PRELIMINARY GEOTECHNICAL EXPLORATION
HELENA HARBOR SITE CERTIFICATION
HELENA, ARKANSAS

Prepared for:

ELECTRIC COOPERATIVES OF ARKANSAS
LITTLE ROCK, ARKANSAS

Prepared by:

GEOTECHNOLOGY, INC.
MEMPHIS, TENNESSEE

Date:

MAY 28, 2021

Geotechnology Project No.:

J034421.01

SAFETY
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GEOTECHNOLOGY INC
FROM THE GROUND UP

May 28, 2021

Mr. J.D. Lowery
Manager – Community & Economic Development
Electric Cooperatives of Arkansas
One Cooperative Way
Little Rock, Arkansas 72209

Re: Preliminary Geotechnical Exploration
Helena Harbor Site Certification
Helena, Arkansas
Geotechnology Project No. J034421.01

Dear Mr. Lowery:

Presented in this report are the results of our preliminary geotechnical exploration performed by Geotechnology, Inc. for the referenced project. The report includes our understanding of the project, observed site conditions, conclusions and/or recommendations, and support data as listed in the Table of Contents.

We appreciate the opportunity to provide geotechnical services for this project. If you have any questions regarding this report, or if we can be of any additional service to you, please do not hesitate to contact us.

Respectfully submitted,

GEOTECHNOLOGY, INC.

Duncan B. Adrian, P.E.
Project Manager

No. 19074
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5/28/21

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HELENA, ARKANSAS

May 28, 2021 | Geotechnology Project No. J034421.01

1.0 INTRODUCTION

Geotechnology, Inc. has prepared this preliminary geotechnical report for Electric Cooperatives of Arkansas, for the potential development of an approximately 2,000-acre tract located north of the Mississippi River in Helena, Arkansas. Our services in this report were provided in general accordance with the scope of services described in our Proposal P034421.01, dated February 5, 2021. Our services were authorized by your signed acceptance of our terms for services on February 23, 2021.

The purposes of the preliminary geotechnical exploration were to develop a general subsurface profile at the site and prepare preliminary geotechnical recommendations as defined in our proposal. A design phase geotechnical exploration is required to finalize the geotechnical recommendations. Our scope of services included site reconnaissance, geotechnical borings, laboratory testing, engineering analyses, and preparation of this report.

A copy of "Important Information about This Geotechnical-Engineering Report," published by the Geotechnical Business Council (GBC) of the Geoprofessional Business Association (GBA), is included in Appendix A for your review. The publication discusses report limitations and ways to manage risk associated with subsurface conditions.

2.0 SITE AND PROJECT DESCRIPTION

The approximately 2,000-acre area is located north of the Mississippi River, in the northwest corner of the intersection of Road 418 and AR-20 Spur in Helena, Arkansas as shown on Figure 1 (Site Location and Topography) in Appendix B. The site is bordered to the north and west by agricultural fields, to the east by AR-20 Spur and agricultural fields, and to the south by Road 418, Phillips Road 422, and the Mississippi River. Two ponds are located approximately ½-mile north of the site.

The site is currently undeveloped and used for agricultural purposes with the exception of the northern corners which have been developed. Based on available imagery and site reconnaissance performed by our personnel, the northwestern corner consists of several silos, buildings, and other structures with associated access drives; the northeastern corner consists of several buildings and associated access drives. Several field access roads and drainage ditches cross the site. The ground surface across the site is covered with grass and fine-grained soil and relatively flat with the exception of the southeast portion where the ground surface slopes downward towards the Mississippi River. It is our understanding the preliminary subsurface information is needed for potential future development.

3.0 PRELIMINARY GEOTECHNICAL EXPLORATION

The preliminary geotechnical exploration consisted of 15 borings, designated as Borings B-1 through -15. The borings were located in the field by a representative of Geotechnology using a GPS unit and coordinates. The boring locations shown on Figure 2 (Aerial Photograph of Site and Boring Locations) in Appendix B are approximate; if elevations or more precise locations are required, the client should retain a registered surveyor to establish boring locations and elevations.

The borings were drilled between April 23 and May 15, 2021 with ATV and track-mounted rotary drill rigs (CME 550X and Diedrich D-50) using hollow-stem augers and wash-rotary drilling methods, as indicated on the boring logs presented in Appendix C. Soil sampling was accomplished ahead of the augers at the depths indicated on the boring logs using 2-inch-outside-diameter (O.D.) split-spoon or 3-inch-O.D., thin-walled Shelby tube samples in general accordance with the procedures outlined by ASTM D1586 and ASTM D1587, respectively. Standard Penetration Tests (SPTs) were performed on the split-spoon samples using an automatic hammer to obtain the standard penetration resistance, or N-value[1], of the sampled material.

The drill crew kept a log of the subsurface profile noting the soil types and stratifications, groundwater, SPT results, and other pertinent data. Observations for groundwater were made in the borings during drilling.

Representative portions of the split-spoon samples were placed in glass jars to preserve sample moisture. The Shelby tubes were capped and taped at their ends to preserve the sample moisture and unit weight, and the tubes were transported and stored in an upright position. The glass jars and Shelby tubes were marked and labeled in the field for identification, then returned to our laboratory in Memphis.

4.0 LABORATORY REVIEW AND TESTING

Laboratory testing was performed on soil samples to assess engineering and index properties. The soil testing consisted of moisture contents (ASTM D2216), Atterberg limits (ASTM D4318), grain size (sieve) analyses (ASTM D6913), and unconsolidated-undrained triaxial compression (UU; ASTM D2850). Most of the laboratory test results are presented on the boring logs in

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[1] The standard penetration resistance, or N-value, is defined as the number of blows required to drive the split-spoon sampler 12 inches with a 140-pound hammer falling 30 inches. Since the split spoon sampler is driven 18 inches or until refusal, the blows for the first 6 inches are for seating the sampler, and the number of blows for the final 12 inches is the N-value. Additionally, “refusal” of the split-spoon sampler occurs when the sampler is driven less than 6 inches with 50 blows of the hammer.

Appendix C. Plots of the Atterberg limit. grain size analyses, and UU tests are also presented in Appendix D.

The boring logs were prepared by a project geotechnical engineer from the field logs, visual classification of the soil samples in the laboratory, and laboratory test results. Terms and symbols used on the boring logs are presented in the Boring Log: Terms and Symbols in Appendix C. Stratification lines on the boring logs indicate approximate changes in strata. The transition between strata could be abrupt or gradual.

5.0 SUBSURFACE CONDITIONS

5.1 Geology

In general, the geology of the site consists of alluvial deposits of sand, silt, and clay from the Mississippi River.

5.2 Stratigraphy

The ground surface at the locations of the borings was covered with topsoil and fine-grained soil. Based on the borings, the stratigraphy generally consisted of predominately fine-grained soils underlain by predominantly coarse-grained soils to the maximum depth of exploration (100 feet). The fine-grained stratum extended to the boring termination depths in Borings B-5 and -12. Interlayered fine-grained layers were encountered in the coarse-grained stratum in Borings B-13 and -14. More specific descriptions of the soil layers are provided below and in the boring logs in Appendix C. A generalized subsurface profile that includes all of the borings drilled during this exploration is provided in Appendix B.

<u>Predominately Fine-Grained Soil</u>. From the ground surface and underlying the topsoil, fine-grained layers comprised of soils classified as very soft to very stiff, low plasticity silt (ML) and lean clay (CL) and high plasticity, fat clay (CH) with varying amounts of sand were encountered to a maximum depth of 98 feet. Moisture contents of the tested samples ranged from approximately 21 to 80 percent. Atterberg limits performed on select samples yielded liquid limits (LL) of 28 to 80 percent and plasticity indices (PI) of 4 to 64 percent. The UU tests performed on relatively undisturbed Shelby tube samples recovered in this stratum yielded undrained shear strengths of 860 and 640 pounds per square foot (psf). The SPT N-values measured in the fine-grained soils ranged from 0 to 20 bpf.

<u>Predominately Coarse-Grained Soil</u>. Soils classified as very loose to very dense silty sand (SM), clayey sand (SC), and intermixed sand (SP, SP-SM, and SP-SC) were encountered below the fine-grained stratum and extended to the maximum boring termination depth of approximately 100 feet. The SPT N-values measured in the coarse-grained soils ranged from 3 to greater than 50 bpf.

5.3 Groundwater

Groundwater was encountered during drilling in Borings B-1 through -5, -7, -10, -11, and -15 at approximate depths ranging from 9 to 13 feet. Groundwater levels will vary over time due to the effects of seasonal variation in precipitation, influence to the Mississippi River, or other factors not evident at the time of exploration.

6.0 PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of Site Conditions for Potential Development

In general, based on the information from the borings, the site is suitable for development from a geotechnical standpoint, but soil improvement may be required. Based on the results of the field and laboratory testing, soft soils and expansive soils are present at varying depths across the site. If lightly loaded structures are planned, measures may be required to mitigate soft soils and expansive clays. If heavier structures are planned, deep foundations will likely be required. Soil improvement may be required below shallow foundations to separate foundations from soft or expansive clays. Additionally, there may be a potential for liquefaction during seismic events. This can be assessed during a design phase geotechnical exploration.

The site is currently used for agricultural purposes and will require stripping of vegetation, topsoil, and organic material. If the structures in the northern corners of the site are to be demolished, all materials associated with past construction should be removed. The following site preparation and earthwork recommendations are preliminary and will be revised based on future development plans and the results of the design-phase exploration.

6.2 Site Preparation and Earthwork

Initial Site Preparation. In general, cut areas and areas to receive new fill should be stripped of topsoil, vegetation, soft soils, and other deleterious materials. Topsoil should be placed in landscape areas or disposed of off-site. Vegetation and tree roots should be over-excavated.

Proofroll. In general, after performing site preparation and excavations in the cut areas, the exposed subgrade should be proofrolled using a heavily loaded truck (18,000 pounds per axle) under the review of the project geotechnical engineer or a representative thereof. This requirement may be waived if the geotechnical engineer determines that proofrolling would disturb an otherwise acceptable subgrade. Soft or yielding soils should be stabilized as directed by the geotechnical engineer. Any undercut should be backfilled with new compacted fill satisfying the material and compaction requirements presented in this section. The undercut soils can be reused provided that they conform to the recommendations contained in this report regarding acceptable fill materials.

Cut Areas. Based on the stratigraphy encountered in the borings, excavations will terminate in low plasticity, sandy soils. These soils are classified as OSHA soil type C. After excavation, the top 6 inches of the resulting subgrade should be compacted to a minimum of 98% of the maximum dry unit weight as determined by a standard Proctor test (ASTM D698).

Suitable Fill. Fill materials should consist of natural soils classifying as lean clay, silty sand, or clayey sand (CL, SM, or SC), have a maximum LL of 45 and a PI of no more than 20 percent. Such materials should be free from organic matter, debris, or other deleterious materials, and have a maximum particle size of 2 inches. The onsite, high plasticity clays are not suitable for use as fill unless modified to reduce the PI such that it meets the previously discussed criteria.

Fill Placement and Compaction. Fill and backfill should be placed in level lifts, up to 8 inches in loose thickness. For soils that exhibit a well-defined moisture density relationship, each lift should be moisture-conditioned to within the acceptable moisture content range provided in Table 1, and compacted with a sheepsfoot roller or self-propelled compactor to at least the minimum percent compaction indicated in Table 1. Moisture-conditioning can include: aeration and drying of wetter soils; wetting drier soils; and/or mixing wetter and drier soils into a uniform blend. For granular soils that do not exhibit a well-defined moisture density relationship, the soils should be compacted to at least the minimum relative densities indicated in Table 2. Thinner lifts should be used for lighter compaction equipment. The backfill should not be flushed or jetted with water in an attempt to obtain compaction.

Table 1. Percent Compaction and Moisture-Conditioning Requirements for Fill and Backfill.

Area	Minimum Percent Compaction[a,b]	Acceptable Moisture Content Range[c]
Structural[d]	95%	±2%
Non-Structural	92%	±2%
Pavement Subgrades	98%	±2%

[a] In reference to the standard Proctor maximum dry unit weight measured by ASTM D698.

[b] For granular soils that do not exhibit a well-defined moisture-density relationship, refer to Table 2 for minimum relative density requirements.

[c] In reference to optimum moisture content as measured by ASTM D698.

[d] Structural Fill and backfill for foundations are defined as fill and backfill located within the zones of influence of structures. The zone of influence of a structure is defined as the area below the footprint and 1V:1H outward and downward projections from the bearing elevation of the structure.

Table 2. Relative Density Compaction Requirements for Granular Fill and Backfill.

Area	Minimum Relative Density[a,b]
Structural[c]	70%
Non-structural	70%
Pavement Base Course	75%

[a] Relative density evaluated from the maximum and minimum index densities measured by ASTM D4253 and D4254, respectively.

[b] For granular soils that exhibit a well-defined moisture density relationship, refer to Table 1 for minimum percent compaction and moisture-conditioning requirements.

[c] Structural fill and backfill for foundations are defined as fill and backfill located within the zone of influence of structures. The zone of influence of a structure is defined as the area below the footprint of the structure and 1V:1H outward and downward projections from the bearing elevation of the structure.

Moisture-Sensitive Soils. Maintaining the moisture content of bearing and subgrade soils within the acceptable ranges provided in Table 1 is important during and after construction for the proposed structures. The clayey bearing and subgrade soils should not be allowed to become wet or dry during or after construction, and measures should be taken to hinder water from ponding on these soils and to reduce drying of these soils during droughts.

Shallow Groundwater. Groundwater was encountered at relatively shallow depths ranging from 9 to 13 feet. If excavations will be required for future developments, dewatering systems may be required to lower the groundwater level. The depth to groundwater will vary overtime, and design-phase geotechnical explorations should be performed for future developments to better establish groundwater levels and to develop recommendations for managing groundwater if required for the project.

Site Water Management. Managing site water is important in successful performance of the pavement and foundation systems. Water from surface runoff, downspouts, and subsurface drains should be collected and discharged through a site drainage system. Final grades should be sloped away from building foundations.

Additional Considerations. Trees and other, deep-rooted vegetation should not be planted within 1.5 times their projected mature foliage radius from foundations, as their roots extract moisture from plastic and low-plastic soils alike, causing them to shrink, which can potentially create foundation settlement issues. Shrubs and flowerbeds should be located a minimum of 5 feet away from the perimeter of shallow foundations.

We recommend that earthwork operations be carried out during drier times of the year and that a grade be maintained at the ground surface to reduce ponding of surface water. Asphalt, concrete, or fill should not be placed over frozen or saturated soils, and frozen or saturated soils should not be used as compacted fill or backfill.

Upon completion of earthwork, disturbed areas should be stabilized. It is also recommended that riprap and/or armoring placed over a separation geofabric be used at the outlets of storm sewers and headwalls to reduce flow velocities and protect against erosion.

6.3 Seismic Considerations

The site lies within the influence of the New Madrid Seismic Zone (NMSZ). We have assumed the projects for this site will be designed in accordance with the 2015 International Building Code (IBC) and ASCE 7-10. The 2015 IBC / ASCE 7-10 stipulates structures be designed based on an earthquake event with a probability of exceedance of 2% in 50 years. Based on the results of the field and laboratory testing, the variability of the soils encountered in the borings, and our interpretation of the 2015 IBC / ASCE 7-10, the site class and seismic parameters may vary across the property. If there is a potential for liquefaction in the proposed development area, the site is classified as Site Class F and will require a site-specific response analysis to determine the seismic accelerations. Additionally, some borings resulted in Site Class E and others resulted in Site Class D. Presented in Table 3 are parameters for Site Classes D and E.

Table 3. Site Class and Seismic Parameters (2% Probability of Exceedance in 50 Years).

Category/ Parameter	Site Class D Designation/ Value	Site Class E Designation/ Value	Site Class F Designation/ Value**	Reference
S_S	0.529g*	0.529g*	--	Latitude 34.402704°N Longitude 90.663960°W
S_1	0.208g*	0.208g*	--	
F_a	1.376	1.641	--	2015 IBC Table 1613.3.3(1)
F_v	1.985	3.169	--	2015 IBC Table 1613.3.3(2)
F_{PGA}	1.236	1.291	--	ASCE 7-10 Table 11.8-1
S_{MS}	0.729g	0.869g	--	2015 IBC Equation 16-37
S_{M1}	0.412g	0.658g	--	2015 IBC Equation 16-38
S_{DS}	0.486g	0.579g	--	2015 IBC Equation 16-39
S_{D1}	0.275g	0.439g	--	2015 IBC Equation 16-40
PGA	0.282g	0.282g	--	ASCE 7-10 Figure 22-7
PGA_M	0.348g	0.364g	--	ASCE 7-10 Equation 11.8-1

* S_S and S_1 were computed using the web-based U.S. Seismic Design Maps (https://hazards.atcouncil.org/) using the indicated latitude and longitude coordinates of the project site.
** Site-specific response analysis required.

Liquefaction and Dynamic Settlement. Liquefaction can occur in loose, saturated, cohesionless soil deposits subjected to earthquake motions. Soils meeting these criteria are present at the site. Based on the results of preliminary analysis, there is liquefaction potential at the site. Liquefaction potential and estimated dynamic settlement amounts can be addressed during the design-phase geotechnical exploration. Please note, the site will classify as Site Class F if there is a potential for liquefaction and will require a site-specific response analysis. It should also be noted that some movement of foundations should be anticipated during seismic events, and dynamic settlements can occur regardless of the occurrence of liquefaction.

6.4 Preliminary Foundations

6.4.1 Shallow Foundations

For preliminary design and budgeting purposes, shallow foundations can be proportioned using a maximum net allowable bearing capacity of 1,400 pounds per square foot (psf) for spread and strip footings. We anticipate this allowable bearing pressure will be suitable for typical warehouse construction. However, mitigating the in situ, soft soils and high plasticity clays will be critical to the performance and life of structures supported on shallow foundations. Settlement analyses can be addressed once a design-phase geotechnical exploration is performed and structural loads are provided.

6.4.2 Ground Improvement

Depending on the anticipated structural loads for future developments at the site, ground improvement (such as aggregate piers) may be considered to facilitate the use of shallow foundations. Ground improvement may be used to increase bearing capacity, reduce potential settlement, and/or mitigate soils susceptible to liquefaction. Specialty design/build contractors can design and install ground improvement using data from this subsurface exploration report and specific details of column loads and layouts for the structure.

6.4.3 Deep Foundations

If future developments will include relatively heavy structural loads, deep foundations can be considered. Suitable deep foundation types generally include driven, steel H-piles or pipe piles. Drilled shafts or augercast piles are also suitable deep foundation types. In general, if deep foundations are required for a future development, the pile lengths will likely terminate in dense sandy soils which vary in depth across the site. Pile capacities can be provided once a design-phase geotechnical exploration is performed and structural loads are provided.

7.0 RECOMMENDED ADDITIONAL SERVICES

We recommend Geotechnology be contacted for additional geotechnical exploration services if plans are developed for the site. Geotechnology can provide design-phase geotechnical services after reviewing plans for the area.

8.0 LIMITATIONS

This report has been prepared on behalf of, and for the exclusive use of, the client for specific application to the named project as described herein. If this report is provided to other parties, it should be provided in its entirety with all supplementary information. In addition, the client should make it clear that the information is provided for factual data only, and not as a warranty of subsurface conditions presented in this report. The contents of this report can only be used for budgeting or preliminary design purposes. A design-phase study will be required before final design is completed.

Geotechnology has attempted to conduct the services reported herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions. The recommendations and conclusions contained in this report are professional opinions. The report is not a bidding document and should not be used for that purpose.

Our scope for this phase of the project did not include any environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements in this report or on the boring logs regarding odors noted or unusual or suspicious items or conditions observed are strictly for the information of our client. Our scope did not include an assessment of the effects of flooding and erosion of creeks or rivers adjacent to or on the project site.

Our scope did not include: any services to investigate or detect the presence of mold or any other biological contaminants (such as spores, fungus, bacteria, viruses, and the by-products of such organisms) on and around the site; or any services, designed or intended, to prevent or lower the risk of the occurrence of an infestation of mold or other biological contaminants.

The analyses, conclusions, and recommendations contained in this report are based on the data obtained from the geotechnical exploration. The field exploration methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Consequently, subsurface conditions could vary gradually, abruptly, and/or nonlinearly between sample locations and/or intervals.

The conclusions or recommendations presented in this report should not be used without Geotechnology's review and assessment if the nature, design, or location of the facilities is changed, if there is a lapse in time between the submittal of this report and the start of work at the site, or if there is a substantial interruption or delay during work at the site. If changes are contemplated or delays occur, Geotechnology must be allowed to review them to assess their impact on the findings, conclusions, and/or design recommendations given in this report. Geotechnology will not be responsible for any claims, damages, or liability associated with any other party's interpretations of the subsurface data or with reuse of the subsurface data or engineering analyses in this report.

The recommendations included in this report have been based in part on assumptions about variations in site stratigraphy that can be evaluated further during earthwork and foundation construction. Geotechnology should be retained to perform construction observation and continue its geotechnical engineering service using observational methods. Geotechnology cannot assume liability for the adequacy of its recommendations when they are used in the field without Geotechnology being retained to observe construction.

APPENDIX A – IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

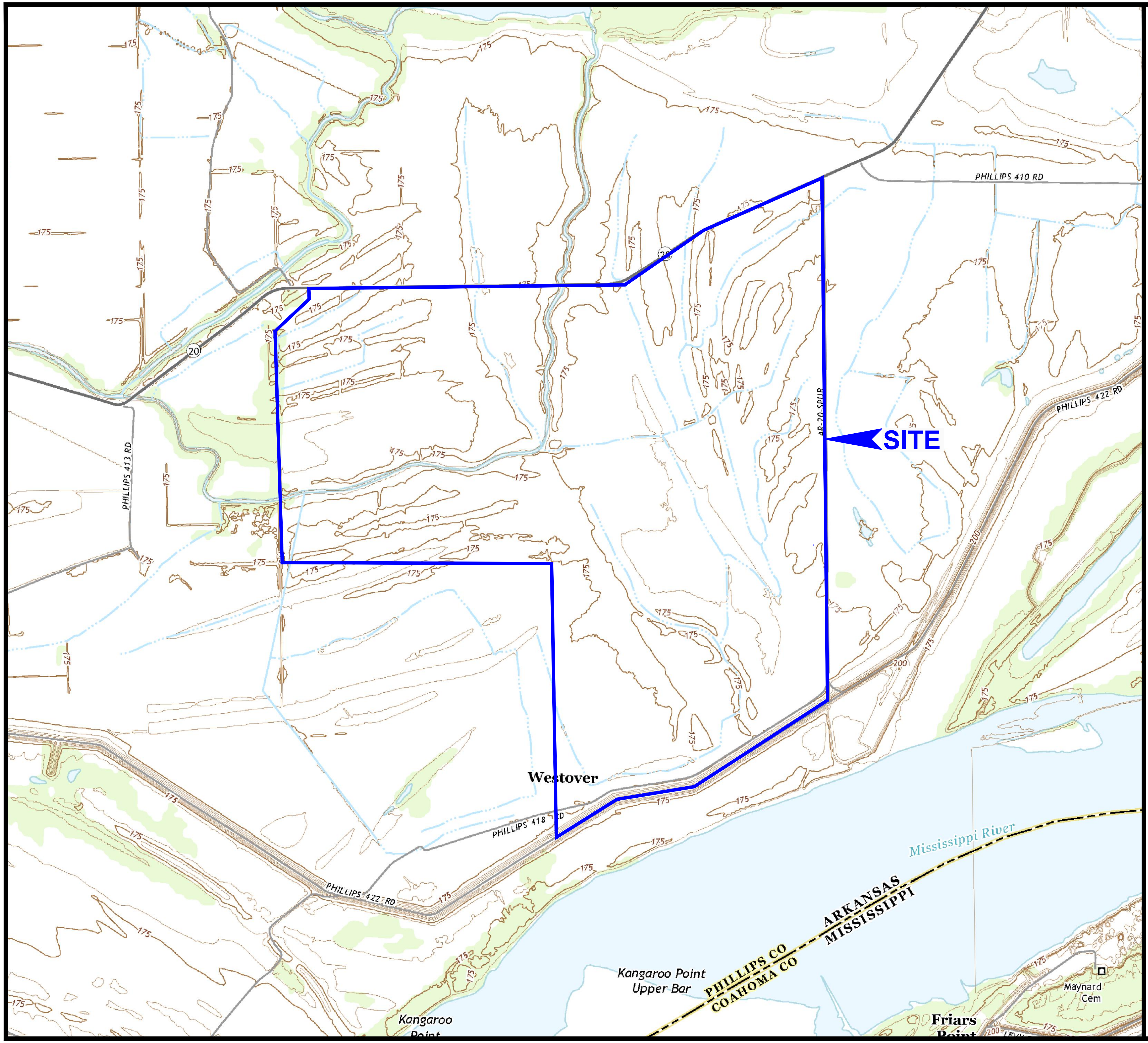
GEOPROFESSIONAL
BUSINESS
ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

APPENDIX B – FIGURES

Figure 1 - Site Location and Topography

Figure 2 – Aerial Photograph of Site and Boring Locations



NOTES

1. Plan adapted from a 7.5 minute U.S.G.S. map for Friars Point NW, Mississippi-Arkansas quadrangle, last revised in 2015.

N

0 2,000 4,000

SCALE IN FEET

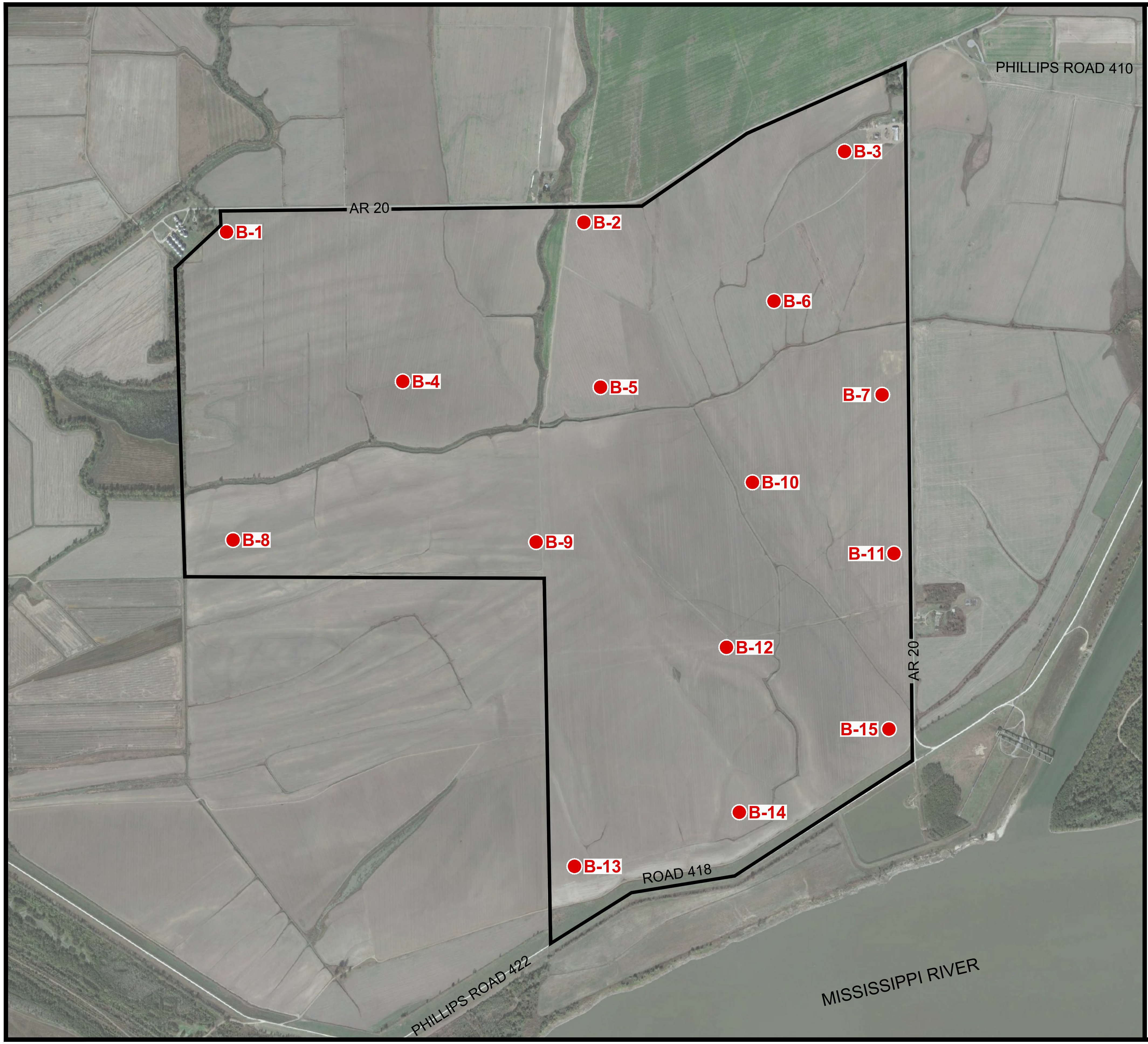
Drawn By: WAH	Ck'd By: ASM	App'vd By: DBA
Date: 5-20-21	Date:5-27-21	Date: 5-27-21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

SITE LOCATION AND TOPOGRAPHY

Project Number J034421.01	FIGURE 1



NOTES

1. Plan adapted from a November 20, 2020 aerial photograph courtesy of Google Earth.
2. Borings were located in the field with reference to site features and are shown approximate only.

LEGEND

● Boring Location

N

0 1,500 3,000

SCALE IN FEET

Drawn By: WAH	Ck'd By: ASM	App'vd By: DBA
Date: 5-20-21	Date: 5-27-21	Date: 5-27-21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

AERIAL PHOTOGRAPH OF SITE AND BORING LOCATIONS

Project Number J034421.01	FIGURE 2

APPENDIX C – BORING INFORMATION

Boring Logs

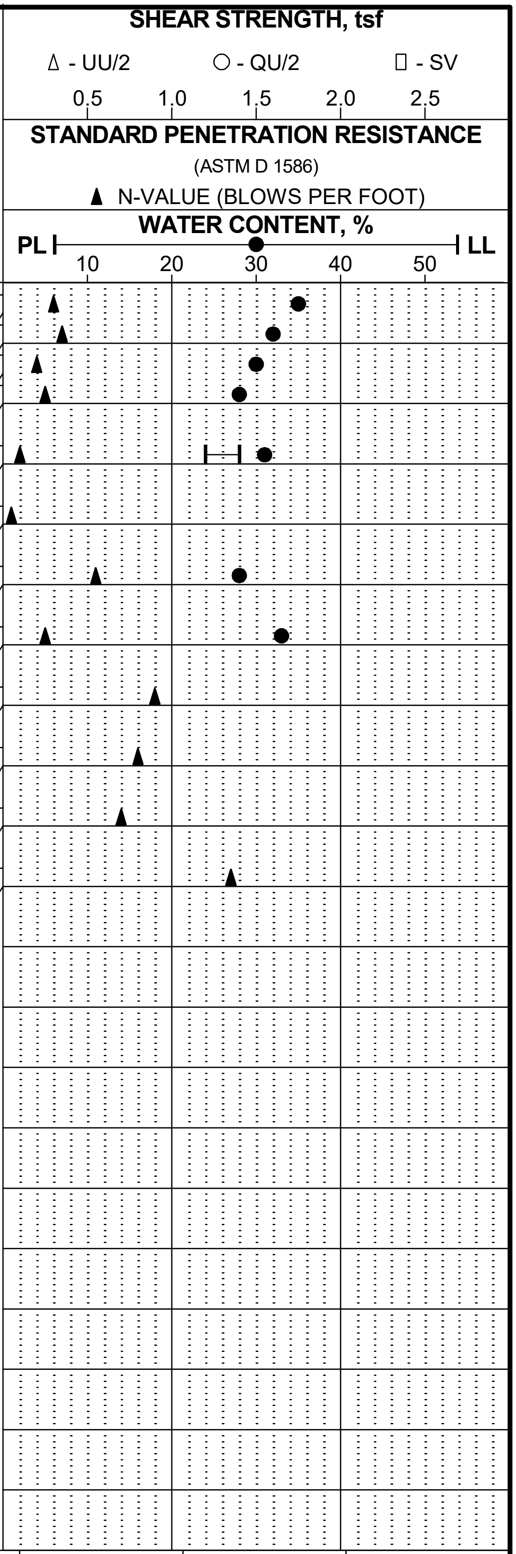
Boring Log Terms and Symbols

Surface Elevation: **NA**

Datum **NA**

Completion Date: **4/28/21**

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Topsoil: 7 inches		
	Medium stiff to soft, gray, FAT CLAY - CH	1-3-3	SS1
5		2-3-4	SS2
	little silt	2-2-2	SS3
10	Medium stiff to soft, gray, clayey SILT - (ML)	1-2-3	SS4
	∇		
15	little sand	0-1-1	SS5
	85% passing No. 200 sieve		
20	Medium dense to loose, gray, SILTY SAND - (SM)	2-1-0	SS6
25		4-4-7	SS7
30	42% passing No. 200 sieve	5-3-2	SS8
35	Medium dense, gray SAND - SP	6-8-10	SS9
40		7-6-10	SS10
45	trace gravel	5-6-8	SS11
		7-10-17	SS12
50	Boring terminated at 50 feet.		
55			
60			
65			
70			
75			
80			
85			
90			
95			
100			



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 13 FEET ∇

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 10 FEET
BMF DRILLER AKM LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 94 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 4/29/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B- 1

Project No. J034421.01

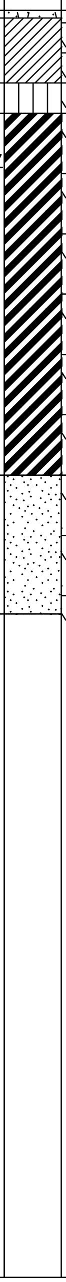
Surface Elevation: NA

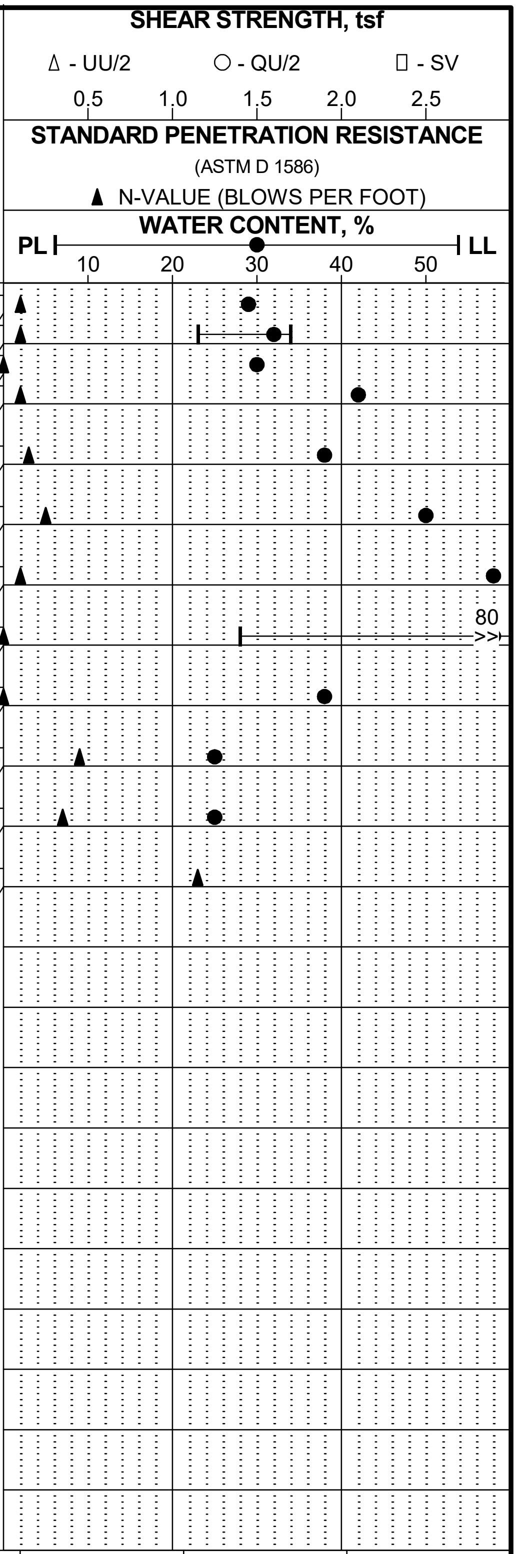
Datum NA

Completion Date: 4/28/21

DESCRIPTION OF MATERIAL

DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
Topsoil: 7 inches		
Soft, brown, silty, LEAN CLAY - (CL)	0-1-1	SS1
	0-1-1	SS2
Very soft, gray and brown, clayey SILT - ML	0-0-0	SS3
Medium stiff to very soft, gray, FAT CLAY - (CH)	0-1-1	SS4
	1-1-2	SS5
	1-2-3	SS6
	1-1-1	SS7
	0-0-0	SS8
	0-0-0	SS9
Loose to medium dense, gray SAND - SP	2-4-5	SS10
	3-3-4	SS11
	8-12-11	SS12
Boring terminated at 50 feet.		





NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 13 FEET ∇

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 10 FEET
BMF DRILLER AKM LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 94 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 4/29/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B- 2

Project No. J034421.01

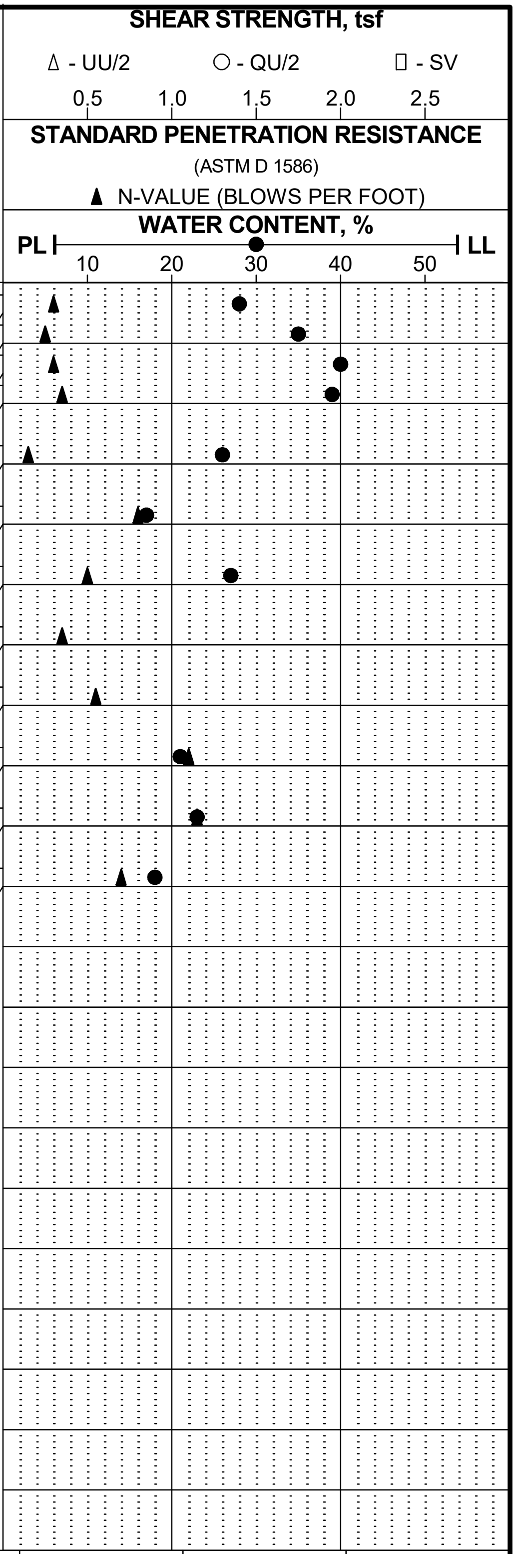
LOG OF BORING 2002 WL J034421.01.GPJ GTINC 0638301.GPJ 5/27/21

Surface Elevation: **NA**

Datum **NA**

Completion Date: **4/22/21**

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium stiff, brown and gray, FAT CLAY - CH		2-3-3	SS1
5			2-2-3	SS2
			2-3-3	SS3
10			2-3-4	SS4
	⊽			
15	Soft, gray and brown, sandy, FAT CLAY - CH		1-1-2	SS5
20	Medium dense to loose, gray SAND - SP trace gravel		5-8-8	SS6
25			4-5-5	SS7
30			4-4-3	SS8
35	Medium dense, gray and brown, SILTY SAND - SM		3-6-5	SS9
40			7-10-12	SS10
45	Medium dense, gray SAND - SP		5-13-10	SS11
50	trace gravel Boring terminated at 50 feet.		5-6-8	SS12
55				
60				
65				
70				
75				
80				
85				
90				
95				
100				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 13 FEET ⊽

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 10 FEET
BMF DRILLER AKM LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 94 %

REMARKS:

Drawn by: EJH	Checked by: ASM	App'vd. by: DBA
Date: 4/27/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B- 3

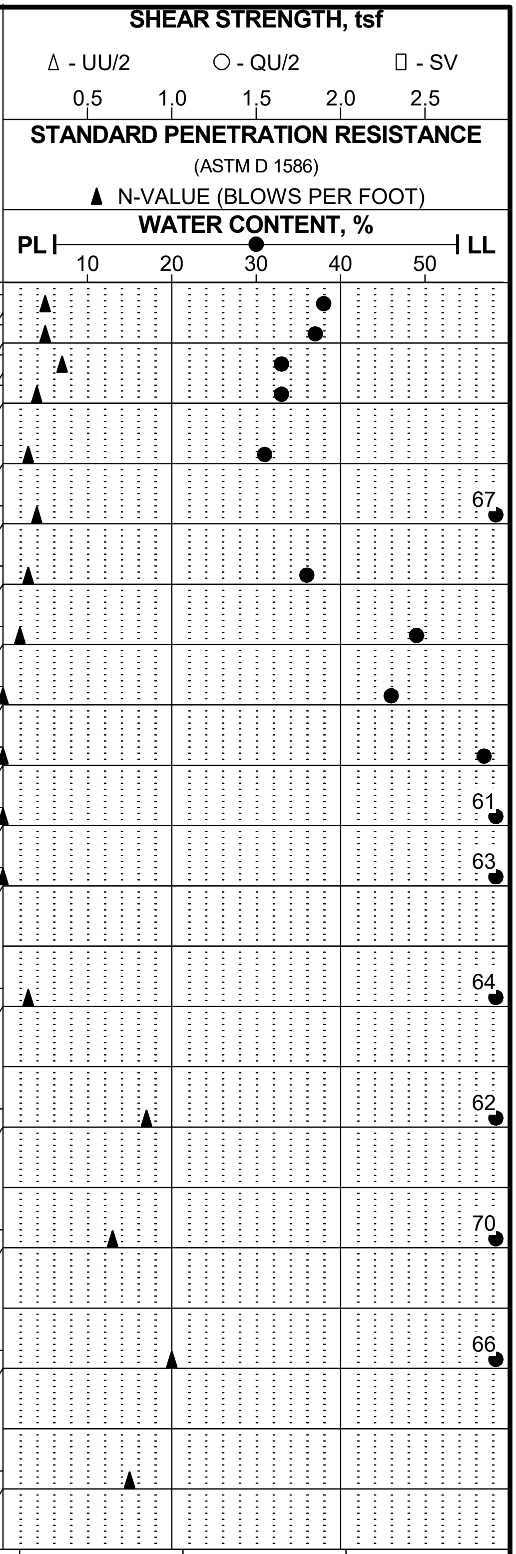
Project No. J034421.01

Surface Elevation: NA

Datum NA

Completion Date: 4/27/21

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	TOPSOIL: 7 inches		
	Medium stiff, gray, FAT CLAY - CH	1-2-3	SS1
5		1-2-3	SS2
		1-3-4	SS3
10	Soft, gray, silty, LEAN CLAY - CL	1-2-2	SS4
	▽		
15	Soft, gray, clayey SILT - ML	2-1-2	SS5
20	Soft, gray, FAT CLAY - CH	0-1-3	SS6
25	Soft, gray SILT - ML	1-2-1	SS7
30	Soft, gray, silty, LEAN CLAY - CL	1-1-1	SS8
35	Very soft to stiff, gray, FAT CLAY - CH	0-0-0	SS9
40		0-0-0	SS10
45		0-0-0	SS11
50		0-0-0	SS12
55			
60		0-1-2	SS13
65			
70	some sand	9-6-11	SS14
75			
80		8-6-7	SS15
85			
90	Very stiff, gray, sandy, FAT CLAY - CH	8-9-11	SS16
95			
100	Medium dense, gray and black SAND - SP some lignite	6-8-7	SS17
	Boring terminated at 100 feet.		



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 13 FEET ▽

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 10 FEET
BMF DRILLER AKM LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 94 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 4/29/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B- 4

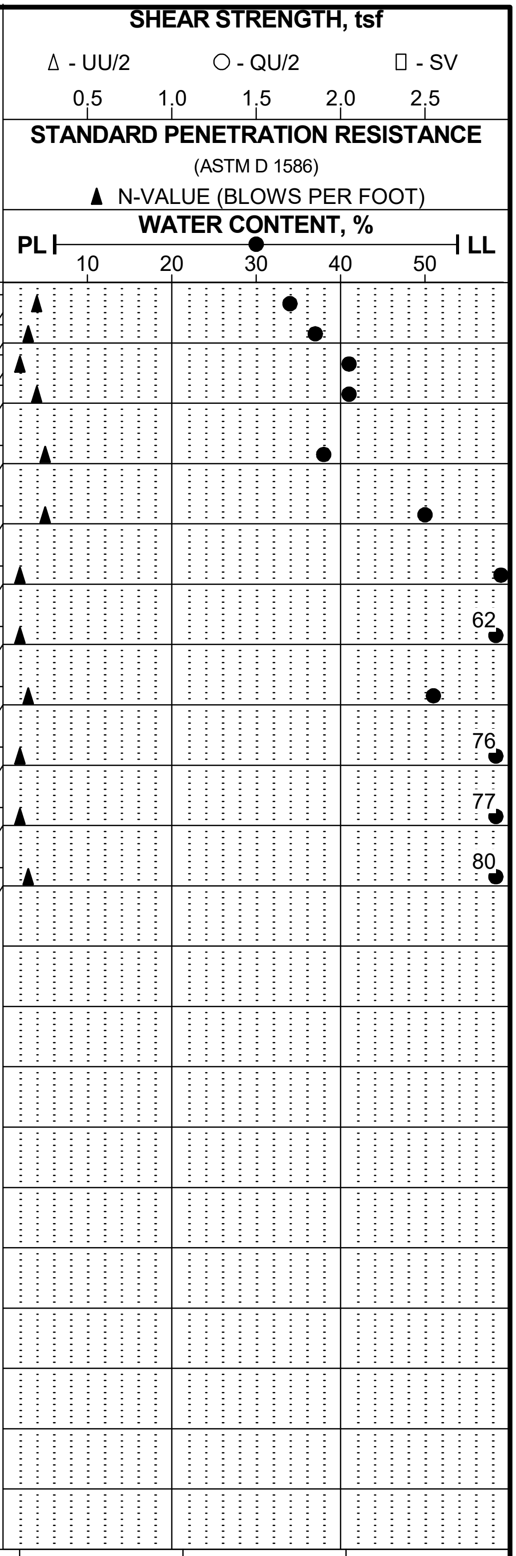
Project No. J034421.01

Surface Elevation: NA

Completion Date: 4/30/21

Datum NA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	TOPSOIL: 7 inches		
	Medium stiff to soft, gray and brown, FAT CLAY - CH	1-2-2	SS1
5		1-1-2	SS2
		1-1-1	SS3
10		1-2-2	SS4
	∇		
15		2-2-3	SS5
20		1-2-3	SS6
25		1-1-1	SS7
30		1-1-1	SS8
35		1-1-2	SS9
40		0-1-1	SS10
45		1-1-1	SS11
50	Boring terminated at 50 feet.	1-2-1	SS12
55			
60			
65			
70			
75			
80			
85			
90			
95			
100			



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 13 FEET ∇

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM __ FEET
BMF DRILLER AKM LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 94 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 4/30/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B- 5

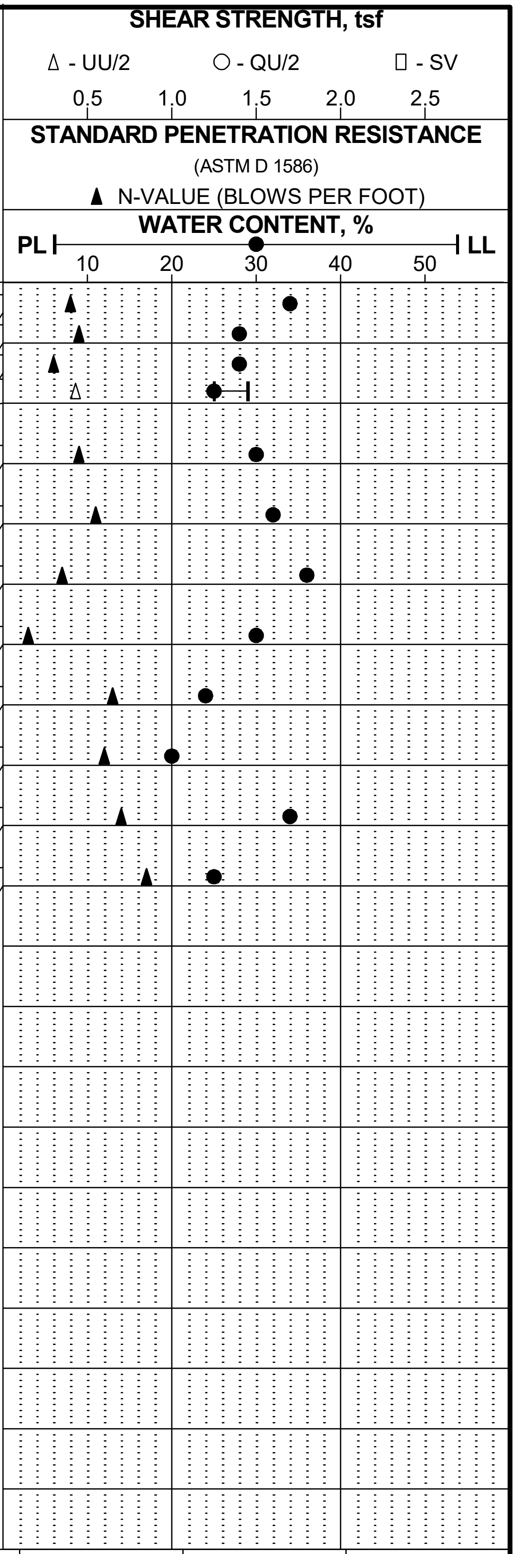
Project No. J034421.01

Surface Elevation: NA

Datum NA

Completion Date: 4/23/21

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	TOPSOIL: 7 inches		2-3-5	SS1
5	Medium stiff to stiff, brown, FAT CLAY - CH		3-4-5	SS2
	Medium stiff, gray, silty, LEAN CLAY - CL		2-3-3	SS3
10	Medium stiff, gray SILT - (ML)		98	ST4
15	Loose, brown, SILTY SAND - SM		3-5-4	SS5
20	Very loose to medium dense, gray SAND - SP little silt		5-5-6	SS6
25	trace silt		5-4-3	SS7
30			4-2-1	SS8
35			5-7-6	SS9
40	little gravel		7-5-7	SS10
45			7-6-8	SS11
50	Boring terminated at 50 feet.		7-8-9	SS12
55				
60				
65				
70				
75				
80				
85				
90				
95				
100				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 10 FEET
BMF DRILLER AKM LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 94 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 4/29/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

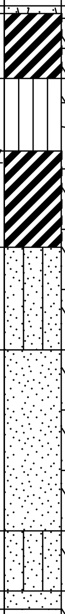
LOG OF BORING: B- 6

Project No. J034421.01

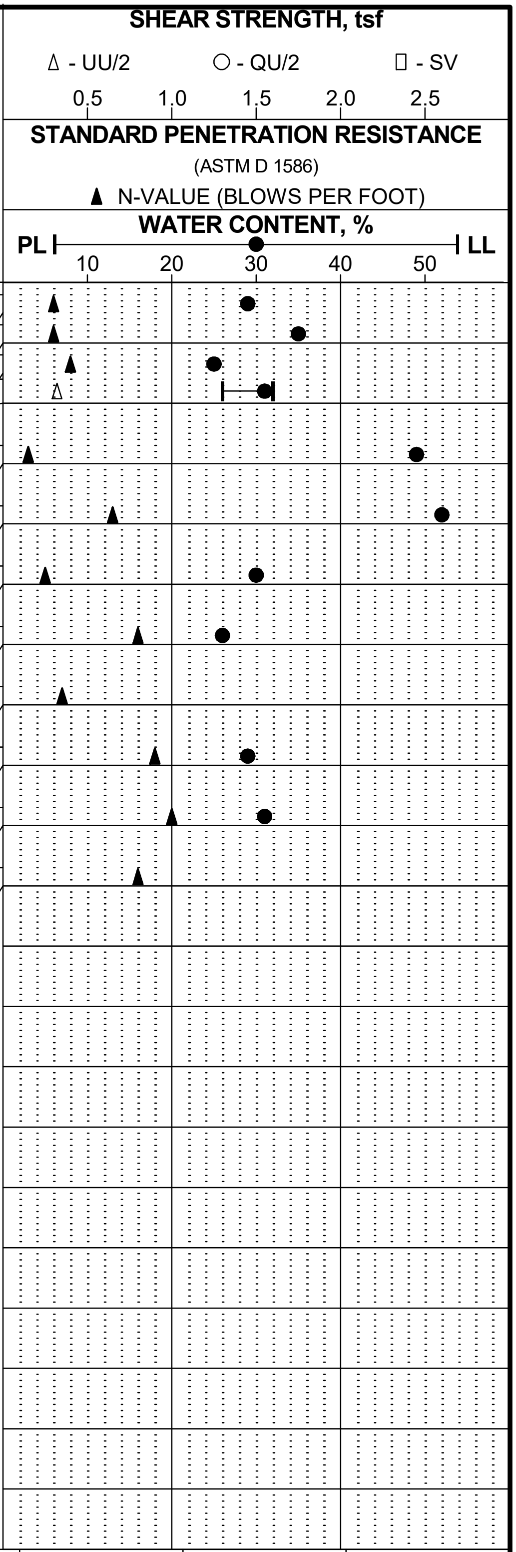
Surface Elevation: NA

Datum NA

Completion Date: 4/26/21



DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	TOPSOIL: 7 inches		
	Medium stiff, brown and gray, FAT CLAY - CH	2-2-4	SS1
5		2-2-4	SS2
	Medium stiff, brown, clayey SILT - (ML)	2-4-4	SS3
		93	ST4
10			
	Soft to stiff, gray, FAT CLAY - CH ∇		
15		1-1-2	SS5
20		2-6-7	SS6
	Loose, gray, SILTY SAND - SM		
25		4-2-3	SS7
30	Loose to medium dense, gray SAND - (SP)	7-7-9	SS8
35	3% passing No. 200 sieve	3-3-4	SS9
40		5-8-10	SS10
45	Medium dense, gray, SILTY SAND - SM	3-8-12	SS11
50	Medium dense, gray SAND - SP	5-8-8	SS12
	Boring terminated at 50 feet.		
55			
60			
65			
70			
75			
80			
85			
90			
95			
100			



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 13 FEET ∇

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 10 FEET
BMF DRILLER AKM LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 94 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 4/29/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B- 7

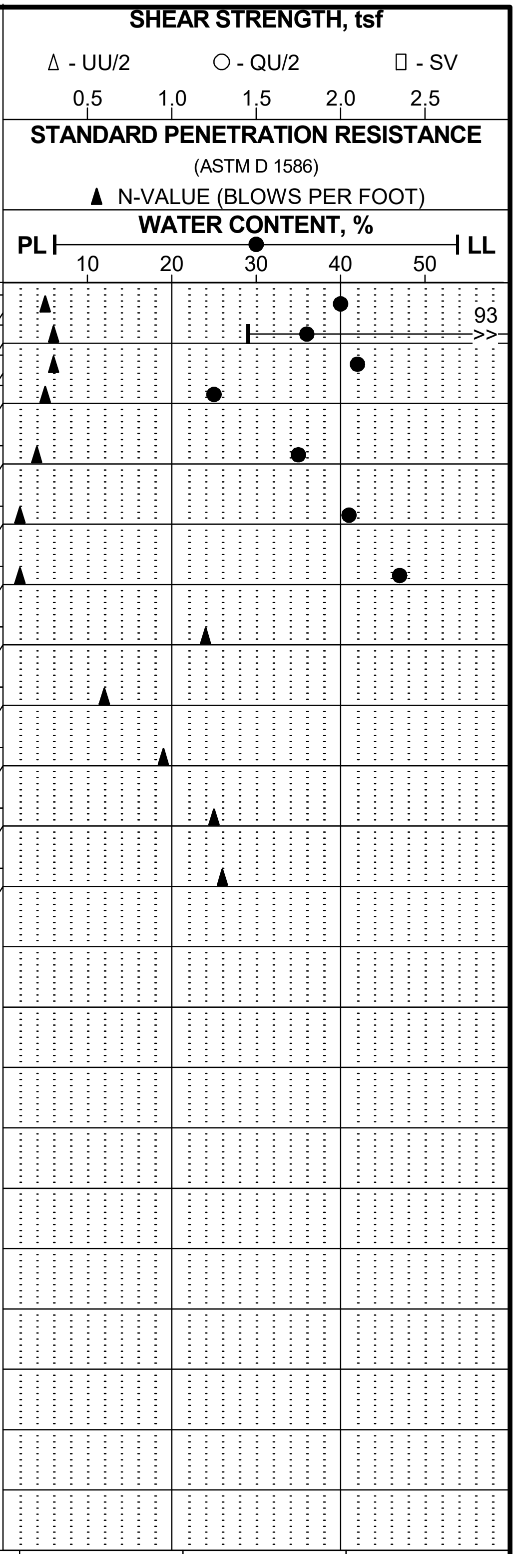
Project No. J034421.01

Surface Elevation: NA

Datum NA

Completion Date: 5/15/21

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium stiff, gray, FAT CLAY - CH	▨	2-2-3	SS1
5		▨	2-2-4	SS2
		▨	2-3-3	SS3
10	Medium stiff to soft, brown and gray to gray, LEAN CLAY - CL	▨	2-2-3	SS4
15		▨	1-1-3	SS5
20	95% passing No. 200 sieve	▨	1-1-1	SS6
25		▨	1-1-1	SS7
30	Medium dense, gray, CLAYEY SAND - (SC) 12% passing No. 200 sieve	▨	6-10-14	SS8
35	Medium dense, gray SAND. trace clay - (SP-SC)	▨	4-5-7	SS9
40		▨	6-11-8	SS10
45	6% passing No. 200 sieve	▨	9-12-13	SS11
50		▨	9-11-15	SS12
	Boring terminated at 50 feet.			
55				
60				
65				
70				
75				
80				
85				
90				
95				
100				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 10 FEET
JCG DRILLER WEC LOGGER
Diedrich D-50 DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 97 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 5/10/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B- 8

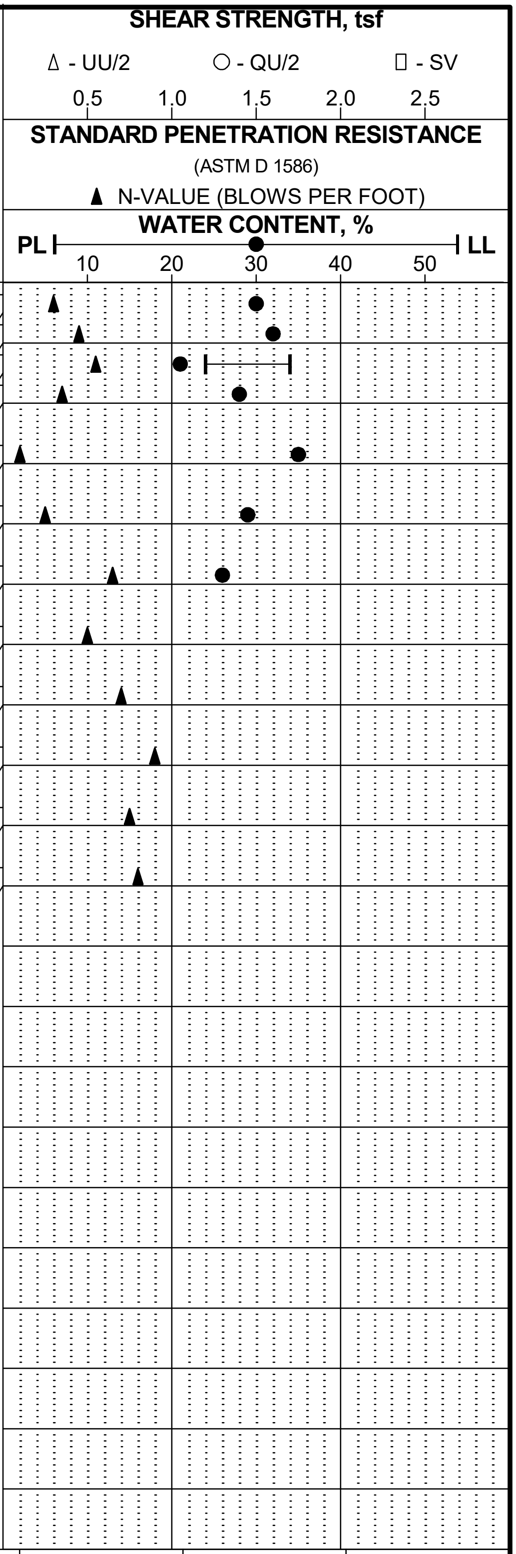
Project No. J034421.01

Surface Elevation: NA

Datum NA

Completion Date: 5/7/21

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium stiff to stiff, brown to gray, FAT CLAY - CH		2-3-3	SS1
5			3-4-5	SS2
	Stiff to soft, brown SILT - (ML)		3-6-5	SS3
10			3-3-4	SS4
15			1-1-1	SS5
20			1-3-2	SS6
25	Stiff, gray, sandy SILT - ML 51% passing No. 200 sieve		4-6-7	SS7
30	Loose to medium dense, gray, SILTY SAND - (SM)		6-5-5	SS8
35	22% passing No. 200 sieve		6-6-8	SS9
40			7-9-9	SS10
45			7-7-8	SS11
50	Medium dense, gray SAND, trace silt - (SP-SM) 7% passing No. 200 sieve Boring terminated at 50 feet.		7-8-8	SS12
55				
60				
65				
70				
75				
80				
85				
90				
95				
100				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 10 FEET

JCG DRILLER WEC LOGGER

Diedrich D-50 DRILL RIG

HAMMER TYPE Auto

HAMMER EFFICIENCY 97 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 5/10/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B- 9

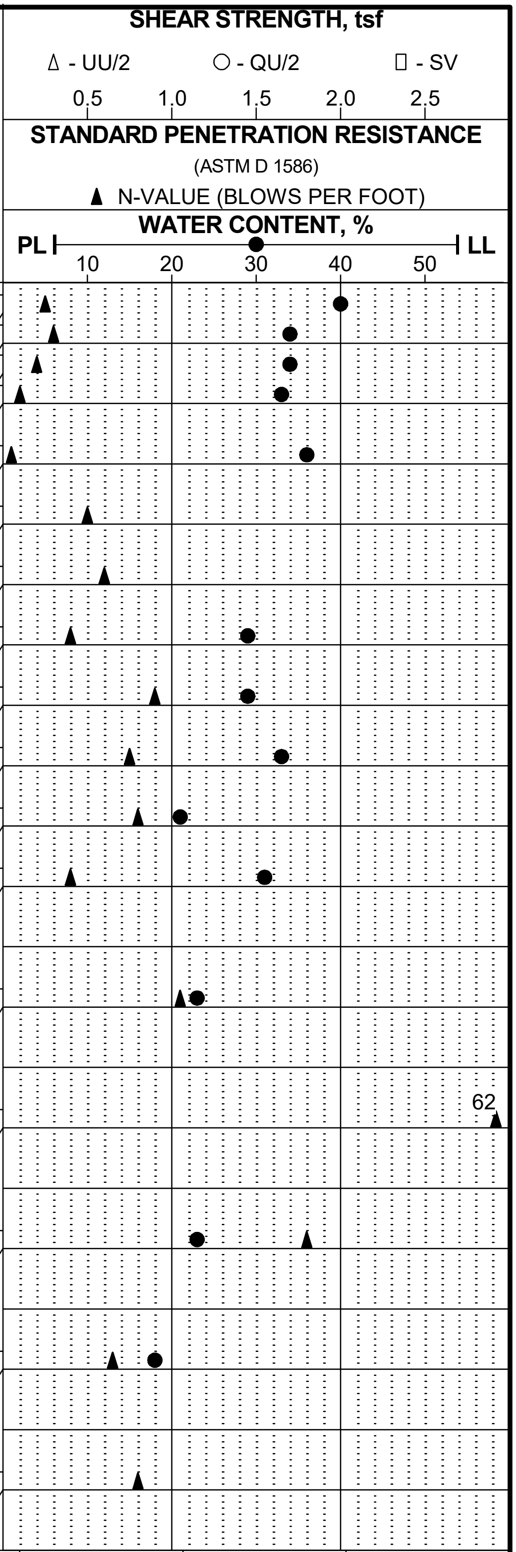
Project No. J034421.01

Surface Elevation: NA

Datum NA

Completion Date: 4/27/21

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	TOPSOIL: 7 inches Medium stiff to soft, brown and gray, FAT CLAY - CH	1-2-3	SS1
5		1-3-3	SS2
		1-2-2	SS3
10	Soft, brown, silty, LEAN CLAY - CL	1-1-1	SS4
15	Very soft, brown SILT - ML 85% passing No. 200 sieve	0-0-1	SS5
20	Loose to medium dense, brown to gray SAND - SP little silt	5-5-5	SS6
25		3-5-7	SS7
30		5-4-4	SS8
35		4-8-10	SS9
40	Medium dense, gray, SILTY SAND - SM	3-6-9	SS10
45	Loose to very dense, gray SAND, trace silt - (SP-SM)	8-6-10	SS11
50	6% passing No. 200 sieve	3-4-4	SS12
55			
60		8-10-11	SS13
65			
70		12-25-37	SS14
75			
80		8-13-23	SS15
85			
90		7-5-8	SS16
95			
100		7-8-8	SS17
	Boring terminated at 100 feet.		



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 13 FEET ▽

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 10 FEET
BMF DRILLER AKM LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 94 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 4/29/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B-10

Project No. J034421.01

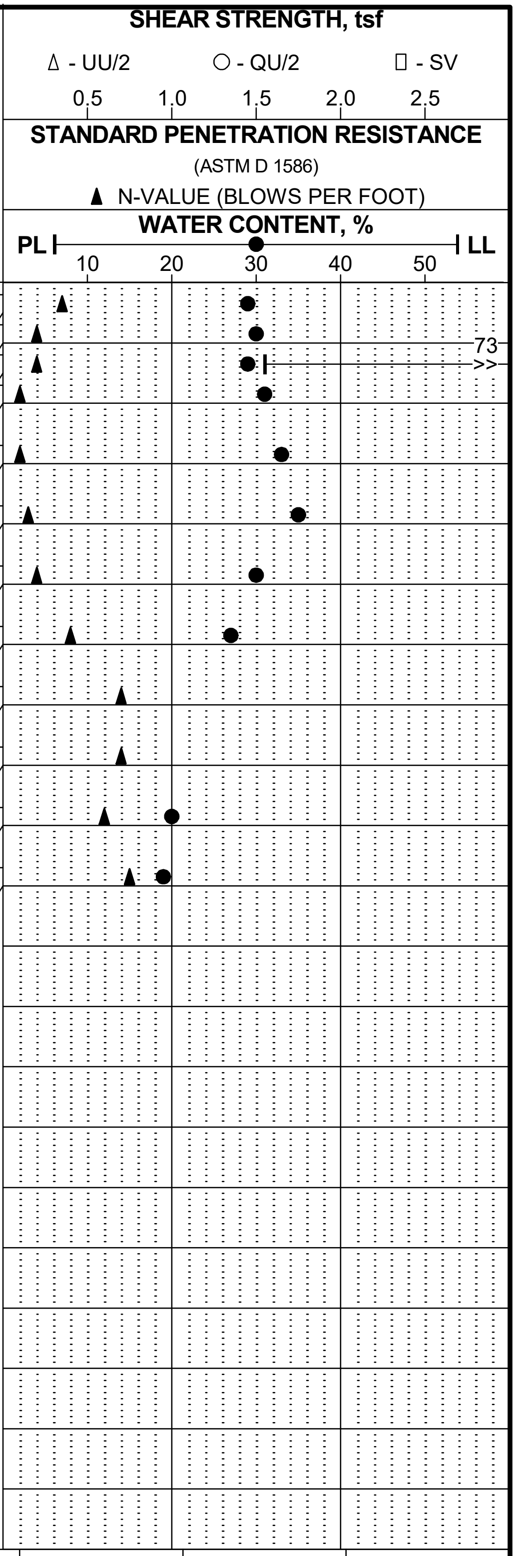
LOG OF BORING 2002 WL J034421.01.GPJ GTINC 0638301.GPJ 5/27/21

Surface Elevation: NA

Datum NA

Completion Date: 4/26/21

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Topsoil: 7 inches		
	Medium stiff, brown, FAT CLAY - CH	2-3-4	SS1
5	Soft, brown, silty, LEAN CLAY - CL	2-2-2	SS2
	Soft, brown, FAT CLAY - (CH)	1-2-2	SS3
10	Soft, brown and gray, silty, LEAN CLAY - CL ▽	1-1-1	SS4
15	Soft, brown SILT - ML	1-1-1	SS5
20	Very loose, gray, SILTY SAND - (SM) 33% passing No. 200 sieve	2-1-2	SS6
25		2-2-2	SS7
30	Loose to medium dense, gray SAND - SP	5-5-3	SS8
35		5-6-8	SS9
40		6-6-8	SS10
45		5-6-6	SS11
50	Boring terminated at 50 feet.	5-7-8	SS12
55			
60			
65			
70			
75			
80			
85			
90			
95			
100			



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 13 FEET ▽

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 10 FEET
BMF DRILLER AKM LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 94 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 4/29/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B-11

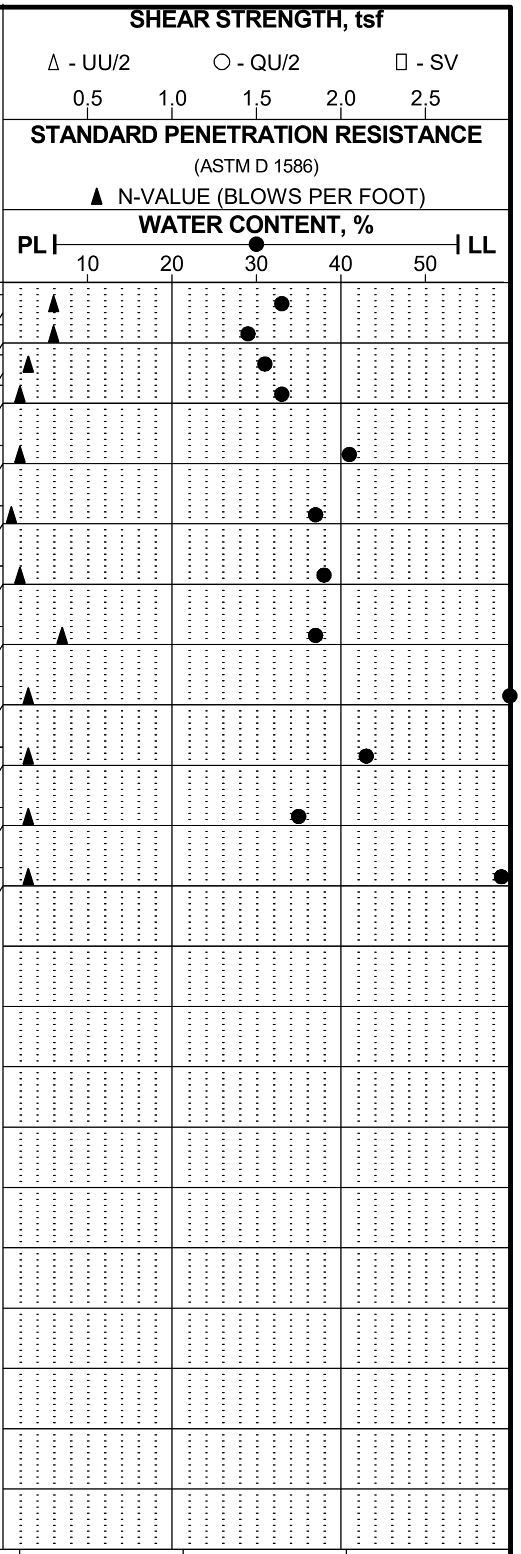
Project No. J034421.01

Surface Elevation: NA

Datum NA

Completion Date: 5/11/21

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium stiff, tan and brown, FAT CLAY - CH		2-3-3	SS1
5	little silt		2-3-3	SS2
	Soft, tan and brown, clayey SILT - ML		2-1-2	SS3
10			1-1-1	SS4
15	Very soft to soft, brown and gray, silty, LEAN CLAY - CL		0-1-1	SS5
20			1-0-1	SS6
25			1-1-1	SS7
30	Medium stiff, gray, sandy, LEAN CLAY - CL		1-2-5	SS8
35	Soft, gray, sandy, FAT CLAY - CH		1-1-2	SS9
40			2-2-1	SS10
45	Soft, gray, silty, LEAN CLAY - CL		1-1-2	SS11
50	Soft, gray, FAT CLAY - CH		1-1-2	SS12
	Boring terminated at 50 feet.			
55				
60				
65				
70				
75				
80				
85				
90				
95				
100				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM __ FEET

JCG DRILLER CRF LOGGER

Diedrich D-50 DRILL RIG

HAMMER TYPE Auto

HAMMER EFFICIENCY 97 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 5/12/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC

FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B-12

Project No. J034421.01

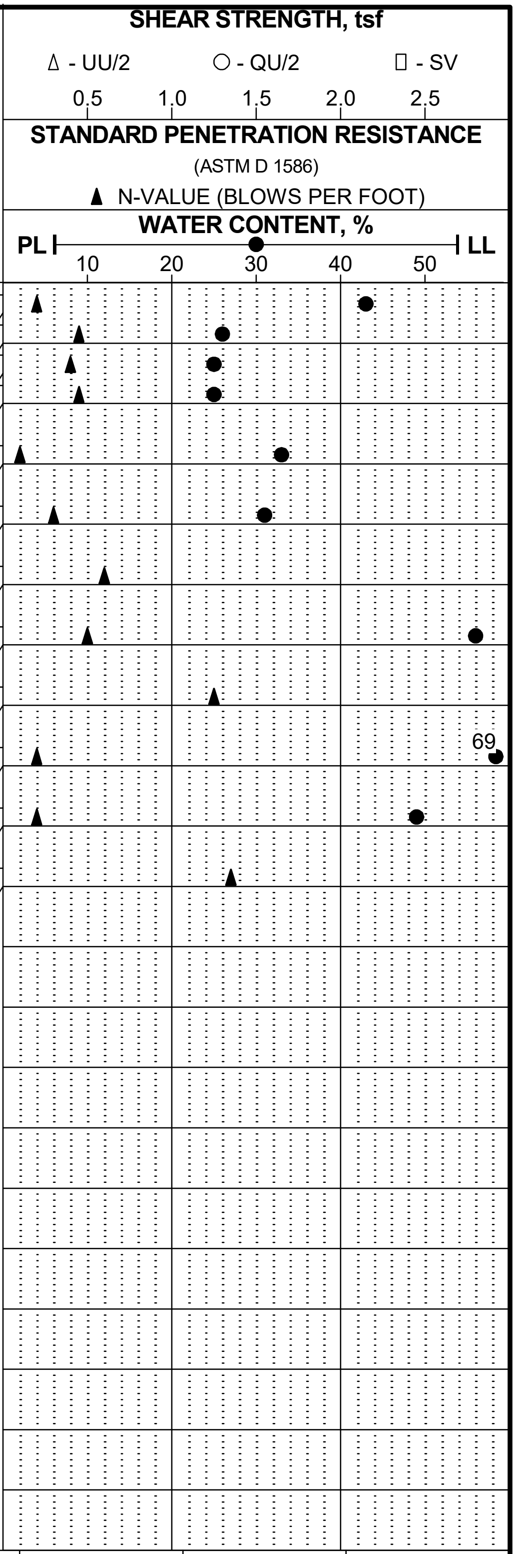
Surface Elevation: NA

Datum NA

Completion Date: 5/11/21

DESCRIPTION OF MATERIAL

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Soft to stiff, brown and gray, FAT CLAY - CH	2-1-3 3-4-5	SS1 SS2
5	Medium stiff, brown and gray, silty, LEAN CLAY - CL	2-4-4	SS3
10	Loose, brown, silty SAND - SM	3-4-5	SS4
15	Soft, brown, sandy SILT - ML	1-1-1	SS5
20	Loose, brown, silty SAND - SM	6-3-3	SS6
25	Medium dense, brown SAND - SP	7-5-7	SS7
30	Stiff, gray, sandy, FAT CLAY - CH	1-6-4	SS8
35	Medium dense, gray SAND - SP	8-10-15	SS9
40	Soft, gray, FAT CLAY - CH	1-2-2 1-2-2	SS10 SS11
45			
50	Medium dense, gray SAND - SP Boring terminated at 50 feet.	10-12-15	SS12
55			
60			
65			
70			
75			
80			
85			
90			
95			
100			



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM __ FEET

JCG DRILLER WEC LOGGER

Diedrich D-50 DRILL RIG

HAMMER TYPE Auto

HAMMER EFFICIENCY 97 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 5/12/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B-13

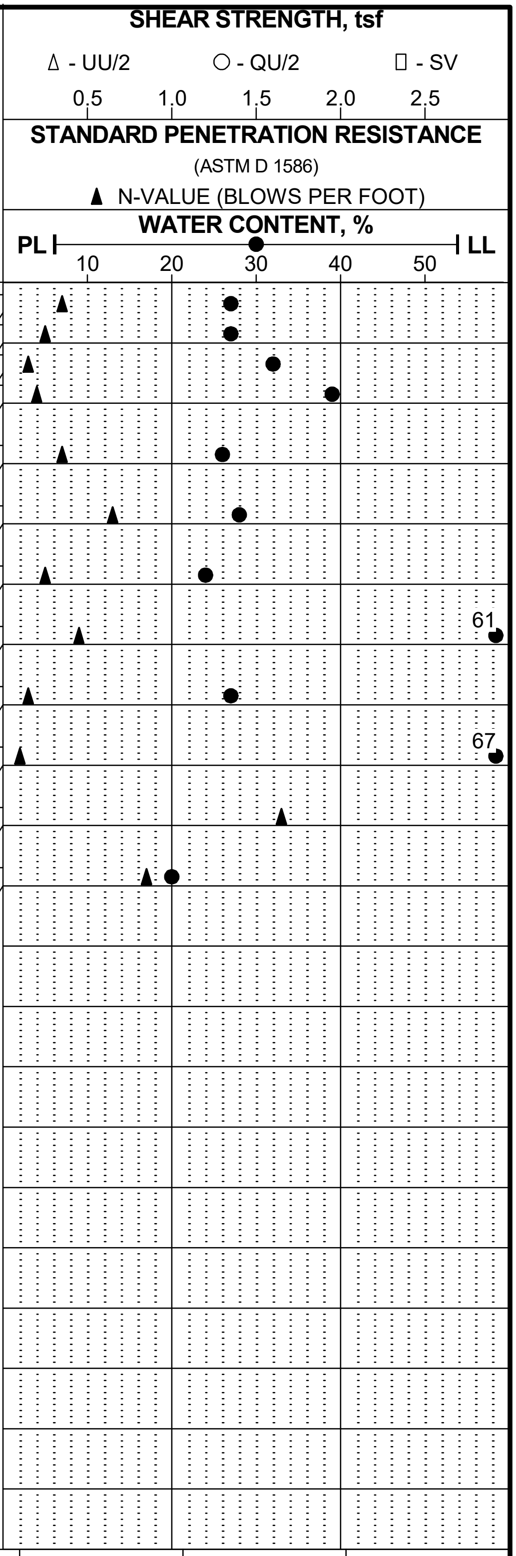
Project No. J034421.01

Surface Elevation: NA

Datum NA

Completion Date: 5/11/21

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium stiff, brown, FAT CLAY - CH		2-3-4	SS1
5	Medium stiff, brown, silty, LEAN CLAY - CL		3-2-3	SS2
	Soft, brown and gray, clayey SILT - ML		1-1-2	SS3
10	Soft, brown and gray, FAT CLAY - CH		1-2-2	SS4
15	Loose, brown, silty SAND - SM		3-4-3	SS5
20	Medium dense to loose, brown to gray SAND - SP		5-6-7	SS6
25			4-3-2	SS7
30	Stiff, gray, sandy, FAT CLAY - CH		1-3-6	SS8
35	Very loose, gray SAND - SP		6-2-1	SS9
40	Soft, gray, FAT CLAY - CH		1-1-1	SS10
45	Medium dense to dense, gray SAND - SP		15-16-17	SS11
50			4-7-10	SS12
	Boring terminated at 50 feet.			
55				
60				
65				
70				
75				
80				
85				
90				
95				
100				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 10 FEET
JCG DRILLER CRF LOGGER
Diedrich D-50 DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 97 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 5/12/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B-14

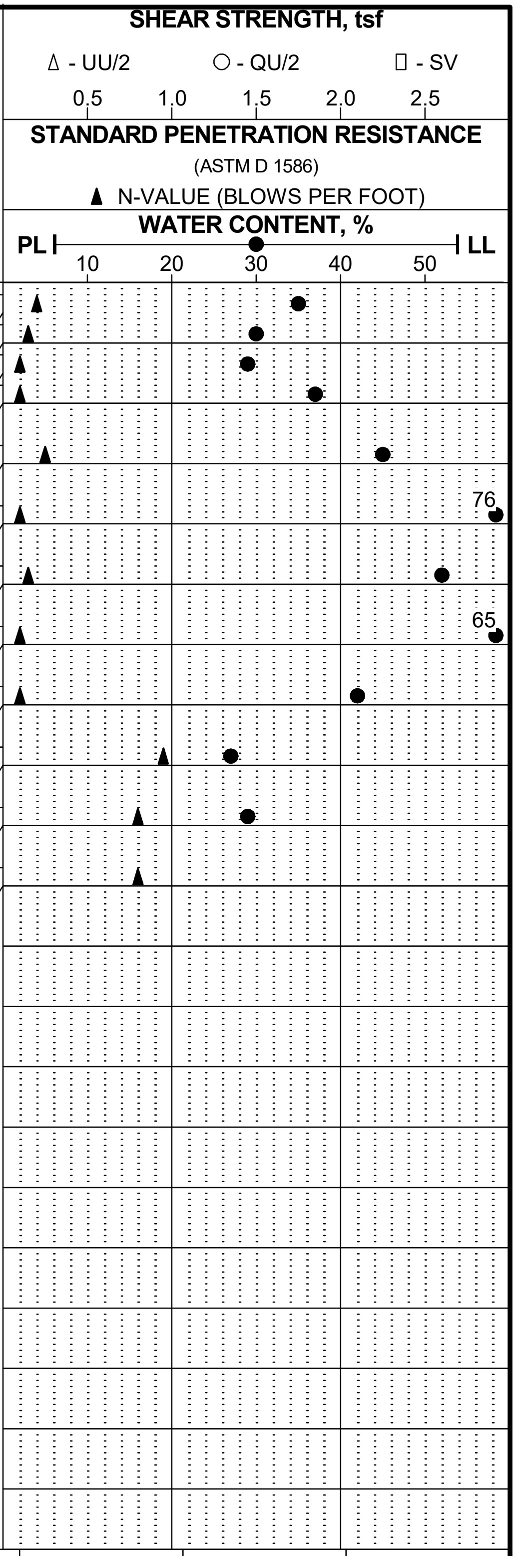
Project No. J034421.01

Surface Elevation: NA

Datum NA

Completion Date: 5/7/21

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Soft, gray and brown, FAT CLAY - CH		2-2-2	SS1
5	little silt		2-1-2	SS2
	Soft, brown and gray, sandy SILT - ML		1-1-1	SS3
10	Soft, gray and brown, silty, LEAN CLAY - CL	∇	1-1-1	SS4
15	Medium stiff to soft, gray, FAT CLAY - CH		2-2-3	SS5
20			1-1-1	SS6
25			1-1-2	SS7
30			0-1-1	SS8
35			1-1-1	SS9
40	Medium dense, gray and black, SILTY SAND - SM		3-7-12	SS10
45			5-7-9	SS11
50	some lignite		5-6-10	SS12
	Boring terminated at 50 feet.			
55				
60				
65				
70				
75				
80				
85				
90				
95				
100				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 9 FEET ∇

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 15 FEET
JCG DRILLER WEC LOGGER
Diedrich D-50 DRILL RIG
HAMMER TYPE Auto
HAMMER EFFICIENCY 97 %

REMARKS:

Drawn by: SWF	Checked by: ASM	App'vd. by: DBA
Date: 5/10/21	Date: 5/18/21	Date: 5/18/21

GEOTECHNOLOGY INC
FROM THE GROUND UP

Helena Harbor Site Certification
Helena, Arkansas

LOG OF BORING: B-15

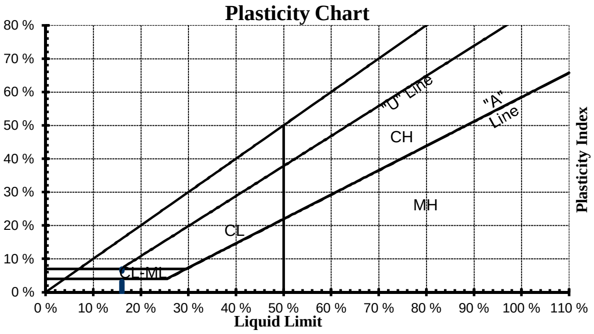
Project No. J034421.01

LOG OF BORING 2002 WL J034421.01.GPJ GTINC 0638301.GPJ 5/27/21

BORING LOG: TERMS AND SYMBOLS

LEGEND

CS	Continuous Sampler
GB	Grab Sample
NQ	NQ Rock Core
PST	Three-Inch Diameter Piston Tube Sample
SS	Split-Spoon Sample (Standard Penetration Test)
ST	Three-Inch Diameter Shelby Tube Sample
*	Sample Not Recovered
PL	Plastic Limit (ASTM D4318)
LL	Liquid Limit (ASTM D4318)
SV	Shear Strength from Field Vane (ASTM D2573)
UU	Shear Strength from Unconsolidated-Undrained Triaxial Compression Test (ASTM D2850)
QU	Shear Strength from Unconfined Compression Test (ASTM D2166)



SOIL GRAIN SIZE

US STANDARD SIEVE

12" 3" 3/4" 4 10 40 200

BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		

300 76.2 19.1 4.76 2.00 0.42 0.074 0.005

SOIL GRAIN SIZE IN MILLIMETERS

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions			***Symbol***	***Description***
Coarse-Grained Soils (More than 50% Larger than No. 200 Sieve Size)	Gravel and Gravelly Soil	Clean Gravels Little or no Fines	GW	Well-Graded Gravel, Gravel- Sand Mixture
			GP	Poorly-Graded Gravel, Gravel-Sand Mixture
		Gravels with Appreciable Fines	GM	Silty Gravel, Gravel-Sand-Silt Mixture
			GC	Clayey-Gravel, Gravel-Sand-Clay Mixture
	Sand and Sandy Soils	Clean Sands Little or no Fines	SW	Well-Graded Sand, Gravelly Sand
			SP	Poorly-Graded Sand, Gravelly Sand
		Sands with Appreciable Fines	SM	Silty Sand, Sand-Silt Mixture
			SC	Clayey-Sand, Sand-Clay Mixture
Fine-Grained Soils (More than 50% Smaller than No. 200 Sieve Size)	Silts and Clays	Liquid Limit Less Than 50	ML	Silt, Sandy Silt, Clayey Silt, Slight Plasticity
			CL	Lean Clay, Sandy Clay, Silty Clay, Low to Medium Plasticity
			OL	Organic Silts or Lean Clays, Low Plasticity
	Silts and Clays	Liquid Limit Greater Than 50	MH	Silt, High Plasticity
			CH	Fat Clay, High Plasticity
			OH	Organic Clay, Medium to High Plasticity
	Highly Organic Soils		PT	Peat, Humus, Swamp Soil

STRENGTH OF COHESIVE SOILS

Consistency	***Undrained Shear Strength (tsf)***	***Unconfined Comp. Strength (tsf)***
Very Soft	less than 0.125	less then 0.25
Soft	0.125 to 0.25	0.25 to 0.5
Medium Stiff	0.25 to 0.5	0.5 to 1.0
Stiff	0.5 to 1.0	1.0 to 2.0
Very Stiff	1.0 to 2.0	2.0 to 3.0
Hard	greater than 2.0	greater than 4.0

DENSITY OF GRANULAR SOILS

Descriptive Term	***Approximate N_{60}-Value Range***
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	>50

N-Value (Blow Count) is the last two, 6-inch drive increments (i.e. 4/7/9, N = 7 + 9 = 16). Values are shown as a summation on the grid plot and shown in the Unit Dry Weight/SPT column.

RELATIVE COMPOSITION

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35 to 50%

OTHER TERMS

Layer - Inclusion greater than 3 inches thick.

Seam - Inclusion 1/8-inch to 3 inches thick

Parting - Inclusion less than 1/8-inch thick

Pocket - Inclusion of material that is smaller than sample diameter

GEOTECHNOLOGY INC
FROM THE GROUND UP

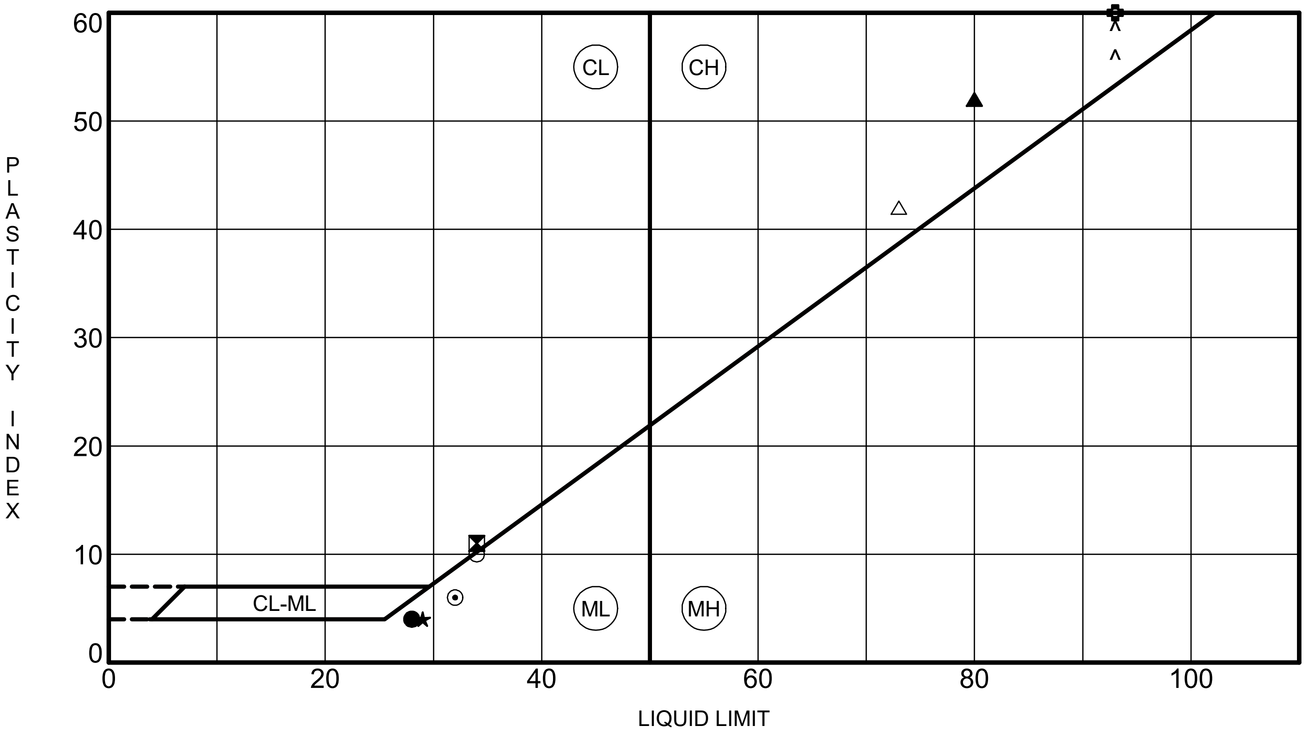
Relative composition and Unified Soil Classification System (USCS) designations are based on visual descriptions and are approximate only. If laboratory tests were performed to classify the soil, the USCS designation is shown in parenthesis.

APPENDIX D – LABORATORY TEST DATA

Atterberg Limits

Grain Size Distribution

Unconsolidated-Undrained Triaxial Compression

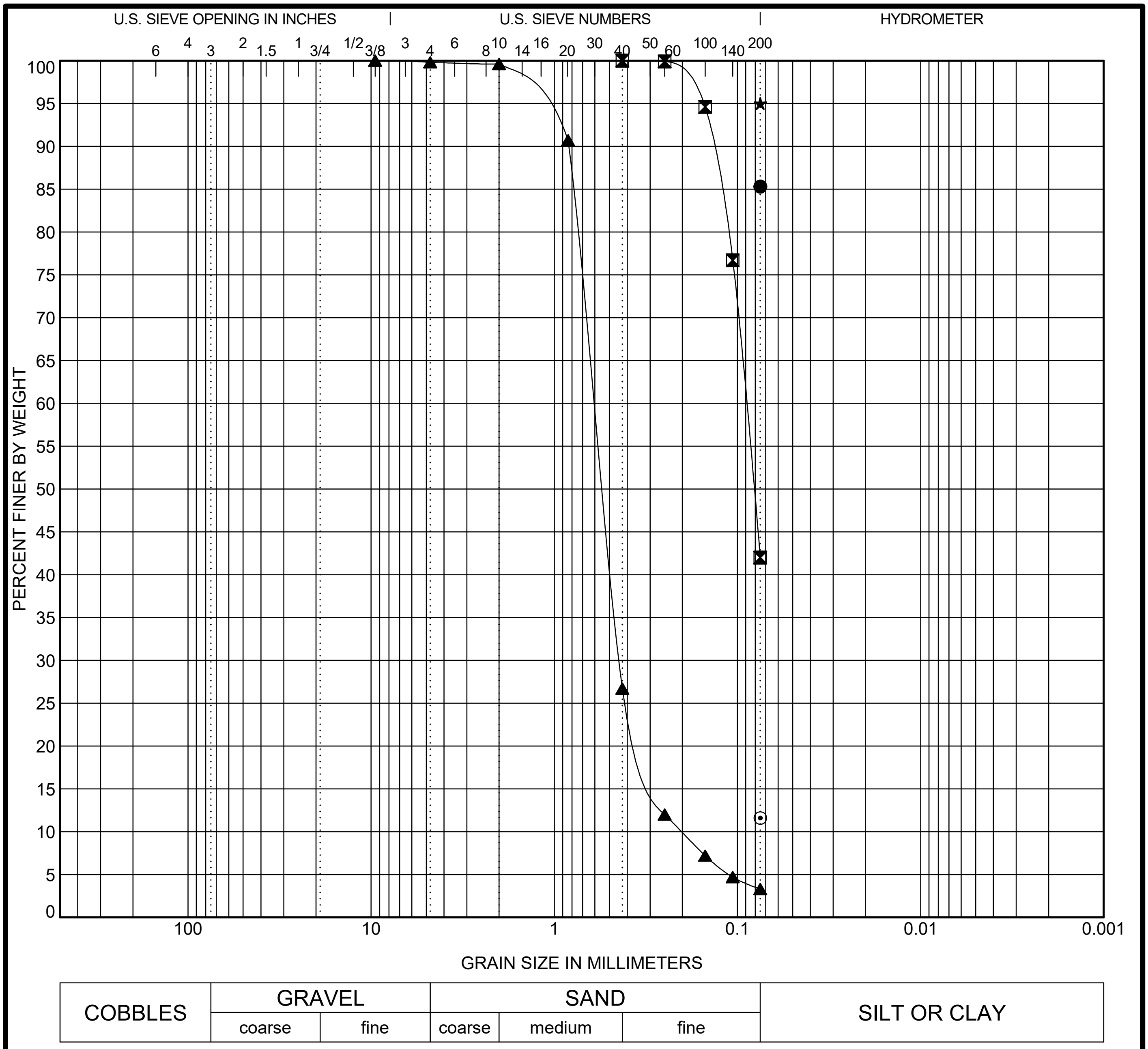


	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B- 1**	**13.5**	**28**	**24**	**4**	**85**	**SILT(ML)**
⧗	**B- 2**	**3.5**	**34**	**23**	**11**		**LEAN CLAY(CL)**
▲	**B- 2**	**28.5**	**80**	**28**	**52**		**FAT CLAY(CH)**
★	**B- 6**	**8.0**	**29**	**25**	**4**		**SILT(ML)**
⊙	**B- 7**	**8.0**	**32**	**26**	**6**		**SILT(ML)**
✿	**B- 8**	**3.5**	**93**	**29**	**64**		**FAT CLAY(CH)**
○	**B- 9**	**6.0**	**34**	**24**	**10**		**SILT(ML)**
△	**B-11**	**6.0**	**73**	**31**	**42**		**FAT CLAY(CH)**

GEOTECHNOLOGY INC
FROM THE GROUND UP

ATTERBERG LIMITS RESULTS

Helena Harbor Site Certification
Helena, Arkansas
J034421.01



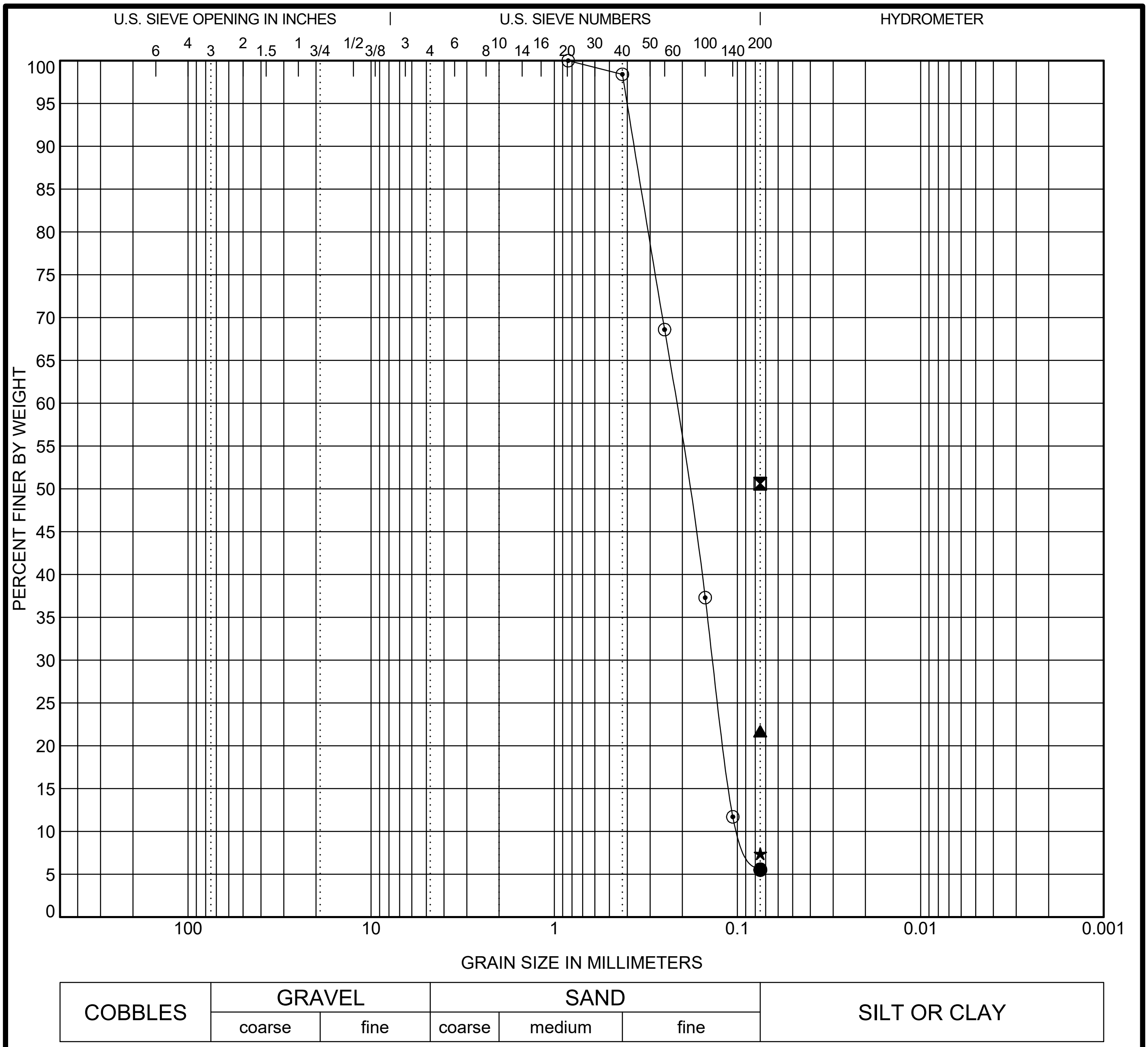
Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	B- 1	13.5	SILT(ML)	28	24	4		
⧗	B- 1	28.5	SILTY SAND(SM)					
▲	B- 7	33.5	POORLY GRADED SAND(SP)				1.58	3.00
★	B- 8	18.5	LEAN CLAY(CL)					
⊙	B- 8	28.5	CLAYEY SAND(SC)					

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B- 1	13.5	0.075				0.0	0.0	85.3	
⧗	B- 1	28.5	0.425	0.09			0.0	58.0	42.0	
▲	B- 7	33.5	9.5	0.606	0.44	0.202	0.2	96.5	3.3	
★	B- 8	18.5	0.075				0.0	0.0	95.0	
⊙	B- 8	28.5	0.075				0.0	0.0	11.6	

GEOTECHNOLOGY INC
FROM THE GROUND UP

GRAIN SIZE DISTRIBUTION

Helena Harbor Site Certification
Helena, Arkansas
J034421.01



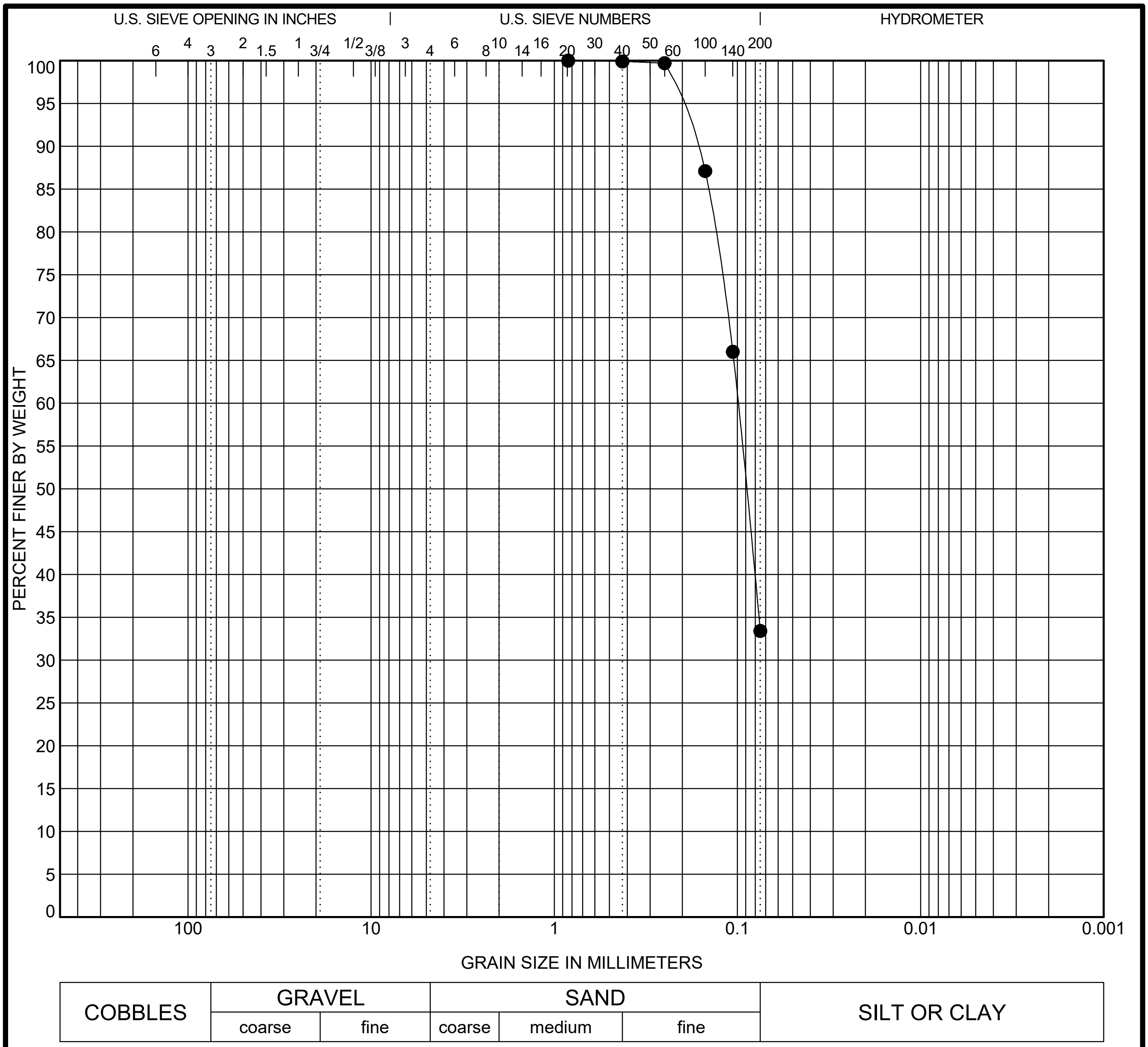
Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	**B- 8**	**43.5**	**POORLY GRADED SAND with CLAY(SP-SC)**					
⧗	**B- 9**	**23.5**	**SANDY SILT(ML)**					
▲	**B- 9**	**33.5**	**SILTY SAND(SM)**					
★	**B- 9**	**48.5**	**POORLY GRADED SAND with SILT(SP-SM)**					
⊙	**B-10**	**48.5**	**POORLY GRADED SAND with SILT(SP-SM)**				**0.88**	**2.26**

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B- 8**	**43.5**	**0.075**				**0.0**	**0.0**	**5.5**	
⧗	**B- 9**	**23.5**	**0.075**				**0.0**	**0.0**	**50.6**	
▲	**B- 9**	**33.5**	**0.075**				**0.0**	**0.0**	**21.7**	
★	**B- 9**	**48.5**	**0.075**				**0.0**	**0.0**	**7.4**	
⊙	**B-10**	**48.5**	**0.84**	**0.217**	**0.136**	**0.096**	**0.0**	**94.4**	**5.6**	

GEOTECHNOLOGY INC
FROM THE GROUND UP

GRAIN SIZE DISTRIBUTION

Helena Harbor Site Certification
Helena, Arkansas
J034421.01



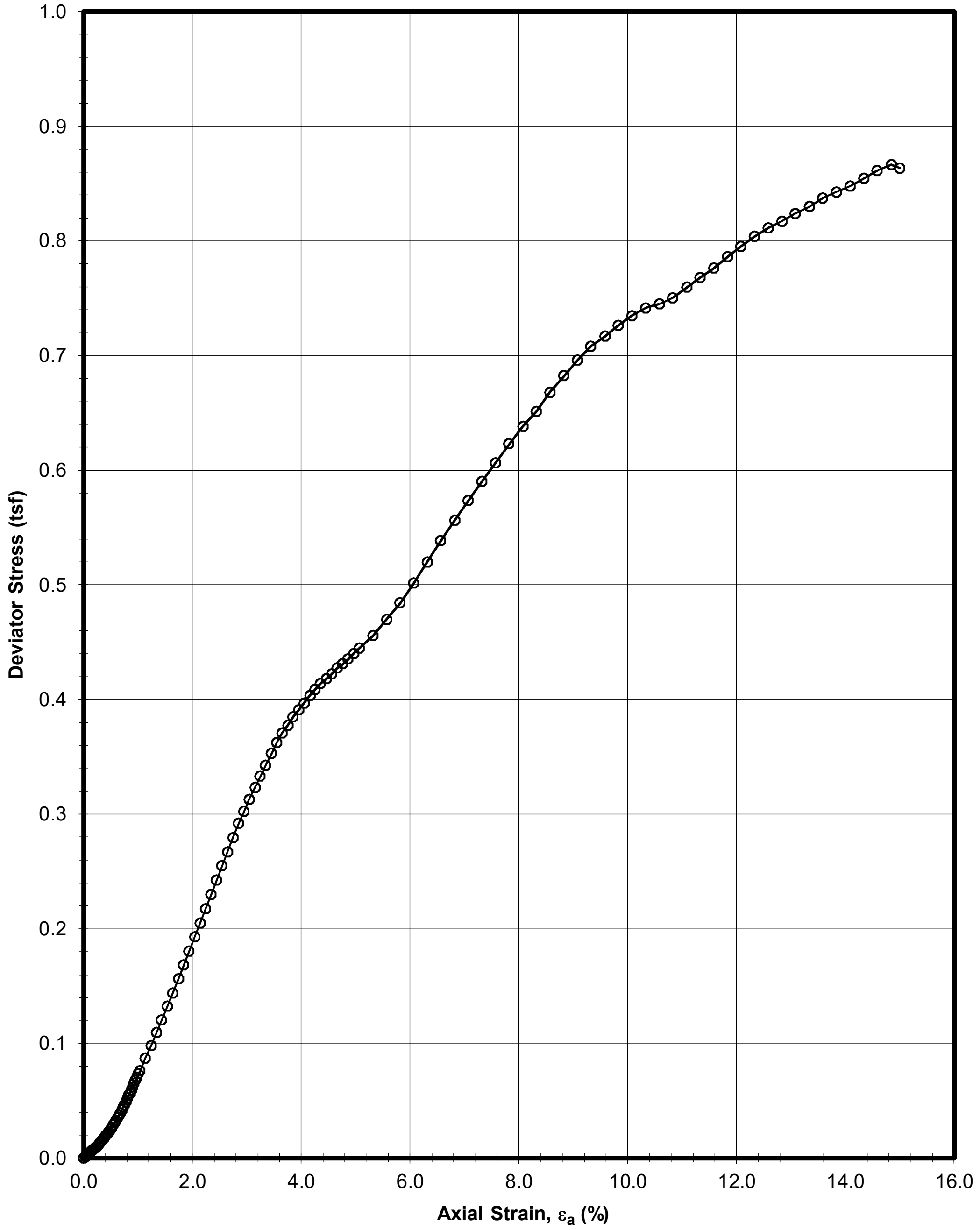
Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	**B-11**	**18.5**	**SILTY SAND(SM)**					

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-11**	**18.5**	**0.84**	**0.099**			**0.0**	**66.6**	**33.4**	

GEOTECHNOLOGY INC
FROM THE GROUND UP

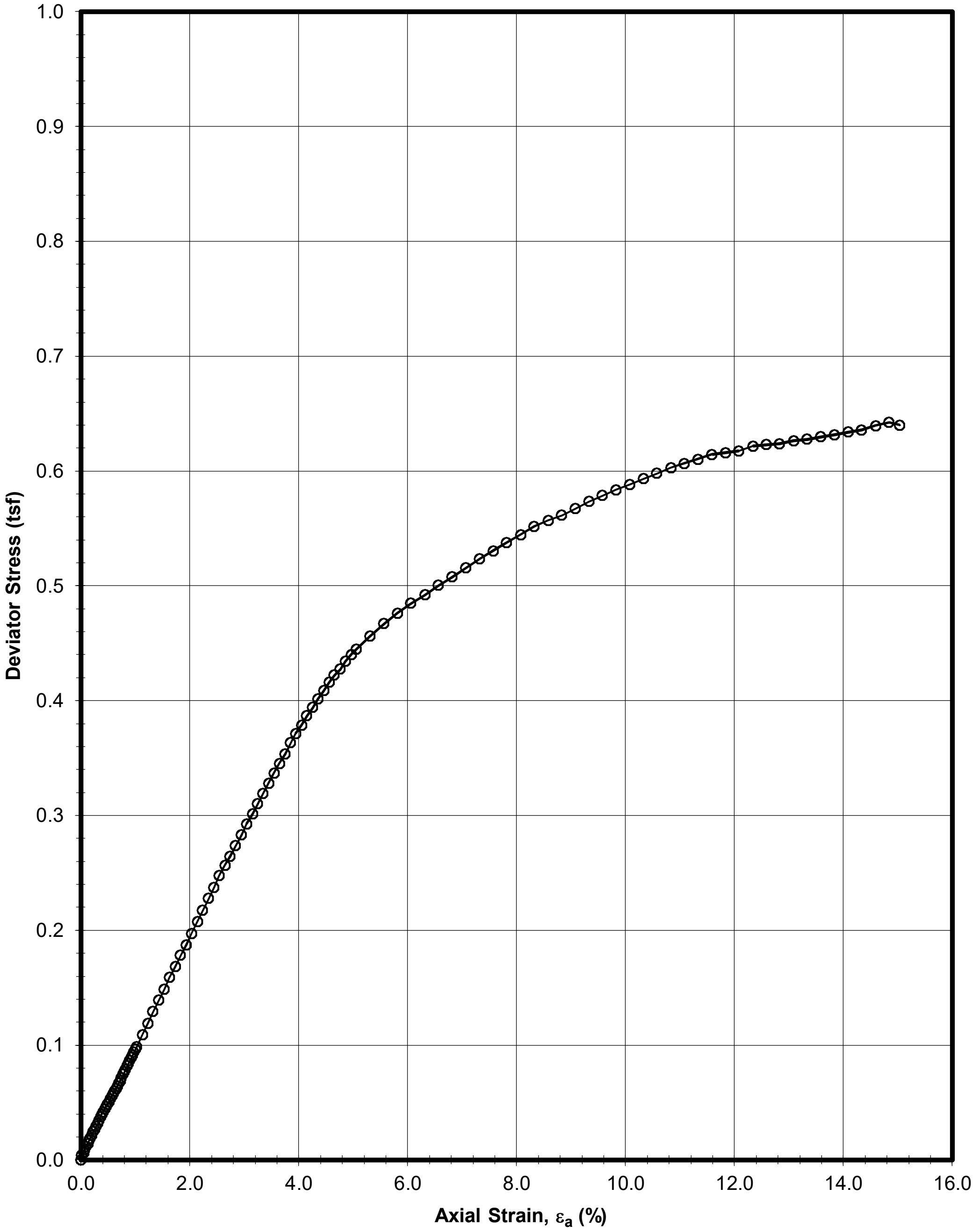
GRAIN SIZE DISTRIBUTION

Helena Harbor Site Certification
Helena, Arkansas
J034421.01



UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

ASTM D 2850
Project No.: J034421.01
Boring: B-6
Sample: ST-4 - Depth: 8 ft.



UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

ASTM D 2850
Project No.: J034421.01
Boring: B-7
Sample: ST-1 - Depth: 8 ft.