be reworked to achieve an even distribution of water in order to achieve a moisture content of $\pm 2\%$ of the material optimum moisture content.

Care should be taken to verify and preserve the specified moisture levels in the reworked clays prior to placement of non-expansive fill.

5.4 FOUNDATION AND SLAB OBSERVATIONS

Protection of Foundation Excavations: Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are made. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, a 1 to 3-inch thick “mud mat” of “lean” concrete should be placed on the bearing soils before the placement of reinforcing steel.

Footing Subgrade Observations: Provided the subgrades are improved as recommended, most of the soils at the foundation bearing elevation are anticipated to be suitable for support of the proposed structure. It is important to have ECS observe the foundation subgrade prior to placing foundation concrete, to confirm the bearing soils are what was anticipated.

Slab Subgrade Verification: Prior to placement of a granular base/drainage layer, the subgrade should be improved/prepared in accordance with recommendations provided in this report.

5.5 UTILITY INSTALLATIONS

Utility Subgrades: The soils encountered in our exploration are expected to be generally suitable for support of utility pipes. The pipe subgrades should be observed and probed for stability by ECS. Utility cuts should not be left open for more than 24 hours or during times when precipitation is anticipated and should be properly backfilled. Any loose or unsuitable materials encountered should be removed and replaced with suitable compacted fill, or pipe stone bedding material.

Utility Backfilling: Backfilling should be accomplished with properly compacted on-site soils, rather than granular materials. If granular materials are used, a utility trench cut-off at the building line is recommended to help prevent water from migrating through the utility trench backfill to beneath the proposed structure. If used, the granular bedding material (often AASHTO #57 stone) should be at least 4 inches thick, but not less than that specified by the civil engineer’s project drawings and specifications. We recommend that the bedding materials be placed up to the springline of the pipe. Fill placed for support of the utilities, as well as backfill over the utilities, should satisfy the requirements for fill placement provided in this report.

Excavation Safety: All excavations and slopes should be constructed and maintained in accordance with OSHA excavation safety standards. The contractor is solely responsible for designing, constructing, and maintaining stable temporary excavations and slopes. The contractor’s responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor’s safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. ECS is providing this information solely as a service to our client. ECS is not assuming responsibility for construction site safety or the contractor’s activities; such responsibility is not being implied and should not be inferred.

6.0 CLOSING

ECS has prepared this report of findings, evaluations, and recommendations to guide geotechnical-related design and construction aspects of the project. In fulfilling our obligations and responsibilities, as listed in the proposal, we performed these services in accordance with the standard of care expected of professionals in the industry performing similar services on projects of like size and complexity at this time in the region. No other representation, expressed or implied, and no warranty or guarantee is included or intended in this report. ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

The description of the proposed project is based on information provided to ECS by the project design team. If any of this information is inaccurate, either due to our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted so that we can review the report in light of the changes and provide additional or alternate recommendations as may be required.

We recommend that ECS review the project's plans and specifications so that we may evaluate those plans/specifications with the intent of the geotechnical report.

Field observations, monitoring, and quality assurance testing during earthwork and foundation installation are an extension of and integral to the geotechnical design recommendations. We recommend that the Owner retain ECS throughout construction.

ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

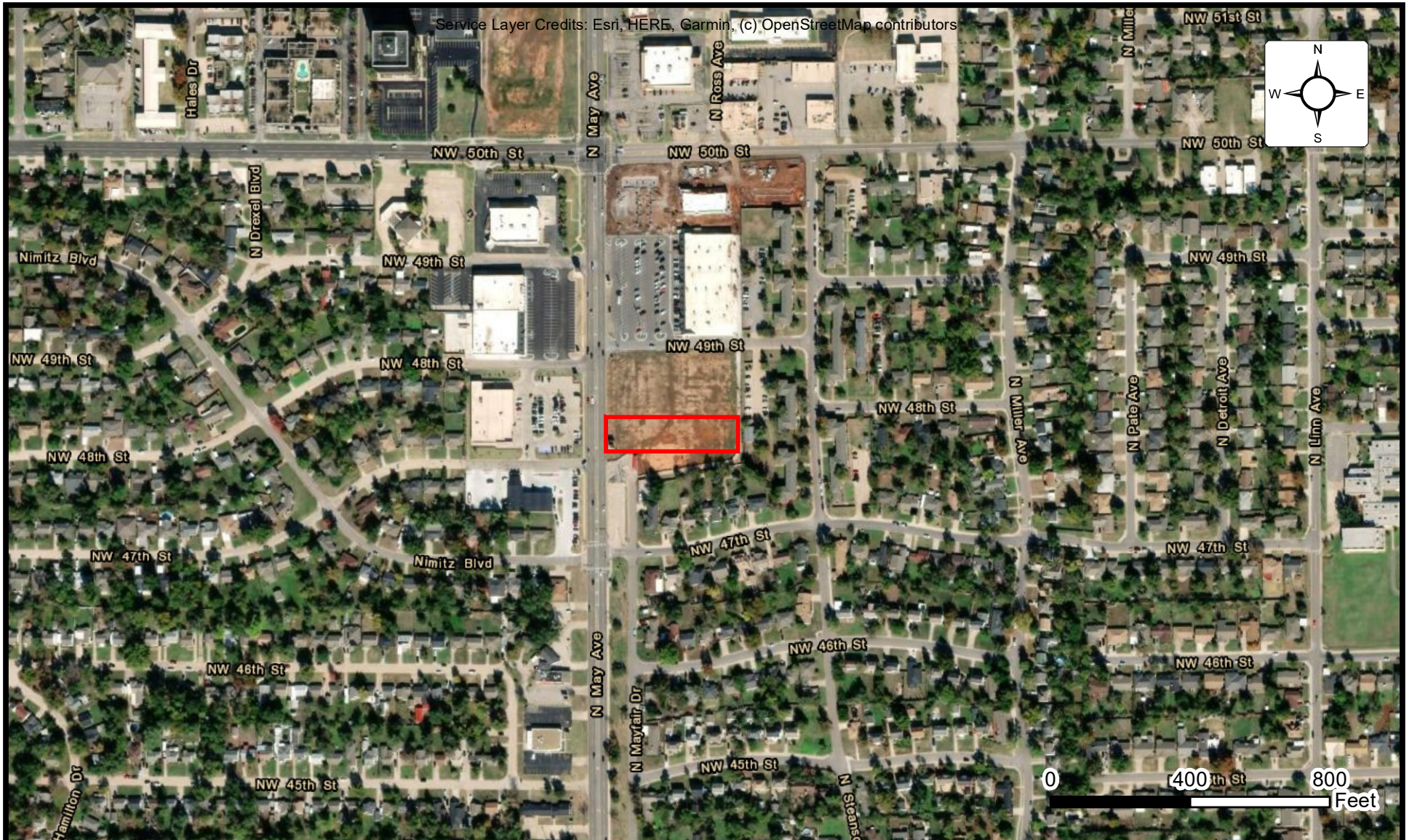
APPENDIX A – Drawings & Reports

Site Location Diagram

Boring Location Diagram

Generalized Subsurface Soil Profile A-A'

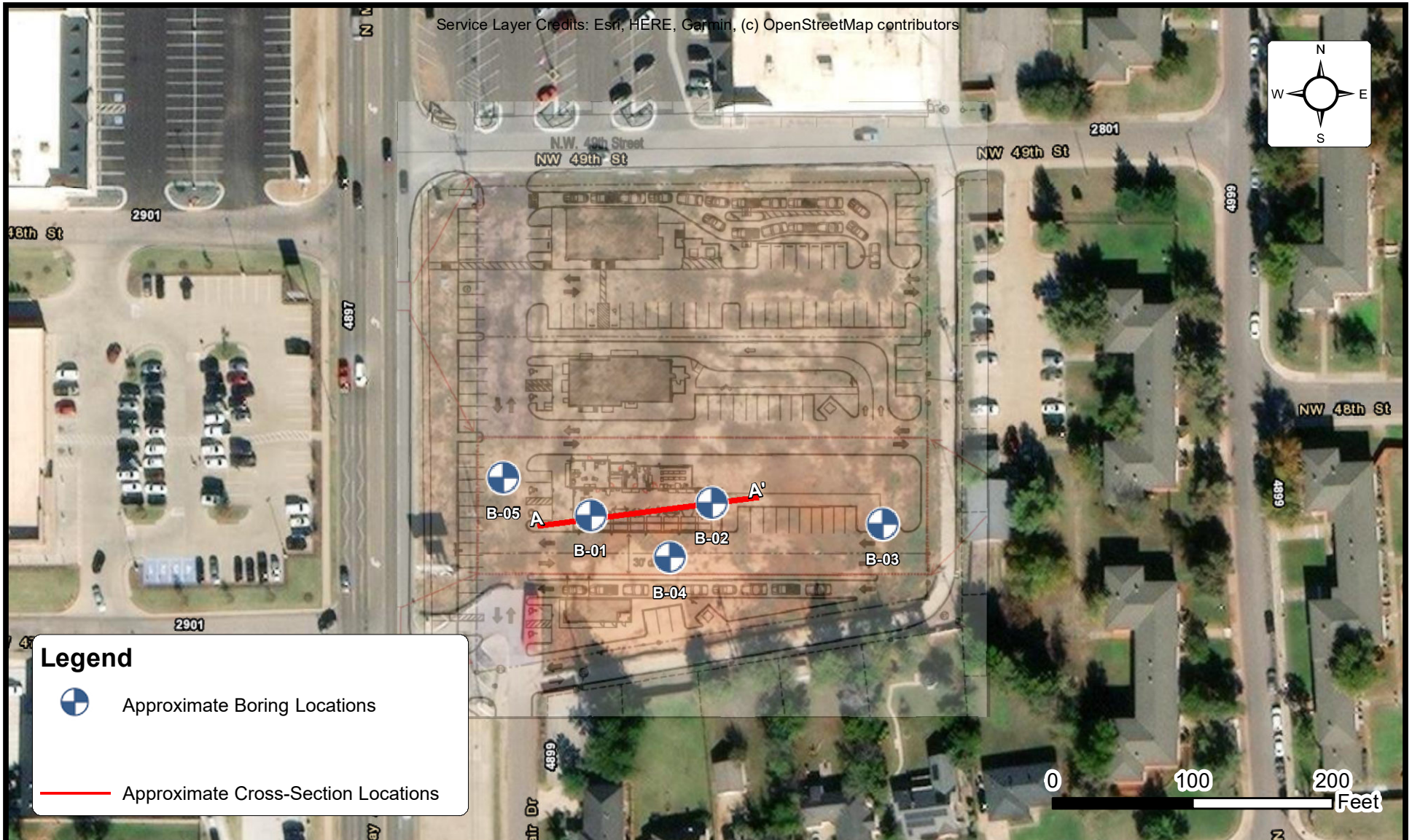
Clay Plug Detail at Trench



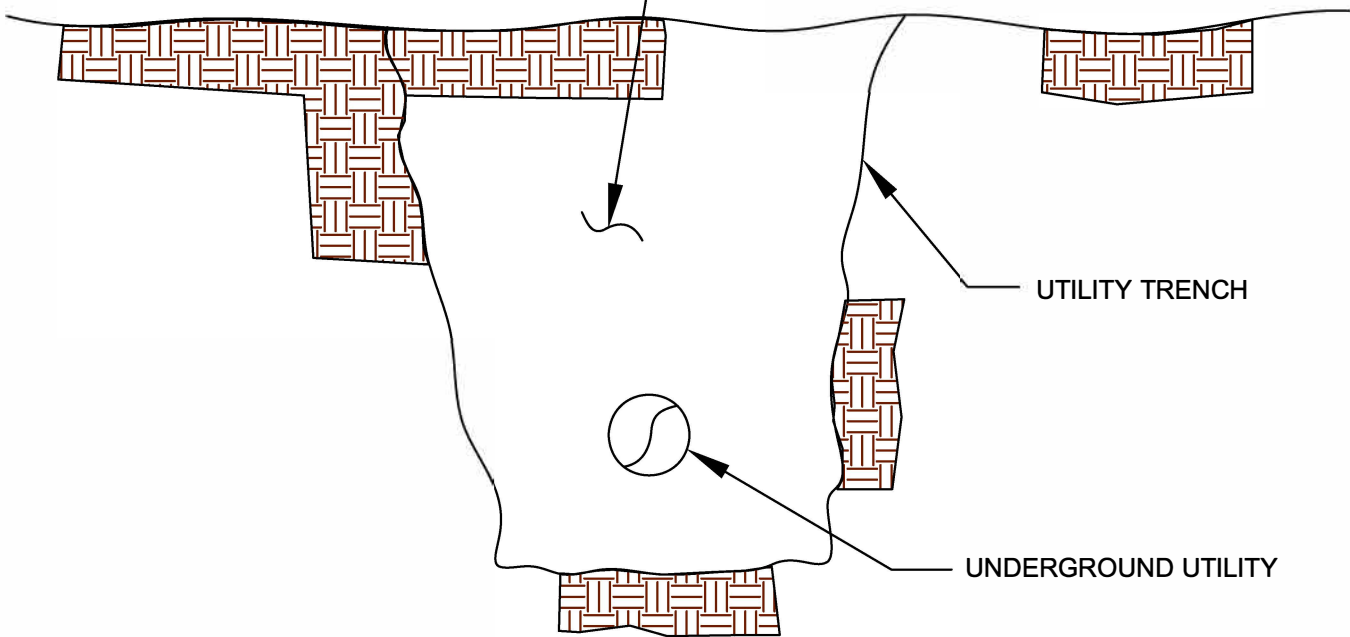
SITE LOCATION DIAGRAM BRAKES PLUS – NW 49TH & MAY

4900 N. MAY AVE, OKLAHOMA CITY, OKLAHOMA
BRAKES PLUS, LLC.

ENGINEER AW
SCALE AS NOTED
PROJECT NO. 58:1830
FIGURE 1 OF 1
DATE 5/8/2024



REFER TO MEP AND/OR CIVIL
DRAWINGS FOR TYPICAL BEDDING
MATERIALS AT EXTERIOR FACE OF
BUILDING. REPLACE BEDDING
MATERIALS WITH SITE CLAY SOIL.
EXTEND CLAY 2 FEET FROM BUILDING.
PLACE IN 8" MAX. LOOSE LIFTS.
COMPACT TO 92% OF STANDARD
PROCTOR (ASTM D-698), ABOVE
OPTIMUM MOISTURE CONTENT.



**TYPICAL DETAIL
DIAGRAM**



**CLAY PLUG AT
UTILITY TRENCH**

ENGINEER	SCALE
	NTS
DRAFTSMAN CLL	PROJECT NO.
REVISIONS	SHEET
	1 OF 1
	DATE
	11/7/08

APPENDIX B – Field Operations

Reference Notes for Boring Logs

Subsurface Exploration Procedure: Standard Penetration Testing (SPT)

Boring Logs B-01 to B-05



REFERENCE NOTES FOR BORING LOGS

MATERIAL^{1,2}

	ASPHALT
	CONCRETE
	GRAVEL
	TOPSOIL
	VOID
	BRICK
	AGGREGATE BASE COURSE
	GW WELL-GRADED GRAVEL gravel-sand mixtures, little or no fines
	GP POORLY-GRADED GRAVEL gravel-sand mixtures, little or no fines
	GM SILTY GRAVEL gravel-sand-silt mixtures
	GC CLAYEY GRAVEL gravel-sand-clay mixtures
	SW WELL-GRADED SAND gravelly sand, little or no fines
	SP POORLY-GRADED SAND gravelly sand, little or no fines
	SM SILTY SAND sand-silt mixtures
	SC CLAYEY SAND sand-clay mixtures
	ML SILT non-plastic to medium plasticity
	MH ELASTIC SILT high plasticity
	CL LEAN CLAY low to medium plasticity
	CH FAT CLAY high plasticity
	OL ORGANIC SILT or CLAY non-plastic to low plasticity
	OH ORGANIC SILT or CLAY high plasticity
	PT PEAT highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION	PARTICLE SIZES
Boulders	12 inches (300 mm) or larger
Cobbles	3 inches to 12 inches (75 mm to 300 mm)
Gravel: Coarse	¾ inch to 3 inches (19 mm to 75 mm)
Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand: Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")	<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS

UNCONFINED COMPRESSIVE STRENGTH, QP ⁴	SPT ⁵ (BPF)	CONSISTENCY ⁷ (COHESIVE)
<0.25	<2	Very Soft
0.25 - <0.50	2 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

RELATIVE AMOUNT ⁷	COARSE GRAINED (%) ⁸	FINE GRAINED (%) ⁸
Trace	≤5	≤5
With	10 - 20	10 - 25
Adjective (ex: "Silty")	25 - 45	30 - 45

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT ⁵	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

WATER LEVELS⁶

	WL (First Encountered)
	WL (Completion)
	WL (Seasonal High Water)
	WL (Stabilized)

FILL AND ROCK

FILL	POSSIBLE FILL	PROBABLE FILL	ROCK

¹Classifications and symbols per ASTM D 2488-17 (Visual-Manual Procedure) unless noted otherwise.

²To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

³Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].

⁴Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

⁵Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf). SPT correlations per 7.4.2 Method B and need to be corrected if using an auto hammer.

⁶The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

⁷Minor deviation from ASTM D 2488-17 Note 14.

⁸Percentages are estimated to the nearest 5% per ASTM D 2488-17.



SUBSURFACE EXPLORATION PROCEDURE: STANDARD PENETRATION TESTING (SPT) ASTM D 1586 Split-Barrel Sampling














Standard Penetration Testing, or **SPT**, is the most frequently used subsurface exploration test performed worldwide. This test provides samples for identification purposes, as well as a measure of penetration resistance, or N-value. The N-Value, or blow counts, when corrected and correlated, can approximate engineering properties of soils used for geotechnical design and engineering purposes.





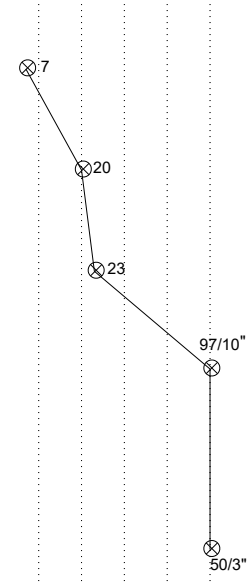


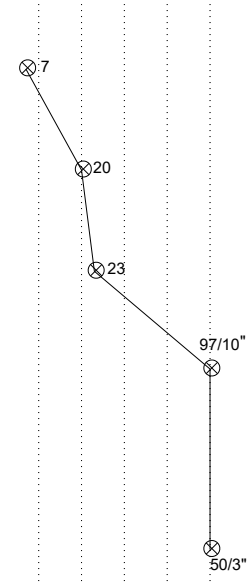


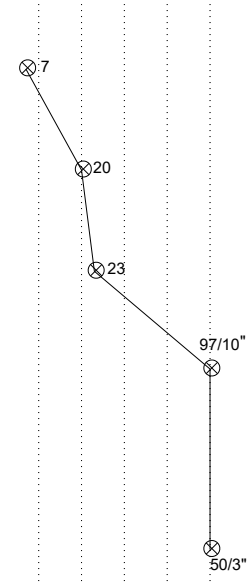





SPT Procedure:




- Involves driving a hollow tube (split-spoon) into the ground by dropping a 140-lb hammer a height of 30-inches at desired depth
- Recording the number of hammer blows required to drive split-spoon a distance of 18-24 inches (in 3 or 4 Increments of 6 inches each)
- Auger is advanced* and an additional SPT is performed
- One SPT typically performed for every two to five feet. An approximate 1.5 inch diameter soil sample is recovered.






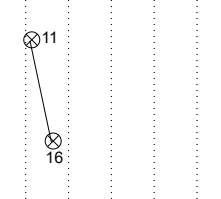
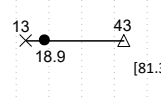
**Drilling Methods May Vary—* The predominant drilling methods used for SPT are open hole fluid rotary drilling and hollow-stem auger drilling.

CLIENT: Brakes Plus, LLC.				PROJECT NO.: 58:1830		BORING NO.: B-01		SHEET: 1 of 1																																																																																																																																																																
PROJECT NAME: Brakes Plus				DRILLER/CONTRACTOR: Drilling Services of Oklahoma																																																																																																																																																																				
SITE LOCATION: 4900 N. May Ave, Oklahoma City, Oklahoma, 73112								LOSS OF CIRCULATION 																																																																																																																																																																
LATITUDE: 35.519853		LONGITUDE: -97.565161		STATION:		SURFACE ELEVATION: 1212.0		BOTTOM OF CASING 																																																																																																																																																																
<table><thead><tr><th rowspan="2">DEPTH (FT)</th><th rowspan="2">SAMPLE NUMBER</th><th rowspan="2">SAMPLE TYPE</th><th rowspan="2">SAMPLE DIST. (IN)</th><th rowspan="2">RECOVERY (IN)</th><th rowspan="2">DESCRIPTION OF MATERIAL</th><th rowspan="2">WATER LEVELS</th><th rowspan="2">ELEVATION (FT)</th><th rowspan="2">BLOWS/6" (N - Value) *</th><th colspan="2">STANDARD PENETRATION BLOWS/FT</th><th colspan="2">ROCK QUALITY DESIGNATION & RECOVERY</th><th colspan="2">LIQUID LIMIT X PLASTIC LIMIT</th></tr><tr><th>10</th><th>20</th><th>30</th><th>40</th><th>50</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr></thead><tbody><tr><td rowspan="4">5</td><td>S-1</td><td>SS</td><td>18</td><td>18</td><td rowspan="4">(CL) LEAN CLAY WITH SAND, brown to reddish brown to red, moist, stiff to hard to very hard</td><td rowspan="4"></td><td rowspan="4">1207</td><td>3-4-5 (9)</td><td>9</td><td></td><td></td><td></td><td></td><td>14</td><td>43</td></tr><tr><td>S-2</td><td>SS</td><td>18</td><td>17</td><td>4-6-8 (14)</td><td>14</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>S-3</td><td>SS</td><td>18</td><td>18</td><td>13-15-18 (33)</td><td>33</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>S-4</td><td>SS</td><td>18</td><td>18</td><td>22-45-49 (94)</td><td>94</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td rowspan="2">15</td><td>S-5</td><td>SS</td><td>2</td><td>2</td><td rowspan="2">(WR) WEATHERED SHALE, red, very hard</td><td rowspan="2"></td><td rowspan="2">1197</td><td>50/2" (50/2")</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>S-6</td><td>SS</td><td>3</td><td>2</td><td>50/3" (50/3")</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>20</td><td colspan="5">END OF BORING AT 18.75 FT</td><td></td><td>1192</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>25</td><td colspan="5"></td><td></td><td>1187</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>30</td><td colspan="5"></td><td></td><td>1182</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></tbody></table>												DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (N - Value) *	STANDARD PENETRATION BLOWS/FT		ROCK QUALITY DESIGNATION & RECOVERY		LIQUID LIMIT X PLASTIC LIMIT		10	20	30	40	50	1	2	3	4	5	5	S-1	SS	18	18	(CL) LEAN CLAY WITH SAND, brown to reddish brown to red, moist, stiff to hard to very hard		1207	3-4-5 (9)	9					14	43	S-2	SS	18	17	4-6-8 (14)	14								S-3	SS	18	18	13-15-18 (33)	33								S-4	SS	18	18	22-45-49 (94)	94								15	S-5	SS	2	2	(WR) WEATHERED SHALE, red, very hard		1197	50/2" (50/2")								S-6	SS	3	2	50/3" (50/3")									20	END OF BORING AT 18.75 FT						1192									25							1187									30							1182								
DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (N - Value) *	STANDARD PENETRATION BLOWS/FT		ROCK QUALITY DESIGNATION & RECOVERY										LIQUID LIMIT X PLASTIC LIMIT																																																																																																																																																			
									10	20	30	40	50	1	2	3	4	5																																																																																																																																																						
5	S-1	SS	18	18	(CL) LEAN CLAY WITH SAND, brown to reddish brown to red, moist, stiff to hard to very hard		1207	3-4-5 (9)	9					14	43																																																																																																																																																									
	S-2	SS	18	17				4-6-8 (14)	14																																																																																																																																																															
	S-3	SS	18	18				13-15-18 (33)	33																																																																																																																																																															
	S-4	SS	18	18				22-45-49 (94)	94																																																																																																																																																															
15	S-5	SS	2	2	(WR) WEATHERED SHALE, red, very hard		1197	50/2" (50/2")																																																																																																																																																																
	S-6	SS	3	2				50/3" (50/3")																																																																																																																																																																
20	END OF BORING AT 18.75 FT						1192																																																																																																																																																																	
25							1187																																																																																																																																																																	
30							1182																																																																																																																																																																	
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL																																																																																																																																																																								
 WL (First Encountered)				Dry		BORING STARTED: Apr 19 2024		CAVE IN DEPTH:																																																																																																																																																																
 WL (Completion)						BORING COMPLETED: Apr 19 2024		HAMMER TYPE: Auto																																																																																																																																																																
 WL (Seasonal High Water)						EQUIPMENT: CME 750		LOGGED BY: EJP		DRILLING METHOD: Solid Stem Auger																																																																																																																																																														
 WL (Stabilized)																																																																																																																																																																								
GEOTECHNICAL BOREHOLE LOG																																																																																																																																																																								

CLIENT: Brakes Plus, LLC.				PROJECT NO.: 58:1830		BORING NO.: B-02		SHEET: 1 of 1																																																																																																																									
PROJECT NAME: Brakes Plus				DRILLER/CONTRACTOR: Drilling Services of Oklahoma																																																																																																																													
SITE LOCATION: 4900 N. May Ave, Oklahoma City, Oklahoma, 73112								LOSS OF CIRCULATION																																																																																																																									
LATITUDE: 35.519882		LONGITUDE: -97.564873		STATION:		SURFACE ELEVATION: 1211.0		BOTTOM OF CASING																																																																																																																									
<table><thead><tr><th rowspan="2">DEPTH (FT)</th><th rowspan="2">SAMPLE NUMBER</th><th rowspan="2">SAMPLE TYPE</th><th rowspan="2">SAMPLE DIST. (IN)</th><th rowspan="2">RECOVERY (IN)</th><th rowspan="2">DESCRIPTION OF MATERIAL</th><th rowspan="2">WATER LEVELS</th><th rowspan="2">ELEVATION (FT)</th><th rowspan="2">BLOWS/6" (N - Value) *</th><th colspan="2">STANDARD PENETRATION BLOWS/FT</th><th colspan="2">LIQUID LIMIT PLASTIC LIMIT</th></tr><tr><th>10</th><th>20</th><th>30</th><th>40</th><th>50</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr></thead><tbody><tr><td rowspan="4">5</td><td>S-1</td><td>SS</td><td>18</td><td>18</td><td rowspan="4">(CL) LEAN CLAY WITH SAND, dark brown to brown to red, moist, firm to very stiff</td><td rowspan="4"></td><td rowspan="4">1206</td><td>2-3-4 (7)</td><td>7</td><td rowspan="4"></td><td rowspan="4">16.6</td></tr><tr><td>S-2</td><td>SS</td><td>18</td><td>18</td><td>7-9-11 (20)</td><td>20</td><td>17</td><td>40</td><td>[77.2%]</td></tr><tr><td>S-3</td><td>SS</td><td>18</td><td>18</td><td>5-7-16 (23)</td><td>23</td><td>19.3</td></tr><tr><td>S-4</td><td>SS</td><td>16</td><td>15</td><td>16-47-50/4" (97/10")</td><td>97/10"</td><td>13.8</td></tr><tr><td>10</td><td></td><td></td><td></td><td></td><td>(WR) WEATHERED SHALE, red, very hard</td><td></td><td>1201</td><td></td><td></td><td></td><td></td></tr><tr><td>15</td><td>S-5</td><td>SS</td><td>3</td><td>2</td><td>END OF BORING AT 13.75 FT</td><td></td><td>1196</td><td>50/3" (50/3")</td><td>50/3"</td><td></td><td></td></tr><tr><td>20</td><td></td><td></td><td></td><td></td><td></td><td></td><td>1191</td><td></td><td></td><td></td><td></td></tr><tr><td>25</td><td></td><td></td><td></td><td></td><td></td><td></td><td>1186</td><td></td><td></td><td></td><td></td></tr><tr><td>30</td><td></td><td></td><td></td><td></td><td></td><td></td><td>1181</td><td></td><td></td><td></td><td></td></tr></tbody></table>												DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (N - Value) *	STANDARD PENETRATION BLOWS/FT		LIQUID LIMIT PLASTIC LIMIT		10	20	30	40	50	1	2	3	4	5	5	S-1	SS	18	18	(CL) LEAN CLAY WITH SAND, dark brown to brown to red, moist, firm to very stiff		1206	2-3-4 (7)	7		16.6	S-2	SS	18	18	7-9-11 (20)	20	17	40	[77.2%]	S-3	SS	18	18	5-7-16 (23)	23	19.3	S-4	SS	16	15	16-47-50/4" (97/10")	97/10"	13.8	10					(WR) WEATHERED SHALE, red, very hard		1201					15	S-5	SS	3	2	END OF BORING AT 13.75 FT		1196	50/3" (50/3")	50/3"			20							1191					25							1186					30							1181				
DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (N - Value) *	STANDARD PENETRATION BLOWS/FT		LIQUID LIMIT PLASTIC LIMIT																																																																																																																						
									10	20	30	40	50	1	2	3	4	5																																																																																																															
5	S-1	SS	18	18	(CL) LEAN CLAY WITH SAND, dark brown to brown to red, moist, firm to very stiff		1206	2-3-4 (7)	7		16.6																																																																																																																						
	S-2	SS	18	18				7-9-11 (20)	20			17	40	[77.2%]																																																																																																																			
	S-3	SS	18	18				5-7-16 (23)	23			19.3																																																																																																																					
	S-4	SS	16	15				16-47-50/4" (97/10")	97/10"			13.8																																																																																																																					
10					(WR) WEATHERED SHALE, red, very hard		1201																																																																																																																										
15	S-5	SS	3	2	END OF BORING AT 13.75 FT		1196	50/3" (50/3")	50/3"																																																																																																																								
20							1191																																																																																																																										
25							1186																																																																																																																										
30							1181																																																																																																																										
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL																																																																																																																																	
 WL (First Encountered)				Dry		BORING STARTED: Apr 19 2024		CAVE IN DEPTH:																																																																																																																									
 WL (Completion)						BORING COMPLETED: Apr 19 2024		HAMMER TYPE: Auto																																																																																																																									
 WL (Seasonal High Water)						EQUIPMENT: CME 750		LOGGED BY: EJP		DRILLING METHOD: Solid Stem Auger																																																																																																																							
 WL (Stabilized)																																																																																																																																	
GEOTECHNICAL BOREHOLE LOG																																																																																																																																	

CLIENT: Brakes Plus, LLC.				PROJECT NO.: 58:1830		BORING NO.: B-03		SHEET: 1 of 1						
PROJECT NAME: Brakes Plus				DRILLER/CONTRACTOR: Drilling Services of Oklahoma										
SITE LOCATION: 4900 N. May Ave, Oklahoma City, Oklahoma, 73112								LOSS OF CIRCULATION 						
LATITUDE: 35.519837		LONGITUDE: -97.564468		STATION:		SURFACE ELEVATION: 1211.0		BOTTOM OF CASING 						
DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (N - Value) *	STANDARD PENETRATION BLOWS/FT		LIQUID LIMIT X PLASTIC LIMIT			
									ROCK QUALITY DESIGNATION & RECOVERY		CALIBRATED PENETROMETER TSF			
									10 20 30 40 50		1 2 3 4 5			
									20 40 60 80 100		WATER CONTENT % [FINES CONTENT] %			
									RQD		10 20 30 40 50			
									REC		15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330 345 360 375 390 405 420 435 450 465 480 495 510 525 540 555 570 585 600 615 630 645 660 675 690 705 720 735 750 765 780 795 810 825 840 855 870 885 900 915 930 945 960 975 990 1000 1015 1030 1045 1060 1075 1090 1105 1120 1135 1150 1165 1180 1195 1210 1225 1240 1255 1270 1285 1300 1315 1330 1345 1360 1375 1390 1405 1420 1435 1450 1465 1480 1495 1510 1525 1540 1555 1570 1585 1600 1615 1630 1645 1660 1675 1690 1705 1720 1735 1750 1765 1780 1795 1810 1825 1840 1855 1870 1885 1900 1915 1930 1945 1960 1975 1990 2005 2020 2035 2050 2065 2080 2095 2110 2125 2140 2155 2170 2185 2200 2215 2230 2245 2260 2275 2290 2305 2320 2335 2350 2365 2380 2395 2410 2425 2440 2455 2470 2485 2500 2515 2530 2545 2560 2575 2590 2605 2620 2635 2650 2665 2680 2695 2710 2725 2740 2755 2770 2785 2800 2815 2830 2845 2860 2875 2890 2905 2920 2935 2950 2965 2980 2995 3010 3025 3040 3055 3070 3085 3100 3115 3130 3145 3160 3175 3190 3205 3220 3235 3250 3265 3280 3295 3310 3325 3340 3355 3370 3385 3400 3415 3430 3445 3460 3475 3490 3505 3520 3535 3550 3565 3580 3595 3610 3625 3640 3655 3670 3685 3700 3715 3730 3745 3760 3775 3790 3805 3820 3835 3850 3865 3880 3895 3910 3925 3940 3955 3970 3985 4000 4015 4030 4045 4060 4075 4090 4105 4120 4135 4150 4165 4180 4195 4210 4225 4240 4255 4270 4285 4300 4315 4330 4345 4360 4375 4390 4405 4420 4435 4450 4465 4480 4495 4510 4525 4540 4555 4570 4585 4600 4615 4630 4645 4660 4675 4690 4705 4720 4735 4750 4765 4780 4795 4810 4825 4840 4855 4870 4885 4900 4915 4930 4945 4960 4975 4990 5005 5020 5035 5050 5065 5080 5095 5110 5125 5140 5155 5170 5185 5200 5215 5230 5245 5260 5275 5290 5305 5320 5335 5350 5365 5380 5395 5410 5425 5440 5455 5470 5485 5500 5515 5530 5545 5560 5575 5590 5605 5620 5635 5650 5665 5680 5695 5710 5725 5740 5755 5770 5785 5800 5815 5830 5845 5860 5875 5890 5905 5920 5935 5950 5965 5980 5995 6010 6025 6040 6055 6070 6085 6100 6115 6130 6145 6160 6175 6190 6205 6220 6235 6250 6265 6280 6295 6310 6325 6340 6355 6370 6385 6400 6415 6430 6445 6460 6475 6490 6505 6520 6535 6550 6565 6580 6595 6610 6625 6640 6655 6670 6685 6700 6715 6730 6745 6760 6775 6790 6805 6820 6835 6850 6865 6880 6895 6910 6925 6940 6955 6970 6985 7000 7015 7030 7045 7060 7075 7090 7105 7120 7135 7150 7165 7180 7195 7210 7225 7240 7255 7270 7285 7300 7315 7330 7345 7360 7375 7390 7405 7420 7435 7450 7465 7480 7495 7510 7525 7540 7555 7570 7585 7600 7615 7630 7645 7660 7675 7690 7705 7720 7735 7750 7765 7780 7795 7810 7825 7840 7855 7870 7885 7900 7915 7930 7945 7960 7975 7990 8005 8020 8035 8050 8065 8080 8095 8110 8125 8140 8155 8170 8185 8200 8215 8230 8245 8260 8275 8290 8305 8320 8335 8350 8365 8380 8395 8410 8425 8440 8455 8470 8485 8500 8515 8530 8545 8560 8575 8590 8605 8620 8635 8650 8665 8680 8695 8710 8725 8740 8755 8770 8785 8800 8815 8830 8845 8860 8875 8890 8905 8920 8935 8950 8965 8980 8995 9010 9025 9040 9055 9070 9085 9100 9115 9130 9145 9160 9175 9190 9205 9220 9235 9250 9265 9280 9295 9310 9325 9340 9355 9370 9385 9400 9415 9430 9445 9460 9475 9490 9505 9520 9535 9550 9565 9580 9595 9610 9625 9640 9655 9670 9685 9700 9715 9730 9745 9760 9775 9790 9805 9820 9835 9850 9865 9880 9895 9910 9925 9940 9955 9970 9985 10000 10015 10030 10045 10060 10075 10090 10105 10120 10135 10150 10165 10180 10195 10210 10225 10240 10255 10270 10285 10300 10315 10330 10345 10360 10375 10390 10405 10420 10435 10450 10465 10480 10495 10510 10525 10540 10555 10570 10585 10600 10615 10630 10645 10660 10675 10690 10705 10720 10735 10750 10765 10780 10795 10810 10825 10840 10855 10870 10885 10900 10915 10930 10945 10960 10975 10990 11005 11020 11035 11050 11065 11080 11095 11110 11125 11140 11155 11170 11185 11200 11215 11230 11245 11260 11275 11290 11305 11320 11335 11350 11365 11380 11395 11410 11425 11440 11455 11470 11485 11500 11515 11530 11545 11560 11575 11590 11605 11620 11635 11650 11665 11680 11695 11710 11725 11740 11755 11770 11785 11800 11815 11830 11845 11860 11875 11890 11905 11920 11935 11950 11965 11980 11995 12010 12025 12040 12055 12070 12085 12100 12115 12130 12145 12160 12175 12190 12205 12220 12235 12250 12265 12280 12295 12310 12325 12340 12355 12370 12385 12400 12415 12430 12445 12460 12475 12490 12505 12520 12535 12550 12565 12580 12595 12610 12625 12640 12655 12670 12685 12700 12715 12730 12745 12760 12775 12790 12805 12820 12835 12850 12865 12880 12895 12910 12925 12940 12955 12970 12985 13000 13015 13030 13045 13060 13075 13090 13105 13120 13135 13150 13165 13180 13195 13210 13225 13240 13255 13270 13285 13300 13315 13330 13345 13360 13375 13390 13405 13420 13435 13450 13465 13480 13495 13510 13525 13540 13555 13570 13585 13600 13615 13630 13645 13660 13675 13690 13705 13720 13735 13750 13765 13780 13795 13810 13825 13840 13855 13870 13885 13900 13915 13930 13945 13960 13975 13990 14005 14020 14035 14050 14065 14080 14095 14110 14125 14140 14155 14170 14185 14200 14215 14230 14245 14260 14275 14290 14305 14320 14335 14350 14365 14380 14395 14410 14425 14440 14455 14470 14485 14500 14515 14530 14545 14560 14575 14590 14605 14620 14635 14650 14665 14680 14695 14710 14725 14740 14755 14770 14785 14800 14815 14830 14845 14860 14875 14890 14905 14920 14935 14950 14965 14980 14995 15010 15025 15040 15055 15070 15085 15100 15115 15130 15145 15160 15175 15190 15205 15220 15235 15250 15265 15280 15295 15310 15325 15340 15355 15370 15385 15400 15415 15430 15445 15460 15475 15490 15505 15520 15535 15550 15565 15580 15595 15610 15625 15640 15655 15670 15685 15700 15715 15730 15745 15760 15775 15790 15805 15820 15835 15850 15865 15880 15895 15910 15925 15940 15955 15970 15985 16000 16015 16030 16045 16060 16075 16090 16105 16120 16135 16150 16165 16180 16195 16210 16225 16240 16255 16270 16285 16300 16315 16330 16345 16360 16375 16390 16405 16420 16435 16450 16465 16480 16495 16510 16525 16540 16555 16570 16585 16600 16615 16630 16645 16660 16675 16690 16705 16720 16735 16750 16765 16780 16795 16810 16825 16840 16855 16870 16885 16900 16915 16930 16945 16960 16975 16990 17005 17020 17035 17050 17065 17080 17095 17110 17125 17140 17155 17170 17185 17200 17215 17230 17245 17260 17275 17290 17305 17320 17335 17350 17365 17380 17395 17410 17425 17440 17455 17470 17485 17500 17515 17530 17545 17560 17575 17590 17605 17620 17635 17650 17665 17680 17695 17710 17725 17740 17755 17770 17785 17800 17815 17830 17845 17860 17875 17890 17905 17920 17935 17950 17965 17980 17995 18010 18025 18040 18055 18070 18085 18100 18115 18130 18145 18160 18175 18190 18205 18220 18235 18250 18265 18280 18295 18310 18325 18340 18355 18370 18385 18400 18415 18430 18445 18460 18475 18490 18505 18520 18535 18550 18565 18580 18595 18610 18625 18640 18655 18670 18685 18700 18715 18730 18745 18760 18775 18790 18805 18820 18835 18850 18865 18880 18895 18910 18925 18940 18955 18970 18985 18995 19000			
(CL) LEAN CLAY, dark brown to reddish brown and gray, moist, firm to stiff									2-3-3 (6)		6		15 38 19.8 [86.6%]	
5									5-6-6 (12)		12			
END OF BORING AT 5 FT									1206					
									1201					
									1196					
									1191					
									1186					
									1181					
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL														
<input checked="" type="checkbox"/> WL (First Encountered) Dry				BORING STARTED: Apr 19 2024				CAVE IN DEPTH:						
<input checked="" type="checkbox"/> WL (Completion)				BORING COMPLETED: Apr 19 2024				HAMMER TYPE: Auto						
<input checked="" type="checkbox"/> WL (Seasonal High Water)				EQUIPMENT: CME 750		LOGGED BY: EJP		DRILLING METHOD: Solid Stem Auger						
<input checked="" type="checkbox"/> WL (Stabilized)														
GEOTECHNICAL BOREHOLE LOG														

CLIENT: Brakes Plus, LLC.				PROJECT NO.: 58:1830		BORING NO.: B-04		SHEET: 1 of 1			
PROJECT NAME: Brakes Plus				DRILLER/CONTRACTOR: Drilling Services of Oklahoma							
SITE LOCATION: 4900 N. May Ave, Oklahoma City, Oklahoma, 73112								LOSS OF CIRCULATION 			
LATITUDE: 35.519771		LONGITUDE: -97.564975		STATION:		SURFACE ELEVATION: 1211.0		BOTTOM OF CASING 			
DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (N - Value) *	⊗ STANDARD PENETRATION BLOWS/FT		△ LIQUID LIMIT
									⊗ PLASTIC LIMIT		○ CALIBRATED PENETROMETER TSF
									10 20 30 40 50		1 2 3 4 5
									20 40 60 80 100		● WATER CONTENT % [FINES CONTENT] %
									ROCK QUALITY DESIGNATION & RECOVERY		10 20 30 40 50
									RQD		
									REC		
									MODIFIED CALIFORNIA SAMPLER BLOWS/FT		
									10 20 30 40 50		
5	S-1	SS	18	14	(CL) LEAN CLAY WITH SAND, red and brown to red, moist, firm to very stiff			2-2-3 (5)	5		
	S-2	SS	18	18				4-8-10 (18)	18		
	END OF BORING AT 5 FT						1206				17.4
10							1201				
15							1196				
20							1191				
25							1186				
30							1181				
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL											
☑ WL (First Encountered)				Dry		BORING STARTED: Apr 19 2024		CAVE IN DEPTH:			
▼ WL (Completion)						BORING COMPLETED: Apr 19 2024		HAMMER TYPE: Auto			
☑ WL (Seasonal High Water)						EQUIPMENT: CME 750		LOGGED BY: EJP		DRILLING METHOD: Solid Stem Auger	
☑ WL (Stabilized)											
GEOTECHNICAL BOREHOLE LOG											

CLIENT: Brakes Plus, LLC.				PROJECT NO.: 58:1830		BORING NO.: B-05		SHEET: 1 of 1										
PROJECT NAME: Brakes Plus				DRILLER/CONTRACTOR: Drilling Services of Oklahoma														
SITE LOCATION: 4900 N. May Ave, Oklahoma City, Oklahoma, 73112								LOSS OF CIRCULATION 										
LATITUDE: 35.519920		LONGITUDE: -97.565372		STATION:		SURFACE ELEVATION: 1213.0		BOTTOM OF CASING 										
DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (N - Value)*	STANDARD PENETRATION BLOWS/FT					LIQUID LIMIT X PLASTIC LIMIT				
									ROCK QUALITY DESIGNATION & RECOVERY					CALIBRATED PENETROMETER TSF				
									10 20 30 40 50					1 2 3 4 5				
									20 40 60 80 100					WATER CONTENT % [FINES CONTENT] %				
									RQD					10 20 30 40 50				
									REC					10 20 30 40 50				
									MODIFIED CALIFORNIA SAMPLER BLOWS/FT					10 20 30 40 50				
									10 20 30 40 50					10 20 30 40 50				
	S-1	SS	18	16	(CL) LEAN CLAY WITH SAND, dark brown to red, moist, stiff to very stiff			2-5-6 (11)										
	S-2	SS	18	18				5-8-8 (16)										
5					END OF BORING AT 5 FT		1208											
10							1203											
15							1198											
20							1193											
25							1188											
30							1183											
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL																		
WL (First Encountered) Dry						BORING STARTED: Apr 19 2024			CAVE IN DEPTH:									
WL (Completion)						BORING COMPLETED: Apr 19 2024			HAMMER TYPE: Auto									
WL (Seasonal High Water)						EQUIPMENT: CME 750			LOGGED BY: EJP		DRILLING METHOD: Solid Stem Auger							
WL (Stabilized)																		
GEOTECHNICAL BOREHOLE LOG																		

APPENDIX C – Laboratory Testing

Laboratory Testing Summary

Laboratory Testing Summary

Page 1 of 1

Sample Source	Sample Number	Start Depth (feet)	End Depth (feet)	Sample Distance (feet)	MC ¹ (%)	Soil Type ²	Atterberg Limits ³			Percent Passing No. 200 Sieve ⁴	Moisture - Density (Corr.) ⁵		CBR Value ⁶	Organic Content (%)
							LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
B-01	S-1	1.0	2.5	1.5	18.7	CL	43	14	29	73.1				
B-01	S-2	3.5	5.0	1.5	19.2									
B-01	S-3	6.0	7.5	1.5	13.9									
B-01	S-4	8.5	10.0	1.5	11.9									
B-02	S-1	1.0	2.5	1.5	16.6									
B-02	S-2	3.5	5.0	1.5	15.6	CL	40	17	23	77.2				
B-02	S-3	6.0	7.5	1.5	19.3									
B-02	S-4	8.5	9.8	1.3	13.8									
B-03	S-1	1.0	2.5	1.5	19.8	CL	38	15	23	86.6				
B-04	S-2	3.5	5.0	1.5	17.4									
B-05	S-1	1.0	2.5	1.5	18.9	CL	43	13	30	81.3				

Notes:

1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions:

MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content (ASTM D 2974)

Project No.: 58:1830
Project Name: Brakes Plus – NW 49th & May
PM: Ethan J Pollard
PE: Andy Wilshire
Printed On: May 8, 2024



ECS Southwest, LLP - Oklahoma City

7801 N Robinson Ave, Suite D-8,
Oklahoma City, OK 73116

Phone: 405-265-5501