GEOTECHNICAL ENGINEERING REPORT

Brakes Plus – 1201 Lonnie Abbott Blvd.
Ada, Oklahoma

Prepared for:

Brakes Plus

Birmingham, Alabama

May 2024

Olsson Project No. 024-02476

Oklahoma Certificate
of Authorization #: 2483

May 31, 2024

Brakes Plus
Attn: Tyler Hendon
1880 SouthPark Drive
Birmingham, AL 35244

RE: Geotechnical Engineering Report
Brakes Plus – 1201 Lonnie Abbot Blvd.
Ada, Oklahoma
Olsson Project No. 024-02476

Dear Mr. Hendon:

In general accordance with our "Letter Agreement for Professional Services" dated April 2, 2024, Olsson, Inc. has completed the authorized geotechnical exploration for the above referenced project. The geotechnical exploration was conducted to evaluate physical characteristics of subsurface conditions with respect to design and construction of the project. The enclosed report summarizes the project characteristics as we understand them, presents the findings of the field exploration and laboratory testing, discusses the observed subsurface conditions, and provides our geotechnical engineering recommendations.

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

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

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

EXECUTIVE SUMMARY

Olsson, Inc. (Olsson) completed a geotechnical exploration for the proposed Brakes Plus in Ada, Oklahoma. The onsite subsurface soils encountered were generally comprised of moderate to high plasticity, soft to very stiff clay (CL-CH) with varying sand contents and high plasticity, medium dense, clayey sand (SC).

The native soils encountered generally appear suitable for support of shallow and/or deep foundations systems. Design and construction related recommendations are provided to mitigate the effects of high plasticity soils at the site.

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

1. PROJECT UNDERSTANDING

1.1 Project Information

We understand the proposed development will include a Brakes Plus building comprising a single-story slab-on-grade structure with associated parking and driveways. **Figure 1** shows the conceptual site layout. Underground utility lines and landscaping areas may also be included in the proposed development. We assume the building structure will generally be of steel and/or wood frame construction. Structure dimensions and loading details are provided in **Table 1.**

Table 1. Project Information.

Project Detail	Value	Notes
Plan Area	4,900 sq ft	Estimated from site base file (DWG) dated October 16, 2023
Finished Floor Elevation	+/- 2 feet of existing grades	Assumed based on existing site grades
Maximum Column Load	60 kips	Assumed
Maximum Wall Load	8 klf	Assumed
Floor Slab Load	150 psf	Assumed

Based on the topographic survey performed by the Olsson Survey team, existing site grades range from an elevation of approximately 961.0 to 991.0.

If the structural loads or site grading differs from these values, the geotechnical engineer should be contacted to verify that the recommendations contained in this report remain valid.

The need for and/or location(s) of potential retaining walls at the site have not been determined. The lateral earth pressures and any related allowable soil bearing pressure recommendations provided in this report are applicable only to the design of rigid below-grade or retaining walls subject to slight rotation, such as cast-in-place cantilever concrete walls.

Figure 1. Conceptual Site Layout Dated April 18, 2024

1.2 Site Description

The proposed Brakes Plus will be located at the southwest corridor of North Texas Avenue and Lonnie Abbott Boulevard in Ada, Oklahoma. At the time of our field exploration, the site surface comprised of a grassy area, and it was accessible to a track drilling rig. A review of historical aerial imagery indicates the proposed site was cleared on the western and northern portion of the project site due to construction to the west of the project site in 2008. The approximate location of the proposed development is shown in **Figure 2**.

Figure 2. 2023 Aerial Photograph Depicting Project Location.

2. SUBSURFACE CONDITIONS

2.1 Subsurface Profile

The subsurface profile was determined based on our field exploration and laboratory testing. Our field exploration (**Appendix A**) included four exploratory borings to depths up to 15 feet, and the field testing including standard penetration tests (SPT). Laboratory testing (**Appendix B**) included fines content (passing #200 sieve), Atterberg limits, moisture content, and soil chemistry tests including pH, soluble sulfate, and soluble chlorides.

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

The subsurface soils at this site comprised of moderate to high plasticity clays with varying sand contents (CL-CH). The general characteristics of each soil stratum are summarized below, with more detailed descriptions provided on the borehole reports in **Appendix A**.

Root Zone

We encountered an approximate 3-inch-thick root zone in the soil test borings. Varying root zone thicknesses may be present in areas outside the completed boreholes.

Native Soils

We encountered native clay with varying sand contents underlying the root zone in the borings extending to a depth of 15 feet. The native soils generally comprised lean to fat clay with varying sand contents (CL-CH) and clayey sand (SC). The clays were described as soft to very stiff, reddish brown to light brown, and slightly moist to very moist, and the sands were described as medium dense, light brown, and very moist.

2.2 Water Level Observations

Subsurface water was not encountered in the soil test borings at the time of drilling operations. However, the Oklahoma Water Resources Board (OWRB) indicates that groundwater levels near the project area may be encountered within the upper 10 feet. Water levels will fluctuate over time with variations in precipitation, site grading, drainage, and adjacent land use. Perched subsurface water conditions can also develop in seams of loose or granular soil.

Long-term monitoring with piezometers generally provides a more representative indication of the potential range of subsurface water conditions. Such monitoring was not completed as part of this exploration. Olsson can provide additional monitoring upon written request of the Owner and/or Olsson's client. Recommendations for addressing effects of water in design and during construction are presented in **Section 6.3** of this report. Changing water conditions must be taken into consideration in any retaining wall foundation design or global stability analysis.

3. GEOTECHNICAL CONSIDERATIONS

The subsurface conditions encountered by Olsson for the site will support the proposed development. However, the site subsurface materials mostly include high plasticity clay soils which are likely to cause swelling pressure under structural features as well as construction issues. Therefore, geotechnical remediations will be necessary to implement during construction to mitigate the design and construction issues caused by the high plasticity subgrade soils.

Historical imagery indicates that the site was next to the construction of a hotel and had some site clearing on the western and northern portion of the current project site.

The recommendations and considerations outlined in **Section 6.1** detail the requirements for potential existing fill, original native soils, and possible imports to be used as structural fill beneath floor slabs, foundations, and pavements.

4. STRUCTURES DESIGN

4.1 Shallow Foundations

Based on the results of our exploration and engineering evaluation, and the understanding that the finished floor elevation (FFE) will be within 2 feet of existing grades, the proposed structure may be supported on a conventional shallow foundation system.

Design parameters for shallow foundations supported in approved undisturbed native soils, recompacted subgrade, or existing already compacted fill are tabulated below.

Table 2. Shallow Foundation Design Parameters.

Design Parameter	Recommended Value
Net Allowable Soil Bearing Pressure	2,300 psf
Estimated Total Settlement	1-inch
Estimated Differential Settlement	½-inch
Minimum Exterior Foundation Depth	2 feet
Minimum Interior Foundation Depth	2 feet
Passive Lateral Earth Pressure Resistance	200 pcf

The net allowable bearing pressure is the bearing pressure in excess of the minimum surrounding overburden pressure at the foundation level. The net allowable soil bearing pressure may be increased by 1/3 for transient loads such as wind or seismic loads.

Exterior footings and footings in unheated areas should bear at the minimum depth recommended in **Table 2**. Minimum foundation depth is measured from the lowest adjacent final ground surface. In no case should footings have dimensions smaller than allowed by local building codes.

An ultimate soil-concrete friction coefficient of 0.35 may be used to evaluate sliding resistance of shallow foundations supported on undisturbed native soils or properly compacted structural fill.

Soft or otherwise unsuitable soils could be encountered during foundation construction. Therefore, foundation subgrades should be observed by an Olsson representative to identify such soils and provide remediation recommendations as necessary. After foundation subgrades have been observed and any required remedial measures are performed, concrete should be placed as quickly as possible to avoid exposure of the foundation subsoils to wetting, drying, or freezing. If foundation soils are subjected to such conditions, Olsson should be contacted to reevaluate the foundation bearing materials.

Provided shallow foundations are designed and constructed in accordance with the recommendations of this report, total post-construction settlements are anticipated to be less than the values tabulated in **Table 2**. To reduce the effects of differential settlement, floor slabs should be separated from wall and column footings with expansion joints.

4.2 Floor Slabs

Recommendations for design of concrete slab-on-grade floors, including preparation of the underlying subgrade, are presented below.

4.2.1 Floor Slab Subgrade Preparation

Based on the results of our exploration and engineering evaluation, we recommend floor slabs be supported by a minimum of 12 inches of low-plasticity structural fill. This structural fill thickness can be achieved through a combination of over-excavation and recompaction of site soils or structural fill placed to raise site grades.

Structural fill soils should extend 5 feet beyond the building perimeter and be moisture-conditioned and recompacted in accordance with **Section 6.2**.

4.2.2 Floor Slab Design Considerations

Care should be taken to maintain the recommended subgrade moisture content and density between site grading operations and placement of the floor slab. Periodic applications of water may be necessary to maintain the proper moisture content of the subgrade.

In many construction projects, floor slab areas are disturbed by construction equipment traffic and are exposed to subgrade disturbing elements between completion of grading operations and placement of the floor slab. Therefore, we recommend that the final floor slab subgrade be proofrolled and evaluated for moisture content and density immediately prior to placement of the granular leveling course or floor slab concrete. Unsuitable soils should be moisture conditioned and recompacted in accordance with **Table 4**, be stabilized in accordance with **Section 6.2**, or removed and replaced.

Provided the recommendations presented in this report are implemented, a subgrade modulus of 125 pounds per square inch per inch (psi/in or pci) may be used to design the floor slab.

If a granular leveling and drainage course is used beneath floor slabs, the material should be free-draining, well-graded, and compacted in accordance with **Table 4** prior to slab placement.

In finished subgrade areas, the design engineer or architect should be consulted regarding the use and position (above or below the granular leveling course) of a vapor retarder. In other areas, vapor retarder should be placed in accordance with recommendations outlined in ACI 302.1R-15, “Guide to Concrete Floor and Slab Construction.”

The procedures recommended above will reduce future subgrade volume change and resultant floor slab movement. However, depending on many factors—including the size and shape of the floor area, the location of construction joints in the slab, the rigidity of the slab and foundation connection, and the magnitude of movement that occurs—cracks within the floor slab should be anticipated. Leaking utility lines or water allowed to accumulate beneath the slab could lead to significant slab movement.

4.3 Seismic Site Classification

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

4.4 Permanent Slopes

We recommend permanent cut or fill slopes be flatter than 3(H):1(V) to maintain long-term stability and to provide ease of maintenance. The crest or toe of cut or fill slopes should be at least 10 feet away from any foundation and at least 5 feet away from the edge of any pavements. Permanent slopes should be vegetated as soon as practical to minimize the potential for erosion. Slopes steeper than 3(H):1(V) are susceptible to erosion, will be difficult to maintain, and could experience problems with instability. Such slopes may require additional slope stability analysis, which is beyond the scope of this report.

The performance of the proposed structure and pavement depends on maintaining the moisture content of the subgrade soils throughout the life of the facility. To reduce the effects of moisture infiltration near the structure, efficient drainage of rainfall or surface runoff should be provided. We recommend a minimum slope of 2 percent for pavement areas and 5 percent for grass or landscaped areas.

4.5 Utilities and Landscaping

Bedding material below and above for site utilities should be in accordance with local building codes. The remaining utility trench should consist of cohesive structural fill placed in accordance with **Table 4**. We also recommend clay plugs or water stops be installed where utility lines enter the building. Clay plugs should extend a minimum of 5 feet from the building exterior.

To reduce the effects of moisture fluctuations in and around the structure and pavements caused by landscaping and maintenance, we recommend the following:

- Downspout drainage should discharge onto splash blocks extending at least 5 feet away from the building.
- Incorporate splash blocks for external hose connections to prevent localized flooding of foundation or backfill soils. Cutoff valves should be installed inside the building to prevent unauthorized use of external hose connections.
- Restrict the type and location of landscaping vegetation around the proposed structure. Maintain a minimum distance between the structure and trees or shrubs equal to the mature radius of the tree or shrub plus 3 feet. Plant native and decorative grasses at least 5 feet from buildings. Poorly placed vegetation can result in settlement induced by desiccation or uplift caused by root growth. These recommendations may be modified in consultation with a landscape architect.
- Ensure that irrigation near the building is carefully controlled and minimized. Avoid installing sprinklers adjacent to foundation or retaining walls and inform building maintenance personnel of the importance of avoiding excessive watering.

5. PAVEMENT DESIGN

5.1 Pavement Subgrade Preparation

Proper pavement performance depends on a subgrade that is relatively uniform, with no abrupt changes in the degree of support. Non-uniform pavement support can result from variations in soil type or moisture content, as well as at the transition from cut to fill areas or where improperly placed utility backfill has been placed across or through pavement areas. Improper subgrade preparation such as inadequate vegetation removal, failure to identify soft or unstable areas by proofrolling, or inadequate compaction can also result in non-uniform subgrade support.

We recommend the proposed pavements be supported by a minimum of 12 inches of low-plasticity structural fill. This structural fill thickness can be achieved through a combination of over-excavation and recompaction of site soils or structural fill placed to raise site grades. Structural fill soils should extend 2 feet beyond the pavement edges and be moisture-conditioned and recompacted in accordance with **Section 6.2**.

Construction scheduling often causes a delay between completion of grading operations and commencement of paving operations. In these instances, pavement areas can be disturbed by construction equipment traffic, desiccation, or wetting. Therefore, we recommend that the final pavement subgrade be proofrolled and evaluated for moisture content and density immediately prior to paving. The proofroll should be performed with a loaded dump truck, motor grader, or similar rubber-tired equipment with a minimum weight of 20 tons. Unsuitable soils should be moisture conditioned and recompacted in accordance with **Table 4**, be stabilized in accordance with **Section 6.2**, or removed and replaced.

5.2 Recommended Pavement Sections

Pavement design is influenced by the anticipated traffic loads and volume, site subgrade conditions, pavement materials, climate, and the desired design life. Changes in traffic conditions can have a significant impact on the service life of the pavement. Such changes could include increases in overall traffic counts, increases in truck traffic, or the unanticipated application of static or turning loads.

The recommended design sections require that the site be properly prepared in accordance with this report and that site drainage be provided to minimize the future wetting of the pavement subgrade.

The recommended minimum pavement thicknesses presented below are based on our experience with similar pavement applications, recognized structural coefficients, and a design life of approximately 20 years. Based on these considerations, we recommend the following minimum pavement design thicknesses.

Table 3. Recommended Pavement Sections.

	Layer/Material	Layer Thickness (inches)		
		Parking Areas	Drive Areas	Heavy Vehicle Areas
Full Depth AC	AC Surface Course	2.0	2.0	--
	AC Base Course	2.0	3.0	--
	Prepared subgrade in accordance with **Section 5.1**	12.0	12.0	--
AC w/Granular Base	AC Surface Course	1.5	1.5.0	--
	AC Base Course	1.5	2.0	--
	ODOT Type “A” Aggregate Base	5.0	6.0	--
	Prepared subgrade in accordance with **Section 5.1**	12.0	12.0	--
Portland Cement Concrete	4,000 psi Portland Cement Concrete	5.0	6.0	7.0
	Prepared subgrade in accordance with **Section 5.1**	12.0	12.0	12.0

Standard duty pavement sections are intended for passenger car parking areas and are not suitable for tractor-trailer traffic. Heavy duty pavement sections are intended for areas that will experience high traffic volumes or heavy axle loads such as main access drives and delivery or trash truck routes. We recommend Portland cement concrete pavements be used in areas with frequent start-stop or turning traffic such as entrance and exit aprons or the parking stalls closest to buildings, as well as areas that support stationary loads such as dumpsters.

Surface drainage around the pavement and proper maintenance are also important for long-term performance. Curbs should be backfilled as soon as possible after construction of the pavement. Backfill should be compacted and should be sloped to prevent water from ponding and infiltration under the pavement. All pavement joints should be sealed, and any cracks should be quickly patched or sealed to prevent moisture from leaching into and softening the subgrade.

5.3 Exterior Flatwork

Cohesive subgrade soils immediately below exterior entryway slabs are considered moderately frost susceptible. If these soils become very moist or saturated and freeze, slab heaving could occur. Positive drainage away from the structure and entry slabs will help limit the potential for moisture infiltration into subgrade soils and subsequent heaving.

The potential for slab heaving adjacent to the buildings can be further limited by supporting exterior entry slabs on a structural stoop or removing and replacing the frost susceptible soils with non-frost-susceptible backfill. Such material typically consists of a well graded sand or crushed aggregate with less than 5 percent passing a #200 sieve.

If a structural stoop is considered to reduce or prevent movement during freeze/thaw cycles, the stoop foundation should extend to the frost depth recommended in **Section 4.1**. To further reduce slab movements adjacent to entryways, we recommend that frost-susceptible cohesive soils below the structural stoop slab be removed to frost depth and replaced with clean, free draining, well graded sand or crushed aggregate with less than 5 percent passing the #200 sieve. The base of the stoop excavation should be sloped to drain water away from the building. A perforated drainpipe should be installed at the low end of the excavation to collect accumulating moisture for discharge to an adjacent storm sewer.

Sidewalks located away from the building can be supported by a minimum of 9 inches of compacted structural fill that has been prepared and compacted following the recommendations of this report. Prepared subgrade should extend a minimum of 1 foot beyond each edge of sidewalks, where feasible.

6. EARTHWORK AND CONSTRUCTION CONSIDERATIONS

6.1 Site Preparation

6.1.1 General

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

At the base of stripping operations and prior to the placement of structural fill, we recommend the top 8 inches of the exposed subgrade soils be scarified, moisture conditioned, and recompacted in accordance with **Section 6.2** of this report. In addition, Olsson should observe the base of foundation excavations to confirm both the native and existing fill are consistent with the materials encountered during our exploration and are suitable of providing the foundation support. If soft soils or deleterious materials are encountered, these materials should be removed and replaced with compacted structural fill.

Soils which cannot be adequately densified in-place should be removed and replaced with approved structural fill or stabilized under the direction of an Olsson representative. The extent of areas requiring removal or stabilization will depend on the conditions observed at the time of construction. Undercut areas should be backfilled with stable fill material similar in composition to the surrounding soils.

If necessary, one or more layers of crushed stone may be considered to stabilize areas where wet soil or water are present. Geogrid or geosynthetic fabric may be used in conjunction with the crushed stone to provide additional stabilization. Chemical stabilization methods such as fly ash, lime, cement kiln dust (CKD), or Portland cement could also be considered with direction from the geotechnical engineer.

6.2 Structural Fill

We recommend that fill materials placed within 12 inches of the base of the floor slab aggregate base or pavements have a liquid limit less than 45 and a plasticity index less than 25. Soils with Atterberg limits greater than these values will require removal, chemical stabilization or blended with less plastic materials prior to use immediately beneath floor slabs or pavements. All structural fill soils should also be relatively free of organic materials (less than about 2 percent by weight), debris, and particles larger than 3 inches in nominal diameter.

Based on our site observations and Atterberg limits testing performed as part of this exploration, the on-site soils generally appear suitable for reuse as structural fill beneath floor slabs, foundations, and pavements. Samples of all proposed structural fill, including on-site soils, should be submitted to Olsson at least seven days before placement for testing and approval.

Proper lift thickness depends on the type of compaction equipment used, but in general, we recommend a maximum lift thickness of 8 inches in loose measurement. Thinner lifts could be required in confined areas such as around manholes, behind retaining walls, or within footing and utility trenches. Soils should be compacted using equipment of appropriate type and size to achieve the recommendations presented in this report. Water flooding is not an acceptable compaction method for any soil type.

We recommend that structural fill and backfill be compacted in accordance with the criteria stated in **Section 6.2**. Utility trenches, foundation excavations, retaining walls, and pavement curbs should be backfilled as soon as possible to reduce the risk of water infiltration into the subgrade.

An Olsson field representative should periodically observe fill placement operations and perform field moisture-density tests to document whether moisture content and compaction requirements are being achieved.

The moisture content of suitable borrow soils should be within the ranges specified in **Table 4**. More stringent moisture limits may be necessary with certain soils. Adjustment of moisture content may be necessary to allow compaction in accordance with project specifications.

Table 4. Structural Fill Placement Guidelines.

Area of Fill Placement	Suitable Material (USCS or Description)	Compaction (ASTM D698 - Standard Proctor)	Moisture Content (Percent of Optimum)
Granular Cushion Beneath Floor Slab	ASTM C-33 No. 57 Aggregate or Approved Alternative	98%*	As necessary to obtain density
Aggregate Base Beneath Pavements	ODOT Type "A" Aggregate Base or Approved Alternative	98%*	As necessary to obtain density
Structural Fill Placed Below Floor Slab and Pavements	Approved soils with LL<45, PI<25	95%	0 to +3 percent
Utility trenches	Approved soils with LL<45, PI<25	95%	0 to +3 percent
** Or 70 percent Relative Density as described below*			

Granular fill materials may not produce a definable moisture-density curve when tested in accordance with ASTM D698 (Standard Proctor). Such materials could alternatively be compacted to a minimum of 70 percent relative density as determined by ASTM D4253 (Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table) and D4254 (Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculations of Relative Density).

Controlled low strength material (CLSM) or flowable fill may be considered for utility or other small backfills. We recommend flowable fill have a compressive strength between 100 and 300 pounds per square inch (psi). CLSM with a maximum compressive strength less than 300 psi can be readily excavated with a backhoe. CLSM can be placed in a single lift, without personnel entering the excavation and without the need for compaction equipment.

6.3 Dewatering Considerations

We did not encounter groundwater at the time of our exploration. While we do not anticipate groundwater will affect shallow construction activities, it may be a factor in deeper excavations, specifically in areas extending deeper than 10 feet below existing grades. Variations in groundwater elevation could occur because of seasonal changes in rainfall, temperature, snowmelt, runoff, localized irrigation demand, or other factors. Saturated soils and higher groundwater elevations should be anticipated in areas near drainage channels and ditches, if any.

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

Settlement of existing structures, utility lines, and pavements can result from nearby dewatering operations. At the time of this report, building structures, pavement areas, and existing utilities were present north and northwest of the proposed project limits. These structures should be monitored during dewatering and construction for unanticipated settlement.

6.4 Temporary Slopes and Excavations

Construction site safety is the sole responsibility of the general contractor. The contractor is also responsible for the means, methods, techniques, sequencing, and operations used during construction. Slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations.

6.5 Equipment Mobility

Some of the soils encountered at this site may be susceptible to softening under the action of construction equipment traffic in combination with wet weather. Mitigation of equipment mobility problems and management of soft surficial soils will depend on the severity of the problem, the season in which construction is performed, and prevailing weather conditions.

During construction, provisions should be made to quickly remove seepage water or storm water from excavations. Water should not be allowed to collect near foundations, floor slabs, pavements, or retaining walls either during or after construction. Undercut or excavated areas should be sloped toward one corner to facilitate the collection and removal of rainwater or surface runoff. Site grading should provide rapid drainage of water away from the structure and pavement areas throughout construction.

Additional guidelines for reducing equipment mobility problems are as follows:

- Optimize surface water drainage at the site.
- Allow for rain days in the construction schedule and wait for dry weather conditions to prevail whenever possible. Avoid operating construction equipment on the site during wet conditions. Rutting the surface will aggravate mobility problems.
- Use construction equipment that is suited for the intended job under the site conditions. Heavy rubber-tired equipment typically requires better site conditions than light, track-mounted equipment.

Ultimately, it may be necessary to take steps to aggressively improve equipment mobility if construction must proceed under unfavorable conditions. More aggressive methods for addressing equipment mobility problems may range from removing a few feet of soft wet soils to utilizing crushed stone materials and/or appropriate stabilization fabrics or geogrids. Other methods include chemical stabilization with Portland cement, lime, fly ash, or cement kiln dust (CKD). The stabilization approach should be determined at the time of construction in consultation with an Olsson geotechnical engineer.

The contractor is responsible for creating and maintaining a stable working platform. Soils that are disturbed by construction activity or adverse weather conditions should be corrected by the contractor to conform with project specifications and this report.

7. REPORT LIMITATIONS

The conclusions and recommendations presented in this report are based on the information available regarding the proposed construction, geotechnical information obtained from our field exploration and laboratory testing, as well as our experience with similar projects. Our borings and testing represent a limited statistical sampling of the subsurface. Conditions may be encountered during construction that are substantially different from those encountered in this exploration and adjustments to design and construction may be necessary.

In the event of any changes in the nature of the proposed project as outlined in this report, the opinions in this report cannot be considered valid unless Olsson reviews the changes, and the opinions of this report are modified or affirmed by Olsson.

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

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

APPENDIX A
Exploration Maps, Logs, and Information

Field Exploration

Our drill crew advanced four (4) borings for this exploration with a truck-mounted drill rig using continuous-flight augers. Boring locations were located in the field by the drill crew using a hand-held GPS unit. The approximate locations of the borings are shown on the Boring Location Map.

Samples were obtained using the methods and at the depths shown on the logs. Recovered samples were sealed in containers, labeled, and protected for transportation to the laboratory for testing.

We interpolated the ground surface elevation at the boring locations using a topographic map provided by Olsson. The surface elevations at the boring locations, rounded to the nearest half-foot, are presented on the boring logs.

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

F:\2024\02001-02500\024-02476\40-Design\Reports\GEO\DWG\Drawing1.dwg
DATE:5/30/2024 USER: dkeith

LEGEND

SOIL BORING LOCATION

PROJECT: 024–02476

DATE: 5/28/2024 | DRAWN BY: DEK

BORING LOCATION MAP

ADA, OKLAHOMA

olsson

9500 Pole Road
Oklahoma City, OK 73160

TEL 402.458.5052
www.olsson.com

BOREHOLE REPORT NO. B-01

PROJECT NAME	CLIENT
Brakes Plus - N. Texas Ave. & Lonnie Abbott Blvd.	Brakes Plus
PROJECT NUMBER	**LOCATION**
024-02476	Ada, Oklahoma

Legend: Split Spoon; Shelby Tube

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ROOT ZONE *3-inches thick* — 0.3'	0								
	SANDY FAT CLAY *reddish brown; moist; stiff*		SS 1	CH	3-4-5 N=9		16.5		69/41	
		5	U 2			1.5	24.9	95.5		P-200 = 40.8%
	6.0'									
	SANDY FAT CLAY *light brown; very moist; firm to very stiff*		SS 3		2-3-4 N=7		29.8			
		10	SS 4	CH	1-2-3 N=5		26.3		61/32	P-200 = 54.2%
	15.0'	15	SS 5		4-8-6 N=14					

BASE OF BORING AT 15.0 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encountered
AD	Not Performed

OLSSON, INC.
9500 POLE ROAD
OKLAHOMA CITY, OK 73160

STARTED:	5/17/24	FINISHED:	5/17/24
DRILL CO.:	WSB	DRILL RIG:	CME 55
DRILLER:	C. MAXEY	LOGGED BY:	J. STEARNS
METHOD: CONTINUOUS FLIGHT AUGER			

olsson	BOREHOLE REPORT NO. B-02	Sheet 1 of 1

PROJECT NAME **Brakes Plus - N. Texas Ave. & Lonnie Abbott Blvd.**	CLIENT **Brakes Plus**
PROJECT NUMBER **024-02476**	LOCATION **Ada, Oklahoma**

Split Spoon | Shelby Tube

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ROOT ZONE *3-inches thick* 0.3'		0								
	SANDY FAT CLAY *dark brown; very moist; firm to very stiff*			SS 1		4-9-11 N=20		18.9			
				SS 2		2-3-5/0"					
	6.0'		5								
	CLAYEY SAND *light brown; very moist; medium dense*			U 3	SC		1.3	23.1	103.7	53/31	P-200 = 35.5%
			10	SS 4		2-4-6 N=10		27.1			
	15.0'		15	SS 5		3-5-8 N=13					

BASE OF BORING AT 15.0 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encountered
AD	Not Performed

OLSSON, INC.
9500 POLE ROAD
OKLAHOMA CITY, OK 73160

STARTED:	5/17/24	FINISHED:	5/17/24
DRILL CO.:	WSB	DRILL RIG:	CME 55
DRILLER:	C. MAXEY	LOGGED BY:	J. STEARNS
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. P-01

PROJECT NAME Brakes Plus - N. Texas Ave. & Lonnie Abbott Blvd.	CLIENT Brakes Plus
PROJECT NUMBER 024-02476	LOCATION Ada, Oklahoma

Split Spoon

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ROOT ZONE *3-inches thick*		0								
	0.3' ***LEAN CLAY*** *brown; slightly moist; soft to firm*			SS 1	CL	1-2-3 N=5		16.9		29/12	P-200 = 61.7%
				SS 2		2-1-2 N=3		13.8			
	5.0'		5								

BASE OF BORING AT 5.0 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encountered
AD	Not Performed

OLSSON, INC.
9500 POLE ROAD
OKLAHOMA CITY, OK 73160

STARTED:	5/17/24	FINISHED:	5/17/24
DRILL CO.:	WSB	DRILL RIG:	CME 55
DRILLER:	C. MAXEY	LOGGED BY:	J. STEARNS
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. P-02

PROJECT NAME: **Brakes Plus - N. Texas Ave. & Lonnie Abbott Blvd.**	CLIENT: **Brakes Plus**
PROJECT NUMBER: **024-02476**	LOCATION: **Ada, Oklahoma**

Split Spoon

ELEVATION (ft)	MATERIAL DESCRIPTION	GRAPHIC LOG	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ROOT ZONE *3-inches thick* — ***0.3'***		0								
	LEAN CLAY *brown; moist; soft to firm*			SS 1		2-3-3 N=6		20.0			
				SS 2		7-2-2 N=4		17.5			
	5.0'		5								

BASE OF BORING AT 5.0 FEET

WATER LEVEL OBSERVATIONS	
WD	Not Encountered
IAD	Not Encountered
AD	Not Performed

OLSSON, INC.
9500 POLE ROAD
OKLAHOMA CITY, OK 73160

STARTED:	5/17/24	FINISHED:	5/17/24
DRILL CO.:	WSB	DRILL RIG:	CME 55
DRILLER:	C. MAXEY	LOGGED BY:	J. STEARNS
METHOD: CONTINUOUS FLIGHT AUGER			

APPENDIX B
Laboratory Test Results

OLSSON, INC.
9500 POLE ROAD
OKLAHOMA CITY, OK 73160

SUMMARY OF LABORATORY RESULTS

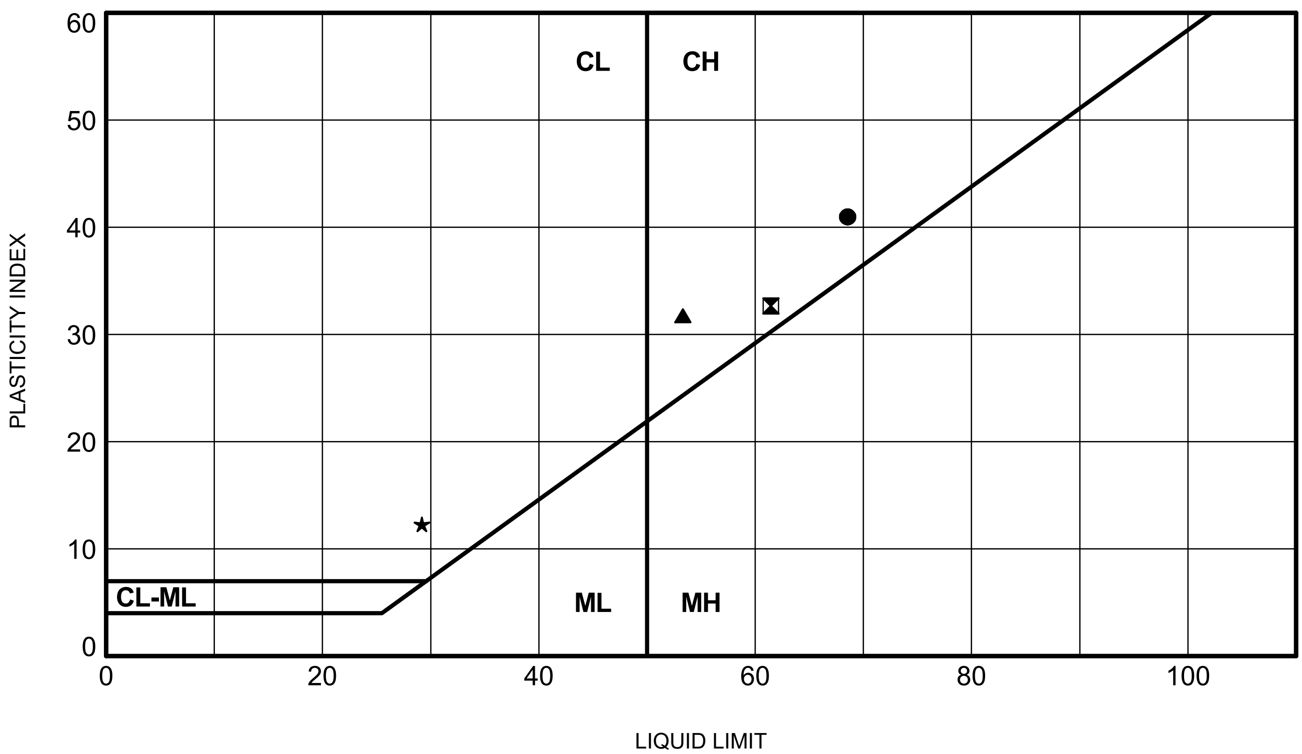
PROJECT NAME: Brakes Plus - N. Texas Ave. & Lonnie Abbott Blvd.
CLIENT: Brakes Plus
PROJECT NUMBER: 024-02476
PROJECT LOCATION: Ada, Oklahoma

BORING NUMBER	SAMPLE I.D.	SAMPLE DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	SATURATION (%)	UNCONFINED STRENGTH (tsf)	STRAIN (%)	ATTERBERG LIMITS			P-200	USCS CLASS.
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
B-01	**SS-1**	1.0 - 2.5'	16.5						69	28	41		CH
B-01	**U-2**	3.5 - 5.0'	24.9	95.5	0.764	87.9	1.5	4.5				40.8	
B-01	**SS-3**	6.0 - 7.5'	29.8										
B-01	**SS-4**	8.5 - 10.0'	26.3						61	29	32	54.2	CH
B-02	**SS-1**	1.0 - 2.5'	18.9										
B-02	**U-3**	6.0 - 7.5'	23.1	103.7	0.625	99.6	1.3	12.0	53	22	31	35.5	SC
B-02	**SS-4**	8.5 - 10.0'	27.1										
P-01	**SS-1**	1.0 - 2.5'	16.9						29	17	12	61.7	CL
P-01	**SS-2**	3.5 - 5.0'	13.8										
P-02	**SS-1**	1.0 - 2.5'	20.0										
P-02	**SS-2**	3.5 - 5.0'	17.5										

OLSSON, INC.
9500 POLE ROAD
OKLAHOMA CITY, OK 73160

ATTERBERG LIMITS RESULTS

PROJECT NAME: Brakes Plus - N. Texas Ave. & Lonnie Abbott Blvd. **CLIENT:** Brakes Plus
PROJECT NUMBER: 024-02476 **PROJECT LOCATION:** Ada, Oklahoma

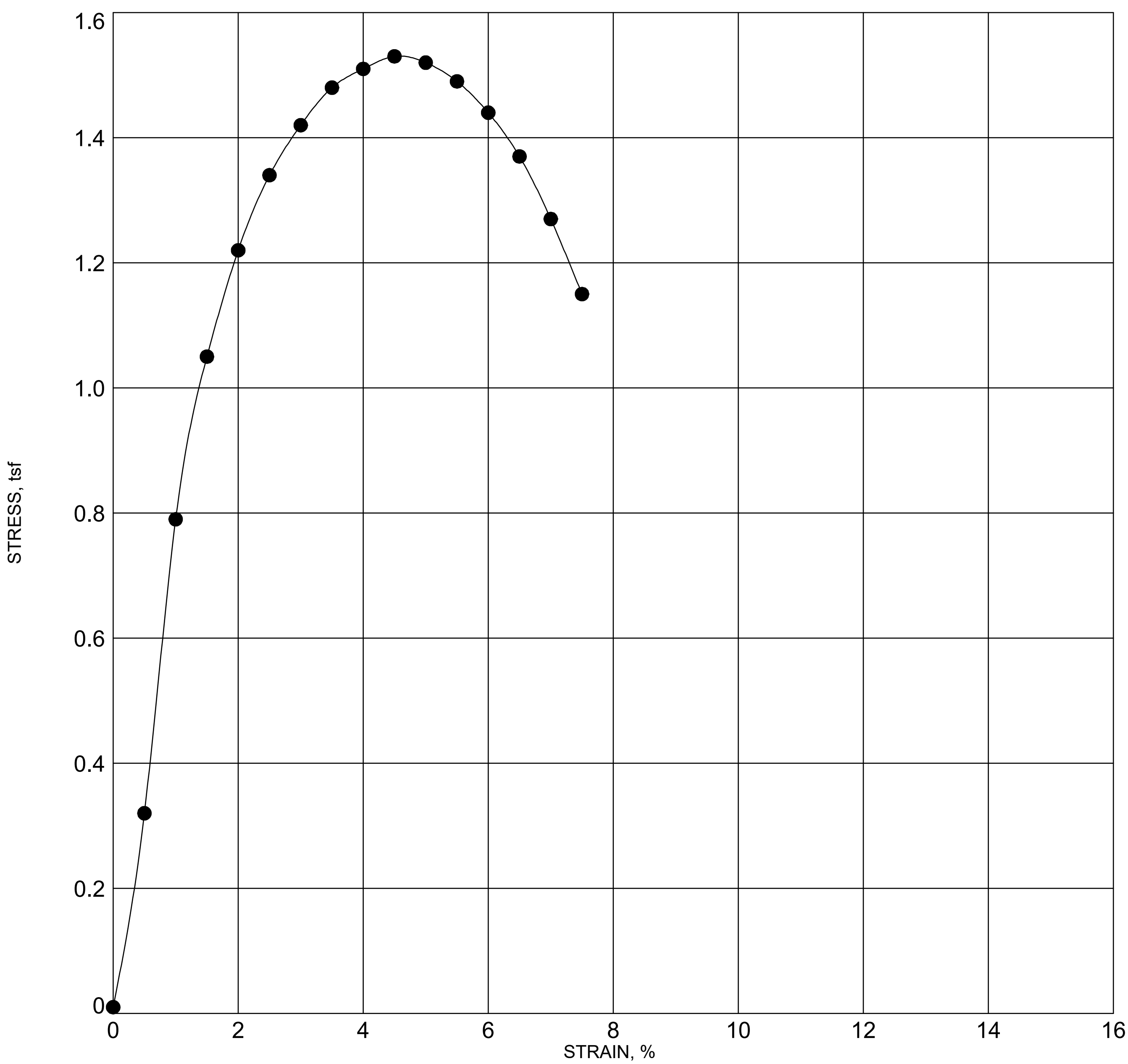


	Boring No.	Sample ID	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Fines (%)	Classification (USCS)
●	**B-01**	**SS-1**	**1.0 - 2.5**	**69**	**28**	**41**		**CH**
⧗	**B-01**	**SS-4**	**8.5 - 10**	**61**	**29**	**32**	**54.2**	**CH**
▲	**B-02**	**U-3**	**6.0 - 7.5**	**53**	**22**	**31**	**35.5**	**SC**
★	**P-01**	**SS-1**	**1.0 - 2.5**	**29**	**17**	**12**	**61.7**	**CL**

OLSSON, INC.
9500 POLE ROAD
OKLAHOMA CITY, OK 73160

UNCONFINED COMPRESSION TEST

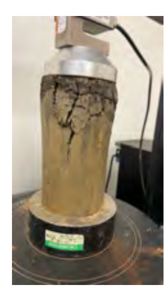
PROJECT NAME: Brakes Plus - N. Texas Ave. & Lonnie Abbott Blvd.
CLIENT: Brakes Plus
PROJECT NUMBER: 024-02476
PROJECT LOCATION: Ada, Oklahoma



Boring No: B-01
Sample Height (in): 5.7
Unconfined Strength (tsf): 1.5

Sample ID: U-2
Sample Diameter (in): 2.8
Strain at Failure (%): 4.5

Sample Depth (ft): 3.5 - 5.0'
Height to Diameter Ratio: 2:1
Sample Break:



Initial Dry Density (pcf): 95.5
Degree of Saturation (%): 87.9

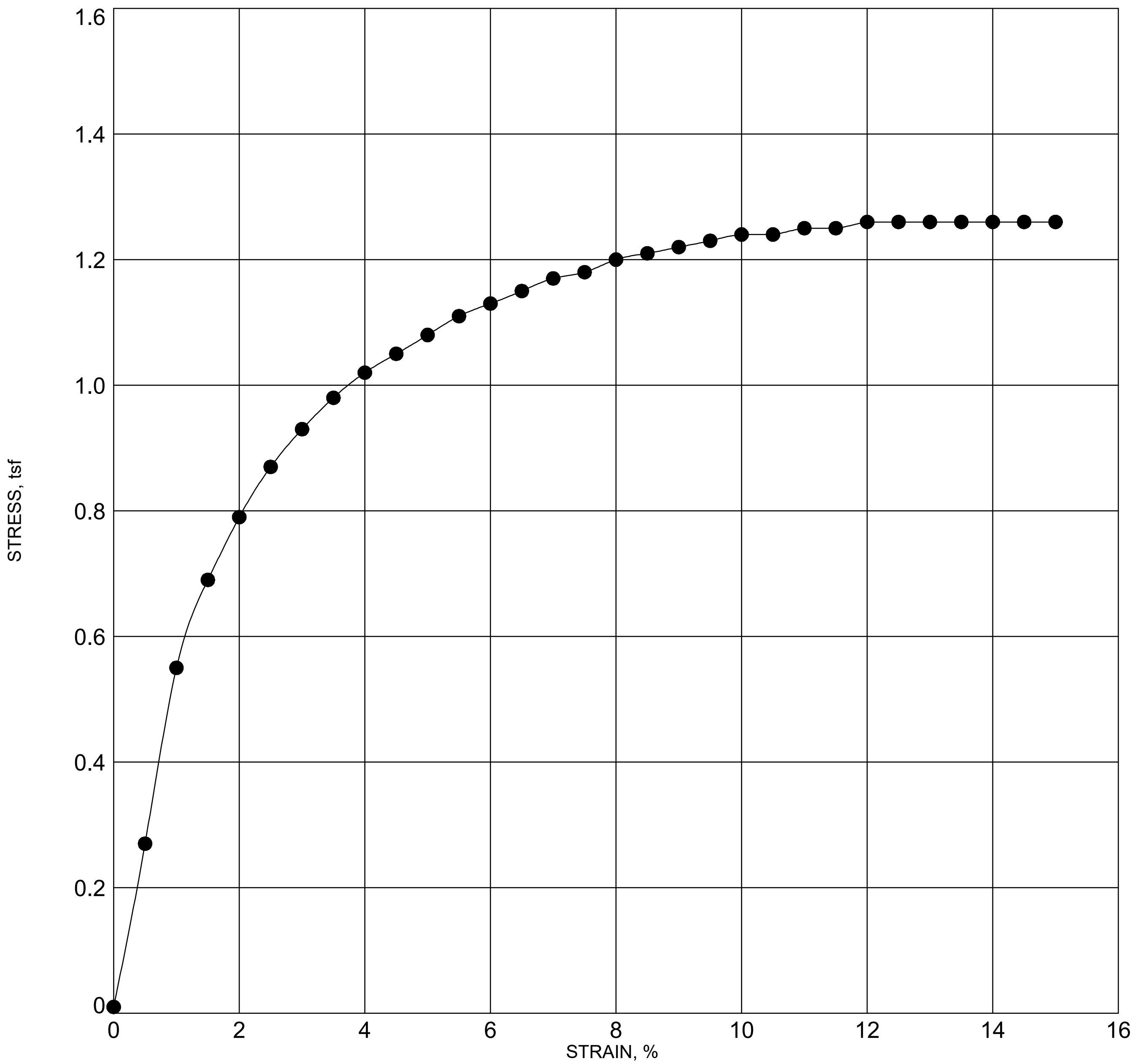
Initial Water Content (%): 24.9
Void Ratio: 0.764

Sample Description:

OLSSON, INC.
9500 POLE ROAD
OKLAHOMA CITY, OK 73160

UNCONFINED COMPRESSION TEST

PROJECT NAME: Brakes Plus - N. Texas Ave. & Lonnie Abbott Blvd. **CLIENT:** Brakes Plus
PROJECT NUMBER: 024-02476 **PROJECT LOCATION:** Ada, Oklahoma



Boring No: B-02
Sample Height (in): 5.7
Unconfined Strength (tsf): 1.3

Sample ID: U-3
Sample Diameter (in): 2.8
Strain at Failure (%): 12.0

Sample Depth (ft): 6.0 - 7.5'
Height to Diameter Ratio: 2:1
Sample Break:

Initial Dry Density (pcf): 103.7
Degree of Saturation (%): 99.6

Initial Water Content (%): 23.1
Void Ratio: 0.625

Sample Description:

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

Olsson Associates	Project: Brakes Plus Ada	
9500 Pole Rd	Project Number: 024-02476	**Reported:**
Oklahoma City OK, 73160	Project Manager: Ms. Delaney Keith	05/29/24 17:02

B2 SS1

E4E0484-01 (Solid) - Sampled: 05/28/24 08:30

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Analyst	Analyzed	Method	Qualifiers
Conventional Chemistry Parameters by EPA Methods									
pH	**8.02**		pH Units	1	EME0606	LDH	05/28/24 14:35	EPA 9045D 2004	H-03
Anions by EPA Method 300.0									
Chloride	**414**	80.0	mg/Kg	50	EME0633	JRH	05/29/24 15:29	EPA 300.0 1993	
Sulfate as SO4	**48.3**	15.0	mg/Kg	5	EME0633	JRH	05/29/24 16:18	EPA 300.0 1993	T-01

Environmental Testing, Inc.

Keith Hopcus For Russell Britten, CEO

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

E4E0484
Original
ETI_OKC_RPT MRL_rev47.0.rpt

E 4 E 0 4 8 4

ENVIRONMENTAL TESTING, INC.

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www.etilab.com

Olsson Associates	Project: Brakes Plus Ada	
9500 Pole Rd	Project Number: 024-02476	**Reported:**
Oklahoma City OK, 73160	Project Manager: Ms. Delaney Keith	05/29/24 17:02

QUALITY CONTROL

Conventional Chemistry Parameters by EPA Methods
Environmental Testing, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifiers
Batch EME0606 - General Prep - Wet Chem (Sd)										
LCS (EME0606-BS1)				**Prepared & Analyzed: 05/28/24**						
pH	7.03		pH Units	7.000		100	99-101			
Duplicate (EME0606-DUP1)		**Source: E4E0412-02**		**Prepared & Analyzed: 05/28/24**						
pH	5.56		pH Units		5.58			0.4	20	

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Olsson Associates	Project: Brakes Plus Ada	
9500 Pole Rd	Project Number: 024-02476	Reported:
Oklahoma City OK, 73160	Project Manager: Ms. Delaney Keith	05/29/24 17:02

QUALITY CONTROL

Anions by EPA Method 300.0
Environmental Testing, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifiers
Batch EME0633 - General Prep - Wet Chem (Sd)										
Blank (EME0633-BLK1)				**Prepared: 05/28/24 Analyzed: 05/29/24**						
Chloride	<1.60	1.60	mg/Kg							
Sulfate as SO4	<3.00	3.00	mg/Kg							
LCS (EME0633-BS1)				**Prepared: 05/28/24 Analyzed: 05/29/24**						
Chloride	6.44	1.60	mg/Kg	6.000		107	90-110			
Sulfate as SO4	30.7	3.00	mg/Kg	30.00		102	90-110			
Matrix Spike (EME0633-MS1)		**Source: E4E0484-01**		**Prepared: 05/28/24 Analyzed: 05/29/24**						
Chloride	670	80.0	mg/Kg	300.0	414	85	80-120			
Sulfate as SO4	1630	150	mg/Kg	1500	ND	108	80-120			
Matrix Spike Dup (EME0633-MSD1)		**Source: E4E0484-01**		**Prepared: 05/28/24 Analyzed: 05/29/24**						
Chloride	660	80.0	mg/Kg	300.0	414	82	80-120	1	20	
Sulfate as SO4	1640	150	mg/Kg	1500	ND	109	80-120	0.8	20	

Environmental Testing, Inc.

Keith Hopcus For Russell Britten, CEO

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Olsson Associates	Project: Brakes Plus Ada	
9500 Pole Rd	Project Number: 024-02476	Reported:
Oklahoma City OK, 73160	Project Manager: Ms. Delaney Keith	05/29/24 17:02

Certifications

Code	Description	Number	Expires
NELAP/OK	NELAP Accredited (ODEQ)	2023-028	08/31/2024
TCEQ	Texas Accedited (TCEQ)	TX-C24-00089	03/31/2025

Qualifiers and Definitions

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

Qualifier	Description
H-03	Sample was received and analyzed past the method holding time.
T-01	The sample was received outside of the regulatory temperature for this analysis.

BRAKES PLUS – 1201 LONNIE ABBOT BLVD.

Oklahoma City, Oklahoma

May 2024

Olsson Project No. 024-02476

LICENSED PROFESSIONAL ENGINEER
SHAMEEM A. DEWAN
34417
5-31-2024
OKLAHOMA