# GEOTECHNICAL EXPLORATION REPORT

**Project Name:**

SH412B and Patrol Road Roundabout
Pryor Creek, Oklahoma

**Prepared for:**

MidAmerica Industrial Park (MAIP)

August 31, 2022
Olsson Project No. G20-1030

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# TABLE OF CONTENTS

# LIST OF FIGURES



# LIST OF TABLES

# APPENDICES

August 31, 2022

MidAmerica Industrial Park
Attn: Mr. Jason Stutzman
PO Box 945
Pryor Creek, OK 74362-0945

RE: Geotechnical Exploration
SH412B and Patrol Road Roundabout
Pryor Creek, Oklahoma
Olsson Project No. G20-1030

Dear Mr. Stutzman:

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 borings and laboratory tests, discusses the observed subsurface conditions, and provides our geotechnical engineering recommendations.

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

Respectfully submitted,
Olsson, Inc.

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# 1. PROJECT UNDERSTANDING

## 1.1. Geotechnical Scope

This geotechnical engineering report presents the results of the subsurface exploration completed for the proposed improvements to SH412B between US412 and SH69A, and the proposed construction of the roundabout at Patrol Road at the MidAmerica Industrial Park (MAIP) in near Pryor Creek, Oklahoma. The total anticipated length of roadway improvements is on the order of 28,000 linear feet. The purpose of this exploration and report is to evaluate the subsurface conditions and provide geotechnical design recommendations for earthwork and roadway construction of the proposed improvements.

## 1.2. Site Location and Description

The project site is located at the MAIP in south-central Mayes County, Oklahoma, just south of the town of Pryor Creek, Oklahoma. The project site extents include SH412B extending from the US412 intersection north to the SH69A intersection. SH412B currently consists of a 2-lane roadway primarily paved with asphalt pavement with concrete present at the US412 intersection. The proposed roundabout is located on the west side of SH412B and includes portions of the existing Patrol Road and undeveloped grass areas. **Figure 1**, below, shows the general site location and project extents with recent aerial imagery.

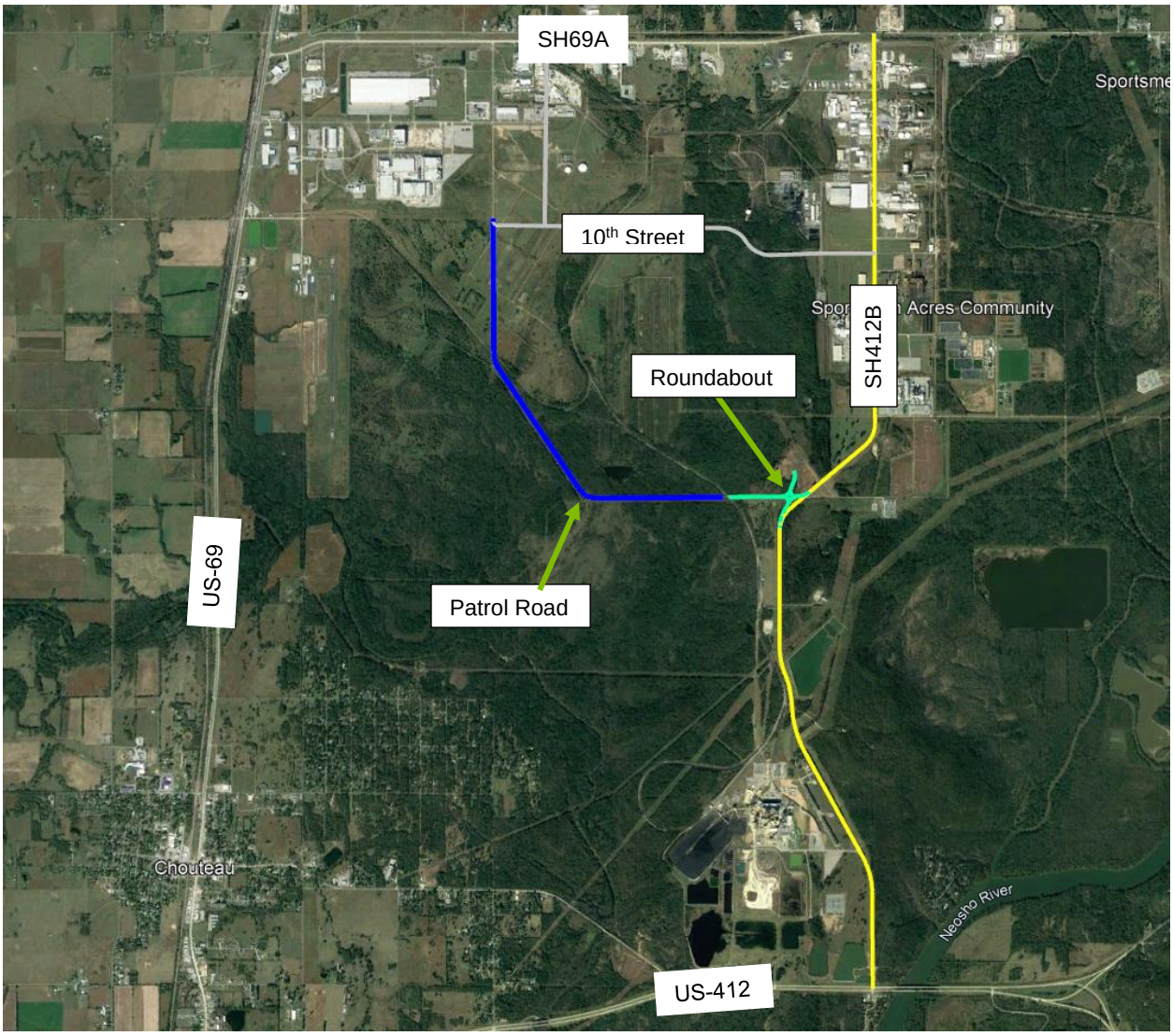


**Figure 1. Project Extents.**

## 1.3. Project Information

The improvements along SH412B will consist of two 12-foot lanes with 8-foot shoulders. The existing horizontal and vertical alignment will be maintained along the roadway. At the intersection of SH412B and Patrol Road, a 4-legged roundabout will be constructed as shown below in **Figure 2**. SH412B will be realigned to accommodate the roundabout and will make up two legs of the proposed roundabout. The other two legs of the roundabout will be for Patrol Road and a new roadway to the north. The extents of the Patrol Road South construction will extend from the roundabout to just west of the railroad crossing.

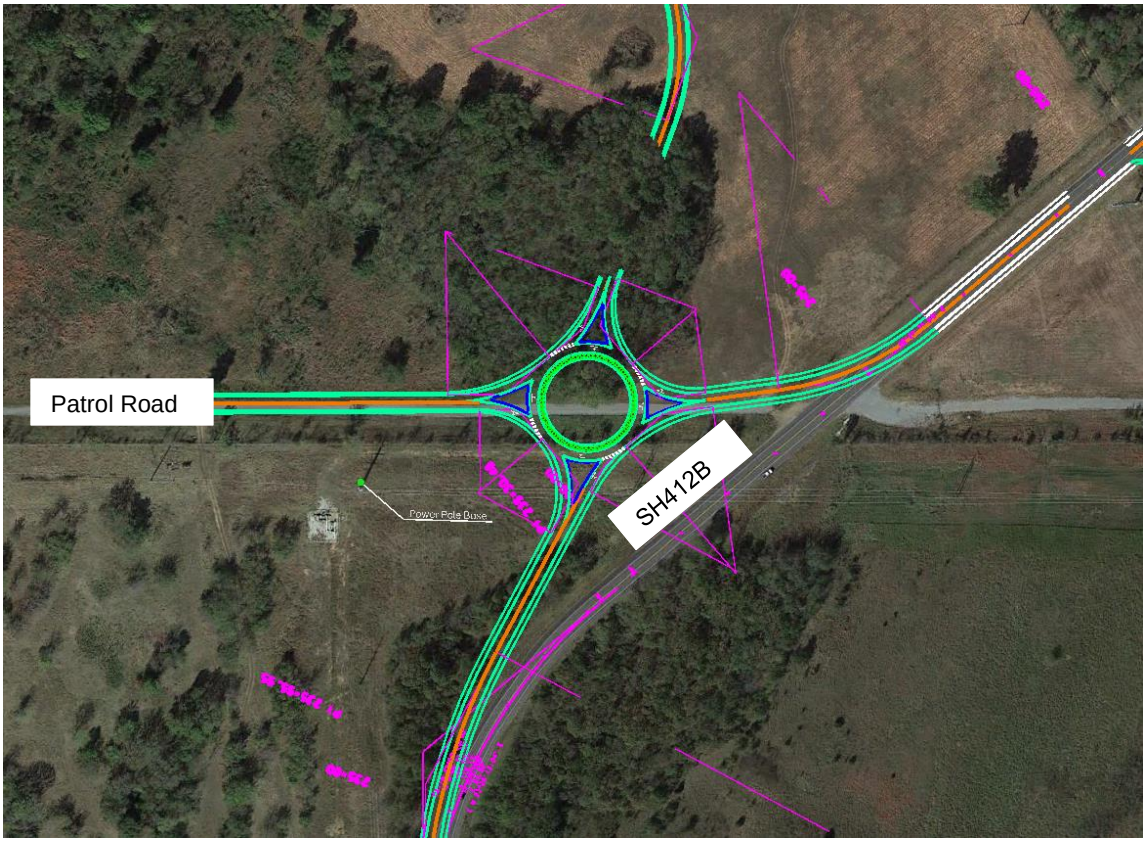


**Figure 2. Proposed Roundabout.**

Intersection modifications at SH412B and US412 are also included. The westbound left turn lane along US412 will be extended to roughly double the turn bay from 400 to 800 linear feet. Along the eastbound lanes of US412, an acceleration lane will be added at SH412B extending approximately 800 LF. The southbound approach will be constructed to allow for three lanes, a dedicated southbound right turn lane, a southbound shared through and left turn lane, and a northbound lane. **Figure 3** depicts the planned improvements at the intersection of SH412B and US412.

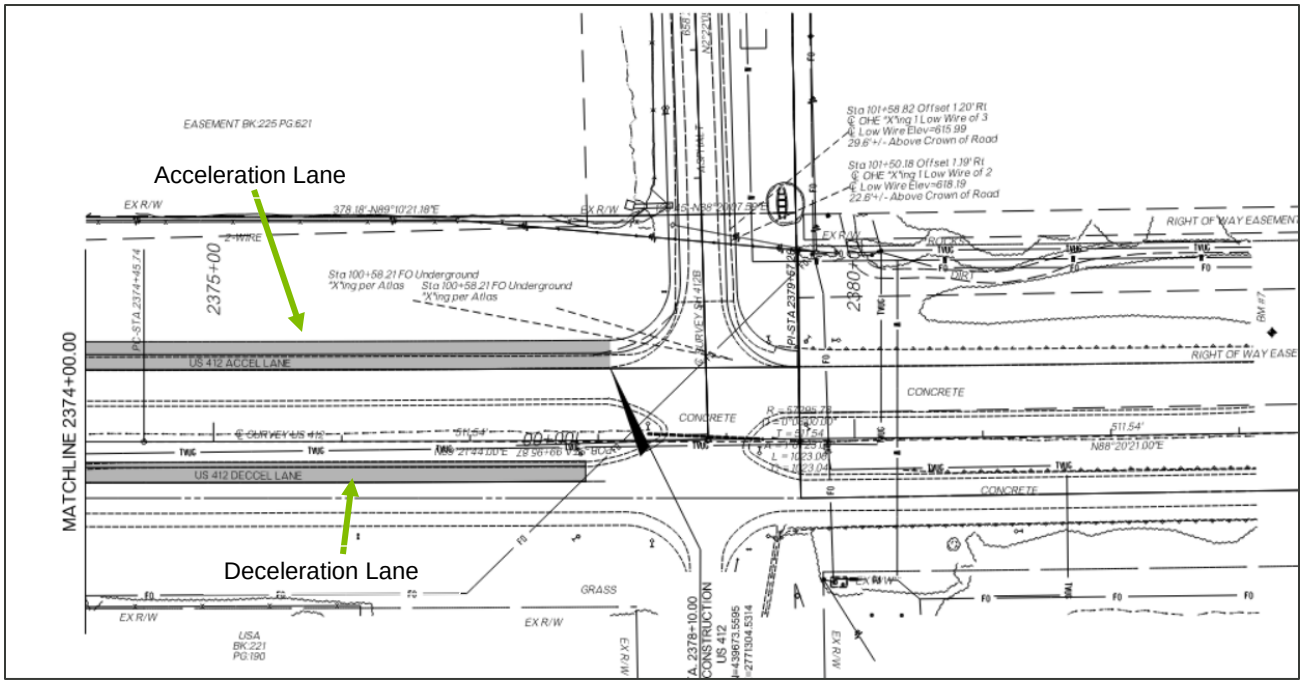


**Figure 3. Proposed US412 and SH412B Intersection.**

The geotechnical recommendations presented herein are based on the available project information, proposed project location, and the subsurface conditions encountered as described in this report. If any of the noted information is incorrect, please inform Olsson so that we may amend the recommendations presented in this report if appropriate.

# 2. EXPLORATION AND TEST PROCEDURES

## 2.1. Field Exploration – In Place/Shoulder Soil Survey

A total of nineteen (19) hand auger borings were completed for the project which were advanced to depths ranging from 1 to 4.2 feet below the existing grade. At the boring locations along SH412B, coring techniques were used to penetrate through the pavement prior to manually advancing the hand auger. Dynamic Cone Penetration (DCP) testing was also performed in the hand auger boring locations to depths ranging from 2.6 to 4.4 feet below the existing grade. The testing was performed immediately below the pavement and base materials, where present. DCP testing was performed in general accordance with ASTM D6951 using a Kessler K-100 instrument. DCP test results were correlated to subgrade strength parameters using correlations provided by the DCP manufacturer. Locations of the hand auger borings are included in Appendix A and DCP test results are provided in Appendix D.

At borings B-03 and B-15, the pavement section and aggregate base were thicker than the length of the core barrel and we were unable to penetrate through the entire aggregate base layer. Hand auger borings were attempted but terminated before reaching the subgrade due to refusal on dense material. The remainder of the borings extended through the pavement and base course materials. Shallow refusal due to the presence of coarse gravel in the subgrade layer was encountered at borings B-01, B-02A, B-08, and B-16, and the borings could not be extended using manual methods.

Grab samples were collected from the hand augers and were placed in sealed containers to prevent moisture content loss. In addition, composite bulk samples of the subgrade were collected at borings B-02A and B-10. Hand auger logs are provided in Appendix B. Upon completion of field operations, all borings were backfilled, and core holes patched with similar materials. The pavement cores were retained and photographed by Olsson. Photographs of pavement cores are provided in Appendix C.

## 2.2. Laboratory Testing

The soils encountered in the borings were visually classified and described in general accordance with the Unified Soil Classification System (USCS). We also performed laboratory tests to evaluate the engineering properties of the recovered soil samples. The testing program included moisture content, Atterberg limits, #200 sieve wash, sieve, Standard Proctor, and California Bearing Ratio (CBR) testing. Analytical soil chemistry testing consisting of soil soluble sulfate and the pH was performed on three samples collected from B-01, B-09, and B-16. Laboratory test results are included on the soil boring logs presented in Appendix B and are summarized in Appendix C.

# 3. SUBSURFACE CONDITIONS

## 3.1. Site Geology

The project site is generally mapped as being underlain by the Pennsylvanian-aged Atoka Formation and the Bloyd and Hale Formations. The shallowest unit of the Atoka Formation is the Hartshorne-Atoka Unit, which consists mostly of shale with some sandstone, siltstone, and limestone. Sandstone units are generally less than 10 feet thick, with the total thickness of the unit ranging from 35 feet in the north part of Mayes County to 90 feet thick in the southern part of the county. The Bloyd and Hale Formations consist primarily of limestone, sandstone, and shale.

A review of the karst map of the United States as provided by Weary and Doctor indicated that borings B-04, B-05, and B-10 are located over shallow or exposed carbonate or calcareous rock. Appendix F shows displays a Karst map for the investigated area. The Bloyd and Hale formations consist of shallow Pennsylvanian-aged limestone that contain carbonate rocks at or near the surface in a humid climate. Based on previous geotechnical explorations, visual observation, and Olsson's experience with similar roadway projects, karst development is considered limited for the project site, but is possible.

## 3.2. Subsurface Profile

The surface materials at this site consisted of a thin layer of topsoil along the shoulder of the roadways and asphalt overlying an aggregate base layer within the limits of the roadway. Beneath the topsoil and aggregate base layer, low plasticity clay with isolated layers of clayey sand, clayey gravel, and moderate plasticity clay was encountered which extended to the termination depth of the borings. At B-03 and B-15, the pavement section and aggregate base were thicker than the length of the core barrel and we were unable to penetrate through the entire aggregate base layer. A full depiction of the materials encountered at boring location is provided on the hand-auger logs in Appendix B.

Please note that the hand auger logs 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.

### Asphalt and Aggregate Base

The asphalt along the roadway ranged in thickness from 6.75 to 13.5 inches. Recovered samples of the asphalt pavement indicated severely deteriorated zone in borings B-08, B-10, and B-15. The underlying aggregate base layer ranged in thickness from 5 to 17 inches. Thicker or thinner

zones of aggregate base materials may be encountered in areas not investigated, as well as at B-03 and B-15 where the final aggregate base layer thickness was undetermined.

## Topsoil

The topsoil encountered along the roadway was approximately 2- to 3-inches thick and generally consisted of a dark brown clay with organics and sand.

## Lean to Fat Clay Soils

Lean to fat clay material was encountered in 14 of the soil test borings. As noted, refusal was encountered in borings B-02A and B-16 due to the presence of coarse gravel within the clay materials. The clay soils were generally comprised of lean clay (CL) to fat clay (CH) indicating low to high plasticity and were described as dark brown to brown to reddish brown to gray, moist, and contained significant amounts of sand and lesser amounts of gravel.

**Table 1. Native Clay Soils Laboratory Test Results.**

| USCS Classification | Moisture Content (%) | Atterberg Limits | | | % Gravel | % Sand | % Passing No. 200 |
|---|---|---|---|---|---|---|---|
| | | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index (%) | | | |
| CL, CH | 15.4-32.3 | 35-65 | 11-25 | 18-40 | 0-7.4 | 8.2-47.4 | 51.6-89.7 |

**Table 2. Native Clay Soils Standard Proctor and CBR Results.**

| Sample Description | Sample Depth (feet) | Maximum Dry Density (pcf) | Optimum Moisture Content (%) | California Bearing Ratio (CBR) (%) |
|---|---|---|---|---|
| Lean Clay (CL), Brown to Reddish Brown | 1.0-3.0 | 108.1-111.4 | 14.9-16.8 | 2-5 |

## Granular Soils

Granular material was encountered in four (4) of the soil test borings. Refusal was encountered at borings B-01 and B-08 due to the presence of coarse gravel. The granular soils were generally comprised of clayey sand (SC) and clayey gravel (GC) and were described as dark brown to brown to gray, and moist.

**Table 3. Native Granular Soils Laboratory Test Results.**

| USCS Classification | Moisture Content (%) | Atterberg Limits | | | % Gravel | % Sand | % Passing No. 200 |
|---|---|---|---|---|---|---|---|
| | | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index (%) | | | |
| CL, CH | 15.4-32.3 | 35-65 | 11-25 | 18-40 | 0-7.4 | 8.2-47.4 | 51.6-89.7 |

## 3.3. Groundwater Summary

Groundwater was encountered in borings B-08, B-09, and B-18 at depths ranging from 1.2 to 2.2 feet below the existing ground surface but was not encountered at the remainder of the completed locations. Given the soil conditions at the site, variations and uncertainties exist with relatively short-term water level observations that were recorded during this exploration, and it is likely that groundwater (if present) in the other explored locations may not have had time to stabilize and equilibrate to the piezometric level in the short time the boreholes were open.

Water levels can and should be anticipated to vary between boring locations, as well as with time within a specific boring. Groundwater levels may be expected to fluctuate with precipitation, site grading, drainage, and adjacent land use.

If present during construction, shallow groundwater is likely to be encountered in more permeable soil seams, through the granular pavement base course materials (where present), or where pavement drains may accumulate water and allow for more concentrated infiltration. Contractors should be prepared to remove water from excavations and to direct water away from the working surface of the roadway to allow work to proceed in the dry. Based on the presence of both granular and cohesive soil, it is anticipated that a series of sumps and pumps would be sufficient to remove water from the excavations. However, for deeper excavations, such as for deep utility construction, or for excavations allowed to remain open for long periods of time, methods to remove groundwater may need to account for a significantly higher volume or recharge rate of water. For general road construction, it would be recommended to grade the surface of the subgrade toward catch basins or other places where the water can gravity drain from the work areas.

# 4. SITE PREPARATION

## 4.1. Geotechnical Considerations

As noted, groundwater was encountered in three of the soil borings at the time of our exploration. Groundwater level may fluctuate over time and may be encountered at varying elevations not previously identified. While groundwater it is not anticipated to adversely impaction the majority of construction operations, some areas along the roadway alignment may require additional measures and/or stabilization techniques to avoid excessive subgrade degradation during grading operations.

The contractor should review the site prior to construction and conduct their own review of site conditions. Proper equipment, necessary dewatering methods and appropriate stabilization techniques should be selected in soft areas to avoid unnecessary impact to the underlying soils. Olsson can assist in determining stabilization recommendations if necessary.

## 4.2. General Site Preparation

Prior to site grading, existing pavements, aggregate base materials, or other deleterious or unsuitable materials should be stripped and removed from areas of new construction. An Olsson field representative can help determine the final stripping and removal depths in areas of concern. Organic soil removed during stripping operations are not considered suitable for reuse as structural fill below or around structures, pavements, or new utilities but may be reused within landscaped or non-loaded areas around the project site.

Site clearing, grubbing, and stripping should be completed during periods of dry weather. Operating heavy equipment on the site during periods of wet weather could result in disturbance (rutting and pumping) of the subgrade soils. The base of new construction excavations should be evaluated by an Olsson geotechnical engineer or their authorized representative prior to placing new fill. New structural fill should be placed and compacted in accordance with the recommendations presented in **Section 4.3**.

In areas of the site to accept new fill, we recommend the top 9 inches of subgrade soils exposed at the base of stripping operations be moisture conditioned, scarified, and recompacted in accordance with **Section 4.3** of this report.

After compaction and prior to placing structural fill, the resultant subgrade should be proofrolled with an Olsson field representative present. Unstable or unsuitable soils revealed by proofrolling that cannot be adequately densified in-place should be removed and replaced with structural fill under the direction of the Olsson representative. Alternatively, consideration could also be given

to stabilizing the soils using geosynthetic materials or chemical stabilization methods. The methods of stabilization would be dependent on the actual conditions encountered at the time of construction. Proofrolling, where feasible, should be completed using a fully loaded, tandem-axle dump truck, scraper, or similar rubber-tired equipment weighing at least 20 tons. The geotechnical engineer should be contacted if additional subgrade stabilization is required to prepare the site for construction.

## 4.3 Structural Fill

We recommend that fills placed within 12 inches of pavements or aggregate base comprise granular soil or clayey soils with a liquid limit less than 45 and a plasticity index less than 25. Soils with Atterberg limits greater than these values will require removal or blending with less plastic materials. 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. Granular fill should not be used for replacing cohesive material in over-excavation zones, as granular soils allow water to collect and pool at the surface of the underlying cohesive materials.

Based on our site observations and laboratory testing performed as part of this exploration, some of the on-site soils generally appear suitable for use as structural fill, but this should be confirmed during construction. 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.

New fill should be placed in maximum loose lift thicknesses of 8 inches and compacted as recommended in Table 4. The lift thicknesses should be limited to 4 inches when compacting in small areas requiring hand-operated equipment such as vibrating plate compactors, walk behind trench rollers, or jumping jacks.

An Olsson representative should regularly observe and monitor the excavation and grading operations and perform field density tests to document that moisture 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. Recommended Fill Placement Guidelines.**

| Area of Fill Placement | Compaction Recommendation (ASTM D698-Standard Proctor) | Moisture Content (Percent of Optimum) |
|---|---|---|
| Aggregate Base Course | 98%* | As necessary to obtain density |
| Pavement Subgrade – 12 in. below base of pavements or aggregate base | 95% | -1 to +3 percent |
| Structural fill placed below Pavement Subgrade | 95% | -1 to +3 percent |
| Utility trenches | 95% | -1 to +3 percent |
| Non-loaded landscaped/grass areas | 92%** | As necessary to obtain density |

* Or 70 percent Relative Density as described below. **Minor subsidence should be expected in these areas.

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.

## 4.4 Drainage and Groundwater Considerations

Water should not be allowed to collect at the ground surfaces near areas of new pavements either during or after construction. Provisions should be made to quickly remove accumulating seepage water or storm water runoff from excavations. Undercut or excavated areas should be sloped towards one corner to allow rainwater or surface runoff to be quickly collected and gravity drained or pumped from construction areas. Subgrade soils that are exposed to precipitation or runoff should be evaluated by Olsson prior to the placement of new fill or pavement to determine if corrective action is required.

To minimize concerns related to improper or inadequate drainage away from pavement bearing subgrades or from cohesive backfill materials used in utility trenches, we recommend that site

grading should provide for efficient drainage of rainfall or surface runoff away from new pavement. Run-off should be collected and discharged directly to the storm sewer system or ditch system.

Consideration could also be given to installing perforated drain tile at low spots along the roadway alignment that daylight into adjacent ditches. Drains will help in collecting and transmitting subsurface water that travels beneath the pavement and pools in low spots. Drains installed below the roadway should be installed a minimum of 18 inches below the base of the pavement, wrapped in filter fabric and embedded in clean crushed aggregate with less than 5 percent passing the No. 200 sieve.

## 4.5 Construction Equipment Mobility

Some of the soils encountered at this site may be susceptible to softening or loosening 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. General 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 construction 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, lime, fly ash, or cement kiln dust (CKD) as noted in **Section 4.2**. The stabilization approach should be determined at the time of construction in consultation with an Olsson geotechnical engineer.

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. Site grading should provide rapid drainage of water away from the building and pavement areas throughout construction.

## 4.6 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; e.g., *OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926,* or successor regulations.

## 4.7 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. Steeper slopes are susceptible to erosion, will be difficult to maintain, and could experience problems with instability. The crest or toe of cut or fill should be 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.

# 5. PAVEMENT DESIGN AND RECOMMENDATIONS

The following sections discuss geotechnical recommendations for pavement design and construction. Based on conversations with Olsson's civil designers and the current project drawings, it is anticipated that the project will consist of full depth pavement reconstruction.

## 5.1 Pavement Subgrade Preparation

All pavements should be supported by a minimum of 12 inches of subgrade prepared in accordance with the recommendations presented in **Section 4** of this report.

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.

Unless very large compaction equipment is used, a single 12-inch fill or prepared subgrade thickness cannot be scarified, moisture conditioned, and compacted in one large lift. To prepare the pavement subgrade with smaller equipment, it may be necessary to provide multiple 6- to 8-inch compacted lifts. The 12-inch thickness of structural fill or prepared subgrade thickness should be in addition to the granular subbase thickness (if used) directly below pavements. The pavement subgrade soils should be tested and documented for compaction and moisture by an Olsson representative immediately prior to pavement construction.

We recommend that prepared subgrades include the entire pavement area and extend laterally at least 2 feet beyond or future pavement limits to provide edge support, where feasible.

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 removed and replaced with compacted structural fill. Chemical stabilization using Portland cement, cement kiln dust (CKD), or lime can increase the durability of the soil subgrade during construction.

## 5.2 Traffic Data

We evaluated the anticipated traffic loading based on available traffic information provided by Olsson. A design lifetime of 30 years for the proposed roadway and roundabout was utilized based on conversations with the civil engineer. The traffic data below were used based on information provided and our understanding of the project:

- Traffic Through Construction
  - 10,000 vehicles per day (2021 ADT)
  - Percent heavy trucks: 35%
  - Annual Growth Rate: 0%
  - Change in Serviceability: 2.0
  - Reliability: 90%
  - Standard Deviation: 0.5 (flexible) & 0.4 (rigid)
  - Lane Factor: 100%
  - Truck Factor: 2.378
  - Directional Distribution Factor: 50%

- SH412B & Roundabout (30-Year Design Life Traffic)
  - 20,000 vehicles per day (2021 ADT)
  - 38,000 vehicles per day (2056 ADT)
  - Percent heavy trucks: 14%
  - Annual Growth Rate: 3%
  - Change in Serviceability: 2.0
  - Reliability: 90%
  - Standard Deviation: 0.5 (flexible) & 0.4 (rigid)
  - Lane Factor: 100%
  - Truck Factor: 2.378
  - Directional Distribution Factor: 50%

Using this information, the estimated ESAL value for the pavement lifetime is 60.5 million ESAL's. If these parameters are incorrect, Olsson should be contacted to re-evaluate the pavement design. Traffic loading in excess of these values may result in premature pavement degradation.

## 5.3 Pavement Design

Based on laboratory and field testing, Olsson recommends utilizing an estimated California Bearing Ratio (CBR) value of 2.5 percent, a resilient modulus ($M_R$) of 3,750 psi, and a modulus of subgrade reaction ("*k*" value) of 75 psi/in for subgrade design.

The recommended design requires that the site be properly prepared in accordance with **Section 5.1** of this report and that properly designed site drainage be provided to minimize potential moisture infiltration and particle migration of the aggregate base layer of the pavement subgrade. The minimum pavement recommendations below are based on results of analysis and typically utilized pavement thicknesses that have performed well across the region. Based on these design parameters, we recommend the following minimum pavement thickness. Alternative layer thicknesses could be considered if desired.

**Table 5. Minimum Recommended Pavement Sections.**

| Concrete Pavement | Asphalt Pavement |
|---|---|
| 14-inch Portland Cement Concrete<br>12.0-Inch Prepared Subgrade | 2.0-inch Type S4 Superpave<br>11.0-inch Type S3 Superpave<br>10.0-inch ODOT Type “A” Aggregate Base<br>12.0-Inch Prepared Subgrade |

For the recommendations herein to be valid, the contractor should verify that the asphalt pavement mix design selected for the project has a minimum composite elastic modulus of 440,000 psi for verification of the recommended design provided herein. Use of a tack coat between the asphalt pavement sections is recommended, and a prime coat should be used between the subgrade and aggregate base or pavement layers. The analysis herein assumes a concrete compressive strength of 4,000 psi. If a different concrete strength is considered, Olsson should be contacted to re-evaluate the pavement thickness. In addition, a fabric separator should be used between the subgrade and aggregate base materials to prevent migration of soil.

We recommend material used for aggregate base consist of Oklahoma Department of Transportation Type A aggregate base (Section 703.01) or approved alternate by the engineer. Consideration could also be given to preparing the soils using chemical stabilization methods, however, given the presence of nearby limestone quarries, it is anticipated that use of aggregate base will be more cost effective.

Surface drainage around the pavements and proper maintenance are also important for long-term performance. New curbs should be backfilled following the recommendations of this report as soon as possible after pavement construction. Backfill should be properly compacted and should be sloped to prevent water from ponding and infiltrating the pavement subgrade. Pavement joints should be caulked, and cracks should be quickly patched or sealed as they occur to prevent moisture from reaching and softening the subgrade soils. A bi-annual or more frequent pavement crack-sealing program is recommended to minimize future moisture infiltration and potential softening of underlying subgrade soils.

## 5.4 Cement Type

Based on the results of the soil chemical testing presented in Appendix E, the sulfate levels in the soil are considered low, and a sulfate exposure class of S0 is recommended for the project site. Therefore, Type I/II cement appears suitable for use in concrete, if utilized.

# 6. REPORT LIMITATIONS AND CLOSURE

The conclusions and recommendations presented in this report are based on the information available regarding the proposed construction, the results obtained from our soil test borings and sampling procedures, the results of the laboratory testing program, and our experience with similar projects. The soil test borings represent a very small statistical sampling of subsurface soils, and it is possible that conditions may be encountered during construction that are substantially different from those indicated by the soil test borings.

In these instances, adjustments to design and construction may be necessary. This geotechnical report is based on the site plan and information provided to Olsson and our understanding of the project as noted in this report. Changes in the location or design of new structures could significantly affect the conclusions and recommendations presented in this geotechnical report. Olsson should be contacted in the event of such changes to determine if the recommendations of this report remain appropriate for the revised site design.

This report was prepared under the direction and supervision of a Professional Engineer registered in the State of Oklahoma with the firm of Olsson. The conclusions and recommendations contained herein are based on generally accepted professional geotechnical engineering practices at the time of this report within this geographic area. No other warranty is expressed, intended or made. This report has been prepared for the exclusive use of the MidAmerica Industrial Park and their authorized representatives for specific application to the proposed project.

# APPENDICES

# APPENDIX A

Boring Location Map, Exploration Summary

| Boring ID | Boring Depth (ft) | Geographic Coordinates, NAD83 (degrees) | | Site Location | Lane Location |
|---|---|---|---|---|---|
| | | Latitude | Longitude | | |
| B-01 | 1.0 | 36.176981 | -95.280501 | US 412 Acceleration Lane | Westbound |
| B-02 | 4.0 | 36.176745 | -95.281411 | US 412 Turn Lane | Eastbound |
| B-02A | 3.2 | 36.177821 | -95.279276 | SH412B | Northbound |
| B-03 | 2.0 | 36.182333 | -95.279320 | SH412B | Southbound |
| B-04 | 4.0 | 36.187617 | -95.280706 | SH412B | Northbound |
| B-05 | 4.0 | 36.192407 | -95.284068 | SH412B | Southbound |
| B-06 | 4.2 | 36.197413 | -95.286731 | SH412B | Northbound |
| B-07 | 3.5 | 36.202781 | -95.288046 | SH412B | Southbound |
| B-08 | 2.2 | 36.208301 | -95.288002 | SH412B | Northbound |
| B-09 | 3.3 | 36.213660 | -95.287193 | Patrol Road Roundabout | -- |
| B-10 | 3.0 | 36.217155 | -95.281257 | SH412B | Northbound |
| B-11 | 2.5 | 36.221949 | -95.279104 | SH412B | Southbound |
| B-12 | 4.0 | 36.227404 | -95.279072 | SH412B | Northbound |
| B-13 | 2.5 | 36.232870 | -95.279134 | SH412B | Southbound |
| B-14 | 3.0 | 36.238156 | -95.279076 | SH412B | Northbound |
| B-15 | 2.2 | 36.243660 | -95.279142 | SH412B | Southbound |
| B-16 | 2.2 | 36.249064 | -95.279113 | SH412B | Northbound |
| B-17 | 3.2 | 36.214145 | -95.288810 | Patrol Road Roundabout | -- |
| B-18 | 2.7 | 36.214874 | -95.286887 | Patrol Road Roundabout | -- |

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**Appendix A: Geotechnical Boring Locations**

Drawn by: WCG

Date: 8-30-2022

**SH412B and Patrol Road Roundabout**
**Pryor Creek, Oklahoma**


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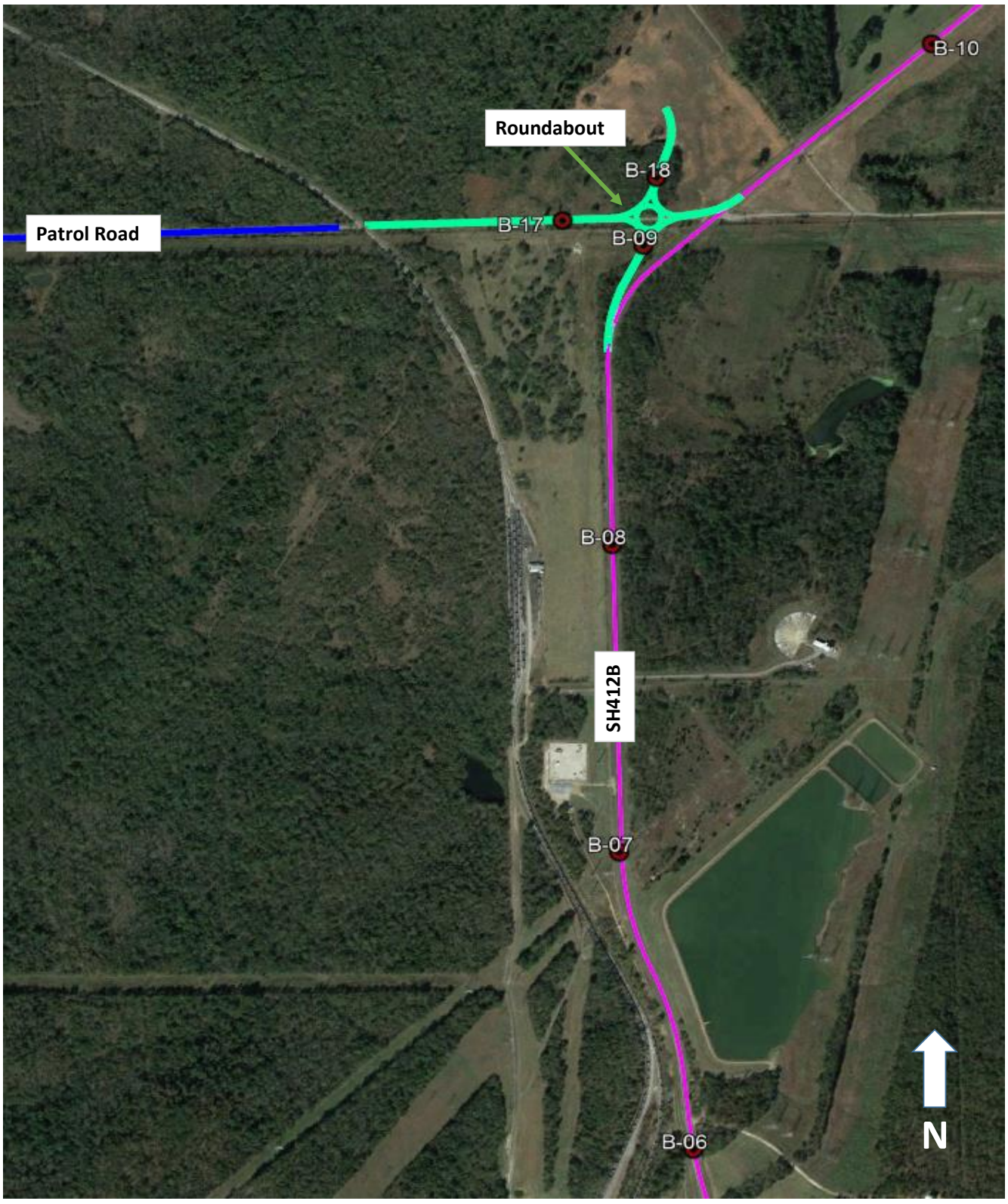
| | |
|---|---|
| Drawn by: WCG | **Appendix A: Geotechnical Boring Locations** |
| Date: 8-30-2022 | **SH412B and Patrol Road Roundabout**<br>**Pryor Creek, Oklahoma** |

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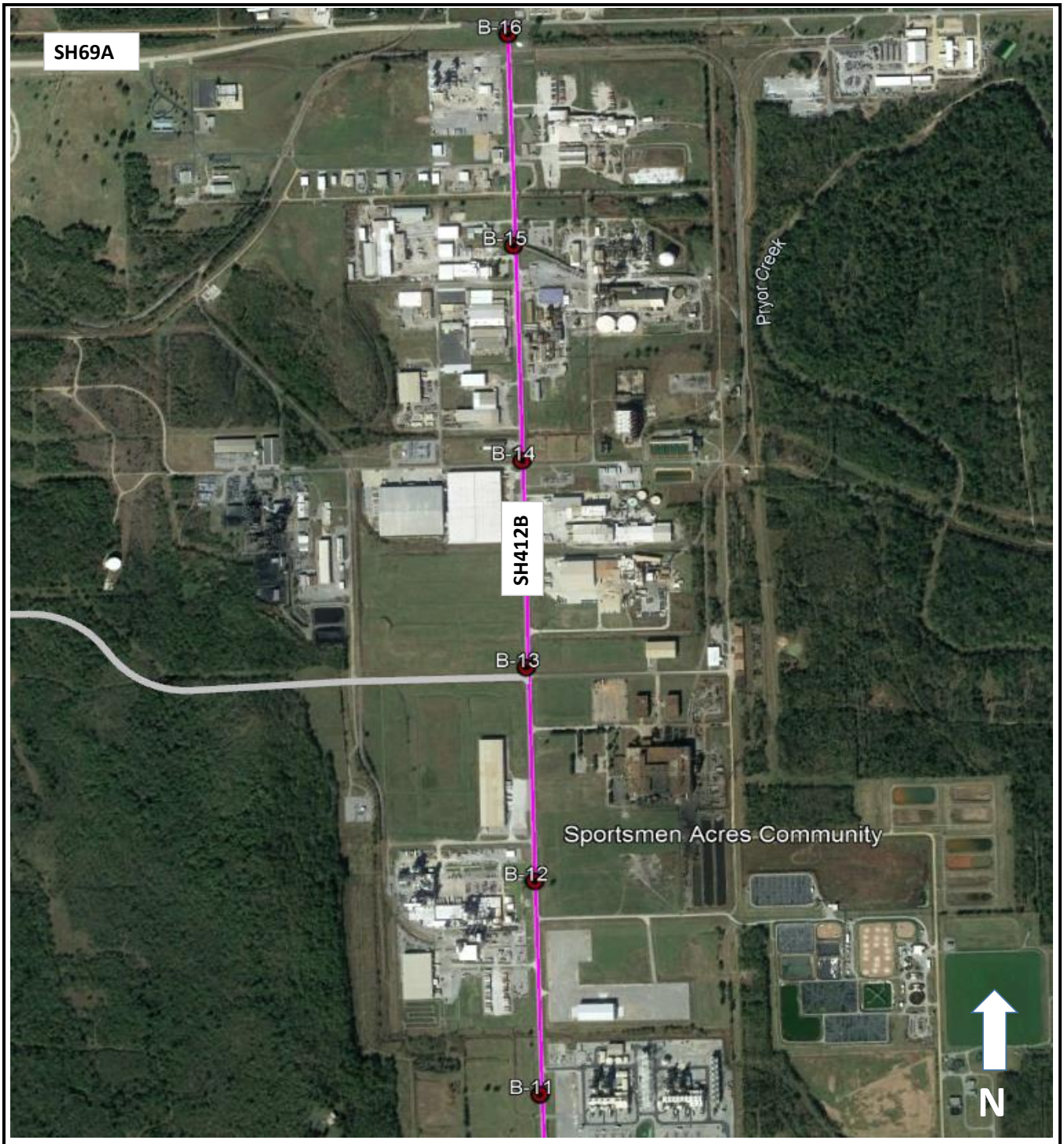
| | |
|---|---|
| Drawn by: WCG | Appendix A: Geotechnical Boring Locations |
| Date: 8-30-2022 | SH412B and Patrol Road Roundabout<br>Pryor Creek, Oklahoma |

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| | |
|---|---|
| Drawn by: WCG | **Appendix A: Geotechnical Boring Locations** |
| Date: 8-30-2022 | **SH412B and Patrol Road Roundabout**<br>**Pryor Creek, Oklahoma** |

# APPENDIX B

Symbols & Nomenclature, Hand Auger Boring Logs

# 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 | FT: | Fish Tail Bit | IAD: | Immediately After Drilling |
| SPT: | Standard Penetration Test Blows per 6.0" | RB: | Rock Bit | AD: | After Drilling |
| | | | | CI: | Cave-In |

### *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 |

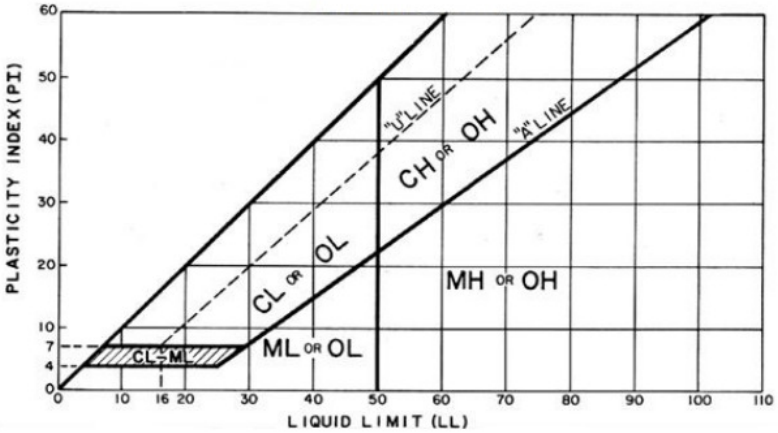
### *COHESIONLESS SOILS*

| 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 |

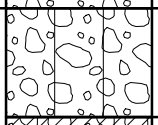
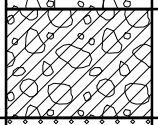
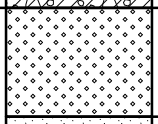
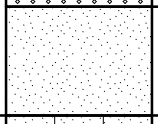
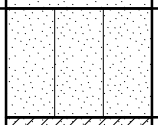
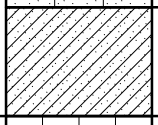
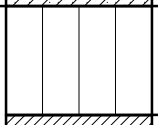
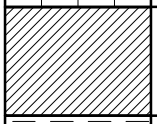
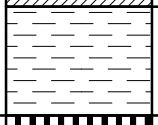
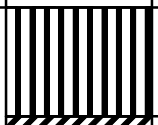
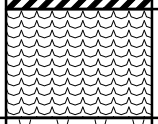
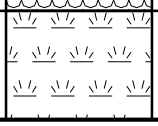
### *PLASTICITY CHART*




### *ROCK QUALITY DESIGNATION (RQD)*

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

# SOIL CLASSIFICATION CHART

| MAJOR DIVISIONS | | | SYMBOLS | | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|---|
| | | | GRAPH | LETTER | |
| COARSE GRAINED SOILS<br>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE | GRAVEL AND GRAVELLY SOILS<br>MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | CLEAN GRAVELS<br>(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<br>(APPRECIABLE AMOUNT OF FINES) |  | GM | SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES |
| | | |  | GC | CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES |
| | SAND AND SANDY SOILS<br>MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE | CLEAN SANDS<br>(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<br>(APPRECIABLE AMOUNT OF FINES) |  | SM | SILTY SANDS, SAND - SILT MIXTURES |
| | | |  | SC | CLAYEY SANDS, SAND - CLAY MIXTURES |
| FINE GRAINED SOILS<br>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

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# BOREHOLE REPORT NO. B-01

Sheet 1 of 1

| PROJECT NAME | CLIENT |
|---|---|
| SH412B and Patrol Rd Roundabout | MidAmerica Industrial Park (MAIP) |
| **PROJECT NUMBER** | **LOCATION** |
| G20-10300 | Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.176981 **LONG**: -95.280501

| 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 | | | | | | | | |
| | ***0.2'*** | | | | | | | | | | |
| | *brown; moist; trace roots; lean clay* | | | | | | | | | | |
| | ***CLAYEY GRAVEL*** | | | | | | | | | | |
| | *gray with brown; moist; with sand; hard to advance auger through* | | | GB 1 | | | | 10.2 | | | |
| | ***1.0'*** | | 1 | GB 2 | | | | | | | |

***REFUSAL AT 1.0 FEET***

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/17/21 | FINISHED: | 11/17/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-02

Sheet 1 of 1

| | |
|---|---|
| PROJECT NAME: SH412B and Patrol Rd Roundabout | CLIENT: MidAmerica Industrial Park (MAIP) |
| PROJECT NUMBER: G20-10300 | LOCATION: Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.176745 **LONG**: -95.281411

| 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*** *0.2'* | | 0 | | | | | | | | |
| | *brown; moist; trace roots; lean clay* | | | | | | | | | | |
| | ***SANDY LEAN CLAY*** | | | GB 1 | | | | 13.2 | | | |
| | *brown; moist; trace roots; trace gravel; some sand* | | 1 | | | | | | | | |
| | *1.8'* | | | | | | | | | | |
| | ***SANDY LEAN CLAY*** | | 2 | GB 2 | | | | | | | |
| | *reddish brown; moist; trace gravel; some sand* | | | | | | | | | | |
| | *2.2'* | | | GB 3 | | | | | | | |
| | ***SANDY LEAN CLAY*** | | | | | | | | | | |
| | *gray; moist; trace rounded gravel; trace roots; some sand; trace red clay pockets* | | 3 | GB 4 | | | | | | | |
| | *4.0'* | | 4 | | | | | | | | |

***BASE OF BORING AT 4.0 FEET***

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/17/21 | FINISHED: | 11/17/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-02A

Sheet 1 of 1

| | |
|---|---|
| PROJECT NAME: SH412B and Patrol Rd Roundabout | CLIENT: MidAmerica Industrial Park (MAIP) |
| PROJECT NUMBER: G20-10300 | LOCATION: Mayes County, Oklahoma |

Grab Sample  Auger Cuttings

**LAT**: 36.177821 **LONG**: -95.279276

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*7" thick; separation at 1.5"*<br>***0.6'*** | | 0 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*brown; moist; with sand; clayey gravel*<br>***2.0'*** | | 1 | GB 1 | | | | | | | |
| | | | 2 | AU 3 | | | | 21.6 | | | |
| | ***SANDY LEAN CLAY***<br>*brown; moist; trace gravel; some sand; difficult to advance auger*<br>***3.2'*** | | 3 | GB 2 | | | | | | | |

***REFUSAL AT 3.2 FEET***

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/15/21 | FINISHED: | 11/15/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-03

Sheet 1 of 1

| PROJECT NAME | CLIENT |
|---|---|
| SH412B and Patrol Rd Roundabout | MidAmerica Industrial Park (MAIP) |
| **PROJECT NUMBER** | **LOCATION** |
| G20-10300 | Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.182333 **LONG**: -95.27932

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*7.5" thick; separation at 1.75"*<br>***0.6'*** | | 0 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*brown; moist; with sand; clayey gravel; difficult to auger through* | | 1 | GB 1 | | | | | | | |
| | | | | GB 2 | GC | | | 9.0 | | 33/19 | P-200 = 12.8% |
| | ***2.0'***<br>*1.9': large gravel* | | 2 | | | | | | | | |

***REFUSAL AT 2.0 FEET***

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/18/21 | FINISHED: | 11/18/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-04

Sheet 1 of 1

| | |
|---|---|
| PROJECT NAME: SH412B and Patrol Rd Roundabout | CLIENT: MidAmerica Industrial Park (MAIP) |
| PROJECT NUMBER: G20-10300 | LOCATION: Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.187617 **LONG**: -95.280706

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*10.5" thick; separations at 3.75 and 5.5"*<br>***0.9'*** | | 0 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*brown; moist; with sand; clayey gravel*<br>***1.7'*** | | 1 | GB 1 | | | | | | | |
| | ***SANDY LEAN CLAY***<br>*reddish brown; moist; trace gravel to 2.0'; some sand*<br>***3.5'*** | | 2 | GB 2 | CL | | | 18.2 | | 40/23 | P-200 = 56.1% |
| | | | 3 | GB 3 | | | | | | | |
| | ***FAT CLAY***<br>*dark brown with brown; moist; trace gravel; some sand*<br>***4.0'*** | | 4 | GB 4 | | | | | | | |

***BASE OF BORING AT 4.0 FEET***

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/15/21 | FINISHED: | 11/15/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-05

Sheet 1 of 1

| | |
|---|---|
| PROJECT NAME: SH412B and Patrol Rd Roundabout | CLIENT: MidAmerica Industrial Park (MAIP) |
| PROJECT NUMBER: G20-10300 | LOCATION: Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.192407 **LONG**: -95.284068

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*9" thick*<br>***0.9'*** | | 0 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*brown; moist; with sand; clayey gravel*<br>***1.6'*** | | 1 | GB 1<br>GB 2 | | | | | | | |
| | ***SANDY LEAN CLAY***<br>*reddish brown; moist; some sand; trace gravel*<br>***2.3'*** | | 2 | GB 3 | | | | | | | |
| | ***FAT CLAY***<br>*dark brown; moist; trace gravel; with sand*<br>***4.0'*** | | 3<br>4 | GB 4 | CH | | | 19.8 | | 55/37 | P-200 = 63.1% |

***BASE OF BORING AT 4.0 FEET***

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/18/21 | FINISHED: | 11/18/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-06

Sheet 1 of 1

| | |
|---|---|
| PROJECT NAME: SH412B and Patrol Rd Roundabout | CLIENT: MidAmerica Industrial Park (MAIP) |
| PROJECT NUMBER: G20-10300 | LOCATION: Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.197413 **LONG**: -95.286731

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*9" thick; separation at 1.75"*<br>***0.8'*** | | 0 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*brown; moist; with sand; clayey gravel*<br>***1.6'*** | | 1 | GB 1 | | | | | | | |
| | ***SANDY LEAN CLAY***<br>*reddish brown with gray; moist; some sand; trace gravel*<br>***2.4'*** | | 2 | GB 2 | | | | 9.9 | | | |
| | ***CLAYEY SAND***<br>*dark brown to black; moist; trace gravel*<br>***3.9'*** | | 3 | GB 3 | | | | | | | |
| | ***SANDY LEAN CLAY***<br>*brown; moist; some sand; trace gravel*<br>***4.2'*** | | 4 | GB 4 | | | | 8.9 | | | |

***BASE OF BORING AT 4.2 FEET***

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/16/21 | FINISHED: | 11/16/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-07

Sheet 1 of 1

| | |
|---|---|
| PROJECT NAME: SH412B and Patrol Rd Roundabout | CLIENT: MidAmerica Industrial Park (MAIP) |
| PROJECT NUMBER: G20-10300 | LOCATION: Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.202781 **LONG**: -95.288046

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*10.5" thick*<br>***0.9'*** | | 0 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*brown; moist; with sand; clayey gravel*<br>***1.3'*** | | 1 | GB 1 | | | | | | | |
| | ***SANDY LEAN CLAY***<br>*brown; moist; some sand; trace gravel*<br>***1.8'*** | | | GB 2 | | | | | | | |
| | ***SANDY LEAN CLAY***<br>*gray and brown; moist; some sand*<br>***3.5'*** | | 2<br>3 | GB 3 | | | | 10.7 | | | |

***BASE OF BORING AT 3.5 FEET***

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/18/21 | FINISHED: | 11/18/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-08

Sheet 1 of 1

| | |
|---|---|
| PROJECT NAME: SH412B and Patrol Rd Roundabout | CLIENT: MidAmerica Industrial Park (MAIP) |
| PROJECT NUMBER: G20-10300 | LOCATION: Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.208301 **LONG**: -95.288002

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*6.75" thick; gravelly/deteriorated zone from 2 to 3.5"*<br>***0.6'*** | | 0 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*brown; moist; with sand; clayey gravel*<br>▽<br>***1.7'*** | | 1 | GB 1 | | | | 11.7 | | | |
| | ***CLAYEY SAND***<br>*brown; moist; fine to medium grained; trace gravel*<br>***2.2'*** | | 2 | GB 2 | | | | | | | |

***REFUSAL AT 2.2 FEET***

| WATER LEVEL OBSERVATIONS | |
|---|---|
| WD | ▽ 1.2 ft |
| IAD | ▼ Not Encountered |
| AD | ▼ Not Performed |

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

| | | | |
|---|---|---|---|
| STARTED: | 11/16/21 | FINISHED: | 11/16/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-09

Sheet 1 of 1

| | |
|---|---|
| PROJECT NAME: SH412B and Patrol Rd Roundabout | CLIENT: MidAmerica Industrial Park (MAIP) |
| PROJECT NUMBER: G20-10300 | LOCATION: Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.21366 **LONG**: -95.287193

| 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*** *0.2'* | | 0 | | | | | | | | |
| | *brown; most; trace roots; lean clay* | | | | | | | | | | |
| | ***FAT CLAY*** | | | GB 1 | | | | | | | |
| | *dark brown; moist; trace gravel; trace sand* | | 1 | | | | | | | | |
| | ▽ *1.7'* | | | | | | | | | | |
| | ***SANDY LEAN CLAY*** | | 2 | GB 2 | | | | 30.1 | | | |
| | *reddish brown with gray; moist; trace black mottling; some sand; trace gravel* | | | | | | | | | | |
| | *3.3'* | | 3 | | | | | | | | |

***BASE OF BORING AT 3.3 FEET***

| WATER LEVEL OBSERVATIONS | |
|---|---|
| WD | ▽ 1.7 ft |
| IAD | ▼ Not Encountered |
| AD | ▼ Not Performed |

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

| | | | |
|---|---|---|---|
| STARTED: | 11/18/21 | FINISHED: | 11/18/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-10

Sheet 1 of 1

| PROJECT NAME | CLIENT |
|---|---|
| SH412B and Patrol Rd Roundabout | MidAmerica Industrial Park (MAIP) |
| **PROJECT NUMBER** | **LOCATION** |
| G20-10300 | Mayes County, Oklahoma |

Grab Sample  Auger Cuttings

**LAT**: 36.217155 **LONG**: -95.281257

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*10.75" thick; deteriorated*<br>***0.9'*** | | 0 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*brown; moist; with sand; clayey gravel*<br>***1.9'*** | | 1 | GB 1 | | | | | | | |
| | ***SANDY LEAN CLAY***<br>*reddish brown; moist; some sand; trace gravel*<br>***3.0'*** | | 2 | AU 3<br>GB 2 | | | | 5.7 | | | |
| | ***BASE OF BORING AT 3.0 FEET*** | | 3 | | | | | | | | |

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/16/21 | FINISHED: | 11/16/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-11

Sheet 1 of 1

| PROJECT NAME | CLIENT |
|---|---|
| SH412B and Patrol Rd Roundabout | MidAmerica Industrial Park (MAIP) |
| **PROJECT NUMBER** | **LOCATION** |
| G20-10300 | Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.221949 **LONG**: -95.279104

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*12.5" thick; separations at 4.75, 6, and 9.5"*<br>***1.1'*** | | 0<br>1 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*brown; moist; with sand; clayey gravel*<br>***1.9'*** | | | GB 1 | | | | | | | |
| | ***FAT CLAY***<br>*dark brown; moist; some sand; trace gravel*<br>***2.5'*** | | 2 | GB 2 | | | | 15.1 | | | |

***BASE OF BORING AT 2.5 FEET***

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/17/21 | FINISHED: | 11/17/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-12

Sheet 1 of 1

| | |
|---|---|
| PROJECT NAME: SH412B and Patrol Rd Roundabout | CLIENT: MidAmerica Industrial Park (MAIP) |
| PROJECT NUMBER: G20-10300 | LOCATION: Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.227404 **LONG**: -95.279072

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*13-inches thick; separations at 2.5, 4.25, and 8.5"*<br>***1.1'*** | | 0<br>1 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*brown with gray; moist; with sand; clayey gravel*<br>***1.9'*** | | | GB 1 | | | | | | | |
| | ***FAT CLAY***<br>*dark brown; moist; trace gravel; some sand*<br>***2.7'*** | | 2 | GB 2 | | | | | | | |
| | ***LEAN CLAY WITH SAND***<br>*dark gray; moist; trace gravel; with sand*<br>***4.0'*** | | 3<br>4 | GB 3 | CL | | | 18.0 | | 31/17 | P-200 = 71.7% |

***BASE OF BORING AT 4.0 FEET***

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/17/21 | FINISHED: | 11/17/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-13

Sheet 1 of 1

| | |
|---|---|
| PROJECT NAME: SH412B and Patrol Rd Roundabout | CLIENT: MidAmerica Industrial Park (MAIP) |
| PROJECT NUMBER: G20-10300 | LOCATION: Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.23287 **LONG**: -95.279134

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*12" thick; separation at 6"*<br>***1.0'*** | | 0<br>1 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*brown; moist; with sand; clayey gravel*<br>***2.3'*** | | 2 | GB 1 | | | | | | | |
| | ***CLAYEY GRAVEL***<br>*dark brown; moist; with sand*<br>***2.5'*** | | | GB 2 | | | | 13.2 | | | |
| | ***BASE OF BORING AT 2.5 FEET*** | | | | | | | | | | |

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/17/21 | FINISHED: | 11/17/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-14

Sheet 1 of 1

| PROJECT NAME | CLIENT |
|---|---|
| SH412B and Patrol Rd Roundabout | MidAmerica Industrial Park (MAIP) |
| **PROJECT NUMBER** | **LOCATION** |
| G20-10300 | Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.238156 **LONG**: -95.279076

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*12" thick*<br>***1.0'*** | | 0<br>1 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*brown; moist; with sand; clayey gravel*<br>***2.2'*** | | 2 | GB 1 | | | | | | | |
| | ***FAT CLAY***<br>*dark brown; moist; trace gravel; occasional small sand pockets*<br>*2.3': encountered large gravel and PVC pipe*<br>***3.0'*** | | 3 | GB 2 | | | | 21.6 | | | |

***BASE OF BORING AT 3.0 FEET***

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/17/21 | FINISHED: | 11/17/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

olsson

# BOREHOLE REPORT NO. B-15

Sheet 1 of 1

| PROJECT NAME | CLIENT |
|---|---|
| SH412B and Patrol Rd Roundabout | MidAmerica Industrial Park (MAIP) |
| **PROJECT NUMBER** | **LOCATION** |
| G20-10300 | Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.24366 **LONG**: -95.279142

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*12.5" thick; deteriorated*<br>***1.1'*** | | 0<br>1 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*brown; moist; with sand; clayey gravel; difficult to advance auger through*<br>***2.2'*** | | 2 | GB 1<br>GB 2 | | | | 11.6 | | | |

***REFUSAL AT 2.2 FEET***

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/17/21 | FINISHED: | 11/17/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-16

Sheet 1 of 1

| | |
|---|---|
| PROJECT NAME: SH412B and Patrol Rd Roundabout | CLIENT: MidAmerica Industrial Park (MAIP) |
| PROJECT NUMBER: G20-10300 | LOCATION: Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.249064 **LONG**: -95.279113

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***ASPHALT***<br>*13.5" thick*<br>***1.1'*** | | 0<br>1 | | | | | | | | |
| | ***AGGREGATE BASE***<br>*gray; moist; with sand; clayey gravel*<br>***2.0'*** | | 2 | GB 1 | | | | | | | |
| | ***FAT CLAY***<br>***2.2'***<br>*dark brown; moist; some sand; trace gravel*<br>***REFUSAL AT 2.2 FEET*** | | | GB 2 | | | | 5.2 | | | |

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/17/21 | FINISHED: | 11/17/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-17

Sheet 1 of 1

| PROJECT NAME | CLIENT |
|---|---|
| SH412B and Patrol Rd Roundabout | MidAmerica Industrial Park (MAIP) |
| **PROJECT NUMBER** | **LOCATION** |
| G20-10300 | Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.214145 **LONG**: -95.28881

| 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 | | | | | | | | |
| | ***0.2'*** | | | | | | | | | | |
| | *brown; moist; lean clay; trace roots* | | | | | | | | | | |
| | ***SANDY LEAN CLAY*** | | | | | | | | | | |
| | *brown; moist; trace roots; trace gravel; some sand* | | 1 | GB 1 | | | | 16.7 | | | |
| | ***2.1'*** | | 2 | | | | | | | | |
| | ***SANDY LEAN CLAY*** | | | GB 2 | | | | | | | |
| | *reddish brown; moist; some sand; trace gravel* | | 3 | | | | | | | | |
| | ***3.2'*** | | | | | | | | | | |

***BASE OF BORING AT 3.2 FEET***

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

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

| | | | |
|---|---|---|---|
| STARTED: | 11/18/21 | FINISHED: | 11/18/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# BOREHOLE REPORT NO. B-18

Sheet 1 of 1

| | |
|---|---|
| PROJECT NAME: SH412B and Patrol Rd Roundabout | CLIENT: MidAmerica Industrial Park (MAIP) |
| PROJECT NUMBER: G20-10300 | LOCATION: Mayes County, Oklahoma |

Grab Sample

**LAT**: 36.214874 **LONG**: -95.286887

| 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***<br>*brown; moist; lean clay; trace roots* ***0.3'*** | | 0 | GB 1 | | | | | | | |
| | ***SANDY LEAN CLAY***<br>*light brown; moist to wet; trace roots; trace orange mottling; trace gravel; some sand* | | 1 | GB 2 | CL | | | 21.6 | | 27/11 | P-200 = 51.2% |
| | ***2.7'*** | | 2 | GB 3 | | | | | | | |

***BASE OF BORING AT 2.7 FEET***

| WATER LEVEL OBSERVATIONS | |
|---|---|
| WD | ▽ 2.2 ft |
| IAD | ▼ 1.6 ft |
| AD | ▼ Not Performed |

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

| | | | |
|---|---|---|---|
| STARTED: | 11/16/21 | FINISHED: | 11/16/21 |
| DRILL CO.: | OLSSON | DRILL RIG: | HAND AUGER |
| DRILLER: | JF | LOGGED BY: | MD |
| METHOD: HAND AUGER | | | |

# APPENDIX C
Core Log Photographs


## CORE LOG: B-02A

| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Northbound** |
| **GPS:** | **36.117821, -95.279276** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/15/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 7 | Separation at 1.5" |
| | Total Core Thickness | 7 | |
| 2 | Aggregate Base | 17 | |
| 3 | Lean Clay (CL), Brown | 14 | |
| | Total Test Depth | 38 | |

**CORE DATA**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☑ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |


## CORE LOG: B-03

| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Southbound** |
| **GPS:** | **36.182333, -95.279320** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/18/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 7.5 | Minor voids |
| | Total Core Thickness | 7.5 | Separation at 1.75" |
| 2 | Aggregate Base | 16.5 | |
| | Total Test Depth | 24 | |

**CORE DATA**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☑ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |

## CORE LOG: B-04

| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Northbound** |
| **GPS:** | **36.187617, -95.280706** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/15/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 10.5 | Minor voids |
| | Total Core Thickness | 10.5 | Separation at 3.75" & 5.5" |
| 2 | Aggregate Base | 10 | |
| 3 | Lean Clay (CL), Reddish Brown | 21.5 | |
| 4 | Fat Clay (CH), Dark Brown | 6 | |
| | Total Test Depth | 48 | |

**CORE DATA**

| | | | | | | |
|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☑ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |

## CORE LOG: B-05

| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Southbound** |
| **GPS:** | **36.192407, -95.284068** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/18/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 9 | Minor voids |
| | Total Core Thickness | 9 | |
| 2 | Aggregate Base | 10 | |
| 3 | Lean Clay (CL), Reddish Brown | 9 | |
| 4 | Fat Clay (CH), Dark Brown | 20 | |
| | Total Test Depth | 48 | |

**CORE DATA**

| | | | | | | |
|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☐ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |

## CORE LOG: B-06

| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Northbound** |
| **GPS:** | **36.197413, -95.286731** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/16/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 9 | Minor voids |
| | Total Core Thickness | 9 | Separation at 1.75" |
| 2 | Aggregate Base | 10 | |
| 3 | Lean Clay (CL), Reddish Brown | 9.5 | |
| 4 | Clayey Sand (SC), Dark Brown | 18 | |
| 5 | Lean Clay (CL), Brown | 3.5 | |
| | Total Test Depth | 50 | |

**CORE DATA**

| | | | | | | |
|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☑ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |

## CORE LOG: B-07

| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Southbound** |
| **GPS:** | **36.202781, -95.288046** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/18/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 10.5 | Minor voids |
| | Total Core Thickness | 10.5 | |
| 2 | Aggregate Base | 5 | |
| 3 | Lean Clay (CL), Brown | 6 | |
| 4 | Lean Clay (CL), Gray & Brown | 20.5 | |
| | Total Test Depth | 42 | |

**CORE DATA**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☐ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |

## CORE LOG: B-08

| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Northbound** |
| **GPS:** | **36.208301, -95.288002** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/16/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 6.75 | Minor voids |
| | Total Core Thickness | 6.75 | Deteriorated zone from 2" to 3.5" |
| 2 | Aggregate Base | 13 | |
| 3 | Clayey Sand (SC), Brown | 6.75 | |
| | Total Test Depth | 26.5 | |

**CORE DATA**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☑ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |

## CORE LOG: B-10

| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Northbound** |
| **GPS:** | **36.217115, -95.281257** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/16/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 10.75 | 2" Vertical crack |
| | Total Core Thickness | 10.75 | Asphalt deteriorated throughout |
| 2 | Aggregate Base | 12 | |
| 3 | Lean Clay (CL), Reddish Brown | 13.25 | |
| | Total Test Depth | 36 | |

**CORE DATA**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☑ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |

## CORE LOG: B-11

| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Southbound** |
| **GPS:** | **36.221949, -95.279104** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/17/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 12.5 | Minor voids<br>Separation at 4.75", 6", 9.5"<br>Deteriorated zone from 4.75" to 6" |
| | Total Core Thickness | 12.5 | |
| 2 | Aggregate Base | 9.5 | |
| 3 | Fat Clay (CH), Dark Brown | 8 | |
| | Total Test Depth | 30 | |

**CORE DATA**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☑ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |


## CORE LOG: B-12

| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Northbound** |
| **GPS:** | **36.227404, -95.279072** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/17/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 13 | Minor voids |
| | Total Core Thickness | 13 | Separation at 2.5", 4.25", 8.5" |
| 2 | Aggregate Base | 9.5 | |
| 3 | Fat Clay (CH), Dark Brown | 9.75 | |
| 4 | Lean Clay (CL), Dark Gray | 15.75 | |
| | Total Test Depth | 48 | Note: Switched to larger barrel at 5.5" |

**CORE DATA**

| | | | | | | |
|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☑ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |


## CORE LOG: B-13

| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Southbound** |
| **GPS:** | **36.23287, -95.279134** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/17/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 12 | Minor voids |
| | Total Core Thickness | 12 | Separation at 6" |
| 2 | Aggregate Base | 15.5 | |
| 3 | Clayey Gravel (GC), Dark Brown | 2.5 | |
| | Total Test Depth | 30 | |

**CORE DATA**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☑ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |


## CORE LOG: B-14

| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Northbound** |
| **GPS:** | **36.238156, -95.279076** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/17/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 12 | Minor voids |
| | Total Core Thickness | 12 | |
| 2 | Aggregate Base | 14.5 | |
| 3 | Fat Clay (CH), Dark Brown | 9.5 | |
| | Total Test Depth | 36 | |

**CORE DATA**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☐ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |

## CORE LOG: B-15

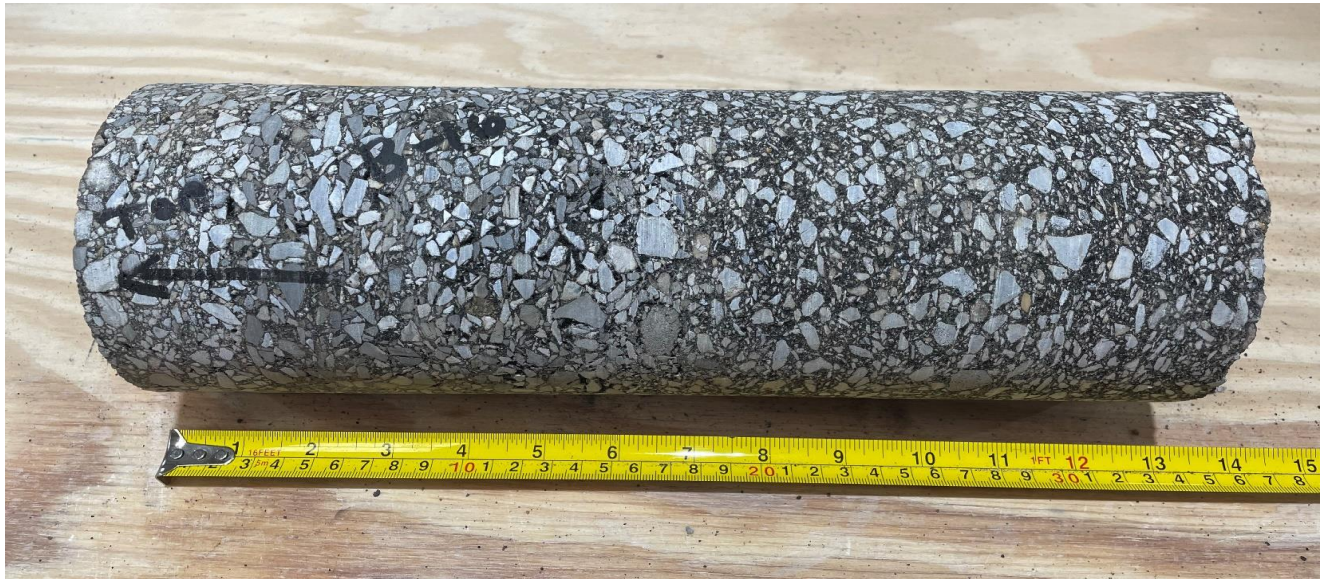
| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Southbound** |
| **GPS:** | **36.243660, -95.279142** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/17/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 12.5 | Minor voids |
| | Total Core Thickness | 12.5 | Rest of core was deteriorated |
| 2 | Aggregate Base | 13.5 | |
| | Total Test Depth | 26 | |

**CORE DATA**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☑ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |



## CORE LOG: B-16

| | |
|---|---|
| **Olsson Project No.:** | **G20-1030** |
| **County:** | **Mayes** |
| **Job Location:** | **SH412B and Patrol Rd S Roundabout** |
| **Lane Direction:** | **Northbound** |
| **GPS:** | **36.243660, -95.279142** |
| **Surveyed By:** | **MD** |
| **Survey Date:** | **11/17/2021** |

**CORE LAYER DATA (FROM TOP TO BOTTOM)**

| Sample No. | Layer Type | Layer Thickness (in.) | Layer Characteristics* |
|---|---|---|---|
| 1 | Asphalt Concrete | 13.5 | Minor voids |
| | Total Core Thickness | 13.5 | |
| 3 | Aggregate Base | 10.5 | |
| 4 | Fat Clay (CH), Dark Brown | 2.5 | |
| | Total Test Depth | 26.5 | |

**CORE DATA**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Surface Material Type: | **A.C.** | ☑ | **P.C.C.** | ☐ | **C.R.C.** | ☐ |
| Stripping or Separation in Asphalt: | **Stripping** | ☑ | **Separation** | ☐ | **N/A** | ☐ |
| Honeycomb or "D" Cracking in PCC: | **Honeycomb** | ☐ | **"D" Cracking** | ☐ | **N/A** | ☑ |
| Stabilized Subgrade Under Pavement: | **Yes** | ☐ | **No** | ☑ | **Unknown** | ☐ |

# APPENDIX D

DCP Test Results

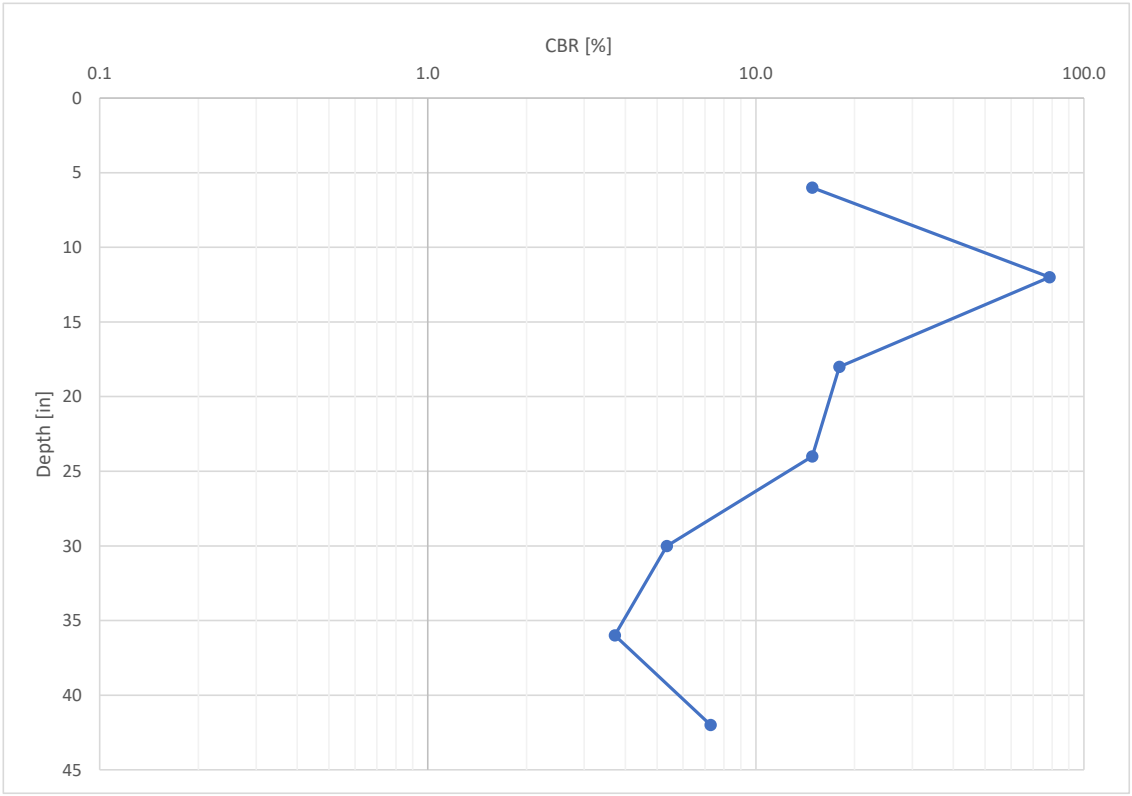
**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | |
|---|---|
| *Project Number:* | G20-10300 |
| *Project:* | SH412B and Patrol Road Roundabout |
| *Date* | 17-Nov |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez |
| *Hammer Weight (lb):* | 17.6 |
| *Materal Classification:* | CL |
| *Elevation:* | At surface |
| *Weather:* | 60 Sunny |

Test Location
**B-01**

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 10 | 6 | 152.4 | 15.2 | 1 | 15.2 | CL | 14.9 | 22297 |
| 23 | 12 | 304.8 | 6.6 | 1 | 6.6 | CL | 78.6 | 117953 |
| 11 | 18 | 457.2 | 13.9 | 1 | 13.9 | CL | 18.0 | 26980 |
| 10 | 24 | 609.6 | 15.2 | 1 | 15.2 | CL | 14.9 | 22297 |
| 6 | 30 | 762 | 25.4 | 1 | 25.4 | CL | 5.4 | 8027 |
| 5 | 36 | 914.4 | 30.5 | 1 | 30.5 | CL | 3.7 | 5574 |
| 7 | 42 | 1066.8 | 21.8 | 1 | 21.8 | CL | 7.3 | 10926 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR



**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | |
|---|---|
| *Project Number:* | G20-10300 |
| *Project:* | SH412B and Patrol Road Roundabout |
| *Date* | 17-Nov |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez |
| *Hammer Weight (lb):* | 17.6 |
| *Materal Classification:* | CL / CH |
| *Elevation:* | At surface |
| *Weather:* | 60 Sunny |

Test Location
**B-02**

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 2 | 6 | 152.4 | 76.2 | 1 | 76.2 | CL | 0.6 | 892 |
| 5 | 12 | 304.8 | 30.5 | 1 | 30.5 | CL | 3.7 | 5574 |
| 8 | 18 | 457.2 | 19.1 | 1 | 19.1 | CL | 9.5 | 14270 |
| 7 | 24 | 609.6 | 21.8 | 1 | 21.8 | CL | 7.3 | 10926 |
| 22 | 30 | 762 | 6.9 | 1 | 6.9 | CH | 50.3 | 75422 |
| 37 | 36 | 914.4 | 4.1 | 1 | 4.1 | CH | 84.6 | 126845 |
| 70 | 39 | 990.6 | 1.1 | 1 | 1.1 | CH | 320.0 | 479956 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR

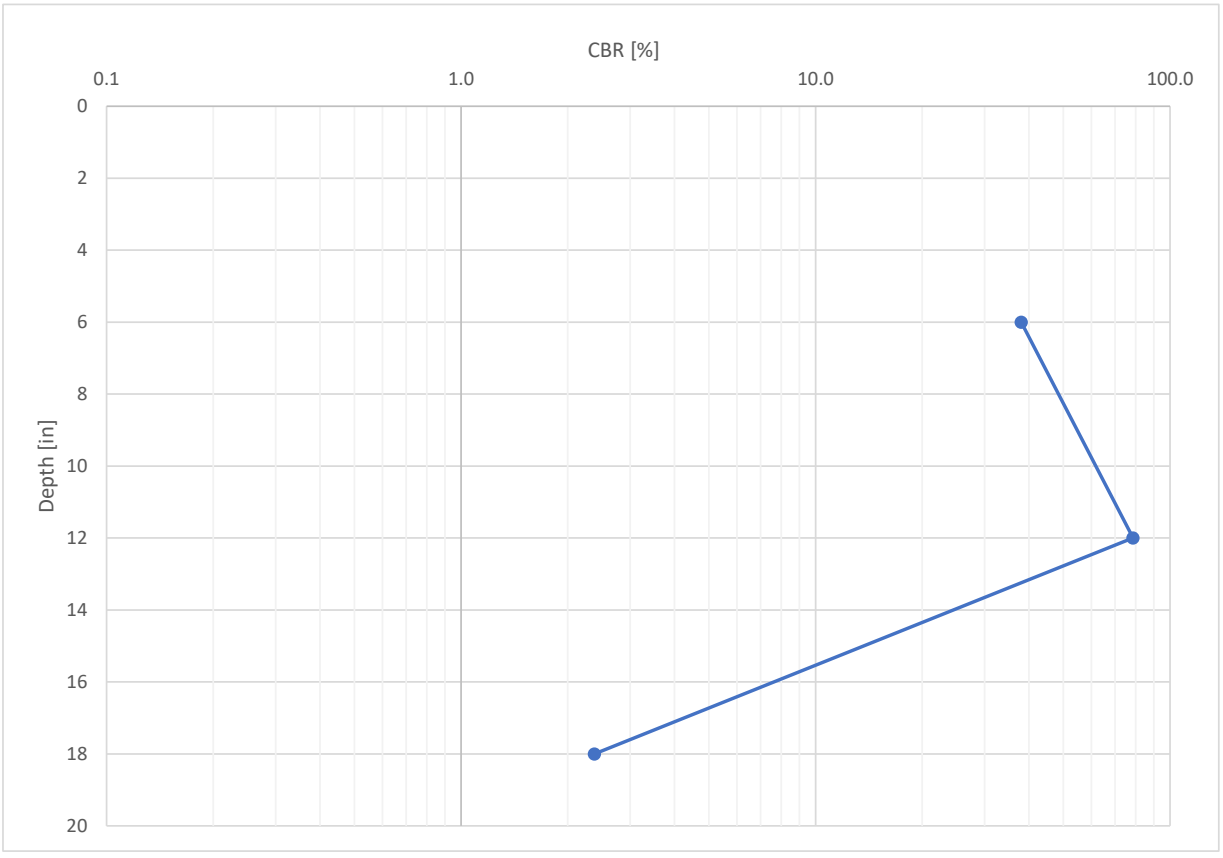
**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | |
|---|---|
| *Project Number:* | G20-10300 |
| *Project:* | SH412B and Patrol Road Roundabout |
| *Date* | 15-Nov |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez |
| *Hammer Weight (lb):* | 17.6 |
| *Materal Classification:* | CL |
| *Elevation:* | Below Pavement and aggregate |
| *Weather:* | 60 Sunny |

Test Location
**B-02A**

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 16 | 6 | 152.4 | 9.5 | 1 | 9.5 | CL | 38.1 | 57081 |
| 23 | 12 | 304.8 | 6.6 | 1 | 6.6 | CL | 78.6 | 117953 |
| 4 | 18 | 457.2 | 38.1 | 1 | 38.1 | CL | 2.4 | 3568 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR



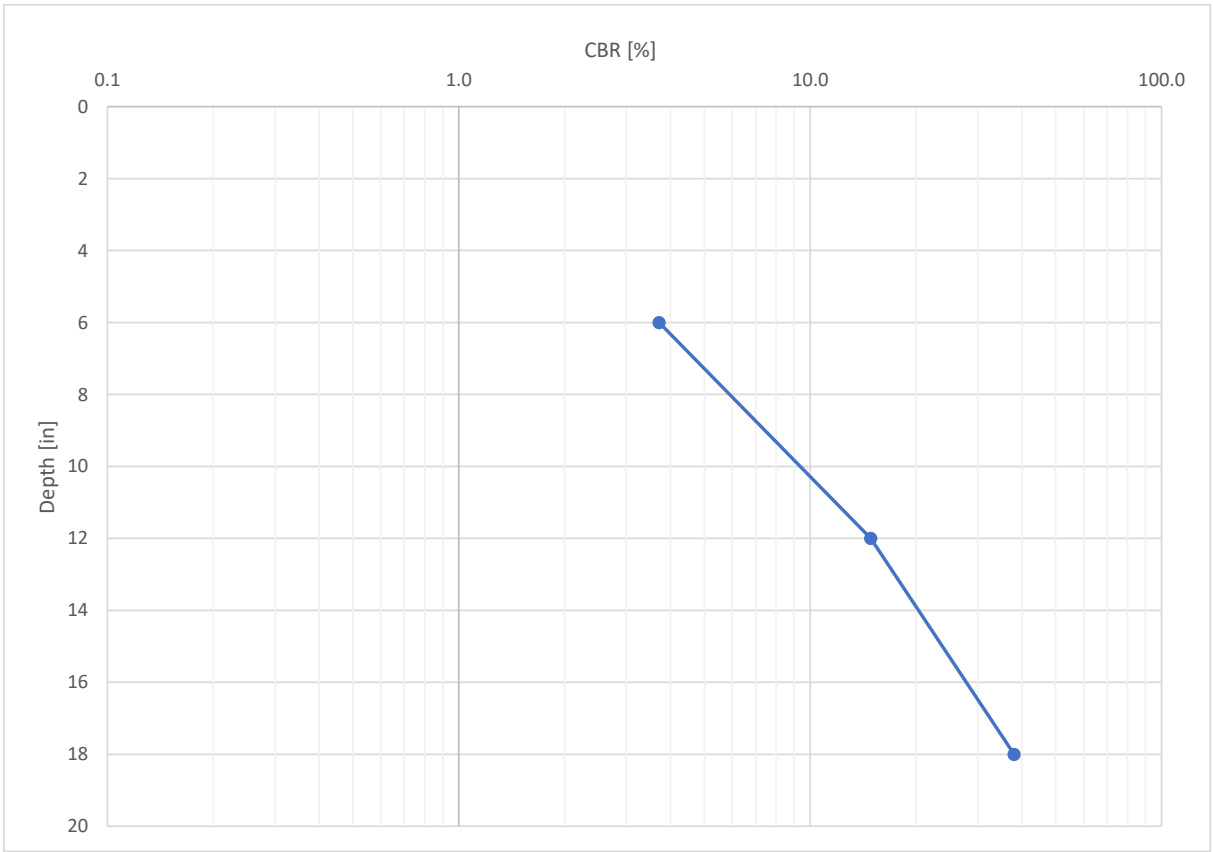
**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | |
|---|---|
| *Project Number:* | G20-10300 |
| *Project:* | SH412B and Patrol Road Roundabout |
| *Date* | 18-Nov |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez |
| *Hammer Weight (lb):* | 17.6 |
| *Materal Classification:* | CL |
| *Elevation:* | Below pavement and aggregate |
| *Weather:* | 60 Sunny |

Test Location
**B-03**

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 5 | 6 | 152.4 | 30.5 | 1 | 30.5 | CL | 3.7 | 5574 |
| 10 | 12 | 304.8 | 15.2 | 1 | 15.2 | CL | 14.9 | 22297 |
| 16 | 18 | 457.2 | 9.5 | 1 | 9.5 | CL | 38.1 | 57081 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR

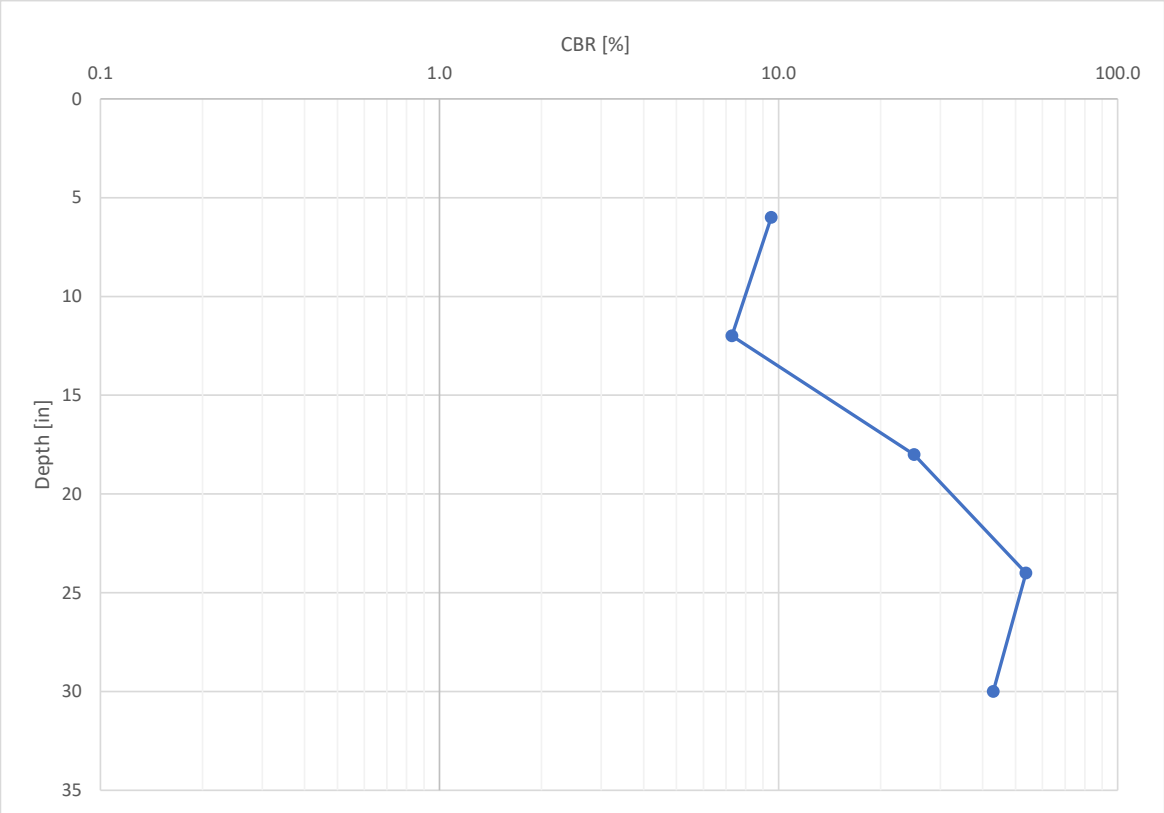


**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | | |
|---|---|---|
| *Project Number:* | G20-10300 | Test Location |
| *Project:* | SH412B and Patrol Road Roundabout | **B-04** |
| *Date* | 15-Nov | |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez | |
| *Hammer Weight (lb):* | 17.6 | |
| *Materal Classification:* | CL | |
| *Elevation:* | Below pavement and aggregate | |
| *Weather:* | 60 Sunny | |

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 8 | 6 | 152.4 | 19.1 | 1 | 19.1 | CL | 9.5 | 14270 |
| 7 | 12 | 304.8 | 21.8 | 1 | 21.8 | CL | 7.3 | 10926 |
| 13 | 18 | 457.2 | 11.7 | 1 | 11.7 | CL | 25.1 | 37683 |
| 19 | 24 | 609.6 | 8.0 | 1 | 8.0 | CL | 53.7 | 80493 |
| 17 | 30 | 762 | 9.0 | 1 | 9.0 | CL | 43.0 | 64439 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR



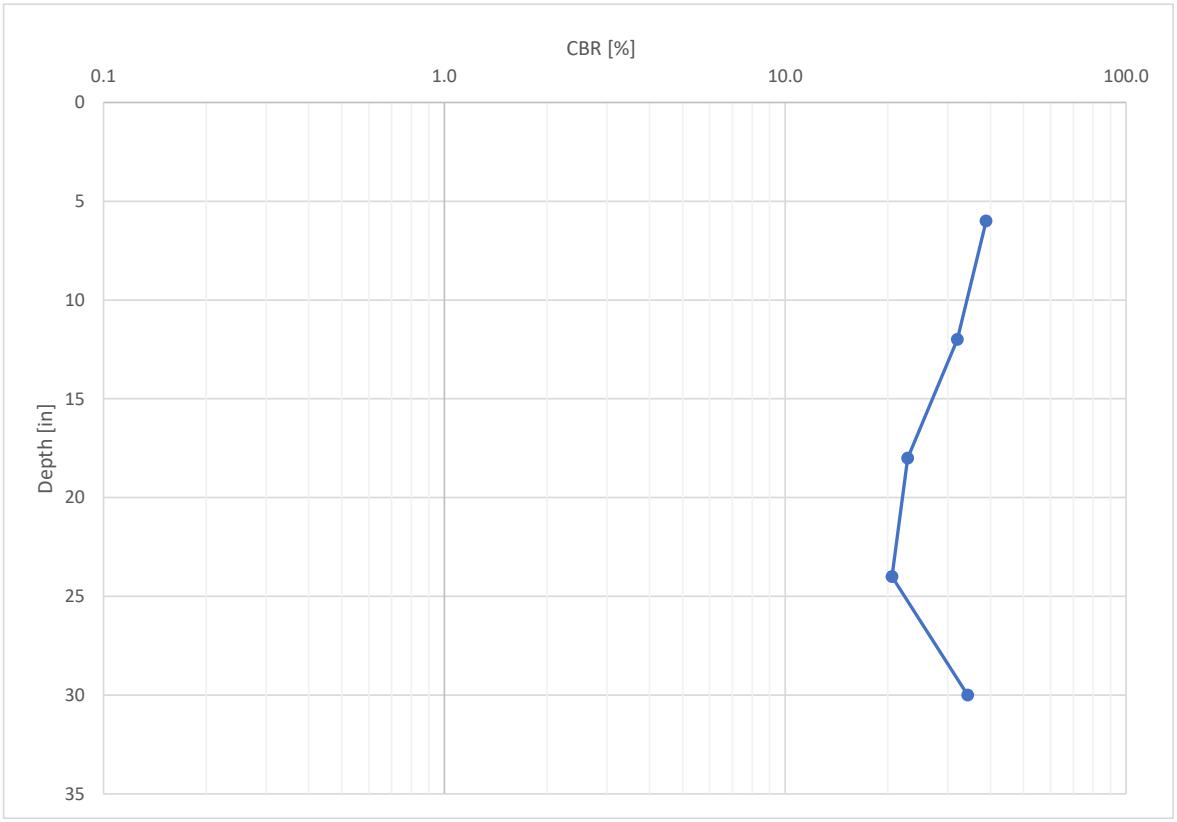
**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | |
|---|---|
| *Project Number:* | G20-10300 |
| *Project:* | SH412B and Patrol Road Roundabout |
| *Date* | 18-Nov |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez |
| *Hammer Weight (lb):* | 17.6 |
| *Materal Classification:* | CH |
| *Elevation:* | Below pavement and aggregate |
| *Weather:* | 60 Sunny |

Test Location
**B-05**

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 17 | 6 | 152.4 | 9.0 | 1 | 9.0 | CH | 38.9 | 58280 |
| 14 | 12 | 304.8 | 10.9 | 1 | 10.9 | CH | 32.0 | 47996 |
| 10 | 18 | 457.2 | 15.2 | 1 | 15.2 | CH | 22.9 | 34283 |
| 9 | 24 | 609.6 | 16.9 | 1 | 16.9 | CH | 20.6 | 30854 |
| 15 | 30 | 762 | 10.2 | 1 | 10.2 | CH | 34.3 | 51424 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR

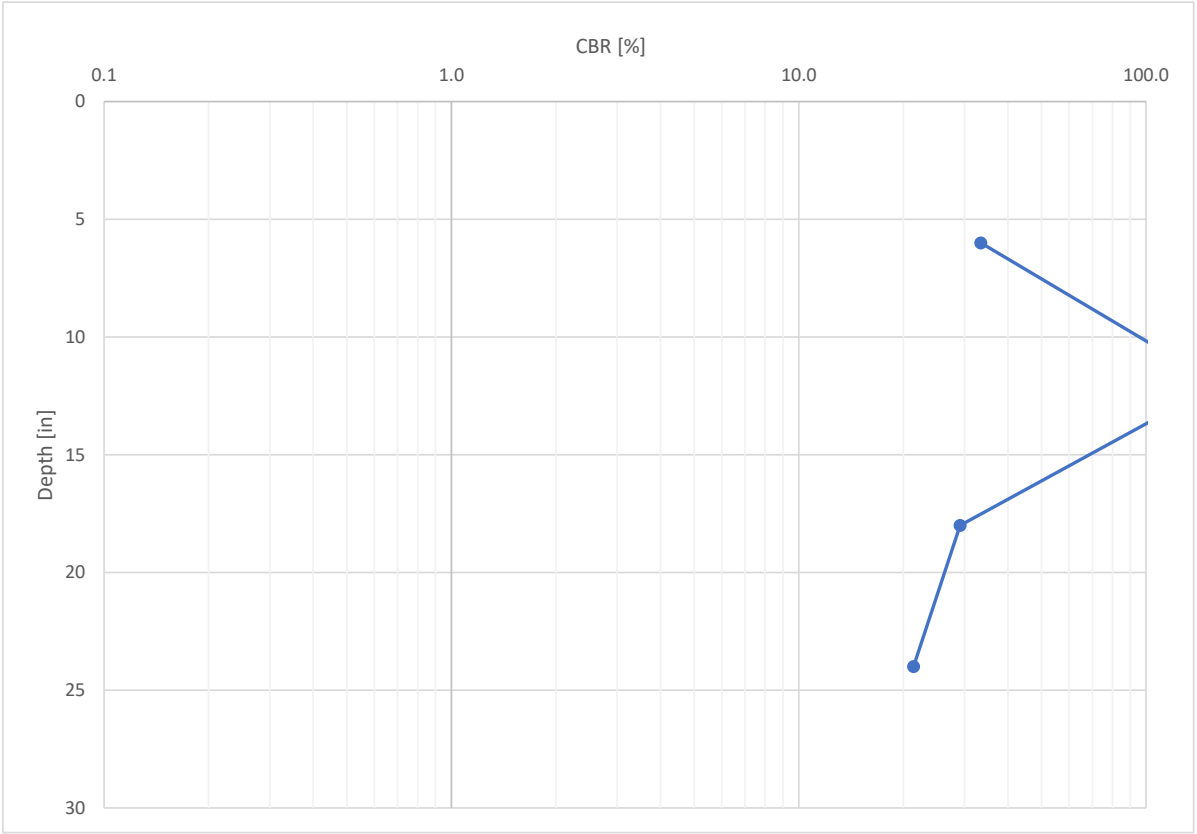


**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | | |
|---|---|---|
| *Project Number:* | G20-10300 | Test Location |
| *Project:* | SH412B and Patrol Road Roundabout | **B-06** |
| *Date* | 16-Nov | |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez | |
| *Hammer Weight (lb):* | 17.6 | |
| *Materal Classification:* | CL / SC | |
| *Elevation:* | Below pavement and aggregate | |
| *Weather:* | 60 Sunny | |

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 15 | 6 | 152.4 | 10.2 | 1 | 10.2 | CL | 33.4 | 50169 |
| 33 | 12 | 304.8 | 4.6 | 1 | 4.6 | CL | 161.9 | 242818 |
| 14 | 18 | 457.2 | 10.9 | 1 | 10.9 | CL | 29.1 | 43703 |
| 12 | 24 | 609.6 | 12.7 | 1 | 12.7 | CL | 21.4 | 32108 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR

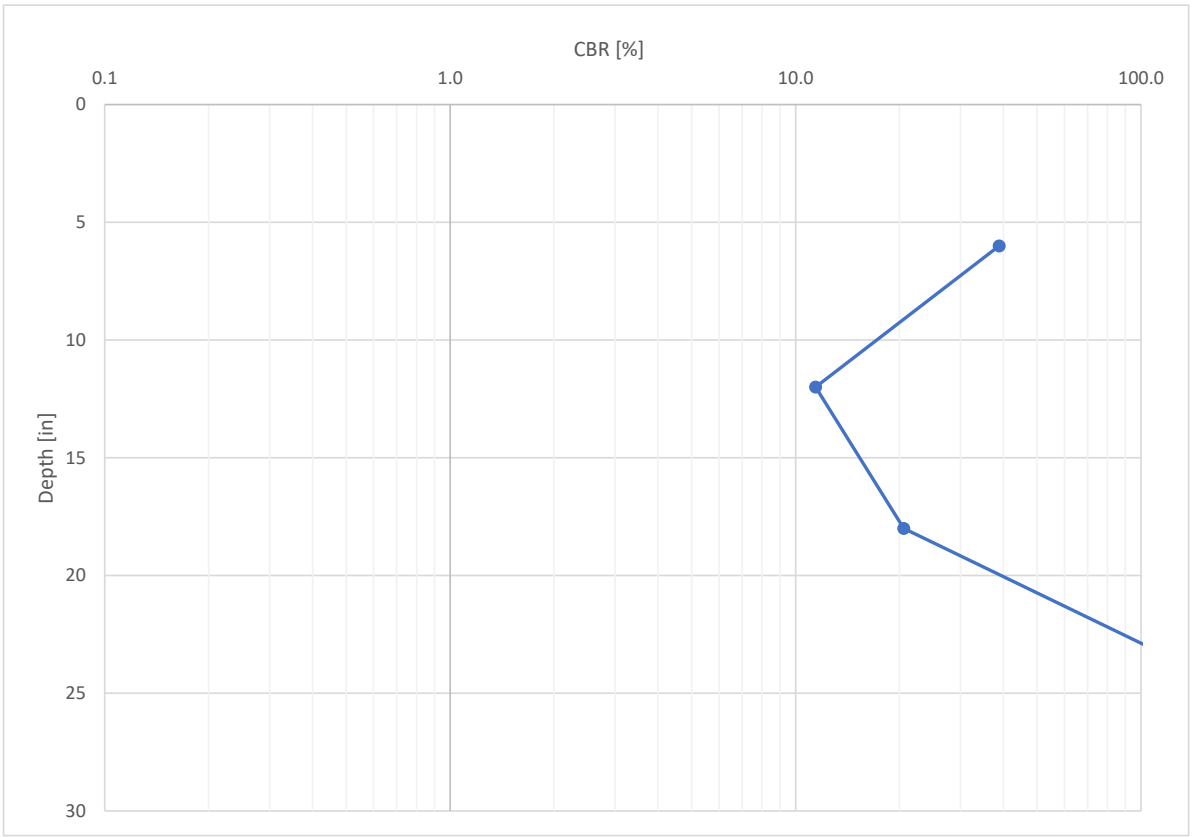


**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | | |
|---|---|---|
| *Project Number:* | G20-10300 | Test Location |
| *Project:* | SH412B and Patrol Road Roundabout | **B-07** |
| *Date* | 18-Nov | |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez | |
| *Hammer Weight (lb):* | 17.6 | |
| *Materal Classification:* | CH | |
| *Elevation:* | Below Pavement | |
| *Weather:* | 60 Sunny | |

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 17 | 6 | 152.4 | 9.0 | 1 | 9.0 | CH | 38.9 | 58280 |
| 5 | 12 | 304.8 | 30.5 | 1 | 30.5 | CH | 11.4 | 17141 |
| 9 | 18 | 457.2 | 16.9 | 1 | 16.9 | CH | 20.6 | 30854 |
| 63 | 24 | 609.6 | 2.4 | 1 | 2.4 | CH | 144.0 | 215980 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR



**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | | |
|---|---|---|
| *Project Number:* | G20-10300 | Test Location |
| *Project:* | SH412B and Patrol Road Roundabout | **B-08** |
| *Date* | 16-Nov | |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez | |
| *Hammer Weight (lb):* | 17.6 | |
| *Materal Classification:* | Other | |
| *Elevation:* | Below pavement and aggregate | |
| *Weather:* | 60 Sunny | |

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 57 | 6 | 152.4 | 2.7 | 1 | 2.7 | Other | 97.1 | 145583 |
| 50 | 6.25 | 158.75 | 0.1 | 1 | 0.1 | Other | 2945.3 | 4417880 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR

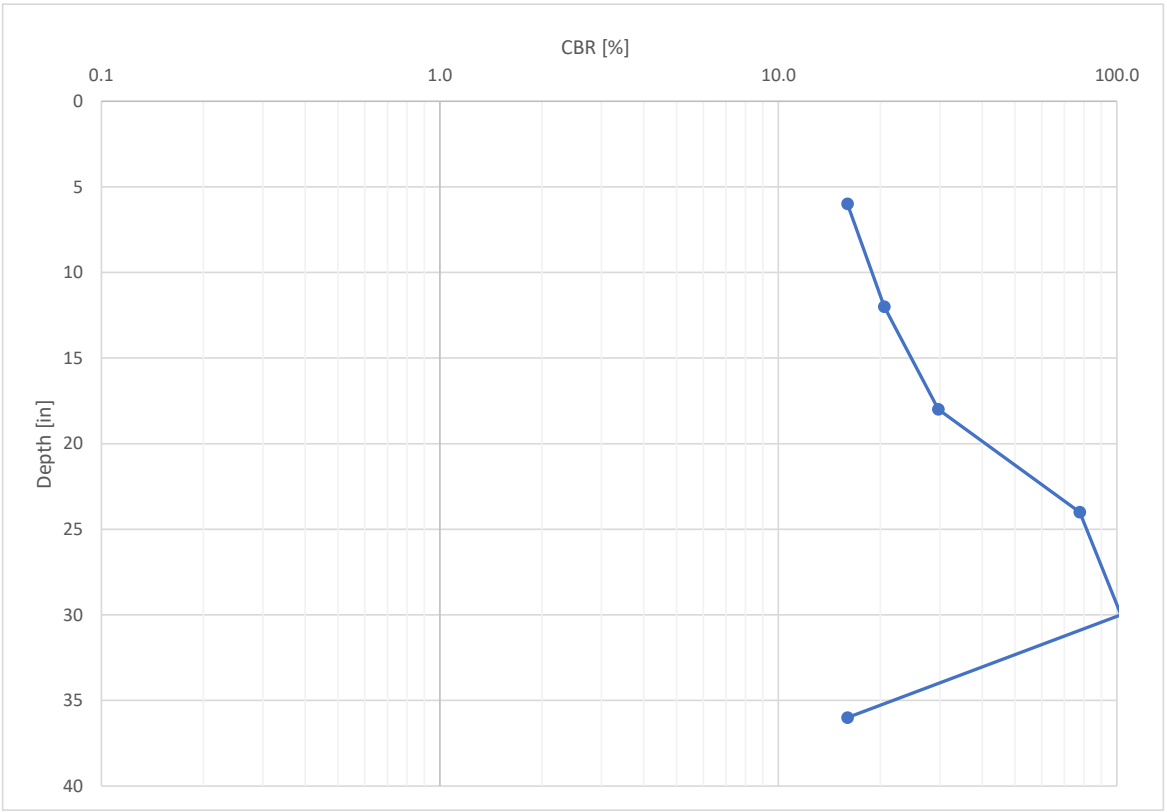
**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | |
|---|---|
| *Project Number:* | G20-10300 |
| *Project:* | SH412B and Patrol Road Roundabout |
| *Date* | 18-Nov |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez |
| *Hammer Weight (lb):* | 17.6 |
| *Materal Classification:* | CL |
| *Elevation:* | 2" below existing grade |
| *Weather:* | 60 Sunny |

Test Location
**B-09**

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 7 | 6 | 152.4 | 21.8 | 1 | 21.8 | CH | 16.0 | 23998 |
| 9 | 12 | 304.8 | 16.9 | 1 | 16.9 | CH | 20.6 | 30854 |
| 13 | 18 | 457.2 | 11.7 | 1 | 11.7 | CH | 29.7 | 44567 |
| 34 | 24 | 609.6 | 4.5 | 1 | 4.5 | CH | 77.7 | 116561 |
| 45 | 30 | 762 | 3.4 | 1 | 3.4 | CH | 102.8 | 154271 |
| 7 | 36 | 914.4 | 21.8 | 1 | 21.8 | CH | 16.0 | 23998 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR

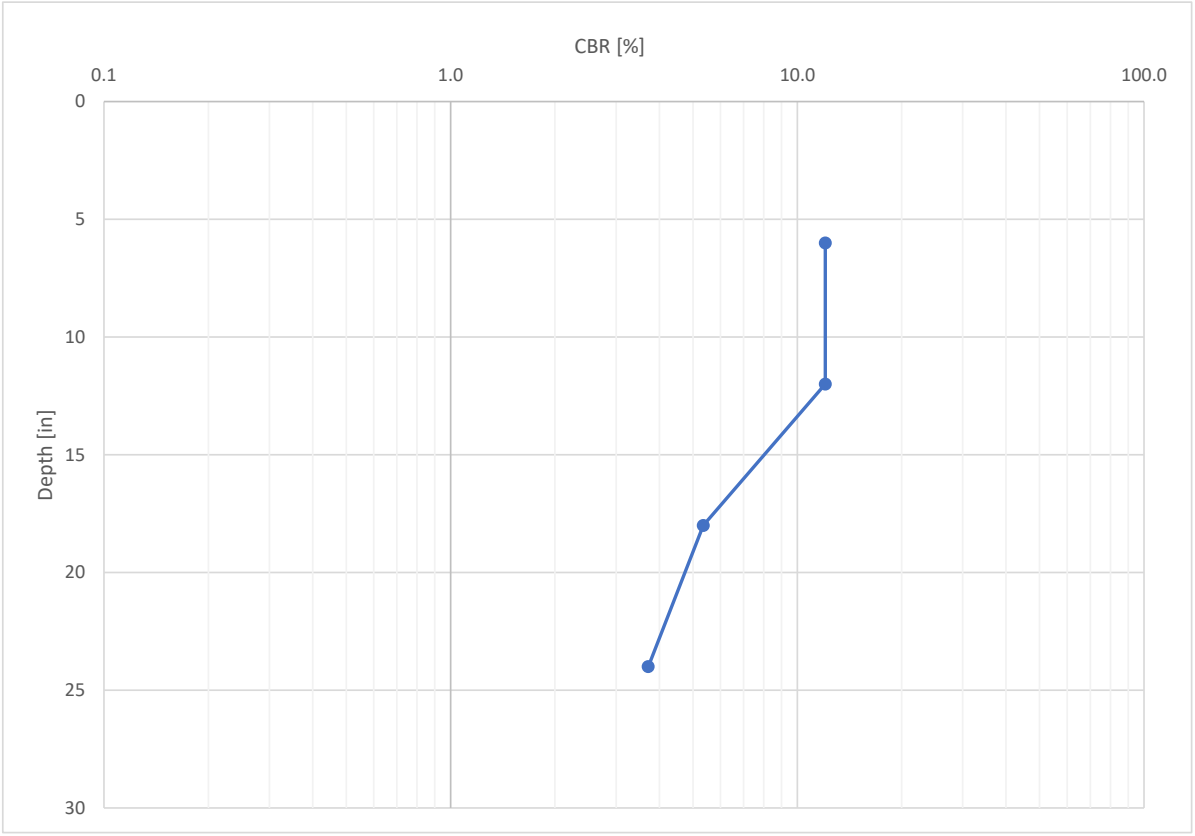


**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | | |
|---|---|---|
| *Project Number:* | G20-10300 | Test Location |
| *Project:* | SH412B and Patrol Road Roundabout | **B-10** |
| *Date* | 16-Nov | |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez | |
| *Hammer Weight (lb):* | 17.6 | |
| *Materal Classification:* | CL | |
| *Elevation:* | Below pavement and aggregate | |
| *Weather:* | 60 Sunny | |

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 9 | 6 | 152.4 | 16.9 | 1 | 16.9 | CL | 12.0 | 18061 |
| 9 | 12 | 304.8 | 16.9 | 1 | 16.9 | CL | 12.0 | 18061 |
| 6 | 18 | 457.2 | 25.4 | 1 | 25.4 | CL | 5.4 | 8027 |
| 5 | 24 | 609.6 | 30.5 | 1 | 30.5 | CL | 3.7 | 5574 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR

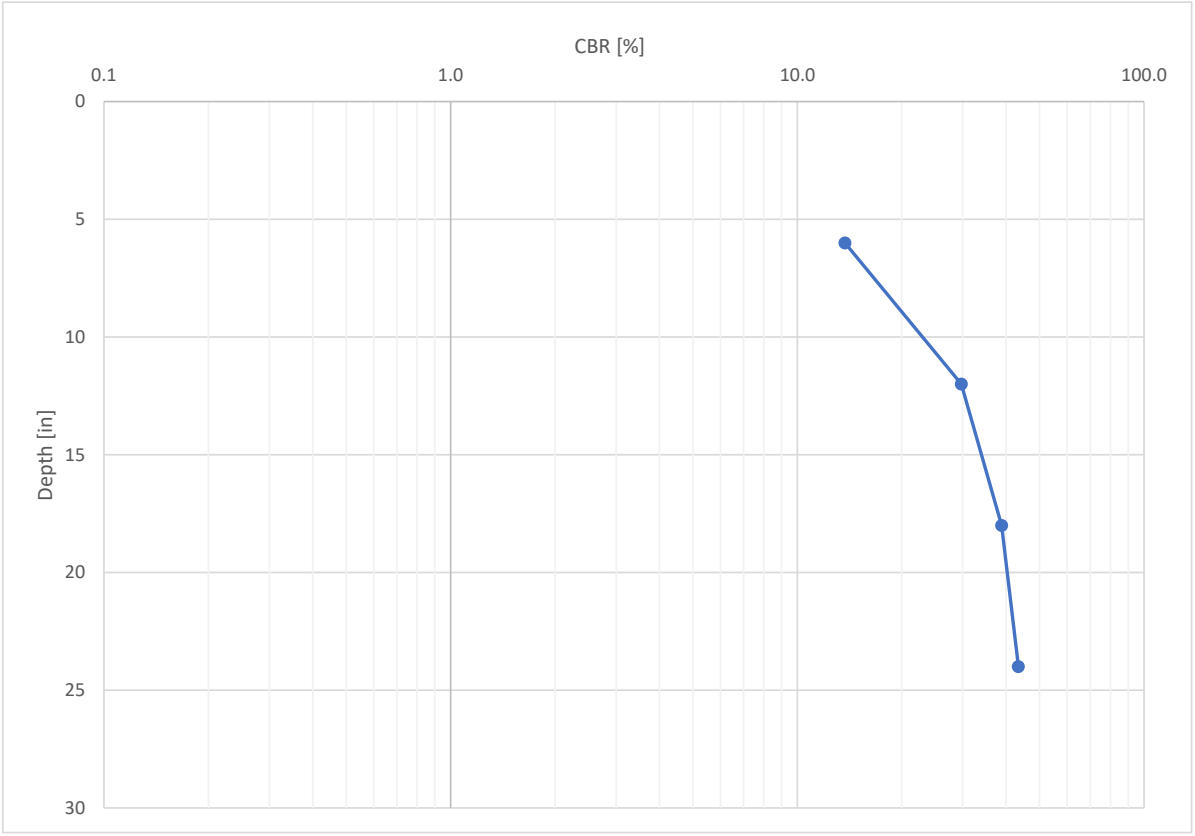


**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | | |
|---|---|---|
| *Project Number:* | G20-10300 | Test Location |
| *Project:* | SH412B and Patrol Road Roundabout | **B-11** |
| *Date* | 17-Nov | |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez | |
| *Hammer Weight (lb):* | 17.6 | |
| *Materal Classification:* | CH | |
| *Elevation:* | Below pavement and aggregate | |
| *Weather:* | 60 Sunny | |

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 6 | 6 | 152.4 | 25.4 | 1 | 25.4 | CH | 13.7 | 20570 |
| 13 | 12 | 304.8 | 11.7 | 1 | 11.7 | CH | 29.7 | 44567 |
| 17 | 18 | 457.2 | 9.0 | 1 | 9.0 | CH | 38.9 | 58280 |
| 19 | 24 | 609.6 | 8.0 | 1 | 8.0 | CH | 43.4 | 65137 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR

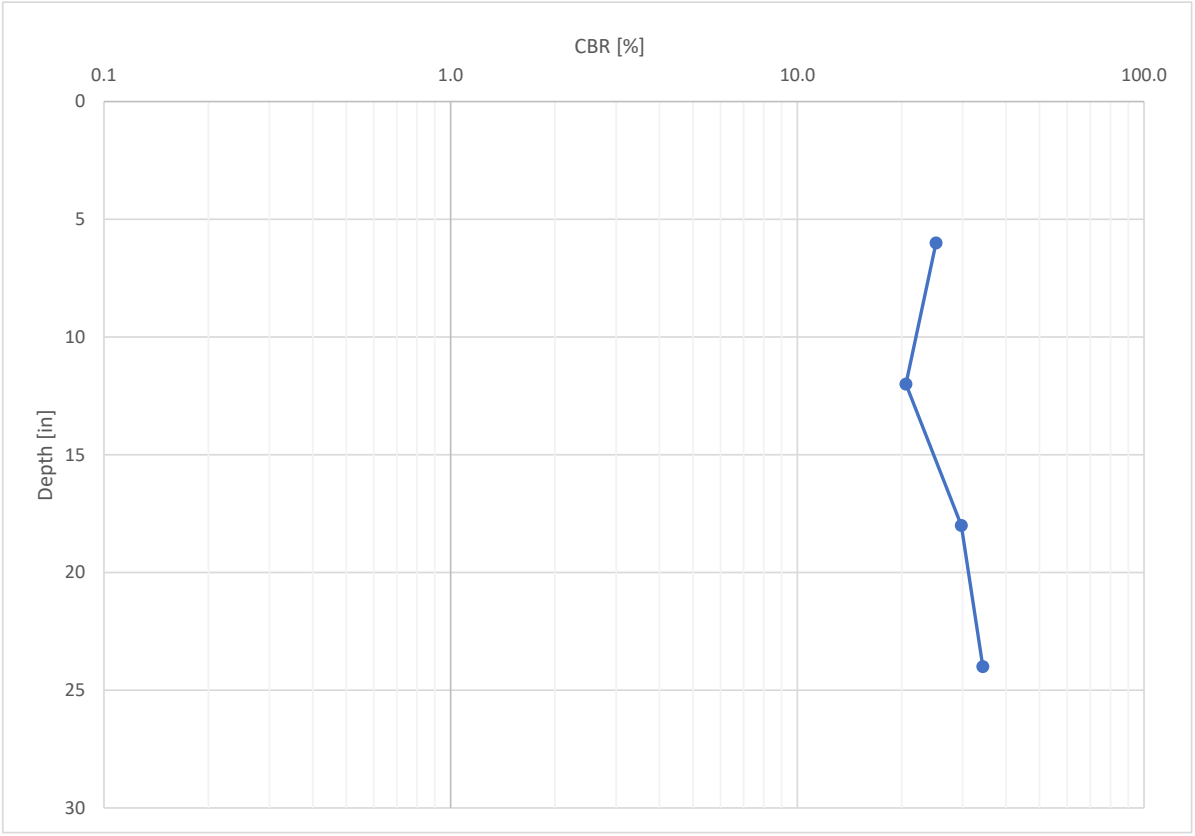


**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | | |
|---|---|---|
| *Project Number:* | G20-10300 | Test Location |
| *Project:* | SH412B and Patrol Road Roundabout | **B-12** |
| *Date* | 17-Nov | |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez | |
| *Hammer Weight (lb):* | 17.6 | |
| *Materal Classification:* | CH | |
| *Elevation:* | Below pavement and aggregate | |
| *Weather:* | 60 Sunny | |

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 11 | 6 | 152.4 | 13.9 | 1 | 13.9 | CH | 25.1 | 37711 |
| 9 | 12 | 304.8 | 16.9 | 1 | 16.9 | CH | 20.6 | 30854 |
| 13 | 18 | 457.2 | 11.7 | 1 | 11.7 | CH | 29.7 | 44567 |
| 15 | 24 | 609.6 | 10.2 | 1 | 10.2 | CH | 34.3 | 51424 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR

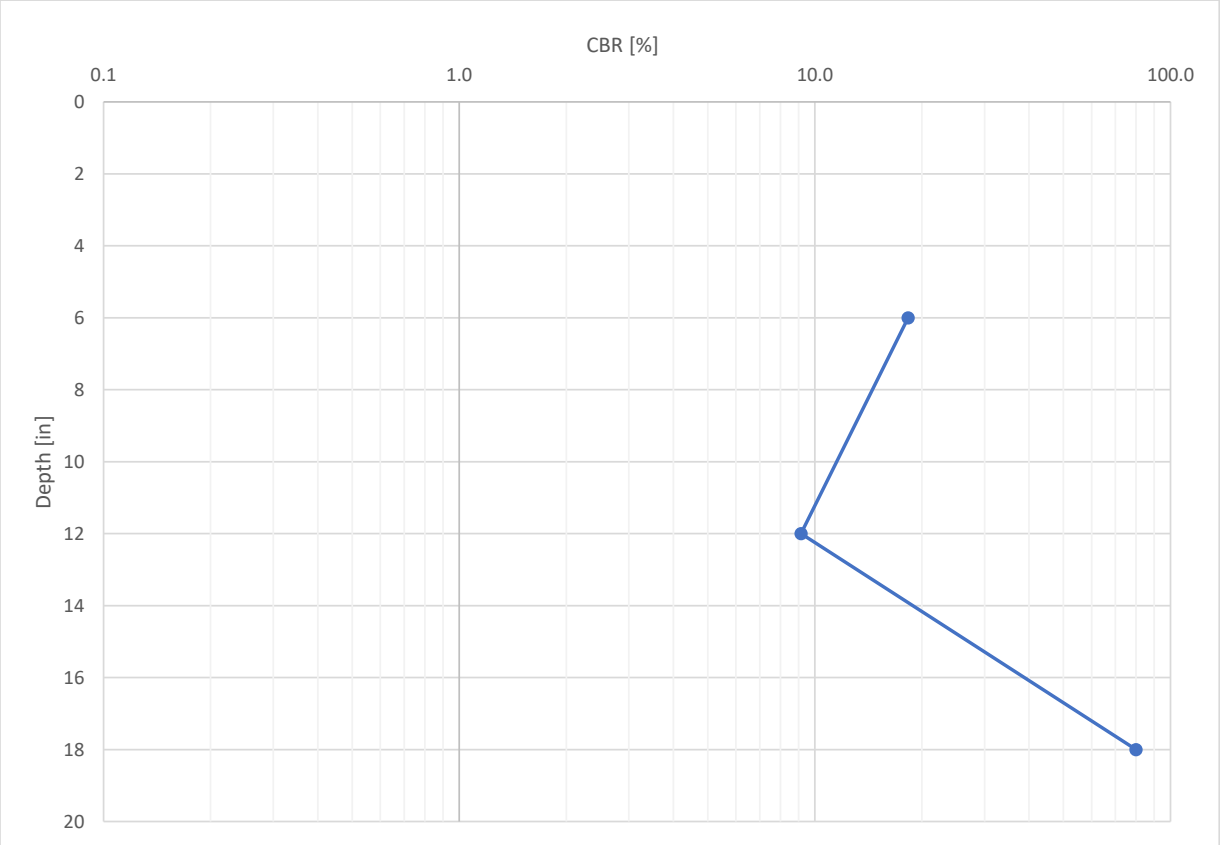


**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | | |
|---|---|---|
| *Project Number:* | G20-10300 | Test Location |
| *Project:* | SH412B and Patrol Road Roundabout | **B-13** |
| *Date* | 17-Nov | |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez | |
| *Hammer Weight (lb):* | 17.6 | |
| *Materal Classification:* | CH | |
| *Elevation:* | Below pavement and aggregate | |
| *Weather:* | 60 Sunny | |

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 8 | 6 | 152.4 | 19.1 | 1 | 19.1 | CH | 18.3 | 27426 |
| 4 | 12 | 304.8 | 38.1 | 1 | 38.1 | CH | 9.1 | 13713 |
| 35 | 18 | 457.2 | 4.4 | 1 | 4.4 | CH | 80.0 | 119989 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR

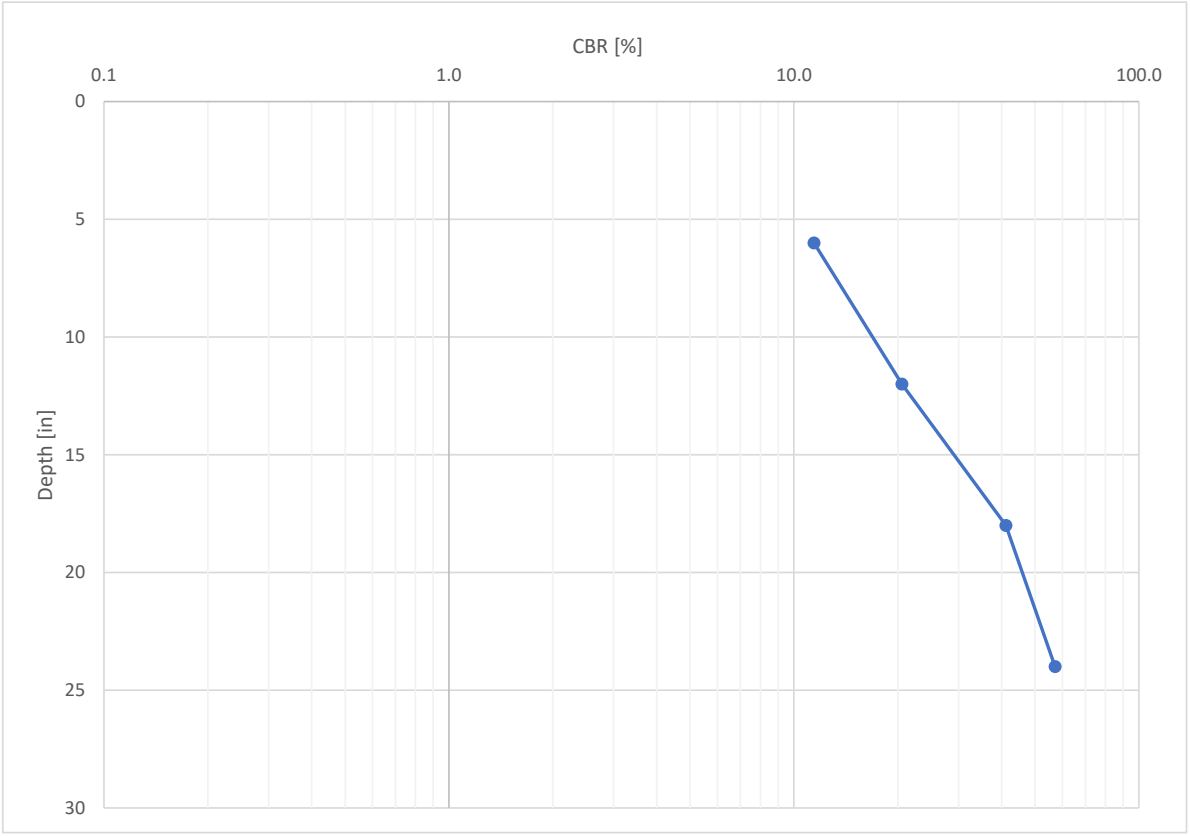


**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | | |
|---|---|---|
| *Project Number:* | G20-10300 | Test Location |
| *Project:* | SH412B and Patrol Road Roundabout | **B-14** |
| *Date* | 17-Nov | |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez | |
| *Hammer Weight (lb):* | 17.6 | |
| *Materal Classification:* | CH | |
| *Elevation:* | Below pavement and aggregate | |
| *Weather:* | 60 Sunny | |

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Ultimate Bearing Capacity* [psf] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 5 | 6 | 152.4 | 30.5 | 1 | 30.5 | CH | 11.4 | 2754 |
| 9 | 12 | 304.8 | 16.9 | 1 | 16.9 | CH | 20.6 | 4069 |
| 18 | 18 | 457.2 | 8.5 | 1 | 8.5 | CH | 41.1 | 6447 |
| 25 | 24 | 609.6 | 6.1 | 1 | 6.1 | CH | 57.1 | 8018 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR

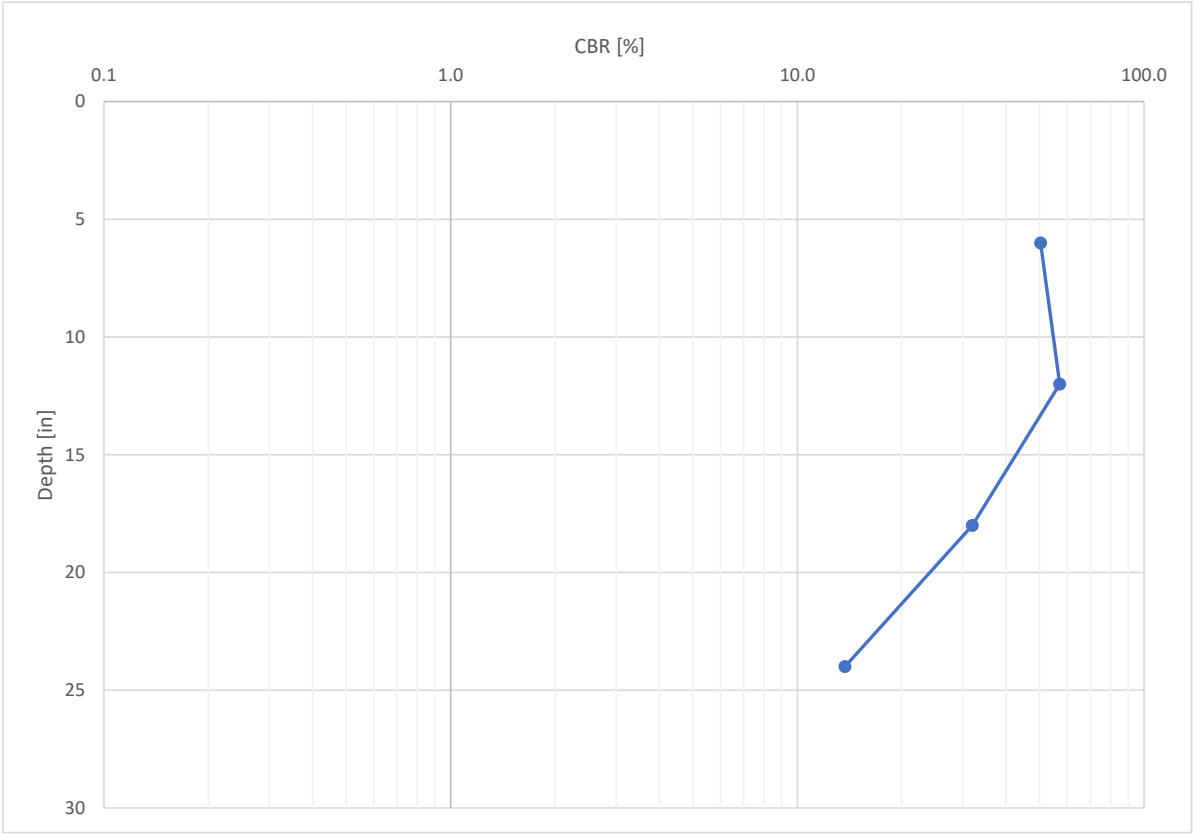


**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | | |
|---|---|---|
| *Project Number:* | G20-10300 | Test Location |
| *Project:* | SH412B and Patrol Road Roundabout | **B-16** |
| *Date* | 16-Nov | |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez | |
| *Hammer Weight (lb):* | 17.6 | |
| *Materal Classification:* | CH | |
| *Elevation:* | Below pavement and aggregate | |
| *Weather:* | 60 Sunny | |

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 22 | 6 | 152.4 | 6.9 | 1 | 6.9 | CH | 50.3 | 75422 |
| 25 | 12 | 304.8 | 6.1 | 1 | 6.1 | CH | 57.1 | 85706 |
| 14 | 18 | 457.2 | 10.9 | 1 | 10.9 | CH | 32.0 | 47996 |
| 6 | 24 | 609.6 | 25.4 | 1 | 25.4 | CH | 13.7 | 20570 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR



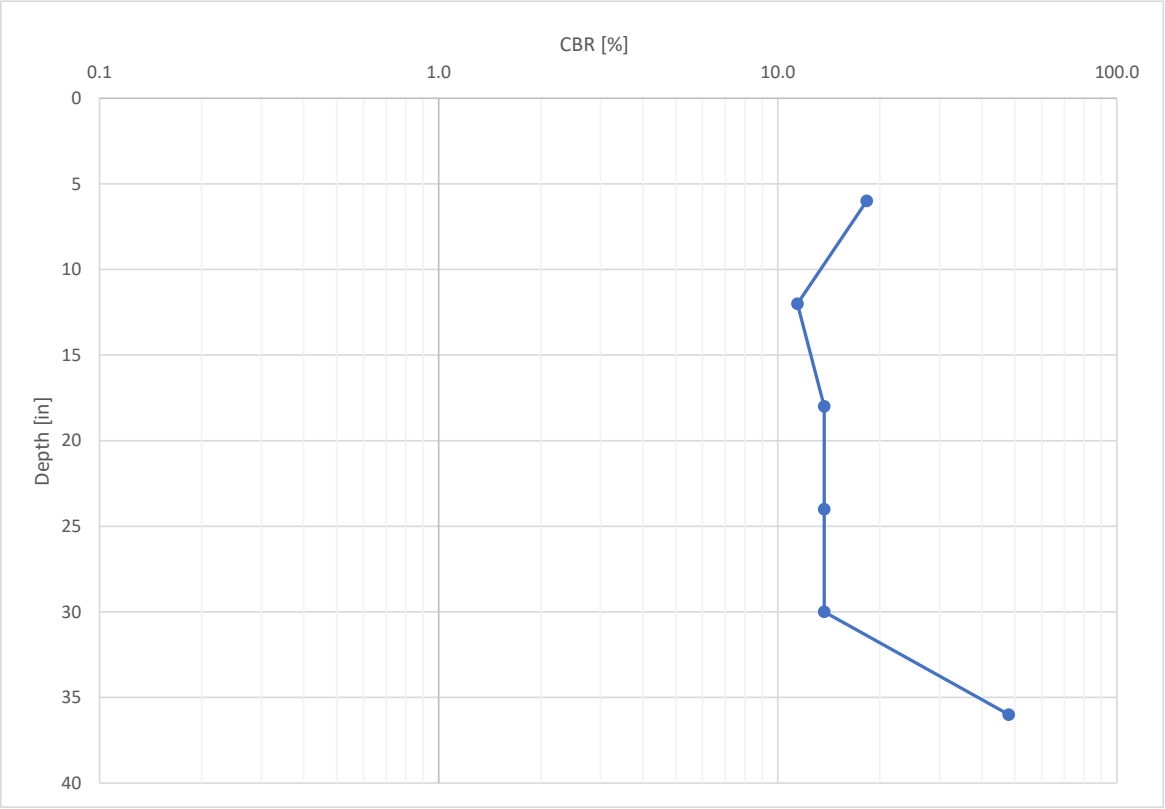
**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | |
|---|---|
| *Project Number:* | G20-10300 |
| *Project:* | SH412B and Patrol Road Roundabout |
| *Date* | 18-Nov |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez |
| *Hammer Weight (lb):* | 17.6 |
| *Materal Classification:* | CH |
| *Elevation:* | 4" below existing grade |
| *Weather:* | 60 Sunny |

Test Location
**B-17**

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 8 | 6 | 152.4 | 19.1 | 1 | 19.1 | CH | 18.3 | 27426 |
| 5 | 12 | 304.8 | 30.5 | 1 | 30.5 | CH | 11.4 | 17141 |
| 6 | 18 | 457.2 | 25.4 | 1 | 25.4 | CH | 13.7 | 20570 |
| 6 | 24 | 609.6 | 25.4 | 1 | 25.4 | CH | 13.7 | 20570 |
| 6 | 30 | 762 | 25.4 | 1 | 25.4 | CH | 13.7 | 20570 |
| 21 | 36 | 914.4 | 7.3 | 1 | 7.3 | CH | 48.0 | 71993 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR



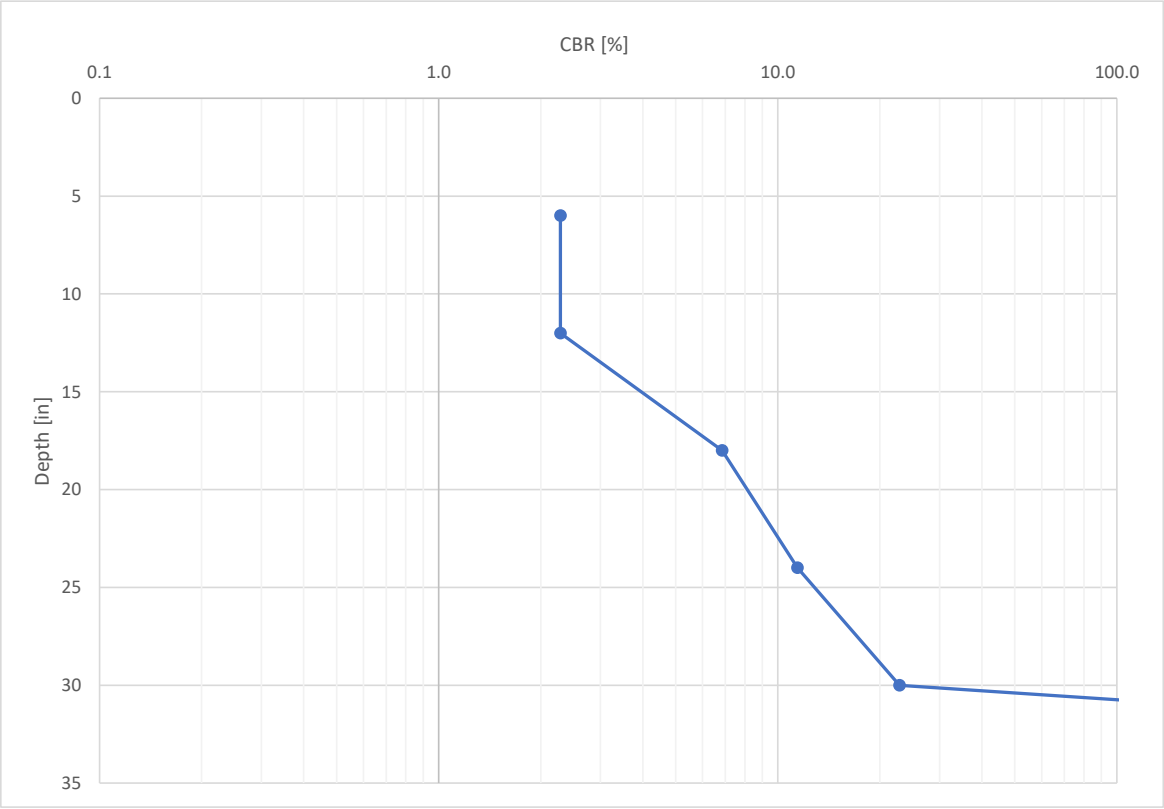
**Olsson**
**DCP Spreadsheet**
**Kessler K-100 DCP**

| | |
|---|---|
| *Project Number:* | G20-10300 |
| *Project:* | SH412B and Patrol Road Roundabout |
| *Date* | 16-Nov |
| *Personnel:* | Megan Dubose, Don Spicer, Jonas Fernandez |
| *Hammer Weight (lb):* | 17.6 |
| *Materal Classification:* | CH |
| *Elevation:* | 6" below existing grade |
| *Weather:* | 60 Sunny |

Test Location
**B-18**

| Number of Blows | Cumulative Penetration [in] | Cumulative Penetration [mm] | Penetration per Blow [mm] | Hammer Blow Factor [1] | DCP Index [mm/blow] | Soil Type [2] | CBR* [%] | Resilient Modulus [psi] [3] |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | -- | -- | -- | -- | -- | -- |
| 1 | 6 | 152.4 | 152.4 | 1 | 152.4 | CH | 2.3 | 3428 |
| 1 | 12 | 304.8 | 152.4 | 1 | 152.4 | CH | 2.3 | 3428 |
| 3 | 18 | 457.2 | 50.8 | 1 | 50.8 | CH | 6.9 | 10285 |
| 5 | 24 | 609.6 | 30.5 | 1 | 30.5 | CH | 11.4 | 17141 |
| 10 | 30 | 762 | 15.2 | 1 | 15.2 | CH | 22.9 | 34283 |
| 50 | 31.5 | 800.1 | 0.8 | 1 | 0.8 | CH | 457.1 | 685651 |

*Correlations taken from Kessler K-100 DCP manual dated 2014. These correlations are recommended by USACE.
1 - Hammer blow factor - 1 for 17.6 lb hammer, 2 for 10.1 lb hammer
2 - Soil Type can be "CL", "CH", or "Other". "Other" includes CL with CBR>10%.
3 - Factor of 1,500 used in $M_R$=1500*CBR



# APPENDIX E

Summary of Laboratory Test Results

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

# SUMMARY OF LABORATORY RESULTS



**PROJECT NAME:** SH412B and Patrol Rd Roundabout
**PROJECT NUMBER:** G20-10300
**CLIENT:** MidAmerica Industrial Park (MAIP)
**PROJECT LOCATION:** Mayes County, Oklahoma

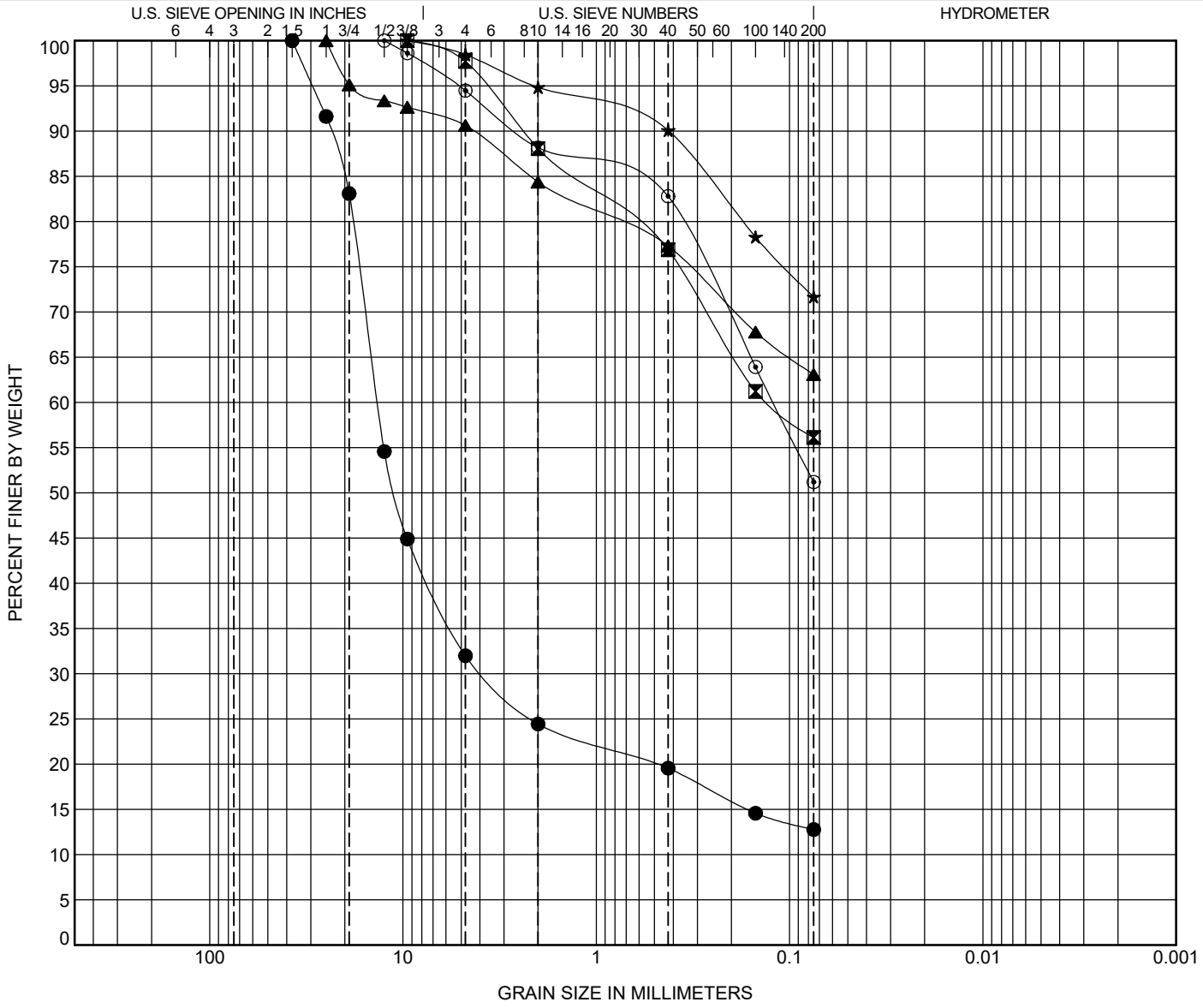
| BORING NUMBER | SAMPLE I.D. | SAMPLE DEPTH (ft) | MOISTURE CONTENT (%) | DRY DENSITY (pcf) | VOID RATIO | SATURATION (%) | UNCONFINED STRENGTH (tsf) | STRAIN (%) | ATTERBERG LIMITS | | | P-200 | USCS CLASS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTIC INDEX | | |
| B-01 | GB-1 | 0.5 - 0.8' | 10.2 | | | | | | | | | | |
| B-02 | GB-1 | 0.0 - 1.0' | 13.2 | | | | | | | | | | |
| B-02A | AU-3 | 1.0 - 3.0' | 21.6 | | | | | | | | | | |
| B-03 | GB-2 | 0.8 - 1.5' | 9.0 | | | | | | 33 | 14 | 19 | 12.8 | GC |
| B-04 | GB-2 | 1.7 - 2.7' | 18.2 | | | | | | 40 | 17 | 23 | 56.1 | CL |
| B-05 | GB-4 | 2.3 - 3.3' | 19.8 | | | | | | 55 | 18 | 37 | 63.1 | CH |
| B-06 | GB-2 | 1.6 - 2.3' | 9.9 | | | | | | | | | | |
| B-06 | GB-4 | 3.9 - 4.2' | 8.9 | | | | | | | | | | |
| B-07 | GB-3 | 1.9 - 2.9' | 10.7 | | | | | | | | | | |
| B-08 | GB-1 | 0.6 - 1.6' | 11.7 | | | | | | | | | | |
| B-09 | GB-2 | 1.8 - 2.8' | 30.1 | | | | | | | | | | |
| B-10 | GB-2 | 1.9 - 2.4' | 5.7 | | | | | | | | | | |
| B-11 | GB-2 | 1.9 - 2.4' | 15.1 | | | | | | | | | | |
| B-12 | GB-3 | 2.7 - 3.7' | 18.0 | | | | | | 31 | 14 | 17 | 71.7 | CL |
| B-13 | GB-2 | 2.3 - 2.5' | 13.2 | | | | | | | | | | |
| B-14 | GB-2 | 2.2 - 3.0' | 21.6 | | | | | | | | | | |
| B-15 | GB-2 | 1.7 - 2.2' | 11.6 | | | | | | | | | | |
| B-16 | GB-2 | 2.0 - 2.2' | 5.2 | | | | | | | | | | |
| B-17 | GB-1 | 0.2 - 1.9' | 16.7 | | | | | | | | | | |
| B-18 | GB-2 | 0.3 - 1.6' | 21.6 | | | | | | 27 | 16 | 11 | 51.2 | CL |

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

# GRAIN SIZE DISTRIBUTION

**PROJECT NAME:** SH412B and Patrol Rd Roundabout **CLIENT:** MidAmerica Industrial Park (MAIP)

**PROJECT NUMBER:** G20-10300 **PROJECT LOCATION:** Mayes County, Oklahoma




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

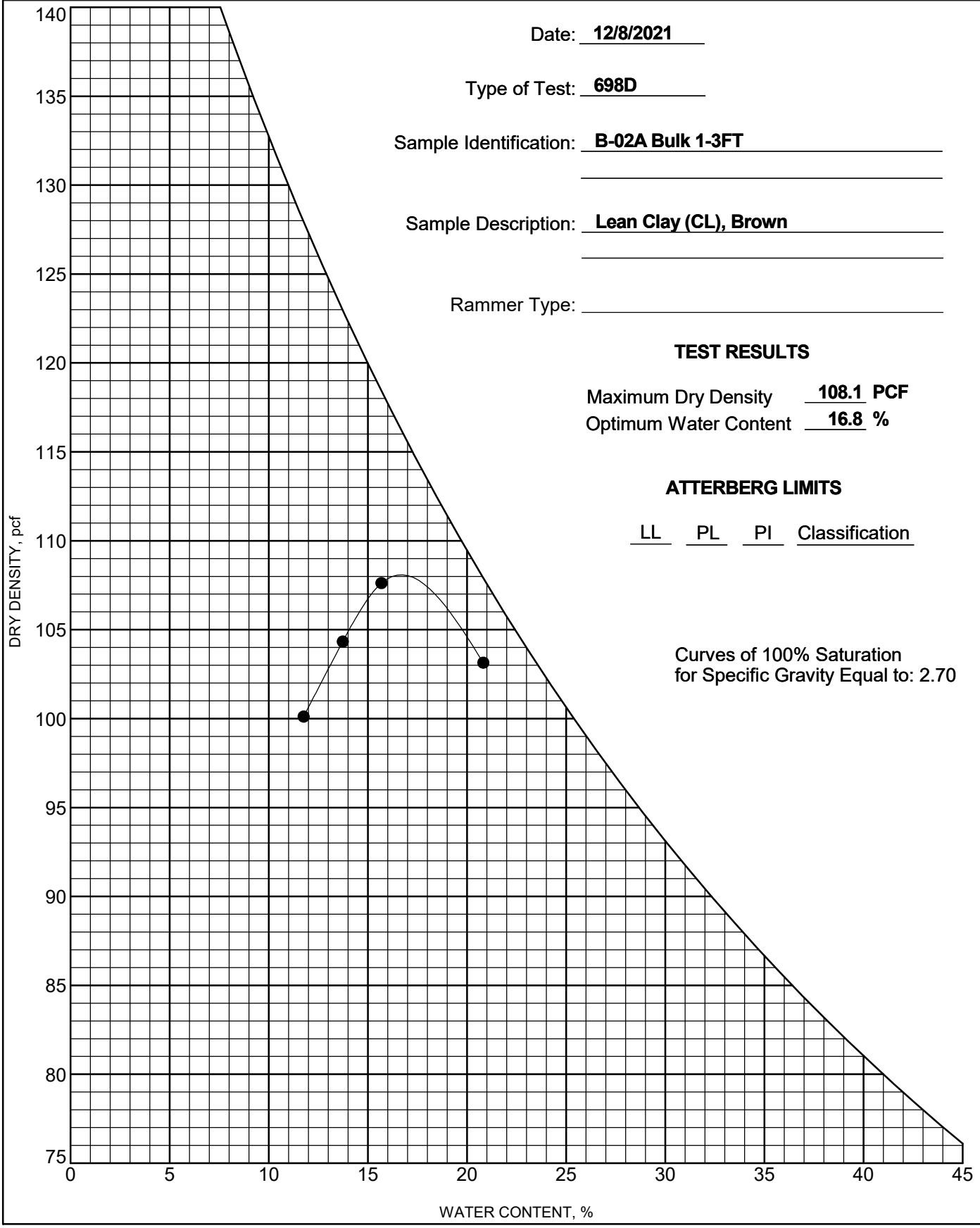
| Boring No. | Sample ID | Depth (ft) | Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● B-03 | GB-2 | 0.8 - 1.5 | | 33 | 14 | 19 | | |
| ⊠ B-04 | GB-2 | 1.7 - 2.7 | | 40 | 17 | 23 | | |
| ▲ B-05 | GB-4 | 2.3 - 3.3 | | 55 | 18 | 37 | | |
| ★ B-12 | GB-3 | 2.7 - 3.7 | | 31 | 14 | 17 | | |
| ⊙ B-18 | GB-2 | 0.3 - 1.6 | | 27 | 16 | 11 | | |

| Boring No. | Sample ID | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|
| ● B-03 | GB-2 | 37.5 | 13.538 | 3.784 | | 68.0 | 19.2 | 12.8 | |
| ⊠ B-04 | GB-2 | 9.5 | 0.127 | | | 2.3 | 41.6 | 56.1 | |
| ▲ B-05 | GB-4 | 25 | | | | 9.4 | 27.5 | 63.1 | |
| ★ B-12 | GB-3 | 9.5 | | | | 1.6 | 26.8 | 71.7 | |
| ⊙ B-18 | GB-2 | 12.5 | 0.121 | | | 5.5 | 43.3 | 51.2 | |

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

# MOISTURE-DENSITY RELATIONSHIP

**PROJECT NAME:** SH412B and Patrol Rd Roundabout
**CLIENT:** MidAmerica Industrial Park (MAIP)
**PROJECT NUMBER:** G20-10300
**PROJECT LOCATION:** Mayes County, Oklahoma




Date: **12/8/2021**

Type of Test: **698D**

Sample Identification: **B-02A Bulk 1-3FT**

Sample Description: **Lean Clay (CL), Brown**

Rammer Type:

**TEST RESULTS**

Maximum Dry Density **108.1** **PCF**
Optimum Water Content **16.8** **%**

**ATTERBERG LIMITS**

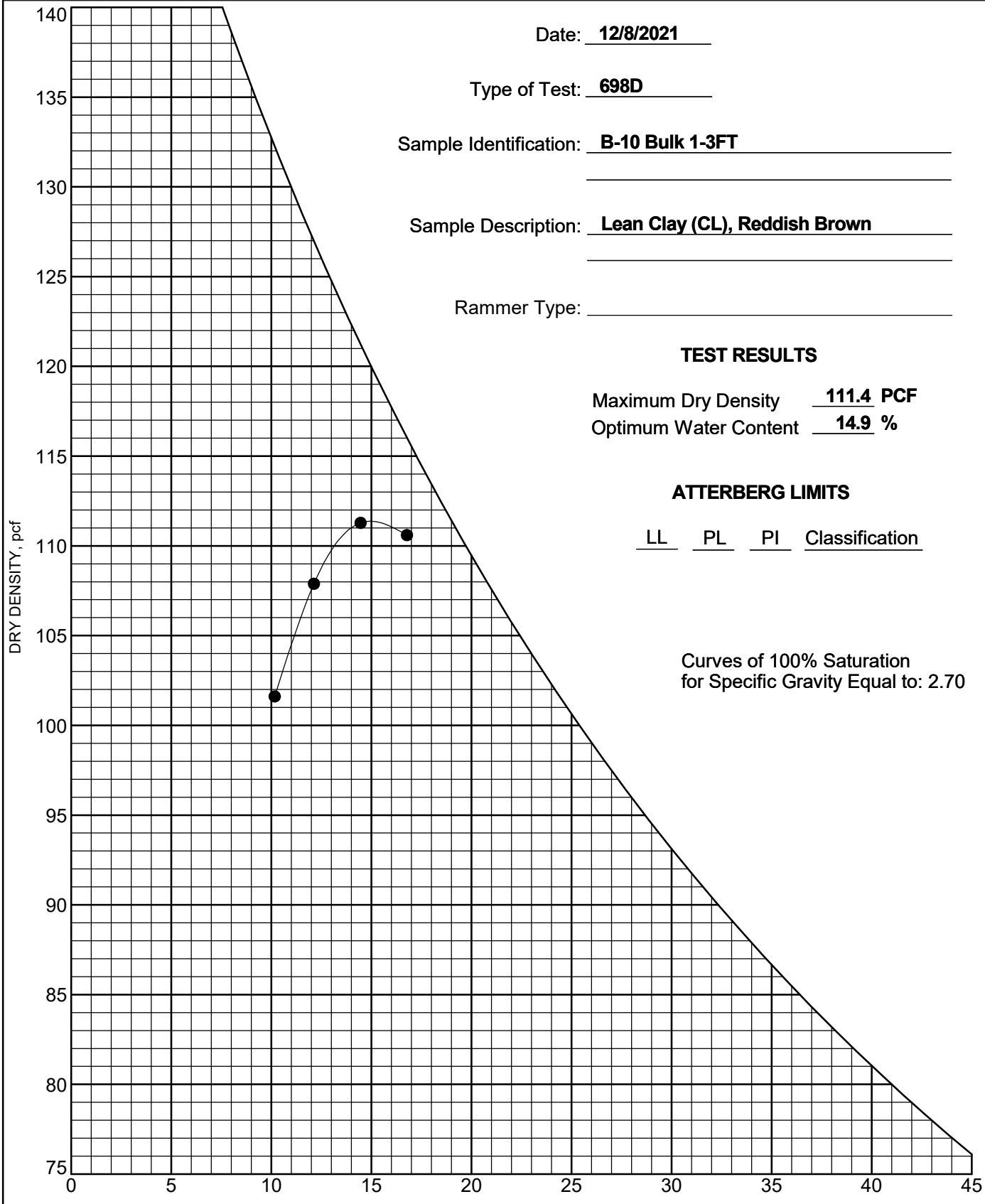
| LL | PL | PI | Classification |
|---|---|---|---|

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

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

# MOISTURE-DENSITY RELATIONSHIP

**PROJECT NAME:** SH412B and Patrol Rd Roundabout
**CLIENT:** MidAmerica Industrial Park (MAIP)
**PROJECT NUMBER:** G20-10300
**PROJECT LOCATION:** Mayes County, Oklahoma




Date: **12/8/2021**

Type of Test: **698D**

Sample Identification: **B-10 Bulk 1-3FT**

Sample Description: **Lean Clay (CL), Reddish Brown**

Rammer Type:

**TEST RESULTS**

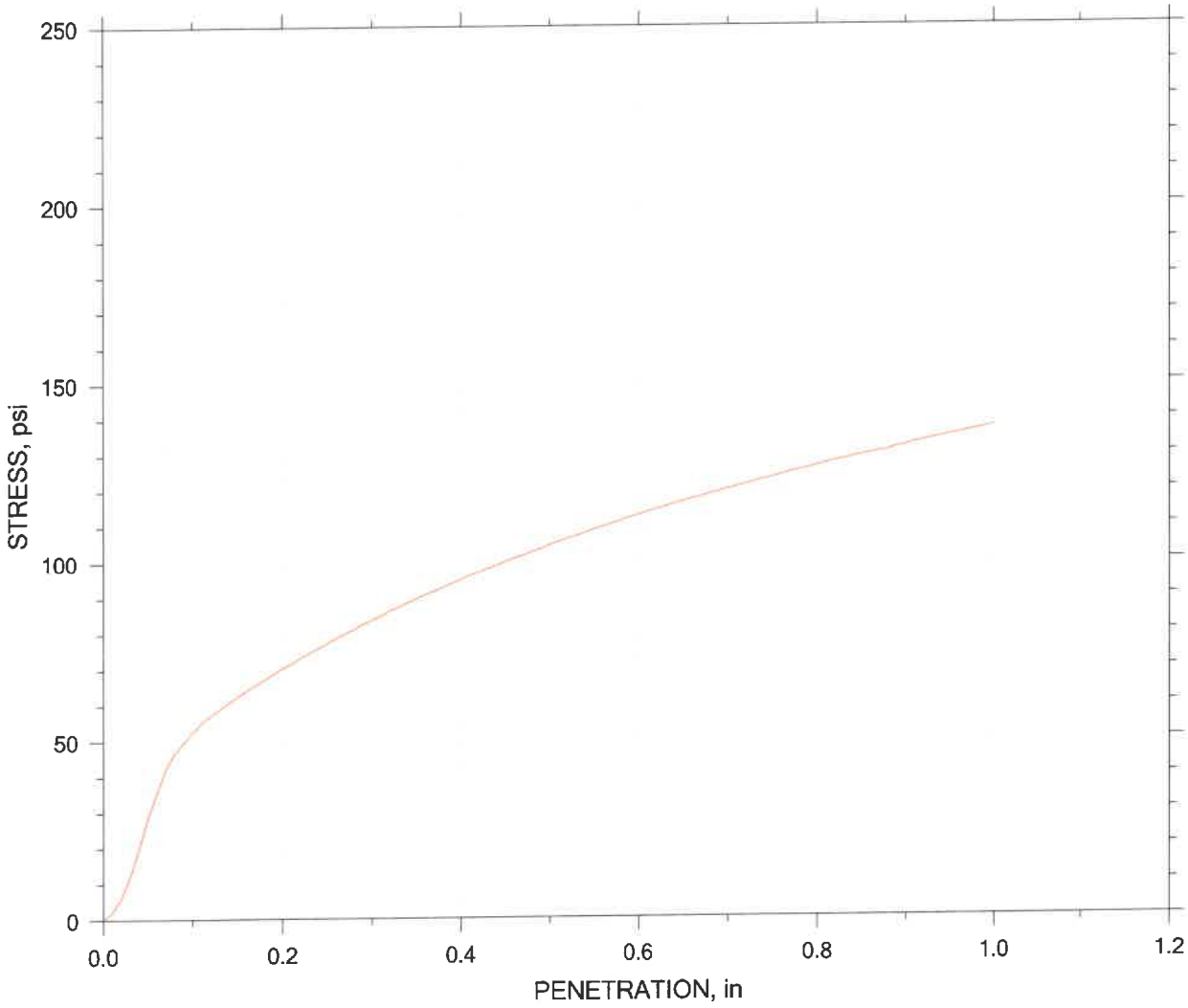
Maximum Dry Density **111.4** **PCF**
Optimum Water Content **14.9** **%**

**ATTERBERG LIMITS**

| LL | PL | PI | Classification |
|---|---|---|---|

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

# CALIFORNIA BEARING RATIO TEST REPORT



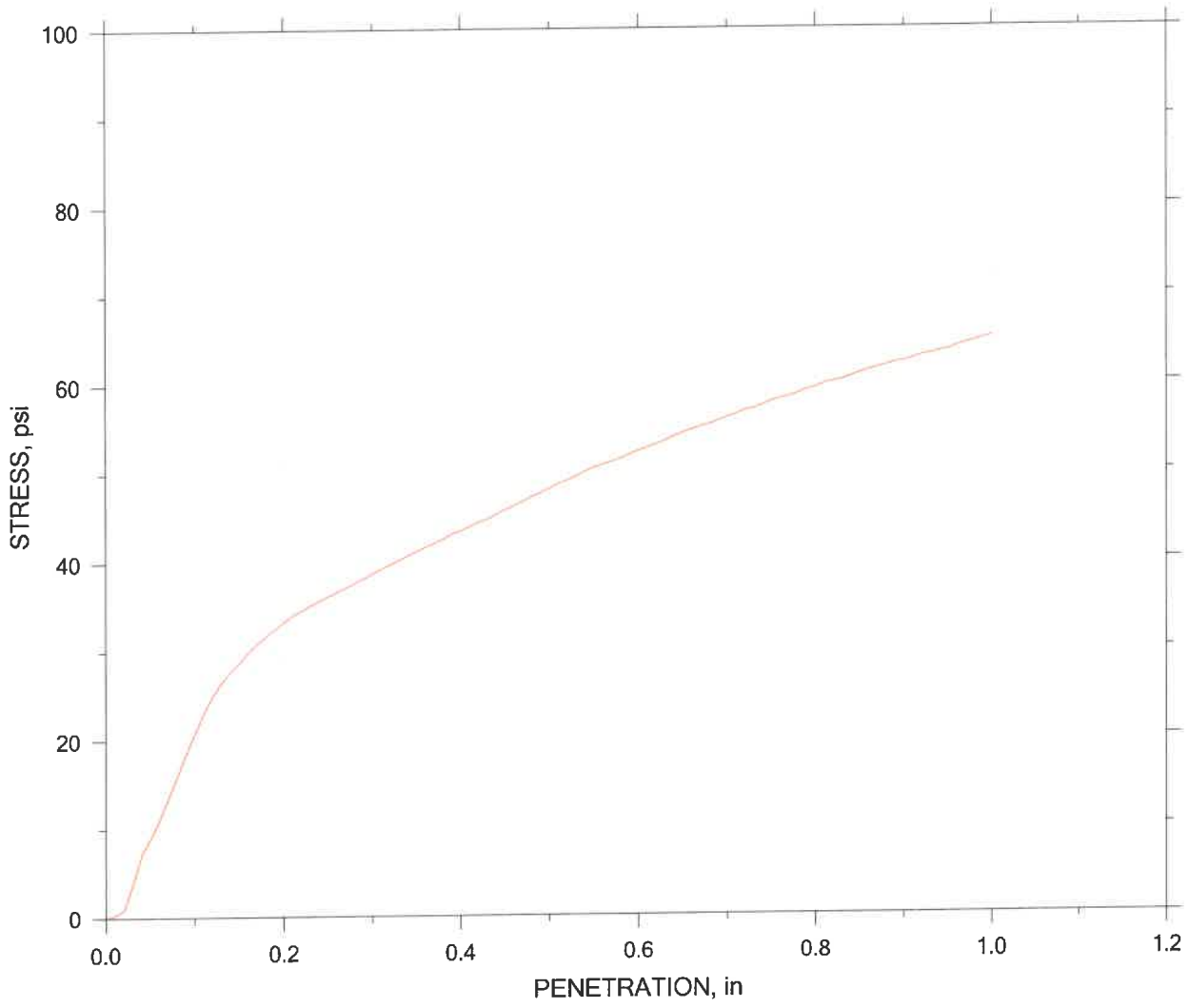

| | |
|---|---|
| Sample Height, in | 4.5625 |
| Sample Area, in² | 28.274 |
| Sample Volume, cc | 2114 |
| Sample Mass, gm | 4085.2 |
| Sample Condition | Soaked |
| Swell, % | 1.01 |
| Surcharge, gm | 4540 |
| Void Ratio | 0.53 |
| Wet Unit Weight, pcf | 120.64 |
| Dry Unit Weight, pcf | 110.03 |

| California Bearing Ratio | | |
|---|---|---|
| at 0.1 in: 5 | at 0.3 in: 4 | at 0.5 in: 4 |
| at 0.2 in: 5 | at 0.4 in: 4 | |

| Water Content | Before | After | Average | Soaked |
|---|---|---|---|---|
| Tare ID | RAVENS | J | | 26 |
| Tare Mass, gm | 122.7 | 126.6 | | 126.8 |
| Mass Tare + Wet Soil, gm | 200.7 | 350.9 | | 677.9 |
| Mass Tare + Dry Soil, gm | 199.1 | 318 | | 578.5 |
| Water Content, % | 2.09 | 17.19 | 9.64 | 22.01 |

| | | |
|---|---|---|
| Project: OOWA SH412B | Location: Mayes County Ok. | Project No.: G20-10300 |
| Boring No.: | Tested By: RO | Checked By: RR |
| Sample No.: B-02A | Test Date: 12/7 | Depth: 1.0-3.0 |
| Test No.: NA | Sample Type: | Elevation: NA |
| Description: 1 of 1 | | |
| Remarks: 2.5K LTII-ID22 | | |

# CALIFORNIA BEARING RATIO TEST REPORT




| | |
|---|---|
| Sample Height, in | 4.5625 |
| Sample Area, in² | 28.274 |
| Sample Volume, cc | 2114 |
| Sample Mass, gm | 4221 |
| Sample Condition | Soaked |
| Swell, % | 1.01 |
| Surcharge, gm | 4540 |
| Void Ratio | 0.57 |
| Wet Unit Weight, pcf | 124.65 |
| Dry Unit Weight, pcf | 107.39 |

| California Bearing Ratio | | |
|---|---|---|
| at 0.1 in: 2 | at 0.3 in: 2 | at 0.5 in: 2 |
| at 0.2 in: 2 | at 0.4 in: 2 | |

| Water Content | Before | After | Average | Soaked |
|---|---|---|---|---|
| Tare ID | 77 | 1 | | cowboys |
| Tare Mass, gm | 126.6 | 125.2 | | 124.6 |
| Mass Tare + Wet Soil, gm | 418.2 | 914.2 | | 663.4 |
| Mass Tare + Dry Soil, gm | 377.3 | 806.3 | | 564.6 |
| Water Content, % | 16.31 | 15.84 | 16.08 | 22.45 |

| | | |
|---|---|---|
| Project: OOWA SH412B | Location: Mayes County Ok. | Project No.: G20-10300 |
| Boring No.: | Tested By: RO | Checked By: RR |
| Sample No.: B-10 | Test Date: 12/9 | Depth: |
| Test No.: NA | Sample Type: | Elevation: NA |
| Description: 1 of 1 | | |
| Remarks: 2.5K LTII-ID22 | | |

# Laboratory Analytical Report

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

08 December 2021

Mr. Robb Roy

Olsson Associates
235 N. MacArthur, Suite 700
Oklahoma City, OK 73127

WO: E1K0385
RE: Pryor, OK

Enclosed are the results of analyses for samples received by the laboratory on 11/23/2021. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Russell Britten

President

Original (P)

ENVIRONMENTAL TESTING, INC.

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

| | | |
|---|---|---|
| Olsson Associates | Project: Pryor, OK | |
| 235 N. MacArthur, Suite 700 | Project Number: G20-10300 | **Reported:** |
| Oklahoma City OK, 73127 | Project Manager: Mr. Robb Roy | 12/08/21 15:53 |

## B-01 GB-1 0.5'-0.8'

**E1K0385-01 (Solid) - Sampled: 11/17/21 10:00**

| Analyte | Result | Reporting Limit | Units | Dilution | Batch | Analyst | Analyzed | Method | Qualifiers |
|---|---|---|---|---|---|---|---|---|---|
| **Conventional Chemistry Parameters by EPA Methods** | | | | | | | | | |
| **pH** | **8.22** | | pH Units | 1 | EJK0553 | MNM | 11/29/21 14:20 | EPA 9045D 2004 | H-03 |

Environmental Testing, Inc.

Russell Britten, President

*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.*

ENVIRONMENTAL TESTING, INC.

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

| | | |
|---|---|---|
| Olsson Associates | Project: Pryor, OK | |
| 235 N. MacArthur, Suite 700 | Project Number: G20-10300 | **Reported:** |
| Oklahoma City OK, 73127 | Project Manager: Mr. Robb Roy | 12/08/21 15:53 |

## B-09 GB-1 0.2'-1.2'

**E1K0385-02 (Solid) - Sampled: 11/17/21 10:00**

| Analyte | Result | Reporting Limit | Units | Dilution | Batch | Analyst | Analyzed | Method | Qualifiers |
|---|---|---|---|---|---|---|---|---|---|
| **Conventional Chemistry Parameters by EPA Methods** | | | | | | | | | |
| **pH** | **5.53** | | pH Units | 1 | EJK0553 | MNM | 11/29/21 14:20 | EPA 9045D 2004 | H-03 |

Environmental Testing, Inc.

Russell Britten, President

*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.*

ENVIRONMENTAL TESTING, INC.

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

| | | |
|---|---|---|
| Olsson Associates | Project: Pryor, OK | |
| 235 N. MacArthur, Suite 700 | Project Number: G20-10300 | **Reported:** |
| Oklahoma City OK, 73127 | Project Manager: Mr. Robb Roy | 12/08/21 15:53 |

## B-16 GB-2 2.0'-2.2'

**E1K0385-03 (Solid) - Sampled: 11/17/21 10:00**

| Analyte | Result | Reporting Limit | Units | Dilution | Batch | Analyst | Analyzed | Method | Qualifiers |
|---|---|---|---|---|---|---|---|---|---|
| **Conventional Chemistry Parameters by EPA Methods** | | | | | | | | | |
| **pH** | **7.82** | | pH Units | 1 | EJK0553 | MNM | 11/29/21 14:20 | EPA 9045D 2004 | H-03 |

# Laboratory Analytical Report

24 November 2021

Russell Britten

Environmental Testing Inc.
4619 N. Santa Fe
Oklahoma City, OK 73118

WO: P1K0098
RE: E1K0385

Enclosed are the results of analyses for samples received by the laboratory on 11/23/2021. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jorge Gamarra For Russell Britten
President

Original (P)

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

Environmental Testing Inc.
4619 N. Santa Fe
Oklahoma City OK, 73118

Project Number: E1K0385
Project Manager: Russell Britten

**Reported:**
11/24/21 10:20

**P1K0098-01 (Solid)**

Sampled: 11/17/2021 10:00:00AM
Sample Name: E1K0385-01

| Parameter | Result | Reporting Limit | Units | Analyzed | Method | Qualifiers |
|---|---|---|---|---|---|---|
| **General Chemistry Parameters** | | | | | | |
| Soluble Sulfate | <200 | 200 | ppm | 11/24/21 | OHD L-49 | |

ETI-Oilab, LLC

Jorge Gamarra For Russell Britten, President

*The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.*

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

Environmental Testing Inc.
4619 N. Santa Fe
Oklahoma City OK, 73118

Project Number: E1K0385
Project Manager: Russell Britten

**Reported:**
11/24/21 10:20

**P1K0098-02 (Solid)**

Sampled: 11/17/2021 10:00:00AM
Sample Name: E1K0385-02

| Parameter | Result | Reporting Limit | Units | Analyzed | Method | Qualifiers |
|---|---|---|---|---|---|---|
| **General Chemistry Parameters** | | | | | | |
| Soluble Sulfate | <200 | 200 | ppm | 11/24/21 | OHD L-49 | |

ETI-Oilab, LLC

Jorge Gamarra For Russell Britten, President

*The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.*

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Oklahoma City, OK 73118
405.488.2400 Phone
405.488.2404 Fax
www.oilab.com

Environmental Testing Inc.
4619 N. Santa Fe
Oklahoma City OK, 73118

Project Number: E1K0385
Project Manager: Russell Britten

**Reported:**
11/24/21 10:20

**P1K0098-03 (Solid)**

Sampled: 11/17/2021 10:00:00AM
Sample Name: E1K0385-03

| Parameter | Result | Reporting Limit | Units | Analyzed | Method | Qualifiers |
|---|---|---|---|---|---|---|
| **General Chemistry Parameters** | | | | | | |
| **Soluble Sulfate** | **920** | 200 | ppm | 11/24/21 | OHD L-49 | |

ETI-Oilab, LLC

Jorge Gamarra For Russell Britten, President

# Sample Receipt Form: P1K0098

## ETI-Oilab, LLC

P1K0098

*Printed: 11/23/2021 1:34:38PM*

P-1-K-0098

**Client:** Environmental Testing Inc.
**Project:** Oilab Testing

**Project Manager:** Russell Britten
**Project Number:** E1K0385

**Report To:**
Environmental Testing Inc.
Russell Britten
4619 N. Santa Fe
Oklahoma City, OK 73118
Phone: (405) 488-2400
Fax: (405) 488-2404

**Invoice To:**
Environmental Testing Inc.
Russell Britten
4619 N. Santa Fe
Oklahoma City, OK 73118
Phone: (405) 488-2400
Fax: (405) 488-2404

**Date Due:** 12/02/21 17:00 (5 day TAT)

Received By: Wayne Hegstrom  Date Received: 11/23/21 13:11

| | | | | | |
|---|---|---|---|---|---|
| Samples Received at: | 25.1°C | | | | |
| Custody seals | No | Received on ice | No | Sufficient sample | Yes |
| Containers intact | Yes | Sample or temp blank frozen | No | | |
| COC/Labels agree | Yes | Headspace in VOA vials | No | | |
| Preservation confirmed | No | Correct containers | Yes | | |

| Analysis | Due | TAT | Expires | Comments |
|---|---|---|---|---|
| **P1K0098-01 E1K0385-01 [Solid] Sampled 11/17/21 10:00 CST** | | | | |
| (oil) Total Soluble Sulfate (OHD-L49) | 12/02/21 17:00 | 5 | 12/17/21 10:00 | |
| **P1K0098-02 E1K0385-02 [Solid] Sampled 11/17/21 10:00 CST** | | | | |
| (oil) Total Soluble Sulfate (OHD-L49) | 12/02/21 17:00 | 5 | 12/17/21 10:00 | |
| **P1K0098-03 E1K0385-03 [Solid] Sampled 11/17/21 10:00 CST** | | | | |
| (oil) Total Soluble Sulfate (OHD-L49) | 12/02/21 17:00 | 5 | 12/17/21 10:00 | |

P1K0098

# ENVIRONMENTAL TESTING, INC.

## SUBCONTRACT ORDER

**Sending Laboratory:**

Environmental Testing, Inc.
4619 N Santa Fe Ave
Oklahoma City, OK 73118
Phone: (405) 488-2400
Fax: (405) 488-2404

Project Manager: Russell Britten

**Subcontracted Laboratory:**

ETI-Oilab LLC
4619 N. Santa Fe
Oklahoma City, OK 73118
Phone: (405) 528-8378
Fax:

Please report to: reports@etilab.com

**Work Order: E1K0385**

| Analysis | Requested TAT | Expires | Comments |
|---|---|---|---|
| **Sample ID: E1K0385-01** ***Solid Sampled: 11/17/21 10:00*** | | | |
| (oil) Total Soluble Sulfate (OHD-L49) | 5 | 12/17/21 10:00 | |
| *Containers Supplied:* Plastic Baggie (A) | | | |
| **Sample ID: E1K0385-02** ***Solid Sampled: 11/17/21 10:00*** | | | |
| (oil) Total Soluble Sulfate (OHD-L49) | 5 | 12/17/21 10:00 | |
| *Containers Supplied:* Plastic Baggie (A) | | | |
| **Sample ID: E1K0385-03** ***Solid Sampled: 11/17/21 10:00*** | | | |
| (oil) Total Soluble Sulfate (OHD-L49) | 5 | 12/17/21 10:00 | |
| *Containers Supplied:* Plastic Baggie (A) | | | |

| Released By | Date/Time | Received By | Date/Time |
|---|---|---|---|
| | 11/23/21 1311 | 11-23-21 | |

ENVIRONMENTAL TESTING, INC.

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

| | | |
|---|---|---|
| Olsson Associates | Project: Pryor, OK | |
| 235 N. MacArthur, Suite 700 | Project Number: G20-10300 | **Reported:** |
| Oklahoma City OK, 73127 | Project Manager: Mr. Robb Roy | 12/08/21 15:53 |

# 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 EJK0553 - General Prep - Wet Chem (Sd)** | | | | | | | | | | |
| **LCS (EJK0553-BS1)** | | | | **Prepared & Analyzed: 11/29/21** | | | | | | |
| pH | 7.04 | | pH Units | 7.000 | | 101 | 99-101 | | | |
| **Duplicate (EJK0553-DUP1)** | | **Source: E1K0385-03** | | **Prepared & Analyzed: 11/29/21** | | | | | | |
| pH | 7.90 | | pH Units | | 7.82 | | | 1 | 20 | |

Environmental Testing, Inc.

Russell Britten, President

*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.*

ENVIRONMENTAL TESTING, INC.

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**Oklahoma City, OK 73118**
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**405.488.2404 Fax**
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| | | |
|---|---|---|
| Olsson Associates | Project: Pryor, OK | |
| 235 N. MacArthur, Suite 700 | Project Number: G20-10300 | **Reported:** |
| Oklahoma City OK, 73127 | Project Manager: Mr. Robb Roy | 12/08/21 15:53 |

## Certifications

| Code | Description | Number | Expires |
|---|---|---|---|
| NELAP/OK | NELAP Accredited (ODEQ) | 2021-151 | 08/31/2022 |
| TCEQ | Texas Accedited (TCEQ) | T104704498-21-11 | 03/31/2022 |

## 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. |

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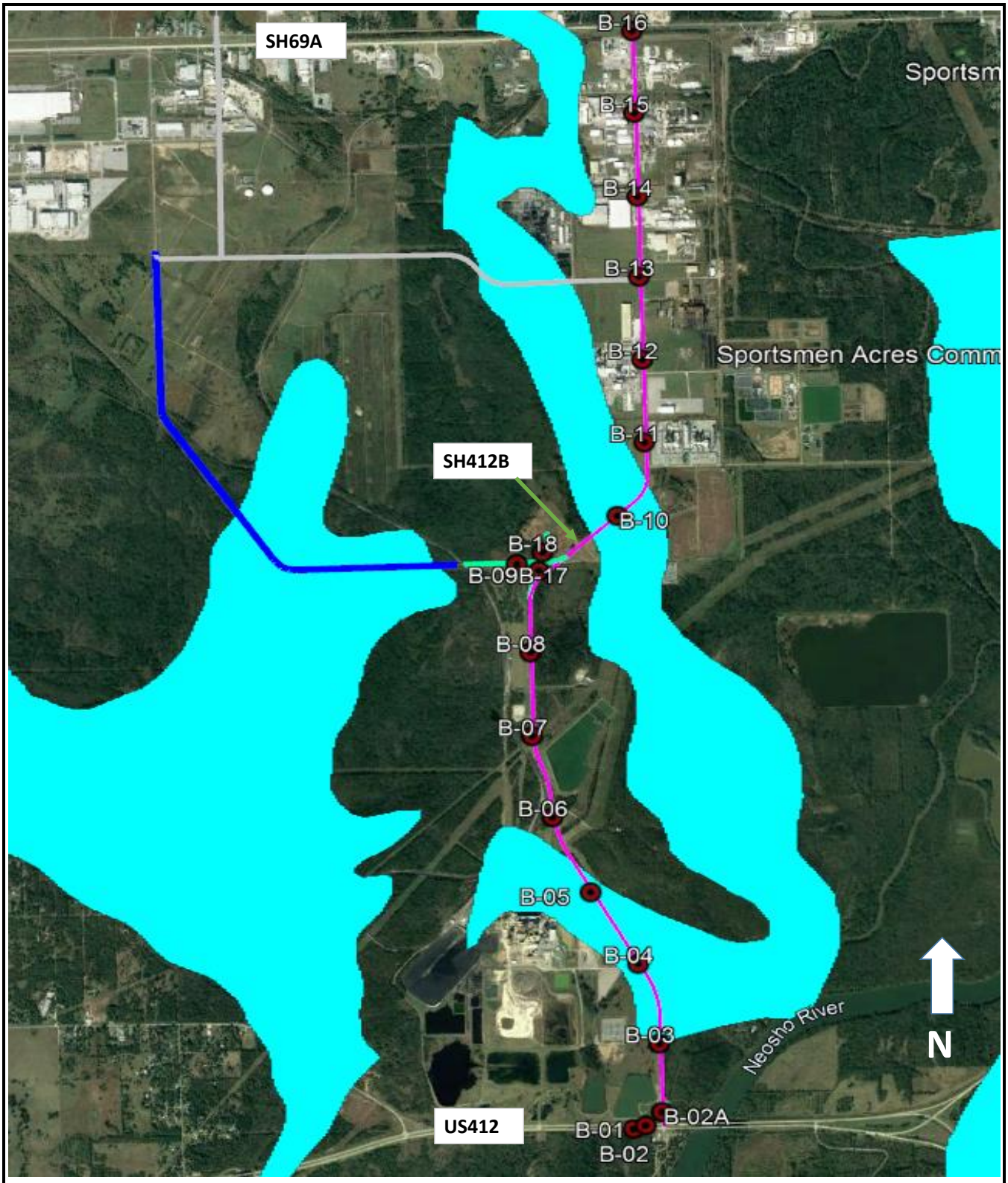
# APPENDIX F

Karst Map




olsson

| | |
|---|---|
| Drawn by: WCG | Appendix F: Karst Map |
| Date: 8-30-2022 | SH412B and Patrol Road Roundabout<br>Pryor Creek, Oklahoma |