REPORT OF GEOTECHNICAL EXPLORATION

Apron Reconstruction
Rough River State Park Airport
Falls of Rough, Kentucky

Prepared For:
Garver USA
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KSWA Project No. 500-19-0006

January 24, 2020

January 24, 2020

Mr. Mark D. Upchurch, P.E.
Garver USA
2525 Harrodsburg Road, Suite 405
Lexington, Kentucky 40504

Subject: **Report of Geotechnical Exploration**
Rough River State Park Airport Apron Reconstruction
Falls of Rough, Kentucky
KSWA Project No. 500-19-0006

Dear Mr. Upchurch:

K. S. Ware and Associates, L.L.C. (KSWA) is pleased to submit this report which provides the results of our geotechnical exploration for the referenced project. Our services were provided in general accordance with our proposal dated June 26, 2019, which was authorized by you November 12, 2019.

The attached report summarizes the project information provided to us, describes the site and subsurface conditions encountered, and details our geotechnical recommendations for the project. The Appendices include figures, descriptions of our field-testing procedures, and our field and laboratory test results.

We appreciate the opportunity to be of service to you on this project. Please contact us if you have any questions regarding this report. We look forward to serving as your geotechnical consultant on the remainder of this project.

Respectfully submitted,

K. S. Ware and Associates, L.L.C.

STATE OF KENTUCKY
DEREK LEE HODNETT
35286
LICENSED PROFESSIONAL ENGINEER

Digitally signed by Derek L. Hodnett
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Keaton Andrus, E.I.
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Senior Geotechnical Engineer

Enclosures: Report of Geotechnical Exploration

Distribution: File (1)

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APPENDICES

1.0 INTRODUCTION

1.1 PROJECT INFORMATION

Our understanding of the project is based on project information provided by Mr. Mark Upchurch of Garver, USA to Mr. Nathan Long of KSWA through an e-mail dated June 19th, 2019. The e-mail included a Request for Proposal with a detailed list of the requested services and information, as well as a site plan showing the locations of the proposed borings.

We understand the existing apron at the Rough River State Park Airport in Falls of Rough, Kentucky is scheduled to be reconstructed. A Site Vicinity Map is included in Appendix A. The apron runs parallel to the existing runway on its northeast side and is approximately 375 feet by 125 feet. KSWA has assumed the reconstructed apron will have an asphalt pavement surface and will have approximately the same area dimensions and grading as the existing apron. Although the grade may remain the same, undercutting may be required to achieve the required subgrade stability for the project.

1.2 PURPOSE AND SCOPE OF EXPLORATION

The purpose of the exploration was to evaluate the subsurface conditions at the existing apron and to prepare general earthwork and information about how the conditions encountered will impact the design and construction of the new pavement. Our scope of services was detailed in our proposal dated June 26, 2019. Our services were authorized by Garver, USA on November 12, 2019.

2.0 SITE GEOLOGY

2.1 GEOLOGIC FORMATION

The site is located in the Western Pennyroyal Physiographic Region. The Western Pennyroyal is dominated by Mississippian-age limestone formations with extensive karstic weathering. Due to the karstic topography, sinkholes, sinking streams, streamless valleys, springs, and caverns characterize the geologic features of the region (Kentucky Geological Survey).

The Geologic Map of the Falls of Rough Quadrangle, Western Kentucky (United States Geological Survey, 1977) shows the site in underlain by the Mississippian-age Glen Dean Limestone. The upper half of this formation varies between limestone with calcareous shale partings, light-gray to olive-gray, platy to medium bedded, locally crossbedded, fine to medium crystalline, and highly fossiliferous to highly calcareous sandstone, light-gray to olive-gray, very fine-grained, and grading to sandy limestone. The lower half of this formation is composed of limestone with calcareous shale partings, dark-gray to brownish-gray, thin to medium bedded, fine to medium crystalline, and fossiliferous.

Like all limestone formations, the carbonate rocks underlying the project site are susceptible to karstic weathering and sinkhole development. Topographic mapping of the area shows several small depressions located within a mile of the project location. Although no depressions were observed at the site, karst poses a risk to the project site.

2.2 SOIL SURVEY

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) web soil survey indicates the majority of the area of exploration is covered with "borrow pit material", which indicates the site was previously filled prior to construction. This is consistent with the soil observed during drilling operations. The southeast corner of the site is underlain by Gilpin silty clay loam.

Gilpin silty clay loam has a varying composition, including silty clay loam, channery silty clay loam, channery silt loam, and channery loam. Typical engineering classifications for the Gilpin silty clay loam include CL, GC, GM, and ML by the Unified Soil Classification System (USCS), and A-2, A-4, A-6, and A-7 by the American Association of State Highway and Transportation Officials (AASHTO) classification.

3.0 EXPLORATION PROCEDURES AND FINDINGS

3.1 GENERAL

We performed our subsurface exploration and field testing on November 26 and 27, 2019. The exploration consisted of asphalt coring, Dynamic Cone Penetrometer (DCP) testing, and soil test boring at 7 locations (B-1 through B-7) across the existing apron. We collected soil using split spoon sampling on 2.5-foot intervals, Shelby Tubes, and by collecting bulk material. KSWA located the requested boring locations in the field with the use of the provided boring layout and a measuring wheel, which allowed our representative to mark the locations using distances from known landmarks. The Boring Location Plan, found in appendix A, shows the approximate boring locations. Additional discussion regarding the field procedures used during this exploration are provided in Appendix B.

3.2 SURFACE AND SUBSURFACE CONDITIONS

The existing apron is approximately 375 feet long and 125 feet wide asphalt-paved area sloping gently for drainage. A small road connects the western side of the apron to the runway and the terminal and parking lot entrance are directly connected to the eastern side of the apron. The area surrounding the apron is grass covered and exhibits little topographic relief. A drainage ditch is located near the southeast side of the apron.

3.2.1 SURFACE MATERIALS

Each of the boring locations was initially cored to determine the thickness of the existing asphalt pavement. This process also allowed us to estimate the thickness of the basestone layer beneath the asphalt pavement. Asphalt thickness measurements ranged from 3 ½ to 6 inches. Basestone measurements ranged from 4 to 5½ inches, but exact measurements may vary due to the tendency of basestone and underlying soil to mix during construction operations. Table 1 includes a summary of the pavement and basestone thicknesses encountered at each boring location. Asphalt core photographs and measurements can be found in Appendix B.

Table 1: Pavement and Basestone Thicknesses

Boring No.	Asphalt Pavement Thickness	Basestone Material Thickness	Total Pavement Thickness
	(in.)	(in.)	(in.)
B-1	4	5	9
B-2	5½	4½	10
B-3	5½	4	9½
B-4	5½	4	9½
B-5	6	4	10
B-6	5½	5½	11
B-7	3½	5	8½

3.2.2 Existing Fill Materials

Beneath the surficial material, we encountered existing fill material at Borings B-2, B-3, B-4, and B-6. The fill materials extend to depths ranging from about 2 to 3 feet and consists of lean clay (CL) and fat clay (CH) with varying amounts of sand. Additionally, the fill at Boring B-6 included small roots throughout the sample. The Standard Penetration Test (SPT) blow counts (N-Values) in the fill ranged from 3 to 4 blows per foot (bpf).

3.2.3 Native Soils

Below the fill material, each boring encountered residual soil to auger refusal. The residuum generally consists of lean clay and sandy lean clay (CL). The consistency of the native material generally ranges from 2 to 13 bpf, but reached values of 23, 27, and over 50 bpf near refusal. Detailed descriptions of soils encountered at each boring location can be found on the Test Boring Logs in Appendix B.

3.2.4 Refusal

Auger refusal was encountered at each boring location at depths between 8.2 and 8.8 feet (average of 8.5 feet).

3.2.5 Groundwater Conditions

Each of the borings was dry upon completion. Isolated perched conditions may exist between our borings, especially along the soil-bedrock interface. Groundwater levels will differ depending on the time of year, climatic conditions, and the degree of construction activities. Each of the borings were backfilled with cuttings upon completion for safety.

3.2.6 Dynamic Cone Penetrometer (DCP) Tests

We performed DCP tests (ASTM D6951) at each boring location prior to soil test boring for the purpose of evaluating the strength of the subgrade materials underlying the existing apron. The DCP test results were plotted to determine the estimated CBR value of the subgrade material. The results of these tests are provided in Table 2. The DCP test data report is included in Appendix C of this report.

Table 2: DCP Estimated CBR Values

Core No.	Depth Range (in)	Estimated CBR Value
B-1	6 – 18	1
B-2	0 – 15	1
B-3	0 – 33	10
B-4	4 – 19	9
B-5	0 – 17	3
B-6	0 – 17	5
B-7	0 – 19	2

4.0 LABORATORY TESTING

We performed laboratory testing on select samples collected during drilling. The testing included natural moisture content determinations, sieve analysis with No. 200 wash, Atterberg Limits, soil moisture/density relationship with standard effort (Proctor), California Bearing Ratio (CBR), and unconfined compressive strength testing on selected soil samples. We performed the laboratory testing in accordance with ASTM procedures. Laboratory results are shown on the boring logs and are included in Appendix D.

We performed moisture content tests on the samples collected from Borings B-01 through B-07. The moisture contents of the lean clays range from 12.7 to 25.9 percent. The fat clay sample that was tested resulted in a moisture content of 32.1 percent.

Sieve analysis and Atterberg limit tests were also performed on select samples. Table 3 summarizes the results of these tests as well as the moisture contents of the select samples.

Table 3: Summary of Laboratory Results

Boring No.	Sample Depth (feet)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS Classification
B-1	4 – 6	22.3	47	25	22	CL
B-4	4 – 5.5	32.1	65	25	40	CH
B-6	1.5 – 3	17.7	33	17	16	CL
Bulk	1 – 4	26.5	45	19	26	CL

The proctor and CBR tests were performed on a bulk sample which was obtained from a combination of auger cuttings from each boring location. The proctor test results indicated a maximum dry density of 104.7 PCF (pounds per cubic foot) and optimum water content of 19.5%. The CBR resulted in a value of 3.2 for soil compacted to about 98% of the maximum dry density (ASTM D698).

5.0 GEOTECHNICAL CONSIDERATIONS

The existing pavement is to be reconstructed to match the existing size and elevation of the existing pavement. Based on the project information provided and the available subsurface data, KSWA's geotechnical concerns for the proposed reconstruction include the presence of soft existing soil and highly plastic clay over large areas of the site. These soils offer low pavement support values in their present state.

Our laboratory testing confirms that the soils at the site include some highly plastic clays classified CH by the USCS. Highly plastic clays can pose problems for site development due to the shrink-swell potential of the soil when exposed to varying moisture contents. The risk of structural damage due to shrinkage or swelling is relatively low for subgrades consisting of undisturbed, residual clay. However, the risks of damage are somewhat greater for pavements that bear upon subgrades consisting of engineered fill constructed of high plasticity clay that is compacted at a moisture content below optimum level. Typical measures to reduce the risk include protecting the subgrade from drying after grading, designing utilities to minimize the change of leakage, and adjusting the moisture content of engineered fill to within 2% of the soil's optimum moisture content. Other options include using shot-rock for engineered fill in areas where shrink-swell behavior could cause damage.

Based upon an engineering reconnaissance of the site, the boring and laboratory data, visual-manual examination of the samples, and KSWA's understanding of the proposed construction and experience as geotechnical engineers, KSWA reached the conclusions and developed the recommendations provided herein. The conclusions and recommendations in this report have been derived by relating the general principles of the discipline of geotechnical engineering to the proposed construction outlined by the Project Information section of this report. Because changes in surface, subsurface, and climatic conditions can occur, the use of this report should be restricted to this specific project. Any changes or modifications which are made in the field during the construction phase which alter site grading, infrastructure, or other related site work, should also be reviewed by KSWA. If conditions which vary from the facts of this report are encountered during construction, the Geotechnical Engineer of Record should be contacted immediately to review the changed conditions in the field and make appropriate recommendations.

6.0 GEOTECHNICAL RECOMMENDATIONS

The recommendations contained in this report section were developed in consideration of the project information detailed in Section 0 of this report. If the information contained in Section 0 changes, we recommend KSWA be contacted to confirm that our design and construction recommendations are appropriate in consideration of the new available information.

6.1 SITE PREPARATION

Based on our field and laboratory test data, KSWA believes several approaches may be considered for reconstructing the apron. These include conventional "remove and replace" with subgrade improvement or full depth reclamation (FDR) of the pavement.

We generally encountered very soft to soft clays below the base stone to depths ranging from about 1 foot at some locations to as deep as 3 feet at others. The pavement reconstruction needs to include measures to remedy the poor subgrade conditions and limited pavement support.

Depending on final design elevation for the apron, the finished subgrade may consist of a combination of soil (e.g., residual clay soils and/or new engineered fill). Based on our laboratory testing of a bulk sample of the on-site soils, we recommend utilizing a maximum CBR value of 3.2 for design of new pavements supported by on-site soils. Existing subgrade moisture contents and soil density will affect the in-place CBR value. Therefore, prior to pavement construction, we recommend that the upper 12 inches of the pavement subgrade be compacted to at least 100 percent of the maximum dry density and within 2 percent of optimum moisture content as indicated by the standard Proctor test (ASTM D698).

6.1.1 *Option 1 – Conventional Remove and Replace*

Several approaches may be used in constructing the new pavement. The following sections provide recommendations for different approaches for achieving a stable subgrade after the existing asphalt is removed.

<u>Undercut and Replace</u>
A more traditional way will be to remove the existing asphalt and base stone to expose the existing subgrade. Once exposed, the subgrade can be proofrolled as recommended in the Construction Considerations section of this report to identify the lateral limits of instability present. We expect between 50 percent and 75 percent of the subgrade area will need to be improved. The improvement may consist of undercutting the soft and/or unsuitable soil to stable ground and replacing the removed material with suitable fill. The suitable fill should have a CBR value of at least 5 or greater. Undercut depths will likely vary from about 1 foot to as much as about 3 feet. The depth of undercut could be reduced with the use of geotextiles/geogrids and backfilling with coarse, crushed stone.

Chemical Stabilization

As an alternative to undercutting and removal of the soft, wet soil, these soils may be chemically modified by mixing cement, hydrated lime, or other product such as Calciment® to improve the strength and pavement support character of the existing soil without removing it. If this method is selected, the existing base stone layer may remain in place and be blended with the underlying soil during chemical stabilization.

Construction activities should be accomplished in accordance with Federal Aviation Administration's (FAA) Standard Specification for Construction of Airports. Actual pavement section thickness should be determined by the design civil engineer or geotechnical engineer based on actual load, traffic volume, and the owner's design life requirements. The minimum aggregate base course thickness should be six inches.

6.1.2 *Option 2 – Full Depth Reclamation (FDR)*

Traditional FDR processes seem appropriate for this site to reduce the amount of material waste and limit the time necessary to improve the subgrade. This method will allow for the existing pavement materials to be pulverized and mixed in place, saving milling costs. After the existing pavement materials are pulverized, the subgrade can be reshaped and elevations adjusted to match adjoining grades prior to mixing cement in with the pulverized asphalt, basestone, and subgrade soil. Once compacted and allowed to cure, the new asphalt paving may be applied directly on the stabilized layer. In areas where surface water drainage is poor, especially at the edge of the pavement, a relatively thin layer of basestone may be added to provide a capillary break. Also, some paving contractors prefer to place several inches of basestone to better shape the subgrade prior to paving. About 2 to 3 inches of basestone is common for this approach, but structurally, it isn't needed.

The mixing depth can vary from 8 to 16 inches or more depending on the equipment. In this case, we believe a mixing depth of 14" is appropriate for the areas identified with the reduced pavement support values. In areas which demonstrate better subsurface conditions, the mixing depth may be reduced to 10 inches. We anticipate only minor amounts of underlying soil will be part of the mixed zone based on the current thickness of asphalt and basestone. If some of the materials are removed prior to mixing cement, some soil content may be included.

A project specific mix design will be necessary to establish the amount of cement to be mixed with the pulverized asphalt, basestone and soil. KSWA recommends a target unconfined strength of 400 psi during the laboratory mix optimization. For field sampling, where test samples are made in less ideal conditions, we recommend a minimum strength of 350 psi be used as the design strength.

6.2 PAVEMENT DESIGN

For design of the new pavement section, KSWA recommends using CBR values as follows for each of the cases described previously.

Table 4: Pavement Support Values

Condition	Repair Method	Comment	CBR Value
Soil Subgrade, Untreated	Remove and Replace with Subgrade improvement	For replacement with soil fill. Higher value may be possible with stone backfill	5
Treated Soil Subgrade	Remove and Replace with Chemical Stabilization of Subgrade	After removing asphalt, mix stabilizing agent to a depth of 10 to 14 inches. CBR and mixing depth depend on additive.	5 to 12
FDR	Pulverize asphalt and stone in place and mix with cement	Place new asphalt on top of stabilized reclaimed pavement	40
FDR with regrading	Pulverize asphalt and stone in place and excavated some of the material to match grades prior to mixing with cement	Place new asphalt on top of stabilized reclaimed pavement	20

As an alternate method of evaluation, the cement stabilized layer may be treated as a subbase layer in developing structural number equivalence. A SN Coefficient of 0.24 is commonly used for cement stabilized material. The underlying CBR below the stabilized zone will still be a value of 3.

6.3 SUBGRADE PREPARATION AND PAVEMENT MAINTENANCE

The soils encountered at the site consist of clay, which are moisture sensitive. Experience indicates there is typically an extensive time lag between the time grading is completed and pavement construction occurs (i.e. grading may occur during hot, dry weather and pavement construction may occur during wet, cool weather). Once grading has been performed, the subgrade may be disturbed throughout the construction process due to utility excavations, construction traffic, desiccation, or rainfall. As a result, the pavement subgrade may become unsuitable for pavement construction over time and corrective action may be required. The subgrade should be carefully evaluated at the time of pavement construction by proof rolling with a heavily-loaded tandem-axle dump truck. Particular attention should be given to high traffic areas that display distress and to areas where backfilled trenches are located.

Design pavement section thicknesses are typically determined based on post-construction traffic loading conditions, which do not account for heavy construction traffic during the early stages of development. A partially constructed structural section subjected to heavy construction traffic can result in pavement deterioration and premature failure. Our experience indicates this pavement construction practice can result in pavements which will not perform as intended. Considering this information, several alternatives are available to mitigate the impact of heavy construction traffic on the pavement construction. These include using thicker sections to account for construction traffic, using some method of stabilization to improve the support characteristics of the pavement subsurface, or by routing heavy construction traffic around paved areas using a "haul road" constructed for that purpose.

Maintenance is essential to good long-term performance of rigid and flexible pavements. Any distressed areas should be repaired promptly to prevent the failure from spreading due to loading and water infiltration.

7.0 CONSTRUCTION CONSIDERATIONS

After completing initial site preparation activities, the exposed subgrade should then be evaluated as follows:

- Perform proof rolling prior to any fill or base material placement in fill areas and/or following cuts to grade in cut areas.
- Proof rolling should be performed using a loaded tandem-axle dump truck or other rubber-tired equipment judged suitable by the geotechnical engineer.
- Our geotechnical engineer or his representative should observe proof rolling activities.
- Remediate soft, organic, or yielding subgrade materials encountered during the proof rolling operations as recommended by our geotechnical engineer. The amount of stabilization required for this project will likely depend on weather conditions and the season that earthwork is performed. Dry summer months will probably require much less stabilization than will wet winter months.

7.1 COMPACTED FILL RECOMMENDATIONS

Once the subgrade has been properly prepared, compacted fill may be placed in accordance with the recommendations provided below to attain final desired construction elevations. Fill operations should not begin until representative soil samples are collected and tested (allow 3 to 4 days for sampling and testing for maximum dry density and optimum moisture content, plus an additional 5 days if CBR Testing is necessary). The test results will be used to determine whether the proposed fill material meets the specified criteria and for quality control during grading. Fill placement and compaction should be observed by our representative on a full-time basis. Materials from both on-site and off-site sources that are proposed for use as structural fill should meet the criteria provided below.

- Liquid Limit less than 50
- Plasticity Index less than 25
- CBR ≥5
- Free of large rock fragments (greater than 3 inches in diameter) and organic materials (less than 5 percent by weight)
- Amount of rock fragments retained on a 3/4-inch sieve should be less than 30 percent by weight

Our laboratory testing indicates that some of the on-site soils are highly plastic and exceed the above liquid limit and plasticity index requirement. These materials should either be used in landscape areas or removed from the site.

Structural fill should be placed and compacted using the following criteria:

- Soil fill should be placed in lifts of uniform thickness. The loose lift thickness should not exceed that which can be properly compacted throughout its entire depth with the equipment available, usually no more than 8 inches for clay and silts and no more than 8 inches for granular soils for area fills. In confined areas such as utility trenches, lift thicknesses of 3 to 4 inches may be required to achieve the recommended degree of compaction.
- Fill should be properly keyed into stripped and scarified subgrades. The upper one foot of materials in planned cut areas or in areas which do not receive more than one foot of new fill should be scarified and recompacted using the guidelines outlined in this report section.
- So that a positive tie is created along the interface of engineered fill and sloping ground (steeper than 4H:1V), we recommend that the host slope be benched as the fill is placed. For this project, benching is defined as grading a saw tooth or terrace configuration into the hillside. In general, at a minimum, we recommend benches should be about three feet tall and a minimum of eight feet wide, although some modification to bench geometry is permissible based upon conditions observed at particular locations. Further, fill placement should begin at the bottom of the slope and the working fill surface should be maintained approximately horizontal.
- Fill should not be placed on frozen or saturated subgrades.
- Fills placed in pavement areas should be compacted to at least 98 percent of the standard Proctor maximum dry density (ASTM D698), except for the upper foot, which should be compacted to 100 percent. Additionally, the compacted fill should be stable under the moving load of a loaded tandem-axle dump truck.
- Density tests should be performed at a frequency of no less than one test per 5,000 to 7,500 square feet for pavement areas for each one-foot thick fill layer placed, with a minimum of two tests per one foot thick fill layer. For utility trenches, one density test should be performed every 50 linear feet for each one-foot thick fill layer placed, with a minimum of two tests per one foot thick fill layer. Any areas not meeting the recommended compaction should be reworked and recompacted to achieve compliance. The recommended test frequencies are for preliminary planning and should be adjusted in the field to account for material variability, rate of placement, weather and other factors.
- The soils should be placed near (within two percent of) the optimum water content (ASTM D698). Aeration (i.e., drying) is often necessary to bring fill materials to the required water content during wet and rainy periods. During dry periods, water may need to be added to achieve the proper water content for compaction. Clayey and silty soils may require aeration prior to compaction, even during dry periods. The water content testing performed during this exploration suggests some of the on-site soils are significantly above the optimum water contents.
- Excavations should be constructed in accordance with applicable Occupational Safety and Health Administration (OSHA) regulations.

7.2 General Earthwork Considerations

During earthwork operations, positive surface drainage should be maintained to prevent water from ponding on the exposed ground surface. The exposed subgrade may be rolled with a rubber-tired or steel drummed roller to improve surface run-off if precipitation is expected. Our geotechnical engineer should be consulted if the subgrade soils become excessively wet or dry, or frozen.

7.3 GROUNDWATER CONTROL RECOMMENDATIONS

Groundwater was not encountered in any of the borings. Groundwater levels may fluctuate with season changes. If water-bearing strata are exposed at subgrade, the magnitude and duration of seepage will vary. We anticipate that in most cases, depending on seasonal conditions, any seepage encountered can be handled by conventional dewatering methods (i.e., pumping from small sumps located near the source or in collector areas). If larger quantities of groundwater are encountered, the Geotechnical Engineer should be contacted.

8.0 QUALIFICATIONS OF RECOMMENDATIONS

The recommendations provided herein were developed in part using the subsurface information obtained from the soil test borings advanced at the site. Soil test borings depict the soil conditions only at the specific location and time at which they were made. The soil conditions at other locations on the site or at other times may differ from those occurring at the boring locations.

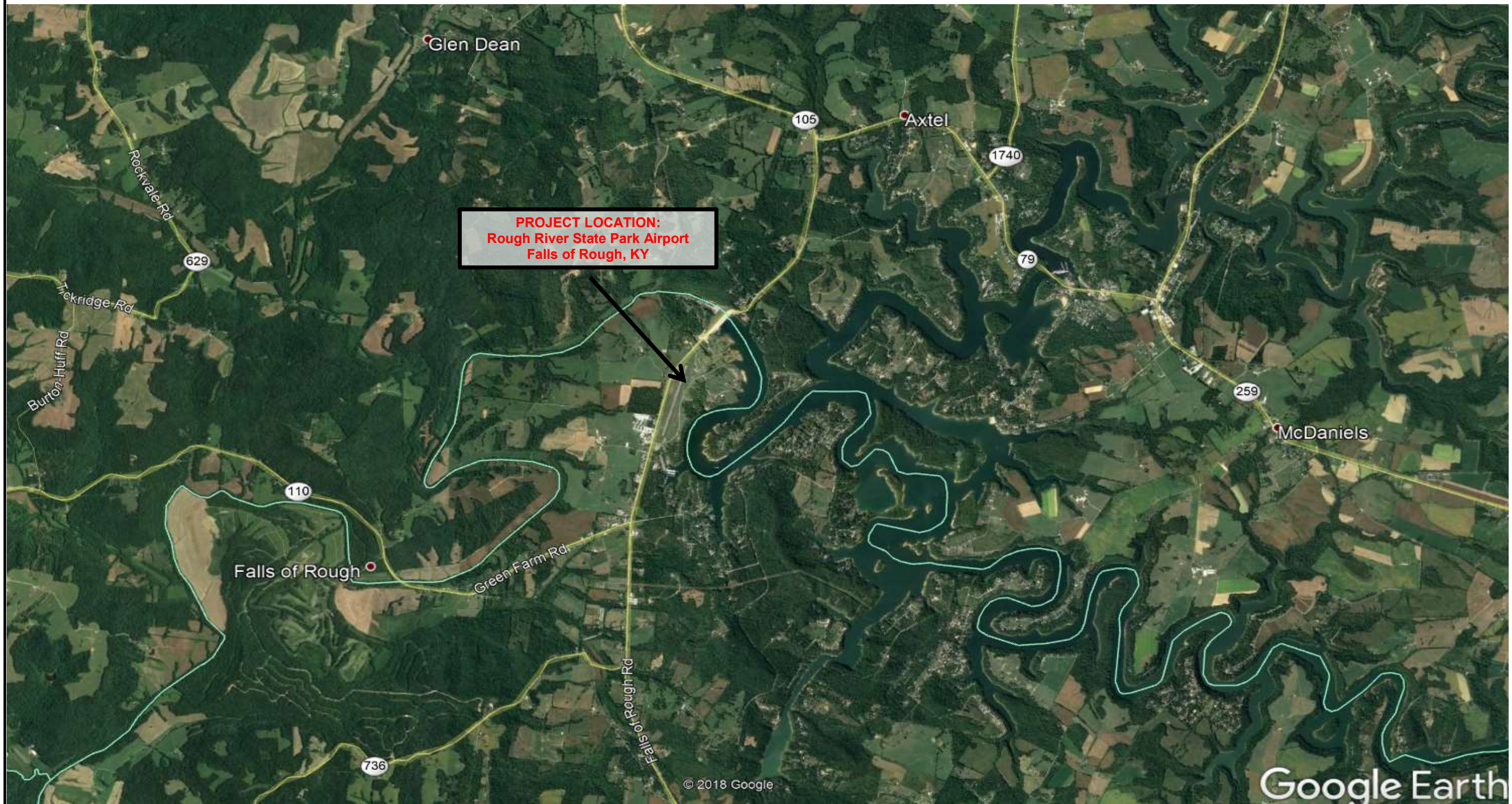
The scope of this geotechnical exploration did not include assessment or exploration for the presence or absence of hazardous or toxic materials in the soil, rock, groundwater, surface water, or air within or beyond the site. Any statements in this report or indicated on the test boring logs regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of KSWA's client.

KSWA's professional services were performed, findings obtained, and recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. KSWA is not responsible for the conclusions, opinions, or recommendations made by others based upon the data included herein.

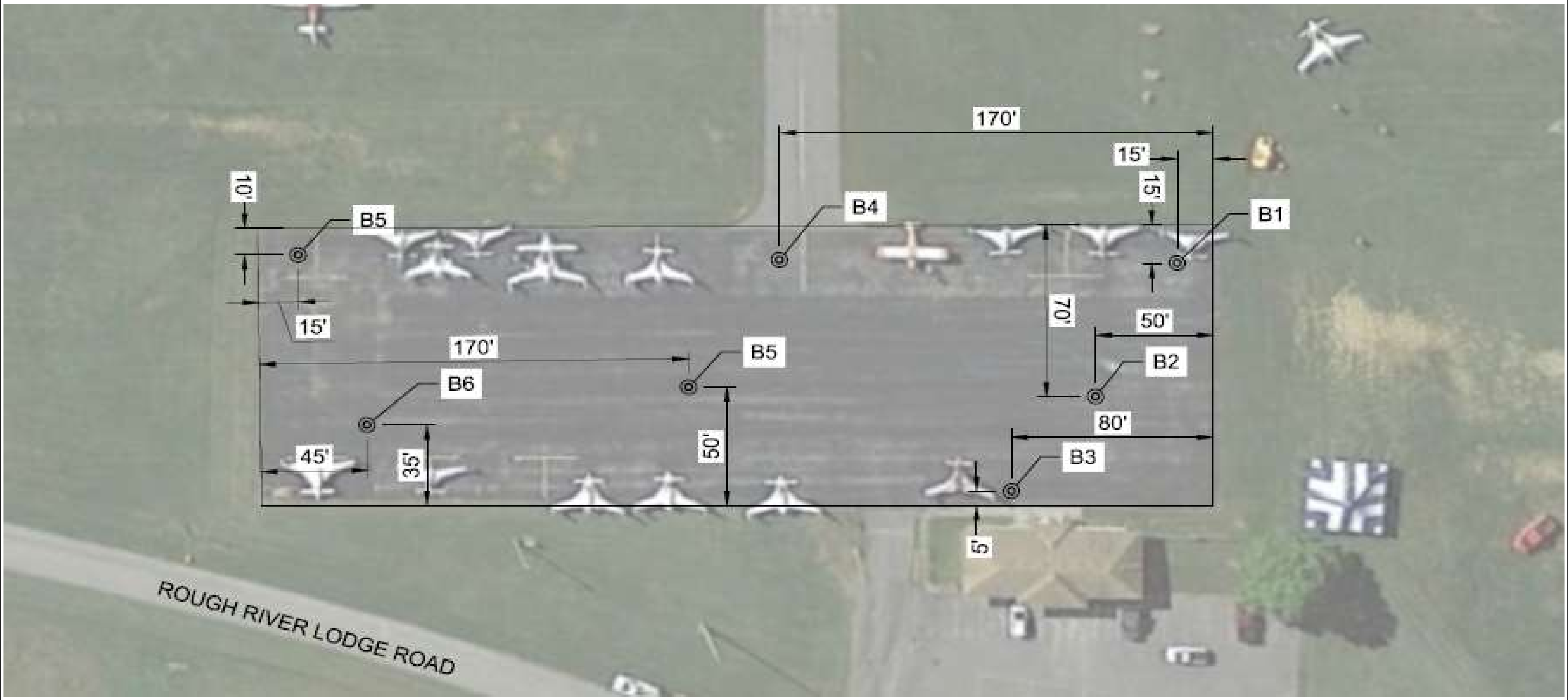
KSWA's services include retaining the soil samples obtained during this study for 30 days after report submittal. Further storage or transfer of the samples can be made at the Client's expense upon a written request.

APPENDIX A

FIGURES



N NOT TO SCALE	500-19-0006 CLIENT: Garver Date: 12/3/2019	**SITE VICINITY MAP** Rough River State Park Airport Apron Reconstruction Falls of Rough, Kentucky DRAWN BY: Keaton Andrus REVIEWED BY:	**LEGEND**	KSWA [KS WARE & ASSOCIATES]	Figure 1



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NOT TO SCALE

500-19-0006

CLIENT: Garver

Date: 12/3/2019

BORING LOCATION PLAN

Rough River State Park Airport Apron Reconstruction
Falls of Rough, Kentucky

DRAWN BY: Keaton Andrus REVIEWED BY:

LEGEND

◎ Boring Location

KSWA [KS WARE & ASSOCIATES]

Figure 2

Appendix B

Field Testing Procedures

Field Classification System

Soil Classification Chart

Test Boring Logs

Pavement Core Photographs

FIELD TESTING PROCEDURES

Drilling, sampling, and testing were conducted in general accordance with methods of the American Society for Testing and Materials (ASTM) or other widely-accepted geotechnical engineering standards. Descriptions of the procedures used during this exploration are provided below.

BORING AND COREHOLE LOCATIONS AND ELEVATIONS

The boring and corehole locations were selected by the Client prior to beginning our exploration. We located the exploration locations on the Exploration Location Plan by estimating distances and angles relative to on-site features. Surveying of boring and core coordinates was beyond the scope of our exploration and was performed by others. We estimate the ground surface elevations at each boring location using Google Earth software.

TEST BORINGS
ASTM D 1586

Test borings were advanced using auger drilling techniques. At regular intervals, soil samples were obtained with a standard 2 ¼ inch I.D. split-barrel sampler. The sampler was initially seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is the *standard penetration resistance*, or N-value.
Standard penetration resistance, when properly evaluated, is an index to the soil's strength and density. The criteria used during this exploration are presented on the Field Classification System sheet in this appendix. Representative portions of the soil samples obtained were placed in sealed containers and transported to our laboratory, where our engineer selected samples for laboratory testing.

The standard penetration tests were performed using an automatic hammer. The automatic hammer has a higher efficiency than the traditional rope and cathead hammer, thus yielding comparatively lower N-values. This reduction in N-value was accounted for during our engineering analysis. However, the consistencies presented on the boring logs were based on the customary relationships with N-value.

PAVEMENT CORES

Pavement cores were advanced using a mechanical coring machine. Four-inch diameter core barrels were used. We measured the thickness of the recovered asphalt cores and extended the coreholes through the base stone using hand-held tools. After penetrating the base course materials, our representative measured the base course thickness. Upon completion, we backfilled the coreholes with asphalt cold patch.

DYNAMIC CONE PENETROMETER TESTING
ASTM D6951

Dynamic Cone Penetrometer (DCP) testing is performed by driving the DCP conical point into the undisturbed subgrade by lifting the 10.1-pound sliding hammer to the handle then releasing it. The total penetration for a given number of blows is measured and recorded in mm/blow, which is used to evaluate stiffness and estimate an in situ CBR strength from appropriate correlations.

REFUSAL MATERIALS

Soil drilling and sampling equipment may not be capable of penetrating hard cemented or very dense soils, thin rock seams, large boulders, waste materials, weathered rock, or sound continuous rock. Refusal is the term applied to materials that cannot be penetrated with soil drilling equipment or where the standard penetration resistance exceeds 100 blows per foot. Core drilling is needed to determine the character and continuity of the refusal materials.

WATER LEVEL READINGS

The boreholes were checked for groundwater during the drilling and upon completion. The groundwater conditions encountered are indicated on the boring logs. Groundwater levels may depend upon recent rainfall or seasonal conditions, construction activity, and other site-specific factors. Since these conditions may change with time, the water level information presented on the boring logs represents the conditions only at the time each measurement was taken.

BORING LOGS

The soil samples obtained during the drilling were visually classified using the Unified Soil Classification System (USCS) as a guide (reference Soil Classification Chart in Appendix B). The Test Boring Logs in Appendix B provide the soil descriptions and penetration resistances, and represent our interpretation of the conditions encountered at each boring location. The stratification lines indicated on the boring records represent the approximate boundaries between material types, but these transitions may be gradual. The boring logs were prepared based on the field logs and review of the laboratory classification test results. The USCS designations indicated on the boring logs are based on visual-manual evaluation of the samples unless otherwise defined by laboratory testing.

The boring logs indicate estimated interfaces between soil strata. The interfaces indicated represent the approximate interface location, but the actual transition between strata may be gradual. Water levels indicated on the boring logs represent the conditions only at the time each measurement was taken.

FIELD CLASSIFICATION SYSTEM

Sands and Gravels

No. of Blows	Relative Density
0-5	Very Loose
6-10	Loose
11-30	Medium dense
31-50	Dense
51+	Very Dense

Silts and Clays

No. of Blows	Relative Consistency
0-2	Very Soft
3-4	Soft
5-9	Firm
10-15	Stiff
16-30	Very Stiff
31+	Hard

Particle Size Identification

Boulders:	8-inch diameter or larger
Cobbles:	3- to 8-inch diameter
Gravel:	
Coarse:	1- to 3-inch
Medium:	0.50- to 1-inch
Fine:	0.25- to 0.50-inch
Sand:	
Coarse:	2.00-mm to 0.25-inch (diameter of pencil lead)
Medium:	0.074-mm to 2.00-mm (diameter of broom straw)
Fine:	0.042-mm to 0.074-mm (diameter of human hair)
Silt:	0.002-mm to 0.042-mm (Cannot see particles)
Clay:	<0.002-mm

Relative Proportions

Descriptive Term	Percent
Trace	1-10
Little	11-20
Some	21-35
And	36-50

Relative Quality of Rock Cores

Quality	RQD
Very Poor	0-25%
Poor	25-50%
Fair	50-75%
Good	75-90%
Excellent	90-100%

$$RQD = \frac{\text{Total length of core recovered in pieces 4 inches long or longer}}{\text{Total length of core run}} \times 100\%$$

Rock Hardness

Very Soft	Rock disintegrates or easily compresses to touch; can be hard to very hard soil
Soft	Rock is coherent but breaks easily to thumb pressure at sharp edges and crumbles with firm hand pressure
Moderately Hard	Small pieces can be broken off along sharp edges by considerable hard thumb pressure; can be broken by light hammer blows
Hard	Rock cannot be broken by thumb pressure, but can be broken by moderate hammer blows
Very Hard	Rock can be broken by heavy hammer blows

KSWA BORING LOG

KSWA
K. S. Ware & Associates, L.L.C.
Geotechnical • CEI • Environmental

BORING NO. B-1

PROJECT NAME: Rough River Apron Reconstruction
LOCATION: Falls of Rough, KY
PROJECT NO.: 500-19-0006

Approx. Surface El. (feet, MSL):
Location: See Map

Depth, feet	MATERIAL DESCRIPTION	Recovery (%)	RQD (%)	SPT Values	N-Value	Pocket Pen (tsf)	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
0.0–0.3	Asphalt (4 Inches)	100								
0.3–1.2	Basestone (10 Inches)									
1.2–3.0	LEAN CLAY (CL), brown with gray mottling, very soft, moist	17		3-1-1	2		12.7			
3.0–6.0	LEAN CLAY (CL) with sand, brown with gray mottling, moist	79					22.3	47	25	22
6.0–8.5	LEAN CLAY (CL), brown with gray mottling, very dense, moist	81		6-10-50/4	50+		17.5			
8.5	AUGER REFUSAL AT 8.5 FBGS BORING TERMINATED									

Completion Depth (ft.): **8.5**
Date Started: **11/27/19**
Date Completed: **11/27/19**
Drilled By: **Strata**
Logged By: **JKA**

Remarks: **Diedrich D-50 Track Mounted Drill Rig. 4 Inch Flight Auger. Auto-Hammer. No groundwater encountered.**

KSWA BORING LOG

K. S. Ware & Associates, L.L.C.
Geotechnical • CEI • Environmental

BORING NO. B-2

PROJECT NAME: Rough River Apron Reconstruction
LOCATION: Falls of Rough, KY
PROJECT NO.: 500-19-0006

Sheet 1 of 1

Approx. Surface El. (feet, MSL):
Location: See Map

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Recovery (%)	RQD (%)	SPT Values	N-Value	Pocket Pen (tsf)	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
0.5		Asphalt (5.5 Inches)		100								
0.8		Basestone (4.5 Inches)										
3.0		SANDY LEAN CLAY (CL), trace gravel, brown, wet (FILL)		61		1-1-2	3		25.9			
6.5		LEAN CLAY (CL), brown with gray mottling, firm, moist		100		2-3-6	9		23.0			
8.2		SANDY LEAN CLAY (CL), gray with brown mottling, very stiff, moist		83		7-8-15	23		15.7			
		AUGER REFUSAL AT 8.2 FBGS BORING TERMINATED										

Depth scale: 4, 8

Completion Depth (ft.): **8.2**
Date Started: **11/27/19**
Date Completed: **11/27/19**
Drilled By: **Strata**
Logged By: **JKA**

Remarks: **Diedrich D-50 Track Mounted Drill Rig. 4 Inch Flight Auger. Auto-Hammer. No groundwater encountered.**

KSWA BORING LOG

K. S. Ware & Associates, L.L.C.
Geotechnical • CEI • Environmental

BORING NO. B-3

PROJECT NAME: Rough River Apron Reconstruction
LOCATION: Falls of Rough, KY
PROJECT NO.: 500-19-0006

Sheet 1 of 1

Approx. Surface El. (feet, MSL):
Location: See Map

Depth, feet	Strata Depth	MATERIAL DESCRIPTION	Recovery (%)	RQD (%)	SPT Values	N-Value	Pocket Pen (tsf)	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
	0.5	Asphalt (5.5 Inches)	100								
	0.8	Basestone (4 Inches)									
	3.0	FAT CLAY (CH), reddish-brown, soft, moist (FILL)	50		2-2-2	4					
4		LEAN CLAY (CL), reddish-brown with gray mottling, chert fragments and partings in lower section of sample, very stiff, moist	38					25.6			
8	8.4		89		6-12-15	27		19.4			
		AUGER REFUSAL AT 8.4 FBGS BORING TERMINATED									

Completion Depth (ft.): **8.4**
Date Started: **11/27/19**
Date Completed: **11/27/19**
Drilled By: **Strata**
Logged By: **JKA**

Remarks: **Diedrich D-50 Track Mounted Drill Rig. 4 Inch Flight Auger. Auto-Hammer. No groundwater encountered.**

KSWA BORING LOG

K. S. Ware & Associates, L.L.C.
Geotechnical • CEI • Environmental

BORING NO. B-4

PROJECT NAME: Rough River Apron Reconstruction
LOCATION: Falls of Rough, KY
PROJECT NO.: 500-19-0006

Sheet 1 of 1

Approx. Surface El. (feet, MSL):
Location: See Map

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Recovery (%)	RQD (%)	SPT Values	N-Value	Pocket Pen (tsf)	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
0.5		Asphalt (5.5 Inches)		100								
1.1		Basestone (8 Inches)										
3.0		SANDY FAT CLAY (CH), reddish-brown, soft, moist to wet (FILL)		50		2-2-2	4					
4												
6.5		FAT CLAY (CL) with sand, orange with black and gray mottling, firm, wet		83		3-3-3	6		32.1	65	25	40
8												
8.5		SANDY LEAN CLAY (CL), orange with brown and gray mottling, stiff, moist		78		3-3-8	11		18.5			
		AUGER REFUSAL AT 8.5 FBGS BORING TERMINATED										

Completion Depth (ft.): **8.5**
Date Started: **11/27/19**
Date Completed: **11/27/19**
Drilled By: **Strata**
Logged By: **JKA**

Remarks: **Diedrich D-50 Track Mounted Drill Rig. 4 Inch Flight Auger. Auto-Hammer. No groundwater encountered.**

KSWA BORING LOG

K. S. Ware & Associates, L.L.C.
Geotechnical • CEI • Environmental

BORING NO. B-5

PROJECT NAME: Rough River Apron Reconstruction

LOCATION: Falls of Rough, KY

PROJECT NO.: 500-19-0006

Approx. Surface El. (feet, MSL):
Location: **See Map**

Depth, feet	MATERIAL DESCRIPTION	Samples	Recovery (%)	RQD (%)	SPT Values	N-Value	Pocket Pen (tsf)	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
0.5	Asphalt (6 Inches)		100								
0.8	Basestone (4 Inches)										
4.0	LEAN CLAY (CL), brown, very soft, moist		56		1-1-1	2		20.4			
8.5	LEAN CLAY (CL), brown with gray and red mottling, firm, moist		100		3-4-5	9		20.8			
			8								
	AUGER REFUSAL AT 8.5 FBGS BORING TERMINATED										

Completion Depth (ft.): **8.5**
Date Started: **11/27/19**
Date Completed: **11/27/19**
Drilled By: **Strata**
Logged By: **JKA**

Remarks: **Diedrich D-50 Track Mounted Drill Rig. 4 Inch Flight Auger. Auto-Hammer. No groundwater encountered.**

KSWA BORING LOG

K. S. Ware & Associates, L.L.C.
Geotechnical • CEI • Environmental

BORING NO. B-6

PROJECT NAME: Rough River Apron Reconstruction
LOCATION: Falls of Rough, KY
PROJECT NO.: 500-19-0006

Sheet 1 of 1

Approx. Surface El. (feet, MSL):
Location: See Map

Depth, feet	Material Description	Recovery (%)	RQD (%)	SPT Values	N-Value	Pocket Pen (tsf)	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
0.0–0.5	Asphalt (5.5 Inches)	100								
0.5–0.9	Basestone (5.5 Inches)									
0.9–2.0	LEAN CLAY (CL) with sand, small roots, gray, wet (FILL)									
2.0–6.5	LEAN CLAY (CL), reddish-brown, stiff, moist	100		3-6-7	13		17.7	33	17	16
		50					23.9			
6.5–8.7	LEAN CLAY (CL), brown with gray and red mottling, stiff, moist	89		3-3-7	10		22.4			
8.7	AUGER REFUSAL AT 8.7 FBGS BORING TERMINATED									

Completion Depth (ft.): **8.7**
Date Started: **11/27/19**
Date Completed: **11/27/19**
Drilled By: **Strata**
Logged By: **JKA**

Remarks: **Diedrich D-50 Track Mounted Drill Rig. 4 Inch Flight Auger. Auto-Hammer. No groundwater encountered.**

KSWA BORING LOG

K. S. Ware & Associates, L.L.C.
Geotechnical • CEI • Environmental

BORING NO. B-7

PROJECT NAME: Rough River Apron Reconstruction
LOCATION: Falls of Rough, KY
PROJECT NO.: 500-19-0006

Approx. Surface El. (feet, MSL):
Location: See Map

Depth, feet	Material Description	Strata Depth	Recovery (%)	RQD (%)	SPT Values	N-Value	Pocket Pen (tsf)	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
	Asphalt (3.5 Inches)	0.3	100								
	Basestone (5 Inches)	0.7									
	LEAN CLAY (CL), gravel at top of sample, brown with gray mottling, soft, moist		67		2-2-2	4		25.4			
4	LEAN CLAY (CL), reddish-brown with gray mottling, stiff, moist	4.0	83		3-4-7	11		23.4			
	SANDY LEAN CLAY (CL), gray with reddish-brown mottling and trace black nodules, stiff, moist	6.5	100		4-6-7	13		18.4			
8	AUGER REFUSAL AT 8.8 FBGS BORING TERMINATED	8.8									

Completion Depth (ft.): **8.8**
Date Started: **11/27/19**
Date Completed: **11/27/19**
Drilled By: **Strata**
Logged By: **JKA**

Remarks: **Diedrich D-50 Track Mounted Drill Rig. 4 Inch Flight Auger. Auto-Hammer. No groundwater encountered.**

ASPHALT CORE PHOTOGRAPHS
ROUGH RIVER AIRPORT APRON RECONSTRUCTION
FALLS OF ROUGH, KENTUCKY
KSWA PROJECT NO. 500-19-0006

B-01

B-02

ASPHALT CORE PHOTOGRAPHS
ROUGH RIVER AIRPORT APRON RECONSTRUCTION
FALLS OF ROUGH, KENTUCKY
KSWA PROJECT NO. 500-19-0006

B-03

B-04

ASPHALT CORE PHOTOGRAPHS
ROUGH RIVER AIRPORT APRON RECONSTRUCTION
FALLS OF ROUGH, KENTUCKY
KSWA PROJECT NO. 500-19-0006

B-05

B-07

Appendix C

DCP Test Results

DCP TEST DATA

B-1

Project: *500-19-0006*
Location: Falls of Rough, KY
Date: 26-Nov-19
Soil Type(s): Low plasticity Clay with CBR<10

Hammer
- (●) 10.1 lbs.
- ( ) 17.6 lbs.
- ( ) Both hammers used

Note: High CBR values in the upper 6 inches of testing result from basestone remaining in corehole.

Soil Type
- ( ) CH
- (●) CL
- ( ) All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
11	50	2
19	100	2
8	150	2
2	230	2
2	290	2
4	340	2
2	400	2
2	450	2
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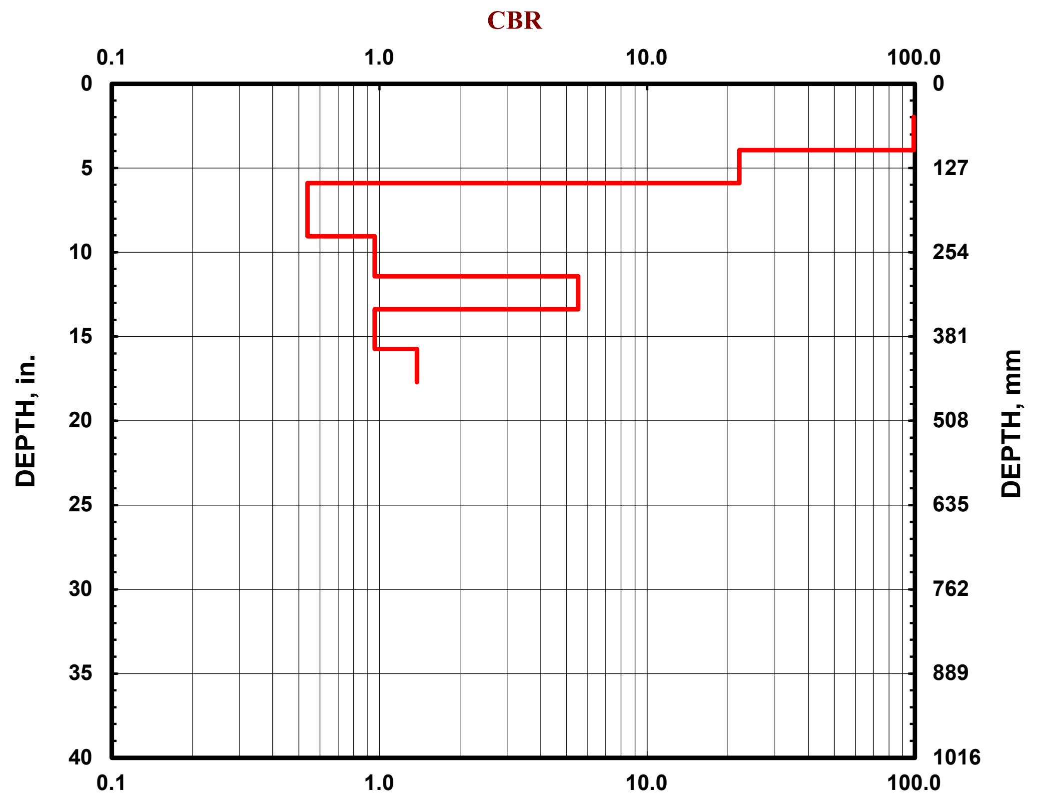

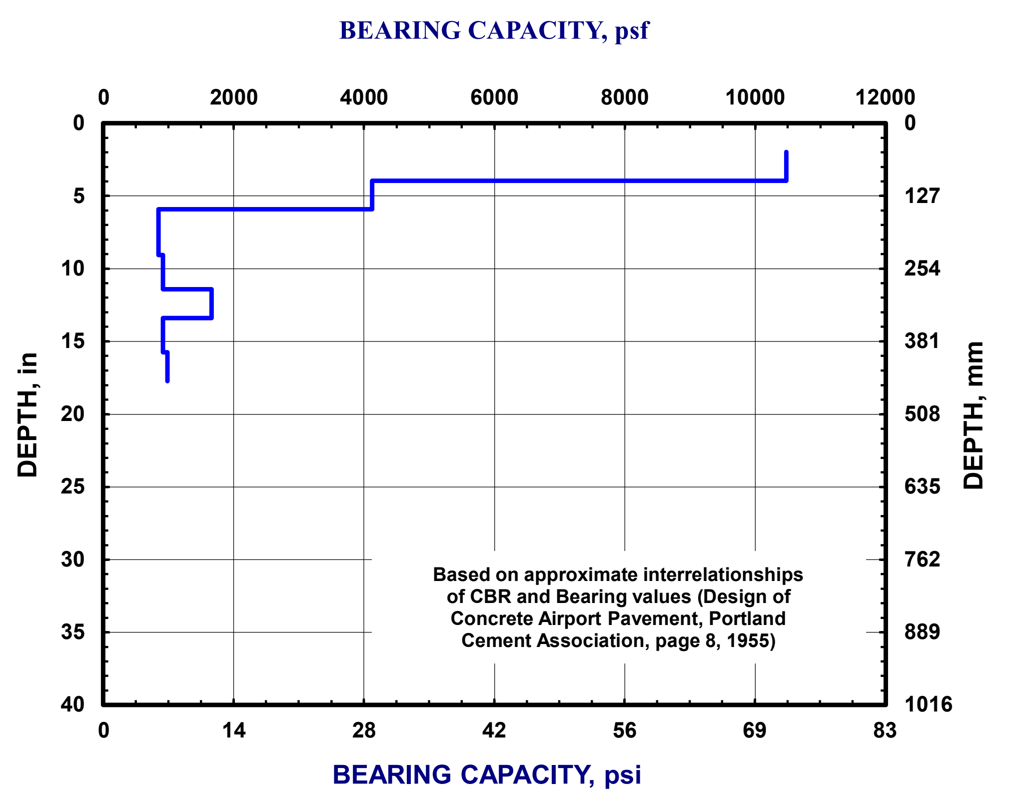

DCP TEST DATA

B-2

Project: *500-19-0006*
Location: Falls of Rough, KY
Date: 26-Nov-19
Soil Type(s): Low plasticity Clay with CBR<10

Hammer
- (●) 10.1 lbs.
- ( ) 17.6 lbs.
- ( ) Both hammers used

Soil Type
- ( ) CH
- (●) CL
- ( ) All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
8	50	2
3	150	2
1	210	2
1	260	2
4	320	2
2	380	2
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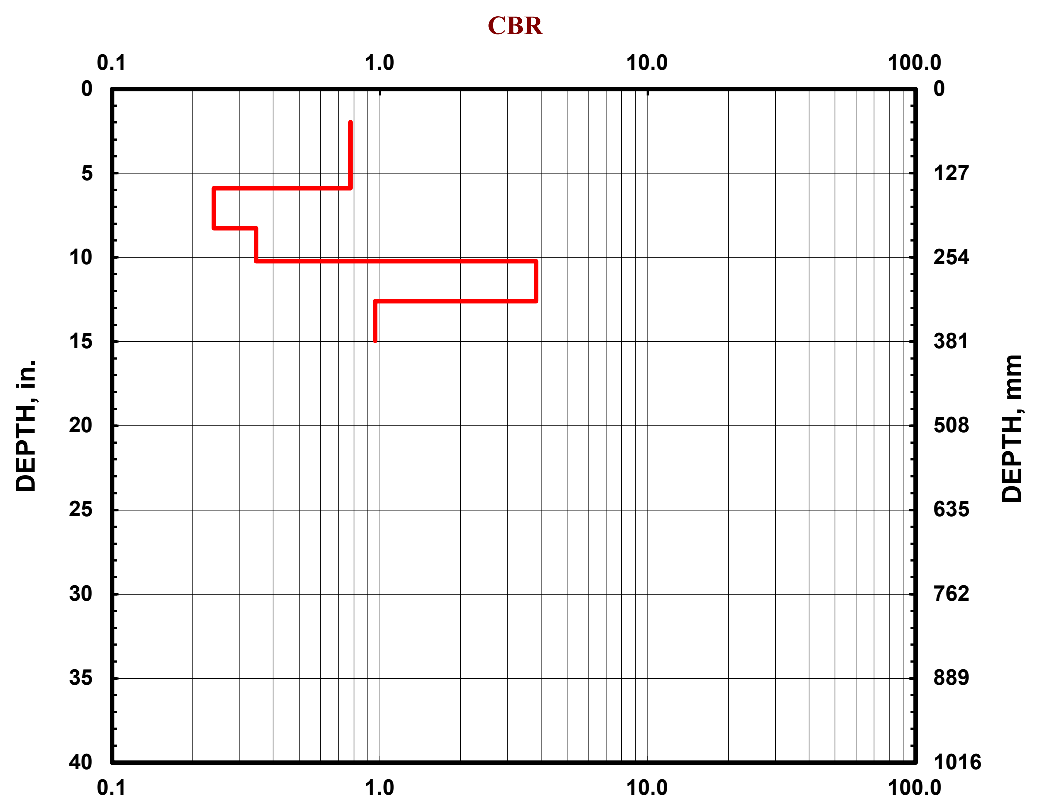

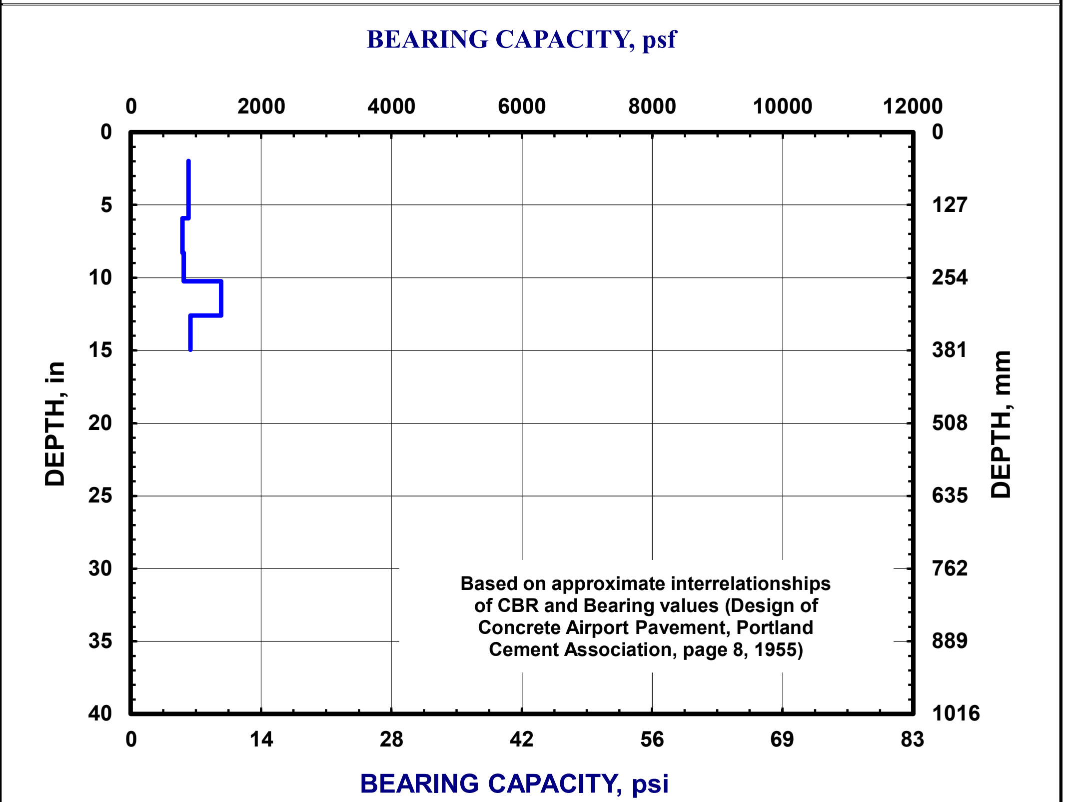

DCP TEST DATA

B-3

Project: *500-19-0006*
Location: Falls of Rough, KY
Date: 26-Nov-19
Soil Type(s): High plasticity Clay

Hammer
- (●) 10.1 lbs.
- ( ) 17.6 lbs.
- ( ) Both hammers used

Soil Type
- (●) CH
- ( ) CL
- ( ) All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
2	50	2
1	100	2
2	200	2
2	280	2
2	340	2
4	400	2
4	450	2
6	510	2
6	560	2
7	600	2
9	650	2
10	700	2
11	750	2
12	800	2
10	850	2
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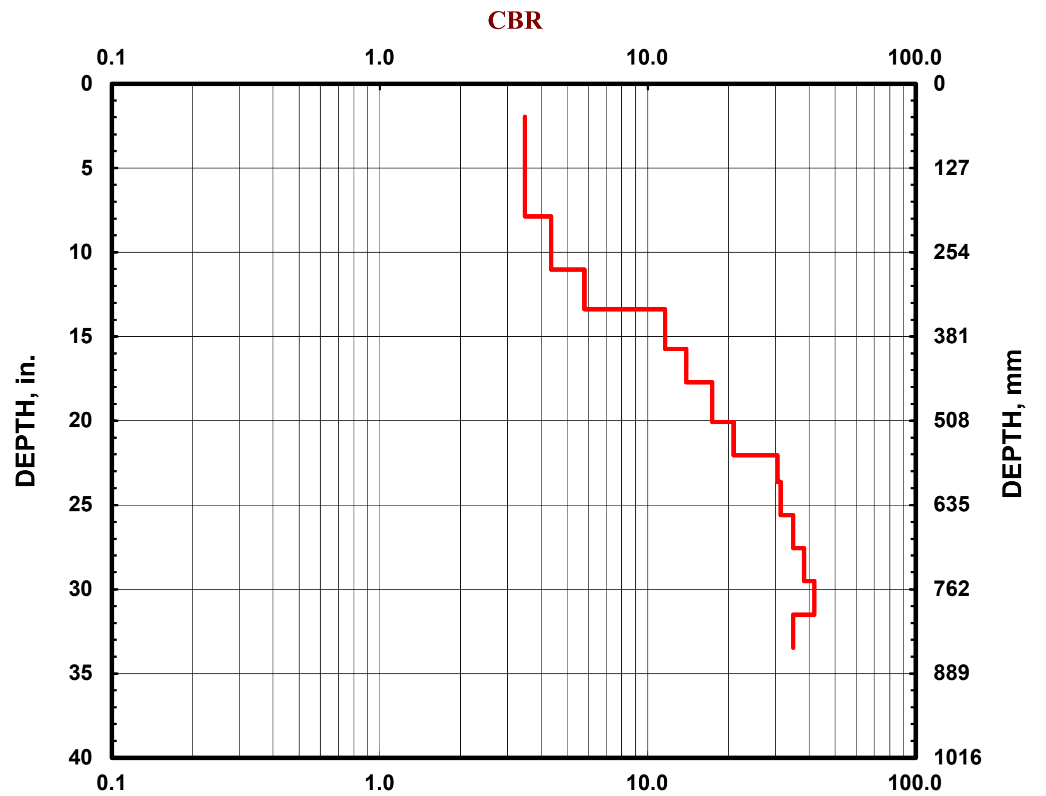

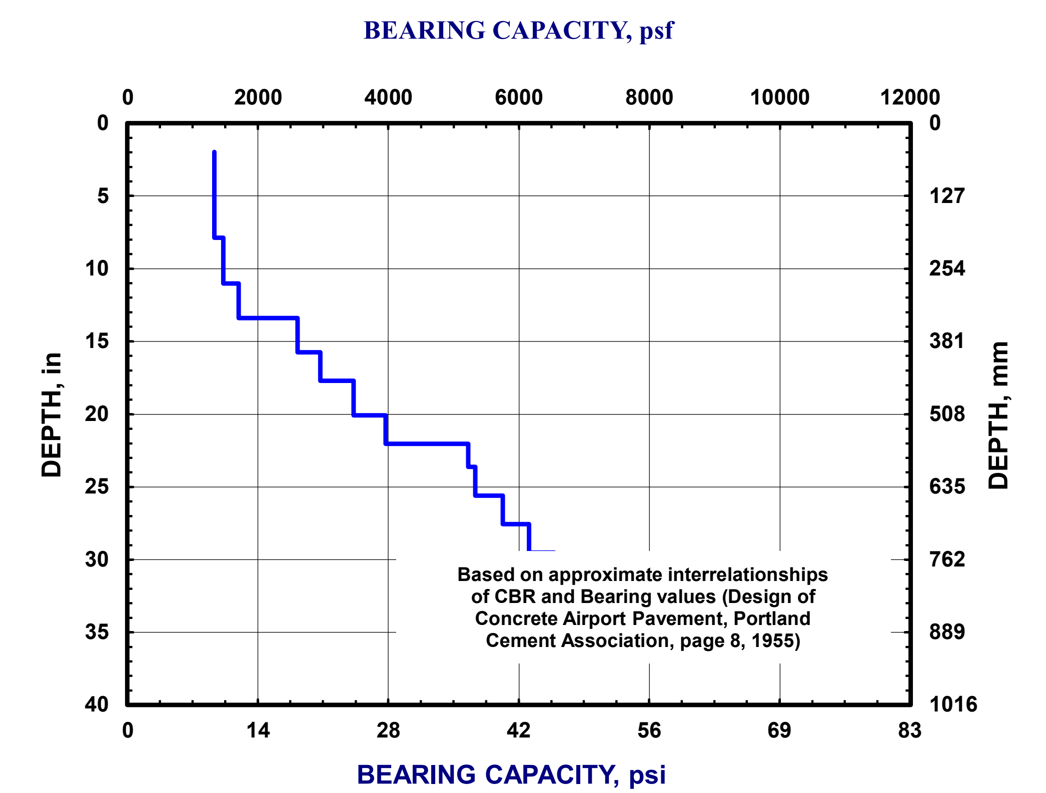

DCP TEST DATA

B-4

Project: *500-19-0006*
Date: 26-Nov-19
Location: Falls of Rough, KY
Soil Type(s): High plasticity Clay

Hammer
- (◉) 10.1 lbs.
- ( ) 17.6 lbs.
- ( ) Both hammers used

Note: High CBR values in the upper 4 inches of testing result from basestone remaining in corehole.

Soil Type
- (◉) CH
- ( ) CL
- ( ) All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
31	50	2
27	100	2
5	150	2
7	220	2
1	270	2
2	330	2
2	380	2
5	430	2
3	480	2
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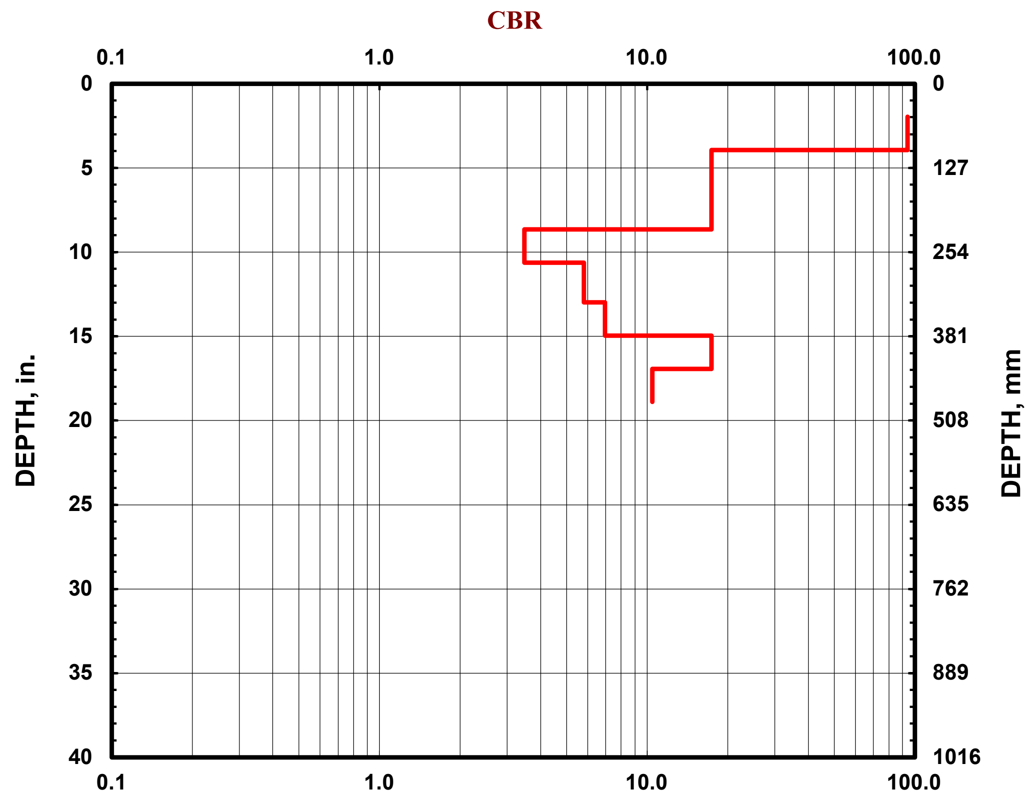

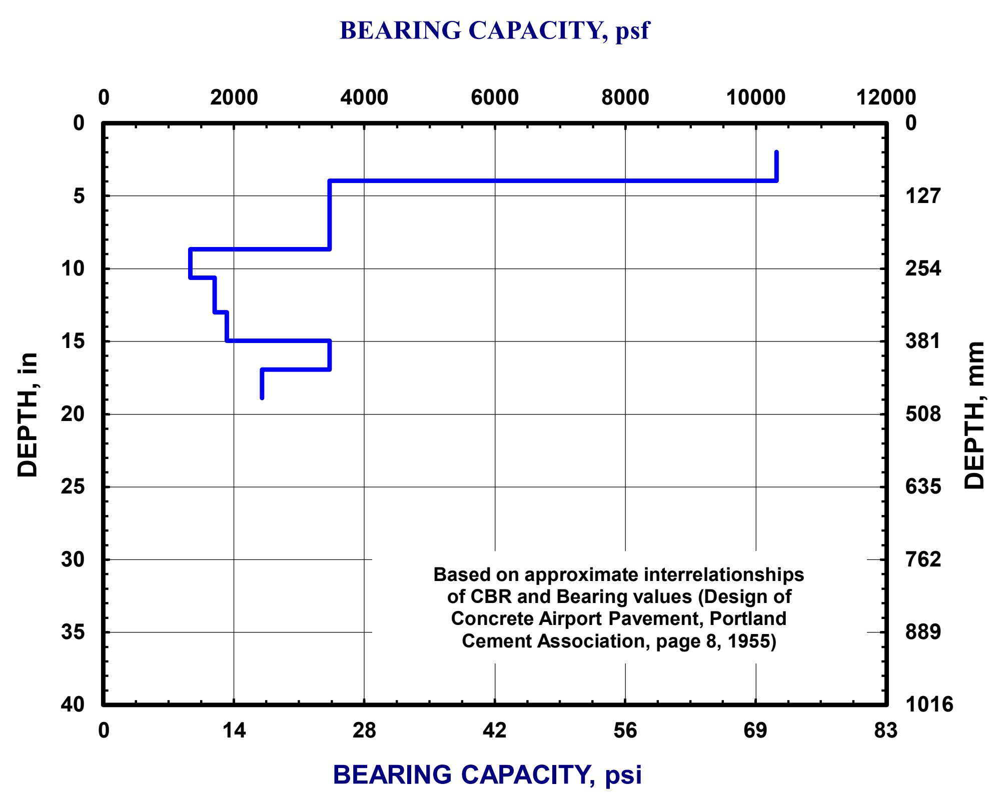

DCP TEST DATA

B-5

Project: *500-19-0006*
Location: Falls of Rough, KY
Date: 26-Nov-19
Soil Type(s): Low plasticity Clay with CBR<10

Hammer
- (●) 10.1 lbs.
- ( ) 17.6 lbs.
- ( ) Both hammers used

Soil Type
- ( ) CH
- (●) CL
- ( ) All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
1	50	2
2	120	2
2	190	2
2	240	2
2	290	2
3	340	2
5	390	2
5	440	2
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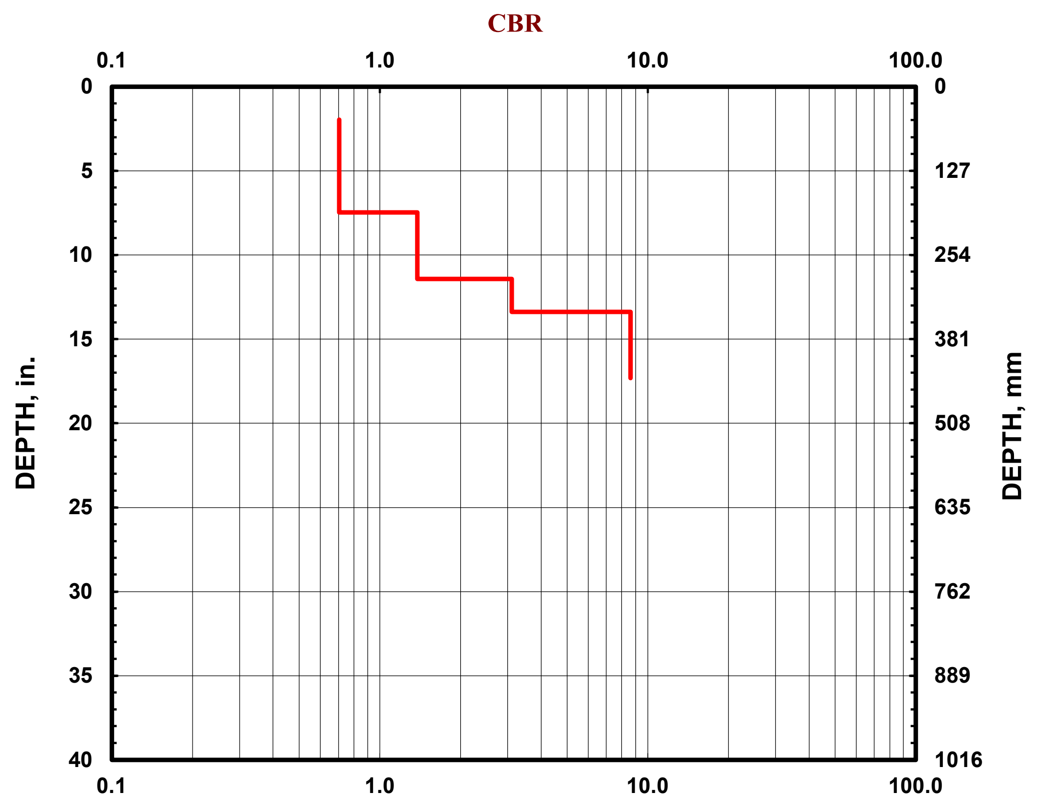

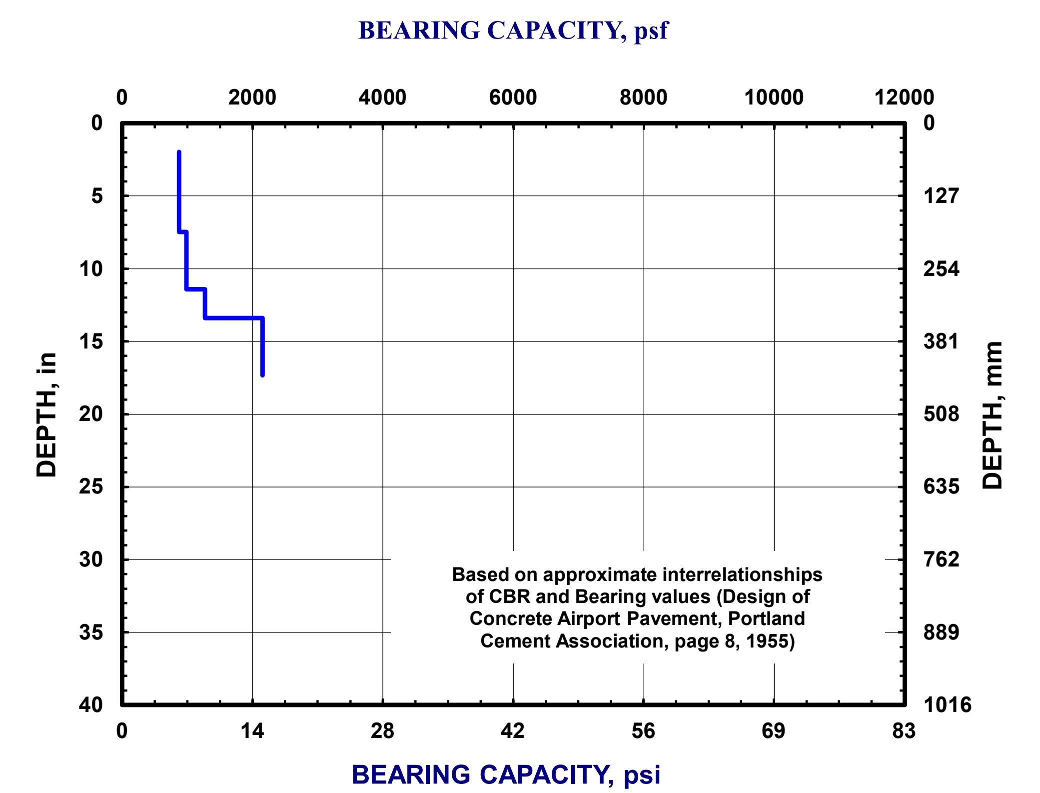

DCP TEST DATA

B-6

Project: *500-19-0006* **Date:** 26-Nov-19
Location: Falls of Rough, KY **Soil Type(s):** Low plasticity Clay with CBR<10

Hammer
- ◉ 10.1 lbs.
- ○ 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ◉ CL
- ○ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
1	70	2
1	120	2
2	180	2
3	230	2
5	280	2
5	330	2
6	390	2
7	440	2
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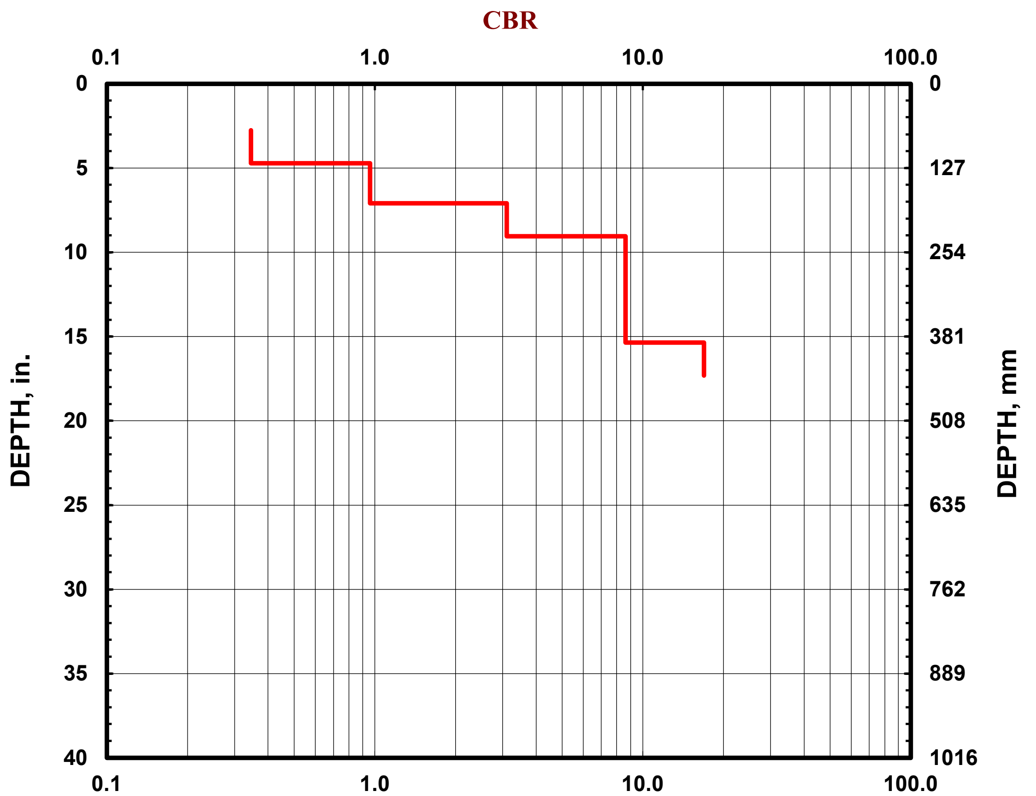

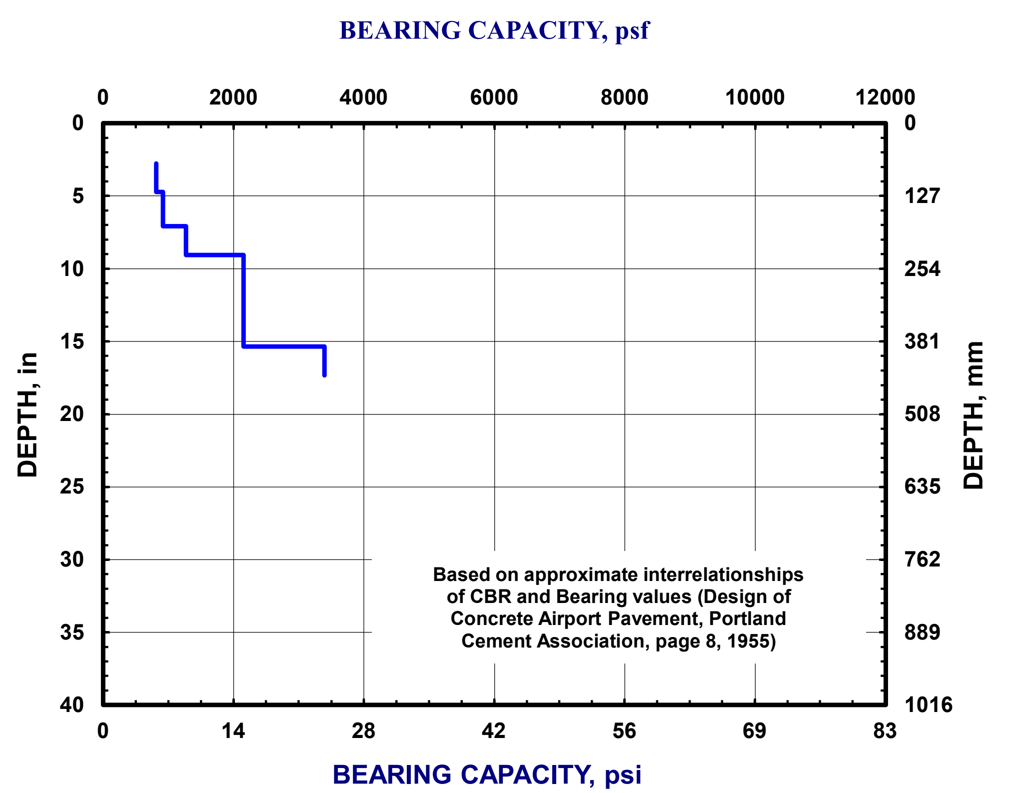

DCP TEST DATA

B-7

Project: *500-19-0006*
Location: Falls of Rough, KY
Date: 26-Nov-19
Soil Type(s): Low plasticity Clay with CBR<10

Hammer
- (●) 10.1 lbs.
- ( ) 17.6 lbs.
- ( ) Both hammers used

Soil Type
- ( ) CH
- (●) CL
- ( ) All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
3	60	2
2	130	2
2	200	2
2	260	2
3	320	2
3	370	2
5	430	2
3	480	2
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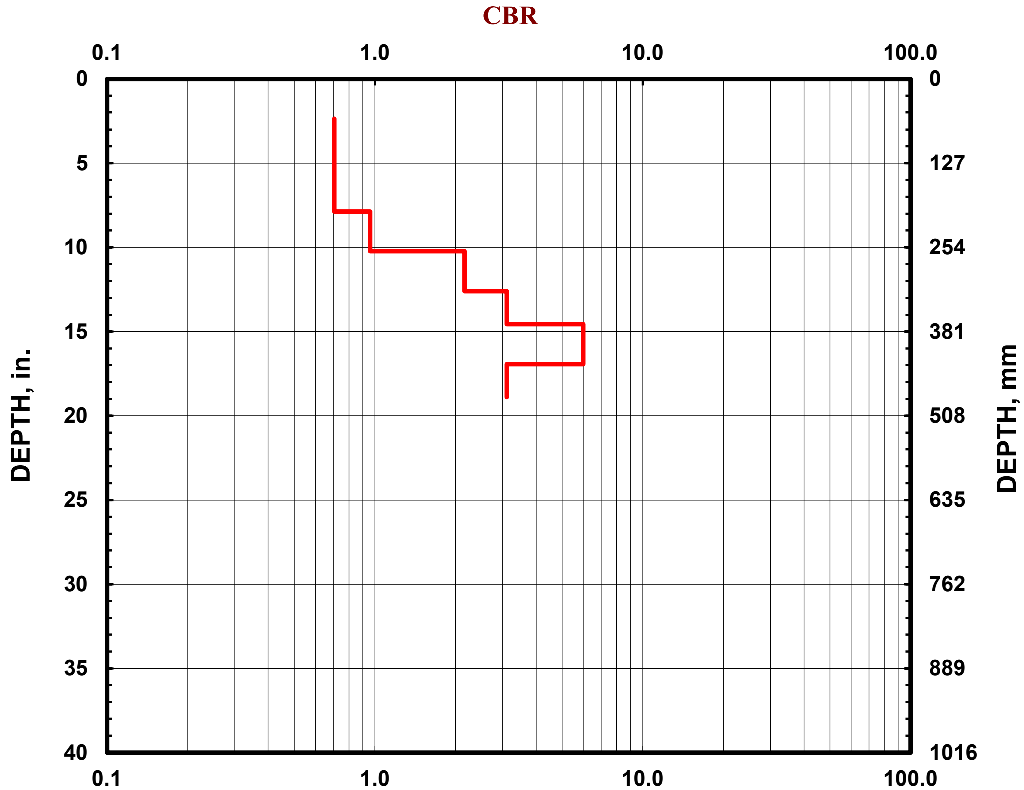

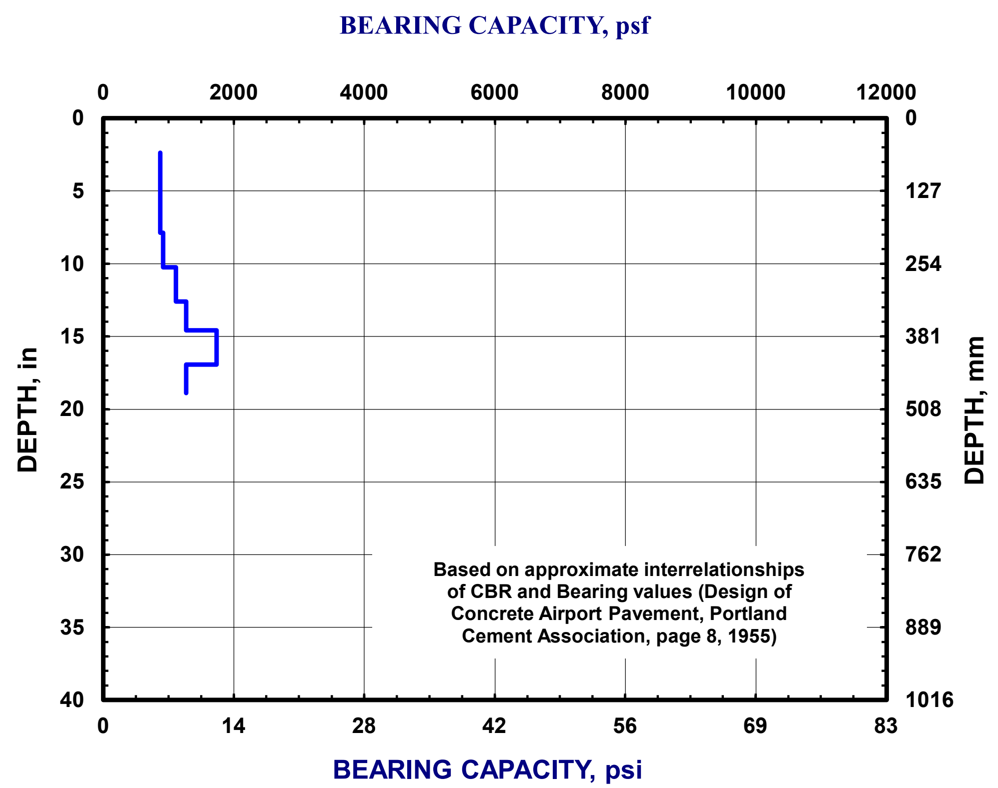

APPENDIX D

Laboratory Test Results

52 Lindsley Avenue, Suite 101
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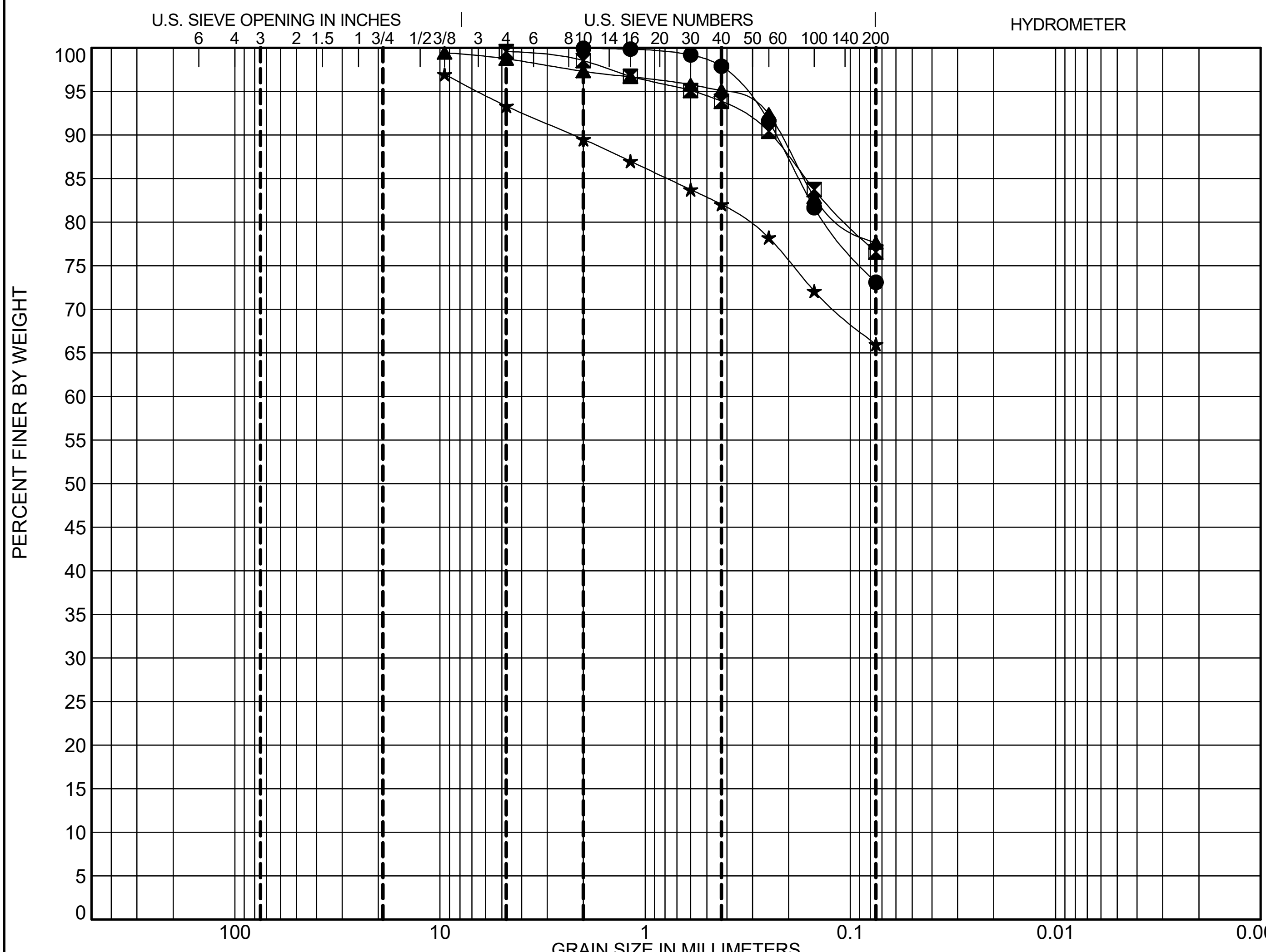
GRAIN SIZE DISTRIBUTION
ASTM D6913 - COARSE GRAIN SIZE
ASTM D7928 - FINE GRAIN SIZE

CLIENT: Garver USA
PROJECT NAME: Rough River Apron Reconstruction
PROJECT NUMBER 500-19-0006
PROJECT LOCATION: Falls of Rough, KY
SOIL DESCRIPTION:



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	Spec. Grav.	LL	PL	PI	Cc	Cu
● B-1, 4'	LEAN CLAY with SAND(CL)		47	25	22		
⧗ B-4, 4'	FAT CLAY with SAND(CH)		65	25	40		
▲ B-6, 1.5'	LEAN CLAY with SAND(CL)		33	17	16		
★ Bulk 1, 1'	SANDY LEAN CLAY(CL)		45	19	26		

Specimen Identification	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Clay
● B-1, 4'	2					26.8	73.1	
⧗ B-4, 4'	4.75					23.0	76.6	
▲ B-6, 1.5'	9.5				0.7	21.1	77.6	
★ Bulk 1, 1'	9.5				3.6	27.3	66.0	

TESTED BY: Z. Shannon **TEST DATE**: 12/10/2019 **REVIEWED BY**: K. Andrus **DATE**: 12/10/2019

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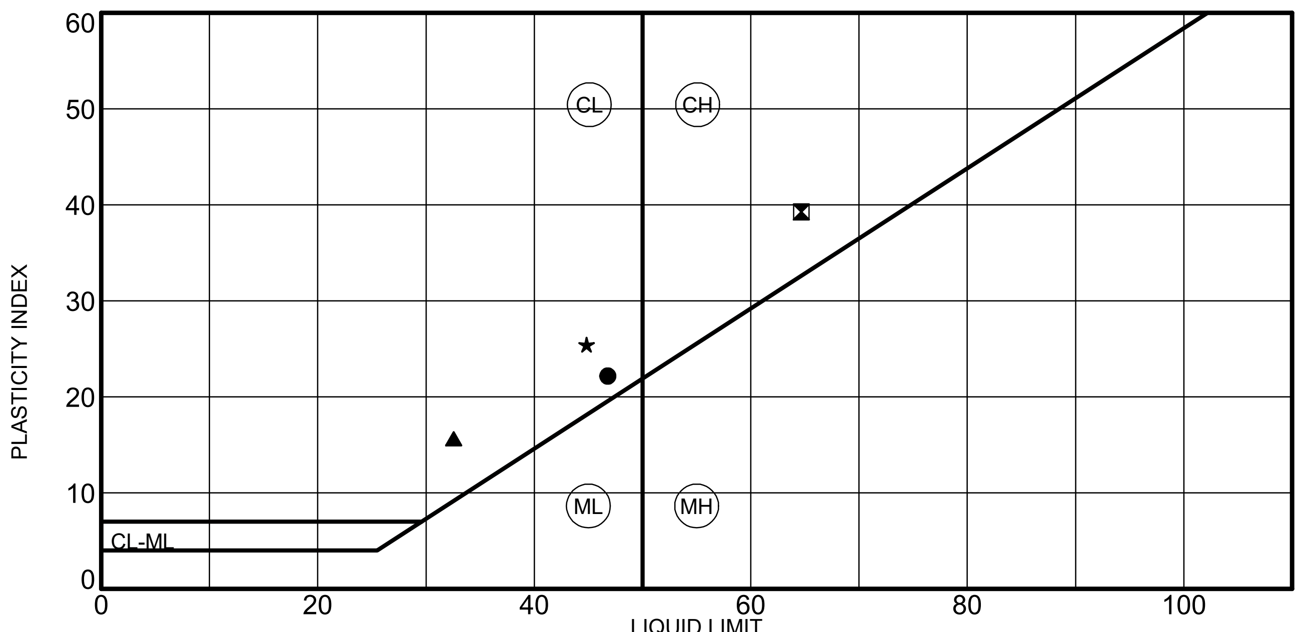
ATTERBERG LIMITS (ASTM D4318)

CLIENT: Garver USA
PROJECT NAME: Rough River Apron Reconstruction
PROJECT NUMBER 500-19-0006
PROJECT LOCATION: Falls of Rough, KY
Equipment Used: Liquid Limit Device, Oven, Ohaus 3kg Scale, Metal Tares, Mortar and Pestle, Spatula, Plastic Grooving Tool



	Specimen Identification	SAMPLE TYPE	LL	PL	PI	% Fines	Soil Description
●	B-1, 4'	ST	47	25	22	73	LEAN CLAY with SAND(CL)
⊠	B-4, 4'	SS	65	25	40	77	FAT CLAY with SAND(CH)
▲	B-6, 1.5'	SS	33	17	16	78	LEAN CLAY with SAND(CL)
★	Bulk 1,1'	B	45	19	26	66	SANDY LEAN CLAY(CL)

Abbreviations:
NP = Non-plastic
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
SS = Split Spoon
ST = Shelby Tube
G = Grab Sample
B = Bulk Sample

TESTED BY: Z. Shannon **TEST DATE:** 12/9/2019

REVIEWED BY: K. Andrus **DATE:** 12/10/2019

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STANDARD PROCTOR (ASTM D698)

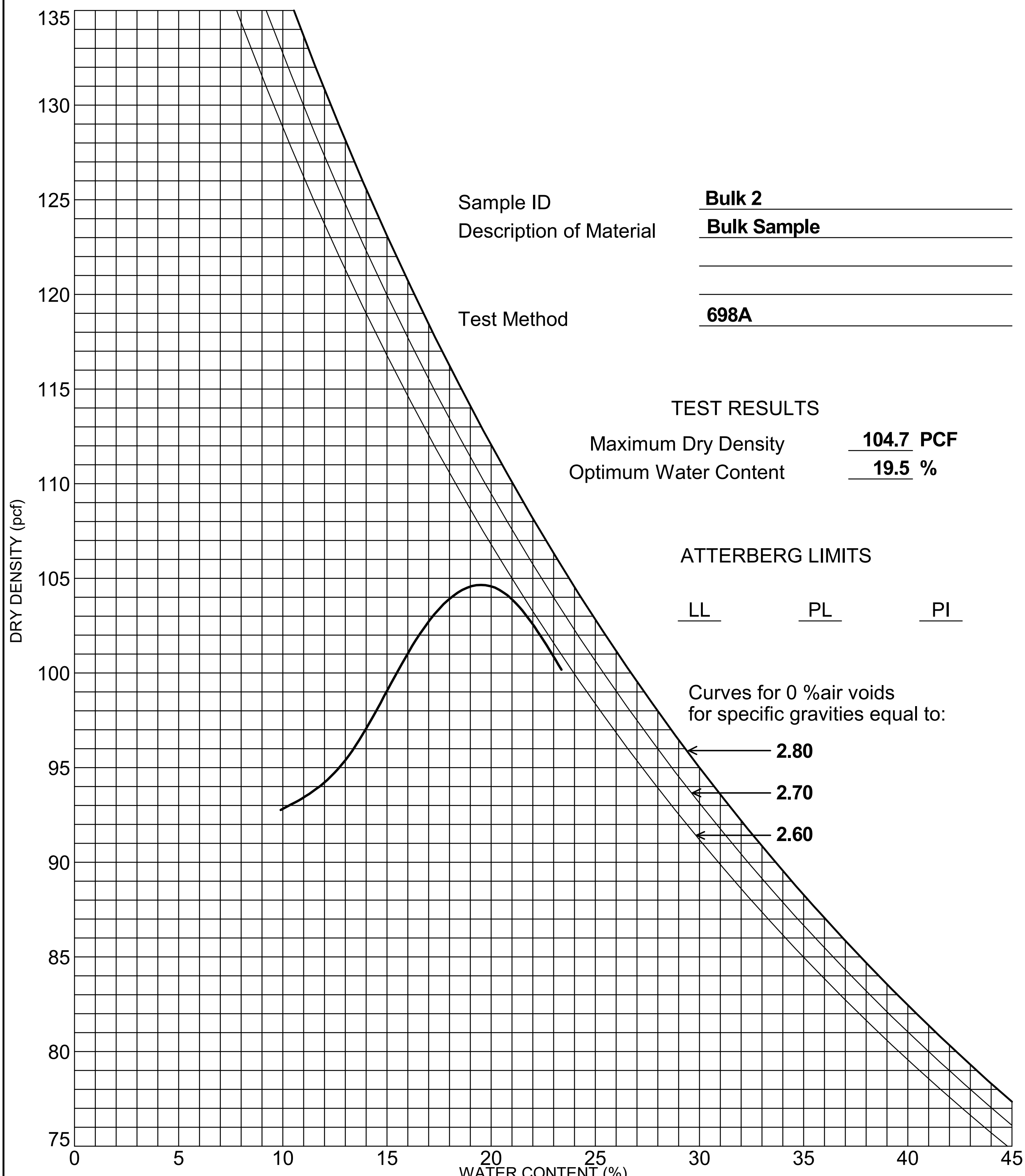
CLIENT: Garver USA

PROJECT NAME: Rough River Apron Reconstruction

PROJECT NUMBER 500-19-0006

PROJECT LOCATION: Falls of Rough, KY

EQUIPMENT USED: Standard Hammer, 4 inch Mold, Ohaus 3 kilogram Scale, Oven, Ohaus 8 kilogram Scale



Sample ID **Bulk 2**

Description of Material **Bulk Sample**

Test Method **698A**

TEST RESULTS

Maximum Dry Density **104.7 PCF**

Optimum Water Content **19.5 %**

ATTERBERG LIMITS

LL	PL	PI

TESTED BY: S. Krikorian
REVIEWED BY: K. Andrus

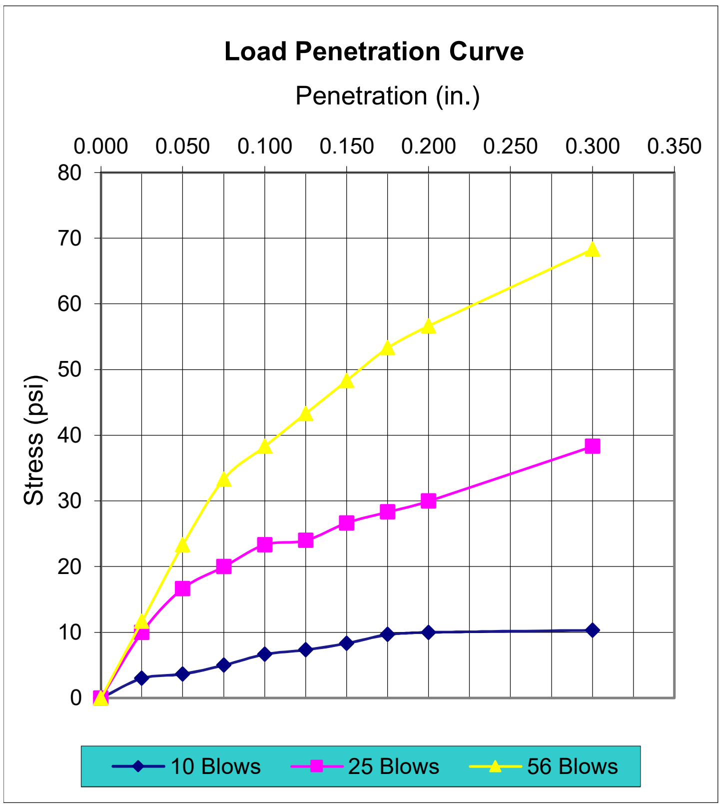
TEST DATE: 1/3/2020
DATE: 1/3/2020

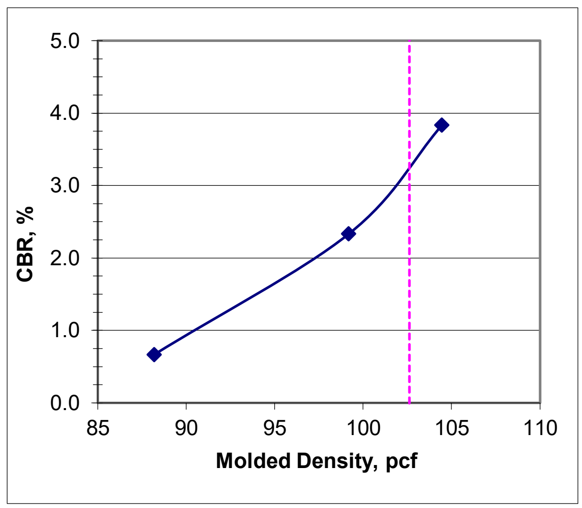
SAMPLE RECEIVED: 12/26/2019

Report of California Bearing Ratio Test (ASTM D1883)

Project Name:	Rough River Airport	Proctor Type:	Standard
Project Number:	500-19-0006	Maximum Dry Density:	104.7
Sample ID:	Bulk #2	Optimum Moisture:	19.5
Date Received:	12/6/2019		
Sample Description:			

Test	Pre-Test			Post-Test			CBR, %		Line	%
# Blows	DD	% Max	%m	DD	% Max	%m	0.1"	0.2"	Corr.	Swell
10	88.2	84.2	20.4	88.8	84.8	29.0	0.7	0.7	0	1.702
25	99.2	94.7	20.3	96.8	92.4	27.3	2.3	2.0	0	1.309
56	104.4	99.8	20.0	103.1	98.5	23.2	3.8	3.8	0	0.764





CBR* = 3.2

* for 98% max DD and
0.1 in. penetration

Submitted By:	Z. Shannon	Date:	1/13/2020
Reviewed By:		Date:	

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UNCONFINED COMPRESSIVE STRENGTH TEST COHESIVE SOIL (ASTM D2166)

CLIENT: Garver USA

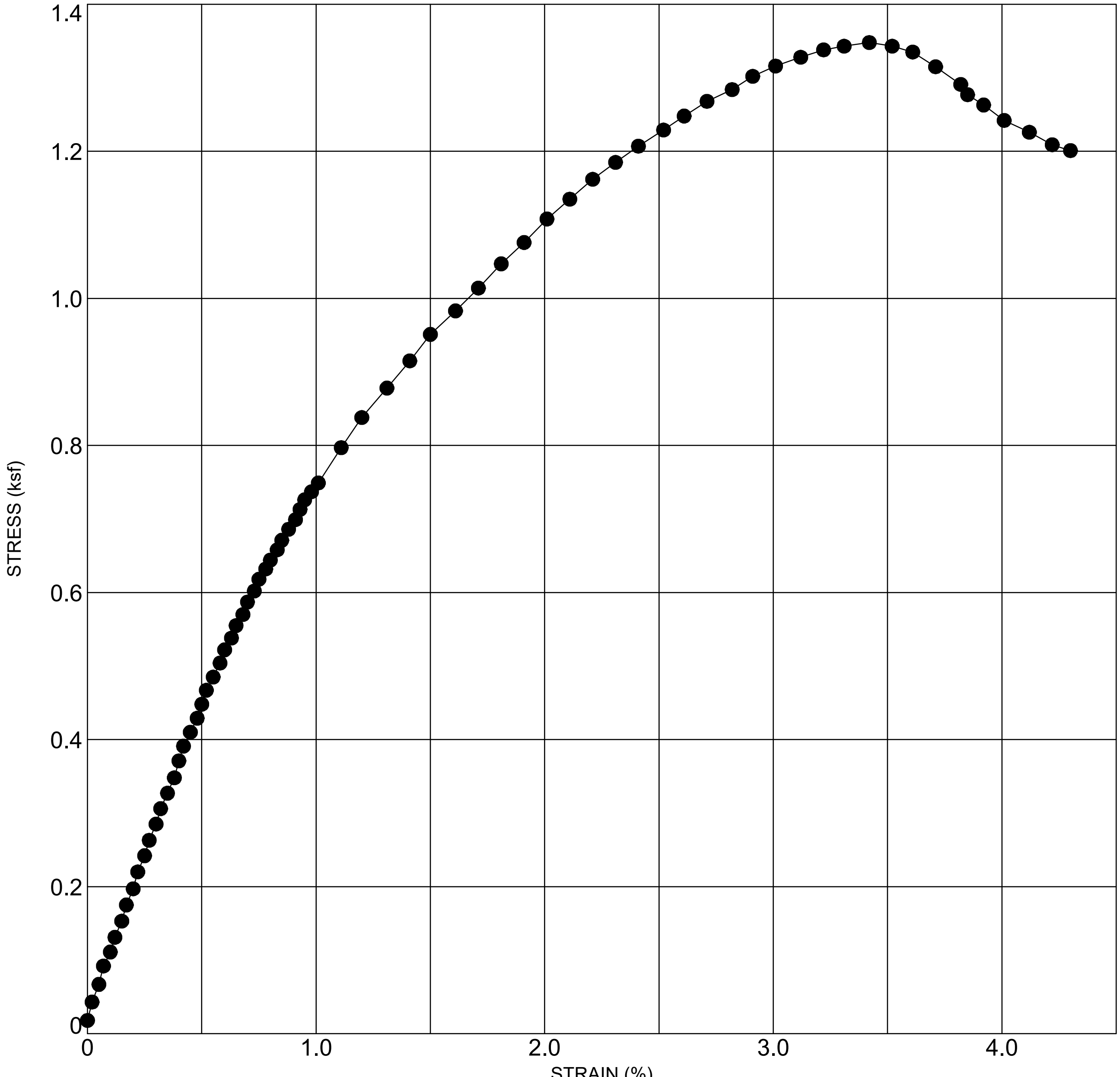
PROJECT NAME: Rough River Apron Reconstruction

PROJECT NUMBER 500-19-0006

PROJECT LOCATION: Falls of Rough, KY

SOIL DESCRIPTION: Lean Clay (CL) with Sand

SAMPLE RECEIVED: 12/2/2019



SAMPLE: B-1, 4 - 6 feet

Diameter (mm): 2.85

Strain at Failure (%): 3.42

Height (mm): 5.60

Strength (ksf): 1.35

Ratio (h/d): 1.96

Dry Density (pcf): 105.1

LL: 47

Water Content (%): 22.3

PL: 25

Rate of Strain to Failure (%): 15

TESTED BY: Z. Shannon

TEST DATE: 12/10/2019

REVIEWED BY:

APPROVED DATE:

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CLIENT: Garver USA

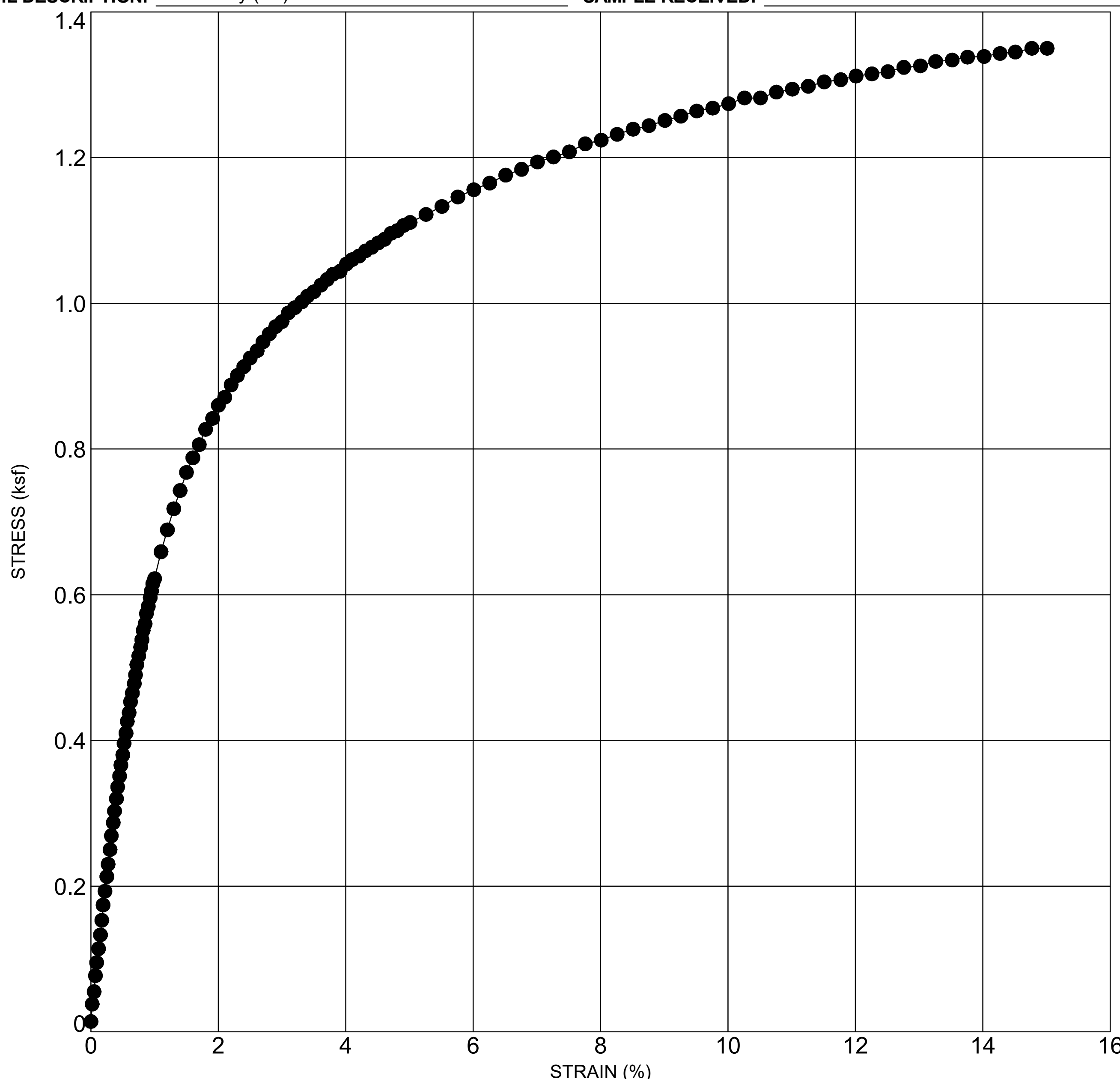
PROJECT NAME: Rough River Apron Reconstruction

PROJECT NUMBER 500-19-0006

PROJECT LOCATION: Falls of Rough, KY

SOIL DESCRIPTION: Lean Clay (CL)

SAMPLE RECEIVED: 12/2/2019



SAMPLE: B-3, 4 - 6 feet

Diameter (mm): 2.88

Height (mm): 5.56

Ratio (h/d): 1.93

LL:

PL:

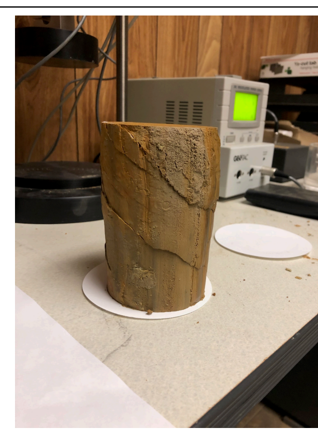
Strain at Failure (%): 14.77

Strength (ksf): 1.35

Dry Density (pcf): 98.5

Water Content (%): 25.6

Rate of Strain to Failure (%): 15



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TEST DATE: 12/10/2019

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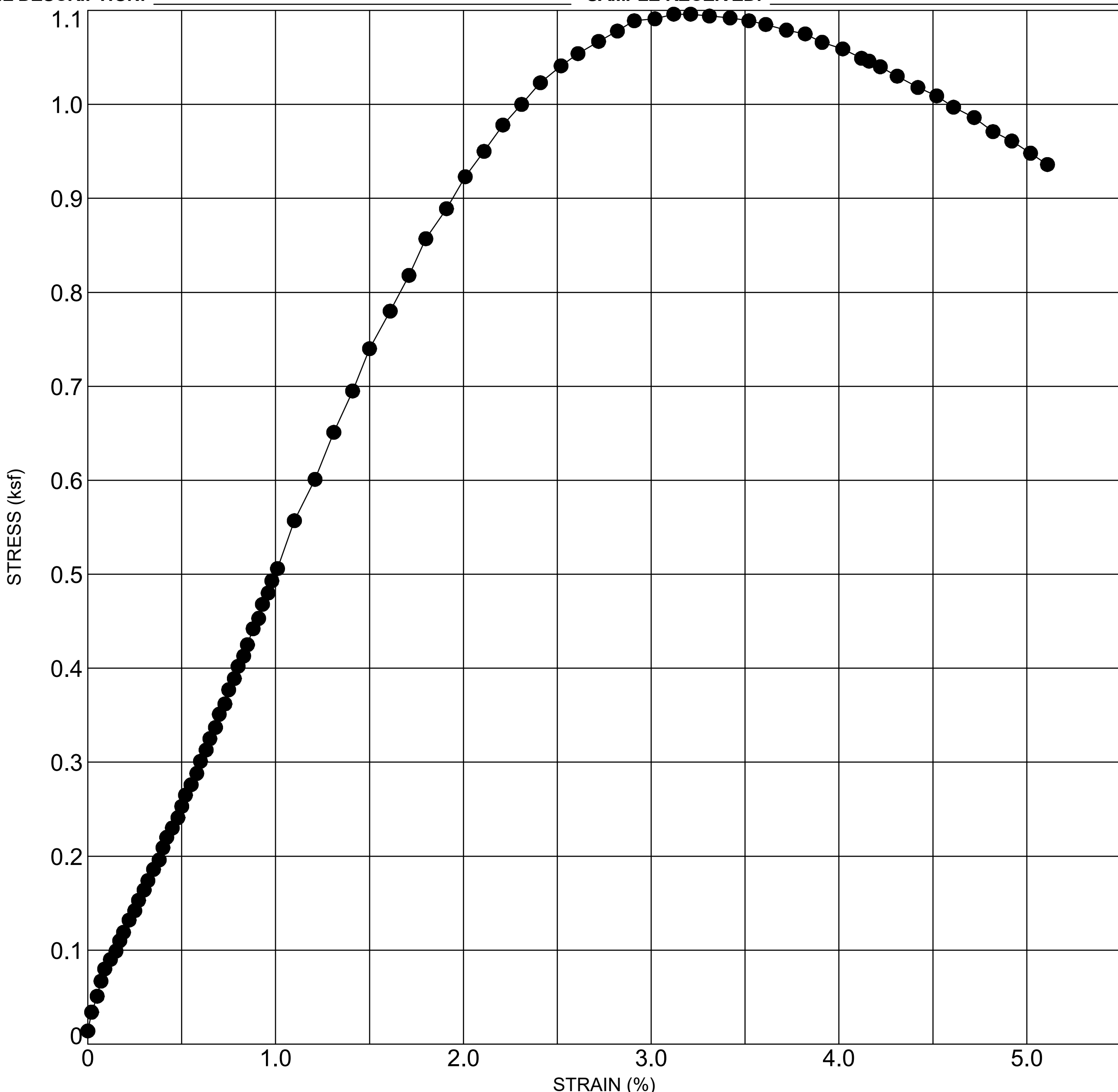
UNCONFINED COMPRESSIVE STRENGTH TEST COHESIVE SOIL (ASTM D2166)

CLIENT: Garver USA
PROJECT NAME: Rough River Apron Reconstruction
PROJECT NUMBER 500-19-0006
PROJECT LOCATION: Falls of Rough, KY
SOIL DESCRIPTION: Lean Clay (CL)
SAMPLE RECEIVED: 12/2/2019



SAMPLE: B-6, 4 - 6 feet

Diameter (mm): 2.88
Height (mm): 5.54
Ratio (h/d): 1.92
LL:
PL:

Strain at Failure (%): 3.12
Strength (ksf): 1.10
Dry Density (pcf): 100.3
Water Content (%): 23.9
Rate of Strain to Failure (%): 15

TESTED BY: Z. Shannon
REVIEWED BY:

TEST DATE: 12/10/2019
APPROVED DATE: