Terracon

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September 7, 2023

Arkadelphia Regional Economic Development Alliance
Economic Development Corporation of Clark County
201 N 26th St
Arkadelphia, AR 71923

Attn: Shelley Short, President & CEO
E: shelley@arkadelphiaalliance.com

Re: Sun Bio Facility 35165046

Dear Ms. Short:

You have requested a copy of the Geotechnical Report, dated June 7, 2016, which Terracon Consultants, Inc. ("Terracon") wrote for the above-referenced project, (the "Report"). The Report was prepared pursuant to a contract with Shandong Sun Paper Industry Joint Stock Co, Ltd (the "Client"). The Client has given its permission to furnish you with a copy of the Report. The Report was created for the sole use of the Client, so these documents are provided to you for informational purposes only. Please note that the Report is only valid as of the date it was written and may not be adequate for your current use. Additionally, by giving you these reports, Terracon is not granting you reliance. Any use of this information by you or any party other than the Client is done at the sole risk of that party.

Please indicate your agreement to the terms of this letter by signing below.

Sincerely,
Terracon Consultants, Inc.

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

AGREED:

By: Shelley Short
Its: President & CEO
Date: 9. 7. 23

Geotechnical Engineering Report

New Heavy Industrial Project
Arkadelphia, Arkansas
June 7, 2016
Project No. 35165046

Prepared for:
Shandong Sun Paper Industry
Yanzhou, Shandong, China

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

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June 7, 2016

Shandong Sun Paper Industry Joint Stock Co., Ltd.
1 Youyi Road
Yanzhou, Shandong 272100, PRC

Attn: Andrzej Bednarski
International Project Director
P: (86) 537 792 5828
M: (86) 1 867 870 6767
E: andrzej@sunpaper.cn

Re: Geotechnical Engineering Report
New Heavy Industrial Project
Arkadelphia, Arkansas
Project No. 35165046

Dear Mr. Bednarski:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above-referenced project. Our study was performed in general accordance with our Proposal Number P3515027R, dated February 29, 2016. Our preliminary findings and recommendations were issued on April 20, 2016. This report presents the findings of the subsurface exploration and provides geotechnical recommendations for designing and constructing foundations and supporting floor slabs, pavements, rails, and other building and site development elements.

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 12/31/2017

Shaun P. Baker, P.E.
Senior Project Manager
Arkansas No. 11817

Daniel E. Pickett, P.E. (TX and LA)
Senior Geotechnical Engineer

Stephen E. Greaber, P.E. (LA)
FoR Principal

6/7/2016
No.11817
SHAUN P. BAKER

Copies to: Addressee - pdf via email
Poyry (Appleton) LLC – pdf via e-mail

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EXECUTIVE SUMMARY

Geotechnical engineering services have been partially completed for the proposed New Heavy Industrial Project planned near the southwest corner of the State Highway 26 and U.S. Highway 67 intersection near Arkadelphia, Arkansas. A site grading plan was not available at the time of preparing these preliminary recommendations. We understand a preliminary finished grade elevation of 265 feet is being considered for developing the site. Based on the information obtained from our subsurface exploration, laboratory testing, and the site grading information provided to us, a summary of our observations and preliminary geotechnical recommendations follows:

- Twenty-nine borings were planned for the field exploration. Fifteen soil borings were drilled at the site between March 17, 2016, and April 10, 2016. Eight borings were drilled to depths of about 80 feet below the existing ground surface. The remaining seven borings were drilled to depths of about 50 feet below the ground surface. Cone Penetration Testing (CPT) soundings were planned at 16 additional locations. At the time of performing the field exploration, the CPT sounding locations were inaccessible to the CPT rig due to soft ground conditions, except for location CPT-1, which was performed in the southeastern portion of the site.

- The on-site soils consisted of native fat clay overlying clayey sand and silty sand. Fat clays were predominant in most borings and extended from the ground surface to depths ranging from about 28.5 to 68.5 feet below the existing ground surface. Dense to very dense clayey sand and silty sand were observed beneath the fat clays to the boring termination depths. Groundwater was observed in Borings B-16, B-20 and B-33 at depths of about 26 to 50 feet below the existing ground surface after at least one day of boring completion. Those groundwater level readings may have been influenced by water used as a drilling fluid to advance the borings to depths below about 10 feet by the wash-rotary drilling method.

- Near-surface low-strength (soils with SPT N-values less than 5 blows per foot) fat clay soils were observed to depths ranging from about 2 to 7.5 feet below the existing ground surface in 12 of the 13 borings, though typically to depths of about 2 to 3.5 feet. In their present condition, the low-strength soils are not suitable for providing direct support to new fill, shallow foundations, on-grade slabs, or pavements. Based on the preliminary design finished grade elevation of 265 feet, we expect that most of the low-strength soils will likely be removed during grading.

- Medium- to very high-plasticity fat clay soils were observed in all of the borings. The on-site fat clays are prone to shrinking and swelling with variations in moisture content. Based on the laboratory testing completed to date and the subsurface conditions observed at the boring locations at the time of the field exploration, we estimate potential vertical rise (PVR) values in the range of about 3 to 4 inches at the existing ground surface, and about 6 to 7 inches under dry conditions. However, cuts required for grading will remove the overburden soils presently confining the fat clays. We expect an immediate (elastic) heave will likely occur as the remaining fat clays swell from the release of the soil overburden pressure. Long-term swell is also expected as the moisture content of the fat clays increases to reach a new equilibrium after being exposed to a shallower depth. For this reason, we recommend the site designers consider raising the finished grade elevation so that the main facility buildings and structures are constructed on a minimum 7-foot layer of new engineered fill. This might require relocating the facility from the higher ridge as presently planned to the lower topographic area to the east. If the planned finished grade elevation of 265 feet is necessary, special design and construction measures will be required to reduce the effects of volume changes on foundations and ground-supported structures. Additional exploration and laboratory testing should be performed before completing final design, but after information regarding site grading, structure loads, and movement tolerances is available.

- Depending on final locations and grades of the structures, overexcavation and replacement of the fat clays with a minimum specified thickness of low-volume change engineered fill could be necessary to reduce potential movement of shallow foundations, grade-supported slabs, pavements and rails. For preliminary consideration, we recommend designing for at least 7 feet of low volume-change, new engineered fill beneath the structures supported on shallow foundations and on-grade slabs. Imported fill materials should have a liquid limit (LL) less than 45 and plasticity index (PI) between 10 and 25. Lime treatment could be considered to reduce the plasticity index of the on-site fat clay soils and reduce the potential for volume change to an acceptable magnitude. Additional laboratory testing will be necessary to evaluate the amount of lime needed to effectively reduce the plasticity and to evaluate the risk of sulfate reacting with the lime additive.

- Based on the subsurface conditions observed at the boring locations and the existing grade, the heavy industrial facility structures could be supported on conventional shallow footing foundations and mat foundations bearing in low-volume change fill. Shallow footing foundations and mat foundations bearing in these materials could be designed using a maximum net allowable bearing pressure of 2,500 psf. Based on the subsurface conditions observed at the boring locations, improving any low-strength soils after grading, and by constructing a thickness of low-volume change, engineered fill beneath structures, we estimate shallow foundation movement could be controlled to less than one inch.

- Structures could be supported on drilled straight-shaft or underreamed pier foundations bearing in tested and approved, very stiff to hard fat clays using a maximum net allowable end bearing pressure of 12,000 psf. Drilled straight-shaft piers bearing in dense to very dense clayey sand and silty sand soils could be designed using a maximum net allowable end bearing pressure of 20,000 psf. Allowable skin friction values are provided in Section **4.5.1 Drilled Pier Foundations**. Total and differential movement of drilled pier foundations, designed as recommended in this report, should be less than one inch.

- The drilled shafts will be subject to uplift as a result of heave in the fat clay soils surrounding the upper portion of the shaft. The magnitude of these loads varies with the shaft diameter, soil parameters, the in-situ moisture levels at the time of construction, and subsequent moisture changes. The shafts must contain sufficient continuous vertical reinforcing to resist the net tensile load from soil-induced uplift as well as structural uplift.

- Underreamed or belled piers could be used to support the structures and resist uplift forces. Some designers prefer to neglect the skin friction component for drilled and underreamed piers because of the difference in magnitudes of movement required to mobilize the skin friction and end bearing components. The pier bell should be designed for a minimum bell diameter of two times the shaft diameter and maximum of three times the shaft diameter. The bell diameter should be at least 36 inches.

- Augered, cast-in-place (ACIP) piles could be used to support the planned structures. Similar to drilled piers, the ACIP piles must contain sufficient continuous vertical reinforcing to resist the net tensile load from soil-induced uplift as well as structural uplift. Driven H piles could also be used for support of the facility buildings and structures without requiring additional reinforcement to resist tensile forces due to uplift caused by the fat clays. Recommendations for ACIP and driven H pile foundations are provided in the respective sections in this report.

- The load capacity values presented in this report are based on a generalized soil profile below the existing ground surface, and this information is provided for conceptual planning and preliminary design. Since soil stratigraphy varies over the site, and since cut and fill will be required in various areas of the site, estimated load capacity values should be determined for specific structures at specific locations after more detailed design information is available.

- Terracon completed geophysical testing to evaluate the seismic shear wave velocity profile of the subsurface conditions to depths below 100 feet of the ground surface. We measured average shear velocities of approximately 1,200 ft/sec and 1,230 ft/sec. Based on the existing site grading and the results of the geophysical testing, the 2012 International Building Code seismic site classification for this site is C.

- Soil-supported floor slabs may be used after grading and preparing the subgrade. Floor slabs should be constructed over a minimum 7-foot thick layer of low volume-change, new engineered fill. The prepared subgrade with a CBR value of at least 3 percent will have a design modulus of the order of 100 psi/in for point-loading conditions when compacted to at least 95 or 98 percent of standard Proctor (ASTM D 698) maximum dry density, as recommended in Section 4.2.4 Compaction Requirements. Structurally supported slabs could also be considered in conjunction with the deep foundations. Voids could also be used beneath grade beams and slabs to accommodate volume changes in the fat clay soils.

- Based on our review of published soils information and the results of the pH, redox and resistivity testing, it appears that the on-site soils have a high steel corrosive potential. Corrosion protection measures, such as cathodic protection, should be considered to protect underground metal piping and tanks that will be exposed to the native soils. The soil resistivity of the native soils should be re-evaluated once the final grading is known if buried metal structures are anticipated to be in contact with the native soils. We recommend that a certified corrosion professional be employed to determine the need for corrosion protection and to design appropriate protective measures.

- Based on soluble chloride and sulfate content test results for the on-site soils, the soils are considered to have mild but positive sulfate exposure. The potential source appears to be low solubility gypsum (calcium sulfate), observed as crystals in some of the soil samples. We recommend that a certified concrete professional be employed to determine the need for sulfate protection and to design appropriate protective measures. Type I cement is commonly used in this region in Arkansas where the project site is located, and appears to be appropriate for this project according to ACI 318, Table 4.3.1.

- Pavement subgrade materials consisting of at least 3 feet of tested and approved, low volume-change new engineered fill will be suitable to support conventional flexible and rigid pavement sections.

- The fill material characteristics and compaction requirements for rail bed fill materials should meet the requirements presented in Sections **4.2.3** and **4.2.4**. We recommend constructing a minimum 3-foot thick layer of low volume-change, low permeability engineered fill for the rail bed within the facility footprint. Depending on final grade, overexcavation and replacement of the fat clay soils with engineered fill could be required. Lime-treated soils could be considered to provide uniform support and reduce the potential for volume changes with variations in moisture content within the medium to high plasticity fat clay soils. The rail bed materials between the facility and the existing rail can consist of on-site soils provided they are constructed as recommended in this report. Ground improvement will likely be required to support the new rail bed fill.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the final geotechnical report must be read in its entirety for a comprehensive understanding of the items contained herein. Section **5.0 GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
NEW HEAVY INDUSTRIAL PROJECT
ARKADELPHIA, ARKANSAS

Project No. 35165046

June 7, 2016

1.0 INTRODUCTION

Geotechnical engineering services have been completed for the proposed New Heavy Industrial Project planned west of U.S. Highway 67 in Arkadelphia, Arkansas. Fifteen borings were drilled for the field exploration at the site between March 17 and April 10, 2016. We attempted to use a cone penetrometer testing (CPT) rig for the cone soundings; however, the site conditions were too wet and soft for the ATV CPT rig at most locations. One CPT sounding was completed in the southeastern portion of the site. The borings were drilled to depths of approximately 50 to 80 feet below the existing ground surface. Boring logs along with site and boring location plans are included in Appendix A of this report.

The purpose of this report is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- footing and mat foundation design and construction
- drilled pier, augered-cast-in-place pile and driven H pile foundation design and construction
- floor slab support
- pavement design and support
- rail roadbed design and support
- earthwork and subgrade preparation
- lateral earth pressures for retaining walls and below-grade structures
- 2012 IBC Seismic Site Class and seismic hazards
- dynamic soil design parameters

Our preliminary findings and recommendations were issued on April 20, 2016.

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Structures and construction	Specific project details are confidential and unavailable to us at this time, but our understanding is the project includes the construction of a greenfield heavy industrial facility with heavy vibrational loads and criteria for limited settlement. The proposed facility will consist of an approximate 1,400-foot by 5,250-foot area which will include process and non-process buildings housing: n Heavy industrial equipment n Bridge cranes n Equipment exerting dynamic and vibratory loading n Large tanks/vessels n Storage areas Major exterior structures and area include: n Wood yard (storage) and crane n Chip storage and conveyors n Bark storage and conveyors n Pipe bridges n Oil storage tanks n Truck scales n Train loading area, switchyard and rails
Maximum loads (provided)	Recovery Boiler: 75,000 kips Turbine/Generator: 39,200 kips Stack: 10,000 kips Pulp Storage Tower: 29,120 kips Columns: 50 to 100 kips (non-process buildings)
Grading	Preliminary finished grade elevation of 265 feet
Cut and fill slopes	Assumed to have declinations of 3H:1V or flatter
Below-grade and retaining wall structures	We expect some below-grade wall and retaining wall structures will be required for the loading and storage structures
Pavements	Pavement and drive areas for heavy equipment installation and maintenance, semi-truck access, fork trucks and rail access

2.2 Site Location and Description

Item	Description
Location	The site is located near the southwest corner of the State Highway 26 and U.S. Highway 67 intersection near Arkadelphia, Arkansas The site footprint is approximately 1 mile in length and 1/4 mile wide
Existing improvements	Undeveloped. The property appears to be comprised of fields and woods
Existing surface cover	Grass, fields and woods
Existing topography	Undulating hills. Overall, the site appears to slope downhill to the west and east from a ridge-like feature. Approximately 50 feet of elevation change occurs between the topographic low and high areas at this site

3.0 SUBSURFACE CONDITIONS

3.1 Geology

Formation [1]	Description [2]
Midway Group, Tm **Tertiary Period** **Paleocene Epoch**	The Midway sequence exposed at the surface in Arkansas represents a marginal marine depositional environment. The lithologies noted include calcareous shale, arenaceous limestone, calcareous glauconitic sandstone, conglomerate, and light to very dark bluish-gray clay shale. Fossils include a rich fauna that includes bivalves, gastropods, foraminifera, and ostracods. The lower boundary of the Midway is unconformable. The thickness is up to 130 feet in outcrop, and much thicker in the subsurface
Arkadelphia Marl, Kad **Cretaceous Period**	The Trinity Group consists of alternating fine quartz sand and gypsum-rich marls with lenticular fossiliferous limestone, gypsum and minor novaculite gravel. This formation is approximately 2,500 feet thick

1. Interactive Geologic Map of Arkansas and Geological Google Earth files published by the Arkansas Geological Survey, 2015, www.geology.ar.gov
2. “Stratigraphic Summary of Arkansas”, published by the Arkansas Geological Commission, 1998, revised 2004.

Surface materials are shown to belong to the Arkadelphia Marl on the Geologic Map of Arkansas. Based on our knowledge of the regional geology and the subsurface conditions observed in the borings, it appears the soils at this site are consistent with those observed in the Midway Group.

3.2 Typical Profile

The field exploration program is described in Appendix A and consisted of drilling 15 borings. Based on the results of the borings, subsurface conditions observed at the site can be generalized as:

Description	Approximate Depth to Bottom of Stratum (feet)[1]	Material Encountered	Consistency/Density
Stratum 1	0 to 7.5	Fat clay Lean clay at BH-36	Very soft to medium stiff
Stratum 2	5 to 33.5	Fat clay	Medium stiff to stiff
Stratum 3	28.5 to 68.5 Below termination depths of 50 feet at BH-23 and BH-25	Fat clay	Very stiff to hard
Stratum 4	43.5 to 78.5 Below termination depths of about 79.7 at BH-19, and 50 at BH-29 and BH-33	Clayey sand	Dense to very dense
Stratum 5	Below termination depths of about 48.9 to 79.9 at borings BH-11 through BH-14, BH-16, BH-18, BH-20, BH-22, BH-31 and BH-36	Silty sand	Dense to very dense

1. Measured below the existing ground surface

The table above includes generalizations and does not reflect specific conditions at each exploration point. Conditions observed at each boring/CPT location are indicated on the individual boring logs and CPT log, respectively. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Descriptions of the field exploration and laboratory programs are included in **Appendix A** and **B,** respectively.

Atterberg limits tests were performed on 33 samples generally representative of the cohesive, native soils. The tested native soils were classified based on the results as fat clay (CH) with one layer of lean clay (CL). The lean clay and fat clay soils were characterized as having medium to very high plasticity. The lean clay and fat clay soils are collectively referred to as fat clays for our analysis and recommendations in the following sections of this report. Selected samples of granular soils were tested for grain size distribution. The granular soils classified as clayey sand (SC) and silty sand (SM). The laboratory test results are shown on the boring logs in **Appendix A** and individual laboratory test reports in **Appendix B**.

3.3 Groundwater

The boreholes were observed while drilling the upper 10 feet by dry auger, and at least 24 hours after completion for the presence and level of groundwater. Groundwater measurements are shown in the lower left corner of the boring logs and summarized in the following table where observed.

Boring Number	Depth to groundwater while drilling, (feet) [1]	Depth to groundwater after at least 1 day, (feet) [1, 2]
BH-16	Water level not determined	46.5 after 48 hours
BH-20	Water level not determined	50 after 24 hours
BH-33	Water level not determined	26 after 72 hours

1. Depths measured below existing ground surface
2. Groundwater depths are rounded to the nearest one-half foot

Water was not observed while drilling by dry auger to a depth of about 10 feet below the existing ground surface. Water level measurements were taken at least 24 hours after boring completion in most of the borings. Water was observed in the three boreholes shown in the table above. Water was not observed in the remaining borings when measured at least 1 day after completion, and those borings were dry and caved at the depths indicated on the boring logs. The borings were advanced below a depth of 10 feet using wash-rotary drilling techniques to the termination depths. Because water was injected in the borings, an accurate groundwater level could not be obtained immediately after boring completion.

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 structure may be higher or lower than indicated on the boring logs. Additionally, perched water may be encountered or develop in the near-surface fat clays due to their low permeability. Longer-term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in these soil types. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

4.1.1 Preliminary Design

Site grading, structure locations and detailed loading conditions, and other information pertaining to site development were not available at the time this report was prepared. Subsurface conditions, as identified by the field and laboratory testing programs, have been reviewed and evaluated with respect to the proposed facility plans known to us at this time. The recommendations provided in this report are based on the subsurface conditions observed at the boring locations and a finished grade elevation of 265 feet. Due to the potential for shrink-swell movements from moisture changes in the identified upper fat clays, if practical, the site designers should consider raising the finished grade elevation to avoid cutting into the high plasticity marine fat clays and so that the main facility buildings and structures can be constructed on a minimum 5-foot thick layer of low volume change and low permeability engineered fill buffer. This might require relocating the facility from the higher ridge as presently planned to the lower topographic area to the east. Further geotechnical exploration and evaluation should be performed as site development plans progress.

4.1.2 Expansive Clay Soils

Medium- to very high-plasticity fat clay soils derived from a marine depositional environment were observed in all of the borings to depths of about 28.5 to 68.5 feet below the existing ground surface. The fat clay soils observed at the boring locations were highly over-consolidated and in a relatively dry condition. Two primary sources of soil movement are anticipated with the fat clay soils at this site. We anticipate an elastic rebound (heave) to occur within the fat clay soils after the overburden soils are cut 5 to 30 feet to reach finished grade. The magnitude of the heave and time over which it will occur will be dependent upon the thickness of soil removed, the new structural loads, and the elastic soil properties of the soils.

Secondly, we anticipate that the fat clay soils will swell after they are exposed to moisture when overburden is removed, or from near-surface seasonal moisture variations. Based on the laboratory testing completed to date and the subsurface conditions observed at the boring locations at the time of the field exploration, we estimate potential vertical rise (PVR) values in the range of about 3 to 4 inches at the existing ground surface, and perhaps up to 6 to 7 inches under a more prolonged seasonal wet condition. We expect an initial swelling within the deeper fat clays as the moisture content increases and equilibrates due to being exposed to near-surface weather/climactic conditions. We expect longer-term volume changes (shrinking and swelling) with seasonal moisture variations after the fat clays equilibrate. As will be necessary for evaluation of the potential heave, additional field and laboratory testing will be necessary to further evaluate the shrink-swell properties of the underlying clays to facilitate predictions of the magnitude and time rate of swelling.

Depending on final locations and grades of the structures, overexcavation and replacement of the fat clays with a minimum specified thickness of low-volume change and relatively low permeability engineered fill will be necessary to reduce the potential for change in moisture of the underlying fat clays and thus the potential for detrimental movement of shallow foundations, grade-supported slabs, pavements and rails. As an alternative, the buildings, equipment structures, and slabs could be structurally supported on suitably designed deep foundations.

Using a low-volume change low permeability buffer of engineered fill as recommended in this report may not eliminate all future subgrade volume change and resultant shallow foundation and floor slab movements. However, the procedures outlined in this report should reduce the potential for subgrade volume change. Additional reduction in cyclical shallow foundation and floor slab movement could be achieved by using a thicker low volume change fill layer and by design and construction of pavement and protective sidewalks around the facility's building and structure perimeters and careful detailing of site drainage features to reduce moisture fluctuations in the subgrade.

This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and at least minor cracking in the structures could still occur. The severity of cracking and other cosmetic damage such as uneven floor slabs will probably increase if any modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and cosmetic distress may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. We would be pleased to discuss other construction alternatives with you upon request.

It should also be recognized that utilities, pipes and conveyors constructed in and/or supported by foundations and slabs constructed on the fat clays will be subjected to movement with variations in moisture content. Differential movement on the order of 7 inches could likely occur between utilities affixed to structures supported on deep foundations and/or a low-volume change buffer fill and those constructed directly over or within the fat clays.

4.1.3 Low-Strength Soils

Near-surface low-strength (soils with SPT N-values less than 5 blows per foot) fat clay soils were observed to depths ranging from about 2 to 7.5 feet below the existing ground surface in 11 of the 15 borings, though typically to depths of about 2 to 3.5 feet. The low-strength soils prevented us from accessing the planned exploration locations with the CPT rig. The field exploration occurred during the regional wet, cool period of the year. Rain and standing water appeared to contribute to the soft soil conditions during the field exploration.

In their present condition, the low-strength soils are not suitable for providing direct support to new fill, shallow foundations, on-grade slabs, or pavements. Based on the understood site grading necessary to reach a preliminary finished grade elevation of about 265 feet, we anticipate most, if not all, of the low-strength soils will be removed in planned cut areas. Where the low-strength soils remain after finalizing the final site grading plan, these soils should be overexcavated and replaced full-depth with low volume change, low permeability engineered fill beneath the planned buildings, structures, and grade-supported slabs.

The on-site lean clay and fat clay soils are prone to strength loss with increases in moisture content. We expect that difficult construction conditions and extensive ground improvement will be required during site preparation and grading during wet conditions based on the site conditions observed during our field exploration. Ground improvement recommendations are discussed in greater detail in Section **4.2 Earthwork**. However, since conditions can vary laterally and with precipitation, we recommend the geotechnical engineer be retained to evaluate the site conditions during construction, so that adjustments can be made if differing conditions are encountered.

4.2 Earthwork

4.2.1 Control of Ground Movement

As discussed above, we expect the fat clays will heave and swell after site grading. Buildings, equipment structures and slabs should be constructed on some thickness of low-volume change low permeability engineered fill buffer or on suitably designed deep foundations. For the low volume change buffer option, we recommend designing for at least 7 feet of low volume-change new engineered fill beneath the structures supported on shallow foundations and on-grade slabs. Depending on the final grading plan, the on-site native fat clay soils may need to be overexcavated and replaced with low-volume change, low permeability engineered fill beneath the planned structures to a depth of 7 feet below the design finished subgrade elevation to provide the required buffer thickness. The low volume change buffer should extend laterally for a distance of at least 10 feet from the perimeter of the structure. The fat clay soils should also be overexcavated and replaced with low-volume change low permeability engineered fill to provide for a minimum 3 feet of buffer below planned pavement and rail subgrade elevation.

The excavated on-site soils are not suitable for re-use as low-volume change, new engineered fill. We anticipate the new engineered fill will need to be imported or the on-site fat clay soils could be treated with lime to reduce the plasticity to an acceptable magnitude. Lime treatment is discussed in greater detail in Section **4.2.5 Subgrade Improvement**.

4.2.2 General Site Preparation

Surface vegetation, trees and root balls and topsoil should be removed from the construction areas. Topsoil measurements were not made at the boring locations; however, stripping depths at or between our boring locations and across the site could vary considerably. As such we recommend actual stripping depths be evaluated by a representative of Terracon during construction to aid in preventing removal of excess material. Close observation and testing should be performed after clearing to evaluate the exposed soils and to provide recommendations if subgrade improvement is needed.

As previously described, low-strength soils were observed in most of the borings to depths of about 2 to 7.5 feet below the existing ground surface. Subject to final grading plans, we expect most of these soils will be removed in cuts during site grading. Any low-strength soils remaining in areas where buildings, equipment structures, and on-grade slabs are planned after grading should be removed and replaced full-depth with new low volume change engineered fill.

In pavement and rail areas where the weak soils are near finished grade elevation, we recommend they be overexcavated full-depth and replaced with engineered fill. In pavement and rail areas receiving sufficient thickness of fill, it is possible that bridge lifts could be used to construct new fill over the low-strength soils to support the pavements and rails, but the applicability of this process would depend on existing grades, design finished grades and specific soil conditions at those locations.

After stripping the surface materials, completing required cuts for grading, and overexcavating low-strength soils and fat clay soils to construct the low-volume change fill layer, but prior to placing new fill, the subgrade should be proof-rolled to aid in locating soft areas. A Terracon geotechnical engineer or a qualified senior technician should observe the site to confirm that the site has been effectively stripped of unsuitable materials. They should also monitor a proof-rolling procedure to evaluate and approve the stability of the exposed subgrade materials. Proof-rolling can be performed with a rubber-tired construction vehicle weighing 25 to 30 tons (total vehicle weight), such as a loaded scraper or tandem-axle dump truck.

Where unstable soils are identified by proof-rolling, they should be scarified, moisture conditioned, and compacted, or removed and replaced full-depth with new engineered fill. Other recommendations for ground improvement are provided in the following section. The appropriate method of improvement, if required, would depend on factors such as schedule, weather, the size of area to be improved, and the nature of the instability. Performing site grading operations during warm, dry periods would help reduce the amount of subgrade stabilization required.

Close monitoring of the site preparation operations outlined herein will be critical in providing proper subgrade support for fill placement. We therefore recommend that the geotechnical engineer be retained to monitor this portion of the work. Furthermore, it may be prudent to have the geotechnical engineer at the site during initial critical phases of the earthwork to observe the actual site conditions and make the necessary recommendations.

4.2.3 Engineered Fill Material Requirements

Engineered fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Imported low-volume change, low permeability material	CL LL ≤ 45 and 10 ≤ PI ≤ 25 Maximum 30% retained on the No. 200 sieve	All locations and elevations
On-site soils [2]	CL and CH LL > 45 or PI > 25	At least 7 feet below planned finished subgrade elevation beneath building, equipment structures and on-grade slabs At least 3 feet below planned finished pavement and rail bed subgrade
Chemically modified on-site soils	Treated CH [3] PI ≤ 25	All locations and elevations
Well-graded granular	GW/GM [4]	Beneath floor slabs and pavements as required

1. Engineered fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation
2. We do not recommend using the native soils as low-volume change fill material unless chemically modified to reduce the plasticity
3. USCS classification of chemically treated soils may not be appropriate as a basis of acceptable soil types. The suitability of the chemically treated soils is dependent upon the reduction in plasticity achieved through treatment. Laboratory testing should be performed to verify the required lime application rate to achieve the desired reduction in plasticity and/or swell potential.
4. Similar to AHTD Class 7 aggregate base course

The on-site soils could possibly be chemically modified by treating them with hydrated lime to reduce the plasticity index to a value suitable for use of that chemically treated soil as engineered fill. Laboratory tests would be needed to determine the optimum amount of lime required to reduce the plasticity index to an acceptable value. Because the soils contain soluble sulfate, additional laboratory testing should be performed on the soil-lime mixture to evaluate for potential adverse lime-sulfate reaction.

Chemical treatment at the site would need to occur in a staging area where the soils can be spread and mixed with the lime, allowed an adequate mellowing period to reduce the plasticity index, then hauled to the location of fill placement, or mixed in-place. This process is sometimes used where suitable engineered fill native material is not available or is very expensive to haul from an off-site borrow source. The relative economics of these approaches must be validated by the client.

4.2.4 Compaction Requirements

Item	Description
Fill lift thickness	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used
	4 to 6 inches in loose thickness when hand-guided equipment (*i.e.* jumping jack or plate compactor) is used
Compaction requirements	At least 95 percent of the material's standard Proctor maximum dry density (ASTM D 698) for fills within 5 feet of final grade
	At least 98 percent of the material's standard Proctor maximum dry density (ASTM D 698) for fills below 5 feet of final grade
Moisture content cohesive soil [1]	-1 percentage points to +3 percentage points of optimum moisture content value as determined by the standard Proctor test at the time of compaction, with stability present
Moisture content granular material [2]	Moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the granular fill material pumping when compacted

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved
2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proof-rolled

4.2.5 Subgrade Improvement

If site grading occurs during the wet periods of the year or if wet conditions develop, the potential for poor subgrade issues will increase. Climate data published by the Southern Regional Climate Center for the Arkadelphia, Clark County, Arkansas vicinity receives its highest normal monthly precipitation from March through May and October through December with an average of about 4.9 to 6.4 inches per month. In August and September, the average monthly precipitation is 2.9 and 3.5 inches per month. Average mean daily temperatures greater than 70 degrees can be expected from May through September. The published average monthly precipitation is presented in the following table.

Average Monthly Rainfall[1]

Month	Monthly Precipitation Average (inches)	Month	Monthly Precipitation Average (inches)
January	3.9	July	4.4
February	4.3	August	2.9
March	4.9	September	3.5
April	4.6	October	5.4
May	6.4	November	5.2
June	3.9	December	5.4

[1] Information obtained from the Southern Regional Climate Center website for Station ID 030220, Arkadelphia, Arkansas.

Methods of subgrade improvement, as described below, could include scarification, moisture conditioning and recompaction; removal of unstable materials and replacement with granular fill (with or without geosynthetics); and chemical modification. The appropriate method of improvement, if required, would be dependent on factors such as schedule, weather, the size of the area requiring ground improvement, and the nature of the instability. More detailed recommendations can be provided during construction as the need for ground improvement occurs. Performing site grading operations during warm seasons and dry periods would help to reduce the amount of ground improvement required.

If the exposed subgrade is unstable during proof-rolling operations, it could be treated using one of the methods outlined below.

- **Scarification and Recompaction** - It may be feasible to scarify, dry, and recompact the exposed soils. The success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Even with adequate time and weather, stable subgrade may not be achievable if the thickness of the soft soil is greater than 1 to 1-1/2 feet. The soil should be moisture conditioned and compacted to meet the requirements in Section **4.2.3 Compaction Requirements**.

- **Bridging Lifts -** Soil bridging lifts composed of imported crushed stone fill could be used in some instances to bridge unstable soils in the pavement area subgrade. A bridging lift should not be used in structural areas where shallow foundations and grade-supported slabs are planned. To use a bridging lift, the unstable soils should be excavated to allow a minimum of 18 to 24 inches of bridging material to be placed below the required minimum thickness of engineered fill. Where a bridge lift is needed, the undercut should be backfilled beginning with an 18- to 24-inch (loose thickness) lift. The top 8 inches of the bridge lift should be compacted to at least 95 percent of the maximum standard Proctor dry density (ASTM D 698). Remaining lifts required to raise grade to finished subgrade elevations should be placed and compacted as recommended in Section **4.2.3 Compaction Requirements**.

- **Crushed Stone** - Crushed stone or gravel could be used to improve subgrade stability. Typical undercut depths would range from 1 foot to 2 feet below finished subgrade elevation. The use of high modulus geotextiles (i.e., engineering fabric or geogrid) could also be considered after underground work such as utility construction is completed. Equipment should not be operated above the fabric or geogrid until one full lift of crushed stone fill is placed above. The use of this option is limited due to potential for this permeable material to allow moisture to penetrate to underlying fat clays.

  The maximum particle size of granular material placed over geotextile fabric or geogrid should not exceed 1½ inches. Geotextiles can also be considered for severe subgrade conditions during winter months. It should be expected that a minimum of 12 to 18 inches of select fill will be required with any geogrid application. The geogrid product manufacturer should recommend select fill gradation requirements.

- **Chemical Modification** – If the subgrade treatment required is relatively extensive, chemical treatment may be more practical than scarification and recompaction or undercutting and placement of crushed stone, with or without geotextiles. The use of hydrated lime or quick-lime could be considered for treating the soils at this site. We also recommend lime-treating the pavement subgrade soils. Terracon performed Eades-Grimes tests on three representative samples of the on-site fat clays to evaluate the amount of lime potentially necessary to reduce the soil plasticity. The results of these tests are presented in **Appendix B**. Based on the laboratory test results, we estimate 4 to 8 percent lime, by dry weight, could be necessary to reduce the plasticity to an acceptable magnitude. In some cases it might be necessary to re-treat the lime-treated soils to further reduce the plasticity.

  We recommend that a comprehensive mix design be performed with samples of the chemical agent to be used and the site soils. This will aid in optimizing the mix design and evaluating for potential negative reactions, such as sulfate-induced heave. Since these agents can vary significantly in terms of chemical composition, it will be important that samples of the actual proposed modifying agent be used in the laboratory mix design. With all chemical modification methods, proper mixing and control of clod sizes, moisture conditioning, and compaction are critical. We recommend that only experienced contractors perform chemical modification and that they provide detailed descriptions of their proposed procedures and equipment, as well as a list of projects successfully completed in the last 5 years.

Further evaluation of the need and recommendations for subgrade treatment can be provided during construction as the geotechnical conditions are exposed.

4.2.6 Utility Trench Backfill

All trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction. Utility trenches are a common source of water infiltration and migration. If utility trenches are backfilled with relatively clean granular material, they should be capped with at least 18 inches of cohesive fill to reduce the infiltration and conveyance of surface water through the trench backfill.

All utility trenches that penetrate beneath the building must be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the buildings and structures. We recommend constructing an effective clay “trench plug” that extends at least 5 feet out from the face of the building or structure exterior. The plug material should consist of clay compacted at a water content at or above the soil’s optimum water content, or low shrink grout. The clay fill should be placed to completely surround the utility line, be compacted in accordance with recommendations in this report and extend to the top of the trench.

4.2.7 Grading and Drainage

During construction, grades should be developed to direct surface water flow away from or around the site. Exposed subgrades should be sloped to provide positive drainage so that saturation of the subgrade is avoided. Surface water should not be permitted to accumulate on the site to reduce the potential for shrinking and swelling within the fat clay soils.

Final grades should be sloped away from the buildings and structures on all sides to promote effective drainage and prevent water from ponding. Downspouts should discharge water a minimum of 10 feet beyond the footprint of the buildings and structures. This can be accomplished through the use of splash-blocks and downspout extensions. Also, the interface between the building/structures and pavements or sidewalks should be effectively sealed to prevent water from infiltrating into the slab-on-grade and pavement subgrade.

4.2.8 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. In some areas, it may be necessary to strip and/or undercut the rutted and wet surface soils prior to performing ground improvement. Subgrade improvement techniques were discussed in detail in Section **4.2.2 Subgrade Improvement.**

The near-surface soils encountered at the site are 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. Dedicated haul roads should be used for controlling construction traffic on the building, structure, and pavement subgrades.

Temporary excavations will probably be required during grading and site development operations. The contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards.

Terracon should be retained during construction to observe earthwork and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of engineered fills; and just prior to construction of building floor slabs and foundations.

4.2.9 Excavations

Presently expected excavations into the on-site native fat clay soils, based on a finished grade elevation of 265 feet, can be conducted using conventional grading and excavating equipment. Excavation of the very stiff to hard fat clay will likely be more difficult, but should still be within the capability of medium- to heavy-tracked excavators and similar equipment.

4.2.10 Cut and Fill Slopes

Based on the preliminary finished grade elevation of 265 feet provided to us, we estimate maximum cuts of about 30 feet and possibly minor fills will be necessary for developing final grade. Permanent cut in the fat clay soils or fill slopes using the on-site fat clay soils should not exceed 6 Horizontal to 1 Vertical (6H:1V) unless evaluated for long-term slope stability. We recommend that slope stability analyses be performed on planned slopes for the deep cuts exceeding 10 feet in height or if steeper slopes are required.

Subject to a final evaluation of grades, some fill embankments or slopes might be constructed using low-volume change, new engineered fill. Fill slopes of engineered fill material should typically not exceed 3H:1V to satisfy acceptable factors of safety for long term stability. Fill slopes placed over a sloping native fat clay must consider potential for long-term “creep” movements typically associated with these over-consolidated marine clays. A slope stability analysis should be performed to evaluate the long-term stability of the planned cut and fill slopes at the facility once the design grades are more defined.

Soil slopes should be covered for protection from rain, and surface runoff should be diverted away from the slopes. For erosion protection, a protective cover of grass or other vegetation should be established on permanent soil slopes as soon as possible. Permanent cut or fill slopes should not exceed 3H:1V unless erosion protection measures beyond simple loaming and seeding are provided. Slopes of 4H:1V or flatter are usually considered acceptable from a maintenance/mowing safety perspective.

We recommend a minimum building/structure setback from the top of slopes of 10 feet. We recommend a minimum pavement setback from the top of slopes of 5 feet.

4.3 Foundation Considerations

The selection of the foundation system will depend on the sensitivity of the structure to settlement and movement, the support required for the structure, and the method and depth of construction. Shallow footing and mat foundations could be used to support relatively lightly loaded structures and buildings or structures that can tolerate movement of about 1 inch, provided the minimum 7-foot thick low volume change, low permeability engineered fill is constructed beneath them.

Deep foundations could be used to support heavily loaded structures and those sensitive to movement greater than 1 inch. Use of the deep foundations requires constructing the recommended low-volume change engineered fill layer to reduce the movement of pier or pile foundation caps, grade beams, and ground-supported slabs caused by volume changes in the on-site fat clays. As an alternative, structural slabs supported on deep foundations could also be used, incorporating void forms below the grade beams and slabs. Recommendations for drilled pier, augered-cast-in-place piles, and driven pile foundations are discussed in the respective subsections below. Other deep foundations (e.g., micropiles or helical piles) or ground-improvement alternatives (e.g., grout columns, rock columns, or aggregate piers) could be considered after more specific project information becomes available.

4.4 Shallow Foundations

By preparing the site as recommended in Section **4.2 Earthwork**, we expect that shallow foundation bearing materials will consist of at least 7 feet of tested and approved, low-volume change, new engineered fill. Footing and mat foundations bearing in new engineered fill could be used to support buildings and equipment structures. Shallow foundation design recommendations are presented in the following subsections.

4.4.1 Shallow Foundation Design Recommendations

Description	Column	Continuous
Maximum net allowable bearing pressure for dead load plus sustained live load	2,500 psf	2,500 psf
Minimum width	30 inches	16 inches
Minimum embedment below finished grade for frost protection [2]	24 inches	24 inches
Estimated total movement [3]	1 inch	1 inch
Estimated differential movement [3]	<1 inch between columns	<1 inch over 40 feet
Allowable passive pressure [4]	750 psf	
Coefficient of sliding friction [4]	0.35 (ultimate)	
Vertical modulus of subgrade reaction for mat foundations (pci)	13	

Continued from page 16

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Based on constructing a minimum 7-foot thick layer of low-volume change, engineered fill
2. For perimeter footings
3. Actual foundation movement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of low-volume change fill, and the quality of earthwork operations
4. The sides of the footing excavation must be nearly vertical and the concrete should be placed neat against the excavation sides for the passive earth pressure value to be valid. The allowable passive pressure is also applicable for backfill placed adjacent to formed foundations and constructed as discussed in Section **4.1.2 Compaction Requirements**. Passive resistance for exterior footings should be neglected in the upper 2 feet of the soil profile unless pavement is constructed directly against the building exterior. No factor of safety has been applied to the coefficient of sliding friction

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4.4.2 Shallow Foundation Construction Considerations

To evaluate the quality of the earthwork activities and check that soil bearing conditions compatible with the design value are achieved, we recommend that the footing excavations be observed and tested by a Terracon representative. The base of all foundation 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. Should the soils at bearing level become excessively dry, disturbed or saturated, or frozen, the affected soil should be removed prior to placing concrete. We recommend using a lean concrete mud-mat over the bearing soils if the excavations must remain open for an extended period of time.

4.5 Deep Foundations

Because of the understood structural loads and settlement tolerances of some of the planned structures, we are presenting some deep foundation options that could also be used to support the heavily loaded structures and structures sensitive to foundation movement.

4.5.1 Drilled Pier Foundations

4.5.1.1 Drilled Pier Design Recommendations

Straight-shaft or underreamed (belled) drilled pier foundations bearing in very stiff to hard, lean to fat clay soils or dense sands could be used to support the heavier building and structure loads. Preliminary design parameters for drilled pier foundations are presented in the following table, based on the generalized soil profile presented in Section **3.2 Typical Profile**. More specific design parameters can be provided for the structures after the final grades and locations are known.

Depth Below Finished Grade (ft)	Material Description / Effective Unit Weight (pcf)	Net Allowable End Bearing Pressure [1] (psf)	Allowable Side Friction [2] (psf)	Allowable Passive Pressure [2] (psf)	Undrained Shear Strength (psf)	Angle of Internal Friction (degrees)
0 to 5	New Fill / 115	Disregard Parameters				
5 to 28.5	New Fill and Stiff Native Fat Clay / 115	Not recommended	550	2,000	2,000	0
28.5 to 43.5	Very Stiff to Hard Fat Clay / 120	12,000	1,020	4,000	4,000	0
Below 43.5	Dense to Very Dense Clayey Sand / 120	20,000	1,100	3,000	0	32

1. The net allowable end bearing pressure refers to the pressure at the foundation bearing level in excess of the surrounding overburden pressure
2. The allowable side friction and passive pressure are based on a rectangular pressure distribution based on correlations from SPT N_{60}-values and laboratory test results averaged over the layer thickness

The design parameters presented in the above table are applicable for the natural undisturbed soils. The end bearing, skin friction, and passive resistance are allowable parameters with factors of safety of about three, two and two, respectively. The values given in the above table are based on the generalized soil profile observed at the borings and experience with similar soil types. Drilled pier foundations should extend at least 3 feet or one pier diameter, whichever is greater, into the bearing stratum to use the recommended allowable end bearing pressures.

Drilled piers should have a minimum shaft diameter of 24 inches. Underreamed piers should only be used if bearing in the fat clay soils. Underreamed piers should have a minimum bell-to-shaft diameter ratio of 2 to 1 and a maximum bell-to-shaft ratio of 3 to 1. The minimum bell diameter should be 36 inches. Some designers prefer to neglect the skin friction component for drilled and underreamed piers because of the difference in magnitudes of movement required to mobilize the skin friction and end bearing components.

If the low-volume change fill layer is not constructed in conjunction with the pier foundations, the drilled shafts will be subject to uplift as a result of heave in the fat clay soils surrounding the upper portion of the shaft. The magnitude of these loads varies with the shaft diameter, soil parameters, the in-situ moisture levels at the time of construction, and subsequent moisture changes. The shafts must contain sufficient continuous vertical reinforcing for the full length of the shaft to resist the net tensile load from soil-induced uplift as well as structural uplift. The uplift load caused by heave of the expansive soil can be approximated by assuming a uniform uplift of 1,100 psf for the stiff fat clay and 1,800 psf for very stiff to hard fat clay, over the shaft perimeter to a depth at least 7 feet from finished grade. Uplift would be resisted by the weight of the foundation and supported load, and by skin friction on the shaft below a depth of 7 feet. Uplift on underreamed piers would also be resisted by the weight of a soil wedge above the underream. The soil wedge can be assumed to extend upward from the bottom of the underream at a slope of 4 vertical to 1 horizontal.

Based on constructing the low volume change, low permeability engineered fill buffer, grade beams should extend a minimum of 24 inches below the final adjacent ground surface for confinement. Recommendations for grade beams and foundation caps in conjunction with structurally supported slabs are provided in Section **4.8 Structurally Supported Floor Slabs.**

Provided piers bear at least 3 feet, or one pier diameter, whichever is greater, into very stiff to hard fat clay or dense to very dense clayey sand soils and are spaced with at least three pier diameter clear separation between piers or the underreamed diameter, a group efficiency reduction factor is not necessary for end bearing or skin friction. We request the drilled pier design plan for our evaluation when it is available.

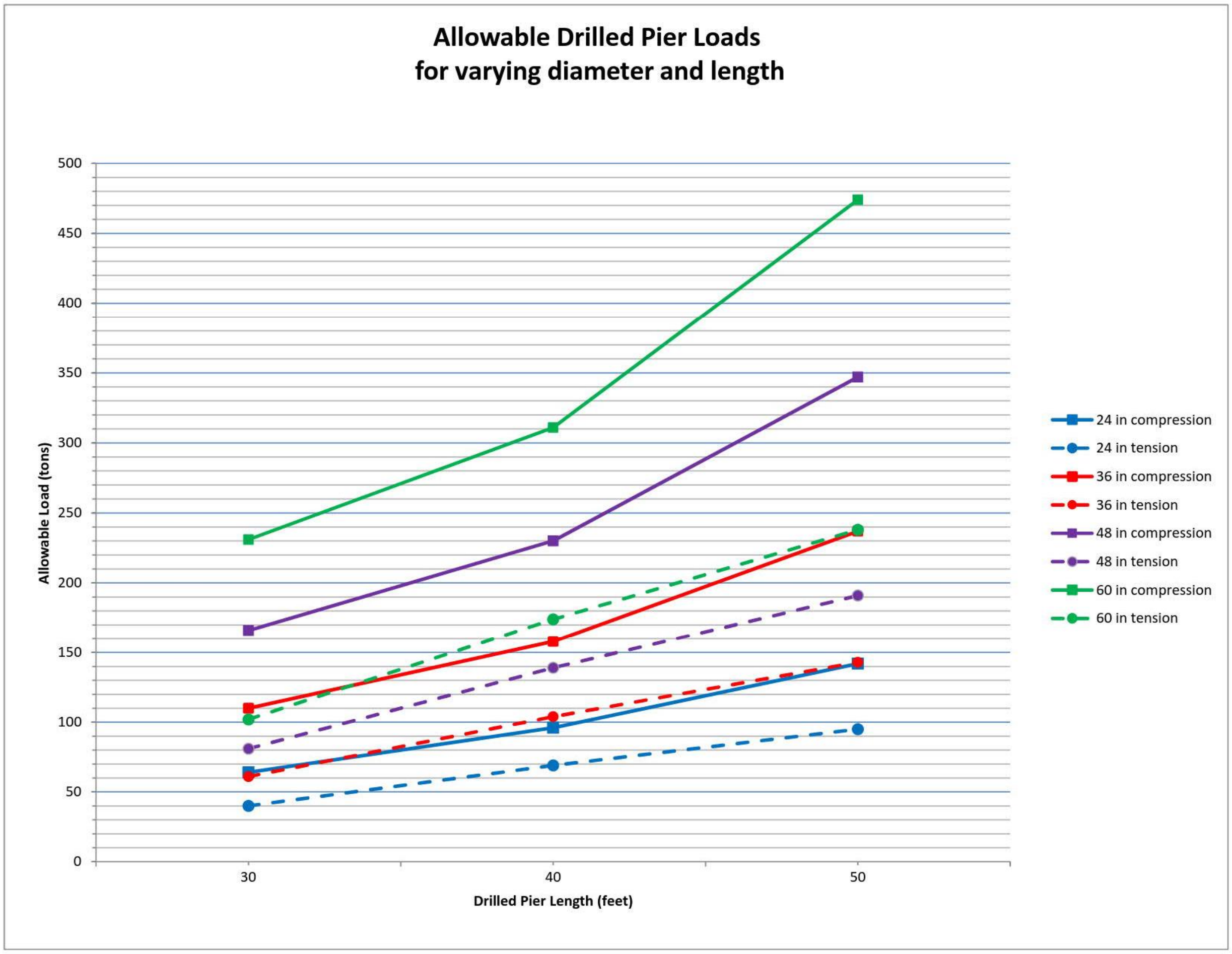
Long-term settlement of drilled pier foundations designed and constructed in accordance with the recommendations presented in this report should be on the order of 1 inch. Long-term differential settlement between piers should less than ½ inch.

4.5.1.2 Drilled Pier Axial Capacity

The analyses were performed in accordance with published methods to calculate axial capacity for drilled straight-shaft pier foundations. We utilized the a-method to determine the allowable skin friction in clay soils and b-method in clayey sand and silty sand. Skin friction for axial loading under compression and uplift conditions should be neglected within 5 feet of the final grade. For design of straight-shaft drilled piers under uplift conditions, the computed skin friction values in cohesive (clay) soils should be multiplied by 0.9 and in granular (sand) soils by 0.7. End bearing capacity was calculated using FHWA-NHI-10-016 *"Drilled Shafts Manual."* Drilled pier foundations should extend at least 3 feet or one pier diameter, whichever is greater, into the desired bearing stratum in order to use the recommended allowable end bearing pressures.

The graphical figure below summarizes the results of our analyses for straight shafts based on the generalized subsurface conditions observed at the boring locations and presented in Section **3.2 Typical Profile**. The figure presents the estimated allowable pier capacities, both in compression (resistance against loads pushing into the ground) and tension (resistance against loads pulling out of the ground). The figure summarizes the results for various diameter straight shafts bearing at depths of about 30 to 50 feet below final grade. The values represent the capacity of a single shaft and do not account for group effect of closely spaced shafts. It is recommended that Terracon be consulted if a large group of shafts will be required to support the proposed structures and the spacing between the drilled shafts will be less than three shaft diameters center-to-center.

A graphical summary of the allowable pier capacities for 24-inch, 36-inch, 48-inch, and 60-inch diameter, drilled straight-shaft pier foundations is provided below. The drilled pier load capacity values are based on a generalized soil profile below the existing ground surface, and this information is provided for conceptual planning and preliminary design. Since soil stratigraphy varies over the site, and since cut and fill will be required in various areas of the site, estimated load capacity values should be determined for specific structures at specific locations after more detailed design information is available.



4.5.1.3 Drilled Pier Lateral Capacity

The following table provides soil parameters (undrained conditions) for performing lateral capacity analyses using LPILE^{TM}.

Depth (feet)	Layer Description / Unit Weight (pcf)	L-Pile Material Type	Static Soil Modulus Parameter K, (pci)	Strain , E_{50} (in/in)
0 to 5	New Fill / 110	3 - Stiff clay without free water	425	0.010
5 to 28.5	New Fill and Stiff Native Fat Clay / 110	3 - Stiff clay without free water	620	0.007
28.5 to 43.5	Very Stiff to Hard Fat Clay / 110	3 - Stiff clay without free water	1,000	0.005
Below 43.5	Dense to Very Dense Clayey Sand / 110	4 - Sand	120	n/a

The response of deep foundations to lateral loads is not only dependent upon the soil material's horizontal subgrade reaction, but also on the shaft actual cross sectional features, effective length, stiffness, arrangement in the shaft cap with respect to direction of loading, and fix-head or free-head cap interaction conditions.

An analysis is usually performed to provide a lateral load that results in some limiting amount of deflection or to a specified maximum yield moment resistance of the pile/shaft. Shafts subjected to lateral and moment loading should be analyzed as part of the structural detailing. Tensile and lateral load resistance of deep foundation elements should be neglected unless the shafts are adequately reinforced.

A reduction in the lateral resistance of the shadowed shaft in a foundation designed with a shaft group (the lead shaft is not affected) should be considered when the shaft spacing in the direction of loading is less than 6 shaft diameters. Group action can be evaluated by reducing the lateral resistance of the shadowed shafts in the direction of loading as a function of the shaft spacing as follows:

Group Reduction Factors				
Pier Spacing (center-to-center, diameters)	**3D**	**4D**	**5D**	**≥6D**
Lead Row	0.7	0.85	1.0	1.0
2nd Row	0.5	0.65	0.85	1.0
3rd Row and higher	0.35	0.5	0.7	1.0

4.5.1.4 Drilled Pier Construction Considerations

The drilling contractor should be experienced in the subsurface conditions observed at the site, and the excavations should be performed with equipment capable of providing a clean bearing area. The drilled straight-shaft foundation should be installed in general accordance with the procedures presented in “Drilled Shafts: Construction Procedure and Design Methods,” Publication No. FHWA-NHI-10-016, FHWA GEC 010, May 2010 by the U.S. Department of Transportation Federal Highway Administration, and “Standard Specification for the Construction of Drilled Piers,” ACI Publication No. 336.1-01, 2011.

Groundwater was observed at a depth of about 26 to 50 feet below the ground surface during the field exploration, but these water level readings may have been influenced by water used as a drilling fluid for advancing the borings. Because water could likely be encountered while excavating the pier foundations, temporary casing or the slurry displacement method should be made available if the water cannot be effectively removed using suction pumps. If temporary casing is used, a sufficient head of plastic concrete having a minimum slump on the order of 6 inches should be maintained inside the casing as it is being withdrawn to prevent an influx of soil and debris into the excavation and concrete arching inside the casing. Slurry drilling will likely be necessary to complete pier excavations extending into the clayey sand and silty sand soils below water. To facilitate pier construction, concrete should be on-site and ready for placement immediately after each pier excavation is completed.

All disturbed material or water should be effectively removed from pier excavations prior to concrete placement.

For construction consideration, where the spacing between adjacent piers is less than a center-to-center distance of three times the larger pier diameter, we recommend waiting at least 24 hours after placing concrete in a pier before starting to drill an adjacent pier.

Because the subsurface conditions could likely vary away from the boring locations, we recommend that the geotechnical engineer or his representative observe the pier installations to evaluate the intended bearing material is observed and sufficiently penetrated.

4.5.2 Augered, Cast-In-Place Piles

Augered, cast-in-place (ACIP) piles (also identified as auger-cast piles) could be used to support the heavily loaded structures and structures sensitive to movement. ACIP piles are constructed by rotating a continuous flight of hollow-stem augers into the ground to a predetermined depth. Once the ACIP piles are drilled to the desired tip elevation, cement grout is then pumped through the auger stem as the auger is gradually withdrawn from the excavation. The result is a continuous grout column in the ground. After installation, footings or a mat foundation can be constructed above the ACIP piles to support the planned equipment structures.

An ACIP pile obtains most of its capacity in friction, as the concrete is cast directly against the soil over the entire pile length. End bearing also contributes partially to the pile capacity.

4.5.2.1 ACIP Pile Design Recommendations

Preliminary design parameters for ACIP pile foundations are presented in the following table, based on the generalized soil profile presented in Section **3.2 Typical Profile**. More specific design parameters can be provided for the structures after the final grades and locations are known.

Depth Below Finished Grade (ft)	Material Description / Effective Unit Weight (pcf)	Net Allowable End Bearing Pressure [1] (psf)	Allowable Side Friction [2] (psf)	Allowable Passive Pressure [2] (psf)	Undrained Shear Strength (psf)	Angle of Internal Friction (degrees)
0 to 5	New Fill / 115	Disregard Parameters				
5 to 28.5	New Fill and Stiff Native Fat Clay / 115	Not recommended	440	800	2,000	0
28.5 to 43.5	Very Stiff to Hard Fat Clay / 120	18,000	815	1,600	4,000	0
Below 43.5	Dense to Very Dense Clayey Sand / 120	30,000	1,040	2,400	0	32

1. The net allowable end bearing pressure refers to the pressure at the foundation bearing level in excess of the surrounding overburden pressure.
2. The allowable side friction and passive pressure are based on a rectangular pressure distribution based on correlations from SPT N_{60}-values and laboratory test results averaged over the layer thickness.

The design parameters presented in the above table are applicable for the natural undisturbed soils. The end bearing, skin friction, and passive resistance are allowable parameters with a factor of safety of about 2.5 and based on performing load tests to evaluate pile performance. The values given in the above table are based on our borings and experience with similar soil types. Lateral resistance and friction in the upper 3 feet should be ignored due to the potential effects of frost action and drilling disturbance.

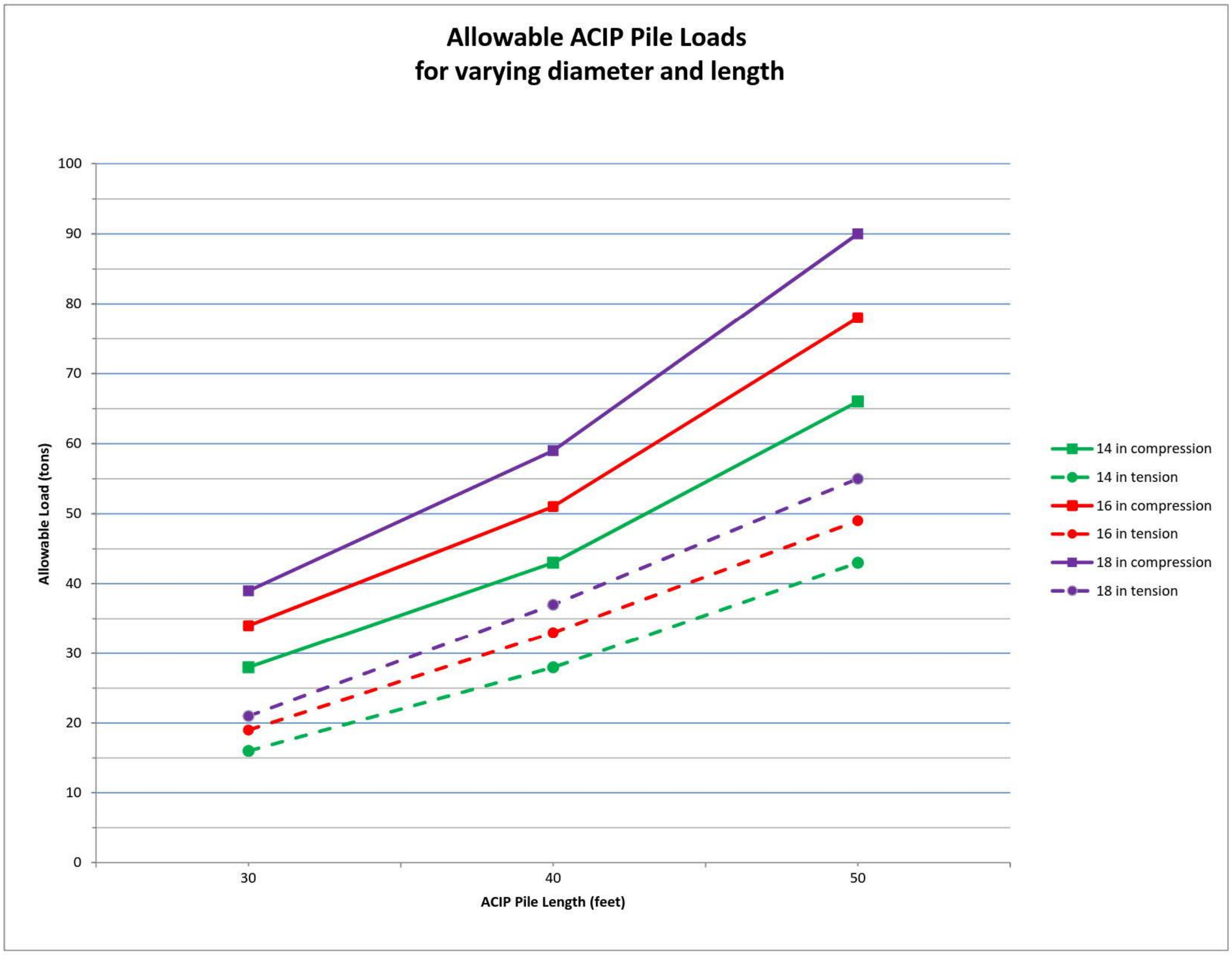
4.5.2.2 ACIP Pile Axial Capacity

We used the soil parameters presented in the table above for calculating the axial capacities of ACIP piles for varying diameters and lengths. The analyses were performed using FHWA-NHI-07-03 *"Design and Construction of Continuous Flight Auger Piles"* to calculate axial capacity for ACIP pile foundations. Skin friction for axial loading under compression conditions should be neglected within 3 feet of the final grade.

A graphical summary of the allowable ACIP pile compression capacities for 14-inch, 16-inch, and 18-inch diameter pile foundations is provided below. The graphical figure below summarizes the results of our analyses based on the generalized subsurface conditions presented in Section **3.2 Typical Profile**. The figure presents the allowable capacities in compression with a factor of safety of about 2.5. Piles in tension and lateral loading are discussed in the following subsection.

The figure summarizes the results for various diameter ACIP piles bearing at depths of about 30 feet, 40 feet, and 50 feet below the existing ground surface. The values represent the capacity of a single pile and do not account for group effect of closely spaced piles. It is recommended that Terracon be consulted if a large group of piles will be required to support the proposed structures and the spacing between the piles will be less than three shaft diameters center-to-center.

The ACIP pile load capacity values are based on a generalized soil profile below the existing ground surface, and this information is provided for conceptual planning and preliminary design. Since soil stratigraphy varies over the site, and since cut and fill will be required in various areas of the site, estimated load capacity values should be determined for specific structures at specific locations after more detailed design information is available.



The allowable tension capacity should be determined using a factor of safety of three, unless a static tension load test is performed. Note either tension or compression allowable resistance calculated with an appropriate factor of safety can be increased by 33 percent for maximum wind gust or other very transient load conditions (subject to verification of allowable structural capacity).

If the low-volume change fill layer is not constructed in conjunction with the ACIP pile foundations, the piles will be subject to uplift as a result of heave in the fat clay soils surrounding the pile. The magnitude of these loads varies with the shaft diameter, soil parameters, the in-situ moisture levels at the time of construction, and subsequent moisture changes. The pile shaft must contain sufficient continuous vertical reinforcing for the full length of the shaft to resist the net tensile load from soil-induced uplift as well as structural uplift. The uplift load caused by heave of the expansive soil can be approximated by assuming a uniform uplift of 1,100 psf for the stiff fat clay and 1,800 psf for very stiff to hard fat clay, over the shaft perimeter to a depth at least 7 feet from finished grade. Uplift would be resisted by the weight of the foundation and supported load, and by skin friction on the pile below a depth of 7 feet.

4.5.2.3 ACIP Pile Construction Considerations

We recommend that a minimum of two full-scale pile load tests be performed to evaluate the actual ACIP pile capacities at this specific site. The results of load tests on production-type piles can be analyzed to estimate unit skin friction (even though the piles are not instrumented) and, depending on the results, potentially justify the use of higher design capacities than computed. The piles for load testing should extend to a d depth similar to the proposed design depths of the piles at the site.

Load testing should consist of the installation of at least one pile per size/depth at each general test location using the installation methods planned for production piling. The contractor should be notified that overage factors achieved for the test piles should be consistent with those anticipated for their production piling. Production piling that exhibit overage factors that are notably less than those measured during the test pile program may require further evaluation of the production piles including additional PIT and possibly PDA Testing with a drop hammer to validate achieving the design capacity. The test piles should be loaded to a minimum of 250 percent and maximum 300 percent of its design capacity after verifying the grout strength, but not sooner than 7 days after installation. Ideally the piles should be loaded to produce top of pile movement as provided below to allow for an accurate interpretation of the ultimate capacity.

Pile Diameter (inches)	Minimum Top of Pile Movement for Load Test Interpretation (inches)
12	0.60
14	0.80
16	1.0
18	1.25

The load test should be implemented by the foundation contractor. However, Terracon should oversee the load testing program and validate our capacity predictions based upon the test results.

The piles can be designed to resist lateral loads using the parameters provided in **Section 4.3.2 Drilled Pier Lateral Capacity** for the lateral analysis using Ensoft's L-PILE program. The allowable passive pressures would apply to the projected diameter of the pile and require some movement to mobilize resistance. Reinforcing steel can be added to the pile to provide lateral load (i.e. bending) resistance. Group action for lateral resistance of piles should be taken into account when spacing is less than 8 diameters (center to center). For a group of piles oriented parallel to a lateral load, design parameters for allowable passive resistance should be reduced in accordance with the following table.

Pile Spacing (Diameters)	Reduction Factor
8D	1.0
6D	0.7
4D	0.4
3D	0.25

We recommend that the piles have an on-center spacing of at least three times the pile diameter. The minimum spacing should be maintained to prevent the pile group compression load capacity from being significantly less than the summation of individual pile capacities. This spacing restriction also serves to reduce the possibility of damaging previously installed piles. Augered cast-in-place piles should not be installed within six pile diameters center-to-center of a pile filled with concrete within the previous 24 hours. This is recommended to avoid possible grout intrusion between piles which could jeopardize the integrity of both piles. If closer pile spacing is required, we should be contacted to evaluate potential group effects.

Design of the piling as structural members should be in accordance with applicable building codes. Tensile and lateral load resistance of ACIP piles should be neglected unless the piles are adequately reinforced. In designing to resist uplift loading, 2/3 of the allowable side friction values provided in the design soil parameter table for compressive loading could be used along with the effective weight of the foundation. The installation of a long reinforcing cage can be problematic in ACIP piles. Therefore, it may be appropriate to thicken the mat or utilize other means of lateral support where more lateral resistance is needed.

Terracon can provide additional lateral and moment load analysis for individual piles and pile groups once detailed foundation design information becomes available. It is our experience that significant lateral load can be supported by ACIP piles, especially if the pile tops are fixed from rotation. Tensile reinforcement may be provided by installing a single reinforcing bar in the center of the pile, possibly through the auger stem prior to grouting.

Proper installation procedures are extremely important to the construction of competent piles. Since augered cast-in-place piles cannot be inspected after construction, a Terracon representative should observe ACIP pile installation on a full-time basis. It is critical that a sufficient volume of grout be continuously pumped at sufficient pressure to prevent suction from developing as the augers are withdrawn from the excavation. Suction can cause the mixing of soil and grout, disturbance of bearing soils, and collapse of the drilled hole. Improper grout injection and auger withdrawal techniques often result in low-capacity auger-cast piles. A pressure head of at least 10 feet of grout either above the injection point or above the water level, whichever is higher, should be maintained at all times during auger withdrawal so that the grout will have a displacing action and resist the movement of loose material into the hole. The auger withdrawal rate should not exceed 10 feet per minute. A computerized instrumentation system is typically available that monitors grout pressure, grout volume and auger depth simultaneously during pile installation. We recommend the contractor utilize this system to enhance our ability to provide quality assurance during pile installation.

Because the grout properties (especially flow) are critical in achieving a well-constructed pile, the grout should include additives that adequately control setting shrinkage. The grout must be fluid enough to be pumped easily and must flow without excessive pressure losses. For compression piles, a minimum grout strength of about 4,000 pounds per square inch (psi) is required. The grout strength and structural integrity of the pile section should be reviewed in conjunction with applicable codes and the expected load conditions.

The geotechnical engineer’s representative should also prepare grout cubes for laboratory compressive strength testing, and periodically check the pile installation equipment used in controlling and measuring the flow rate of grout into the piles.

Maximum long-term settlement of ACIP pile foundations, designed and constructed as recommended above, should be less than 1 inch, but should be confirmed by pile load testing. Differential settlements between piles could approach half the total settlement.

4.5.3 Driven Pile Foundations

4.5.3.1 Design for Axial Compressive Loads and Uplift

After appropriate ground improvements are achieved to mitigate the expansive clays, the structures could be supported on driven piles, if the site can be made accessible to the pile driving equipment. Based on the subsurface conditions observed at the boring locations, prestressed or reinforced concrete piles or steel piles could be considered. Steel piles are considered to be less affected by the shrinking and swelling of the fat clays than concrete or timber piles. The recommendations below are based on using steel H piles.

Driven piles will primarily develop load resistance through side friction between the pile and the surrounding soils and some load resistance through end bearing. This additional resistance has been included in our analysis. Design recommendations for driven pile foundations are presented in the following paragraphs.

Preliminary design parameters for driven piles foundations are presented in the following table, based on the generalized soil profile presented in Section **3.2 Typical Profile**. More specific design parameters can be provided for the structures after the final grades and locations are known.

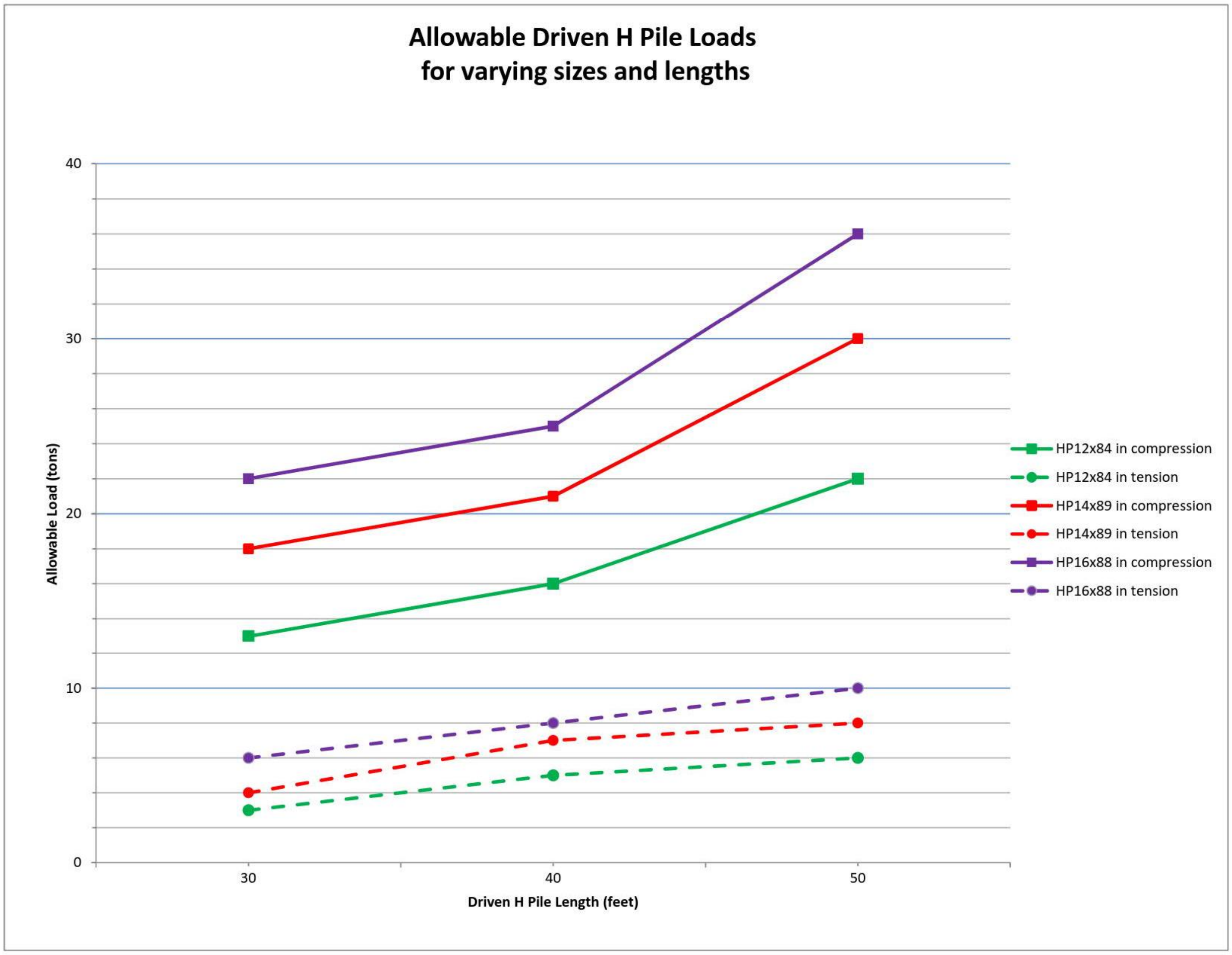
Depth Below Finished Grade (ft)	**Material Description / Effective Unit Weight (pcf)**	**Net Allowable End Bearing Pressure [1] (psf)**	**Allowable Side Friction [2] (psf)**	**Allowable Passive Pressure [2] (psf)**	**Undrained Shear Strength (psf)**	**Angle of Internal Friction (degrees)**
0 to 5	New Fill / 115	Disregard Parameters				
5 to 28.5	New Fill and Stiff Native Fat Clay / 115	Not recommended	500	1,750	2,000	0
28.5 to 43.5	Very Stiff to Hard Fat Clay / 120	16,000	530	3,500	4,000	0
Below 43.5	Dense to Very Dense Clayey Sand / 120	24,000	250	2,700	0	32

1. The net allowable end bearing pressure refers to the pressure at the foundation bearing level in excess of the surrounding overburden pressure
2. The allowable side friction and passive pressure are based on a rectangular pressure distribution based on correlations from SPT N_{60}-values and laboratory test results averaged over the layer thickness

The design parameters presented in the above table are applicable for the natural undisturbed soils. The end bearing, skin friction, and passive resistance are allowable parameters with factors of safety of about 2.25. The values given in the above table are based on the generalized soil profile observed at the borings and experience with similar soil types.

The graphical figure below summarizes the results of our analyses based on the generalized subsurface conditions observed at the boring locations and presented in Section **3.2 Typical Profile**. The figure presents the estimated allowable pile capacities, both in compression (resistance against loads pushing into the ground) and tension (resistance against loads pulling out of the ground). The figure summarizes the results for various pile sizes bearing at depths of about 30 to 50 feet below final grade. The values represent the capacity of a single pile and do not account for group effect of closely spaced piles. It is recommended that Terracon be consulted if a group of piles will be required to support the proposed structures and the spacing between the drilled piles will be less than three pile diameters center-to-center.

A graphical summary of the allowable pile capacities for driven HP12x84, HP14x89, and HP16x88 pile foundations is provided below. The H-pile load capacity values are based on a generalized soil profile below the existing ground surface, and this information is provided for conceptual planning and preliminary design. Since soil stratigraphy varies over the site, and since cut and fill will be required in various areas of the site, estimated load capacity values should be determined for specific structures at specific locations after more detailed design information is available.



Other capacities could be obtained with different pile types, cross-sectional areas and lengths.

A reduction factor of 0.7 should be applied to the average ultimate side friction for designing driven piles in tension.

The H piles can be designed to resist lateral loads using the parameters provided in **Section 4.3.2 Drilled Pier Lateral Capacity** for the lateral analysis using Ensoft's L-PILE program. The allowable passive pressures would apply to the projected diameter of the pile and require some movement to mobilize resistance.

4.5.3.2 Installation

We recommend piles be spaced on-center no closer than three times the pile width; and no less than approximately 3 feet. The minimum spacing should be maintained to prevent the pile group compression load capacity from being significantly less than the summation of individual pile capacities. This spacing restriction also serves to limit surface heave and to reduce the possibility of damaging previously installed piles or structures.

At least two indicator piles should be driven prior to ordering production piles. Indicator pile installation should be observed by the geotechnical engineer. The results of the indicator pile driving can be used to evaluate driving resistance, termination criteria, and pile length. The indicator piles can be part of the design pile layout.

A load test is recommended on one of the indicator piles prior to ordering production piles, to verify the planned embedment depth and the contractor's installation methods can produce a pile foundation that will achieve design capacity and perform satisfactorily. The geotechnical engineer should be retained to select the indicator pile to be load tested, observe, analyze and report the load test results, and develop recommendations for production foundation depths and installation procedures. The load test should be performed in general accordance with ASTM D 1143. Accurate deflection measurements should be made using at least two independent systems. The same pile-driving rig and hammer should be used to drive indicator and production piles.

We recommend that piles be driven to the dynamic driving resistance required for the recommended design capacity. The driving resistance should be determined by a wave equation driving analysis performed by the geotechnical engineer. Driving should be terminated immediately if refusal (i.e., 10 blows per inch for concrete) is reached to prevent damaging the piles. The pile foundation system and pile hammer information should be provided to Terracon for wave equation driving analysis.

The installation of a pile foundation system should be in accordance with the local and state requirements and be monitored by the geotechnical engineer. The geotechnical engineer's representative should verify and record all aspects of the installation. In general, the representative should:

- Be familiar with all aspects of the installation
- Be present continuously during driving
- Record the dimensions of each pile, locate, and report any obvious defects
- Count and record the blows for each foot of driving

- Record energy rating of hammer and adjust where appropriate for chamber pressure, such as in the case of a diesel hammer
- Have knowledge of soil conditions at the site and the minimum required penetration of each pile
- Be cognizant of intended pile support mechanisms on which to base acceptance or rejection or pre-drilling, etc.

Long-term settlement of driven pile foundations, designed and constructed as recommended above, is estimated to be less than 1 inch but should be confirmed by pile load testing. The estimated settlement for a pile group will be greater than that for an individual pile, and will depend on element capacity, pile group capacity, pile group orientation, and tip bearing level. Other driven pile group sizes, tip elevations and foundation pressures could be considered.

4.6 Seismic Considerations

The International Building Code (IBC) requires structural design to be in accordance with the appropriate site class definition for soil profile type. Based upon the Site Class Definitions in IBC 2012, Section 1613.3.2, which refers to ASCE 7, Chapter 20, Table 9.4.1.2, and the average shear wave velocity of 1,200 ft/s and 1,230 ft/s derived from our seismic survey data, as shown in **Exhibits A-28** and **A-29**, Terracon recommends a Class C seismic site classification for design.

The average shear-wave velocity analysis and recommendations presented in this report are based upon the data obtained from the seismic refraction survey performed at the indicated locations and on the indicated date. This analysis does not reflect variations that may occur across the site, or variations that may occur throughout the year, such as groundwater fluctuations. The refraction microtremor method is an approximate method, and one of many methods that can be used to determine shear-wave velocities. There are other costlier methods that can be used to further increase the accuracy of the seismic site classification and shear-wave profile.

Code Used	Site Classification
2012 International Building Code (IBC) [1]	C [2]
Ground Motion Parameter	**Value (g) [3,4]**
S_S	0.232
S_1	0.109
S_{MS}	0.279
S_{M1}	0.184
S_{DS}	0.186
S_{D1}	0.123

Continued from page 31

1. Site Class defined in general accordance with Chapter 20 of ASCE 7 per 2012 IBC
2. Chapter 20 of ASCE 7 uses a site soil profile determination extending to a depth of 100 feet for seismic site classification. The borings performed for this report extended to a maximum depth of about 80 feet. Average shear wave velocities of 1,200 ft/sec and 1,230 ft/sec for a 100-foot depth profile were derived from our seismic survey data. This seismic site class definition considers a very dense soil and soft rock profile
3. Latitude 34.778 and Longitude -92.181 degrees
4. The U.S. Seismic Design Maps tool developed by the USGS was utilized to develop these seismic parameters

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4.6.1 Earthquake Considerations

The New Madrid Fault system extends about 120 miles southward from the area of Charleston, Missouri and Cairo, Illinois, through New Madrid and Caruthersville, generally following Interstate 55 to Blytheville and down to Marked Tree, Arkansas. The fault is active and reportedly averages more than 200 measured events per year (1.0 or more on the Richter scale), or about 20 per month. Tremors large enough to be felt (2.5 to 3.0 on the Richter scale) typically occur annually. The New Madrid fault system was responsible for the major 1811 and 1812 New Madrid Earthquakes that caused severe damage throughout the regional Mississippi Valley. A major earthquake, 7.5 or greater, is predicted to occur in this area about every 200 to 300 years (the last in 1812).

The New Madrid Fault system is considered to be active and particularly affects loose granular soils and soft clays. Granular soils beneath the groundwater level are susceptible to pore water pressure increase during earthquake events. Increases in pore pressure can cause liquefaction, which results in a significant decrease of soil shear strength. Based on the subsurface conditions observed at the boring locations, the medium stiff to hard fat clay, medium dense to very dense clayey sand and silty sand soils are not liquefiable.

4.6.2 Dynamic Properties/Soil Stiffness

This section addresses dynamic soil properties and other soil properties requested for design of foundations. The average shear-wave velocity analysis and recommendations presented in this report are based upon the data obtained from multi-channel analysis of surface waves (MASW) seismic refraction methodology. This analysis does not reflect variations that may occur across the site. The MASW method is an approximate method, and one of many methods that can be used to evaluate shear-wave velocity profiles. Other more comprehensive methods exist (such as down-hole seismic profiling) that can be used to further increase the accuracy of the seismic site classification and shear-wave profile.

- A shear wave velocities (V_s) profile was obtained within the native soils using MSAW modeling approach which is outlined in this report. The shear wave velocity increased with depth and ranged from approximately 510 to 2,440 feet per second (ft/s), with a weighted average of around 1,200 feet/second in the top 100 feet.

- Poisson's ratio and damping ratio were estimated based on the soil type and estimated depth to groundwater data.

Dynamic Soil Properties				
Parameter	**Depth Range [1] (feet)**			
	0 – 18	**18 – 35**	**35 – 60**	**60 – 100**
Interpreted average shear wave velocity, Vs (ft/s)	510	1,000	1,400	2,500
Estimated low-strain shear modulus, Gmax [2](ksf)	905	3,600	7,300	22,000
Estimated damping ratio [2]	0.03	0.03	0.03	0.01
Estimated Poisson's ratio, v	0.4	0.4	0.4	0.4
Low-strain Young's modulus, E_0 [2] (ksf)	2,500	10,800	20,400	61,600

1. Approximate depth below existing grade at the time of our field activities
2. Low-strain shear modulus (< 5×10^{-4} strain level), Gmax = ρV_s^2 and low strain damping ratio
3. Low-strain Young's modulus, $E_0 = 2G_0(1+v)$

The geotechnical parameters outlined above should be considered approximate and are based upon values obtained from MASW profiling and the referenced analytical methods. The parameters obtained from these analyses are subject to the inherent variability of the soil profile and idealized methods used in the analysis. The above values have no factor of safety included. Variations of the soils and their engineering properties are likely to occur across the site that could result in deviations from the parameters discussed in this report. Dynamic analysis of foundations typically is an iterative process between the structural engineer and the geotechnical engineer and is highly dependent on the levels of strain assumed in the analysis.

4.7 On-Grade Floor Slabs

Some of the structures are expected to have floor slabs-on-grade. Soil stratigraphy within the construction areas is expected to consist of expansive fat clays. As indicated previously, the potential vertical rise (PVR) at finished grade is expected to be in the range of 6 to 7 inches. To reduce the PVR to an acceptable value for construction of slabs-on-grade, a minimum 7-foot thick layer of low-volume change, low permeability new engineered fill should be constructed as recommended in Section **4.2 Earthwork**. Our recommendation for floor slabs-on-grade are presented in the following table.

Item	Description
Floor slab support	At least 7 feet of tested and approved, new engineered fill per Section **4.2 Earthwork**
Modulus of subgrade reaction	100 pounds per square inch per in (psi/in) for point loading conditions
Aggregate base course/capillary break [2]	4 inches of free draining granular material or as required by design

1. Upon completion of grading operations in the facility and building areas, care should be taken to maintain the recommended subgrade moisture content and density prior to construction of the slabs-on-grade. If the subgrade should become desiccated prior to construction of the slabs-on-grade, the affected material should be removed or the materials scarified, moistened, and re-compacted
2. The floor slab design should include a capillary break, comprised of free-draining, compacted, granular material. Free-draining granular material should have less than 5 percent fines (material passing the #200 sieve)

Control joints should be saw-cut in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or any cracks that develop should be sealed with a water-proof, non-extruding compressible compound.

The use of a vapor retarder should be considered beneath concrete slabs-on-grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment or materials sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

4.8 Structurally Supported Slabs

If it is desired to support the building slabs and structures on a structurally supported slab system, a minimum void space of 12 inches is recommended beneath all components of the slab and grade beam system to prevent movement of those components if the fat clay soil swells.

The minimum void space can be provided by the use of cardboard carton forms, or a deeper crawl space. The bottom of the void should preferably be higher than adjacent exterior grades. The subgrade surface below the floor system should be sloped to appropriate drainage outlets to reduce the possibility of water accumulation in the void space.

A high humidity environment in the void space could result in moisture penetration into the concrete floor slab, which might cause distress to floor coverings or equipment and materials that are sensitive to moisture. Therefore, prevention of a high humidity environment should be included in the design.

A ventilated and drained crawl space is preferred under the building for several reasons, including the following:

- Ground movements will affect the project utilities, which can cause breaks in the lines and distress to interior fixtures
- A crawl space permits utilities to be hung from the superstructure, which greatly reduces the possibility of distress due to ground movements. It also can provide ready access in the event repairs are necessary
- Ground movements are uneven. A crawl space can be positively drained preventing the ponding of water and reducing the possibility of distress due to unexpected ground movements

Proper construction of the voids and soil retainers is very important. If a cardboard carton system is used on this project, we recommend that the carton form supplier provide, during initial concrete operations, a representative to instruct the work force on the proper installation methods for both the forms and the concrete.

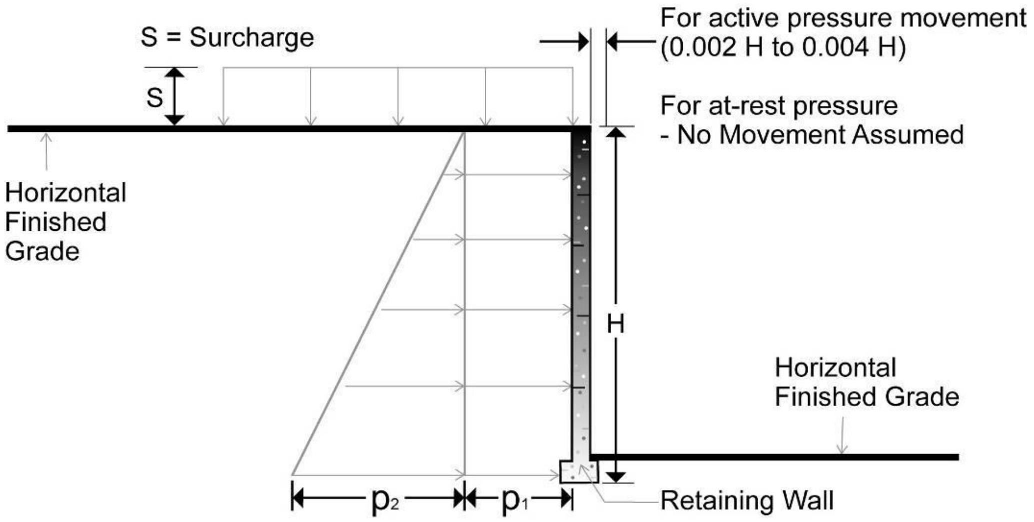
4.8.1 Grade Beams / Pier and Pile Caps in Conjunction with Structural Slabs

A minimum void space of 12 inches is recommended between the bottom of grade beams or pier/pile cap extensions and the subgrade. This void will serve to reduce distress resulting from swell pressures generated by the fat clay soils. Structural cardboard forms are one acceptable means of providing this void beneath cast-in-place elements. Soil retainers should be used to prevent infilling of the void.

The grade beams should be formed rather than cast against earth trenches. Backfill against the exterior face of grade beams, wall panels and pier caps should be low volume-change, low permeability engineered fill placed and compacted as described in Sections **4.2.3 Engineered Fill Material Types** and **4.2.4 Compaction Requirements**.

4.9 Lateral Earth Pressures

Reinforced concrete walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement such as walls for the receiving tunnel structure. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls or for pressures from swell of fat clays that may be present behind walls.



Earth Pressure Coefficients

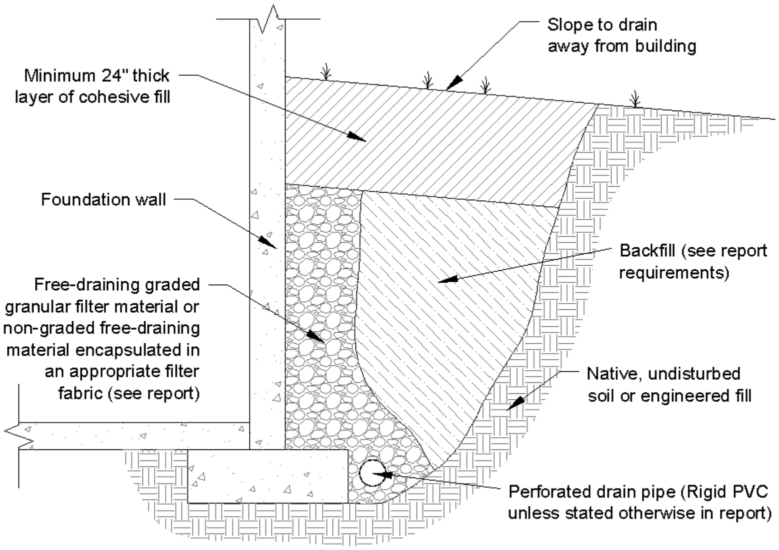
Earth Pressure Conditions	Coefficient for Backfill Type	Equivalent Fluid Density (pcf)	Surcharge Pressure, p_1 (psf)	Earth Pressure, p_2 (psf)
Active (Ka)	Granular - 0.33 Lean Clay Fill - 0.42	40 50	(0.33)S (0.42)S	(40)H (50)H
At-rest (Ko)	Granular - 0.50 Lean Clay Fill - 0.58	60 70	(0.50)S (0.58)S	(55)H (70)H
Passive (Kp)	Granular - 3.0 Lean Clay Fill - 2.4	360 288	--- ---	--- ---

Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 H to 0.004 H, where H is wall height
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance
- Uniform surcharge, where S is surcharge pressure
- In-situ soil backfill weight a maximum of 120 pcf
- Horizontal backfill, compacted between 95 and 98 percent of standard Proctor maximum dry density
- Loading from heavy compaction equipment not included
- No hydrostatic pressures acting on wall
- No dynamic loading
- No safety factor included in soil parameters

- Ignore passive pressure in frost zone

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 degrees from vertical for the active and at-rest cases, and 60 degrees for the passive case. To calculate the resistance to sliding, a value of 0.35 should be used as the ultimate coefficient of friction between the footing and the underlying soil.



Because of the potential for water to collect behind the foundation wall and cause the high plasticity fat clay soils to swell, the fat clay soils should be undercut and replaced at least 4 feet below the design bottom of wall foundation with low volume-change, low permeability engineered fill.

To control hydrostatic pressure behind the wall we recommend that a drain be installed at the foundation wall with a collection pipe leading to a reliable discharge.

- Granular backfill in this case consists of ASTM D 448 No. 57 or 67 stone or equivalent
- Perforated pipe should be rigid PVC, sized to transport the expected water
- Exterior ground surface should consist of a 24-inch clay cap sloped to drain from the wall
- The clay cap can be replaced by a pavement section
- Weep holes can be considered in lieu of the perforated drain pipe for retaining walls if the water seepage will not impact adjacent structures

If drainage is not possible, then combined hydrostatic and lateral earth pressures should be calculated for lean clay backfill using an equivalent fluid weighing 90 and 100 pcf for active and at-rest conditions, respectively. For granular backfill, an equivalent fluid weighing 75 and 85 pcf should be used for active and at-rest conditions, respectively. These pressures do not include the influence of surcharge, equipment or floor loading, which should be added. Heavy equipment should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures exceeding those provided.

4.10 Corrosivity

Chemical analyses have been completed on selected samples from the on-site soils. Laboratory testing included pH, resistivity and chloride and sulfate content tests to provide an indication of the corrosion potential of the soils against steel, and sulfate attack on concrete. The results of this testing are tabulated below and presented in Exhibit B-16 Chemical Laboratory Test Report in Appendix B.

Corrosion Potential of Soils

Test	Bulk Sample BH-11 1 to 3 feet	Bulk Sample BH-12 1 to 3 feet	Bulk Sample BH-20 1 to 3 feet	Units	Method
pH	7.83	5.16	5.37	pH	AWWA 4500 H
Water soluble sulfate	182	556	96	mg/kg	ASTM D 516
Water soluble chloride	125	100	100	mg/kg	ASTM D 512
Soil resistivity	611	1,465	2,255	ohms-cm	ASTM G 57
Oxidation-reduction potential (Redox)	+723	+658	+776	mV	ASTM D 1498

Based on our review of published soils information and the results of the pH, redox and resistivity testing, it appears that the on-site soils have a high steel corrosive potential per the DIPRA scale. Corrosion protection measures, such as cathodic protection, should be considered to protect underground metal piping and tanks that will be exposed to the native soils. The soil resistivity of the native soils should be re-evaluated once the final grading is known if buried metal structures are anticipated to be in contact with the native soils. We recommend that a certified corrosion professional be employed to determine the need for corrosion protection and to design appropriate protective measures.

Based on soluble chloride and sulfate content test results for the on-site soils, the soils are considered to have mild but positive sulfate exposure. The source appears to be low solubility gypsum (calcium sulfate), observed as crystals in some of the soil samples. We recommend that a certified concrete professional be employed to determine the need for sulfate protection and to design appropriate protective measures. Type I cement is commonly used in this region in Arkansas where the project site is located, and is appropriate for this project according to ACI 318, Table 4.3.1.

Materials from off-site borrow sources were not tested. We can also perform chemical testing on proposed imported fill.

4.11 LSI Findings

Two soil samples were collected from Borings BH-13 and BH-31 as part of the requested Limited Site Investigation (LSI). The soil samples were placed in laboratory-prepared glassware, sealed with custody tape and placed on ice in a cooler which was secured with a custody seal. The sample cooler and completed chain-of-custody forms were relinquished to Arkansas Analytical, Inc. in Little Rock, Arkansas.

Soil sampling results were compared to EPA Regional Screening Levels (RSLs) for an industrial setting. Concentrations of TPH in soil were compared to the Arkansas Department of Environmental Quality (ADEQ) Hazardous Waste Division recommended screening levels.

Based on the soil analytical results, VOCs, PAHs, RCRA metals, TPH (DRO/GRO), and PCB constituents were not detected above the laboratory detection limits in the submitted soil samples, with the exception of arsenic, barium, chromium, and lead metal levels. The analytical results table and laboratory report for the soil samples are presented in Exhibits B-17 and B-18. Arsenic, barium, chromium, and lead metal levels exceeded the detection limits. However, these metals are naturally occurring, and are within the range of the EPA Regional Screening Levels.

4.12 Pavements

4.12.1 Subgrade Preparation

Based on the subsurface conditions encountered at the boring locations and preparing the subgrade as recommended in Section **4.2 Earthwork**, the pavement subgrade materials should consist of at least 3 feet of tested and approved, low-volume change, low permeability new engineered fill.

Within 2 days before placing aggregate base, we recommend the moisture content and density of the top 8 inches of the subgrade be evaluated and then the subgrade should be proof-rolled. Areas not in compliance with the required ranges of moisture or density should be moisture conditioned and compacted. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted fill.

4.12.2 Pavement Design Considerations

Recommended pavement sections for parking areas and drives are included in the below table. The alternative minimum pavement sections are based on the completed subgrade having a CBR value of 3 percent and a modulus of subgrade reaction (k) of 100 psi/in. Imported fill materials should have the ability to achieve a minimum CBR value of 3 percent and meet the other requirements for engineered fill recommended in Section **4.2 Earthwork**. In no case should soils classifying as ML, CL-ML, or SM according to the Unified Soil Classification System be used as engineered fill in pavement areas.

The light-duty pavement sections assume that light-duty parking areas will be traveled by only automobiles and pick-up trucks totaling less than 100 vehicles per day. The heavy-duty pavement section for entrances, truck drives and truck parking areas is based on one hundred 25-ton semi-tractor trailer units per day for a 5-day work week. If the anticipated traffic exceeds our assumptions, please contact Terracon so that the recommended pavement sections can be re-evaluated and modified if necessary.

Long-term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing preventive maintenance. The civil engineer should consider the following recommendations in the design and layout of pavements:

- Site grading at a minimum 2 percent grade away from the pavements
- The subgrade and the pavement surface have a minimum 1/4 inch per foot slope to promote effective surface drainage
- Joint sealant should be applied to cracks
- Effective perimeter drainage should be constructed
- All landscaped areas in or adjacent to pavements should be sealed to reduce or prevent moisture migration to subgrade soils
- Low permeability backfill should be compacted against the exterior side of curb and gutter
- Curb, gutter and/or sidewalk should be placed directly on engineered fill subgrade materials rather than on unbound granular base course materials

4.12.3 Estimates of Minimum Pavement Thickness

Traffic Area	Pavement Section[1]	Minimum Recommended Pavement Section Thickness (in.)				
		Asphalt Surface Course[2]	Asphalt Binder Course[2]	Portland Cement Concrete[2] (4,000 psi)	Aggregate Base[2]	Total Thickness
Light-duty	I	3	---	---	8	11
	II	---	---	5	4[3]	9
Heavy-duty	I	3	4.5	---	8	12.5
	II	---	---	9	4[3]	13

1. Pavement Section I = Asphaltic Concrete over Aggregate Base
   Pavement Section II = 4,000 psi, Air Entrained Portland Cement Concrete (PCC)
2. Arkansas State Highway and Transportation Department Standard Specifications for Highway Construction
3. The aggregate base layer could be omitted if a minimum 24-inch thick layer of lime-treated subgrade is constructed

These pavement sections are considered minimal sections based upon the expected traffic and the existing subgrade conditions. Their satisfactory performance will require that timely maintenance be performed and effective drainage be developed and maintained.

Asphaltic concrete should conform to the requirements for asphaltic concrete hot mix binder course (25 mm) and surface course (12.5 mm) in Sections 406 and 407, respectively, of the AHTD *Standard Specifications for Highway Construction,* 2014 Edition. The aggregate base course should consist of crushed stone that conforms to the requirements for Class 7 aggregate base in Section 303 of the 2014 AHTD specifications. Concrete should conform to the requirements for Portland Cement Concrete Pavement in Section 501 of the AHTD Specifications. To improve the subgrade conditions, use of lime could be considered as a treatment technique, as outlined in Section 301 of AHTD Specifications. Laboratory evaluation is recommended to determine the effect of chemical treatment on subgrade soils prior to construction.

We recommend all portland cement concrete pavement details for joint spacing, joint reinforcement, and joint sealing be prepared in accordance with American Concrete Institute (ACI 330R and ACI 325.9R, current editions). Portland cement concrete pavements subjected to heavy trucks should be provided with mechanically reinforced joints (doweled or keyed) in accordance with ACI 330R, current edition.

4.13 Rail Bed Recommendations

4.13.1 Fill Material Characteristics and Compaction Requirements

The fill material characteristics and compaction requirements for rail bed fill materials should meet the requirements presented in Sections **4.2.3** and **4.2.4**. We recommend constructing a minimum 3-foot thick layer of low volume-change, low permeability engineered fill for the rail bed within the facility footprint. Depending on final grade, overexcavation and replacement of the fat clay soils with engineered fill could be required. Lime-treated soils could be considered to provide uniform support and reduce the potential for volume changes with variations in moisture content within the medium to high plasticity fat clay soils. The rail bed materials between the facility and the existing rail can consist of on-site soils provided they are constructed as recommended in this report.

4.13.2 Earthwork Construction Considerations

Final grade and embankment surface should be sloped to properly drain away from the base of the embankment to prevent ponding of water. Per Chapter 1 of AREMA guidelines, this slope should be a minimum of 2 percent. In periods of dry weather, the surficial soils may be of sufficient strength to allow fill construction on the stripped and grubbed ground surface. However, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wet or subjected to repetitive construction traffic. The use of low ground pressure construction equipment would aid in reducing subgrade disturbance. The use of remotely operated equipment, such as a backhoe, would be beneficial to perform cuts and reduce subgrade disturbance. If unstable subgrade conditions are encountered, ground improvement measures, as described in Section **4.2.2 Ground Improvement** will need to be used.

The completed rail bed surface should be graded to promote drainage of surface water away from the track bed at a minimum slope of 2 percent away from the crown point. If the clay soil subgrade should become frozen, desiccated, saturated, or disturbed prior to placement of the subballast/ballast, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to subballast/ballast placement.

Upon completion of filling and grading, care should be taken to maintain the rail bed moisture content prior to the placement of the subballast/ballast. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared rail bed or in excavations. If the rail bed should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to construction.

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade/rail bed preparation; proof-rolling; placement and compaction of controlled compacted fills; and backfilling of excavations into the completed subgrade.

4.13.3 Permanent Slopes

Based on the preliminary grading, cut slopes into predominantly native fat clay soils are expected to construct the new railroad track bed. Permanent slopes for the track bed should be designed and constructed as recommended in Section **4.2.10 Cut and Fill Slopes**.

4.13.4 Track Subgrade

We recommend the clay soil track rail bed be proof-rolled prior to placement of final ballast or subballast. Proof-rolling should be accomplished using a loaded tandem axle dump truck or scraper. We recommend proof-rolling equipment have a minimum gross weight of 20 tons. Soft spots identified by proof-rolling should be remediated as described previously.

The on-site fat clay soils have high swell potential, low permeability (and thus poor internal drainage), low strength when saturated, and are moderately susceptible to frost action. If compacted with moisture and density control as recommended in this report, clay soils can be used to construct embankments. However, clay soils must be placed within a relatively narrow moisture range in order to achieve the recommended compaction. Soils that are too wet or too dry cannot be compacted to the recommended densities. If soils that comprise the subgrade are wet and/or unstable, it will not be possible to achieve compaction of soils placed on top of unsuitable materials. Soft, unstable soils, where encountered, can be addressed as outlined in Section **4.2 Earthwork**.

4.14 Track Sections

No track design information was available at the time of preparing this report. We anticipate that the ballast and subballast thickness are being designed by others as design plans are developed. Railroad ballast section thickness design should be developed in general accordance with the AREMA Chapter 1 and UPRR requirements. We would be pleased to assist you with the design, if requested.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, 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. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

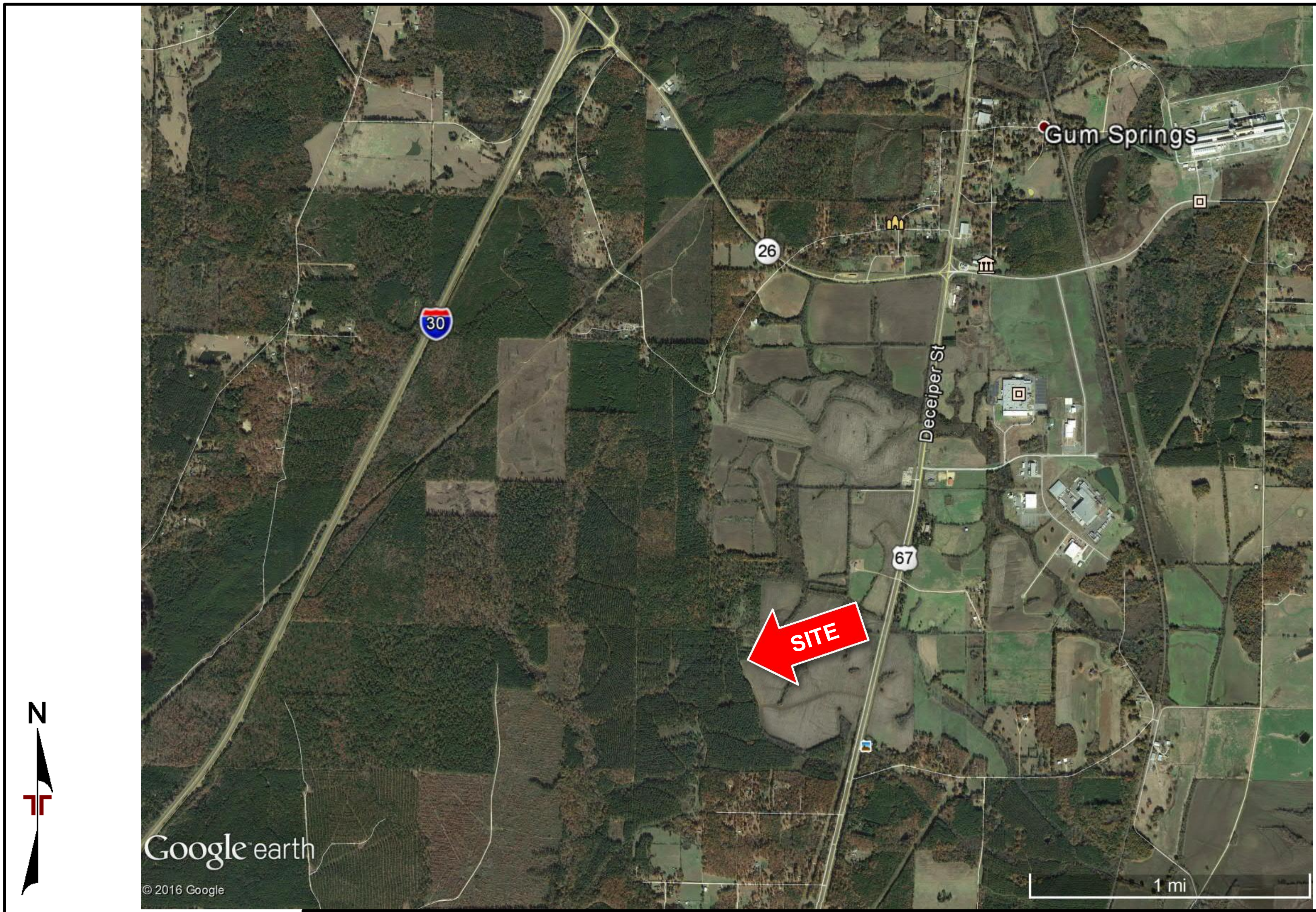
The average shear-wave velocity analysis and recommendations presented in this report are based upon the data obtained from the seismic refraction survey performed at the indicated location and on the indicated date. This analysis does not reflect variations that may occur across the site, or variations that may occur throughout the year, such as groundwater fluctuations. The refraction microtremor method is an approximate method, and one of many methods that can be used to determine shear-wave velocities. There are other costlier methods that can be used to further increase the accuracy of the seismic site classification and shear-wave profile.

As with any geophysical testing method, the processes rely on instrument signals to indicate physical conditions in the field. Signal information can be affected by on-site conditions beyond the control of the operator such as but not limited to, soil types, soil moisture, and/or ambient site activity. Interpretation of those signals is based on a combination of known factors combined with the experience of the operator and geophysical scientist evaluating the results. Utilizing conventional observation, sampling and testing ("truthing") of select areas is highly recommended to confirm the results from the geophysical survey. As with all geophysical methods, the results provide a level of confidence but should not be considered absolute.

The scope of services for this project 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.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION



AERIAL PHOTOGRAPHY OBTAINED FROM GOOGLE EARTH

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

Project Manager: SPB	Project No. 35165046
Drawn by: SPB	Scale: AS SHOWN
Checked by: DEP	File Name: 5046.BLP
Approved by: SPB	Date: 4/18/2016

Terracon

25809 I 30

Bryant, Arkansas 72022-9313

SITE LOCATION PLAN

Proposed New Heavy Industrial Project

Arkansas Highway 26 & US Highway 67
Arkadelphia, Arkansas

Exhibit

A-1

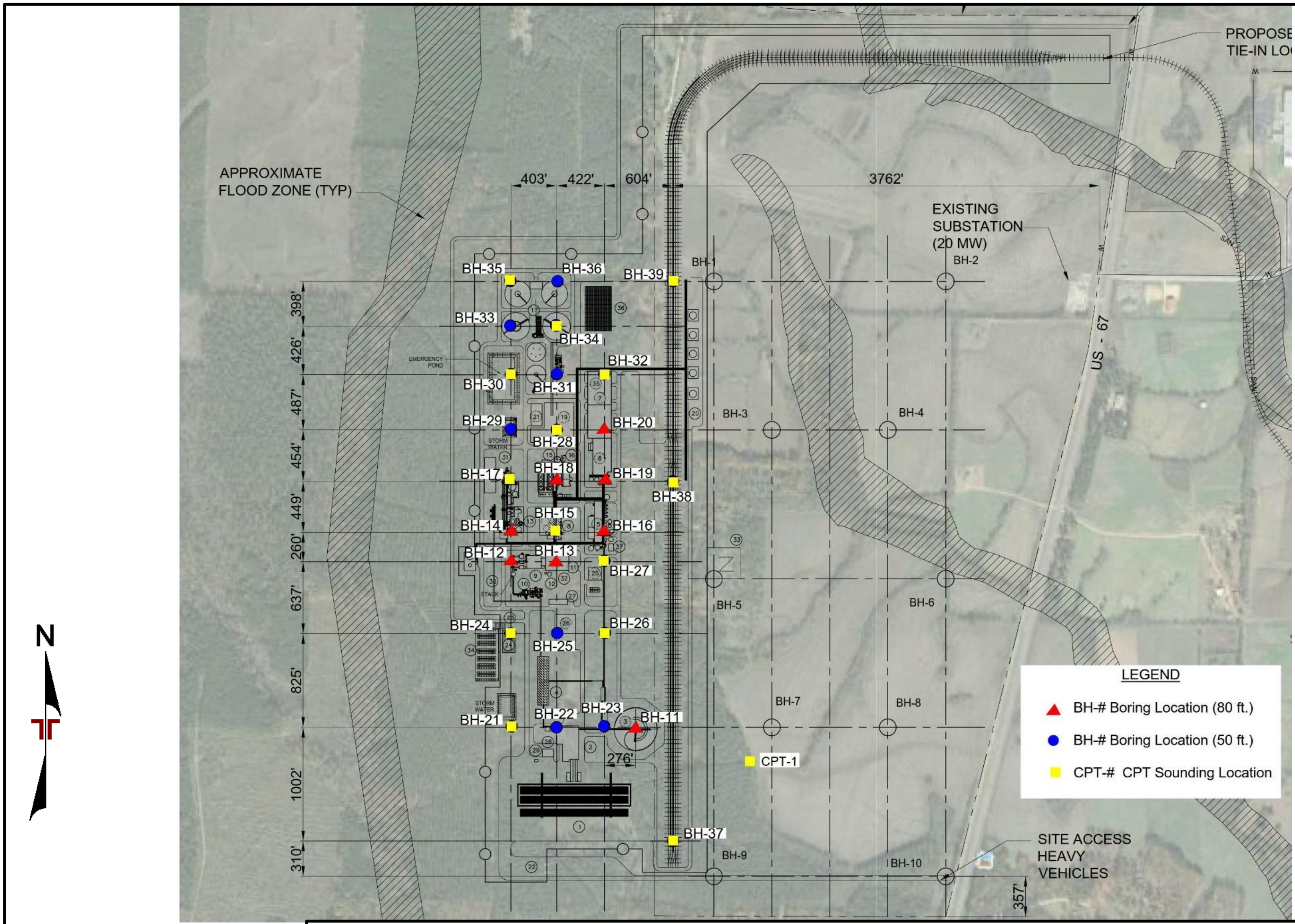


IMAGE BASED ON BORING LOCATION PLAN PROVIDED TO US BY CLIENT

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

Project Manager:	SPB	Project No.	35165046
Drawn by:	SPB	Scale:	AS SHOWN
Checked by:	DEP	File Name:	5046.BLP
Approved by:	SPB	Date:	4/18/2016

Terracon

25809 I 30

Bryant, Arkansas 72022-9313

BORING LOCATION PLAN

Proposed New Heavy Industrial Project

Arkansas Highway 26 & US Highway 67

Arkadelphia, Arkansas

Exhibit

A-2

Field Exploration Description

Fifteen soil borings were drilled at the site between March 17, 2016, and April 10, 2016. Eight borings were drilled to depths of about 80 feet below the existing ground surface. The remaining seven borings were drilled to depths of about 50 feet below the ground surface. Cone Penetration Testing (CPT) soundings were planned at sixteen additional locations. At the time of performing the field exploration, the CPT sounding locations were inaccessible to the CPT rig due to soft ground conditions, except for location CPT-1. The results of the CPT sounding at location CPT-1 are presented on Exhibit A-19.

Terracon personnel established the borings in the field by using a hand-held GPS to establish the approximate locations shown on the attached Boring Location Plan. The approximate latitude and longitude coordinates were estimated using Google Earth Pro, and then used with the GPS to locate the borings in the field while clearing access with the dozer. Ground surface elevations at the approximate boring locations were estimated by Terracon from Google Earth Pro. The estimated ground surface elevations are shown near the top of the boring logs and are rounded to the nearest foot. The locations and elevations of the borings should be considered accurate only to the degree implied by the methods used to define them.

The borings were drilled with an ATV-mounted rotary drill rig using 3-1/4” hollow-stem augers in the upper approximately 10 feet of the boring, and then mud rotary drilling techniques to the boring termination depths. Samples were obtained using the split-barrel and thin-walled steel (Shelby) tube sampling procedures at depth intervals of 1½ to 2½ feet in the upper 10 feet, and 5-foot intervals thereafter, in general accordance with industry standards.

In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound standard hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in-situ consistency of cohesive soils and relative density of granular soils.

An automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. A significantly greater efficiency is achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. This higher efficiency has an appreciable effect on the SPT-N value. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge is pushed hydraulically into the soil to obtain a relatively undisturbed sample.

Bulk samples were collected from auger cuttings generated in the top 3 feet of Borings BH-11, BH-12, BH-18, BH-20, BH-25, BH-31 and BH-36 through BH-39.

Exhibit A-3

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification.

Field logs were prepared by the drill crew. The logs included visual classifications of the materials observed during drilling as well as the driller's interpretation of the subsurface conditions between samples. The final boring logs included with this report represent the engineer's interpretation of the field logs and includes modifications based on laboratory observation and tests of the samples.

Our exploration services include storing the collected soil samples and making them available for inspection for 6 months from the report date. The samples will then be discarded unless requested otherwise.

Electrical Earth Resistivity Survey

Four earth electrical resistivity surveys (EER) were performed at the requested boring locations, BH-22, BH-27, BH-30, and BH-36. The field EER surveys consisted of two field tests at each location performed perpendicularly in the approximate north-south and east-west directions.

The field EER surveys were conducted in general accordance with ASTM G 57 Field Measurement of Soil Resistivity Using the Wenner Four Electrode Method. The field EER surveys were conducted at increasing "a" spacings of 2.5, 5, 10, 15, 20, 30, 40, and 50 feet in both directions. The field EER test results are shown on Exhibits A-20 through A-27.

Geophysical Seismic Shear Wave Velocity Survey

Terracon used a seismic refraction system consisting of one SeismicSource DAQLink III seismographs and 24 geophones to derive subsurface seismic velocity information. Linear arrays of 24 geophones were placed along linear arrays as indicated on Exhibit 1. Refraction microtremors produced by ambient seismic noise were recorded in the field. The data was then processed using a wavefield-transformation data-processing technique and an interactive Rayleigh-wave dispersion-modeling tool. The refraction microtremor exploits aspects of spectral analysis of surface waves (SASW) and multi-channel analysis of surface waves (MASW) to derive a shear wave (s-wave) profile and an average shear-wave velocity along the array for a corresponding depth. The results are discussed in Section **4.6 Seismic Considerations** and presented in Exhibits A-28 and A-29.

Limited Environmental Assessment

Soil samples were collected from Borings BH-13 and BH-31at approximate depths of 0.5, 2, 3.5, 5, 8.5, 13.5, 15 and 18.5 feet below the existing ground surface and observed to document soil and rock lithology, color, moisture content and sensory evidence of impairment. The soil samples were field-screened using a MiniRAE 3000 photo ionization detector (PID) to assess the presence of volatile organic compounds (VOCs). The PID did not measure elevated readings (> 1 ppm) in the noted samples.

One soil sample from each of the borings listed above was submitted to a certified laboratory for analysis of volatile organic compounds (VOCs), Polynuclear Aromatic Hydrocarbons (PAHs), RCRA metals, TPH (DRO/GRO) and PCB analyses. As elevated PID readings were not detected, the samples submitted for analysis were chosen based on the field professional's judgement at depths of 5 feet from Boring BH-13 and 8.5 feet from Boring BH-31. Groundwater was not observed, so no water samples were submitted.

The selected soil samples were placed in laboratory-prepared glassware, sealed with custody tape and placed on ice in a cooler which was secured with a custody seal. The sample cooler and completed chain-of-custody forms were relinquished to Arkansas Analytical, Inc. in Little Rock, Arkansas.

Soil sampling results were compared to EPA Regional Screening Levels (SLs) for an industrial setting. Concentrations of TPH in soil were compared to the Arkansas Department of Environmental Quality (ADEQ) Hazardous Waste Division recommended screening levels.

Based on the soil analytical results, VOCs, PAHs, RCRA metals, TPH (DRO/GRO), and PCB constituents were not detected above the laboratory detection limits in the submitted soil samples, with the exception of arsenic, barium, chromium, and lead metal levels. The analytical results table and laboratory report for the soil samples are presented in Appendix B.

LSI Limitations

Terracon makes no warranties, either express or implied, regarding the findings, conclusions or recommendations regarding this limited environmental assessment. Terracon does not warrant the work of laboratories, regulatory agencies or other third parties supplying information used in the preparation of the report. These LSI services were performed in accordance with the scope of work agreed with you, our client, as reflected in our proposal.

Findings, conclusions and recommendations resulting from these services are based upon information derived from the on-site activities and other services performed under this scope of work; such information is subject to change over time. Certain indicators of the presence of hazardous substances, petroleum products, or other constituents may have been latent, inaccessible, unobservable, non-detectable or not present during these services, and we cannot represent that the site contains no hazardous substances, toxic materials, petroleum products, or other latent conditions beyond those identified during this LSI. Subsurface conditions may vary from those encountered at specific borings or wells or during other surveys, tests, assessments, investigations or exploratory services; the data, interpretations, findings, and our recommendations are based solely upon data obtained at the time and within the scope of these services.

Exhibit A-3

BORING LOG NO. BH-11

PROJECT: **New Heavy Industrial Project**

CLIENT: **Shandong Sun Paper Industry**
Yanzhou, Shandong

SITE: **US Hwy 67 and AR Hwy 26**
Arkadelphia, Arkansas

ENGINEER: **Poyry (Appleton) LLC**
Appleton, Wisconsin

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 34.039075° Longitude: -93.113747° Surface Elev.: 274 (Ft.) DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	**FAT CLAY (CH)**, reddish-brown and brown, medium stiff			☒	0-2-2 N=4	4000 (HP)				25		110-23-87	
▨				☒	2-3-5 N=8	4000 (HP)				34			
▨				■		4000 (HP)				26	88	76-21-54	91
▨	5.0 269 **FAT CLAY (CH)**, reddish-brown, brown and gray, stiff	5		☒	3-5-6 N=11	6000 (HP)				32			
▨				■		9000 (HP)				29	90	85-21-64	95
▨		10		☒	3-5-8 N=13	9000 (HP)				29			
▨		15		☒	4-6-8 N=14	9000 (HP)				32		92-22-70	
▨		20		☒	4-6-7 N=13	9000 (HP)				34			
▨		25		☒	5-6-8 N=14	9000 (HP)				30			
▨	28.5 245.5												

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10ft; Wash bore with 3 7/8" drag bit from 10 ft to 79.5 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

Bulk Sample BH-11: 1 to 3 feet

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/10/2016	Boring Completed: 4/10/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-4

BORING LOG NO. BH-11

PROJECT: **New Heavy Industrial Project**

CLIENT: **Shandong Sun Paper Industry**
Yanzhou, Shandong

SITE: **US Hwy 67 and AR Hwy 26**
Arkadelphia, Arkansas

ENGINEER: **Poyry (Appleton) LLC**
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.039075° Longitude: -93.113747°

Surface Elev.: 274 (Ft.)

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
							TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			LL-PL-PI	
▨	**FAT CLAY (CH)**, brown and dark gray, very stiff to hard	30		☒	6-7-9 N=16	9000 (HP)				34		94-24-70	
▨		35		☒	7-9-15 N=24	9000 (HP)				30			
▨		40		☒	12-15-22 N=37	9000 (HP)				28		89-27-62	
▨		45		☒	10-15-19 N=34	9000 (HP)				28			
▨		50		☒	12-13-17 N=30	9000 (HP)				28			
▨		55		☒	13-15-25 N=40	9000 (HP)				28			

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10ft; Wash bore with 3 7/8" drag bit from 10 ft to 79.5 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

25809 I 30
Bryant, AR

Boring Started: 4/10/2016	Boring Completed: 4/10/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-4

BORING LOG NO. BH-11

Page 3 of 3

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.039075° Longitude: -93.113747°

Surface Elev.: 274 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FAT CLAY (CH), brown and dark gray, very stiff to hard *(continued)*													
			60		☒	13-17-23 N=40	9000 (HP)				28			
			65		☒	18-19-24 N=43	9000 (HP)				24			
	68.5	205.5												
	CLAYEY SAND (SC), fine grained, dark gray, very dense		70		☒	32-50/5"					28		36-30-6	20
			75		☒	50/4"					42			
	78.5	195.5												
	SILTY SAND (SM), fine grained, gray, very dense				☒	22-42-50/2"					28			16
	79.7	194.5												
	Boring Terminated at 79.7 Feet													

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10ft; Wash bore with 3 7/8" drag bit from 10 ft to 79.5 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/10/2016	Boring Completed: 4/10/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-4

BORING LOG NO. BH-12

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.043133° Longitude: -93.117703°

Surface Elev.: 293 (Ft.)

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨		**FAT CLAY (CH)**, brown and gray, soft to medium stiff				☒	0-2-2 N=4								
	2.0		291												
▨		**FAT CLAY (CH)**, mottled light gray and brown, medium stiff to stiff				■		3000 (HP)							
	5.0		288	5											
▨		**FAT CLAY (CH)**, brown to olive-brown, medium stiff to stiff				■									
	8.5		284.5												
▨		**FAT CLAY (CH)**, brown and gray, stiff		10		☒	3-4-4 N=8	5500 (HP)							
				15		☒	3-6-7 N=13	6000 (HP)							
				20		☒	3-5-7 N=12	8000 (HP)							
	23.5		269.5												
▨		**FAT CLAY (CH)**, gray and brown, very stiff		25		☒	4-6-9 N=15	9000 (HP)							

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 78.5 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

Bulk Sample BH-12: 1 to 3 feet

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/30/2016	Boring Completed: 3/30/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-5

BORING LOG NO. BH-12

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.043133° Longitude: -93.117703°

Surface Elev.: 293 (Ft.)

DEPTH	ELEVATION (Ft.)	Material	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FAT CLAY (CH), gray and brown, very stiff *(continued)*	30		☒	5-7-12 N=19	9000 (HP)							
33.5	259.5	**FAT CLAY (CH)**, gray to dark gray, hard	35		☒	9-13-17 N=30	9000 (HP)							
			40		☒	8-13-17 N=30	9000 (HP)							
43.5	249.5	**CLAYEY SAND (SC)**, fine grained, dark gray, medium dense to dense	45		☒	7-7-7 N=14	6000 (HP)							
			50		☒	13-20-27 N=47	9000 (HP)							
					☒	50/5"								
			55											

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 78.5 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/30/2016

Boring Completed: 3/30/2016

Drill Rig: Acker Renegade #679

Driller: TF

Project No.: 35165046

Exhibit: A-5

BORING LOG NO. BH-12

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.043133° Longitude: -93.117703°

Surface Elev.: 293 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
CLAYEY SAND (SC), fine grained, dark gray, medium dense to dense *(continued)*				☒	23-9-18 N=27	9000 (HP)							
63.5	229.5												
SILTY SAND (SM), fine to coarse grained, gray, very dense				☒	25-32-44 N=76	9000 (HP)							
				☒	15-28-50/4"								
				☒	12-25-50/2"								
78.6	214.5				50/1"								
Boring Terminated at 78.6 Feet													

Depth scale (Ft.): 60, 65, 70, 75

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 78.5 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/30/2016	Boring Completed: 3/30/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-5

BORING LOG NO. BH-13

PROJECT: **New Heavy Industrial Project**

CLIENT: **Shandong Sun Paper Industry**
Yanzhou, Shandong

SITE: **US Hwy 67 and AR Hwy 26**
Arkadelphia, Arkansas

ENGINEER: **Poyry (Appleton) LLC**
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.043133° Longitude: -93.117702°

Surface Elev.: 292 (Ft.)

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	**FAT CLAY (CH)**, mottled brown, red and light gray, stiff			☒	3-4-5 N=9	2500 (HP)				34			
	2.0 / 290												
▨	**FAT CLAY WITH SAND (CH)**, brown and light gray, very soft to soft			☒	0-0-3 N=3								
	5.0 / 287	5											
▨	**FAT CLAY (CH)**, brown, stiff to very stiff			☒	3-5-7 N=12	5500 (HP)				30			
				■									
		10		☒	5-6-10 N=16	9000 (HP)				29			
				■						40	78	79-23-56	81
		15											
	18.5 / 273.5												
▨	**FAT CLAY (CH)**, brown, hard			☒	6-7-25 N=32	9000 (HP)				30		87-22-65	
		20											
	23.5 / 268.5												
▨	**FAT CLAY (CH)**, brown, stiff			☒	4-5-7 N=12	7500 (HP)				35		95-25-70	
		25											

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 80ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/5/2016	Boring Completed: 4/5/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-6

BORING LOG NO. BH-13

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.043133° Longitude: -93.117702°

Surface Elev.: 292 (Ft.)

GRAPHIC LOG	DEPTH / DESCRIPTION / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	**FAT CLAY (CH)**, brown, stiff *(continued)*	30		☒	4-6-8 N=14	7000 (HP)				33			
▨	33.5 — 258.5												
▨	**FAT CLAY (CH)**, gray to dark gray, very stiff to hard	35		☒	10-13-17 N=30	9000 (HP)				31			
▨		40		☒	7-13-16 N=29	9000 (HP)				29			
▨		45		☒	10-12-18 N=30	9000 (HP)				29			
▨		50		☒	10-15-20 N=35	9000 (HP)				29			
▨		55		☒	10-15-21 N=36	9000 (HP)				28			

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 80ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/5/2016	Boring Completed: 4/5/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-6

BORING LOG NO. BH-13

Page 3 of 3

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.043133° Longitude: -93.117702°

Surface Elev.: 292 (Ft.)

GRAPHIC LOG	DEPTH / DESCRIPTION / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FAT CLAY (CH), gray to dark gray, very stiff to hard *(continued)*												
		60		☒	11-11-11 N=22	9000 (HP)				24			
	63.5 — 228.5												
	CLAYEY SAND (SC), dark gray, dense	65		☒	12-17-24 N=41					33			47
	68.5 — 223.5												
	SILTY SAND (SM), gray, very dense			☒	50/6"					31			23
		70											
		75		☒	50/6"								
	78.9 — 213			☒	50/5"								
	Boring Terminated at 78.9 Feet												

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 80ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/5/2016	Boring Completed: 4/5/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 35165046 - ALL TESTING.GPJ

BORING LOG NO. BH-14

Page 1 of 3

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.043552° Longitude: -93.117702°

Surface Elev.: 293 (Ft.)

DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), brown, very soft to soft			☒	0-0-0 N=0					34		71-22-49	
			☒	0-0-2 N=2					30		71-20-51	
3.5 / 289.5												
FAT CLAY (CH), brown, stiff to very stiff			☒	3-4-4 N=8	1000 (HP)				36			
	5		☒	3-3-4 N=7	3500 (HP)				37		91-18-73	
	10		☒	4-4-5 N=9	5500 (HP)				35			
	15		☒	4-5-6 N=11	6000 (HP)				36			
olive-brown and gray	20		☒	4-5-8 N=13	7000 (HP)				36			
	25		☒	5-6-8 N=14	8000 (HP)				34		97-27-70	
28.5 / 264.5												

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 80 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/1/2016	Boring Completed: 4/1/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-7

BORING LOG NO. BH-14

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.043552° Longitude: -93.117702°

Surface Elev.: 293 (Ft.)

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	**FAT CLAY (CH)**, gray, very stiff to hard			☒	5-8-11 N=19								
		30											
				☒	9-12-24 N=36	9000 (HP)				29			
		35											
				☒	13-15-20 N=35	9000 (HP)							
		40											
				☒	5-7-15 N=22	9000 (HP)							
		45											
	48.5 244.5												
▨	**CLAYEY SAND (SC)**, fine grained, dark gray, dense to very dense			☒	16-17-24 N=41					30			
		50											
				☒	10-18-24 N=42					40			
		55											

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 80 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/1/2016	Boring Completed: 4/1/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-7

BORING LOG NO. BH-14

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.043552° Longitude: -93.117702°

Surface Elev.: 293 (Ft.)

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), fine grained, dark gray, dense to very dense *(continued)*												
				☒	10-20-50/5"					27			
		60											
				☒	19-24-34 N=58					39			
		65											
	68.5 / 224.5												
	SILTY SAND (SM), fine grained, gray, very dense			☒	21-50/6"								
		70											
				☒	33-33-50/5"								
		75											
				☒	25-22-50/5"								
	79.9 / 213												
	Boring Terminated at 79.9 Feet												

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 80 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/1/2016
Boring Completed: 4/1/2016
Drill Rig: Acker Renegade #679
Driller: TF
Project No.: 35165046
Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 35165046 - ALL TESTING.GPJ

BORING LOG NO. BH-16

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.043553° Longitude: -93.114947°

Surface Elev.: 280 (Ft.)

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	**FAT CLAY (CH)**, brown and reddish-brown, very soft 2.0 278			☒	0-0-0 N=0	4000 (HP)				28			
▨	**FAT CLAY WITH SAND (CH)**, reddish-brown and gray, medium stiff to stiff			☒	4-5-6 N=11	2000 (HP)				48		77-17-60	85
▨	5.0 275	5		☒	0-2-3 N=5	3000 (HP)				43			
▨	**FAT CLAY (CH)**, light brown and gray, stiff to very stiff			☒	4-6-7 N=13	5500 (HP)				24			
▨		10		☒	6-7-8 N=15					58			
▨		15		☒	6-6-10 N=16					52			
▨		20		☒	5-7-8 N=15					60			
▨		25		☒	5-9-11 N=20	3000 (HP)							

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 79.5 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *46.5 ft at 48 hours after completion*

65.7 ft

25809 I 30
Bryant, AR

Boring Started: 3/29/2016	Boring Completed: 3/29/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-8

BORING LOG NO. BH-16

Page 2 of 3

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.043553° Longitude: -93.114947°

Surface Elev.: 280 (Ft.)

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FAT CLAY (CH), light brown and gray, stiff to very stiff *(continued)*	30		☒	5-8-14 N=22	3000 (HP)							
	33.5 246.5												
	FAT CLAY (CH), dark gray, very stiff to hard	35		☒	6-9-12 N=21	9000 (HP)							
		40		☒	9-11-18 N=29	5000 (HP)				29		91-26-65	99
		45		☒	10-15-20 N=35								
			▽										
		50		☒	10-15-19 N=34								
		55		☒	10-13-19 N=32	8000 (HP)							

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 79.5 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *46.5 ft at 48 hours after completion*

65.7 ft

25809 I 30
Bryant, AR

Boring Started: 3/29/2016	Boring Completed: 3/29/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-8

BORING LOG NO. BH-16

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.043553° Longitude: -93.114947°

Surface Elev.: 280 (Ft.)

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	**FAT CLAY (CH)**, dark gray, very stiff to hard *(continued)*												
▨		60		☒	11-16-24 N=40	9000 (HP)							
▨		65	▨	☒	10-15-19 N=34								
▨	68.5 — 211.5 **CLAYEY SAND (SC)**, fine grained, gray, very dense			☒	25-50/4"								
▨		70											
▨		75		☒	40-50/3"								
▨	79.3 — 200.5 **SILTY SAND (SM)**, fine grained, gray			☒	20-50/4"					41		34-16-18	25
	Boring Terminated at 79.3 Feet												

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 79.5 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *46.5 ft at 48 hours after completion*

▨ *65.7 ft*

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/29/2016	Boring Completed: 3/29/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-8

BORING LOG NO. BH-18

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.044956° Longitude: -93.116289°

Surface Elev.: 281 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	**FAT CLAY (CH)**, reddish-brown and brown, medium stiff to stiff				☒	0-3-3 N=6	5000 (HP)				24			
▨	with large well-rounded gravel				☒	3-4-5 N=9	5000 (HP)				24			
▨	3.5	277.5												
▨	**FAT CLAY (CH)**, gray and reddish-brown, brown, stiff				☒	3-3-6 N=9	5000 (HP)				36			
▨			5		☒	5-7-7 N=14	5000 (HP)				34		104-20-84	
▨	8.5	272.5												
▨	**FAT CLAY (CH)**, with thin sand seams, light brown and gray, stiff to very stiff, blocky fracture		10		☒	4-6-8 N=14	9000 (HP)				28			
▨			15		☒	5-6-9 N=15	9000 (HP)				33			
▨			20		☒	6-6-7 N=13	9000 (HP)				34			
▨			25		☒	6-6-7 N=13	9000 (HP)							
▨	28.5	252.5												

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 79 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

Bulk Sample BH-18: 1 to 3 feet

WATER LEVEL OBSERVATIONS

Water level not determined

42 ft

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/24/2016

Boring Completed: 3/24/2016

Drill Rig: Acker Renegade #679

Driller: TF

Project No.: 35165046

Exhibit: A-9

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 35165046 - ALL TESTING.GPJ

BORING LOG NO. BH-18

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 34.044956° Longitude: -93.116289° Surface Elev.: 281 (Ft.) DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
							TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			LL-PL-PI	
▨	**FAT CLAY (CH)**, with gypsum crystals, brown and gray, very stiff	30		☒	5-6-7 N=13	9000 (HP)							
	33.5 247.5												
▨	**FAT CLAY (CH)**, dark gray, very stiff to hard	35		☒	6-9-13 N=22	9000 (HP)							
		40		☒	11-13-18 N=31	9000 (HP)							
			▽										
		45		☒	13-15-18 N=33	4000 (HP)							
	48.5 232.5												
▨	**CLAYEY SAND (SC)**, dark gray, dense to very dense	50		☒	9-14-24 N=38								
				☒	40-50/5"								19
		55											

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 79 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

▽ *42 ft*

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/24/2016	Boring Completed: 3/24/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-9

BORING LOG NO. BH-18

Page 3 of 3

PROJECT: New Heavy Industrial Project	**CLIENT:** Shandong Sun Paper Industry Yanzhou, Shandong
SITE: US Hwy 67 and AR Hwy 26 Arkadelphia, Arkansas	**ENGINEER:** Poyry (Appleton) LLC Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.044956° Longitude: -93.116289°

Surface Elev.: 281 (Ft.)

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST TEST TYPE	STRENGTH TEST COMPRESSIVE STRENGTH (psf)	STRENGTH TEST STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	58.5	**CLAYEY SAND (SC)**, dark gray, dense to very dense *(continued)*	222.5												
		SILTY CLAY (SM), fine grained, dark gray, very dense					42-50/3"								
				60											
							50/4"								
				65											
							50/6"								
				70											
							18-36-50/4"								
				75											
	79.0		202				50/6"								
		Boring Terminated at 79 Feet													

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 79 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

42 ft

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/24/2016	Boring Completed: 3/24/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-9

BORING LOG NO. BH-19

Page 1 of 3

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.044956° Longitude: -93.114947°

Surface Elev.: 276 (Ft.)

DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), reddish-brown and gray, medium stiff to stiff			X	1-2-3 N=5	4000 (HP)				36			
			■		4000 (HP)				26		54-14-40	87
			■		3000 (HP)	UC	1897	11	34	86	112-18-94	97
5.0 / 271	5											
FAT CLAY (CH), brown and gray, stiff to very stiff, blocky fracture			X	3-4-6 N=10	9000 (HP)				29			
			X	5-6-10 N=16					27			
	10											
very stiff to hard below 13 feet			■		9000 (HP)				28			
			X	5-5-8 N=13	9000 (HP) 9000 (HP)				31			
	15	▽										
			X	4-6-8 N=14	9000 (HP)				34			
	20											
			X	5-6-9 N=15	9000 (HP)							
	25											

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 80 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

▽ *16 ft*

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/24/2016
Boring Completed: 3/24/2016
Drill Rig: Acker Renegade #679
Driller: TF
Project No.: 35165046
Exhibit: A-10

BORING LOG NO. BH-19

Page 2 of 3

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.044956° Longitude: -93.114947°

Surface Elev.: 276 (Ft.)

DEPTH / DESCRIPTION / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), brown and gray, stiff to very stiff, blocky fracture *(continued)* with gypsum crystals	30		☒	7-7-10 N=17								
	35		☒	6-8-13 N=21								
38.5 … 237.5 **FAT CLAY (CH)**, dark gray, very stiff to hard	40		☒	9-14-16 N=30	9000 (HP)							
	45		☒	10-13-15 N=28	9000 (HP)							
	50		☒	9-11-20 N=31	9000 (HP)							
with thin sand seams	55		☒	10-12-20 N=32	9000 (HP)							

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 80 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

16 ft

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/24/2016	Boring Completed: 3/24/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-10

BORING LOG NO. BH-19

Page 3 of 3

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.044956° Longitude: -93.114947°

Surface Elev.: 276 (Ft.)

DEPTH	DESCRIPTION	ELEVATION (Ft.)
	FAT CLAY (CH), dark gray, very stiff to hard *(continued)*	
63.5		212.5
	CLAYEY SAND (SC), fine grained, gray to dark gray, very dense	
79.7		196.5
	Boring Terminated at 79.7 Feet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
60		☒	13-16-24 N=40	9000 (HP)							
65		☒	8-17-50/4"								
70		☒	18-50/4"								
75		☒	23-50/2"								
		☒	28-28-50/2"								

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 80 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

16 ft

25809 I 30
Bryant, AR

Boring Started: 3/24/2016	Boring Completed: 3/24/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-10

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 35165046 - ALL TESTING.GPJ

BORING LOG NO. BH-20

Page 1 of 3

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.046364° Longitude: -93.114947°

Surface Elev.: 273 (Ft.)

DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), reddish-brown and gray, soft to medium stiff			☒	0-2-2 N=4	4500 (HP)				29			
			☒	3-3-4 N=7	4000 (HP)				33			
			☒	4-4-4 N=8	4000 (HP)				34			
stiff	5		☒	1-5-6 N=11	5500 (HP)				31			
brown and gray, very stiff			☒	5-8-9 N=17	9000 (HP)				28			
	10											
13.5 / 259.5												
FAT CLAY (CH), blocky, light brown to brown, stiff to very stiff			☒	3-4-6 N=10	6000 (HP)				36		96-23-73	
	15											
			☒	5-6-8 N=14	8500 (HP)				31			
	20											
			☒	6-6-9 N=15	9000 (HP)							
	25											

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 79 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

Bulk Sample BH-20: 1 to 3 feet

WATER LEVEL OBSERVATIONS

▽ *50 ft After One Day*

▨ *69.5 ft After One Day*

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/23/2016	Boring Completed: 3/23/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-11

BORING LOG NO. BH-20

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.046364° Longitude: -93.114947°

Surface Elev.: 273 (Ft.)

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	**FAT CLAY (CH)**, blocky, light brown to brown, stiff to very stiff *(continued)*	30		☒	6-6-10 N=16	9000 (HP)							
▨	brown and gray	35		☒	6-6-10 N=16	8000 (HP)							
▨	38.5 / 234.5 **FAT CLAY (CH)**, dark gray, very stiff to hard	40		☒	12-13-17 N=30	9000 (HP)							
▨		45		☒	13-14-20 N=34	9000 (HP)							
▨		50	▽	☒	15-15-23 N=38	9000 (HP)							
▨		55		☒	18-15-24 N=39	9000 (HP)							

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 79 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *50 ft After One Day*

69.5 ft After One Day

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/23/2016	Boring Completed: 3/23/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-11

BORING LOG NO. BH-20

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.046364° Longitude: -93.114947°

Surface Elev.: 273 (Ft.)

DEPTH		ELEVATION (Ft.)
	FAT CLAY (CH), dark gray, very stiff to hard *(continued)*	
58.5	**CLAYEY SAND (SC)**, fine grained, gray, very dense	214.5
78.5	**SILTY SAND (SM)**, fine grained, gray, very dense	194.5
79.4	***Boring Terminated at 79.4 Feet***	193.5

DEPTH (Ft.)	FIELD TEST RESULTS
60	15-28-40 N=68
	50/4"
65	
	50/6"
70	
	50/6"
75	
	40-50/5"

Columns: GRAPHIC LOG; DEPTH (Ft.); WATER LEVEL OBSERVATIONS; SAMPLE TYPE; FIELD TEST RESULTS; LABORATORY TORVANE/HP (psf); STRENGTH TEST: TEST TYPE, COMPRESSIVE STRENGTH (psf), STRAIN (%); WATER CONTENT (%); DRY UNIT WEIGHT (pcf); ATTERBERG LIMITS LL-PL-PI; PERCENT FINES

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 79 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *50 ft After One Day*

▨ *69.5 ft After One Day*

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/23/2016	Boring Completed: 3/23/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-11

BORING LOG NO. BH-22

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.039075° Longitude: -93.116288°

Surface Elev.: 275 (Ft.)

DEPTH / DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY WITH GRAVEL (CH), brown, soft				☒	0-0-2 N=2	3000 (HP)				32			
2.0	273												
FAT CLAY (CH), reddish-brown, light brown and brown, medium stiff to stiff				☒	2-3-3 N=6	2000 (HP)				48			
				■		3000 (HP)				31		101-26-75	78
		5		☒	3-4-6 N=10	6000 (HP)				35			
- gypsum crystals present				☒	4-6-6 N=12	9000 (HP)				29			
		10											
				■		9000 (HP)				36	83	97-34-63	
		15		☒	3-6-7 N=13	9000 (HP)				37			
				■		9000 (HP)				39			
		20											
23.5	251.5												
FAT CLAY (CH), with iron staining, brown and dark gray, very stiff to hard		25		☒	3-7-9 N=16	9000 (HP)				32			

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 50 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/8/2016	Boring Completed: 4/8/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-12

BORING LOG NO. BH-22

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.039075° Longitude: -93.116288°

Surface Elev.: 275 (Ft.)

DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FAT CLAY (CH), with iron staining, brown and dark gray, very stiff to hard *(continued)*		30		☒	6-11-15 N=26	9000 (HP)				27			
			35		☒	11-15-19 N=34					26			
			40		☒	11-14-27 N=41					29			
43.5	**CLAYEY SAND (SC)**, fine grained, dark gray, very dense	231.5	45		☒	24-28-32 N=60					23			
48.5	**SILTY SAND (SM)**, fine grained, gray, very dense	226.5			☒	22-38-50/5"								
49.9	***Boring Terminated at 49.9 Feet***	225												

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 50 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/8/2016	Boring Completed: 4/8/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-12

BORING LOG NO. BH-23

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.039075° Longitude: -93.114947°

Surface Elev.: 272 (Ft.)

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
							TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			LL-PL-PI	
▨	**FAT CLAY (CH)**, reddish-brown, brown and gray, medium stiff			■		5000 (HP)				18	99	66-26-40	91
▨				☒	2-3-4 N=7	5000 (HP)				31			
▨	- with sand at about 5 feet	5		■		8000 (HP)				24	94	90-22-68	78
▨	8.5 263.5												
▨	**FAT CLAY (CH)**, brown and gray, stiff	10		☒	4-4-6 N=10	9000 (HP)				28		89-24-65	94
▨	- with gypsum crystals and iron staining	15		☒	4-5-6 N=11	9000 (HP)				35			
▨		20		☒	4-5-6 N=11	9000 (HP)				35			
▨		25		☒	5-6-7 N=13	9000 (HP)				33			
▨	28.5 243.5												

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 50 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/8/2016	Boring Completed: 4/8/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-13

BORING LOG NO. BH-23

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 34.039075° Longitude: -93.114947° Surface Elev.: 272 (Ft.) DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	**FAT CLAY (CH)**, dark gray, very stiff to hard	30		☒	4-7-9 N=16	9000 (HP)				31			
▨		35		☒	9-12-17 N=29	9000 (HP)				28			
▨		40		☒	11-14-18 N=32	9000 (HP)				29			
▨		45		☒	11-15-17 N=32	9000 (HP)				29			
▨	50.0 222	50		☒	12-16-27 N=43	9000 (HP)				22			
	Boring Terminated at 50 Feet												

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 50 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/8/2016

Boring Completed: 4/8/2016

Drill Rig: Acker Renegade #679

Driller: TF

Project No.: 35165046

Exhibit: A-13

BORING LOG NO. BH-25

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.041453° Longitude: -93.116289°

Surface Elev.: 289 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST TEST TYPE	STRENGTH TEST COMPRESSIVE STRENGTH (psf)	STRENGTH TEST STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	**FAT CLAY (CH)**, brown, soft to medium stiff				■									
▨					■									
▨	5.0	284	5		☒	3-4-6 N=10								
▨	**FAT CLAY (CH)**, olive-brown and gray, stiff													
▨	8.5	280.5			☒	3-4-5 N=9								
▨	**FAT CLAY (CH)**, brown and gray, stiff to very stiff		10											
▨					☒	0-9-12 N=21								
▨			15											
▨					☒	4-6-7 N=13								
▨			20											
▨	23.5	265.5			☒	4-5-8 N=13								
▨	**FAT CLAY (CH)**, with gypsum crystals, gray and brown, stiff to very stiff		25											

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 50 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

Bulk Sample BH-25: 1 to 3 feet

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/30/2016	Boring Completed: 3/30/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-14

BORING LOG NO. BH-25

Page 2 of 2

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 34.041453° Longitude: -93.116289° Surface Elev.: 289 (Ft.) DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	**FAT CLAY (CH)**, with gypsum crystals, gray and brown, stiff to very stiff *(continued)*	30		☒	5-6-9 N=15								
▨	33.5 255.5												
▨	**FAT CLAY (CH)**, gray to dark gray, very stiff to hard	35		☒	7-12-17 N=29								
▨		40		☒	10-12-17 N=29								
▨		45		☒	10-12-14 N=26								
▨	50.0 239	50		☒	12-17-19 N=36								
	Boring Terminated at 50 Feet												

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 50 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/30/2016	Boring Completed: 3/30/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-14

BORING LOG NO. BH-29

Page 1 of 2

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.046364° Longitude: -93.117703°

Surface Elev.: 270 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), reddish-brown and brown, medium stiff				☒	1-3-3 N=6	6000 (HP)				33		86-16-70	
2.0	268												
FAT CLAY (CH), reddish-brown and brown, very soft				☒	0-0-0 N=0	3500 (HP)				30 26			
3.5	266.5												
FAT CLAY (CH), reddish-brown, brown and gray, stiff to very stiff				☒	4-4-6 N=10	5000 (HP)				30			
brown and gray, very stiff to stiff		5		☒	6-7-9 N=16	7000 (HP)				30			
			▨										
		10		☒	5-6-8 N=14	8000 (HP)				33			
		15		☒	3-5-6 N=11	7500 (HP)				39			
- with gypsum crystals		20		☒	3-4-7 N=11	8000 (HP)				37			
23.5	246.5												
FAT CLAY (CH), with silty sand lenses, dark gray to gray, very stiff		25		☒	4-4-14 N=18	8000 (HP)							
28.5	241.5												

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 50 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

▨ *6.8 ft After One Day*

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/22/2016	Boring Completed: 3/22/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-15

BORING LOG NO. BH-29

Page 2 of 2

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.046364° Longitude: -93.117703°

Surface Elev.: 270 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
CLAYEY SAND (SC), fine grained, brown to gray, very dense 33.5	236.5	30		☒	45-50/4"							38-15-23	22
SILTY SAND (SM), trace clay seams, medium grained, gray, very dense 38.5	231.5	35		☒	38-50/6"								
CLAYEY SAND (SC), fine grained, gray, dense 43.5	226.5	40		☒	13-18-24 N=42								
SILTY SAND (SM), medium grained, gray, very dense 48.5	221.5	45		☒	21-41-50/5"								
CLAYEY SAND (SC), medium grained, gray, very dense 50.0	220	50		☒	10-18-36 N=54								
Boring Terminated at 50 Feet													

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 50 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

6.8 ft After One Day

25809 I 30
Bryant, AR

Boring Started: 3/22/2016	Boring Completed: 3/22/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-15

BORING LOG NO. BH-31

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.047631° Longitude: -93.116288°

Surface Elev.: 275 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
		FAT CLAY (CH), reddish-brown and gray, medium stiff to very stiff
8.5	266.5	**FAT CLAY (CH)**, gray, light brown to dark brown, stiff to very stiff

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		☒	0-2-3 N=5	3000 (HP)				27		60-28-32	78
		■		4000 (HP)				30			
		■		6000 (HP)				26			
5		■		6000 (HP)							
		☒	4-7-8 N=15	9000 (HP)				29			
10											
		■		9000 (HP)				36	81	93-19-74	94
15											
		☒	5-6-8 N=14	9000 (HP)				34			
20											
		☒	4-6-7 N=13	9000 (HP)				33			
25											

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 49 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

Bulk Sample BH-31: 1 to 3 feet

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/4/2016	Boring Completed: 4/4/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-16

BORING LOG NO. BH-31

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.047631° Longitude: -93.116288°

Surface Elev.: 275 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	**FAT CLAY (CH)**, gray, light brown to dark brown, stiff to very stiff *(continued)*		30		☒	5-6-9 N=15	9000 (HP)				36			
▨			35		☒	8-11-19 N=30	9000 (HP)				28			
▨	38.5	236.5												
▨	**CLAYEY SAND (SC)**, dark gray, dense		40		☒	7-13-17 N=30					30			35
▨	43.5	231.5												
▨	**SILTY SAND (SM)**, dark gray, very dense		45		☒	39-50/4"					27			20
▨	48.9	226			☒	50/5"								
	Boring Terminated at 48.9 Feet													

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 49 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
25809 I 30
Bryant, AR

Boring Started: 4/4/2016	Boring Completed: 4/4/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-16

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 35165046 - ALL TESTING.GPJ

BORING LOG NO. BH-33

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.048897° Longitude: -93.117703°

Surface Elev.: 268 (Ft.)

GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨	2.0	**FAT CLAY (CH)**, with organics, reddish-brown and brown, medium stiff	266		☒	0-3-3 N=6	3000 (HP)				33			
▨	5.0	**FAT CLAY (CH)**, with coarse gravel, brown, soft to medium stiff	263		☒	1-2-3 N=5					17			
					■		1000 (HP)				19		68-19-49	31
▨	7.5	**FAT CLAY (CH)**, gray and reddish-brown, soft	260.5		☒	0-0-2 N=2	4000 (HP)				35			
▨	8.5	**FAT CLAY (CH)**, blocky, with fine gravel, gray, very stiff to hard	259.5		■		9000 (HP)				31		99-24-75	98
▨	18.5	**FAT CLAY (CH)**, with gypsum crystals and iron staining, gray and brown, very stiff to stiff	249.5		☒	5-7-9 N=16	9000 (HP)				28			
					☒	4-5-6 N=11	9000 (HP)				36			
▨	23.5	**FAT CLAY (CH)**, with silty sand seams and iron staining, gray and brown, stiff	244.5		☒	3-5-5 N=10	9000 (HP)				36			
▨	28.5	**SANDY FAT CLAY (CH)**, some silt, gray, very stiff	239.5	▽	☒	4-5-14 N=19	9000 (HP)							

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10ft; Wash bore with 3 7/8" drag bit from 10ft to 50ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *26 ft at 72 hours after completion*

▨ *40 ft 72 hours after completion*

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/18/2016	Boring Completed: 3/22/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-17

BORING LOG NO. BH-33

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.048897° Longitude: -93.117703°

Surface Elev.: 268 (Ft.)

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), fine grained, gray, dense to very dense	30		☒	9-37-50/5"								
		35		☒	40-30-30 N=60							47-14-33	35
		40	▨	☒	20-23-27 N=50								
		45		☒	20-21-42 N=63								
	50.0 / 218	50		☒	22-22-27 N=49								
	Boring Terminated at 50 Feet												

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10ft; Wash bore with 3 7/8" drag bit from 10ft to 50ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *26 ft at 72 hours after completion*

▨ *40 ft 72 hours after completion*

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/18/2016	Boring Completed: 3/22/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-17

BORING LOG NO. BH-36

Page 1 of 2

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.049858° Longitude: -93.116289°

Surface Elev.: 280 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0	280	**LEAN CLAY WITH SAND (CL)**, reddish-brown and brown, soft to medium stiff
3.5	276.5	**FAT CLAY (CH)**, reddish-brown and brown, soft to medium stiff
8.5	271.5	**FAT CLAY (CH)**, blocky, gray, stiff

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5–2		■						24	90	48-20-28	85
2–3.5		☒	0-0-3 N=3					37		42-19-23	
3.5–5		■						38		87-15-72	95
5–6.5		☒	1-3-4 N=7					37			
8	▨										
8.5–10		☒	5-6-8 N=14					32			
13.5–15		☒	4-4-4 N=8					35			
18.5–20		☒	5-6-6 N=12					35			
23.5–25		☒	4-4-6 N=10								

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 49 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

Bulk Sample BH-36: 1 to 3 feet

WATER LEVEL OBSERVATIONS

Water level not determined

▨ *8 ft 12 hours after completion*

Terracon
25809 I 30
Bryant, AR

Boring Started: 3/17/2016	Boring Completed: 3/17/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-18

BORING LOG NO. BH-36

PROJECT: New Heavy Industrial Project

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

ENGINEER: Poyry (Appleton) LLC
Appleton, Wisconsin

LOCATION See Exhibit A-2

Latitude: 34.049858° Longitude: -93.116289°

Surface Elev.: 280 (Ft.)

GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
▨		**FAT CLAY (CH)**, blocky, gray, stiff *(continued)* - with gypsum crystals at about 28.5 feet		30		☒	4-5-6 N=11								
▨	33.5	**FAT CLAY (CH)**, gray, very stiff to hard	246.5	35		☒	11-11-17 N=28								
▨				40		☒	9-12-18 N=30								
▨	43.5	**CLAYEY SAND (SC)**, medium grained, gray, dense	236.5	45		☒	7-17-26 N=43								
▨	48.5	**SILTY SAND (SM)**, medium grained, gray, very dense	231.5			☒	50/4"								
	48.8	***Boring Terminated at 48.8 Feet***	231												

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

Hammer Type: Automatic

Advancement Method:
4 1/4" Hollow stem auger to 10 ft; Wash bore with 3 7/8" drag bit from 10 ft to 49 ft

Abandonment Method:
Boring backfilled with bentonite hole plug and soil cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

8 ft 12 hours after completion

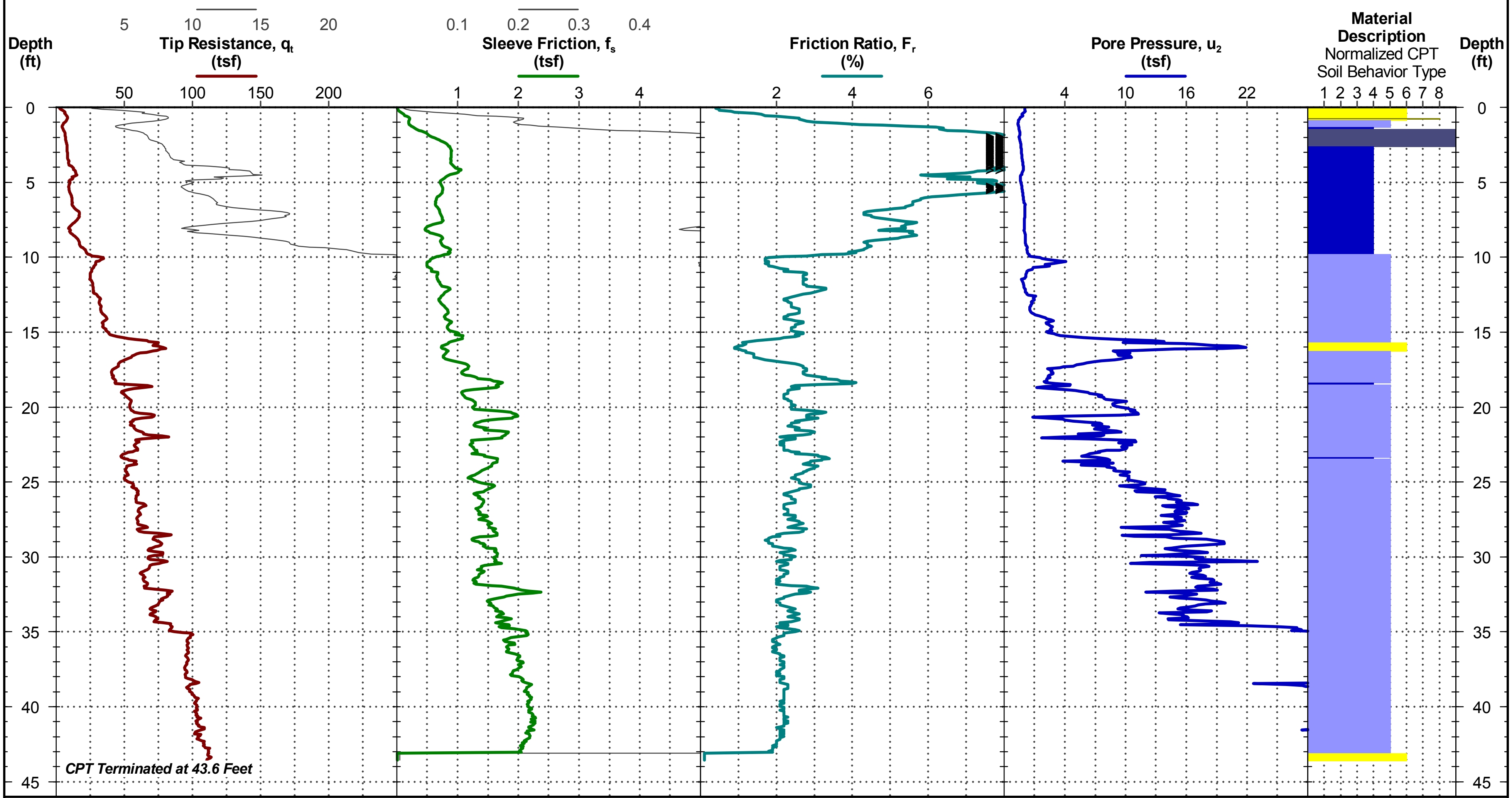
Terracon
25809 I 30
Bryant, AR

Boring Started: 3/17/2016	Boring Completed: 3/17/2016
Drill Rig: Acker Renegade #679	Driller: TF
Project No.: 35165046	Exhibit: A-18

CPT LOG NO. CPT-1

Page 1 of 1

PROJECT: New Heavy Industrial Project	**CLIENT:** Shandong Sun Paper Industry Yanzhou, Shandong	**TEST LOCATION:** See Exhibit A-2
SITE: US Hwy 67 and AR Hwy 26 Arkadelphia, Arkansas	**ENGINEER:** Poyry (Appleton) LLC Appleton, Wisconsin	



See Exhibit A-3 for description of field procedures.

See Appendix C for explanation of symbols and abbreviations.

CPT sensor calibration reports available upon request.

🟥	1 Sensitive, fine grained
🟧	2 Organic soils - clay
🟩	3 Clay - silty clay to clay
🟦	4 Silt mixtures - clayey silt to silty clay
🟦	5 Sand mixtures - silty sand to sandy silt
🟨	6 Sands - clean sand to silty sand
🟨	7 Gravelly sand to dense sand
🟫	8 Very stiff sand to clayey sand
⬛	9 Very stiff fine grained

Probe no. DPG1337	Terracon 25809 I 30 Bryant, AR	CPT Started: 3/19/2016	CPT Completed: 3/19/2016
		Rig: ATV	Operator: M. May
		Project No.: 35165046	Exhibit: A-19

EXHIBIT A-20

ELECTRICAL EARTH RESISTIVITY SURVEY
New Heavy Industrial Project
Arkadelphia, Arkansas
Terracon Project No. 35165046
TEST NO. 1 (E-W run BH-22)

STATION NAME: New Heavy Industrial Project

STATION LOCATION: US Hwy 67 and AR Hwy 26

DATE: 4/5/2016

TEMPERATURE: 81°

SOIL MOISTURE: Moist

SURFACE SOIL TYPE: CH

TEST INSTRUMENT TYPE: Wenner 4 Electrode

TESTED BY: Josh Farler

TEST NO.	ELECTRODE SPACING "C" (FEET)	TEST PROBE DEPTH (INCHES)	METER READING, "C" TEST (OHMS)	MULTIPLIER	EARTH RESISTIVITY (OHM-CM)
1	2.5	12	5.98	479	2,864
2	5	12	1.47	958	1,408
3	10	12	0.42	1,916	805
4	15	12	0.26	2,873	747
5	20	12	0.18	3,831	690
6	30	12	0.11	5,747	632
7	40	12	0.09	7,662	690
8	50	12	0.09	9,578	862

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EXHIBIT A-21

ELECTRICAL EARTH RESISTIVITY SURVEY
New Heavy Industrial Project
Arkadelphia, Arkansas
Terracon Project No. 35165046

TEST NO. 2 (N-S run BH-22)

STATION NAME: New Heavy Industrial Project

STATION LOCATION: US Hwy 67 and AR Hwy 26

DATE: 4/5/2016

TEMPERATURE: 81°

SOIL MOISTURE: Moist

SURFACE SOIL TYPE: CH

TEST INSTRUMENT TYPE: Wenner 4 Electrode

TESTED BY: Josh Farler

TEST NO.	ELECTRODE SPACING "C" (FEET)	TEST PROBE DEPTH (INCHES)	METER READING, "C" TEST (OHMS)	MULTIPLIER	EARTH RESISTIVITY (OHM-CM)
1	2.5	12	5.98	479	2,864
2	5	12	1.39	958	1,331
3	10	12	0.41	1,916	785
4	15	12	0.24	2,873	690
5	20	12	0.18	3,831	690
6	30	12	0.12	5,747	690
7	40	12	0.10	7,662	766
8	50	12	0.09	9,578	862

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EXHIBIT A-22
ELECTRICAL EARTH RESISTIVITY SURVEY
New Heavy Industrial Project
Arkadelphia, Arkansas
Terracon Project No. 35165046
TEST NO. 1 (E-W run BH-27)

STATION NAME: New Heavy Industrial Project

STATION LOCATION: US Hwy 67 and AR Hwy 26

DATE: 4/5/2016

TEMPERATURE: 73°

SOIL MOISTURE: Moist

SURFACE SOIL TYPE: CH

TEST INSTRUMENT TYPE: Wenner 4 Electrode

TESTED BY: Josh Farler

TEST NO.	ELECTRODE SPACING "C" (FEET)	TEST PROBE DEPTH (INCHES)	METER READING, "C" TEST (OHMS)	MULTIPLIER	EARTH RESISTIVITY (OHM-CM)
1	2.5	12	13	479	6,226
2	5	12	3.47	958	3,324
3	10	12	0.6	1,916	1,149
4	15	12	0.27	2,873	776
5	20	12	0.17	3,831	651
6	30	12	0.1	5,747	575
7	40	12	0.08	7,662	613
8	50	12	0.07	9,578	670

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EXHIBIT A-23
ELECTRICAL EARTH RESISTIVITY SURVEY
New Heavy Industrial Project
Arkadelphia, Arkansas
Terracon Project No. 35165046
TEST NO. 2 (N-S run BH-27)

STATION NAME: New Heavy Industrial Project

STATION LOCATION: US Hwy 67 and AR Hwy 26

DATE: 4/5/2016

TEMPERATURE: 75°

SOIL MOISTURE: Moist

SURFACE SOIL TYPE: CH

TEST INSTRUMENT TYPE: Wenner 4 Electrode

TESTED BY: Josh Farler

TEST NO.	ELECTRODE SPACING "C" (FEET)	TEST PROBE DEPTH (INCHES)	METER READING, "C" TEST (OHMS)	MULTIPLIER	EARTH RESISTIVITY (OHM-CM)
1	2.5	12	12.4	479	5,938
2	5	12	3.82	958	3,659
3	10	12	0.68	1,916	1,303
4	15	12	0.25	2,873	718
5	20	12	0.17	3,831	651
6	30	12	0.11	5,747	632
7	40	12	0.08	7,662	613
8	50	12	0.07	9,578	670

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Consulting Engineers & Scientists

EXHIBIT A-24

ELECTRICAL EARTH RESISTIVITY SURVEY
New Heavy Industrial Project
Arkadelphia, Arkansas
Terracon Project No. 35165046
TEST NO. 1 (N-S run BH-30)

STATION NAME: New Heavy Industrial Project

STATION LOCATION: US Hwy 67 and AR Hwy 26

DATE: 4/5/2016

TEMPERATURE: 81°

SOIL MOISTURE: Moist

SURFACE SOIL TYPE: CH

TEST INSTRUMENT TYPE: Wenner 4 Electrode

TESTED BY: Josh Farler

TEST NO.	ELECTRODE SPACING "C" (FEET)	TEST PROBE DEPTH (INCHES)	METER READING, "C" TEST (OHMS)	MULTIPLIER	EARTH RESISTIVITY (OHM-CM)
1	2.5	12	7.74	479	3,707
2	5	12	2.28	958	2,184
3	10	12	0.53	1,916	1,015
4	15	12	0.30	2,873	862
5	20	12	0.23	3,831	881
6	30	12	0.19	5,747	1,092
7	40	12	0.18	7,662	1,379
8	50	12	0.16	9,578	1,532

Terracon
Consulting Engineers & Scientists

EXHIBIT A-25

ELECTRICAL EARTH RESISTIVITY SURVEY
New Heavy Industrial Project
Arkadelphia, Arkansas
Terracon Project No. 35165046
TEST NO. 2 (E-W run BH-30)

STATION NAME: New Heavy Industrial Project

STATION LOCATION: US Hwy 67 and AR Hwy 26

DATE: 4/5/2016

TEMPERATURE: 81°

SOIL MOISTURE: Moist

SURFACE SOIL TYPE: CH

TEST INSTRUMENT TYPE: Wenner 4 Electrode

TESTED BY: Josh Farler

TEST NO.	ELECTRODE SPACING "C" (FEET)	TEST PROBE DEPTH (INCHES)	METER READING, "C" TEST (OHMS)	MULTIPLIER	EARTH RESISTIVITY (OHM-CM)
1	2.5	12	9.50	479	4,549
2	5	12	2.09	958	2,002
3	10	12	0.54	1,916	1,034
4	15	12	0.30	2,873	862
5	20	12	0.23	3,831	881
6	30	12	0.19	5,747	1,092
7	40	12	0.17	7,662	1,303
8	50	12	0.16	9,578	1,532

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EXHIBIT A-26
ELECTRICAL EARTH RESISTIVITY SURVEY
New Heavy Industrial Project
Arkadelphia, Arkansas
Terracon Project No. 35165046
TEST NO. 1 (E-W run BH-36)

STATION NAME: New Heavy Industrial Project

STATION LOCATION: US Hwy 67 and AR Hwy 26

DATE: 4/5/2016

TEMPERATURE: 79°

SOIL MOISTURE: Moist

SURFACE SOIL TYPE: CH

TEST INSTRUMENT TYPE: Wenner 4 Electrode

TESTED BY: Josh Farler

TEST NO.	ELECTRODE SPACING "C" (FEET)	TEST PROBE DEPTH (INCHES)	METER READING, "C" TEST (OHMS)	MULTIPLIER	EARTH RESISTIVITY (OHM-CM)
1	2.5	12	9.85	479	4,717
2	5	12	2.36	958	2,260
3	10	12	0.43	1,916	824
4	15	12	0.25	2,873	718
5	20	12	0.16	3,831	613
6	30	12	0.11	5,747	632
7	40	12	0.08	7,662	613
8	50	12	0.07	9,578	670

Terracon
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EXHIBIT A-27
ELECTRICAL EARTH RESISTIVITY SURVEY
New Heavy Industrial Project
Arkadelphia, Arkansas
Terracon Project No. 35165046
TEST NO. 2 (N-S run BH-36)

STATION NAME: New Heavy Industrial Project

STATION LOCATION: US Hwy 67 and AR Hwy 26

DATE: 4/5/2016

TEMPERATURE: 79°

SOIL MOISTURE: Moist

SURFACE SOIL TYPE: CH

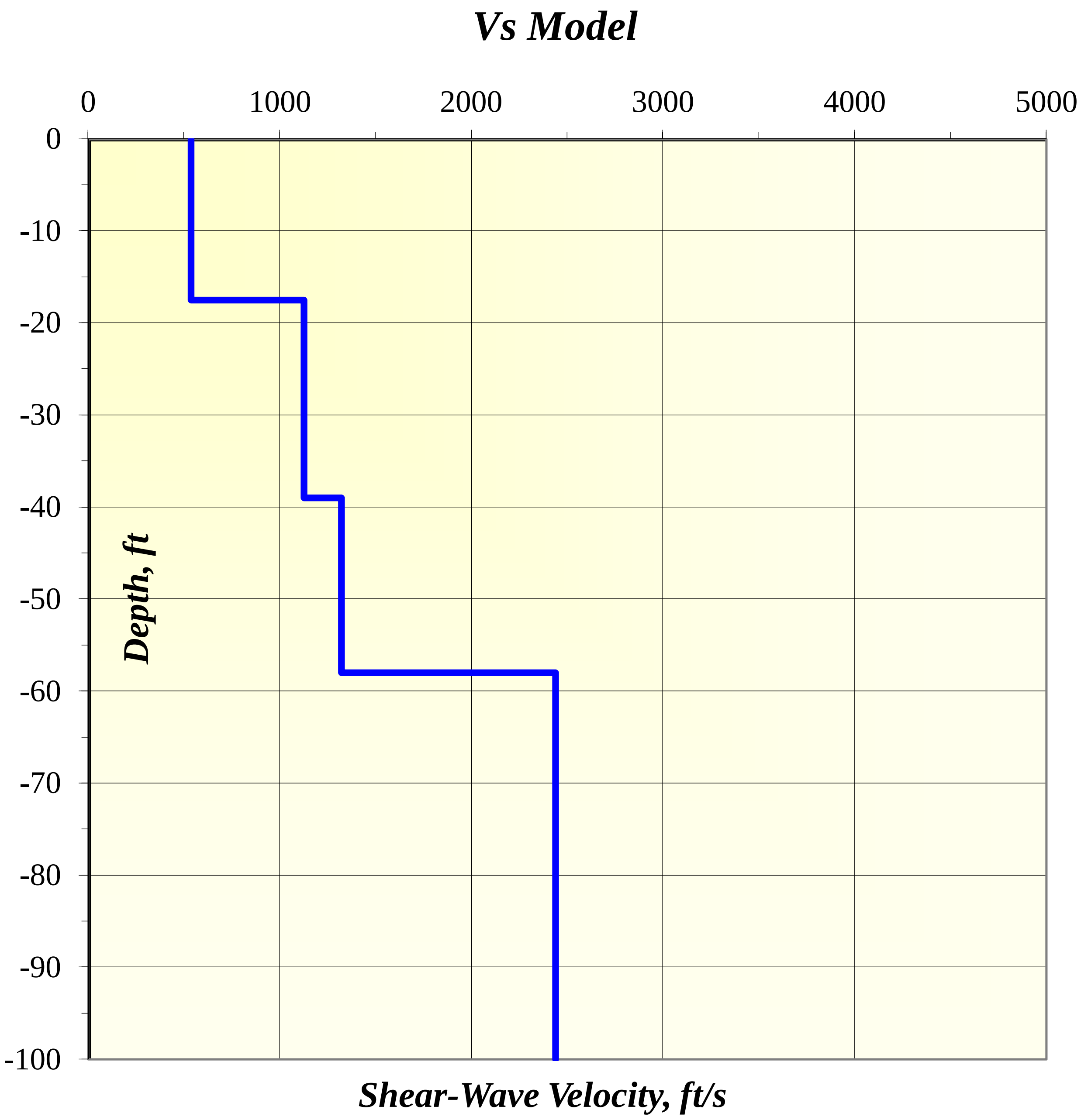
TEST INSTRUMENT TYPE: Wenner 4 Electrode

TESTED BY: Josh Farler

TEST NO.	ELECTRODE SPACING "C" (FEET)	TEST PROBE DEPTH (INCHES)	METER READING, "C" TEST (OHMS)	MULTIPLIER	EARTH RESISTIVITY (OHM-CM)
1	2.5	12	9.28	479	4,444
2	5	12	1.94	958	1,858
3	10	12	0.48	1,916	919
4	15	12	0.26	2,873	747
5	20	12	0.17	3,831	651
6	30	12	0.11	5,747	632
7	40	12	0.08	7,662	613
8	50	12	0.08	9,578	766

Terracon
Consulting Engineers & Scientists

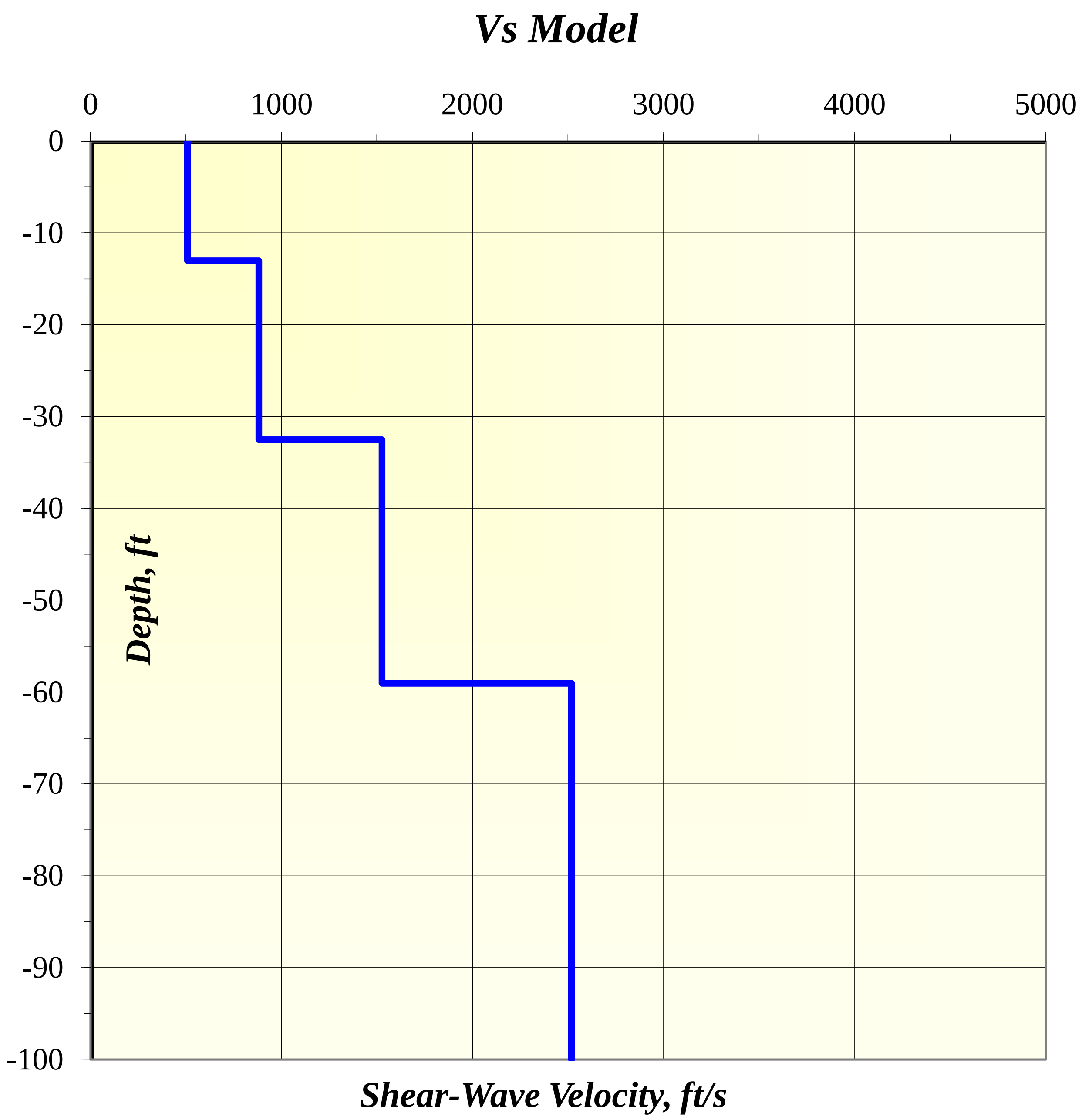
North-South Profile



Average Shear Wave Velocity to 100 ft (rounded) = 1200 ft/s

Project Manager: SPB	Project No. 35165046	Terracon Consulting Engineers & Scientists	Shear Wave Profile	EXHIBIT #
Drawn by: JWA	Scale: N.T.S.	4701 N. STILES AVE OKLAHOMA CITY, OKLAHOMA 74145	New Heavy Industrial Project Shandong Sun Paper Industry Arkadelphia, Arkansas	A-28
Checked by: RAK	File Name: NS.xlsx	PH. (405) 525-0453 FAX. (405) 557-0549		
Approved by: SPB	Date: APR 2016			

West-East Profile



Average Shear Wave Velocity to 100 ft (rounded) = 1230 ft/s

Project Manager: SPB	Project No. 35165046	Terracon Consulting Engineers & Scientists	Shear Wave Profile	EXHIBIT #
Drawn by: JWA	Scale: N.T.S.	4701 N. STILES AVE OKLAHOMA CITY, OKLAHOMA 74145	New Heavy Industrial Project Shandong Sun Paper Industry Arkadelphia, Arkansas	A-29
Checked by: RAK	File Name: WE.xlsx	PH. (405) 525-0453 FAX. (405) 557-0549		
Approved by: SPB	Date: APR 2016			

APPENDIX B
LABORATORY TESTING

Laboratory Testing Description

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in Appendix C. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

The following tests were performed on selected soil samples:

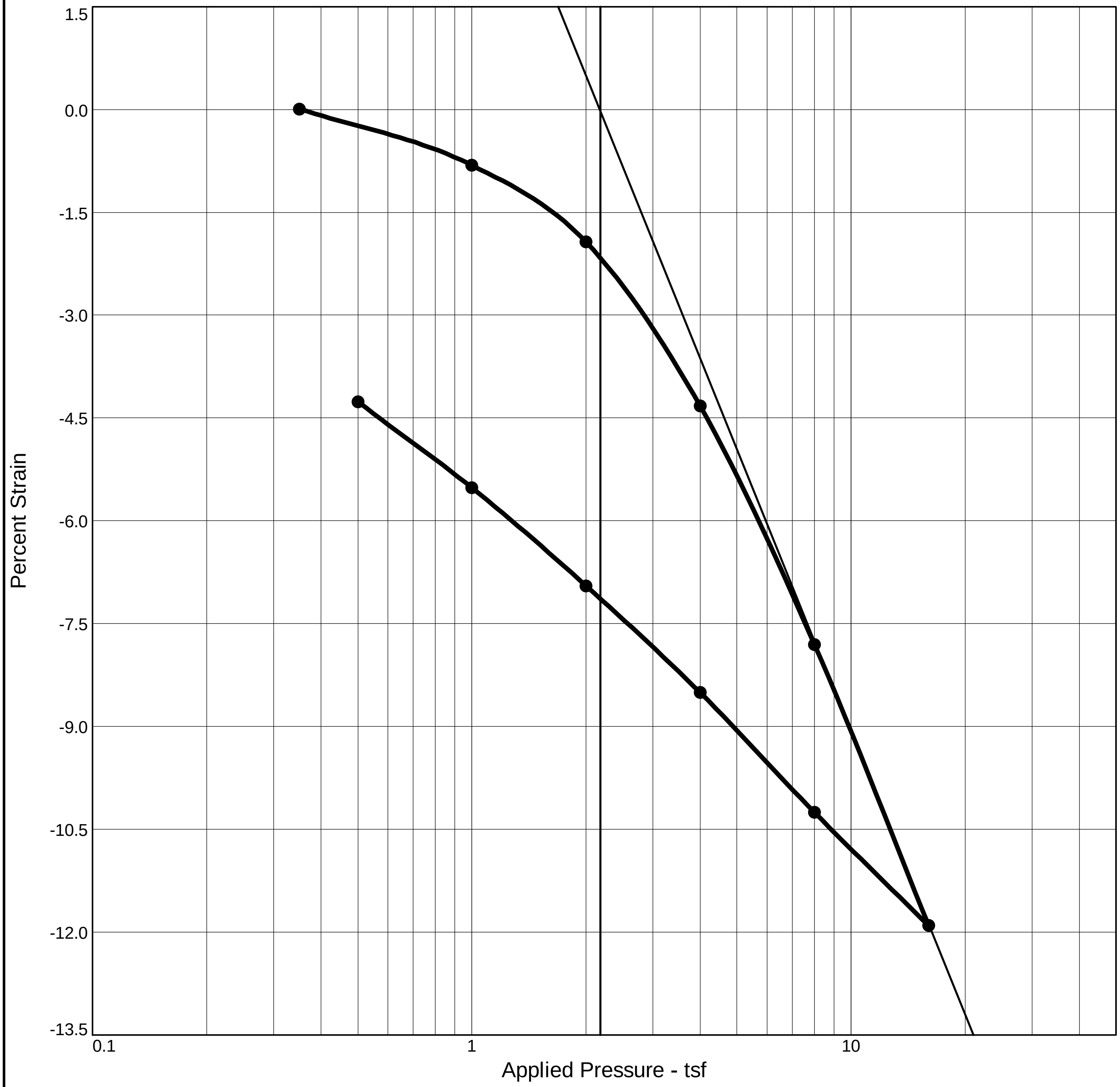
- Moisture content (ASTM D 2216)
- Hand penetrometer
- Atterberg limits (ASTM D 4318)
- Percent fines (percent passing the No. 200 sieve or P200) (ASTM D 1140)
- Sieve analysis (ASTM D 422)
- One-dimensional consolidation (ASTM D 2435)
- One-dimensional swell (ASTM D 4546)
- Eades-Grimes lime series (ASTM D 6276)
- Corrosivity suite
- Analytical VOCs, PAHs, RCRA metals, TPH (DRO/GRO), and PCB

The test results are presented on the boring logs in Appendix A and in this Appendix B. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Descriptive classifications of the soils indicated on the boring logs are in accordance with Exhibit C-1 Explanation of Boring Log Information and Exhibit C-2 Unified Soil Classification System. Also shown are estimated Unified Soil Classification Symbols. A brief description of this classification system is included in Appendix C. All classification was by visual manual procedures (ASTM D2487) and from the laboratory test results.

Procedural standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practices or professional judgment.

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
88.1 %	28.8 %	89.5	85	64	2.7	0.38	3.47	0.26	0.10	0.883

MATERIAL DESCRIPTION	USCS	AASHTO
Fat Clay	CH	X

Project No. 35165046 **Client:** Shandong Sun Paper Industry Joint Stock Co, Ltd

Project: Proposed New Heavy Industrial Project

Source of Sample: B-11 **Depth:** 7.0-8.5 ft **Sample Number:** 5

Terracon Consultants, Inc.

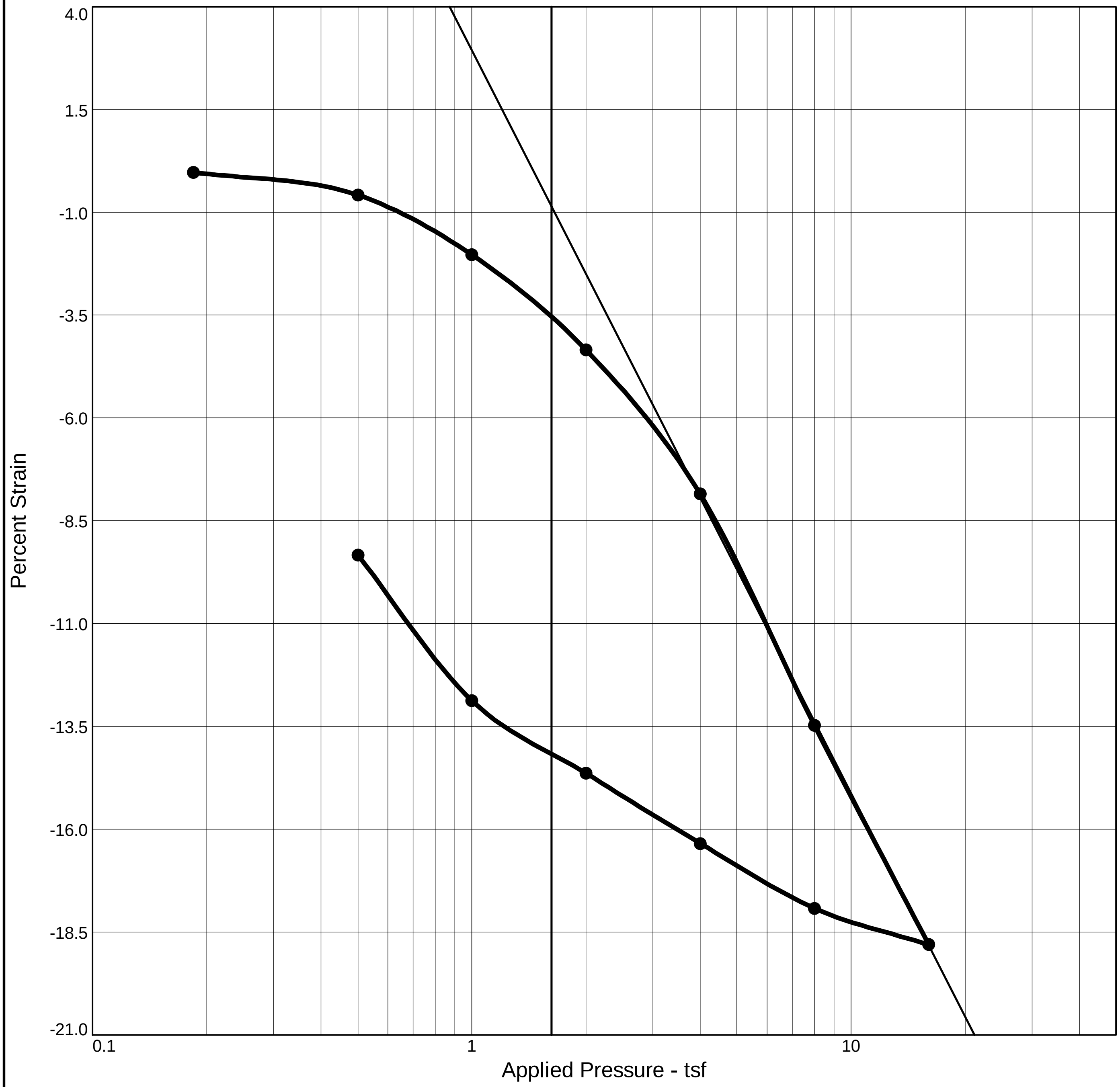
Chattanooga, TN

Remarks:

Swell pressure of 702psf.

Exhibit B-2

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
92.8 %	39.5 %	78.4	79	56	2.7	0.59	2.54	0.39	0.17	1.149

MATERIAL DESCRIPTION	USCS	AASHTO
Fat Clay with Sand	CH	X

Project No. 35165046 **Client:** Shandong Sun Paper Industry Joint Stock Co, Ltd

Project: Proposed New Heavy Industrial Project

Source of Sample: B-13 **Depth:** 13.5-15.0 ft **Sample Number:** 6

Remarks:

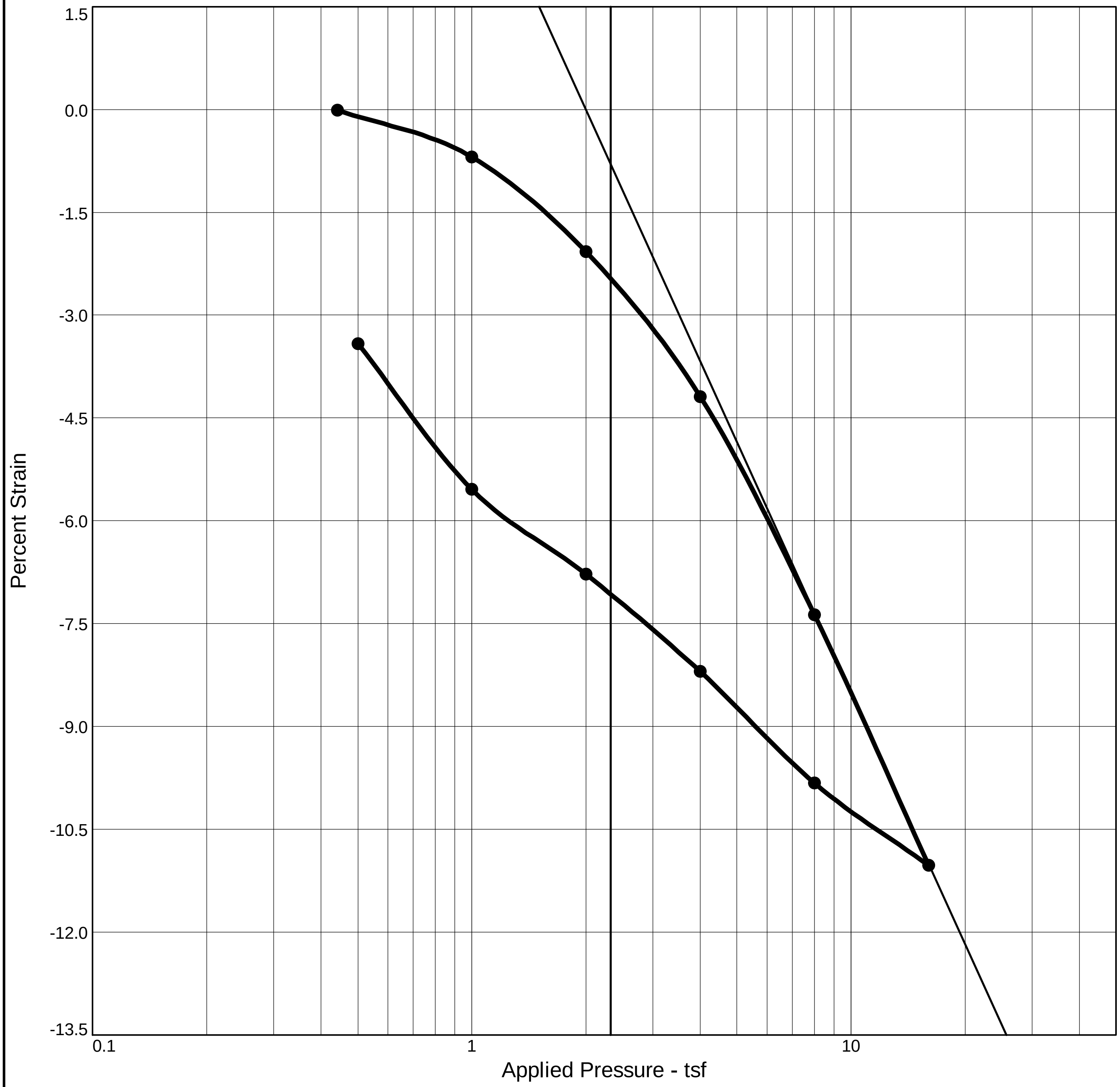
Swell pressure of 369psf.

Terracon Consultants, Inc.

Chattanooga, TN

Exhibit B-3

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
93.0 %	35.6 %	82.8	97	63	2.7	0.58	3.54	0.25	0.10	1.035

MATERIAL DESCRIPTION	USCS	AASHTO
Brown and Gray Clay	X	X

Project No. 35165046 **Client:** Shandong Sun Paper Industry Joint Stock Co, Ltd

Project: Proposed New Heavy Industrial Project

Source of Sample: B-22 **Depth:** 12.5-14.0 ft **Sample Number:** 6

Terracon Consultants, Inc.

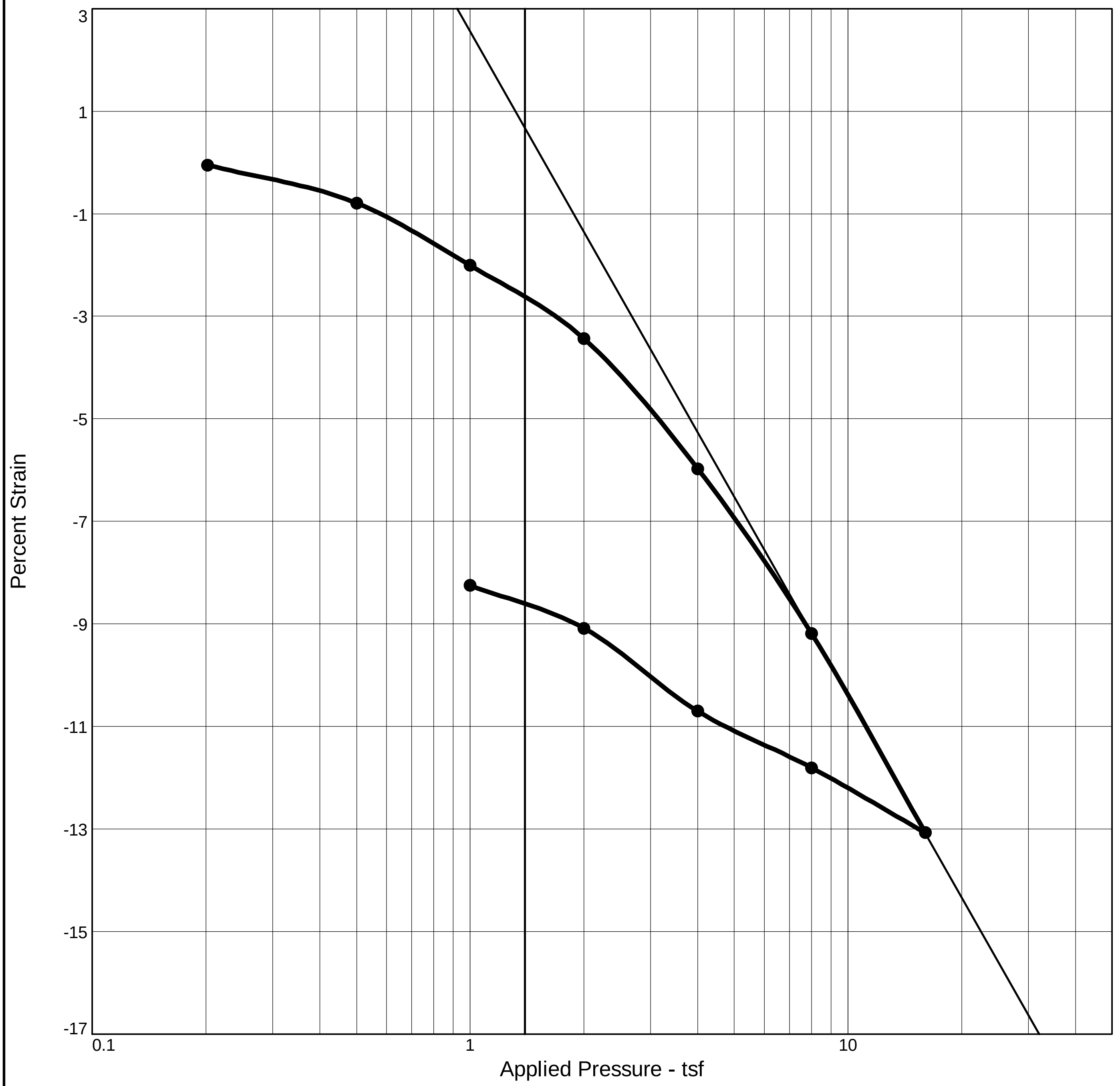
Chattanooga, TN

Remarks:

Swell pressure of 884psf.

Exhibit B-4

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
91.0 %	36.4 %	81.0	95	64	2.7	0.61	2.82	0.27	0.08	1.080

MATERIAL DESCRIPTION	USCS	AASHTO
Fat Clay	CH	X

Project No. 35165046 **Client:** Shandong Sun Paper Industry Joint Stock Co, Ltd

Project: Proposed New Heavy Industrial Project

Source of Sample: B-31 **Depth:** 13.5-15.0 ft **Sample Number:** 6

Terracon Consultants, Inc.

Chattanooga, TN

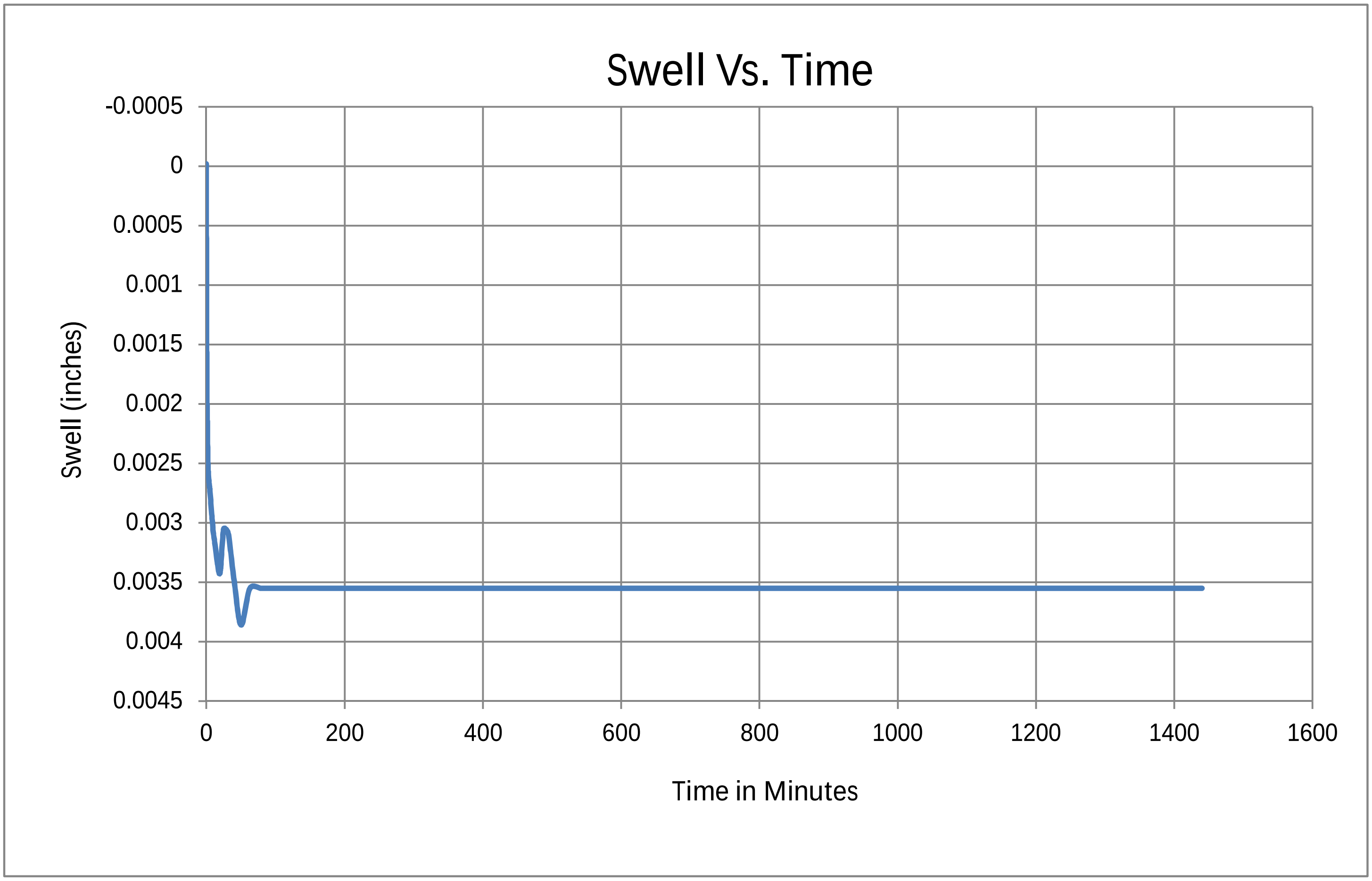
Remarks:

Swell pressure of 404psf.

Exhibit B-5

SWELL PERCENT DETERMINATION
ASTM D4546

Project: New Heavy Industrial Project
Project No.: 35165046
Sample No.: 3
Boring No.: B-11
Depth: 3.5-5.0 ft
Sample Description: Fat Clay



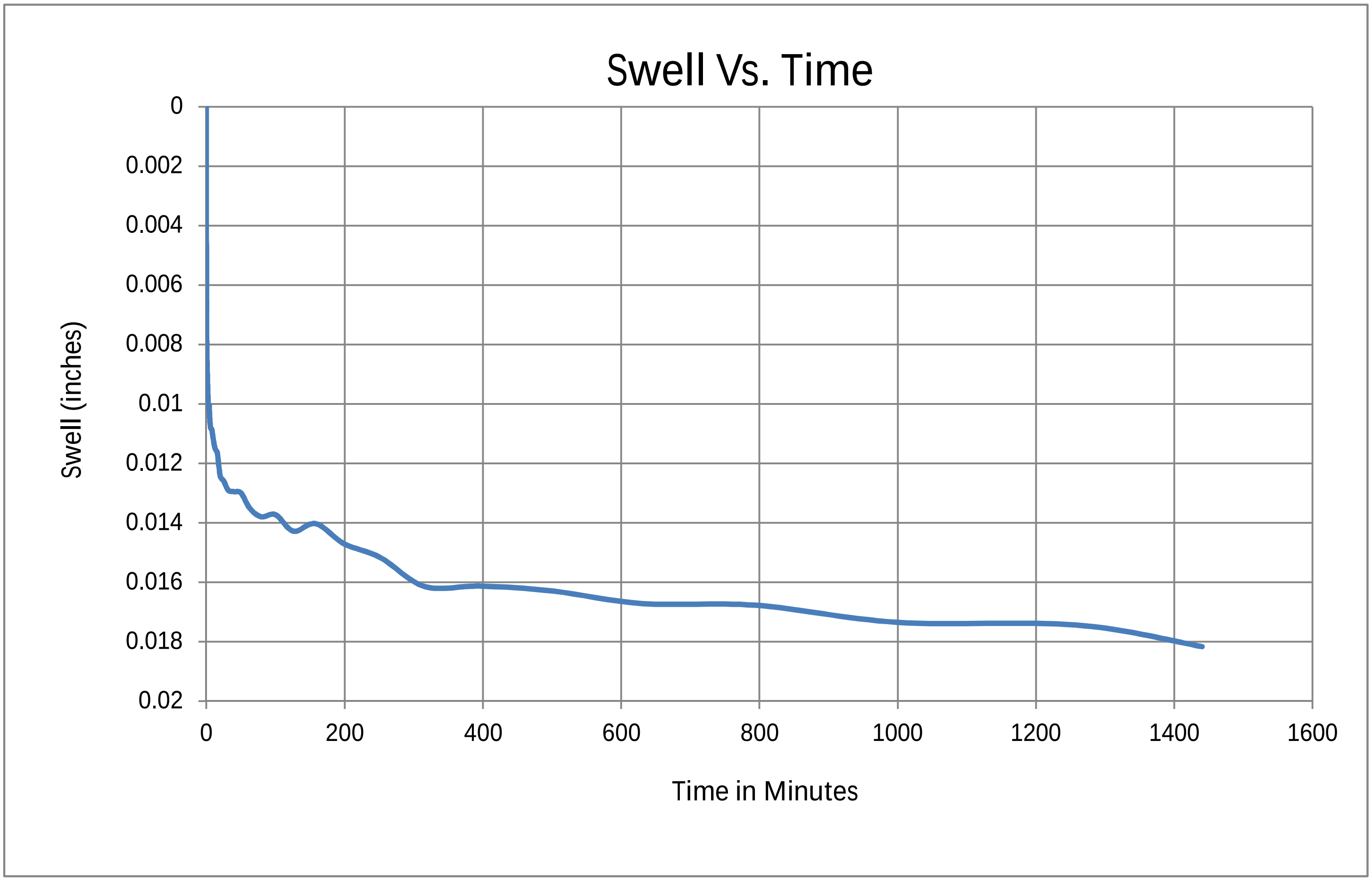
Maximum Swell Percent
0.39

Percent Moisture:	25.59
Dry Density (pcf):	88.1
Seating Load (psf):	500

Exhibit B-6

SWELL PERCENT DETERMINATION
ASTM D4546

Project: New Heavy Industrial Project
Project No.: 35165046
Sample No.: 3
Boring No.: B-11
Depth: 3.5-5.0 ft
Sample Description: Fat Clay



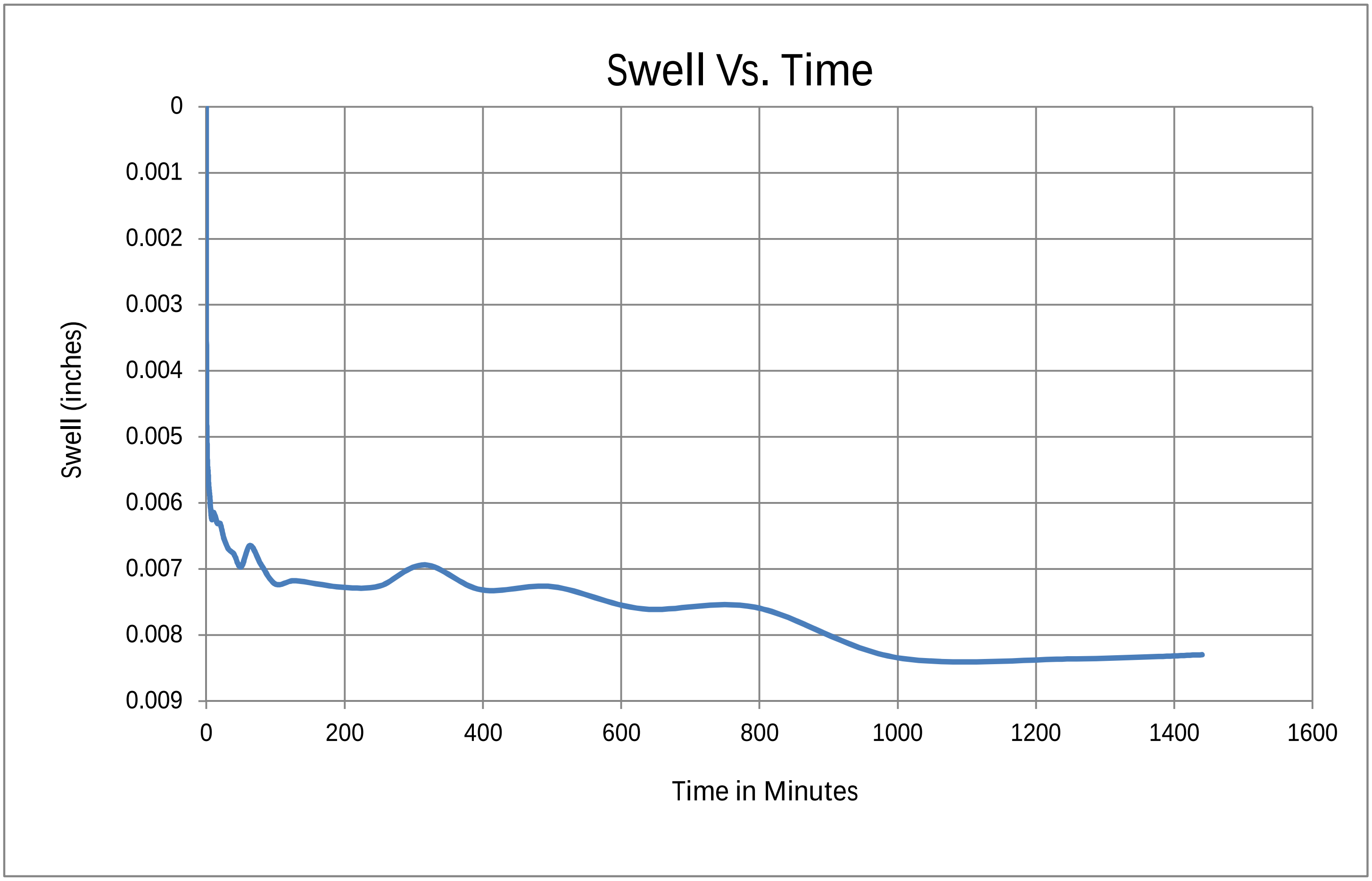
Maximum Swell Percent
1.82

Percent Moisture: 25.32
Dry Density (pcf): 83.5
Seating Load (psf): 1000

Exhibit B-7

SWELL PERCENT DETERMINATION
ASTM D4546

Project: New Heavy Industrial Project
Project No.: 35165046
Sample No.: 3
Boring No.: B-11
Depth: 3.5-5.0 ft
Sample Description: Fat Clay



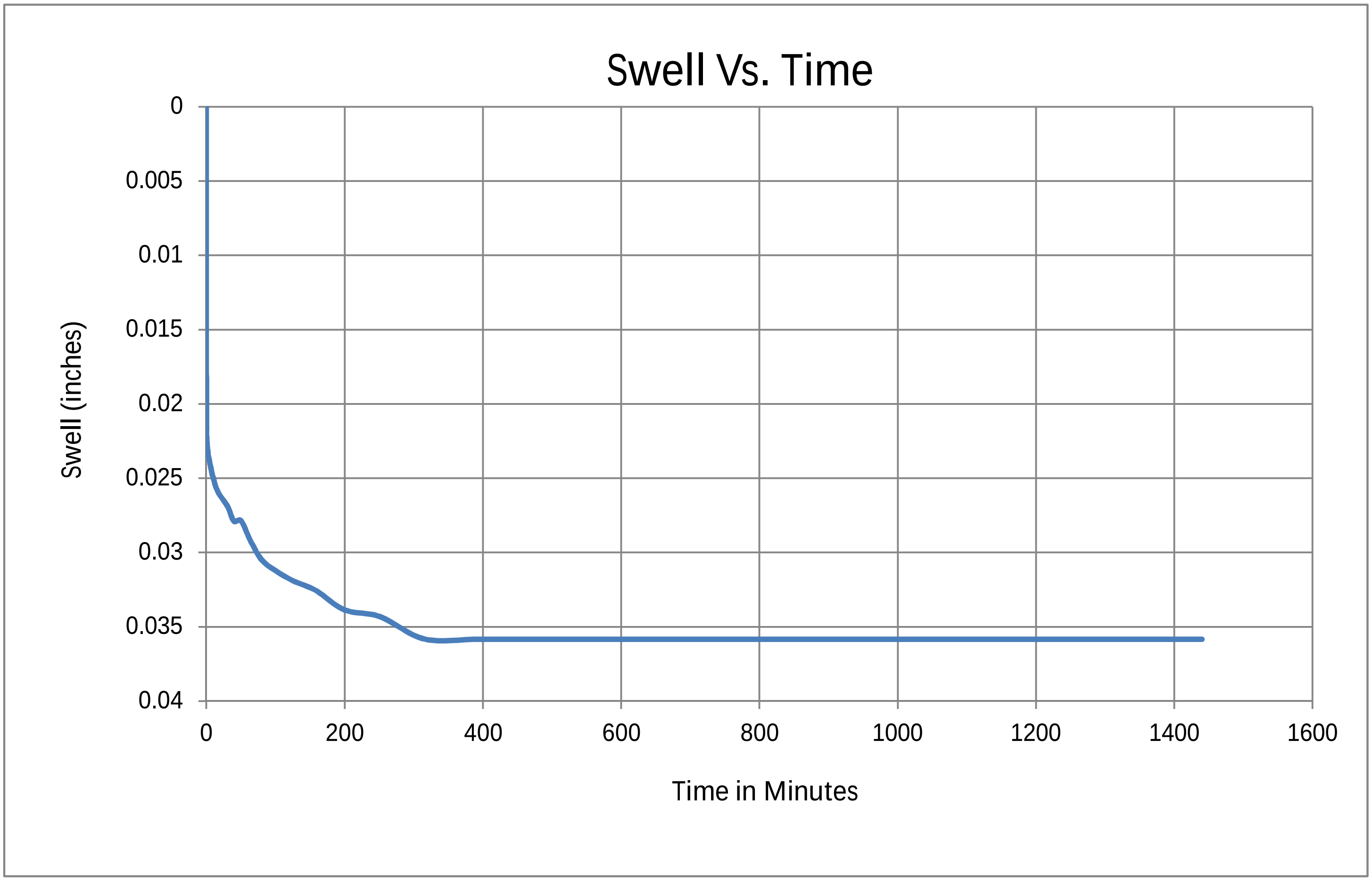
Maximum Swell Percent
0.84

Percent Moisture: 34.81
Dry Density (pcf): 83.0
Seating Load (psf): 2000

Exhibit B-8

SWELL PERCENT DETERMINATION
ASTM D4546

Project: New Heavy Industrial Project
Project No.: 35165046
Sample No.: 3
Boring No.: B-11
Depth: 3.5-5.0 ft
Sample Description: Fat Clay



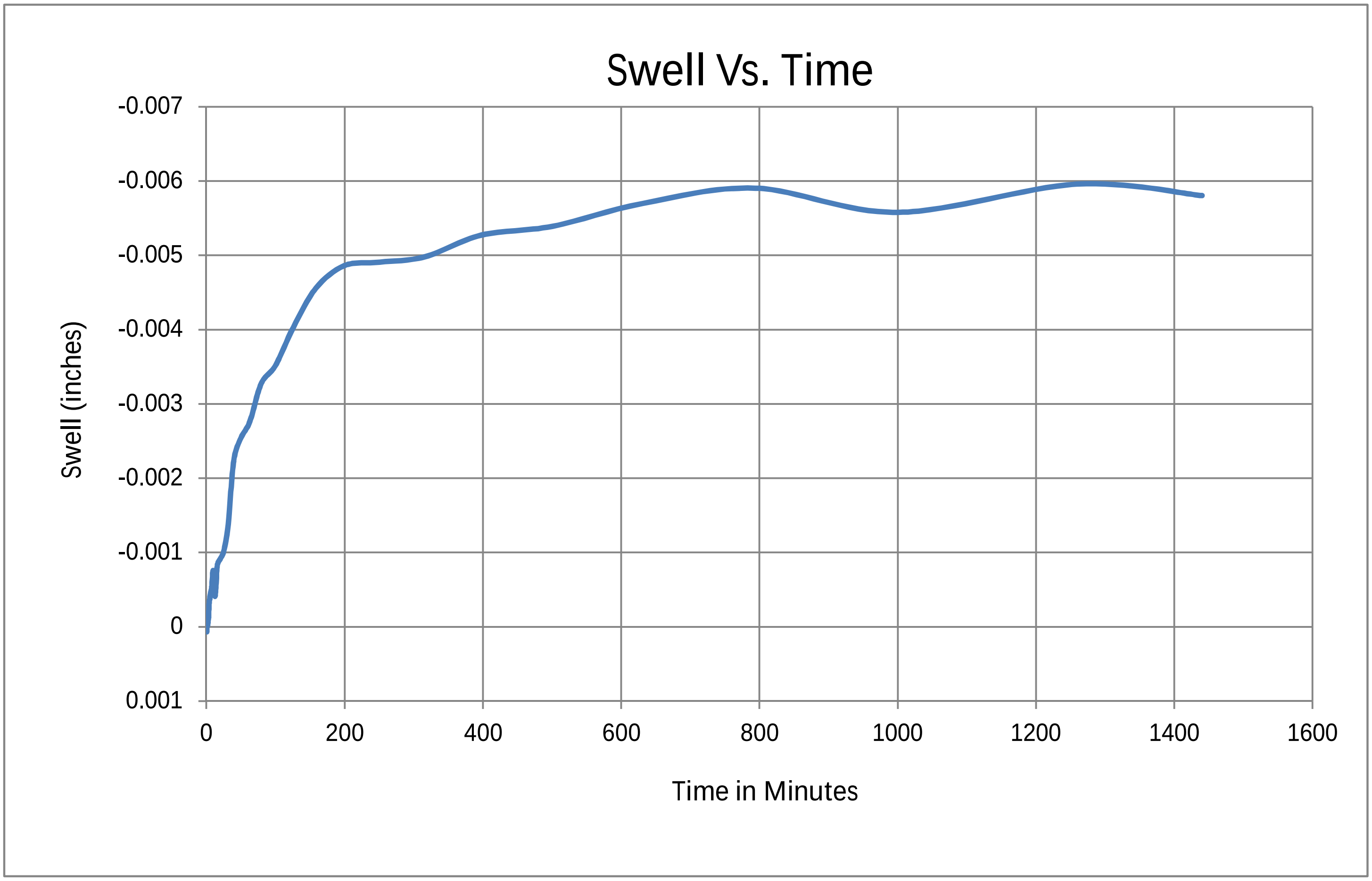
Maximum Swell Percent
3.58

Percent Moisture: 34.84
Dry Density (pcf): 85.6
Seating Load (psf): 4000

Exhibit B-9

SWELL PERCENT DETERMINATION
ASTM D4546

Project: New Heavy Industrial Project
Project No.: 35165046
Sample No.: 1
Boring No.: B-23
Depth: 0.5-2.0 ft
Sample Description: Fat Clay



Maximum Swell Percent
-0.60

Percent Moisture:	17.91
Dry Density (pcf):	98.5
Seating Load (psf):	750

Exhibit B-10

SWELL PERCENT DETERMINATION
ASTM D4546

Terracon

Project: New Heavy Industrial Project

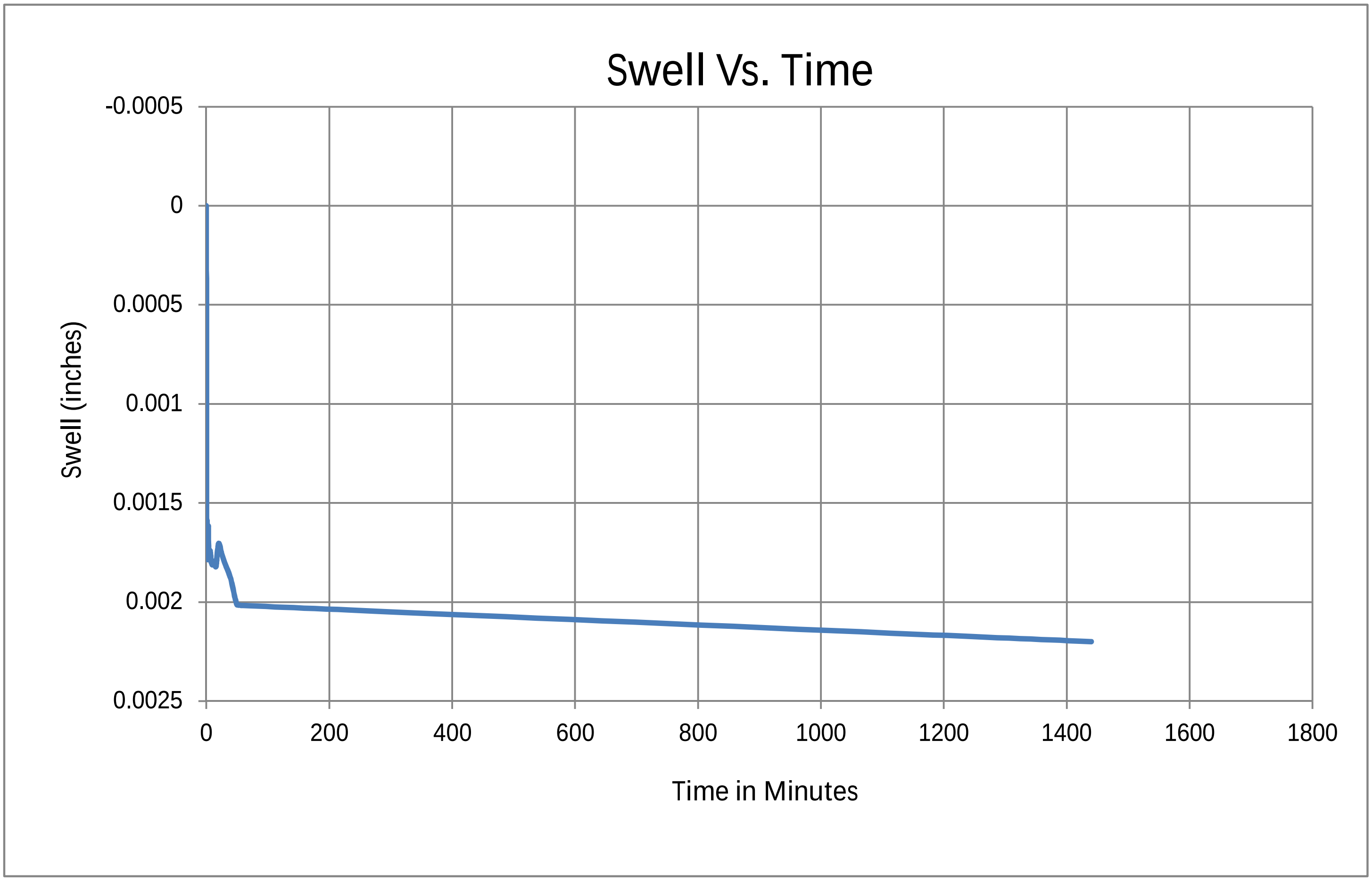
Project No.: 35165046

Sample No.: 1

Boring No.: B-36

Depth: .5-2.0

Sample Description: Reddish Orange and Gray Clay



Maximum Swell Percent
0.2200

Percent Moisture: 31.85
Dry Density (pcf): 90.0
Seating Load (psf): 500

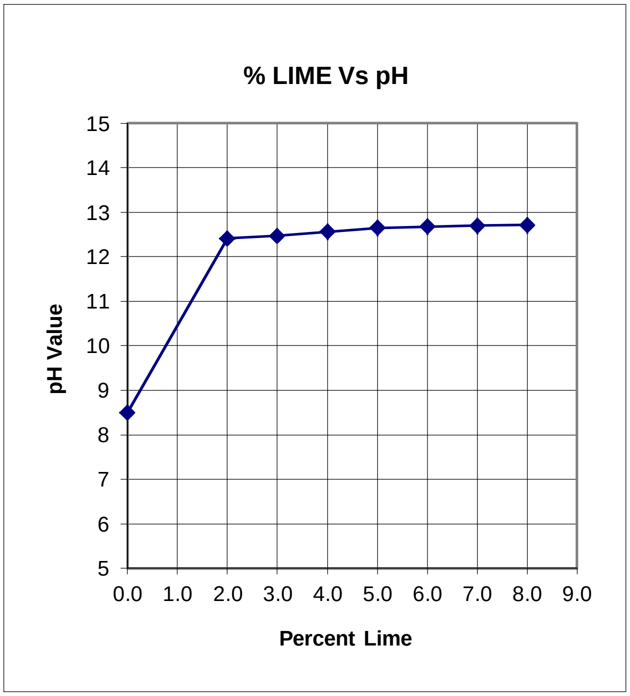
Exhibit B-11

LIME SERIES TEST RESULTS

ASTM D6276

Project: New Heavy Industrial Project
Project #: 35165046
Description: Yellowish Brown Clay
Sample #: B-11, Depth: 1 to 3 ft
Date: May 18, 2016

Test No.	Lime %	pH
Base	100.0	12.71
1	0.0	8.50
2	2.0	12.41
3	3.0	12.47
4	4.0	12.56
5	5.0	12.65
6	6.0	12.68
7	7.0	12.70
8	8.0	12.71



Terracon

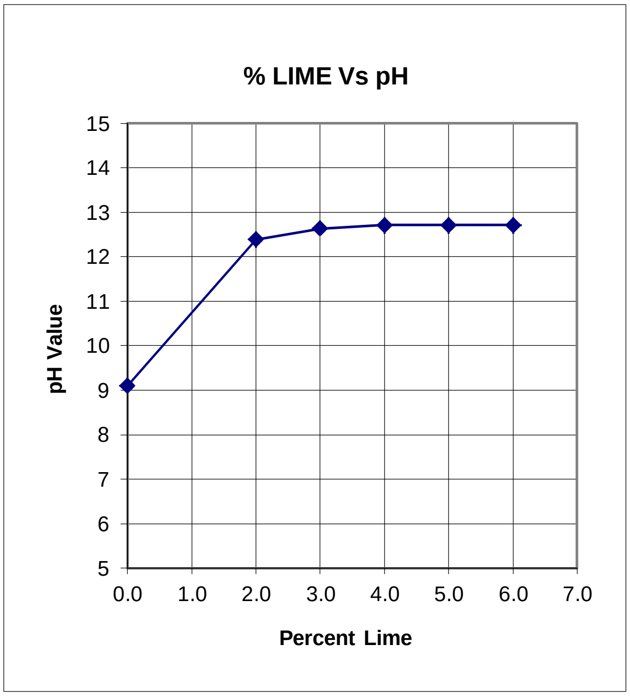
Exhibit B-12

LIME SERIES TEST RESULTS

ASTM D6276

Project: New Heavy Industrial Project
Project #: 35165046
Description: Yellowish Brown Clay
Sample #: B-12, Depth: 1 to 3 ft
Date: May 18, 2016

Test No.	Lime %	pH
Base	100.0	12.71
1	0.0	9.10
2	2.0	12.39
3	3.0	12.63
4	4.0	12.71
5	5.0	12.71
6	6.0	12.71



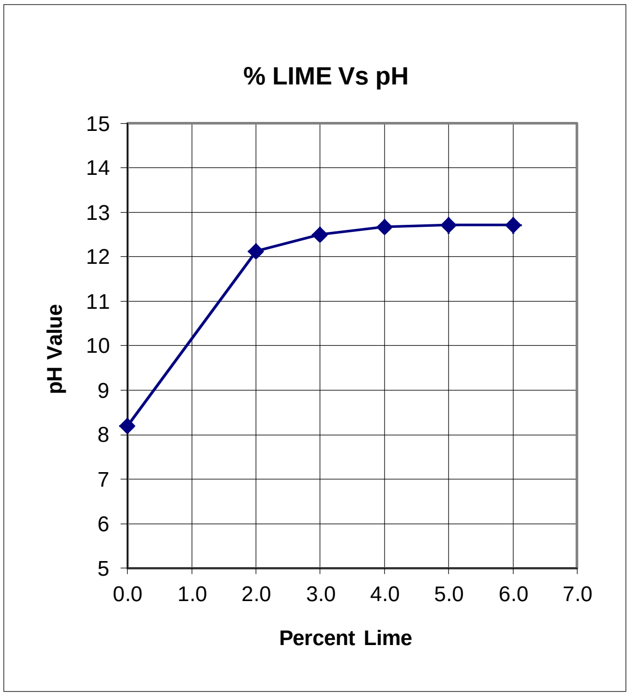
Terracon

LIME SERIES TEST RESULTS

ASTM D6276

Project:	New Heavy Industrial Project
Project #:	35165046
Description:	Yellowish Brown Clay
Sample #:	B-20, Depth: 1 to 3 ft
Date:	May 18, 2016

Test No.	Lime %	pH
Base	100.0	12.71
1	0.0	8.20
2	2.0	12.12
3	3.0	12.50
4	4.0	12.67
5	5.0	12.71
6	6.0	12.71

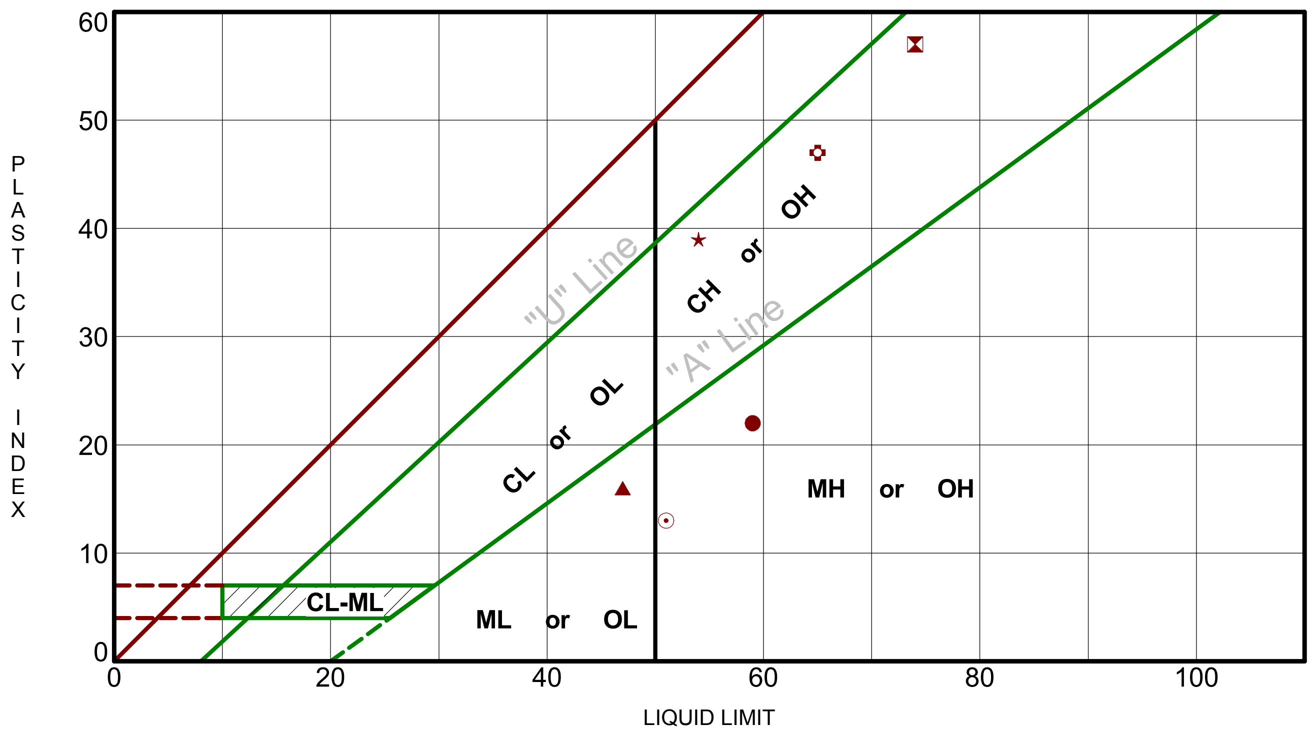


Terracon

Exhibit B-14

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
● **B-11-8% Lime**	**1**	**59**	**37**	**22**			
⧗ **B-11-Raw**	**1**	**74**	**17**	**57**			
▲ **B-12-4% Lime**	**1**	**47**	**31**	**16**			
★ **B-12-Raw**	**1**	**54**	**15**	**39**			
⊙ **B-20-5% Lime**	**1**	**51**	**38**	**13**			
✥ **B-20-Raw**	**1**	**65**	**18**	**47**			

PROJECT: New Heavy Industrial Project

SITE: US Hwy 67 and AR Hwy 26
Arkadelphia, Arkansas

25809 I 30
Bryant, AR

PROJECT NUMBER: 35165046

CLIENT: Shandong Sun Paper Industry
Yanzhou, Shandong, China

EXHIBIT: B-15

CHEMICAL LABORATORY TEST REPORT

Project Number: 35165046
Service Date: 05/04/16
Report Date: 05/05/16
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

Shandong Sun Paper Industry
Yanzhou, Shandong

Project

New Heavy Industrial Project
Gum Springs, Arkansas

Sample Submitted By: Terracon (35) **Date Received:** 5/3/2016 **Lab No: 16-0416**

Results of Corrosion Analysis

Sample Number	Bulk	Bulk	Bulk
Sample Location	B-11	B-12	B-20
Sample Depth (ft.)	1.0-3.0	1.0-3.0	1.0-3.0
pH Analysis, AWWA 4500 H	7.83	5.16	5.37
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	182	556	96
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	125	100	100
Total Salts, AWWA 2510, (mg/kg)	2789	2027	470
Red-Ox, ASTM D 1498, (mV)	+723	+658	+776
Resistivity, ASTM G 57, (ohm-cm)	611	1465	2522

Nil = <1.0mg/kg

Analyzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

Exhibit B-16

EXHIBIT B-17

Soil Analytical Results (Soil Borings BH-13 and BH-31)
Proposed Heavy Industrial Project
Arkadelphia, Arkansas

Boring	**BH-13**	**BH-31**	**Typical Background Range (Region VI)**	**EPA Industrial Screening Levels**
Sample Depth (ft)	5 - 6.5	8.5 - 10		
Metals (mg/kg)				
Arsenic	**3.73**	**3.31**	1.1-16.7	3
Barium	**81.2**	**14.1**	430	220,000
Cadmium	< 0.314	< 0.312	0.01-1	980
Chromium	**23.9**	**25.2**	38	1,800,000
Lead	**11.8**	**13.3**	10-18	800
Mercury	< 0.133	< 0.124	0.1	40
Selenium	< 6.28	< 6.24	0.2	5,800
Silver	< 1.89	< 1.87	0.01-5	5,800
VOCs (mg/kg)				
VOCs (mg/kg)	ND	ND	NA	NA
TPH (mg/kg)				
TPH GRO	< 2.0	< 2.0	NA	440*
TPH DRO	< 10.00	< 10.00	NA	2300*
PCBs (mg/kg)				
PCBs	ND	ND	NA	NA
PAHs (mg/kg)				
PAHs (mg/kg)	ND	ND	NA	NA

*Arkansas Department of Environmental Quality Recommended Screening Levels

< - not detected at concentrations above the laboratory detection limit.
Concentrations in **Bold** exceed the respective screening level.
NA - Not Applicable ND - None Detected

Arkansas Analytical Inc.

8100 National Dr. - Little Rock, AR 72209
501-455-3233   Fax 501-455-6118

20 April 2016

Shaun Baker
Terracon
25809 Interstate 30
Bryant, AR 72022

Project: Soil Samples

Project Number: 35165046 -- April 2016

SDG Number: 1604142

Enclosed are the results of analyses for samples received by the laboratory on 07-Apr-16 16:44. If you have any questions concerning this report, please feel free to contact me.

Sample Receipt Information:

Custody Seals	✓
Containers Correct	✓
COC/Labels Agree	✓
Received On Ice	✓
Temperature on Receipt	10.0°C

Sincerely,

Norma James / Teresa Coins

Norma James and/or Teresa Coins
Technical Director and/or QA Officer

Exhibit B-18

20 April 2016

Shaun Baker
Terracon
25809 Interstate 30
Bryant, AR 72022
Project: Soil Samples

Project Number: 35165046 -- April 2016
Date Received: 07-Apr-16 16:44

CASE NARRATIVE

Sample Delivery Group – 1604142

One *OR* more of the qualifiers described below may appear in this report.

SAMPLE RECEIPT QUALIFIERS:

Qualifier	Description
ET	Samples received above required temperature.
ET	Samples received above required temperature. Although collected and received the same day, no ice was present to indicate the cooling preservation was attempted.
E2	Result qualified as it was received and analyzed outside of holding time. Analysis is considered a "Field" analysis.
E2	Result qualified as it was received and/or analyzed outside of holding time.
E3	Result qualified as it was received in the incorrect container and/or preservation.

QUALITY CONTROL QUALIFIERS:

Qualifier	Description
E20	Sample used as "parent" for the associated analytical batch.
%D3/S-01 / E1	Surrogate failed to recover within acceptance criteria (%D3/S-01). Results associated with this surrogate were qualified as "estimated" (E1).
B	Present in the Associated Blank
B1	Present in Blank, but Not In the Sample.
%D2 / E5	Laboratory Control Spike (LCS) and/or Laboratory Control Spike Duplicate (LCSD) failed to recover with acceptance criteria (%D2). Associated results were qualified as "estimated" (E5).
%D1	Matrix Spike (MS) and/or Matrix Spike Duplicate (MSD) failed acceptance criteria.
MBA	Failed criteria due the high concentration of analyte in the parent sample.
MBI	Failed criteria due an interference in the parent sample.
%D3	Quality Control Surrogate failed acceptance criteria.
NREC	Quality Control Surrogate failed.

CALIBRATION QUALIFIERS:

Qualifier	Description
CR	Result above highest calibration standard, but within linear calibration range.
Est3	Result at the instrument was above the concentration of the highest standard in the calibration curve.
E5	Second Source Verification Failure
E7	Internal Standard Response Failure
E11	Initial Calibration Minimum Response Factor Failure
E21	CCV Low
E-01	CCV High
E35	Low Level CCV Failure

20 April 2016

Shaun Baker
Terracon
25809 Interstate 30
Bryant, AR 72022
Project: Soil Samples

Project Number: 35165046 -- April 2016
Date Received: 07-Apr-16 16:44

ANALYTICAL RESULTS

Lab Number:	**1604142-01**
Sample Name:	**B-31 S-5 / 8.5' - 10'**
Date/Time Collected:	**4/4/16 16:45**
Sample Matrix:	**Soil**

PCBs	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
Aroclor-1016	mg/kg dry	< 0.063	ET	4/14/16 13:39	B604191	8082A
Aroclor-1260	mg/kg dry	< 0.063	ET	4/14/16 13:39	B604191	8082A
Aroclor-1254	mg/kg dry	< 0.063	ET	4/14/16 13:39	B604191	8082A
Aroclor-1242	mg/kg dry	< 0.063	ET	4/14/16 13:39	B604191	8082A
Aroclor-1248	mg/kg dry	< 0.063	ET	4/14/16 13:39	B604191	8082A
TCMX [surr]	%	96.4		4/14/16 13:39	B604191	8082A
DCBP [surr]	%	118		4/14/16 13:39	B604191	8082A

Polynuclear Aromatic Hydrocarbons	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
Naphthalene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Acenaphthylene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Acenaphthene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Fluorene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Phenanthrene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Anthracene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Fluoranthene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Pyrene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Benzo (a) anthracene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Chrysene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Benzo[b]fluoranthene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Benzo[k]fluoranthene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Benzo[a]pyrene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Indeno[1,2,3-cd]pyrene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Dibenz[a,h]anthracene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
Benzo[g,h,i]perylene	mg/kg	< 0.979	ET	4/11/16 17:11	B604146	8270D, Rev 4, 2007
2-Fluorophenol [surr]	%	68.7		4/11/16 17:11	B604146	8270D, Rev 4, 2007
Phenol-d5 [surr]	%	77.6		4/11/16 17:11	B604146	8270D, Rev 4, 2007
2,4,6-Tribromophenol [surr]	%	64.1		4/11/16 17:11	B604146	8270D, Rev 4, 2007
Nitrobenzene-d5 [surr]	%	68.8		4/11/16 17:11	B604146	8270D, Rev 4, 2007
2-Fluorobiphenyl [surr]	%	65.0		4/11/16 17:11	B604146	8270D, Rev 4, 2007
Terphenyl-d14 [surr]	%	80.1		4/11/16 17:11	B604146	8270D, Rev 4, 2007

Total Metals	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
Arsenic	mg/kg dry	**3.31**		4/12/16 17:35	B604160	6010C Rev 3 (2007)
Barium	mg/kg dry	**14.1**		4/12/16 17:35	B604160	6010C Rev 3 (2007)
Cadmium	mg/kg dry	< 0.312		4/12/16 17:35	B604160	6010C Rev 3 (2007)
Chromium	mg/kg dry	**25.2**		4/12/16 17:35	B604160	6010C Rev 3 (2007)
Lead	mg/kg dry	**13.3**		4/12/16 17:35	B604160	6010C Rev 3 (2007)
Mercury	mg/kg dry	< 0.124	E35, ET	4/19/16 13:34	B604244	6010C Rev 3 (2007)
Selenium	mg/kg dry	< 6.24		4/12/16 17:35	B604160	6010C Rev 3 (2007)
Silver	mg/kg dry	< 1.87		4/12/16 17:35	B604160	6010C Rev 3 (2007)

TPH-DRO by 8015D	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
TPH-DRO	mg/kg	< 10.0	ET	4/12/16 18:14	B604151	8015D, Rev 4 2003 (Mod)

ANALYTICAL RESULTS

Lab Number: **1604142-01**
Sample Name: **B-31 S-5 / 8.5' - 10'**
Date/Time Collected: **4/4/16 16:45**
Sample Matrix: **Soil**

TPH-DRO by 8015D	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
o-Terphenyl [surr]	%	85.8		4/12/16 18:14	B604151	8015D, Rev 4 2003 (Mod)

TPH-GRO by 8015D	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
TPH-GRO	mg/kg	< 2.00	ET	4/11/16 16:26	B604127	8015D, Rev 4 2003 (Mod)
Fluorobenzene [surr]	%	98.2		4/11/16 16:26	B604127	8015D, Rev 4 2003 (Mod)
4-Bromochlorobenzene [surr]	%	98.5		4/11/16 16:26	B604127	8015D, Rev 4 2003 (Mod)

Volatiles	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
1,1,1,2-Tetrachloroethane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,1,1-Trichloroethane	mg/kg	< 0.0141	E-01, ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,1,2,2-Tetrachloroethane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,1,2-Trichloroethane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,1-Dichloroethane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,1-Dichloroethene	mg/kg	< 0.0141	E-01, ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,1-Dichloropropene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,2,3-Trichlorobenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,2,3-Trichloropropane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,2,4- Trimethylbenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,2,4-Trichlorobenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,2-Dibromo-3-chloropropane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,2-Dibromoethane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,2-Dichlorobenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,2-Dichloroethane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,2-Dichloropropane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,2-Dimethylbenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,3,5- Trimethylbenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,3-Dichlorobenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,3-Dichloropropane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,3-Dimethylbenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,4-Dichlorobenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,4-Dimethylbenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
2,2-Dichloropropane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
2-Butanone	mg/kg	< 0.0706	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
2-Chloroethyl Vinyl Ether	mg/kg	< 0.0706	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
2-Chlorotoluene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
2-Hexanone	mg/kg	< 0.0706	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
4-Chlorotoluene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
4-Methyl-2-pentanone	mg/kg	< 0.0706	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Acrolein	mg/kg	< 0.0706	E-01, E5, ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Acrylonitrile	mg/kg	< 0.0706	E5, ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Benzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Bromobenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Bromochloromethane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Bromodichloromethane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006

20 April 2016

Shaun Baker
Terracon
25809 Interstate 30
Bryant, AR 72022
Project: Soil Samples

Project Number: 35165046 -- April 2016
Date Received: 07-Apr-16 16:44

ANALYTICAL RESULTS

Lab Number:	**1604142-01**
Sample Name:	**B-31 S-5 / 8.5' - 10'**
Date/Time Collected:	**4/4/16 16:45**
Sample Matrix:	**Soil**

Volatiles	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
Bromoform	mg/kg	< 0.0141	E-01, ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Bromomethane	mg/kg	< 0.0706	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Carbon disulfide	mg/kg	< 0.0706	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Carbon Tetrachloride	mg/kg	< 0.0141	E-01, ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Chlorobenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Chlorodibromomethane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Chloroethane	mg/kg	< 0.0706	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Chloroform	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Chloromethane	mg/kg	< 0.0706	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
cis-1,3-Dichloropropene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Dibromomethane	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Dichlorodifluoromethane	mg/kg	< 0.0706	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Ethylbenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Hexachlorobutadiene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Isopropylbenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Methylene Chloride	mg/kg	< 0.0706	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Methyl-tert-Butyl Ether	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Naphthalene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
n-Butylbenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
n-Propylbenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
p-Isopropyltoluene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
sec-Butylbenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Styrene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
tert-Butylbenzene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Tetrachloroethene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Toluene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
trans-1,2-Dichloroethene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
trans-1,3-Dichloropropene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Trichloroethene	mg/kg	< 0.0141	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Trichlorofluoromethane	mg/kg	< 0.0706	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
Vinyl chloride	mg/kg	< 0.0706	ET	4/8/16 15:37	B604124	8260C, Rev 3, 2006
4-Bromofluorobenzene [surr]	%	86.0		4/8/16 15:37	B604124	8260C, Rev 3, 2006
1,2-Dichloroethane-d4 [surr]	%	119		4/8/16 15:37	B604124	8260C, Rev 3, 2006
Toluene-d8 [surr]	%	98.8		4/8/16 15:37	B604124	8260C, Rev 3, 2006

20 April 2016

Shaun Baker
Terracon
25809 Interstate 30
Bryant, AR 72022
Project: Soil Samples

Project Number: 35165046 -- April 2016
Date Received: 07-Apr-16 16:44

ANALYTICAL RESULTS

Lab Number:	**1604142-02**
Sample Name:	**B-13 S-4 / 5' - 6.5'**
Date/Time Collected:	**4/5/16 11:30**
Sample Matrix:	**Soil**

PCBs	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
Aroclor-1016	mg/kg dry	< 0.066	ET	4/14/16 14:05	B604191	8082A
Aroclor-1260	mg/kg dry	< 0.066	ET	4/14/16 14:05	B604191	8082A
Aroclor-1254	mg/kg dry	< 0.066	ET	4/14/16 14:05	B604191	8082A
Aroclor-1242	mg/kg dry	< 0.066	ET	4/14/16 14:05	B604191	8082A
Aroclor-1248	mg/kg dry	< 0.066	ET	4/14/16 14:05	B604191	8082A
TCMX [surr]	%	100		4/14/16 14:05	B604191	8082A
DCBP [surr]	%	127		4/14/16 14:05	B604191	8082A

Polynuclear Aromatic Hydrocarbons	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
Naphthalene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Acenaphthylene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Acenaphthene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Fluorene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Phenanthrene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Anthracene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Fluoranthene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Pyrene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Benzo (a) anthracene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Chrysene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Benzo[b]fluoranthene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Benzo[k]fluoranthene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Benzo[a]pyrene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Indeno[1,2,3-cd]pyrene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Dibenz[a,h]anthracene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
Benzo[g,h,i]perylene	mg/kg	< 0.981	ET	4/11/16 17:32	B604146	8270D, Rev 4, 2007
2-Fluorophenol [surr]	%	64.3		4/11/16 17:32	B604146	8270D, Rev 4, 2007
Phenol-d5 [surr]	%	72.6		4/11/16 17:32	B604146	8270D, Rev 4, 2007
2,4,6-Tribromophenol [surr]	%	60.5		4/11/16 17:32	B604146	8270D, Rev 4, 2007
Nitrobenzene-d5 [surr]	%	63.4		4/11/16 17:32	B604146	8270D, Rev 4, 2007
2-Fluorobiphenyl [surr]	%	60.8		4/11/16 17:32	B604146	8270D, Rev 4, 2007
Terphenyl-d14 [surr]	%	79.0		4/11/16 17:32	B604146	8270D, Rev 4, 2007

Total Metals	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
Arsenic	mg/kg dry	**3.73**		4/12/16 17:39	B604160	6010C Rev 3 (2007)
Barium	mg/kg dry	**81.2**		4/12/16 17:39	B604160	6010C Rev 3 (2007)
Cadmium	mg/kg dry	< 0.314		4/12/16 17:39	B604160	6010C Rev 3 (2007)
Chromium	mg/kg dry	**23.9**		4/12/16 17:39	B604160	6010C Rev 3 (2007)
Lead	mg/kg dry	**11.8**		4/12/16 17:39	B604160	6010C Rev 3 (2007)
Mercury	mg/kg dry	< 0.133	E35, ET	4/19/16 13:38	B604244	6010C Rev 3 (2007)
Selenium	mg/kg dry	< 6.28		4/12/16 17:39	B604160	6010C Rev 3 (2007)
Silver	mg/kg dry	< 1.89		4/12/16 17:39	B604160	6010C Rev 3 (2007)

TPH-DRO by 8015D	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
TPH-DRO	mg/kg	< 10.0	ET	4/12/16 18:56	B604151	8015D, Rev 4 2003 (Mod)

20 April 2016

Shaun Baker
Terracon
25809 Interstate 30
Bryant, AR 72022
Project: Soil Samples

Project Number: 35165046 -- April 2016
Date Received: 07-Apr-16 16:44

ANALYTICAL RESULTS

Lab Number: **1604142-02**
Sample Name: **B-13 S-4 / 5' - 6.5'**
Date/Time Collected: **4/5/16 11:30**
Sample Matrix: **Soil**

TPH-DRO by 8015D	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
o-Terphenyl [surr]	%	81.0		4/12/16 18:56	B604151	8015D, Rev 4 2003 (Mod)

TPH-GRO by 8015D	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
TPH-GRO	mg/kg	< 2.00	ET	4/11/16 16:53	B604127	8015D, Rev 4 2003 (Mod)
Fluorobenzene [surr]	%	98.6		4/11/16 16:53	B604127	8015D, Rev 4 2003 (Mod)
4-Bromochlorobenzene [surr]	%	97.0		4/11/16 16:53	B604127	8015D, Rev 4 2003 (Mod)

Volatiles	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
1,1,1,2-Tetrachloroethane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,1,1-Trichloroethane	mg/kg	< 0.0131	E-01, ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,1,2,2-Tetrachloroethane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,1,2-Trichloroethane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,1-Dichloroethane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,1-Dichloroethene	mg/kg	< 0.0131	E-01, ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,1-Dichloropropene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,2,3-Trichlorobenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,2,3-Trichloropropane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,2,4- Trimethylbenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,2,4-Trichlorobenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,2-Dibromo-3-chloropropane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,2-Dibromoethane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,2-Dichlorobenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,2-Dichloroethane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,2-Dichloropropane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,2-Dimethylbenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,3,5- Trimethylbenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,3-Dichlorobenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,3-Dichloropropane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,3-Dimethylbenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,4-Dichlorobenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,4-Dimethylbenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
2,2-Dichloropropane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
2-Butanone	mg/kg	< 0.0654	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
2-Chloroethyl Vinyl Ether	mg/kg	< 0.0654	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
2-Chlorotoluene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
2-Hexanone	mg/kg	< 0.0654	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
4-Chlorotoluene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
4-Methyl-2-pentanone	mg/kg	< 0.0654	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Acrolein	mg/kg	< 0.0654	E-01, E5, ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Acrylonitrile	mg/kg	< 0.0654	E5, ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Benzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Bromobenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Bromochloromethane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Bromodichloromethane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006

Arkansas Analytical Inc.

20 April 2016

Shaun Baker
Terracon
25809 Interstate 30
Bryant, AR 72022
Project: Soil Samples

Project Number: 35165046 -- April 2016
Date Received: 07-Apr-16 16:44

ANALYTICAL RESULTS

Lab Number: 1604142-02
Sample Name: B-13 S-4 / 5' - 6.5'
Date/Time Collected: 4/5/16 11:30
Sample Matrix: Soil

Volatiles	Units	Result	Qualifier(s)	Date/Time Analyzed	Batch	Method
Bromoform	mg/kg	< 0.0131	E-01, ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Bromomethane	mg/kg	< 0.0654	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Carbon disulfide	mg/kg	< 0.0654	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Carbon Tetrachloride	mg/kg	< 0.0131	E-01, ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Chlorobenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Chlorodibromomethane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Chloroethane	mg/kg	< 0.0654	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Chloroform	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Chloromethane	mg/kg	< 0.0654	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
cis-1,3-Dichloropropene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Dibromomethane	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Dichlorodifluoromethane	mg/kg	< 0.0654	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Ethylbenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Hexachlorobutadiene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Isopropylbenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Methylene Chloride	mg/kg	< 0.0654	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Methyl-tert-Butyl Ether	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Naphthalene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
n-Butylbenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
n-Propylbenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
p-Isopropyltoluene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
sec-Butylbenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Styrene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
tert-Butylbenzene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Tetrachloroethene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Toluene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
trans-1,2-Dichloroethene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
trans-1,3-Dichloropropene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Trichloroethene	mg/kg	< 0.0131	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Trichlorofluoromethane	mg/kg	< 0.0654	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
Vinyl chloride	mg/kg	< 0.0654	ET	4/8/16 16:00	B604124	8260C, Rev 3, 2006
4-Bromofluorobenzene [surr]	%	93.2		4/8/16 16:00	B604124	8260C, Rev 3, 2006
1,2-Dichloroethane-d4 [surr]	%	120		4/8/16 16:00	B604124	8260C, Rev 3, 2006
Toluene-d8 [surr]	%	98.3		4/8/16 16:00	B604124	8260C, Rev 3, 2006

20 April 2016

Shaun Baker
Terracon
25809 Interstate 30
Bryant, AR 72022
Project: Soil Samples

Project Number: 35165046 -- April 2016
Date Received: 07-Apr-16 16:44

QUALITY CONTROL RESULTS

Volatiles -- Batch: B604124 (Soil)

Prepared: 08-Apr-16 12:10 By: CT -- Analyzed: 08-Apr-16 17:22 By: ct

Analyte	BLK	LCS / LCSD	MS / MSD	Dup	RPD	Qualifiers
1,1,1,2-Tetrachloroethane	<0.0150 mg/kg	100% / NA	104% / 98.0%		6.69%	
1,1,1-Trichloroethane	<0.0150 mg/kg	115% / NA	114% / 111%		3.04%	E-01
1,1,2,2-Tetrachloroethane	<0.0150 mg/kg	89.5% / NA	86.1% / 93.2%		7.45%	
1,1,2-Trichloroethane	<0.0150 mg/kg	85.3% / NA	95.2% / 82.0%		15.3%	
1,1-Dichloroethane	<0.0150 mg/kg	105% / NA	107% / 101%		6.57%	
1,1-Dichloroethene	<0.0150 mg/kg	111% / NA	118% / 114%		4.47%	E-01
1,1-Dichloropropene	<0.0150 mg/kg	113% / NA	120% / 105%		13.7%	
1,2,3-Trichlorobenzene	<0.0150 mg/kg	93.8% / NA	86.6% / 79.1%		9.57%	
1,2,3-Trichloropropane	<0.0150 mg/kg	94.6% / NA	102% / 94.5%		7.92%	
1,2,4- Trimethylbenzene	<0.0150 mg/kg	89.9% / NA	89.8% / 88.7%		1.67%	
1,2,4-Trichlorobenzene	<0.0150 mg/kg	92.3% / NA	87.2% / 83.2%		5.20%	
1,2-Dibromo-3-chloropropane	<0.0150 mg/kg	102% / NA	110% / 105%		5.64%	
1,2-Dibromoethane	<0.0150 mg/kg	96.6% / NA	104% / 91.1%		14.0%	
1,2-Dichlorobenzene	<0.0150 mg/kg	92.0% / NA	97.6% / 92.5%		5.87%	
1,2-Dichloroethane	<0.0150 mg/kg	108% / NA	112% / 102%		9.81%	
1,2-Dichloropropane	<0.0150 mg/kg	98.9% / NA	97.5% / 93.6%		4.58%	
1,2-Dimethylbenzene	<0.0150 mg/kg	95.1% / NA	97.7% / 89.0%		9.67%	
1,3,5- Trimethylbenzene	<0.0150 mg/kg	92.8% / NA	95.1% / 90.7%		5.12%	
1,3-Dichlorobenzene	<0.0150 mg/kg	93.5% / NA	95.7% / 94.1%		2.13%	
1,3-Dichloropropane	<0.0150 mg/kg	89.6% / NA	99.8% / 88.4%		12.5%	
1,3-Dimethylbenzene	<0.0150 mg/kg	91.2% / NA	95.3% / 84.6%		12.3%	
1,4-Dichlorobenzene	<0.0150 mg/kg	94.0% / NA	99.8% / 90.7%		10.0%	
1,4-Dimethylbenzene	<0.0150 mg/kg	91.2% / NA	95.3% / 84.6%		12.3%	
2,2-Dichloropropane	<0.0150 mg/kg	104% / NA	111% / 107%		5.00%	
2-Butanone	<0.0750 mg/kg	119% / NA	134% / 116%		14.3%	
2-Chloroethyl Vinyl Ether	<0.0750 mg/kg	103% / NA	102% / 104%		2.06%	
2-Chlorotoluene	<0.0150 mg/kg	88.3% / NA	93.1% / 86.3%		8.05%	
2-Hexanone	<0.0750 mg/kg	95.6% / NA	98.9% / 87.4%		12.8%	
4-Chlorotoluene	<0.0150 mg/kg	92.4% / NA	94.6% / 90.5%		4.93%	
4-Methyl-2-pentanone	<0.0750 mg/kg	91.1% / NA	94.8% / 81.3%		15.8%	
Acrolein	<0.0750 mg/kg	158% / NA	150% / 131%		14.0%	%D2, E-01, E5
Acrylonitrile	<0.0750 mg/kg	104% / NA	114% / 106%		7.04%	E5
Benzene	<0.0150 mg/kg	113% / NA	112% / 108%		4.35%	
Bromobenzene	<0.0150 mg/kg	95.0% / NA	95.1% / 90.6%		5.34%	
Bromochloromethane	<0.0150 mg/kg	114% / NA	121% / 112%		9.00%	
Bromodichloromethane	<0.0150 mg/kg	106% / NA	111% / 106%		4.75%	
Bromoform	<0.0150 mg/kg	101% / NA	120% / 102%		17.0%	E-01
Bromomethane	<0.0750 mg/kg	101% / NA	115% / 107%		7.65%	
Carbon disulfide	<0.0750 mg/kg	111% / NA	120% / 106%		13.2%	
Carbon Tetrachloride	<0.0150 mg/kg	113% / NA	121% / 113%		7.40%	E-01
Chlorobenzene	<0.0150 mg/kg	91.7% / NA	101% / 87.4%		14.5%	
Chlorodibromomethane	<0.0150 mg/kg	96.0% / NA	105% / 88.7%		17.6%	
Chloroethane	<0.0750 mg/kg	92.2% / NA	97.9% / 90.3%		8.52%	
Chloroform	<0.0150 mg/kg	112% / NA	118% / 111%		7.06%	
Chloromethane	<0.0750 mg/kg	90.9% / NA	93.3% / 89.9%		4.25%	
cis-1,3-Dichloropropene	<0.0150 mg/kg	105% / NA	102% / 101%		0.824%	
Dibromomethane	<0.0150 mg/kg	109% / NA	115% / 107%		8.22%	
Dichlorodifluoromethane	<0.0750 mg/kg	87.2% / NA	90.3% / 83.0%		8.99%	

20 April 2016

Shaun Baker
Terracon
25809 Interstate 30
Bryant, AR 72022
Project: Soil Samples

Project Number: 35165046 -- April 2016
Date Received: 07-Apr-16 16:44

QUALITY CONTROL RESULTS

Volatiles -- Batch: B604124 (Soil)

Prepared: 08-Apr-16 12:10 By: CT -- Analyzed: 08-Apr-16 17:22 By: ct

Analyte	BLK	LCS / LCSD	MS / MSD	Dup	RPD	Qualifiers
Ethylbenzene	<0.0150 mg/kg	90.2% / NA	96.1% / 88.9%		8.24%	
Hexachlorobutadiene	<0.0150 mg/kg	91.4% / NA	72.6% / 67.8%		7.34%	
Isopropylbenzene	<0.0150 mg/kg	89.9% / NA	92.2% / 84.5%		9.19%	
Methylene Chloride	<0.0750 mg/kg	110% / NA	106% / 104%		2.26%	
Methyl-tert-Butyl Ether	<0.0150 mg/kg	111% / NA	107% / 100%		6.43%	
Naphthalene	<0.0150 mg/kg	91.6% / NA	99.1% / 89.8%		10.4%	
n-Butylbenzene	<0.0150 mg/kg	82.4% / NA	83.6% / 78.9%		6.17%	
n-Propylbenzene	<0.0150 mg/kg	88.1% / NA	94.2% / 85.7%		9.98%	
p-Isopropyltoluene	<0.0150 mg/kg	93.1% / NA	91.2% / 89.8%		2.09%	
sec-Butylbenzene	<0.0150 mg/kg	87.5% / NA	87.3% / 86.4%		1.47%	
Styrene	<0.0150 mg/kg	94.0% / NA	107% / 92.3%		15.6%	
tert-Butylbenzene	<0.0150 mg/kg	91.3% / NA	94.5% / 88.9%		6.59%	
Tetrachloroethene	<0.0150 mg/kg	95.7% / NA	103% / 91.2%		12.7%	
Toluene	<0.0150 mg/kg	94.3% / NA	91.6% / 84.7%		8.19%	
trans-1,2-Dichloroethene	<0.0150 mg/kg	108% / NA	118% / 106%		11.4%	
trans-1,3-Dichloropropene	<0.0150 mg/kg	91.8% / NA	96.0% / 87.4%		9.84%	
Trichloroethene	<0.0150 mg/kg	112% / NA	132% / 108%		19.9%	D
Trichlorofluoromethane	<0.0750 mg/kg	103% / NA	111% / 103%		8.23%	
Vinyl chloride	<0.0750 mg/kg	95.8% / NA	105% / 92.9%		12.8%	
1,2-Dichloroethane-d4 [surr]	109 %	91.9% / NA	94.4% / 93.8%		NA	
4-Bromofluorobenzene [surr]	87.0 %	97.4% / NA	104% / 98.2%		NA	
Toluene-d8 [surr]	97.0 %	92.2% / NA	98.9% / 88.6%		NA	

TPH-GRO by 8015D -- Batch: B604127 (Soil)

Prepared: 11-Apr-16 10:00 By: AT -- Analyzed: 11-Apr-16 17:47 By: tt

Analyte	BLK	LCS / LCSD	MS / MSD	Dup	RPD	Qualifiers
TPH-GRO	<2.00 mg/kg	97.6% / NA	103% / 100%		2.35%	
4-Bromochlorobenzene [surr]	99.0 %	97.7% / NA	97.0% / 97.3%		NA	
Fluorobenzene [surr]	97.7 %	101% / NA	101% / 101%		NA	

20 April 2016

Shaun Baker
Terracon
25809 Interstate 30
Bryant, AR 72022
Project: Soil Samples

Project Number: 35165046 -- April 2016
Date Received: 07-Apr-16 16:44

QUALITY CONTROL RESULTS

Polynuclear Aromatic Hydrocarbons -- Batch: B604146 (Soil)

Prepared: 11-Apr-16 13:44 By: KR -- Analyzed: 11-Apr-16 16:29 By: KR

Analyte	BLK	LCS / LCSD	MS / MSD	Dup	RPD	Qualifiers
Acenaphthene	<1.00 mg/kg	73.7% / NA	72.1% / 69.5%		3.83%	
Acenaphthylene	<1.00 mg/kg	72.8% / NA	74.8% / 70.3%		6.36%	
Anthracene	<1.00 mg/kg	77.2% / NA	75.6% / 73.1%		3.48%	
Benzo (a) anthracene	<1.00 mg/kg	78.6% / NA	79.5% / 74.9%		6.15%	
Benzo[a]pyrene	<1.00 mg/kg	78.6% / NA	74.2% / 75.7%		1.80%	
Benzo[b]fluoranthene	<1.00 mg/kg	76.5% / NA	72.0% / 76.3%		5.65%	
Benzo[g,h,i]perylene	<1.00 mg/kg	73.8% / NA	76.5% / 81.1%		5.65%	
Benzo[k]fluoranthene	<1.00 mg/kg	76.5% / NA	73.7% / 74.2%		0.571%	
Chrysene	<1.00 mg/kg	81.5% / NA	85.1% / 77.9%		8.99%	
Dibenz[a,h]anthracene	<1.00 mg/kg	78.0% / NA	69.9% / 76.6%		8.89%	
Fluoranthene	<1.00 mg/kg	75.1% / NA	76.9% / 72.8%		5.64%	
Fluorene	<1.00 mg/kg	77.6% / NA	79.9% / 71.9%		10.7%	
Indeno[1,2,3-cd]pyrene	<1.00 mg/kg	75.8% / NA	71.8% / 73.1%		1.62%	
Naphthalene	<1.00 mg/kg	63.8% / NA	63.1% / 60.9%		3.66%	
Phenanthrene	<1.00 mg/kg	78.0% / NA	78.8% / 78.2%		0.847%	
Pyrene	<1.00 mg/kg	76.1% / NA	77.0% / 74.4%		3.59%	
2,4,6-Tribromophenol [surr]	68.5 %	74.8% / NA	72.9% / 64.1%		NA	
2-Fluorobiphenyl [surr]	75.0 %	73.3% / NA	80.5% / 75.0%		NA	
2-Fluorophenol [surr]	70.6 %	73.1% / NA	67.9% / 69.8%		NA	
Nitrobenzene-d5 [surr]	72.1 %	65.5% / NA	67.2% / 61.6%		NA	
Phenol-d5 [surr]	78.4 %	69.8% / NA	65.0% / 66.8%		NA	
Terphenyl-d14 [surr]	85.2 %	85.9% / NA	78.5% / 80.8%		NA	

TPH-DRO by 8015D -- Batch: B604151 (Soil)

Prepared: 11-Apr-16 16:19 By: TB -- Analyzed: 11-Apr-16 20:17 By: mb

Analyte	BLK	LCS / LCSD	MS / MSD	Dup	RPD	Qualifiers
TPH-DRO	<10.0 mg/kg	83.2% / NA	79.7% / 75.3%		5.70%	
o-Terphenyl [surr]	83.8 %	86.6% / NA	94.7% / 90.2%		NA	

Total Metals -- Batch: B604160 (Soil)

Prepared: 12-Apr-16 12:50 By: HF -- Analyzed: 12-Apr-16 17:27 By: HF

Analyte	BLK	LCS / LCSD	MS / MSD	Dup	RPD	Qualifiers
Arsenic	<2.50 mg/kg wet	103% / NA	91.8% / 90.7%		2.33%	
Barium	<0.500 mg/kg wet	98.9% / NA	76.9% / 75.4%		1.34%	
Cadmium	<0.250 mg/kg wet	102% / NA	85.5% / 83.8%		3.34%	
Chromium	<2.00 mg/kg wet	102% / NA	86.6% / 89.0%		1.34%	
Lead	<5.00 mg/kg wet	100% / NA	79.2% / 77.6%		2.98%	
Selenium	<5.00 mg/kg wet	98.1% / NA	86.0% / 84.0%		3.56%	
Silver	<1.50 mg/kg wet	98.9% / NA	88.3% / 87.7%		1.89%	

20 April 2016

Shaun Baker
Terracon
25809 Interstate 30
Bryant, AR 72022
Project: Soil Samples

Project Number: 35165046 -- April 2016
Date Received: 07-Apr-16 16:44

QUALITY CONTROL RESULTS

PCBs -- Batch: B604191 (Soil)

Prepared: 14-Apr-16 10:49 By: MB -- Analyzed: 14-Apr-16 12:22 By: mb

Analyte	BLK	LCS / LCSD	MS / MSD	Dup	RPD	Qualifiers
Aroclor-1016	<0.050 mg/kg wet	119% / NA	105% / 101%		3.54%	
Aroclor-1260	<0.050 mg/kg wet	141% / NA	119% / 115%		3.14%	
DCBP [surr]	102 %	102% / NA	107% / 101%		NA	
TCMX [surr]	73.6 %	64.8% / NA	71.6% / 67.2%		NA	

Total Metals -- Batch: B604244 (Soil)

Prepared: 18-Apr-16 12:45 By: HF -- Analyzed: 19-Apr-16 13:29 By: HF

Analyte	BLK	LCS / LCSD	MS / MSD	Dup	RPD	Qualifiers
Mercury	<0.100 mg/kg wet	99.6% / NA	98.7% / 95.4%		11.4%	

QUALIFIER(S)

*%D2:	Laboratory Control Spike and/or Laboratory Control Spike Duplicate Percent Recovery Does Not Meet Laboratory Acceptance Criteria
*D:	RPD Value Does Not Meet Laboratory Acceptance Criteria
*E-01:	Estimated Result; This Analyte Failed "High" in the CCV; If the sample is non-detect for this analyte, the CCV demonstrated the analyte would have been detected were it present.
*E35:	Estimated Result Due to Low Level CCV Failure
*E5:	Estimated Result Due to Quality Control Failure
*ET:	Estimated Result; Temperature Upon Receipt Exceeded 6 Degrees Centigrade

All Analysis performed according to EPA approved methodology when available:
SW 846, Revised December, 1996; EPA 600/4-79-020, Revised March, 1983; Standard Methods.
Instrument calibration and quality control samples performed at or above frequency specified in analytical method.

Reviewed by: Norma James / Teresa Coins

Norma James and/or Teresa Coins
Technical Director and/or QA Officer

Arkansas Analytical inc.

11701 Interstate 30, Bldg. 1, Ste. 115
Little Rock, AR 72209
PHONE: 501-455-3233
FAX: 501-455-6118

CHAIN OF CUSTODY RECORD

CLIENT INFORMATION

Terracon
25809 I-30
Bryant, AR 72022

Attn: Shawn Baker

Project Description

35165046

Reporting Information

Telephone: 501-847-9292
Fax: 501-847-9210
Email: Shawn.Baker@Terracon.com

Turnaround Time

1 Day (100%)
2 Day (50%)
3 Day (25%)
[✓ 5 Day (Routine)]

Preservation Codes:

1. Cool, 4 Degrees Centigrade
2. Sulfuric Acid (H_2SO_4), pH < 2
3. Nitric Acid (HNO_3), pH < 2
4. Thiosulfate for Dechlorination
5. Hydrochloric Acid(HCl)
6. Sodium Hydroxide (NaOH), pH > 12

Bottle Type Code

G = Glass; P = Plastic
V = Septum; A = Amber

TEST PARAMETERS

	~~BTEX, MTBE, TPH-GRO (Water)~~	~~TPH-DRO (Water)~~	~~VOCs~~	~~BTEX, MTBE~~, TPH-GRO, TPH-DRO (Soil)	~~Metals~~	RCRA-Metals	VOC+PAHs	TPH-GRO/DRO	PCB
Preservative Code:	1, 5	1		1					
Bottle Type:	G	G		G					

Sampler(s) Signature

Sampler(s) Printed

Field Number	SAMPLE COLLECTION Date/s	SAMPLE COLLECTION Time/s	Grab	Comp	Number of Bottles	Sample Matrix	SAMPLE IDENTIFICATION/ DESCRIPTION	~~BTEX, MTBE, TPH-GRO (Water)~~	~~TPH-DRO (Water)~~	~~VOCs~~	~~BTEX, MTBE~~, TPH-GRO, TPH-DRO (Soil)	~~Metals~~	RCRA-Metals	VOC+PAHs	TPH-GRO/DRO	PCB	Arkansas Analytical Work Order Number: 1604142
B-31 5-5	4-4-16	4:45pm	X		3		8.5'-10'						X	X	X	X	01
B-13 5-4	4-5-16	11:30am	X		3		5'-6.5'						X	X	X	X	02

1. Relinquished by: (Signature)	Date/Time	2. Received by: (Signature)
	4-7-16 1644	
3. Relinquished by: (Signature)	**Date/Time**	**4. Received by lab: (Signature)**
		Sydney James

SAMPLE CONDITION UPON RECEIPT IN LAB

1. CUSTODY SEALS: ✓ Yes ___No
2. CONTAINERS CORRECT: ✓ Yes ___No
3. COC/LABELS AGREE: ✓ Yes ___No
4. RECEIVED ON ICE: ✓ Yes ___No
5. TEMPERATURE ON RECEIPT: 10°C
6. TEMPERATURE GUN ID: HHT #2

FOR COMPLETION BY LAB ONLY

REMARKS / SAMPLE COMMENTS

Revision 2
2/14/14

APPENDIX C
SUPPORTING DOCUMENTS

EXPLANATION OF BORING LOG INFORMATION

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

▯ **Auger**	☒ **Split Spoon**
■ **Shelby Tube**	▮ **Macro Core**
☒ **Ring Sampler**	▮ **Rock Core**
✋ **Grab Sample**	▱ **No Recovery**

WATER LEVEL

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

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

(HP)	**Hand Penetrometer**
(T)	**Torvane**
(b/f)	**Standard Penetration Test (blows per foot)**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. 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 Includes gravels, sands and silts.			**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.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Terracon

Exhibit C-1

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 $1 > Cc > 3$[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 $1 > Cc > 3$[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" line[J]		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] $Cu = D_{60}/D_{10} \qquad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[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.

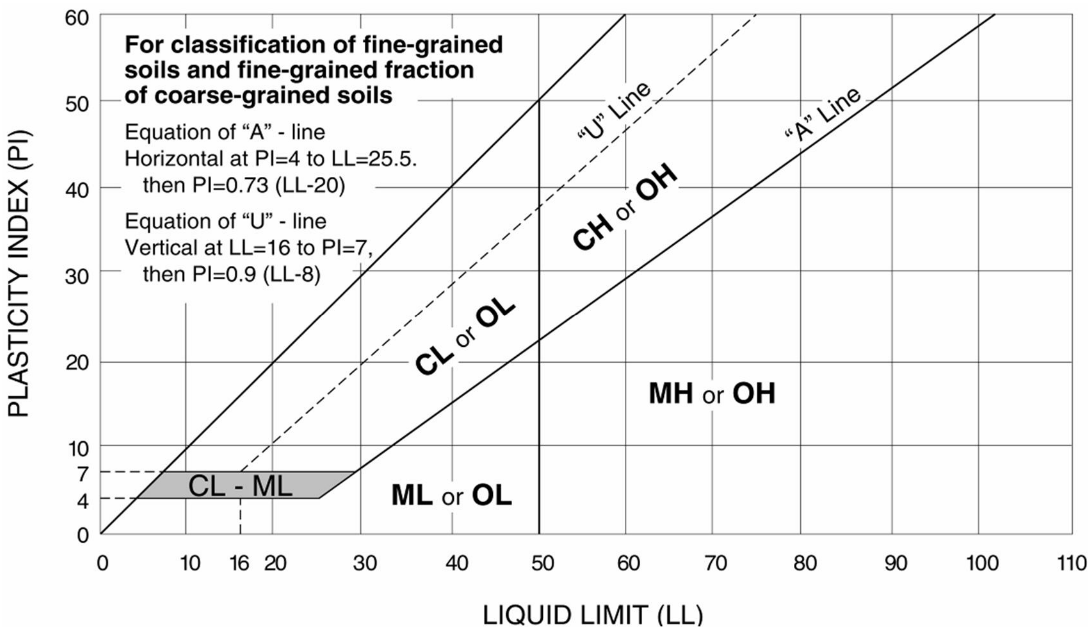


Exhibit C-2