GEOTECHNICAL ENGINEERING REPORT

Brakes Plus Northstar Crossing
Lincoln, Nebraska

Prepared for:
Express Oil

Birmingham, Alabama

December 2024

Olsson Project No. 024-05713

Nebraska Certificate of Authorization #: CA-0638

olsson®

December 6, 2024

Express Oil
Attn: Ashley Bernatski
1880 SouthPark Drive
Birmingham, Alabama 35244

RE: Geotechnical Engineering Report
Brakes Plus Northstar Crossing
Lincoln, Nebraska
Olsson Project No. 024-05713

Dear Ms. Bernatski:

In general accordance with our “Letter Agreement for Professional Services” dated September 25, 2024, Olsson, Inc. has completed the authorized geotechnical exploration for the above-referenced project. The geotechnical exploration was conducted to evaluate the 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 exploration and laboratory testing, discusses the observed subsurface conditions, and provides our geotechnical engineering recommendations.

A boring location map, boring logs, and a description of our exploration program, are provided in **Appendix A**. Laboratory test results are presented in **Appendix B**.

We appreciate the opportunity to provide our geotechnical engineering services for this project and 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.
Nebraska Certificate of Authority No. CA-0638

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EXECUTIVE SUMMARY

This report discusses the geotechnical exploration and recommendations for the proposed construction of a single-story, slab on grade Brakes Plus in Lincoln, Nebraska. Subsurface water was not encountered in any of our soil borings and is not anticipated to impact shallow foundation construction activities. Based on our exploration and analyses, previously placed fill soils and newly placed structural fill soils are suitable for supporting the proposed structure, if the soils are prepared in accordance with the recommendations throughout this report.

Previously placed fill was encountered in all our soil borings across the project site to depths ranging from 3.5 to 6 feet below existing grades. The existing fill soils appear to have been placed with some degree of compaction and moisture-conditioning based on laboratory testing.

Based on laboratory testing, previously placed fill soils exhibit expansive characteristics and could swell if exposed to an increase in moisture content. Therefore, remedial measures are needed below the floor slabs and pavements to reduce the risk of swell potential. We recommend 24 to 36 inches of lean clay (CL) structural fill materials support the concrete floor slabs while 12 to 24 inches of lean clay (CL) structural fill materials support the pavements. The lean clay support thickness should not comprise glacial till soils.

If the recommendations throughout this report are followed, a net allowable bearing capacity of 2,500 pounds per square foot (psf) can be used for the design of structure foundations.

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 commercial building will comprise a single-story, slab-on-grade structure. We anticipate the structure will generally be of wood frame. **Table 1** summarizes project information used as part of this investigation.

Table 1. Project Information.

Project Detail	Value	Notes
Approximate Plan Area	5,000 ft^2	Provided by Olsson Design Team
Finished Floor Elevation	1190.25	
Maximum Column Load	150 kips	Estimated based on experience with similar projects
Maximum Wall Load	4 kips per lineal foot (klf)	

Based on the topographic survey performed by the Olsson Survey team, existing site grades range from an elevation of approximately 1189 to 1191 in the building pad. As such, up to 2 feet of fill and 2 feet of excavation may be required to achieve the design site grades in the building pad.

If the structural loads or site grading exceed 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.

1.2 Site Description

The proposed commercial building will be located on northeast corner of the intersection of North 27th Street and Enterprise Drive in Lincoln, Nebraska. At the time of our field exploration, the site surface comprised grass surfacing and was accessible to a truck-mounted drilling rig.

The approximate location of the new structure is shown in **Figure 1**.

Figure 1. 2024 Google Earth Aerial Photograph

2. SUBSURFACE CONDITIONS

2.1 Subsurface Profile

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 fill materials underlain by glacial deposits. The general characteristics of each soil stratum are summarized below, with more detailed descriptions provided on the borehole reports in **Appendix A**.

Surfacing and Topsoil

We encountered a 4- to 6-inch-thick topsoil zone in all our borings across the project site.

Existing Fill

We encountered existing fill in all our borings across the project site, extending to depths ranging from 3.5 to 6 feet. Fill materials generally comprised fat clay (CH) or lean to fat clay (CL/CH) and were described as stiff to hard, grayish brown to dark reddish brown, and slightly moist to moist. Generally, the parent material of the existing fill materials appears to be glacial till.

Glacial Till

We encountered glacial till deposits in all our borings across the project site, extending from depths of 3.5 feet to boring termination depths ranging from 15 to 25 feet. Glacial till soils generally comprised lean to fat clay (CL/CH) and were described as stiff to hard, light brown to gray, and moist.

2.2 Water Level Observations

Subsurface water was not encountered in the soil test borings at the time of drilling operations. However, 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. Any retaining wall foundation design or global stability analysis must take into consideration changing water conditions.

3. GEOTECHNICAL CONSIDERATIONS

Previously placed fill was encountered in all our soil borings across the project site at depths ranging from 3.5 to 6 feet below existing grades. Based on results of laboratory tests performed on samples recovered from the existing fill, these materials generally appear to have been placed with some degree of compactive effort. Recommendations are provided in this report to support the new foundations directly on existing fill materials and floor slabs directly on newly placed structural fill.

Based on the results of the laboratory testing, the on-site existing fill materials exhibit expansive characteristics and may swell when exposed to an increase in moisture content. Therefore, remedial measures are needed below floor slabs and pavements to reduce the risk of swell potential. Refer to **Section 4.2.1** for recommendations on overexcavation depths below floor slabs and **Section 5.1** for recommendations on overexcavation depths below pavements.

Based on laboratory testing and our engineering analyses, previously placed fill may require blending with less plastic materials before reuse as structural fill. Refer to **Section 6.2** for structural fill placement recommendations.

Groundwater was not encountered in any of our soil borings across the project site. If groundwater is encountered during any construction activities, the contractor should use their means and methods for dewatering accordingly.

4. STRUCTURES DESIGN

Based on the results of our borings, laboratory testing, engineering evaluation, and that the finished floor elevation (FFE) is 1190.25, our opinion is that the subsurface conditions are suitable for supporting the proposed structure on a shallow foundation system.

4.1 Shallow Foundation Design Parameters

Design parameters for shallow foundations supported in existing fill materials are tabulated below.

Table 2. Shallow Foundation Design Parameters.

Design Parameter	Recommended Value
Net Allowable Soil Bearing Pressure	2,500 psf
Estimated Total Settlement	< 1 inch
Estimated Differential Settlement	< 0.5 inches
Minimum Exterior Foundation Depth	3.5 feet

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 0.30 may be used to evaluate sliding resistance of shallow foundations supported on undisturbed native soils or properly compacted structural fill. Please see **Section 4.3** for information regarding lateral earth pressures.

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 laboratory testing, the on-site existing fill materials exhibit expansive characteristics and could swell if exposed to an increase in moisture content. Therefore, remedial measures will be needed below the proposed floor slabs to reduce the risk for swell potential. We recommend floor slabs be supported by a minimum of 24 to 36 inches of lean clay (CL) structural fill. The lean clay (CL) structural fill soils should not comprise glacial till soils. 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 the 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 5** or be stabilized in accordance with **Section 6.2**.

Provided the recommendations presented in this report are implemented, a subgrade modulus of 110 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 5** prior to slab placement. In finished 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 Lateral Earth Pressures

The following soil parameters are provided for designing cast-in-place concrete cantilevered retaining walls and/or foundation walls subject to lateral earth pressures. These parameters are based on the assumption that retained soils will be similar in composition to the on-site soils encountered during this investigation. These recommendations are not applicable to the design of modular block - geogrid reinforced backfill (MSE) or gravity block walls. Recommendations for these types of wall systems are beyond the scope of this report.

Walls which are rigidly restrained at the top and are essentially unable to deflect or rotate should be designed for at rest earth pressure conditions. Walls that are unrestrained at the top and are free to deflect or rotate slightly may be designed for active earth pressure conditions. The passive earth pressure condition is used to evaluate the resistance of soil to lateral loads. **Table 3** presents recommended values of earth pressure coefficients and equivalent fluid densities based on our experience with soils in the area.

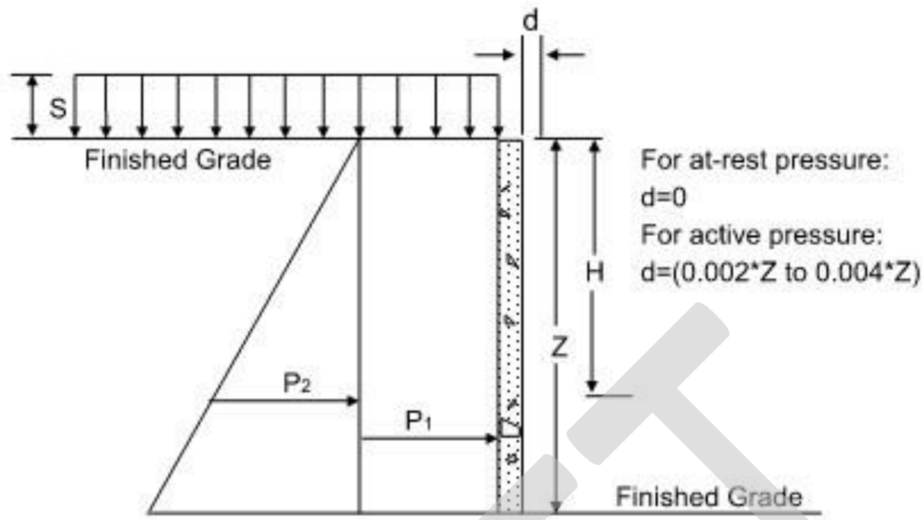
Table 3. Earth Pressure Parameters.

Earth Pressure Coefficient (K)			Equivalent Fluid Density (G)	
			Drained Condition (pcf)	Undrained Condition (pcf)
At Rest (K_0)	Cohesive	0.56	70	95
	Granular*	0.47	55	--
Active (K_a)	Cohesive	0.39	50	85
	Granular*	0.31	40	--
Passive (K_p)	Cohesive	2.56	305	210
	Granular*	3.25	390	--

**Granular values may be used for design only if a drainage system is installed and the granular backfill extends upward from the base of the wall as noted below.*

The above parameters are based on the considerations noted below and are shown in **Figure 2**, below.

- Equivalent fluid densities do not include a factor of safety or consider the effects of surcharge loading (P_1), point loads, or construction equipment loads.
- Mobilization of active pressure requires the wall rotate about the base, with top-of-wall movements (d) on the order of 0.002*Z to 0.004*Z (granular) or 0.010*Z to 0.020*Z (cohesive), where Z is the wall height.
- Mobilization of passive pressure requires a lateral wall movement (d) on the order of 0.020*Z to 0.060*Z (granular) or 0.020*Z to 0.040*Z (cohesive), where Z is the wall height.
- Drained earth pressure parameters assume a permanent drainage system is installed behind the wall to prevent the development of hydrostatic pressure.
- Backfill has a maximum unit weight of 120 pcf.
- The ground surface in front of and behind the wall is horizontal.



Legend of Symbols			
Z	Wall Height (ft)	**P_1**	Surcharge Pressure (psf)
H	Depth Below Surface (ft)	**P_2**	Earth Load (psf)
d	Wall Displacement (ft)	**K**	Earth Pressure Coefficient
S	Surcharge Load (psf)	**G**	Equivalent Fluid Density (pcf)
Pressure Calculations			
Surcharge Pressure	P_1 (psf) = K x S (psf)	**Earth Pressure**	P_2 (psf) = G (pcf) x H (ft)

Figure 2. Lateral Earth Pressure Calculations.

Backfill soils placed within a lateral distance from the face of the wall to 70 percent of the wall height should consist of granular material or select lean clay with a liquid limit less than 45. To utilize earth pressure parameters for granular materials, the granular backfill must extend out from the base of the wall at angles of 45 and 60 degrees from the vertical for the active and passive cases, respectively.

Sliding resistance along the base of a wall supported on suitable native soils or properly compacted structural fill may be evaluated using an ultimate sliding friction value of 0.30. Appropriate factors of safety should be applied to the calculated lateral earth pressures and sliding friction resistance. This factor of safety typically ranges from 1.5 to 2. Passive earth pressure resistance should be neglected within the frost zone (typically 3.5 feet).

If a foundation key is considered to resist lateral sliding loads using passive earth pressure, the key should be placed below the wall stem or to the toe side of the wall stem. Sliding resistance along the base of the foundation should be neglected within the passive earth pressure zone.

4.4 Seismic Site Classification

For this project site, the soil conditions encountered at the boring are consistent with Site Class "D" as defined by ASCE 7. 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 native materials to those encountered which extend to a depth of 100 feet.

4.5 Permanent Slopes

We recommend permanent cut or fill slopes be shallower 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 from any foundation and at least 5 feet 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.

4.6 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 5**. 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.

Based on the results of laboratory testing, the on-site existing fill materials exhibit expansive characteristics and could swell if exposed to an increase in moisture content. Therefore, remedial measures will be needed below the proposed pavements to reduce the risk for swell potential. We recommend the proposed pavements be supported by a minimum of 12 to 24 inches of lean clay (CL) structural fill and not comprise of glacial till soils. 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 produces 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 5** or be stabilized in accordance with **Section 6.2**.

5.2 Recommended Pavement Sections

Pavement design is influenced by the anticipated traffic loads and volume, site subgrade conditions, pavement materials, 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.

Our recommended minimum pavement thicknesses are presented below. These minimum thicknesses are based on our experience with similar pavement applications and recognized structural coefficients.

Table 4. Recommended Pavement Sections.

<table>
<tr><th rowspan="2"></th><th rowspan="2">Layer</th><th rowspan="2">Material</th><th colspan="2">Layer Thickness (inches)</th></tr>
<tr><th>Standard Vehicle Areas</th><th>Heavy Vehicle Areas</th></tr>
<tr><td rowspan="3">Full Depth AC</td><td>AC Surface Course</td><td>NDOT Section 1028, Asphaltic Concrete, Type SPR</td><td>1.5</td><td>2.0</td></tr>
<tr><td>AC Base Course</td><td>NDOT Section 1028, Asphaltic Concrete, Type SPR</td><td>4.5</td><td>6.0</td></tr>
<tr><td>Subgrade</td><td>Prepared in accordance with Section 6.2</td><td>12.0 to 24.0</td><td>12.0 to 24.0</td></tr>
<tr><td rowspan="2">Portland Cement Concrete</td><td>PCC</td><td>NDOT Section 1002, Portland Cement Concrete</td><td>5.0</td><td>7.0</td></tr>
<tr><td>Subgrade</td><td>Prepared in accordance with Section 6.2</td><td>12.0 to 24.0</td><td>12.0 to 24.0</td></tr>
</table>

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. The heavy-duty pavement sections noted above assume a maximum of 10 tractor-trailers or single-unit trucks per day for the design life of the pavement. 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.

Because parking lots are subjected to slow-moving and static load conditions, PG64-34 asphalt cement is recommended for the surface and base course. This grade of asphalt cement produces an asphaltic concrete that is less susceptible to rutting and creep caused by slow-moving or static loads during warm periods. We recommend minimum asphaltic cement pavement surface course thicknesses of 1.5 inches in standard duty areas and 2 inches in heavy duty areas.

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 General Site Preparation

Vegetation, topsoil, roots, pavements, 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 or demolition excavations and prior to the placement of structural fill, we recommend the top 9 inches of the exposed subgrade soils be scarified and recompacted in accordance with **Section 6.2** of this report.

As previously discussed, the on-site existing fill materials exhibit expansive characteristics and could swell if exposed to an increase in moisture content. Therefore, we recommend floor slabs be supported by a minimum of 24 to 36 inches of lean clay (CL) structural fill, as described in **Section 4.2.1**. In addition, we recommend pavements be supported by a minimum of 12 to 24 inches of lean clay (CL) structural fill, as described in **Section 5.1**.

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, 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 24 to 36 inches of the base of the floor slab aggregate base (if used) have a liquid limit less than 45, and a plasticity index less than 25, and not comprise glacial till soil. We recommend structural fill soils within 12 to 24 inches of the base of pavements have a liquid limit less than 50, and a plasticity index less than 30, and not comprise glacial till soil. Soils with Atterberg limits greater than these values will require removal or blending 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 as noted below.

- Existing fill
    - Suitable for reuse at depths greater than 24 to 36 inches below the bottom of the floor slabs and 12 to 24 inches below the base of pavements unless blended with less plastic materials
- Glacial Till
    - Suitable for reuse at depths greater than 24 to 36 inches below the base of floor slabs and 12 to 24 inches below the base of 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 5**. 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 5. Structural Fill Placement Guidelines.

Area of Fill Placement	Compaction (ASTM D698 - Standard Proctor)	Moisture Content (Percent of Optimum)
Granular cushion beneath floor slabs/pavements (if used)	98%*	As necessary to obtain density
Floor Slab Subgrade – 24 to 36 in. below base of floor slab	98%	Optimum to +3 percent
Pavement Subgrade – 12 to 24 in. below base of pavement/granular cushion	98%	Optimum to +3 percent
Structural fill placed below floor slab or pavement subgrade	98%	-1 to +3 percent
Utility trenches	98%	Optimum to +3 percent
Landscaping/Grass Areas	92%	As necessary to obtain density

** 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

Groundwater was not encountered in any of our borings across the project site. While we do not anticipate groundwater will affect shallow construction activities, it may be a factor in utility excavations. 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.

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, pavement areas and existing utilities were present within the area 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 several 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, 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.

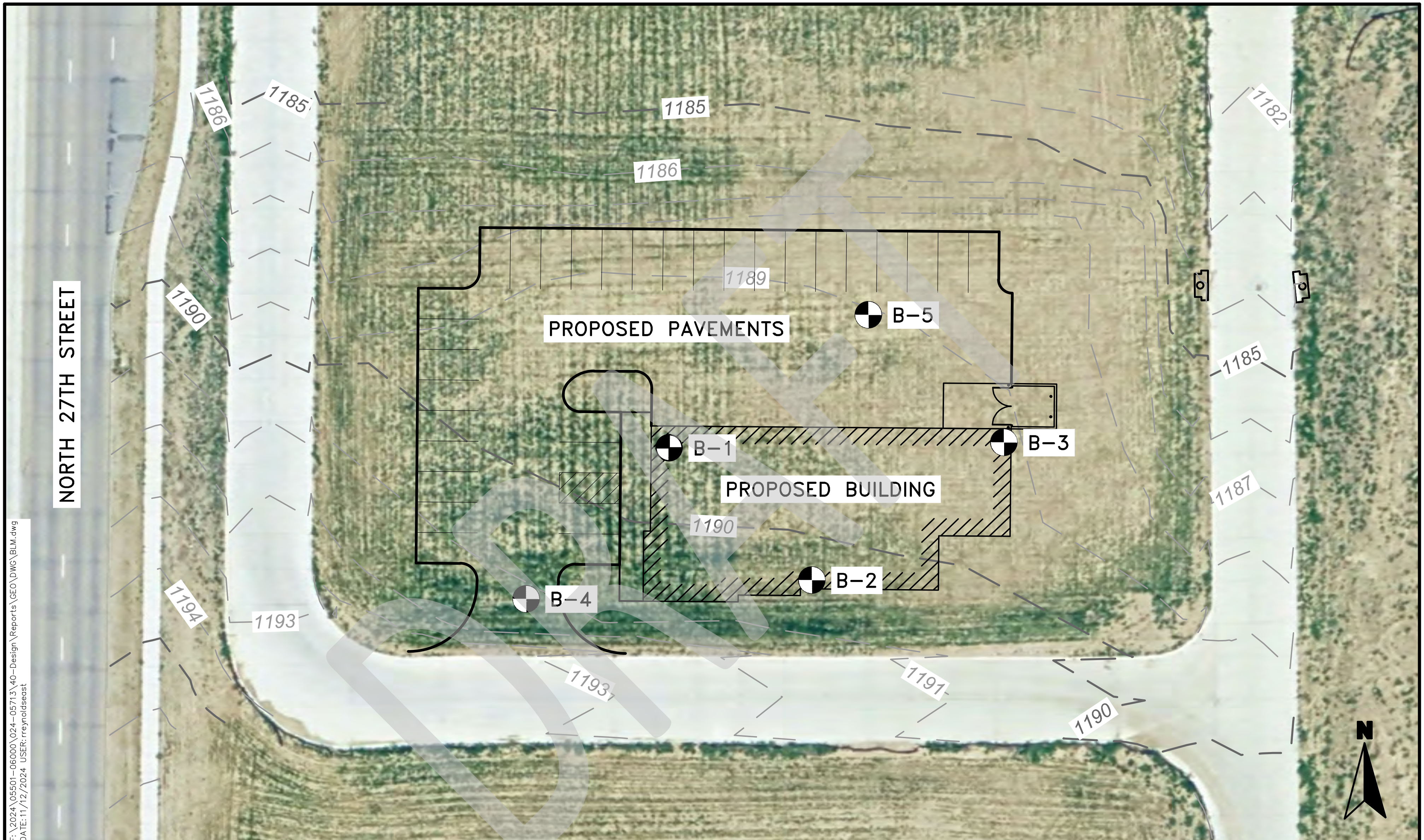
In the event of any changes in the nature of the proposed project as outlined in this report, the opinions in this report cannot be considered valid unless Olsson reviews the changes, and the opinions of this report are modified or affirmed by Olsson.

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 Express Oil and their authorized representatives for specific application to the discussed project.

APPENDIX A

Exploration Map, Logs, and Information



LEGEND

SOIL BORING LOCATION

0 20 40 80

SCALE IN FEET

olsson

PROJECT: 024-05713

DATE: 10/29/24

DRAWN BY: RARE

BORING LOCATION MAP

LINCOLN, NEBRASKA

1101 Libra Drive, Suite 2
Lincoln, NE 68512

TEL 402.458.5052
www.olsson.com

SYMBOLS AND NOMENCLATURE

DRILLING NOTES

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon Sample (1.375” ID, 2.0” OD)	HSA:	Hollow Stem Auger	NE:	Not Encountered
U:	Thin-Walled Tube Sample (3.0” OD)	CFA:	Continuous Flight Auger	NP:	Not Performed
CS:	Continuous Sample	HA:	Hand Auger	NA:	Not Applicable
BS:	Bulk Sample	CPT:	Cone Penetration Test	% Rec:	Percent of Recovery
MC:	Modified California Sampler	WB:	Wash Bore	WD:	While Drilling
GB:	Grab Sample	RB:	Rock Bit	IAD:	Immediately After Drilling
SPT:	Standard Penetration Test Blows per 6.0”	PP:	Pocket Penetrometer	AD:	After Drilling

DRILLING PROCEDURES

Soil samples designated as “U” samples on the boring logs were obtained in using Thin-Walled Tube Sampling techniques. Soil samples designated as “SS” samples were obtained during Penetration Test using a Split-Spoon Barrel sampler. The standard penetration resistance ‘N’ value is the number of blows of a 140-pound hammer falling 30 inches to drive the Split-Spoon sampler one foot. Soil samples designated as “MC” were obtained in using Thick-Walled, Ring-Lined, Split-Barrel Drive sampling techniques. Recovered samples were sealed in containers, labeled, and protected for transportation to the laboratory for testing.

WATER LEVEL MEASUREMENTS

Water levels indicated on the boring logs are levels measured in the borings at the times indicated. In relatively high permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with only short-term observations.

SOIL PROPERTIES & DESCRIPTIONS

Descriptions of the soils encountered in the soil test borings were prepared using Visual-Manual Procedures for Descriptions and Identification of Soils.

PARTICLE SIZE

Boulders	12 in. +	Coarse Sand	4.75mm-2.0mm	Silt	0.075mm-0.005mm
Cobbles	12 in.-3 in.	Medium Sand	2.0mm-0.425mm	Clay	<0.005mm
Gravel	3 in.-4.75mm	Fine Sand	0.425mm-0.075mm		

COHESIVE SOILS

Consistency	Unconfined Compressive Strength (Qu) (tsf)
Very Soft	<0.25
Soft	0.25 – 0.5
Firm	0.5 – 1.0
Stiff	1.0 – 2.0
Very Stiff	2.0 – 4.0
Hard	> 4.0

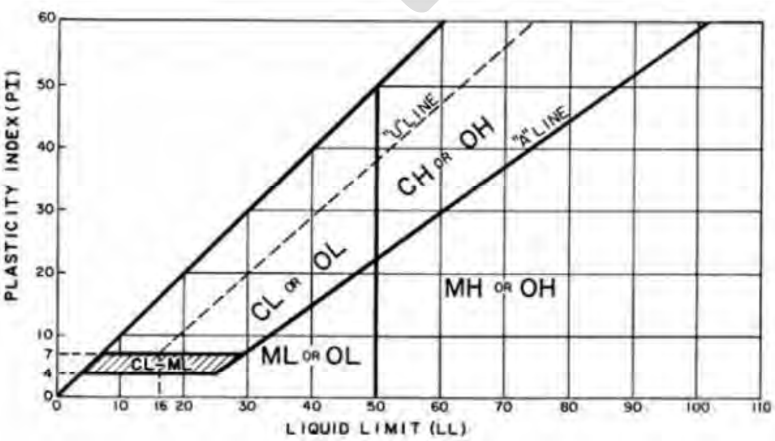
COHESIONLESS SOILS

Relative Density	‘N’ Value
Very Loose	0 – 3
Loose	4 – 9
Medium Dense	10 – 29
Dense	30 – 49
Very Dense	≥ 50

COMPONENT %

Description	Percent (%)
Trace	<5
Few	5 - 10
Little	15 - 25
Some	30 - 45
Mostly	50 - 100

PLASTICITY CHART



ROCK QUALITY DESIGNATION (RQD)

Description	RQD (%)
Very Poor	0 – 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 – 100

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SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

BOREHOLE REPORT NO. B-1

PROJECT NAME: **Brakes Plus Northstar Crossing**

CLIENT: **Express Oil**

PROJECT NUMBER: **024-05713**

LOCATION: **Lincoln, Nebraska**

Legend: Shelby Tube; Split Spoon

APPROX. SURFACE ELEV. (ft): 1189.5

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
	TOPSOIL 0.3'	0								
	FILL									
	Fat clay (CH): Hard, dark brown, moist, trace fine gravel, trace iron staining		U 1				15.8	113.4		
1185	*Fat clay (CH): Hard, light brown, moist, trace fine to coarse sand* 6.0'	5	U 2			6.4	15.1	112.9		
	GLACIAL TILL									
	Lean to fat clay (CL/CH): Stiff, grayish brown, moist, trace fine sand, trace calcium, trace manganese, trace iron staining		U 3				18.6	108.6		
1180	*Lean to fat clay (CL/CH): Stiff, light brown, moist, trace fine sand*	10	SS 4		3-6-8 N=14		18.7			
1175	*Lean to fat clay (CL/CH): Stiff, grayish brown, moist, trace fine sand, trace calcium, trace iron staining*	15	U 5				20.5	109.0		
1170	*Lean to fat clay (CL/CH): Very stiff, grayish brown, moist, trace fine sand, trace calcium* 20.0'	20	SS 6		4-6-10 N=16					

CONTINUED NEXT PAGE

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

OLSSON, INC.
1101 LIBRA DRIVE, STE 2
LINCOLN, NEBRASKA 68512

STARTED:	10/28/24	FINISHED:	10/28/24
DRILL CO.:	OLSSON	DRILL RIG:	CME 75
DRILLER:	B. WHITLA	LOGGED BY:	D. LUDWIG
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-1

PROJECT NAME	CLIENT
Brakes Plus Northstar Crossing	Express Oil
PROJECT NUMBER	LOCATION
024-05713	Lincoln, Nebraska

Legend: Shelby Tube; 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
	GLACIAL TILL		20								
1165	*Lean to fat clay (CL/CH): Very stiff, grayish brown, moist, trace fine sand, trace iron staining* ***25.0'***		25	U 7							

BASE OF BORING AT 25.0 FEET

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

OLSSON, INC.
1101 LIBRA DRIVE, STE 2
LINCOLN, NEBRASKA 68512

STARTED:	10/28/24	FINISHED:	10/28/24
DRILL CO.:	OLSSON	DRILL RIG:	CME 75
DRILLER:	B. WHITLA	LOGGED BY:	D. LUDWIG
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-2

PROJECT NAME	CLIENT
Brakes Plus Northstar Crossing	Express Oil
PROJECT NUMBER	**LOCATION**
024-05713	Lincoln, Nebraska

Legend: Shelby Tube; Split Spoon

APPROX. SURFACE ELEV. (ft): 1190.5

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
		0								
1190	*TOPSOIL* (0.3')									
	FILL									
	Lean to fat clay (CL/CH): Very stiff, grayish brown, slightly moist, trace fine to coarse sand		U 1	CL/CH			14.0	111.2	49/29	
	Lean to fat clay (CL/CH): Very stiff, grayish brown, moist, trace fine sand, trace manganese, trace iron staining	5	U 2			2.4	17.9	107.4		
1185	(6.0')									
	GLACIAL TILL									
	Lean to fat clay (CL/CH): Very stiff, brown, moist		U 3				20.1	103.8		
	Lean to fat clay (CL/CH): Hard, grayish brown, moist, trace fine sand, trace calcium, trace iron staining	10	U 4			4.7	18.7	108.8		
1180										
	Lean to fat clay (CL/CH): Very stiff, grayish brown, moist, trace fine sand, trace calcium, trace iron staining	15	SS 5		6-8-19 N=27					
1175										
	Lean to fat clay (CL/CH): Hard, grayish brown, moist, trace fine to coarse sand, trace calcium, trace iron staining (20.0')	20	SS 6		7-14-24 N=38		19.4			
	BASE OF BORING AT 20.0 FEET									

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

OLSSON, INC.
1101 LIBRA DRIVE, STE 2
LINCOLN, NEBRASKA 68512

STARTED:	10/28/24	FINISHED:	10/28/24
DRILL CO.:	OLSSON	DRILL RIG:	CME 75
DRILLER:	B. WHITLA	LOGGED BY:	D. LUDWIG
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-3

PROJECT NAME	CLIENT
Brakes Plus Northstar Crossing	Express Oil
PROJECT NUMBER	**LOCATION**
024-05713	Lincoln, Nebraska

Legend: Shelby Tube (solid); Split Spoon (X)

APPROX. SURFACE ELEV. (ft): 1189.0

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
	TOPSOIL — 0.5'		0								
	FILL										
	Lean to fat clay (CL/CH): Stiff, dark brown, moist, trace fine sand, trace iron staining			U 1			1.8	15.2	106.2		
1185	*Lean to fat clay (CL/CH): Hard, dark reddish brown, slightly moist, trace fine sand, trace iron staining* — 6.0'		5	U 2			4.9	12.9	113.1		
	GLACIAL TILL										
	Lean to fat clay (CL/CH): Stiff, grayish brown, moist, trace fine sand, trace iron staining			U 3				21.7	104.1		
1180	*Lean to fat clay (CL/CH): Stiff, grayish brown, moist, trace fine sand, trace calcium, trace iron staining*		10	U 4				17.1	111.7		
1175	*Lean to fat clay (CL/CH): Stiff, grayish brown, moist, trace fine sand, trace calcium, trace iron staining*		15	U 5							
1170	*Lean to fat clay (CL/CH): Stiff, grayish brown, moist, trace fine to coarse sand, trace calcium, trace iron staining* — 20.0'		20	SS 6		4-7-8 N=15					

BASE OF BORING AT 20.0 FEET

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

OLSSON, INC.
1101 LIBRA DRIVE, STE 2
LINCOLN, NEBRASKA 68512

STARTED:	10/28/24	FINISHED:	10/28/24
DRILL CO.:	OLSSON	DRILL RIG:	CME 75
DRILLER:	B. WHITLA	LOGGED BY:	D. LUDWIG
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-4

PROJECT NAME: **Brakes Plus Northstar Crossing**

CLIENT: **Express Oil**

PROJECT NUMBER: **024-05713**

LOCATION: **Lincoln, Nebraska**

Legend: Shelby Tube; Split Spoon

APPROX. SURFACE ELEV. (ft): 1191.0

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
	TOPSOIL ***0.4'***		0								
1190	***FILL***										
	Lean to fat clay (CL/CH): Stiff, brown, moist, trace fine to coarse sand, trace iron staining			U 1				15.9	106.9		
	Lean to fat clay (CL/CH): Stiff, grayish brown, moist		5	U 2							
1185	***6.0'***										
	GLACIAL TILL										
	Lean to fat clay (CL/CH): Stiff, grayish brown, moist, trace fine to coarse sand, trace calcium, trace iron staining			U 3				21.2	106.3		
	Lean to fat clay (CL/CH): Stiff, grayish brown, moist, trace fine to coarse sand, trace calcium, trace iron staining		10	U 4							
1180											
	Lean to fat clay (CL/CH): Stiff, grayish brown, moist, trace fine to coarse sand, trace calcium, trace iron staining ***15.0'***		15	SS 5		5-6-7 N=13		22.9			

BASE OF BORING AT 15.0 FEET

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

OLSSON, INC.
1101 LIBRA DRIVE, STE 2
LINCOLN, NEBRASKA 68512

STARTED:	10/28/24	FINISHED:	10/28/24
DRILL CO.:	OLSSON	DRILL RIG:	CME 75
DRILLER:	B. WHITLA	LOGGED BY:	D. LUDWIG
METHOD: CONTINUOUS FLIGHT AUGER			

olsson	BOREHOLE REPORT NO. B-5	Sheet 1 of 1

PROJECT NAME	CLIENT
Brakes Plus Northstar Crossing	Express Oil
PROJECT NUMBER 024-05713	LOCATION Lincoln, Nebraska

Legend: Shelby Tube; Split Spoon

APPROX. SURFACE ELEV. (ft): 1189.0

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
	TOPSOIL **0.3'**		0								
	FILL *Lean to fat clay (CL/CH): Stiff, brown, moist, trace fine sand, trace iron staining* **3.5'**			U 1				17.1	103.9		
1185	***GLACIAL TILL*** *Lean to fat clay (CL/CH): Stiff, brown, moist, trace fine sand, trace iron staining*		5	U 2							
	Lean to fat clay (CL/CH): Stiff, dark brown, moist, trace fine to medium sand			U 3				21.5	104.2		
1180	*Lean to fat clay (CL/CH): Stiff, gray, moist, trace fine to medium sand*		10	U 4				17.4			
1175	*Lean to fat clay (CL/CH): Stiff, gray, moist, trace fine to medium sand, trace calcium, trace iron staining* **15.0'**		15	SS 5		3-6-8 N=14					

BASE OF BORING AT 15.0 FEET

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

OLSSON, INC.
1101 LIBRA DRIVE, STE 2
LINCOLN, NEBRASKA 68512

STARTED:	10/28/24	FINISHED:	10/28/24
DRILL CO.:	OLSSON	DRILL RIG:	CME 75
DRILLER:	B. WHITLA	LOGGED BY:	D. LUDWIG
METHOD: CONTINUOUS FLIGHT AUGER			

Field Exploration

A drill crew advanced the 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.

APPENDIX B
Laboratory Test Results

OLSSON, INC.
1101 LIBRA DRIVE, STE 2
LINCOLN, NEBRASKA 68512

SUMMARY OF LABORATORY RESULTS

PROJECT NAME: Brakes Plus Northstar Crossing
CLIENT: Express Oil
PROJECT NUMBER: 024-05713
PROJECT LOCATION: Lincoln, Nebraska

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	PLASTIC INDEX		
B-1	**U-1**	1.0 - 2.5'	15.8	113.4	0.487	87.9							
B-1	**U-2**	3.5 - 5.0'	15.1	112.9	0.493	82.8	6.4	3.3					
B-1	**U-3**	6.0 - 7.5'	18.6	108.6	0.552	90.8							
B-1	**SS-4**	8.5 - 10.0'	18.7										
B-1	**U-5**	13.5 - 15.0'	20.5	109.0	0.547	100.0							
B-2	**U-1**	1.0 - 2.5'	14.0	111.2	0.516	73.1			49	20	29		CL/CH
B-2	**U-2**	3.5 - 5.0'	17.9	107.4	0.569	84.8	2.4	3.2					
B-2	**U-3**	6.0 - 7.5'	20.1	103.8	0.624	86.8							
B-2	**U-4**	8.5 - 10.0'	18.7	108.8	0.549	92.0	4.7	2.2					
B-2	**SS-6**	18.5 - 20.0'	19.4										
B-3	**U-1**	1.0 - 2.5'	15.2	106.2	0.587	70.0	1.8	3.1					
B-3	**U-2**	3.5 - 5.0'	12.9	113.1	0.491	70.7	4.9	3.1					
B-3	**U-3**	6.0 - 7.5'	21.7	104.1	0.620	94.5							
B-3	**U-4**	8.5 - 10.0'	17.1	111.7	0.509	90.5							
B-4	**U-1**	1.0 - 2.5'	15.9	106.9	0.577	74.2							
B-4	**U-3**	6.0 - 7.5'	21.2	106.3	0.586	97.9							
B-4	**SS-5**	13.5 - 15.0'	22.9										
B-5	**U-1**	1.0 - 2.5'	17.1	103.9	0.623	73.9							
B-5	**U-3**	6.0 - 7.5'	21.5	104.2	0.618	94.0							
B-5	**U-4**	8.5 - 10.0'	17.4										
Bulk 1	**GB-1**	0.5 - 6.0'	20.1						52	21	31	86.3	CH

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LINCOLN, NEBRASKA 68512

CONSOLIDATION TEST

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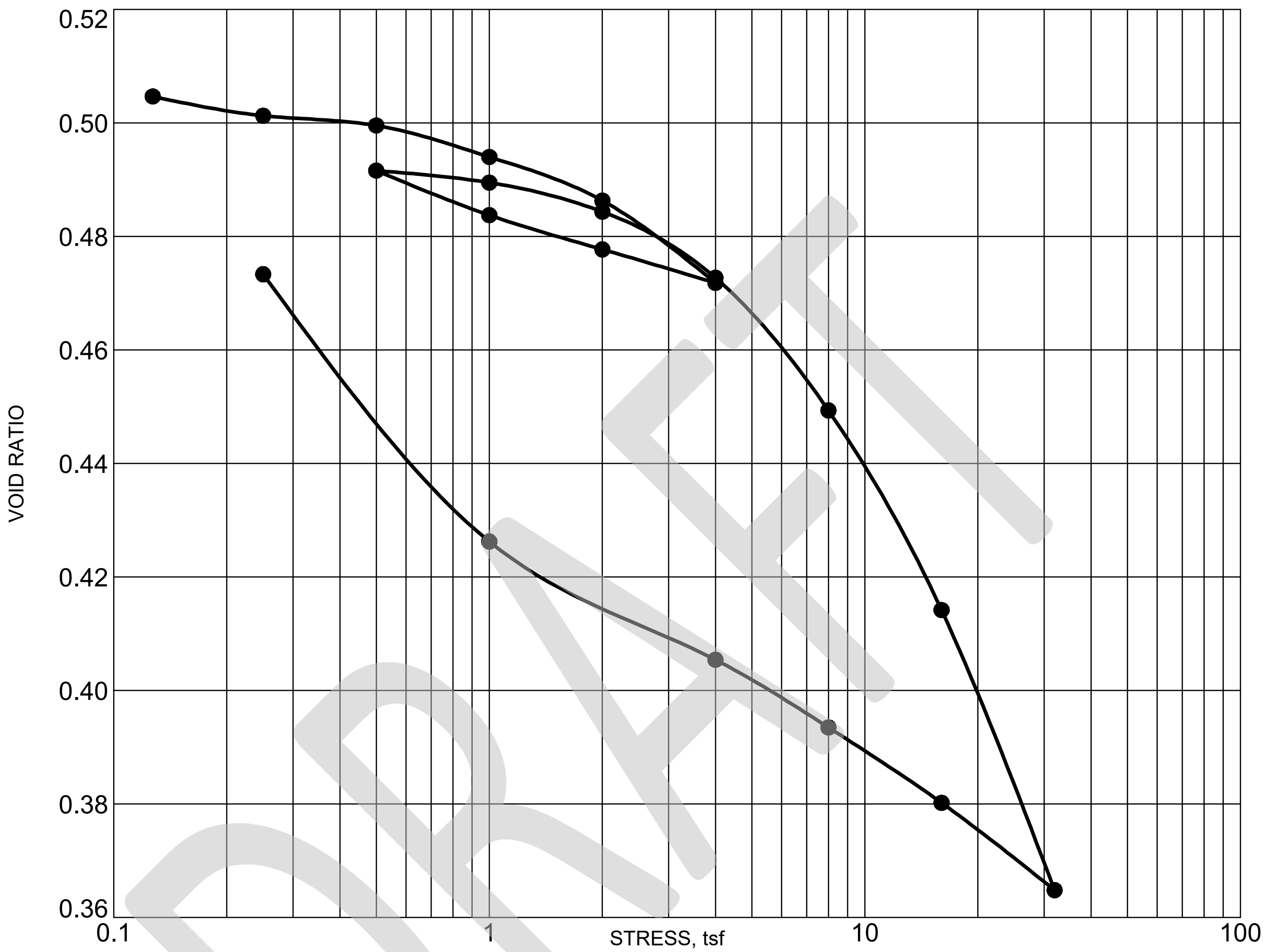
PROJECT NAME: Brakes Plus Northstar Crossing **CLIENT:** Express Oil
PROJECT NUMBER: 024-05713 **PROJECT LOCATION:** Lincoln, Nebraska



Boring No: B-3
Sample ID: U-4
Sample Depth: 8.5 - 10.0'
Start Date: 10/29/24
Technician: N. LAU
Apparatus: LT II - 22
Specific Gravity: 2.7

Initial Water Content (%): 17.1
Final Water Content (%): 18.8
Initial Dry Density (pcf): 111.7
Initial Void Ratio: 0.510
Final Void Ratio: 0.490
Initial Degree of Saturation (%): 90.5
Final Degree of Saturation (%): 100.0

Est. Preconsolidation Stress (tsf): 5.5
Laboratory Water Type: Distilled Water
Test Procedure Method: B
Interpretation Procedure: NA
Stress at Inundation (psf): 50.0
Specimen Trimming Method: Turntable

ATTERBERG LIMITS

LL	PL	PI	Classification

Sample Description: Glacial till: Lean to fat clay (CL/CH): Grayish brown

Notes:

OLSSON, INC.
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LINCOLN, NEBRASKA 68512

MOISTURE-DENSITY RELATIONSHIP

PROJECT NAME: Brakes Plus Northstar Crossing **CLIENT:** Express Oil
PROJECT NUMBER: 024-05713 **PROJECT LOCATION:** Lincoln, Nebraska

Date: **10/31/24**

Type of Test: **698D**

Sample Identification: **B-1 Bulk: (0.5'-6.0')**

Sample Description: **Fill: Fat clay (CH): Dark brown**

Rammer Type:

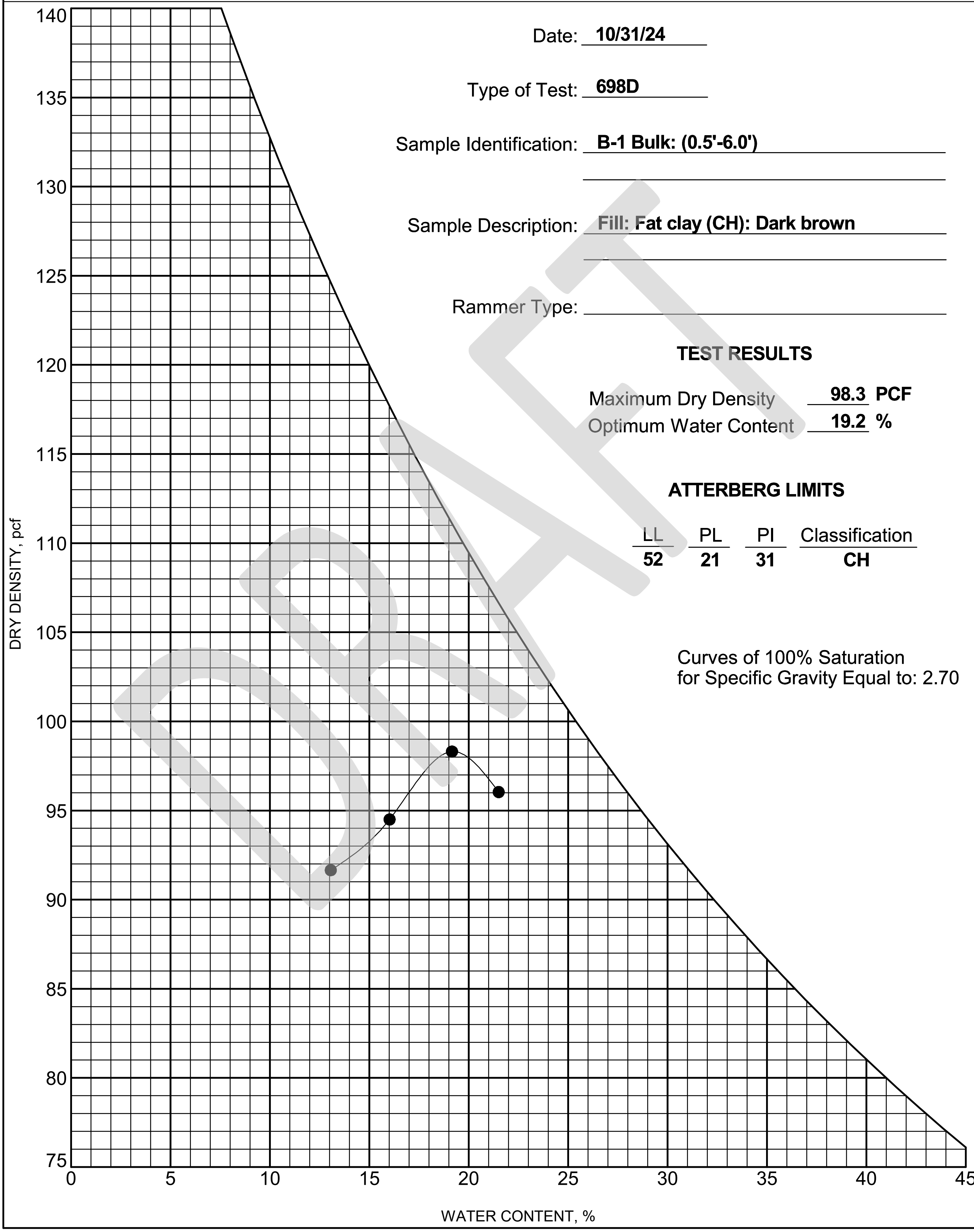
TEST RESULTS

Maximum Dry Density **98.3** **PCF**
Optimum Water Content **19.2** **%**

ATTERBERG LIMITS

LL	PL	PI	Classification
52	**21**	**31**	**CH**

Curves of 100% Saturation
for Specific Gravity Equal to: 2.70



BRAKES PLUS NORTHSTAR CROSSING

Lincoln, Nebraska

December 2024

Olsson Project No. 024-05713