ARKANSAS DEPARTMENT OF TRANSPORTATION

SUBSURFACE INVESTIGATION

STATE JOB NO. 100995

FEDERAL AID PROJECT NO. BFP-NHPP-0016(80)

CACHE RIVER STR. & APPRS. (S. OF EGYPT) (S)

STATE HIGHWAY 91 **SECTION** 2

IN CRAIGHEAD **COUNTY**

The information contained herein was obtained by the Department for design and estimating purposes only. It is being furnished with the express understanding that said information does not constitute a part of the Proposal or Contract and represents only the best knowledge of the Department as to the location, character and depth of the materials encountered. The information is only included and made available so that bidders may have access to subsurface information obtained by the Department and is not intended to be a substitute for personal investigation, interpretation and judgment of the bidder. The bidder should be cognizant of the possibility that conditions affecting the cost and/or quantities of work to be performed may differ from those indicated herein.

ARKANSAS DEPARTMENT OF TRANSPORTATION
ArDOT.gov | IDriveArkansas.com | Scott E. Bennett, P.E., Director
MATERIALS DIVISION
11301 West Baseline Road | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2185 | Fax: 501.569.2368

October 28, 2019

TO: Mr. Trinity Smith, Engineer of Roadway Design

SUBJECT: Job No. 100995
Cache River Str. & Apprs. (S. of Egypt) (S)
Route 91 Section 2
Craighead County

Based on soil information from projects in the surrounding area, an estimated R-Value of less than five is appropriate for pavement design.

Listed below is the additional information requested for use in developing the plans:

Asphalt Concrete Hot Mix **Type**	**Asphalt Cement %**	**Mineral Aggregate %**
Surface Course	5.0	95.0
Binder Course	4.1	95.9
Base Course	3.9	96.1

Michael C. Benson
Materials Engineer

MCB:pt:bjj
Attachment
cc: State Constr. Eng. – Master File Copy
District 10 Engineer
System Information and Research Div.
G. C. File

Geotechnical Engineering Report

Job No. 100995, Cache River Structures and Approaches
Egypt, Arkansas

May 1, 2020
Terracon Project No. 35195198

Prepared for:
Michael Baker International, Inc.
Little Rock, Arkansas

Prepared by:
Terracon Consultants, Inc.
Little Rock, Arkansas

Terracon
GeoReport

May 1, 2020

Michael Baker International, Inc.
1400 West Markham, Suite 204
Little Rock, Arkansas 72201

Attn: Mr. Scott Thornsberry
P: (501) 244-1004
E: scott.thornsberry@mbakerintl.com

Re: Geotechnical Engineering Report
Job No. 100995, Cache River Structures and Approaches
Highway 91
Egypt, Arkansas
Terracon Project No. 35195198

Dear Mr. Thornsberry:

We have completed a subsurface exploration and Geotechnical Engineering evaluation for the referenced project. This study was performed in general accordance with Task Order Number 107, dated January 13, 2020. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning the proposed bridge replacement for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.
Certificate of Authorization #223 Expires 12/31/2021

Kimberly A Daggitt
Kimberly A. Daggitt, P.E.
Project Engineer

Christopher S. Handley, P.E.
Geotechnical Department Manager

Kole C. Berg
Kole C. Berg, P.E* (*licensed in IA, IL, KS, MO and WI)
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No. 16398
KIMBERLY A. DAGGITT

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Environmental ■ Facilities ■ Geotechnical ■ Materials

REPORT TOPICS

Note: This report was originally delivered in a web-based format. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report

Job No. 100995, Cache River Structures and Approaches
Highway 91
Egypt, Arkansas

Terracon Project No. 35195198
May 1, 2020

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering evaluation performed for the proposed Cache River Bridge Replacement to be located along Highway 91 near Egypt, Arkansas. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Foundation design and construction
- Lateral earth pressures
- Seismic site class per AASHTO

The geotechnical engineering Scope of Services for this project included the advancement of three bridge borings (designated B-1, B-2, and B-4) to depths ranging from approximately 100 to 120 feet below existing site grades and 4 roadway borings (designated R-1 through R-4) to depths of about 10 feet below existing site grades. An additional bridge boring (designated B-3) was proposed, but the planned boring location was inaccessible to the drill rig due to high water conditions. This boring will be performed during a drier period of the year and results of that boring will be released as an addendum to this report.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field investigation are included on the boring logs and/or as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field investigation and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	Bridge number 03258 on Highway 91 is being replaced near Egypt, Craighead County, Arkansas. See **Site Location**
Existing Improvements	Existing bridge over Cache River
Current Ground Cover	Existing bridge structure with asphalt pavement approaches and vegetated embankments
Existing Topography	We have assumed that the bridge replacement will be at or near the existing grade of the existing bridge. If large elevation changes are planned, please notify Terracon so that we can re-evaluate the recommendations as necessary.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Project Description	ArDOT is proposing to replace the existing bridge structure and approaches.
Bridge Construction	Based on an email received from Fred Harper on March 9, 2020 we understand that steel pipe piles are being considered for bridge foundation support.
Bridge Elevation	We understand that the new bridge alignment is planned to the west of the existing bridge alignment. We assume that the new bridge will be at or near the elevation of the existing bridge and roadway alignment. Terracon should be notified if any major changes are made to the planned bridge elevation that will affect the bridge replacement.
Maximum Loads	Maximum bridge loads were not provided at the time of the report. We must be notified if any uplift or lateral load resistance is required by design.
Pavements	Approach pavement borings were performed as part of the scope of work for this project. Recommendations for design resilient modulus were provided by a letter dated, April 9, 2020.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface investigation, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each investigation point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Upper Alluvial Soils**	Sands, silts, clays and mixtures of these soils associated with alluvial deposits
2	**Sand soils**	Loose to very dense sand soils containing varying amounts of clay.

The boreholes were observed for groundwater while drilling by dry auger. Groundwater was observed in Borings B-1 and B-2 at depths ranging from approximately 2 to 3½ feet below the existing surface while drilling by dry auger. Groundwater was not observed in boring B-4 while drilling with dry auger. Wash boring (mud rotary) procedures were initiated at a depth of about 10 feet and utilized to advance the bridge borings to the termination depths. This procedure utilizes water as a drilling fluid; therefore, groundwater readings taken after the introduction of water into the borehole are not representative of the groundwater conditions. No groundwater measurements were taken after the start of rock coring. The groundwater levels observed in the boreholes can be found on the boring logs in **Exploration Results.**

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structures may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

The Arkansas Department of Transportation is proposing a bridge replacement along Highway 91 over Cache River in Craighead County, Arkansas. The native soils encountered at the boring locations are associated with alluvial deposits. Silty sand, lean clay and fat clays were observed overlying sand soils containing varying amounts of clay at the bridge structure location. The results of our study indicate that the site can be developed for the proposed bridge replacement. During our study the following geotechnical conditions were identified:

- Low-strength soils
- Liquefaction potential
- Moisture-sensitive soils

The following discussion addresses these items and provides the basis for design recommendations present in the subsequent sections. Additional construction-related concepts are provided in the various **Construction Consideration** sections of this report.

Low-strength Soils

Low-strength (soils with SPT N-values of 5 blows per foot or lower) silty sand, lean clay and fat clay soils were observed in Borings B-1, B-2, and R-2 in some layers ranging from near the surface to up to about 30 feet below the existing ground surface. In their present condition, the low-strength soils are not suitable for providing direct support to shallow foundations associated with the bridge structure such as bridge abutments or wingwalls or pavements. These low-strength soils are expected to be compressible under new embankment fills. It is our understanding that the bridge abutments will be supported on steel pipe pile foundations. These low-strength alluvial soils would provide a low skin friction and lateral resistance, which were factored into the design parameters provided in the **Deep Foundation** section.

Liquefaction Potential

Bridge borings B-1 and B-2 contained loose to medium dense soils typically observed to a depth range of about 30 feet below the existing ground surface. These soils were sandy in nature and could be subject to liquefaction during seismic events. Liquefaction analyses were performed on the borings using the groundwater depths observed during the subsurface investigation. From the liquefaction analysis performed, soils to a depth of about 30 feet in Boring B-1 and soils to a depth of about 25 feet in Boring B-2 have the potential to liquefy. During an earthquake events, liquefaction of these soils would result in reductions in lateral resistance of pile foundations. We have taken the reduced resistance in these liquefiable layers into account in the recommended pile resistance curves presented in this report.

Moisture-Sensitive Soils

The lean clay soils that were observed at or near the ground surface at some of the boring locations are moisture-sensitive and prone to further strength loss with increased moisture content. These soils could become unstable with typical earthwork and construction traffic, especially after precipitation events; therefore, effective drainage should be completed early in the construction sequence and maintained during and after construction. If possible, the construction should be performed during warmer and drier times of the year. If construction is performed during the winter months, an increased risk for unstable subgrade conditions will occur.

Based on the subsurface conditions observed as well as the conversations with the client, we understand that driven pipe piles are being considered for the support of the bridge. The **Deep Foundations** section addresses the support of the bridge on driven pipe piles. The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork should be performed as required in the ArDOT Standard Specification for Highway Construction. The following recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project are considered general recommendations for earthwork on-site. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, and other geotechnical conditions during construction of the project. Terracon should be retained during the site preparation operations.

Site Preparation

We understand that deep foundations are being utilized for the support of the bridge. Because of this, we anticipate that preparation of the subgrade may not be necessary in the bridge foundation areas. Where site preparation and grading are necessary for the roadway and approach aprons to the bridge, surface vegetation, topsoil, pavements and any other surface and subsurface structures should be removed from the construction areas. Unstable subgrade conditions will likely develop during site clearing operations, particularly near the creek and if the soils are wet and/or subjected to repetitive construction traffic. Using low ground pressure (tracked or balloon tired) construction equipment would aid in reducing subgrade disturbance. Even with using low ground pressure equipment, difficult conditions should be expected if the ground surface is disturbed and wetted.

After stripping, completing grading operations, and prior to placing fill, the subgrade should be proof-rolled to aid in locating loose of soft areas. Proof-rolling can be performed with a loaded tandem axle dump truck. Where unstable soils are identified by proof-rolling, stabilization could include scarification, moisture-conditioning and compaction; or removal of unstable materials and replacement with aggregate. The appropriate method of improvement, if required, would depend on factors such as schedule, weather, the size of the area to be treated, and the nature of the instability. More detailed recommendations can be provided during construction. Construction during warm, dry periods would help reduce the amount of subgrade stabilization required.

Fill Material Types

Fil materials should be free of organic matter and debris. The upper on-site soils or approved imported borrow material may be used as fill material. Based on the limited lab testing performed, the existing fill material and native soils sampled on-site appear to be suitable for use as engineered fill. Though on-site soils appear suitable, we recommend thorough testing prior to reuse. Materials with plasticity indices greater than 20 should not be used within the upper 2 feet of the finished pavement subgrade.

While ArDOT has no specific requirement for borrow materials, they do require that the material be capable of forming and maintaining stable embankment when compacted. Therefore, we recommend specifically avoiding elastic silts (MH) and organic soils (OL, OH and PT) when considering materials for use as borrow.

We suggest that approved imported borrow soils meet the following material property requirements:

Sieve Size	Percent Finer by Weight (ASTM C136)
3 inches	100
No. 4	50-100
No. 200	15-50

- Plasticity Index……………………………………………………..20(max)

Fill Placement

Where fill is placed on existing slopes steeper than 4H:1V, benches should be cut into the existing slopes prior to fill placement. The benches should have a minimum vertical face height of 1 foot and a maximum vertical face height of 3 feet and should be cut wide enough to accommodate the compaction equipment. This benching will help provide a positive bond between the fill and natural soils and reduce the possibility of failure along the fill/natural soil interface. We recommend that fill slopes be filled beyond the planned final slope face and then cut back to develop an adequately compacted slope face.

Earthwork Construction Considerations

Unstable subgrade conditions are likely to develop during general construction operations, particularly where the soils are wetted and/or subjected to repetitive construction traffic. Unstable soils, where encountered, should be improved in-place prior to placing new engineered fill. If the in-place soils cannot be sufficiently improved, it may be necessary to strip and/or undercut the rutted and wet surface soils prior to performing subgrade improvement. Subgrade improvement techniques are discussed in detail in the following paragraphs.

The near-surface clay, sandy clay, and clayey sand soils observed at this site are moisture-sensitive and susceptible to disturbance from construction activity, particularly when the soil has a high natural moisture content or is wetted by surface water or seepage. During wetter periods of the year, these soils will pump and rut under the weight of heavy construction equipment, especially rubber-tired vehicles. The contractor should consider using track-mounted (low ground pressure) equipment to reduce subgrade disturbance and/or instability.

If unstable subgrade conditions are encountered, the methods described below can be considered to improve subgrade strength. Common methods include scarification, moisture conditioning and compaction, removal of unstable materials and replacement with granular fill (with or without geosynthetics), and chemical stabilization. The appropriate method of improvement, if required, depends on factors such as schedule, weather, the size of area to be stabilized, and the nature of the instability.

If the exposed subgrade becomes unstable, methods outlines below can be considered.

- **Scarification and Compaction –** It may be feasible to scarify, dry and compact the exposed soils. The success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Stable subgrades likely would not be achievable if the thickness of the unstable soil is greater than about 1 foot, if the unstable soil is at or near the groundwater levels, or if construction is performed during a period of wet or cool weather when drying is difficult.

- **Crushed Stone –** The use of crushed stone or crushed gravel is the most common procedure to improve subgrade stability. Typical undercut depths would be expected to range from about 6 to 30 inches below the finished subgrade elevation. The use of high modulus geosynthetics (i.e., geotextile or geogrid) can also be considered after underground work such as utility construction is completed. Prior to placing the geotextile or geogrid, we recommend that all below-grade construction, such as utility line installation, be completed to avoid damaging the geosynthetics. Equipment should not be operated above the geosynthetics until one full lift of crushed stone fill is placed above it. The maximum particle size of granular material placed over the geosynthetics should conform to the manufacturer's recommendations and generally should not exceed 1½ inches.

Further evaluation of the need for subgrade stabilization should be provided by a qualified geotechnical engineer during construction as the subgrade conditions are exposed on a broad scale.

Temporary excavations will probably be required during grading operations. As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming any responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proof-roll to require mitigation.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

DEEP FOUNDATIONS

Driven Pile Design Parameters

Soil parameters used to determine the nominal and factored resistances of driven steel pipe piles are shown below. The values were developed based on our interpolation of the generalized stratigraphy of the borings near the bridge abutments and our experience with the soils in the project area.

Boring B-1

Stratum	Approximate Depth to Bottom of Stratum	Material Description	Effective Unit Weight (pcf)	Undrained Shear Strength (psf)	Friction Angle (°)
1	2	Silty sand	110	--	26
2	8.5	Silty sand	50	--	26
3	18.5	Lean clay	55	750	--
4	28.5	Silty sand	50	--	26
5	43.5	Poorly graded sand with clay	55	--	30
6	58.5	Poorly graded sand with clay	60	--	32
7	68.5	Clayey sand	60	--	30
8	100	Poorly graded sand with clay	60	--	34

Boring B-2

Stratum	Approximate Depth to Bottom of Stratum	Material Description	Effective Unit Weight (pcf)	Undrained Shear Strength (psf)	Friction Angle (°)
1	2	Poorly graded sand with clay	110	--	26
2	13.5	Poorly graded sand with clay and silty sand	50	--	26
3	18.5	Fat clay with sand	55	750	--

Stratum	Approximate Depth to Bottom of Stratum	Material Description	Effective Unit Weight (pcf)	Undrained Shear Strength (psf)	Friction Angle (°)
4	28.5	Clayey sand	50	--	28
5	48.5	Clayey sand and poorly graded sand with clay	55	--	30
6	58.5	Poorly graded sand with clay	60	--	32
7	68.5	Poorly graded sand with clay	60	--	30
8	78.5	Clayey sand	60	--	32
9	88.5	Poorly graded sand with clay	60	--	30
10	98.5	Poorly graded sand with clay	60	--	32
11	108.5	Poorly graded sand with clay	60	--	30
12	120	Poorly graded sand with clay	60	--	34

Boring B-4

Stratum	Approximate Depth to Bottom of Stratum	Material Description	Effective Unit Weight (pcf)	Undrained Shear Strength (psf)	Friction Angle (°)
1	2	Sandy lean clay	115	1,000	--
2	5	Sandy lean clay	55	1,000	--
3	33.5	Clayey sand and Poorly graded sand with clay	55	--	28
4	48.5	Poorly graded sand with clay	55	--	32
5	88.5	Poorly graded sand with clay and clayey sand	55	--	30
6	100	Poorly graded sand with clay	55	--	32

Driven Pile Resistances

Based on the general profiles above, the driven pile axial resistances for a steel pipe with various diameters were determined at different depths. The graphical representations of the nominal pile resistances are attached to this report.

For the graphs:

- The nominal resistances are applicable if the center-to-center spacing of the piles is equal to or greater than 3 times the maximum pile section dimension.
- The factored resistance values are based on the nominal resistance multiplied by the structural resistance factor of 0.35 for clays and 0.45 for sands from Resistance Factors for Geotechnical Resistance of Driven Piles, φ [AASHTO 10.5.5.2.3-1]. The resistance factor can be increased if pile dynamic analysis or wave equation analyses are specified.
- Potentially liquefiable layers were identified during liquefaction analysis. To account for the effect of liquefaction, the skin resistance contribution of liquefiable layers was negated from the resistance calculations of the pile. Piles should not terminate in a potentially liquefiable layer of soil.
- The effects of lateral spreading and flow sliding were not analyzed as part of this report, if lateral spreading or flow sliding are a critical design element, Terracon should be contacted to analyze these effects on the pile resistance values.

Wall thickness for pipe piles should be selected in consideration of the design nominal resistance (or conversely, the maximum nominal resistance, or structural limit state, should be established for the selected pipe pile section). The critical event occurs during driving, and the pile stresses should be maintained less than $0.9F_y$ to reduce the potential for damage to the pile (F_y = yield strength of steel). The driving stress was often correlated to a maximum allowable design capacity of $0.25*F_y*A_{st}$ using ASD methods (where A_{st} = cross sectional steel area). For LRFD design methods, resistance factors for the strength limit state are provided in AASHTO Article 6.5.4.2 for pipe pile sections. The use of pile tips is not considered necessary at this site.

For piles designed and installed in accordance with the recommendations provided in this report, total settlements of about 1 inch or less are expected.

Driven Pile Downdrag Considerations

During a seismic event, settlement of liquefiable soil layers will apply additional loads to the piles. This is caused by adhesion between the pile and downward moving soil. The following tables can be used to develop resistances for piles during liquefaction events.

Boring B-1

From the liquefaction analyses performed, soils from about 3.5 to 28.5 feet in Boring B-1 were determined to be liquefiable during a seismic event. The following downdrag loads can be applied for resistance analysis during a seismic event.

Top Depth (ft)	Bottom Depth (ft)	Material Description	Undrained Shear Strength (psf)	Friction Angle (°)	Nominal Downdrag Load (psf)
0	8.5	Silty sand	0	26	-250
8.5	18.5	Sandy lean clay	750	0	-400
18.5	28.5	Silty sand	0	26	-250
28.5	43.5	Silty sand	0	30	Below liquefiable layers
43.5	58.5	Poorly graded sand with clay	0	32	
58.5	68.5	Poorly graded sand with clay	0	30	
68.5	100	Clayey sand and poorly graded sand with clay	0	34	

Boring B-2

From the liquefaction analyses performed, soils from the surface to 25 feet in Boring B-2 were determined to be liquefiable during a seismic event. The following downdrag loads can be applied for resistance analysis during a seismic event.

Top Depth (ft)	Bottom Depth (ft)	Material Description	Undrained Shear Strength (psf)	Friction Angle (°)	Nominal Downdrag Load (psf)
0	2	Poorly graded sand with clay	0	26	-250
2	13.5	Poorly graded sand with clay	0	26	-250
13.5	18.5	Fat clay with sand	750	0	-400
18.5	25	Clayey sand	0	28	-250

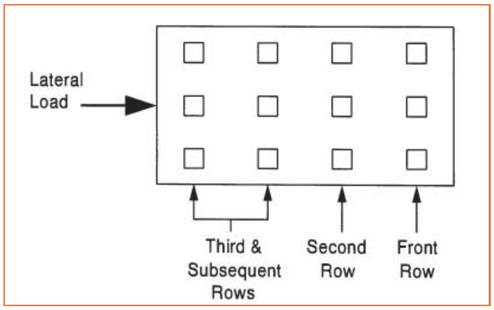
Top Depth (ft)	Bottom Depth (ft)	Material Description	Undrained Shear Strength (psf)	Friction Angle (°)	Nominal Downdrag Load (psf)
25	48.5	Clayey sand and poorly graded sand with clay	0	30	Below liquefiable layers
48.5	58.5	Poorly graded sand with clay	0	32	
58.5	68.5	Poorly graded sand with clay	0	30	
68.5	78.5	Clayey sand	0	32	
78.5	88.5	Poorly graded sand with clay	0	30	
88.5	98.5	Poorly graded sand with clay	0	32	
98.5	108.5	Poorly graded sand with clay	0	30	
108.5	120	Poorly graded sand with clay	0	34	

Driven Pile Lateral Resistance

The strength parameters listed in the Soil Strength Parameters section can be used as input values for use in LPILE analyses. LPILE will estimate values of k_h and E_{50} based on the provided strength values. Effective unit soil weights should be used for input assuming a maximum groundwater level similar to flood stage elevation.

When piles are used in groups, the lateral resistances of the piles in the second, third, and subsequent rows of the group should be reduced as compared to the capacity of a single, independent pile. Guidance for applying p-multiplier factors to the p values in the p-y curves for each row of pile foundations within a pile group are as follows:

- Front row: $P_m = 0.8$;
- Second row: $P_m = 0.4$
- Third and subsequent row: $P_m = 0.3$.



The load resistances provided herein are based on the stresses induced in the supporting soil strata. The structural capacity of the piles should be checked to assure that they can safely accommodate the combined stresses induced by axial and lateral forces. Lateral deflections of piles should be evaluated using an appropriate analysis method, and will depend upon the pile's diameter, length, configuration, stiffness and "fixed head" or "free head" condition. We can provide additional analyses and estimates of lateral deflections for specific loading conditions upon request. The load-carrying capacity of piles may be improved by increasing the diameter of pipe piles.

Driven Pile Construction Considerations

The contractor should select a driving hammer and cushion combination which can install the selected piling without overstressing the pile material. The hammer should have a rated energy in foot-pounds at least equal to 15 percent of the design compressive load capacity in pounds. The contractor should submit the pile driving plan and the pile hammer-cushion combination to the engineer for evaluation of the driving stresses in advance of pile installation. During driving, a maximum of 10 blows per inch is recommended to reduce the potential of damage to the piles.

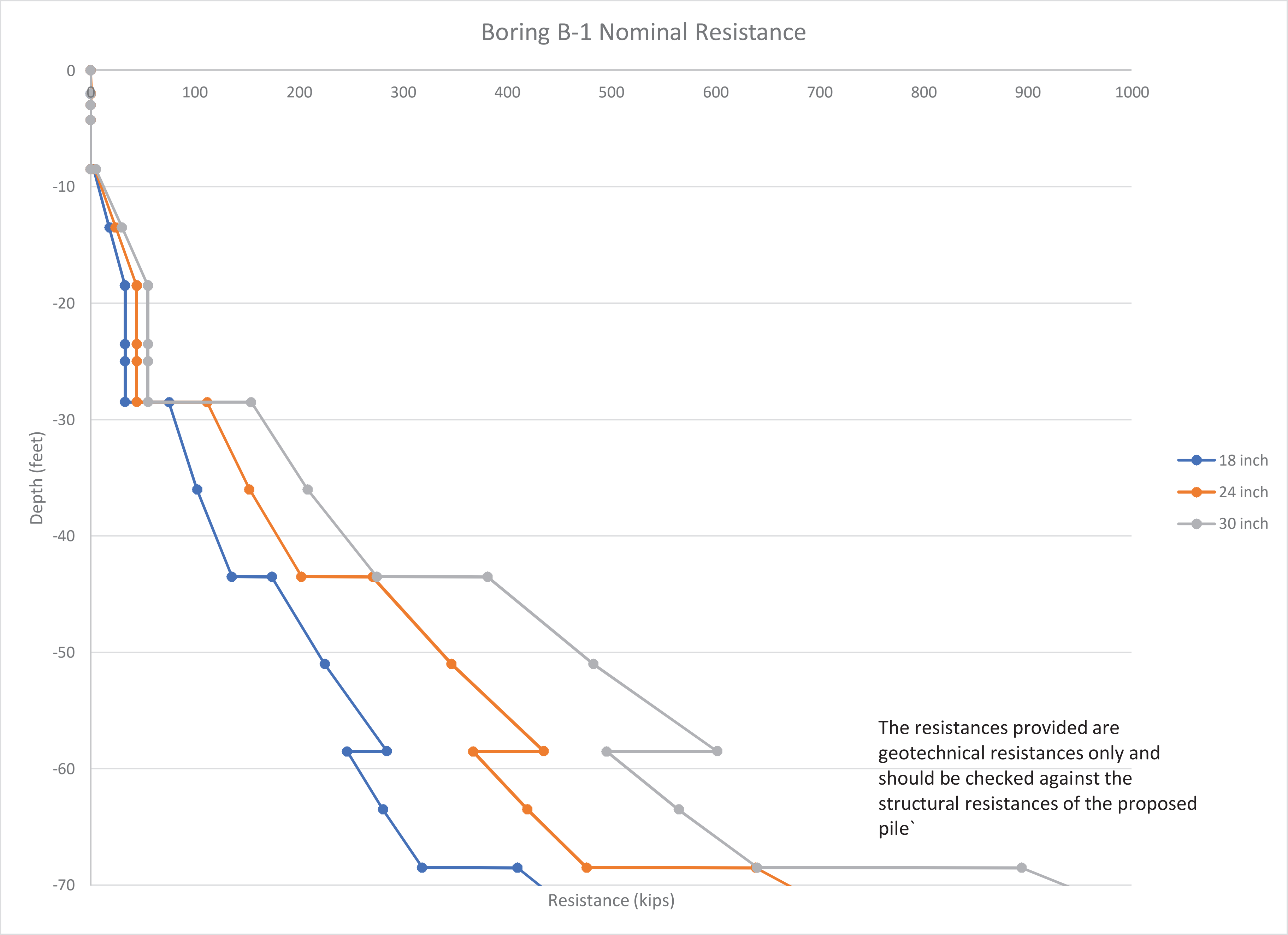
Pile driving conditions, hammer efficiency, and stress on the pile during driving could be better evaluated during installation using a Pile Driving Analyzer (PDA). A Terracon representative should observe pile driving operations. Each pile should be observed and checked for buckling, crimping and alignment in addition to recording penetration resistance, depth of embedment, and general pile driving operations.

The pile driving process should be observed by the Geotechnical Engineer or approved technician. Terracon should document the pile installation process including soil and groundwater conditions encountered, consistency with expected conditions, and details of the installed pile.

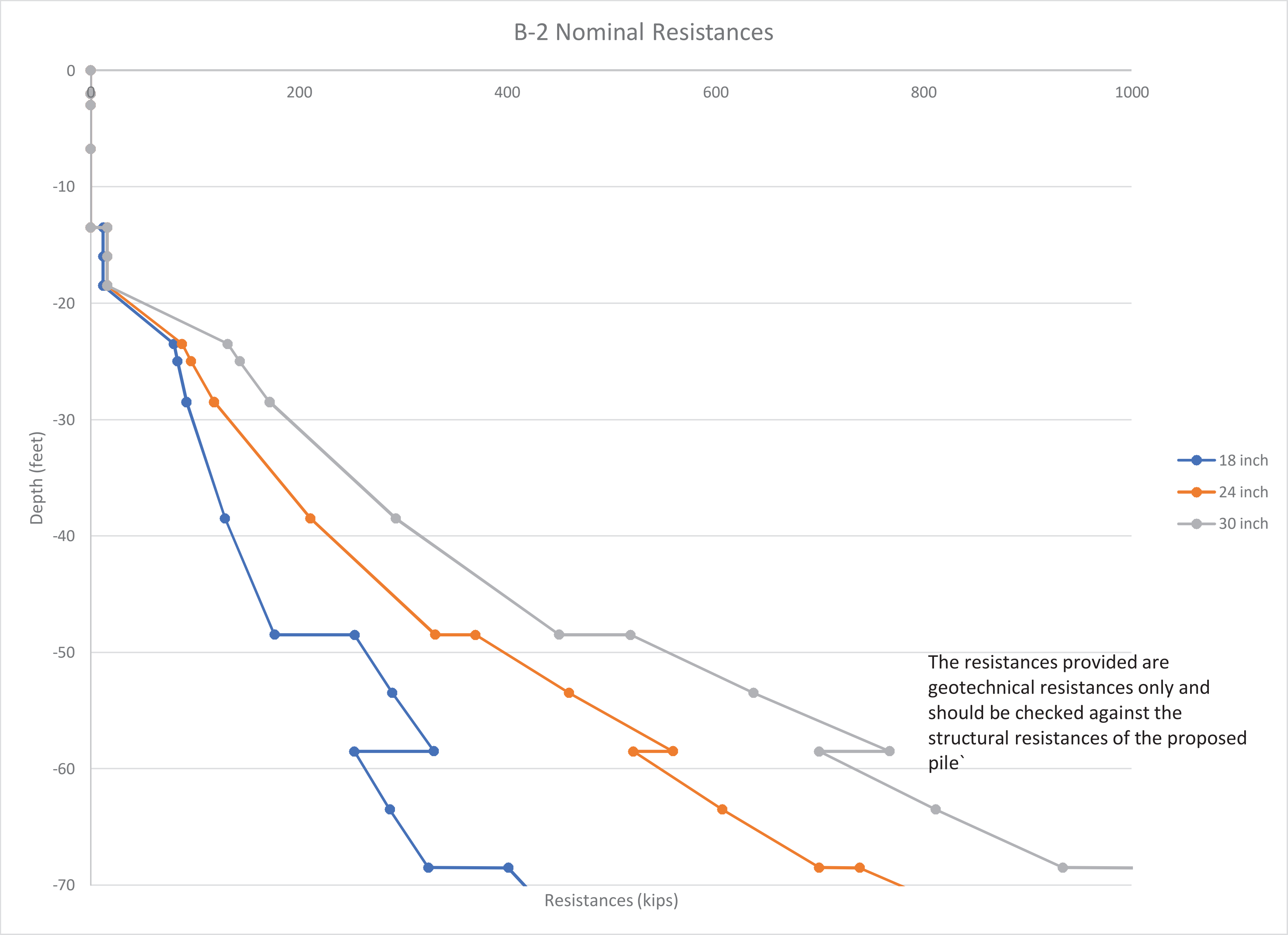
Excavations for pile caps should be observed by the Geotechnical Engineer or approved technician. The base of all excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

SEISMIC CONSIDERATIONS

The Site Class is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with AASHTO 2017. Based on the soil properties encountered at the site and as described on the investigation logs and results, it is our professional opinion that the **Seismic Site Class is E**. The borings at this site extended to a maximum depth of 120 feet. Geophysical testing may be performed to confirm the conditions.



The resistances provided are geotechnical resistances only and should be checked against the structural resistances of the proposed pile`



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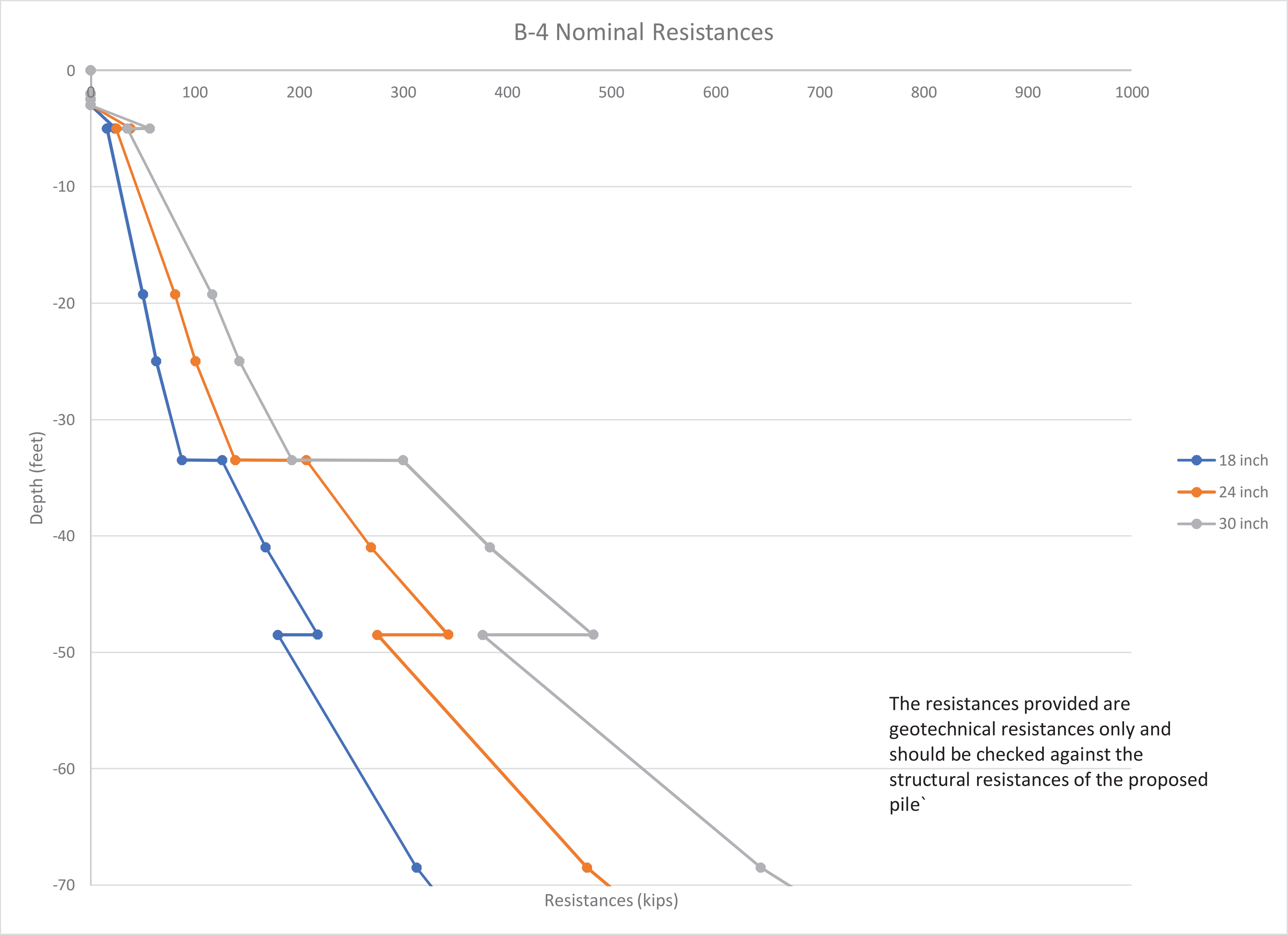


The resistances provided are geotechnical resistances only and should be checked against the structural resistances of the proposed pile`

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site investigation. Natural variations will occur between investigation point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, cost estimating, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

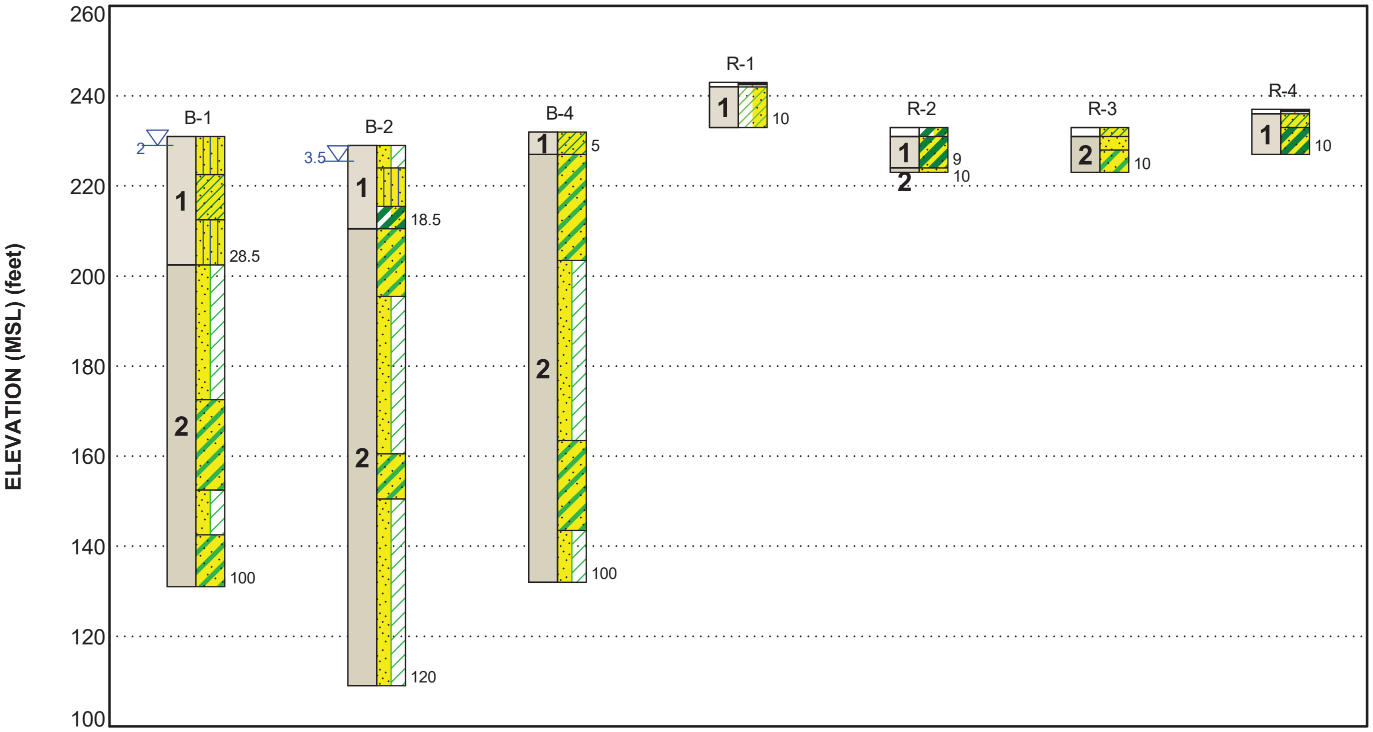
FIGURES

Contents:

GEOMODEL

ArDOT Job. 100995 Cache River Bridge ■ Egypt, Arkansas
Terracon Project No. 35195198

Terracon GeoReport



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Upper Alluvial Soils**	Sands, silts, clays and mixtures of these soils associated with alluvial deposits
2	**Sand soils**	Loose to very dense sand soils containing varying amounts of clay

LEGEND

▥ Silty Sand	▨ Clayey Sand	▢ Aggregate Base Course	▩ Poorly-graded Sand
▨ Sandy Lean Clay	▨ Fat Clay with Sand	▧ Lean Clay with Sand	
▧ Poorly-graded Sand with Clay	■ Asphalt	▨ Sandy Fat Clay	

▽ First Water Observation

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

ATTACHMENTS

INVESTIGATION AND TESTING PROCEDURES

Field Investigation

Number of Borings	Boring Depth (feet)	Location
3 (B-1, B-2, and B-4) [1]	100 to 120	Bridge borings
4 (R-1 through R-4)	10	Roadway borings

1. Boring B-3 was not accessible to our drill rig due to high water at the time of the exploration.

Boring Layout and Elevations: The locations of the field investigation (borings) were measured in the field by Terracon's investigation team using a hand-held GPS unit to measure the latitude and longitude coordinates. The accuracy of the investigation points is usually within about +/- 20 feet horizontally of the noted location.

Subsurface Exploration Procedures: We advanced the borings with a track-mounted, rotary drill rig using continuous flight augers and mud-rotary procedures. Samples were obtained using split barrel and thin-walled tube sampling procedures. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. We observed and recorded groundwater levels during dry drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion. Pavements were patched with cold-mix asphalt and/or pre-mixed concrete, as appropriate.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

Representative soil samples were tested in the laboratory to measure their natural water content, gradation and Atterberg limits. The test results are provided on the appended boring logs and laboratory test reports.

The soil samples were classified in the laboratory based on visual observation, texture, plasticity, and the laboratory testing described above. The soil descriptions presented on the boring logs are in accordance with the enclosed General Notes and Unified Soil Classification System (USCS). The estimated USCS group symbols for native soils are shown on the boring logs, and a brief description of the USCS is included in this report.

SITE LOCATION AND INVESTIGATION PLANS

Contents:

Note: All attachments are one page unless noted above.

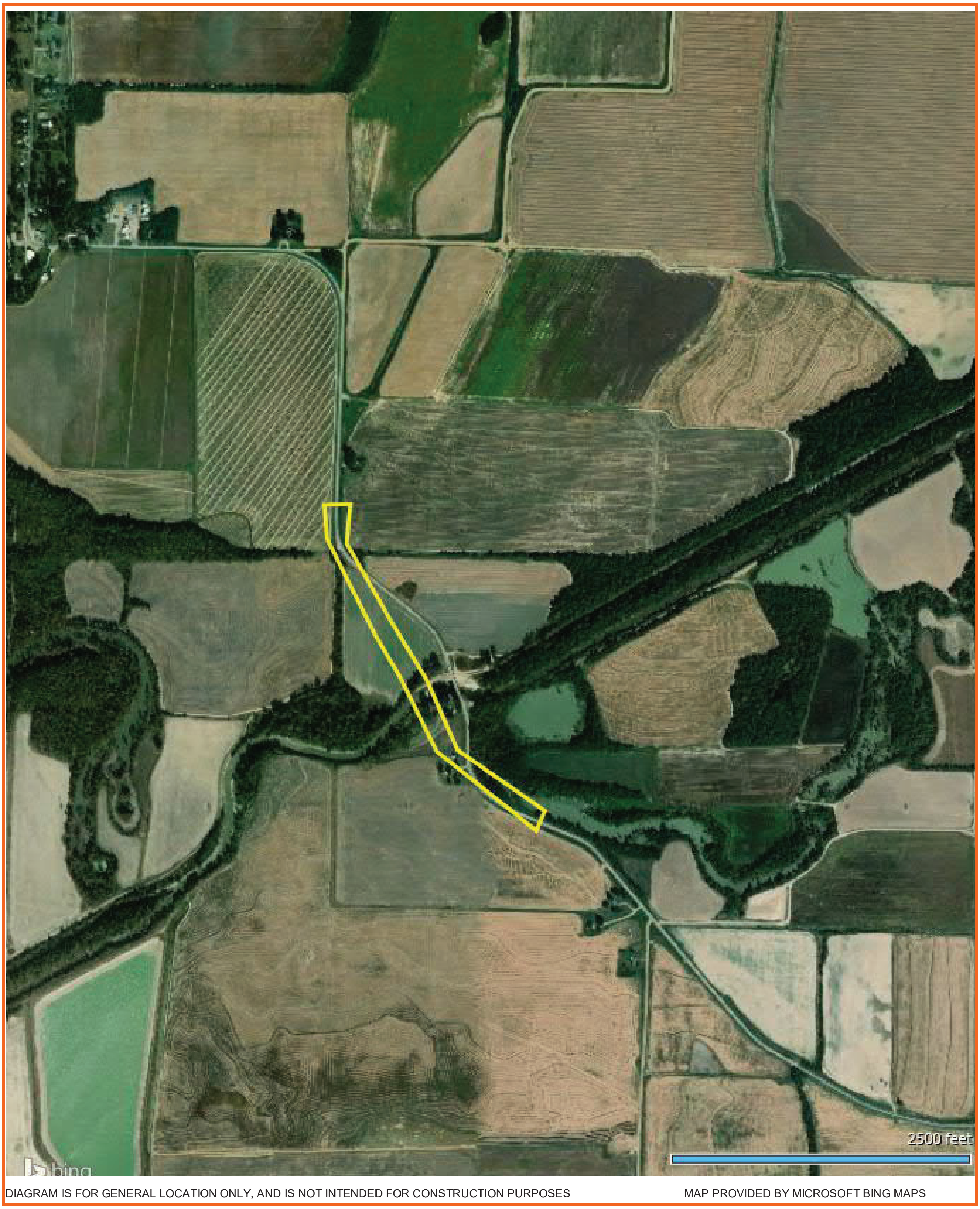


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN – Roadway Borings

ArDOT Job. 100995 Cache River Bridge ■ Egypt, Arkansas
April 29, 2020 ■ Terracon Project No. 35195198

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS
NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED
BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Boring Logs (B-1 through R-4)

Note: All attachments are one page unless noted above.

BORING LOG NO. B-1

Page 1 of 4

PROJECT: ArDOT Job. 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.8574° Longitude: -90.9339°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		**SILTY SAND (SM)**, fine grained, brown and gray, very loose to medium dense		▽	☒	4-2-2 N=4				34			
					☒	2-6-7 N=13				22		NP	14
					☒	5-4-2 N=6				21			
			5		☒	0-0-0 N=0				22			
		8.5											
		SANDY LEAN CLAY (CL), gray, medium stiff to stiff	10		☒	0-3-3 N=6				26		24-15-9	54
			15		☒	3-3-5 N=8				24			
		18.5											
		SILTY SAND (SM), fine grained, gray, loose	20		☒	3-2-2 N=4				25		NP	24
			25		☒	3-2-3 N=5				29			
		28.5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 100 feet: Mud rotary

Abandonment Method:
Boring backfilled with auger cuttings

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *2 feet while drilling*

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-04-2020	Boring Completed: 03-04-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. B-1

PROJECT: ArDOT Job. 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.8574° Longitude: -90.9339°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2	▨	**POORLY GRADED SAND WITH CLAY (SP-SC)**, fine grained, gray, medium dense to dense	30		☒	6-7-9 N=16				19			6
			35		☒	8-11-14 N=25				19			
			40		☒	12-12-17 N=29				18			
			45		☒	9-18-24 N=42				20			
			50		☒	11-15-27 N=42				20			
			55										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 100 feet: Mud rotary

Abandonment Method:
Boring backfilled with auger cuttings

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *2 feet while drilling*

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-04-2020	Boring Completed: 03-04-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. B-1

PROJECT: ArDOT Job. 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.8574° Longitude: -90.9339°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2		**POORLY GRADED SAND WITH CLAY (SP-SC)**, fine grained, gray, medium dense to dense *(continued)*											
		58.5 **CLAYEY SAND (SC)**, fine grained, gray, medium dense to dense	60		☒	10-11-12 N=23				25			14
			65										
			70		☒	18-22-24 N=46				21			
			75										
		78.5 **POORLY GRADED SAND WITH CLAY (SP-SC)**, fine grained, gray, dense	80		☒	15-21-26 N=47				21			7
			85										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 100 feet: Mud rotary

Abandonment Method:
Boring backfilled with auger cuttings

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *2 feet while drilling*

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-04-2020	Boring Completed: 03-04-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. B-1

PROJECT: ArDOT Job. 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 35.8574° Longitude: -90.9339° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2	▨	**POORLY GRADED SAND WITH CLAY (SP-SC)**, fine grained, gray, dense *(continued)* 88.5											
	▨	**CLAYEY SAND (SC)**, trace gravel, fine grained, gray, dense to very dense	90		☒	19-26-37 N=63				17			13
			95										
		100.0			☒	22-20-14 N=34				15			
		Boring Terminated at 100 Feet	100										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 100 feet: Mud rotary

Abandonment Method:
Boring backfilled with auger cuttings

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *2 feet while drilling*

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-04-2020

Boring Completed: 03-04-2020

Drill Rig: CME 763

Driller: ME

Project No.: 35195198

BORING LOG NO. B-2

PROJECT: **ArDOT Job. 100995 Cache River Bridge**

CLIENT: **Michael Baker International LLC**
Little Rock, Arkansas

SITE: **Kings Highway**
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.8575° Longitude: -90.9339°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1	▨	**POORLY GRADED SAND WITH CLAY (SP-SC)**, fine grained, brown, very loose			☒	2-1-2 N=3				9			9
	▨			▽	☒	1-2-1 N=3				10			
	▨	5.0			☒	2-1-2 N=3				19			
	▨	**SILTY SAND (SM)**, fine grained, brown, loose	5		☒	5-5-4 N=9				20		NP	16
	▨	13.5	10		☒	3-2-2 N=4				22			
	▨	**FAT CLAY WITH SAND (CH)**, gray, medium stiff 18.5	15		☒	0-0-7 N=7				32		51-13-38	77
2	▨	**CLAYEY SAND (SC)**, fine grained, gray, loose to medium dense	20		☒	4-3-2 N=5				27			
	▨		25		☒	5-8-11 N=19						NP	18

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 100 feet: Mud rotary

Abandonment Method:
Boring backfilled with auger cuttings

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *3.5 feet while drilling*

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-03-2020	Boring Completed: 03-03-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. B-2

PROJECT: **ArDOT Job. 100995 Cache River Bridge**

CLIENT: **Michael Baker International LLC**
Little Rock, Arkansas

SITE: **Kings Highway**
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.8575° Longitude: -90.9339°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		CLAYEY SAND (SC), fine grained, gray, loose to medium dense *(continued)*	30		☒	8-12-14 N=26				16			
		33.5											
2		**POORLY GRADED SAND WITH CLAY (SP-SC)**, fine grained, gray, medium dense to dense	35		☒	10-11-11 N=22				15			5
			40		☒	9-12-18 N=30				17			
			45		☒	16-15-13 N=28				23			11
			50		☒	18-23-23 N=46				24			
			55										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 100 feet: Mud rotary

Abandonment Method:
Boring backfilled with auger cuttings

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *3.5 feet while drilling*

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-03-2020	Boring Completed: 03-03-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. B-2

PROJECT: ArDOT Job. 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.8575° Longitude: -90.9339°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2		**POORLY GRADED SAND WITH CLAY (SP-SC)**, fine grained, gray, medium dense to dense *(continued)*	60 65		☒	11-14-15 N=29				26			
		68.5 **CLAYEY SAND (SC)**, fine grained, gray, dense	70 75		☒	16-24-23 N=47				21			18
		78.5 **POORLY GRADED SAND WITH CLAY (SP-SC)**	80 85		☒	15-12-12 N=24				17			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 100 feet: Mud rotary

Abandonment Method:
Boring backfilled with auger cuttings

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *3.5 feet while drilling*

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-03-2020
Boring Completed: 03-03-2020
Drill Rig: CME 763
Driller: ME
Project No.: 35195198

BORING LOG NO. B-2

PROJECT: ArDOT Job. 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 35.8575° Longitude: -90.9339° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
							TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)			LL-PL-PI	
2		**POORLY GRADED SAND WITH CLAY (SP-SC)** *(continued)*											
			90		☒	18-19-24 N=43				25			9
			95										
			100		☒	13-13-12 N=25				17			
			105										
			110		☒	29-36-49 N=85				17			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 100 feet: Mud rotary

Abandonment Method:
Boring backfilled with auger cuttings

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *3.5 feet while drilling*

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-03-2020	Boring Completed: 03-03-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. B-2

PROJECT: **ArDOT Job. 100995 Cache River Bridge**

CLIENT: **Michael Baker International LLC**
Little Rock, Arkansas

SITE: **Kings Highway**
Egypt, Arkansas

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 35.8575° Longitude: -90.9339° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
							TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)			LL-PL-PI	
2	▨	**POORLY GRADED SAND WITH CLAY (SP-SC)** *(continued)*	115										
		120.0	120		☒	14-12-12 N=24							
		Boring Terminated at 120 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 100 feet: Mud rotary

Abandonment Method:
Boring backfilled with auger cuttings

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *3.5 feet while drilling*

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-03-2020	Boring Completed: 03-03-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. B-4

Page 1 of 4

PROJECT: ArDOT Job. 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.858° Longitude: -90.9345°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1	▨	**SANDY LEAN CLAY (CL)**, brown and gray, stiff to hard			☒	0-5-4 N=9				23			
					☒	8-11-16 N=27				20		43-15-28	68
		5.0			☒	20-17-15 N=32				23			
2	▨	**CLAYEY SAND (SC)**, fine grained, brown and gray, medium dense	5		☒	5-7-6 N=13				21			
					☒	5-5-5 N=10				15			39
			10										
					☒	5-8-12 N=20				12			
			15										
					☒	9-11-11 N=22				16			14
			20										
					☒	5-6-10 N=16				21			
			25										
		28.5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 5 feet: Hollow-stem auger
5 to 100 feet: Mud rotary

Abandonment Method:
Boring backfilled with auger cuttings

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-04-2020	Boring Completed: 03-04-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. B-4

PROJECT: ArDOT Job. 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 35.858° Longitude: -90.9345° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2		**POORLY GRADED SAND WITH CLAY (SP-SC)**, fine grained, brown and gray, medium dense to very dense	30		☒	10-8-11 N=19				19			6
			35		☒	12-14-22 N=36				19			
			40		☒	14-20-22 N=42				19			8
			45		☒	17-23-29 N=52				18			
			50		☒	10-10-11 N=21				23			7
			55										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 5 feet: Hollow-stem auger
5 to 100 feet: Mud rotary

Abandonment Method:
Boring backfilled with auger cuttings

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-04-2020	Boring Completed: 03-04-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. B-4

PROJECT: ArDOT Job. 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.858° Longitude: -90.9345°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2	▨	**POORLY GRADED SAND WITH CLAY (SP-SC)**, fine grained, brown and gray, medium dense to very dense *(continued)*			☒	7-7-14 N=21				27			
			60										
			65										
	▨	68.5 **CLAYEY SAND (SC)**, fine grained, brown and gray, medium dense			☒	9-10-11 N=21				33			22
			70										
			75										
					☒	7-10-12 N=22				26			
			80										
			85										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 5 feet: Hollow-stem auger
5 to 100 feet: Mud rotary

Abandonment Method:
Boring backfilled with auger cuttings

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-04-2020	Boring Completed: 03-04-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. B-4

PROJECT: ArDOT Job. 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.858° Longitude: -90.9345°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2		**CLAYEY SAND (SC)**, fine grained, brown and gray, medium dense *(continued)* 88.5											
		POORLY GRADED SAND WITH CLAY (SP-SC), fine grained, brown and gray, dense	90		☒	20-17-17 N=34				23			7
			95										
		100.0	100		☒	17-15-16 N=31				18			
		Boring Terminated at 100 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 5 feet: Hollow-stem auger
5 to 100 feet: Mud rotary

Abandonment Method:
Boring backfilled with auger cuttings

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-04-2020	Boring Completed: 03-04-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. R-1

PROJECT: **ArDOT Job. 100995 Cache River Bridge**

CLIENT: **Michael Baker International LLC**
Little Rock, Arkansas

SITE: **Kings Highway**
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.8548° Longitude: -90.9309°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.5 **ASPHALT CONCRETE - 6 inches**											
		1.0 **AGGREGATE BASE COURSE - 6 inches**											
1		**LEAN CLAY WITH SAND (CL)**, with sand seams, gray and brown, stiff to very stiff			☒	4-4-4 N=8				19		42-12-30	83
					☒	3-4-4 N=8				20			
			5		☒	4-5-8 N=13				18			
		10.0	10		☒	4-8-13 N=21				22			
		Boring Terminated at 10 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow stem auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-05-2020	Boring Completed: 03-05-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. R-2

PROJECT: ArDOT Job. 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.8564° Longitude: -90.9334°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	▨	**FAT CLAY WITH SAND (CH)**, brown and gray, soft 2.0			☒	2-1-2 N=3						NP	
1	▨	**SANDY FAT CLAY (CH)**, gray, stiff to very stiff			☒	4-4-5 N=9				23			
					☒	12-13-15 N=28				22			
			5		☒	9-12-15 N=27				20			75
		9.0											
2	▨	**POORLY GRADED SAND (SP)**, fine grained, gray, medium dense 10.0	10		☒	4-6-9 N=15				20			
		Boring Terminated at 10 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow stem auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-05-2020	Boring Completed: 03-05-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. R-3

Page 1 of 1

PROJECT: ArDOT Job. 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.8591° Longitude: -90.9352°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	▨	**SANDY LEAN CLAY (CL)**, brown, stiff 2.0			☒	0-4-4 N=8				22		33-13-20	62
2	░	**POORLY GRADED SAND (SP)**, fine grained, brown, medium dense			☒	5-5-5 N=10				23			
	░	5.0	5		☒	4-5-5 N=10				14			
	▨	**CLAYEY SAND (SC)**, fine grained, brown, medium dense			☒	4-5-6 N=11				20			
	▨	10.0	10		☒	2-4-5 N=9				22			

Boring Terminated at 10 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow stem auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-05-2020	Boring Completed: 03-05-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. R-4

PROJECT: ArDOT Job. 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.8618° Longitude: -90.9366°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		0.5 **ASPHALT CONCRETE - 5 inches**											
		1.0 **AGGREGATE BASE COURSE - 6 inches**											
		SANDY LEAN CLAY (CL), brown and gray, stiff			☒	4-4-5 N=9				18		36-13-23	69
					☒	4-4-6 N=10				17			
		4.0 **SANDY FAT CLAY (CH)**, gray, stiff to very stiff	5		☒	0-8-11 N=19				22			
		10.0	10		☒	3-4-5 N=9				17			
		Boring Terminated at 10 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow stem auger

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
25809 I 30
Bryant, AR

Boring Started: 03-05-2020	Boring Completed: 03-05-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

ArDOT Job. 100995 Cache River Bridge ■ Egypt, Arkansas

Terracon Project No. 35195198

SAMPLING

☐ Grab Sample

☒ Standard Penetration Test

WATER LEVEL

▽ **Water Initially Encountered**

▽ **Water Level After a Specified Period of Time**

▼ **Water Level After a Specified Period of Time**

▨ **Cave In Encountered**

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

N	**Standard Penetration Test Resistance (Blows/Ft.)**
(HP)	**Hand Penetrometer**
(T)	**Torvane**
(DCP)	**Dynamic Cone Penetrometer**
UC	**Unconfined Compressive Strength**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above “A”		CL	Lean clay [K, L, M]
			PI < 4 or plots below “A” line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above “A” line		CH	Fat clay [K, L, M]
			PI plots below “A” line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add “with sand” to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add “with organic fines” to group name.

[I] If soil contains ≥ 15% gravel, add “with gravel” to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add “with sand” or “with gravel,” whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add “sandy” to group name.

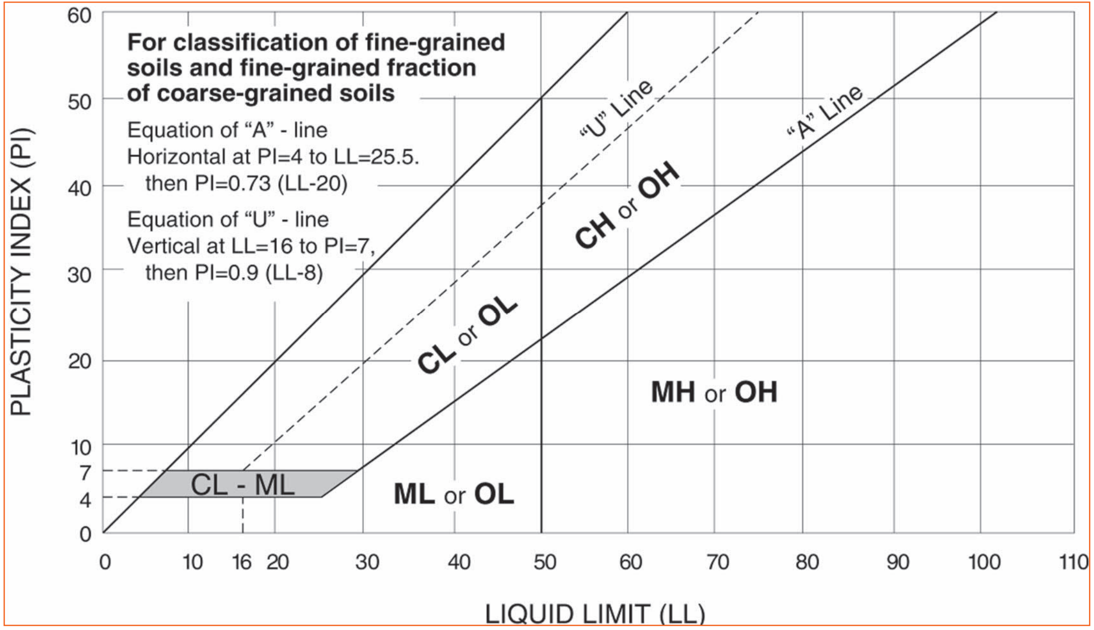
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.

[N] PI ≥ 4 and plots on or above “A” line.

[O] PI < 4 or plots below “A” line.

[P] PI plots on or above “A” line.

[Q] PI plots below “A” line.



September 24, 2020

Michael Baker International, Inc.
1400 West Markham, Suite 204
Little Rock, Arkansas 72201

Attn: Mr. Scott Thornsberry
P: (501) 244-1004
E: scott.thornsberry@mbakerintl.com

Re: Addendum No. 1 to Geotechnical Engineering Report
Job No. 100995, Cache River Structures and Approaches
Highway 91
Egypt, Arkansas
Terracon Project No. 35195198

Dear Mr. Thornsberry:

We have completed a subsurface exploration and Geotechnical Engineering evaluation for Boring B-3. This boring location was inaccessible at the time of our previous subsurface exploration for the referenced project. This letter presents design and construction parameters associated with the performed boring, and should be used in conjunction with Terracon's Geotechnical Engineering Report, Terracon Project No. 35195198, dated May 1, 2020.

GEOTEHCNICAL CONSIDERATIONS

Boring B-3 was advanced to a depth of about 120 feet below the existing ground surface. This boring was previously inaccessible to our drill rig due to high water and soft soil conditions at the time of our subsurface exploration for this project. Like the previous borings, the upper soils in Boring B-3 are associated with alluvial deposits and included mixtures of silt, sand and clay. Sand soils containing varying amounts of clay were observed underlying the alluvial deposits. No groundwater was observed while drilling by dry auger, and no water measurements were taken after wash boring procedures were initiated at a depth of approximately 10 feet. During our study, the following geotechnical considerations were identified:

- Low-strength soils
- Liquefaction potential
- Moistures-sensitive soils

Low-strength soils

Low-strength (soils with SPT N-values of 5 blows per foot or lower) silty clay, sandy silty clay, and clayey sand soils were observed at depths ranging from the surface to about 13.5 feet below the existing ground surface. In their present condition, the low-strength soils are not suitable for providing direct support to shallow foundations associated with the bridge structure such as abutments or wingwalls. These low-strength soils are expected to be compressible under new embankment fills. We understand that the bridge abutments on steel pipe pile foundations. These low-strength alluvial soils would provide a low skin friction and lateral resistance, which were factored into the design parameters provided in this letter.

Liquefaction potential

Boring B-3 contained medium stiff to stiff sandy silty clay soils and loose to medium dense clayey sand soils to a depth of about 30 feet below the existing ground surface. These soils could be subject to liquefaction during seismic events. Based on our liquefaction analysis soils to a depth of 25 feet have a potential to liquefy. During earthquake events, liquefaction of these soils would result in reduction in lateral resistance of pile foundations. We have taken the reduced resistance in these liquefiable layers into account in the recommended pile resistance curves presented with this letter.

Moisture-Sensitive Soils

The silty clay soils that were observed at or near the ground surface at the boring location are moisture-sensitive and prone to further strength loss with increased moisture content. These soils could become unstable with typical earthwork and construction traffic, especially after precipitation events; therefore, effective drainage should be completed early in the construction sequence and maintained during and after construction. If possible, the construction should be performed during warmer and drier times of the year. If construction is performed during the winter months, an increased risk for unstable subgrade conditions will occur.

DEEP FOUNDATIONS

Soil parameters used to determine the nominal and factored resistances of driven steel pipe piles are shown below. The values were developed based on our interpolation of the generalized stratigraphy of the borings near the bridge abutments and our experience with the soils in the project area.

Boring B-3

Stratum	Approximate Depth to Bottom of Stratum	Material Description	Effective Unit Weight (pcf)	Undrained Shear Strength (psf)	Friction Angle (°)
1	2	Silty clay	115	1,000	--
2	8.5	Sandy silty clay	50	1,000	--
3	28.5	Clayey sand	50	--	26
4	68.5	Poorly graded sand and poorly graded sand with clay	50	--	30
5	88.5	Poorly graded sand with clay	60	--	32
6	120	Poorly graded sand with clay	60	--	36

Driven Pile Resistances

Based on the general profiles above, the driven pile axial resistances for a steel pipe with various diameters were determined at different depths. The graphical representations of the nominal pile resistances are attached to this report.

For the graphs:

- The nominal resistances are applicable if the center-to-center spacing of the piles is equal to or greater than 3 times the maximum pile section dimension.
- The factored resistance values are based on the nominal resistance multiplied by the structural resistance factor of 0.35 for clays and 0.45 for sands from Resistance Factors for Geotechnical Resistance of Driven Piles, φ [AASHTO 10.5.5.2.3-1]. The resistance factor can be increased if pile dynamic analysis or wave equation analyses are specified.
- Potentially liquefiable layers were identified during liquefaction analysis. To account for the effect of liquefaction, the skin resistance contribution of liquefiable layers was negated from the resistance calculations of the pile. Piles should not terminate in a potentially liquefiable layer of soil.
- The effects of lateral spreading and flow sliding were not analyzed as part of this report, if lateral spreading or flow sliding are a critical design element, Terracon should be contacted to analyze these effects on the pile resistance values.

Wall thickness for pipe piles should be selected in consideration of the design nominal resistance (or conversely, the maximum nominal resistance, or structural limit state, should be established for the selected pipe pile section). The critical event occurs during driving, and the pile stresses should be maintained less than $0.9F_y$ to reduce the potential for damage to the pile (F_y = yield strength of steel). The driving stress was often correlated to a maximum allowable design capacity of $0.25*F_y*A_{st}$ using ASD methods (where A_{st} = cross sectional steel area). For LRFD design methods, resistance factors for the strength limit state are provided in AASHTO Article 6.5.4.2 for pipe pile sections. The use of pile tips is not considered necessary at this site.

For piles designed and installed in accordance with the recommendations provided in this report, total settlements of about 1 inch or less are expected.

Driven Pile Downdrag Considerations

During a seismic event, settlement of liquefiable soil layers will apply additional loads to the piles. This is caused by adhesion between the pile and downward moving soil. The following tables can be used to develop resistances for piles during liquefaction events.

Boring B-3

From the liquefaction analyses performed, soils from about 0 to 23.5 feet in Boring B-3 were determined to be liquefiable during a seismic event. The following downdrag loads can be applied for resistance analysis during a seismic event.

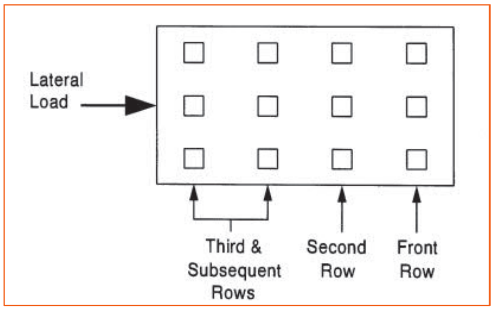
Top Depth (ft)	Bottom Depth (ft)	Material Description	Undrained Shear Strength (psf)	Friction Angle (°)	Nominal Downdrag Load (psf)
0	8.5	Silty clay and Sandy silty clay	1,000	--	-400
8.5	23.5	Clayey sand	--	26	-250
23.5	28.5	Clayey sand	--	26	Below liquefiable layers
28.5	68.5	Poorly graded sand and poorly graded sand with clay	--	30	
68.5	88.5	Poorly graded sand with clay	--	32	
88.5	120	Poorly graded sand with clay	--	36	

Driven Pile Lateral Resistance

The strength parameters listed in the Soil Strength Parameters section can be used as input values for use in LPILE analyses. LPILE will estimate values of k_h and E_{50} based on the provided strength values. Effective unit soil weights should be used for input assuming a maximum groundwater level similar to flood stage elevation.

When piles are used in groups, the lateral resistances of the piles in the second, third, and subsequent rows of the group should be reduced as compared to the capacity of a single, independent pile. Guidance for applying p-multiplier factors to the p values in the p-y curves for each row of pile foundations within a pile group are as follows:

- Front row: $P_m = 0.8$;
- Second row: $P_m = 0.4$
- Third and subsequent row: $P_m = 0.3$.



The load resistances provided herein are based on the stresses induced in the supporting soil strata. The structural capacity of the piles should be checked to assure that they can safely accommodate the combined stresses induced by axial and lateral forces. Lateral deflections of piles should be evaluated using an appropriate analysis method, and will depend upon the pile's diameter, length, configuration, stiffness and "fixed head" or "free head" condition. We can provide additional analyses and estimates of lateral deflections for specific loading conditions upon request. The load-carrying capacity of piles may be improved by increasing the diameter of pipe piles.

Driven Pile Construction Considerations

The contractor should select a driving hammer and cushion combination which can install the selected piling without overstressing the pile material. The hammer should have a rated energy in foot-pounds at least equal to 15 percent of the design compressive load capacity in pounds. The contractor should submit the pile driving plan and the pile hammer-cushion combination to the engineer for evaluation of the driving stresses in advance of pile installation. During driving, a maximum of 10 blows per inch is recommended to reduce the potential of damage to the piles.

Pile driving conditions, hammer efficiency, and stress on the pile during driving could be better evaluated during installation using a Pile Driving Analyzer (PDA). A Terracon representative should observe pile driving operations. Each pile should be observed and checked for buckling, crimping and alignment in addition to recording penetration resistance, depth of embedment, and general pile driving operations.

The pile driving process should be observed by the Geotechnical Engineer or approved technician. Terracon should document the pile installation process including soil and groundwater conditions encountered, consistency with expected conditions, and details of the installed pile.

Excavations for pile caps should be observed by the Geotechnical Engineer or approved technician. The base of all excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

Closure

This supplemental letter should be used in conjunction with Terracon’s Geotechnical Engineering Report dated May 1, 2020 (Terracon Project No. 35195198). All other recommendations and considerations from the original geotechnical report not specifically addressed in this letter still apply. The qualifications and limitations stated in our geotechnical report apply to this addendum.

We appreciate the opportunity to be of service to you. If you have any questions or comments, or if we can be of further assistance, please do not hesitate to contact us.

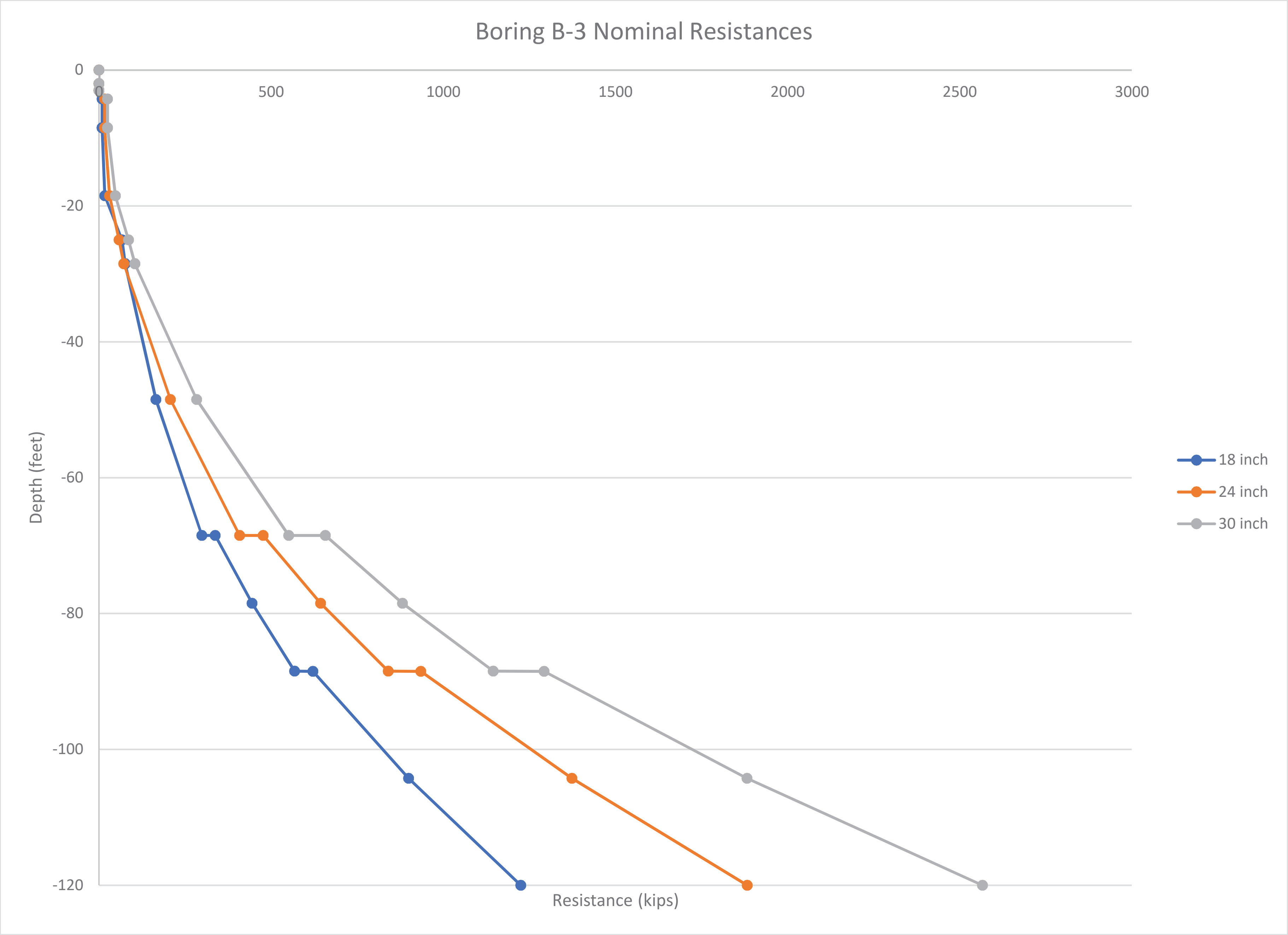
Sincerely,
Terracon Consultants, Inc.
Certificate of Authorization No. 223 expires 12/31/2021

Kimberly A Daggitt
Kimberly A. Daggitt, P.E.
Project Engineer

Chris S Handley
Christopher S. Handley, P.E.
Geotechnical Department Manager

Kole C. Berg
Kole C. Berg, P.E. (IA, IL, KS, MO, WI)
Senior Engineer

No. 16398
KIMBERLY A. DAGGITT


Boring B-3 Nominal Resistances
0
-20
-40
-60
-80
-100
-120
Depth (feet)
0
500
1000
1500
2000
2500
3000
Resistance (kips)
18 inch
24 inch
30 inch

BORING LOG NO. B-3

PROJECT: ArDOT Job 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 35.8578° Longitude: -90.9342° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
							TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)			LL-PL-PI	
	▨	**SILTY CLAY (CL-ML)**, gray and brown, medium stiff 2.0			☒	1-2-3 N=5				20.5			
	▨	**SANDY SILTY CLAY (CL-ML)**, dark gray, gray and brown, medium stiff to stiff			☒	3-2-3 N=5				19.2		33-14-19	64
	▨				☒	3-4-5 N=9				17.4			
	▨		5		☒	3-3-4 N=7				18.9		NP	
	▨	8.5											
	▨	**CLAYEY SAND (SC)**, dark gray, loose to medium dense	10		☒	2-2-3 N=5				25.0			20
	▨		15		☒	3-5-6 N=11				19.8			
	▨		20		☒	3-8-3 N=11				31.8			24
	▨		25		☒	5-8-9 N=17				38.7			
	▨	28.5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 120 feet: Mud rotary

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
25809 I 30
Bryant, AR

Boring Started: 07-27-2020	Boring Completed: 07-27-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. B-3

PROJECT: ArDOT Job 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 35.8578° Longitude: -90.9342° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED SAND (SP), medium to coarse grained, gray, medium dense to dense	30		☒	6-8-10 N=18				20.5			
			35		☒	5-7-11 N=18				21.8			4
			40		☒	13-20-23 N=43				23.6			
		43.5 **CLAYEY SAND (SC)**, fine to medium grained, gray and brown, medium dense	45		☒	11-14-15 N=29				31.2			
			50		☒	6-7-9 N=16				31.2			14
			55										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 120 feet: Mud rotary

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
25809 I 30
Bryant, AR

Boring Started: 07-27-2020	Boring Completed: 07-27-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. B-3

PROJECT: **ArDOT Job 100995 Cache River Bridge**

CLIENT: **Michael Baker International LLC**
Little Rock, Arkansas

SITE: **Kings Highway**
Egypt, Arkansas

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 35.8578° Longitude: -90.9342° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		CLAYEY SAND (SC), fine to medium grained, gray and brown, medium dense *(continued)* 58.5											
		POORLY GRADED SAND WITH CLAY (SP-SC), coarse grained, gray and brown, medium dense to very dense	60		☒	10-11-13 N=24				23.0			
			65										
			70		☒	15-16-17 N=33				22.3			7
			75										
			80		☒	15-18-18 N=36				18.4			
			85										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 120 feet: Mud rotary

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
25809 I 30
Bryant, AR

Boring Started: 07-27-2020	Boring Completed: 07-27-2020
Drill Rig: CME 763	Driller: ME
Project No.: 35195198	

BORING LOG NO. B-3

PROJECT: **ArDOT Job 100995 Cache River Bridge**

CLIENT: **Michael Baker International LLC**
Little Rock, Arkansas

SITE: **Kings Highway**
Egypt, Arkansas

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 35.8578° Longitude: -90.9342° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED SAND WITH CLAY (SP-SC), coarse grained, gray and brown, medium dense to very dense *(continued)*											
					☒	21-28-40 N=68				18.5			6
			90										
			95										
					☒	21-50/5"				18.8			
			100										
			105										
					☒	50/2"				19.2			
			110										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 120 feet: Mud rotary

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
25809 I 30
Bryant, AR

Boring Started: 07-27-2020

Boring Completed: 07-27-2020

Drill Rig: CME 763

Driller: ME

Project No.: 35195198

BORING LOG NO. B-3

PROJECT: ArDOT Job 100995 Cache River Bridge

CLIENT: Michael Baker International LLC
Little Rock, Arkansas

SITE: Kings Highway
Egypt, Arkansas

LOCATION See Exploration Plan

Latitude: 35.8578° Longitude: -90.9342°

MODEL LAYER	GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
							TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)			LL-PL-PI	
	▨	**POORLY GRADED SAND WITH CLAY (SP-SC)**, coarse grained, gray and brown, medium dense to very dense *(continued)*	115										
	▨				☒	26-26-31 N=57				24.5			7
		120.0	120										
		Boring Terminated at 120 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
0 to 10 feet: Hollow-stem auger
10 to 120 feet: Mud rotary

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
25809 I 30
Bryant, AR

Boring Started: 07-27-2020

Boring Completed: 07-27-2020

Drill Rig: CME 763

Driller: ME

Project No.: 35195198

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

ArDOT Job. 100995 Cache River Bridge ■ Egypt, Arkansas

Terracon Project No. 35195198

SAMPLING

✋	Grab Sample
☒	Standard Penetration Test

WATER LEVEL

▽	**Water Initially Encountered**
▽	**Water Level After a Specified Period of Time**
▼	**Water Level After a Specified Period of Time**
▨	**Cave In Encountered**

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

N	**Standard Penetration Test Resistance (Blows/Ft.)**
(HP)	**Hand Penetrometer**
(T)	**Torvane**
(DCP)	**Dynamic Cone Penetrometer**
UC	**Unconfined Compressive Strength**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or [$Cc<1$ or $Cc>3.0$] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or [$Cc<1$ or $Cc>3.0$] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	$PI > 7$ and plots on or above "A"		CL	Lean clay [K, L, M]
			$PI < 4$ or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains $\geq$ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains $\geq$ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains $\geq$ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] $PI \geq 4$ and plots on or above "A" line.

[O] $PI < 4$ or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.