GEOTECHNICAL EXPLORATION REPORT

OF

SPECIAL K DRILLING NO. 2
MURRAY INDUSTRIAL PARK
MURRAY, KENTUCKY

Submitted By:

BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

November 26, 2012

Mr. Mark Manning
Murray Calloway EDC
P.O. Box 1911
Murray, Kentucky 42071

Re: **Geotechnical Exploration Report**
Special K Drilling No. 2
Murray Industrial Park
Murray, Kentucky

Dear Mr. Manning:

Bacon Farmer Workman Engineering & Testing, Inc., is pleased to present the attached Geotechnical Exploration Report for the referenced site. The geotechnical exploration was conducted in accordance with applicable ASTM Standards.

The attached report includes a review of pertinent project information provided to us, descriptions of site and subsurface conditions encountered and our general recommendations for site preparation and construction phase concerns. The Appendix contains a Boring Layout Map, results of all field and laboratory tests conducted for this project and foundation design criteria.

We appreciate the opportunity to serve you and look forward to future association with you on this and other projects. If you have questions concerning this report, please call our office.

Sincerely,
BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

Christopher N. Farmer, P.E.
Principal Engineer

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Attachments: Geotechnical Exploration Report

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1.0 Objective

The purpose of this geotechnical study is to explore the subsurface conditions present at the site and to determine pertinent engineering properties of the materials encountered.

2.0 Project Information

The project consists of a proposed development at the Murray Industrial Park. Based on available information the proposed development involves the construction of a manufacturing facility that will utilize a type of hydraulic stamping press. The facility will be housed in a standard pre-engineered metal building. The hydraulic stamping press weight would be on the order of 800 tons and would be constructed in a pit approximately 22 feet x 44 feet in dimension and approximately 18 feet in depth. No other structural information was available at the time of this report.

2.1 Site Description

A site reconnaissance was conducted on November 14, 2012. Observations made during the site visit were used to aid in interpreting topographic, geologic and other conditions that may affect proposed construction.

The project site currently is composed of vacant land located inside the Murray Industrial Park, north of the city of Murray.

The site is located within the United States Geologic Survey, Murray, KY 7.5-Minute Quadrangle. The general topography of the project area is relatively flat, with a slight downward slope in topography towards the north. The approximate elevation of the site ranges from 490- 525 feet above sea level (National Geodetic Vertical Datum of 1929).

2.2 Exploratory Method

The procedures used by BFW, Inc. for field and laboratory sampling and testing are in general accordance with ASTM procedures, and established engineering practice. A total of 12 soil test borings were advanced at the site. Two of the borings were drilled to an approximate depth of 30 feet below ground surface (bgs); the remaining ten borings were advanced to approximately 20 feet bgs. The soil test borings were distributed across a proposed building footprint and were established in the field by BFW, Inc. representatives (see Boring Location Map in Appendix B).

A CME-75 truck mounted rotary-drilling rig was used to advance the soil test borings and to obtain soil samples for laboratory evaluation. The test borings were advanced in accordance with geotechnical investigative procedures outlined in ASTM D-1452.

Disturbed samples were retrieved during Standard Penetration tests (ASTM D-1586) using an automatic hammer assembly at various depths in the underlying stratum. The Standard Penetration test consists of driving a 2-inch outside diameter split-barrel sampler (split-spoon) into the soil with a 140-pound weight falling freely through a distance of 30 inches. The sampler was driven in three successive 6-inch increments, with the number of blows per increment being recorded. The number of blows required to advance the sampler the last 12 inches is termed the Standard Penetration Resistance (N). Due to the non-cohesive nature of the upper soils, undisturbed samples were not collected.

The project manager observed and directed the drilling operations and visually classified soil samples obtained in accordance with Unified Soil Classification System and ASTM D-2488 guidelines. Records of the conditions encountered and visual soil classification were prepared and incorporated in Subsurface Boring Logs included in the report appendix.

The Subsurface Boring Logs represent our interpretation of the conditions encountered within the soil test borings. It should be noted that strata changes may vary from those encountered within the soil test borings, transitions may be gradual or abrupt, and conditions may vary significantly at other locations. The groundwater information listed represents conditions at the time of drilling and at least 24 hours after drilling activities. Representative soil samples obtained from the boring were preserved in plastic bags, sealed and taken to the laboratory for testing.

3.0 Subsurface Conditions

3.1 Regional

The University of Kentucky, Kentucky Geologic Map Information Service (kgs.uky.edu/kgsmap/kgsgeoserver/viewer.asp) was reviewed to determine regional geologic setting underlying the site. According to the online database, the site is immediately underlain by Quaternary loess and continental deposits, followed by the Tertiary Claiborne and Porters Creek Formations. Descriptions of each underlying unit are as follows in order of depositional age.

The local loess deposits are composed of "Silt and clay, gray to yellowish-brown, unstratified. Mapped by photogeologic methods and checked in the field."

The continental deposits are composed of "Gravel, sand, and clay: Gravel, yellowish-brown to red; pebbles and cobbles of chert and much less abundant quartz pebbles in matrix of poorly sorted, argillaceous, cherty, quartzose sand. Chert pebbles rounded, tabular, average 1 to 2 inches in diameter; tabular cobbles as much as 6 inches in diameter common. Quartz pebbles highly spherical, few exceed 1/2 inch in diameter. Gravel commonly well cemented with iron oxide. In severely gullied area 0.15 mile south of Bethel Cemetery, unit consists of mottled white, yellow, brown, and red, highly argillaceous, micaceous, very fine to fine-grained sand. Locally lenses of poorly sorted sand and more rarely of light-colored clay occur within the gravel."

The Tertiary Claiborne Formation is composed of "Sand, brown to red, medium- to coarse-grained, locally contains very coarse grained sand and granules; in places cemented with iron oxide; distinct crystal faces common on quartz grains. Formation contains at least one lens of light-colored silty clay and poorly sorted argillaceous sand similar to clay and sand in Wilcox Formation."

The Tertiary Porters Creek Formation is composed of "Clay, silt, and sand: Clay, dark-gray, dries light gray, slightly silty, moderately micaceous, brittle, fractures conchoidally. Scattered lignitized plant fragments occur in one exposure in upper part. Silt and fine-grained sand, grayish-orange to reddish-brown, argillaceous, contain abundant mica and dark opaque minerals; most abundant in upper part of formation; locally inter-bedded with clay; also occur as scattered lenses. Clastic dikes, similar in composition to the silts and sands described above, locally fill fractures in the clay."

3.2 Site-specific

In 2006 this site, as part of the larger Murray Industrial Complex, was leveled to a relative grade through embankment cutting and fill placement. Based on a map of the original topography, the original grade along the southern half of the property was cut by approximately 8 – 10 feet; whereas the northern half of the site was built up on fill ranging from 4 – 10 feet depending on location. The boring locations were chosen by the architect and field-checked by BFW (see Boring Location Map, Appendix B).

Due to the cut/fill of soil at this site, lateral correlations of the upper zones of most of the borings cannot be made as changes in lithology vary greatly with depth and most likely follow the original topography. The majority of the site is covered with a thin layer of placed topsoil. Underlying the topsoil in some of the borings was a brown-grayish brown silty clay of medium plasticity (borings B-1, B-3, B-4, B-5, B-10, B-11, and B-12) that was encountered to approximately 5 – 15 feet bgs. This silty clay (natural or fill) was of a firm to stiff consistency with blow counts ranging from 4 – 14. Underlying the silty clay was a brown-reddish brown, sometimes gray sandy gravel with sparse clay. In borings advanced through areas of cut (B-2, B-6, B-7, B-8, B-9), this sandy gravel was identified near the surface. The gravel had a loose to very dense consistency with blow counts ranging from 6 – 50+. This gravel was identified from approximately 12 – 18 feet where a light reddish orange sandy silt with light gray clay lensing was encountered. This silty material was identified as the Tertiary-aged Claiborne Formation due to oxidation characteristics and the abundant presence of mica. The Claiborne Formation grades into the Porters Creek Formation with depth, which was also encountered at the site in the form of a dark gray blocky clay/silt at approximately 29 feet bgs in borings B-7 and B-8. These Tertiary sediments range from soft to very hard in consistency, with the softest material near contact with the upper sandy gravels (blow counts ranging from 2 – 50+). Refer to Subsurface Boring Logs in Appendix C for more detail.

3.3 Groundwater

Groundwater measurements were taken in each of the soil test borings immediately following drilling activities and after 24-hours. Groundwater was not identified in any of the soil test borings advanced. Each of the soil test borings were backfilled with soil cuttings at the completion of the subsurface investigation. It should be noted that the soil borings were advanced during the "dry" season of the year during an extended time of drought. It is likely that during the wet time of the year that static groundwater levels or "perched" water will be encountered in the gravel layers above the lower Tertiary formations.

4.0 Laboratory Testing

Laboratory soil tests were conducted in accordance with applicable ASTM Standards. Natural moisture contents were determined for all samples collected. Liquid and Plastic Limits tests were conducted for selected soil samples to verify field classification of the soils. In addition, these tests evaluate the potential for volumetric changes in the soil. Laboratory test results are tabulated in Appendix D.

4.1 Laboratory Results

4.1.1 Natural moisture contents

Natural moisture contents were determined for the soil samples collected. The following table provides average moisture content derived from the soil samples analyzed. Exact moisture contents for all samples are provided in the appendix.

Natural Moisture Contents	
Depth (feet bgs)	**Soil moisture content (%)**
0 – 1.5	8.8 – 24.7
4.0 – 5.5	6.3 – 26.2
8.5 – 10.0	9.0 – 25.3
13.5 – 15.0	11.0 – 63.4
18.5 – 20.0	9.4 – 61.3
23.5 – 25.0	62.3 – 66.9
28.5 – 30.0	48.1 – 62.7

4.1.2 Atterberg Limits (Index Tests)

Atterberg Limits testing was conducted on samples collected from various borings. From the test results, liquid limit and plastic limit values were obtained. A plasticity index was then calculated using the liquid and plastic limit values. Using the results from the Atterberg Limits tests, the soils were classified using the Unified Soil Classification System.

One sample collected from soil test boring, B-1 (4.0'-6.0') was classified as a lean clay (CL) of low to medium plasticity with a plasticity index (PI) of 17.

A designation of CL includes lean clays, gravelly clays, sandy clays, and silty clays. Soil samples that have a Plasticity Index <20 have a low potential for soil volume change due to changing moisture contents.

4.1.3 Standard Penetration Tests

Field and laboratory tests were conducted to evaluate the soil strength characteristics on site. Standard Penetration Tests (SPTs) conducted in the field in the soils encountered produced low "N" values (blow counts) in the range of 4 to 12 in the upper silty clay / fill material; 6 – 50+ in the sandy gravels/clays (continental deposits) and 2 – 50+ in the lower tertiary clays.

The "N" values are roughly correlated with the average soil consistency and an unconfined compressive strength. The "N" values indicate that the soil consistencies are soft to hard/dense. SPT results are provided on the Subsurface Boring Logs located in the appendix.

4.1.4 Unconfined Compression Tests

Due to the relatively non-cohesive nature of the in-situ soils, unconfined compression strength testing could not be performed.

5.0 Geotechnical Considerations and Recommendations

Based on the results of the subsurface exploration, current site conditions observed, and laboratory results, items of geotechnical interest and considerations are discussed in the following sections.

5.1 Basis for Recommendations

The following recommendations are based on data from this exploration and the stated project information. In our evaluations, we have utilized both subsurface data from this exploration and our experience with similar structures and subsurface conditions. If the structural information is incorrect or changed subsequent to our reporting, if the siting or building components have been changed, or if the subsurface conditions encountered during the construction vary from those reported, our recommendations should be reviewed in light of the changed conditions.

Experience indicates that the actual subsoil conditions at a site could vary from those generalized on the basis of soil test borings made at specific locations. Therefore, it is essential that a geotechnical engineer be retained to provide soil-engineering services during the site preparation, excavation, and foundation construction phases of the proposed project. The geotechnical engineer should observe compliance with the design concepts, specifications, and recommendations, and to allow design changes in the event subsurface conditions differ from those anticipated prior to the start of construction.

5.2 General Geotechnical Considerations

5.2.1 Upper Silty Soil Zones / Construction Traffic / Subgrade Degradation

Based on the subsurface data encountered the upper, in-situ soils consist of low plasticity silty clays and clay loams. It should be noted that silty clays are very susceptible to degrade to unsuitable soils in the presence of moisture and construction traffic. In addition, silty soils are typically difficult to properly compact when wet of optimum moisture content as determined by a Standard Proctor test. The importance of these characteristic of silty soils cannot be overstated. The contractor must fully understand the causes and effects of moisture versus compaction for silty soil and the detrimental effect of construction traffic on soil subgrades. A discussion of silty soils and some of the potential negative effects of moisture and construction traffic are provided below.

The silty clay soils need to be close to its optimum moisture content (as determined by the Standard Proctor) before it can be properly compacted to the required density. If the silty clay soils are too dry or wet (above or below the optimum moisture content) then the soils will typically not compact properly even with above normal compaction efforts. If the soils are too dry then water can be easily added on site during the compaction activities. However, if the soil moistures are too high, as typically the case in the spring and winter months, then the silts must be manipulated to accelerate drying by discing and aerating or by other means that would require above routine efforts.

The contractor should understand that aerating the silty soil requires a concerted effort to overturn, disc and manipulate the soils multiple times during the drying process. Typically, overturning the soils and discing once or twice will not be sufficient effort to dry the soils. It is the process of continually overturning and exposing the soils to the sun and wind that actually causes the drying process. However, this process is less effective during the wet seasons of the year and would typically require longer drying times. If the project time constraints do not allow for aeration, then additional drying methods, such as lime stabilization or other methods may be needed.

It is also important to note that at the end of each day or prior to any rainfall events that the soil must be smoothed and rolled to minimize any surface water infiltration. The site grading should always provide for positive site drainage away from the project site even during construction activities. Surface water / storm water should not be allowed to pond on the surface or in tire ruts.

Another characteristic of the silty clay soils is the high potential of subgrade degradation in the presence of elevated moistures and construction traffic. As is common construction knowledge, extremely large tire loadings are typically present on construction sites from dump trucks, concrete trucks, masonry block and brick/masonry block forklifts (Pettybone). The tire loadings from these vehicles are usually the most significant concentrated loadings that the soil subgrades will most likely encounter. In many cases these tire loadings will exceed the overall shear strength of the in-situ soils and rutting and pumping will occur as a result. This is especially true during repeated heavy tire loadings occur when the soil subgrade wet or above its optimum moisture content. To reiterate, the contractor should be aware that repeated heavy construction traffic loadings will cause significant damage to the soil subgrade especially when the soils are wet or saturated.

5.3 Foundation Recommendations

5.3.1 Shallow Foundations (Pre-engineered Metal Building)

Based on the anticipated structural loadings from a typical pre-engineered metal building it is recommended that shallow foundation be used for structural support. Shallow foundations should be seated in the existing in-situ soils or properly compacted engineered fill. A net allowable soil bearing pressures of 2,800 pounds per square feet (psf) should be used for continuous and spread foundations. Continuous and isolated footings should have minimum widths of at least 24 inches and 36 inches respectively.

Shallow foundations should be seated to a minimum depth of 24-inches for protection against frost heavy. The foundation bearing seats should be inspected by competent personnel prior to any steel or concrete placement. Water should not be allowed to accumulate in the foundation excavation prior to concrete placement.

5.3.2 Mat Foundations (Hydraulic Press Pit)

Based on available information the proposed development involves the construction of a manufacturing facility that will utilize a type of hydraulic stamping press. In general, the press weight would be on the order of 800 tons and would be constructed in a pit approximately 22 feet x 44 feet in dimension and approximately 18 feet in depth.

Based on the subsurface data obtained, the soils encountered near the 18 – 20 feet depth were softer in consistency but increased with depths below 20 feet. It is anticipated that pits with a depth of 18 feet will require overexcavation to approximately 22 feet in depth to bear on the high consistency soils. Foundations may bear at this deeper depth or a properly compacted rock pad of limestone dense graded aggregate may be used to bring excavation back to required foundation grade.

Based on the limited structural data available, a reinforced mat-style foundation would be recommended for structural support. A net allowable soil bearing pressures of 3,000 pounds per square feet (psf) should be used for the raft foundation seated at a minimum depth of 22 feet below ground surface or on a properly compacted rock pad backfilled to proper foundation elevation.

5.3.3 Seismic Site Class (2009 International Building Code)

Based on requirements of the 2009 International Building Code, site classification are required for the design of seismic elements of structures. Upon review of subsurface soil data obtained and the 2009 International Building Code and the subsurface conditions encountered a Site Class D is recommended for use in design.

5.3.4 Conventional Floor Slabs

If subgrade soils are properly undercut and compacted as described in this report then a modulus of subgrade reaction (k) of 200 pounds per cubic inch (pci) may be used for floor slab design provided that the subgrade is properly compacted throughout to at least 98% of Standard Proctor and within 2% of optimum.

Provided that the subgrade has been properly compacted and inspected a minimum of 4-inch thick layer of free-draining compacted granular aggregate should be placed beneath the proposed floor slab. The compacted aggregate will provide a better load distribution from the floor slab to the soil, and it will provide additional protection against the migration of moisture upward through the floor slab.

5.4 General Site Preparation Recommendations

5.4.1 Clearing / Grubbing / Stripping

Each area of construction on the subject site should be cleared, stripped and grubbed of topsoil / organics, fill material, deleterious materials and soft/unsuitable soils.

Any extensive soft soil deposits encountered should be evaluated by extensive proof rolling and/or shallow excavations to determine the amount of undercutting required. Under no circumstances should the stripped material (ie. old fill, trees, topsoil) be used as fill for any excavations, low-lying areas, or for any subsurface structural element.

5.4.2 Subgrade Preparation

After stripping and clearing, the areas intended to support floor slabs, new fill, and pavements should be carefully inspected by a qualified geotechnical personnel. Competent geotechnical personnel should be present during any undercutting activities to determine when adequate subgrade bearing has been achieved.

The site subgrade should be proof-rolled in the presence of competent geotechnical personnel. Proof-rolling activities should occur after a suitable period of dry weather to avoid degrading the subgrade. Proof-rolling should be performed by making repeated passes over the subgrade with a 20 to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. The vehicle should make a sufficient number of passes in each of two perpendicular directions covering the proposed development area.

Any areas judged to deflect excessively during, proof rolling should be undercut and rerolled. This process should be repeated until all soft soils are removed or the geotechnical engineer recommends an alternate stabilization method such as lime stabilization. Based on the saturated and silty nature of the site subgrade lime stabilization should be considered during the design phase.

Any proof rolling activities should occur immediately before fill placement. If fill material is not immediately placed and subgrade is allowed to stand unprotected, then additional proof-rolling activities will be required in the same area to verify subgrade stability.

It is important to note that at the end of each day or prior to any rainfall events that the site subgrade be smoothed and rolled to minimize any surface water infiltration. The site grading should always provide for positive site drainage away from the project site even during construction activities. Surface water / storm water should not be allowed to pond on the surface or in tire ruts.

5.4.3 Engineered Fill Placement

Prior to any fill activities taking place, we recommend that representative samples of the proposed fill material be collected (minimum 5-gallon container of material) and tested to determine the laboratory compaction characteristics, plasticity and natural moisture contents. The tests should be conducted to determine the suitability of proposed fill material. Based on the subsurface data obtained, the in-situ soils should be acceptable for use as engineered fill material once stripped of topsoil / organics and rootballs.

Proposed fill materials should be free of organics, deleterious debris, or rocks larger than 3 inches in diameter. Suitable fill soil should have a plasticity index (PI) of less than 30 and a maximum dry density according to the standard Proctor compaction test of at least 100 pounds per cubic foot (pcf). All fill soils and fill pads should be properly compacted and tested.

The fill should be compacted to at least 98 percent of the soil maximum dry density (ASTM D-698 "Standard Proctor") under structures and building slabs. Fill materials under proposed paved areas, walkways and athletic fields should be compacted to at least 95 percent of the soils maximum dry density (ASTM D-698). Fill materials in lawn area should be compacted to at least 92 percent of the soils maximum dry density. Moisture contents of the fill materials should be maintained to within ± 2 percent of the soils optimum moisture.

The soil should be placed in lifts of 8 inches or less for materials compacted by heavy equipment and not more than 4 inches loose depth for hand compaction equipment. Each lift should be compacted and tested by nuclear density gauge methods prior to placing additional lifts every 2,500 square feet. All fill pads should extend laterally at least 10 feet beyond the building before sloping down. In-place density testing should be conducted for each lift placed to check the compaction achieved.

Positive surface drainage should be maintained to prevent water from ponding on the surface during all earthwork operations. After each days work or prior to any anticipated rainfall, the subgrade should be rolled with a rubber-tired or steel-drummed roller to improve surface runoff. The geotechnical engineer should be notified if the subgrade soils become excessively wet, dry or frozen.

As is common construction knowledge, extremely large tire loadings are typically present on construction sites from dump trucks, concrete trucks, masonry block and brick/masonry block forklifts (Pettybone). The tire loadings from these vehicles are usually the most significant concentrated loadings that the soil subgrades will most likely encountered. In many cases these tire loadings will exceed the overall shear strength of the in-situ soils or recently placed engineered fill and rutting and pumping will occur as a result. This is especially true during repeated heavy tire loadings occur when the soil subgrade wet or above its optimum moisture content. It is important that the site subgrade be properly maintained by the contractor for the extent of the entire project. The site should not be allowed to become rutted or water allowed to pond.

5.4.4 Surface Water Control

The site was observed to have moderate surface drainage conditions due to the slope of the site. Active methods must be used to keep surface water and rainwater from ponding or draining into the proposed building pad area. Surface water should not be allowed to pond on the building subgrade surfaces. This is especially true during construction activities. Proper erosion and sedimentation control plans must be developed as per the City and State requirement.

5.5 Other Design Considerations

5.5.1 Project Specifications

Specifications for this project should meet local building codes and OSHA guidelines. The observations, recommendations, and considerations presented in this report should be fully read and understood by the owner, project designer(s) and contractor(s) prior to final submittal of project plans and specifications.

5.5.2 Construction Monitoring

The implementation of a soil and concrete quality testing program aids in assuring that the end product is that which was designed. Thorough testing also allows opportunity for correction before major problems develop. For these reasons, Bacon Farmer Workman Engineering & Testing, Inc. (BFW), recommends the retainage of a qualified testing laboratory (by the Owner) to conduct quality tests on structural fill, aggregate base course, and concrete placement.

6.0 Qualifications of Recommendations

Our evaluation of foundation and pavement design and construction conditions has been based on our understanding of the site and on conditions encountered in the borings at the time of investigation. The general subsurface conditions used were based on our interpolation of the subsurface data between the borings. Regardless of the thoroughness of a subsurface investigation, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. Therefore, experienced geotechnical engineers should observe earthwork and foundation construction to confirm that the conditions anticipated in design are noted. Otherwise, Bacon Farmer Workman Engineering & Testing, Inc. (BFW), assumes no responsibility for construction compliance with the design concepts, specifications, or recommendations.

The design recommendations in this report have been developed on the basis of the previously described project characteristics and subsurface conditions. If project criteria or locations change, a qualified geotechnical engineer should be permitted to determine whether the recommendations must be modified. The findings of such a review will be presented in a supplemental report.

The nature and extent of variations between the borings may not become evident until the course of construction. If such variations are encountered, it will be necessary to reevaluate the recommendations of this report after on-site observations of the conditions.

Our professional services have been performed, our findings derived, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. Bacon Farmer Workman Engineering & Testing, Inc. (BFW), is not responsible for the conclusions, opinions, or recommendations of others based on this data.

Appendix A

Boring Log / Laboratory Procedure Guide

BORING LOG / LABORATORY PROCEDURE GUIDE

SUBSURFACE EXPLORATION

Bacon Farmer Workman Engineering & Testing, Inc., conducts soil test borings, field sampling and laboratory analysis in general accordance with methods of the American Society for Testing Materials (ASTM) and generally accepted engineering practices. Soil test borings were advanced with truck or track mounted rotary-type drilling rig equipment. Hollow stem or solid flight augers were used to advance soil test borings (ASTM D 1452). A series of soil samples are typically obtained for visual inspection and laboratory analysis during drilling activities. The samples collected may include disturbed, undisturbed or auger cutting samples.

BORING LOCATIONS / ELEVATIONS

Boring Locations are either selected by our project manager or have been selected by the client. The borings are typically located in the field by estimating right angles and measuring distances from site landmarks. Because of the locating methods used, the boring locations indicated on the Boring Location Plan (In Appendix) are approximate unless specifically noted. When topographic plans of the site are provided, the project engineer estimates the surface elevation of the boring locations using available information. Surveying to determine the locations and elevations of the borings is typically beyond the scope of the typical geotechnical study. Therefore, the boring locations and elevations should be considered approximate unless specifically noted.

BORING LOGS / RECORDS

The Subsurface Boring Logs included in this report are our interpretation of the conditions encountered at each boring location. The Subsurface Boring Logs are prepared on the basis of the field crew's observations during drilling, engineering review of the soil samples obtained, and laboratory testing on selected samples. Soil descriptions are made using the Unified Soil Classification System and ASMT D 2488 as guides. The depths designating strata changes on the Boring Records are estimations. In many geologic settings, the transition between strata is gradual.

GROUNDWATER LEVEL READINGS

Groundwater levels are monitored in each borehole upon the completion of drilling. In low permeability soils such as silts and clays, the groundwater level in the boreholes may take several or more hours to stabilize. Therefore, when possible, water level readings are also made at least 24-hours after drilling activities cease. Groundwater levels may be dependent upon recent rainfall activity and other site specific factors. Since these conditions may change with time, the water level information presented on the Subsurface Boring Logs represents the conditions only at the time each measurement is taken.

SAMPLING TECHNIQUES

Soil samples are typically obtained at selected depths during the drilling activities. Representative portions of the soil samples obtained are placed in sealed containers, labeled, and transported to the laboratory. The soil samples obtained are used for visual classification, and for strength, index and consistency testing. Samples obtained from the drilling activities include: Disturbed, undisturbed and bulk samples. Disturbed samples are collected during the Standard Penetration Tests using a split spoon sampler and hammer as described in the following section. Undisturbed samples are obtained by advancing a thin-walled Shelby tube with hydraulic pressure as described in the following section. Bulk samples are obtained from the auger cuttings generated during the advancement of the augers.

The **STANDARD PENETRATION TEST** (**ASTM D 1586)** is a method to obtain disturbed soil samples for examination and testing and to obtain relative density and consistency information. A standard 1.4-inch I.D. / 2-inch O. D. split-barrel (split spoon) sampler is driven three 6-inch increments with a 140 lb. hammer falling 30 inches. The hammer can either be of a trip, free-fall design or actuated by a rope and cathead. The hammer blows required to drive the sampler the final foot is the *standard penetration resistance (N-value)*. Standard penetration resistance, when properly evaluated, is an index to the soil's strength, consistency and density. Upon completion of each standard penetration test, the sampler is brought to the surface and the tube is split open to expose the soils penetrated. Our project manager / engineer examines the soil and places a representative portion of the soil into a sealed container for transportation to our laboratory.

BORING LOG / LABORATORY PROCEDURE GUIDE
(Continued)

UNDISTURBED SOIL SAMPLING (ASTM D 1587) is a method used to obtain a relatively undisturbed soil sample for more precise laboratory analysis including unconfined compressive strengths, compressibility or permeability. Undisturbed soil sampling is conducted by advancing a 3–inch O. D., 16 gauge, steel tube (Shelby Tube) with a sharpened edge slowly and uniformly into the underlying soil stratum under constant hydraulic pressure to the desired sampling elevation. The tube is then removed from the ground and both ends are sealed to prevent loss of moisture. The depth at which the undisturbed samples were collected is indicated on the Subsurface Boring Logs.

SOIL LABORATORY TESTS

The **MOISTURE CONTENT (ASTM D 2216)** of soils is an indicator of various physical properties, including strength and compressibility. Each test sample is weighed and then placed in an oven ($110^{\circ}C \pm 5^{\circ}C$). The sample remains in the oven until the free moisture has evaporated. The dried sample is removed from the oven, allowed to cool and then reweighed. The moisture content is computed by dividing the weight of evaporated water by the weight of the dry sample. The results are expressed as a percent.

ATTERBERG LIMITS (ASTM D 4318) tests are used to help define the relationship between behavior changes in fine-grained soils at different moisture contents values. Depending upon the moisture content, a fine-grained soil may occur in a liquid, plastic, semi-solid, or solid state. These set of tests are used to establish the approximate moisture contents at which the soil changes its state. **LIQUID LIMIT** – a soil specimen is wetted until it is in a viscous fluid state. A portion of the soil is then placed in a standardized dimension brass cup, and a groove is made through the middle of the soil specimen with a grooving tool of standardized dimensions. The cup is attached to a cam that lifts it 10 mm, and then allows it to freefall and strike a hard rubber base. The cam is rotated at about 2 drops per second until the two halves of the soil specimen come in contact at the bottom of the groove along a distance of 13 mm. The number of blows required to close the groove is recorded, and a portion of the specimen is subjected to moisture content determination. Additional water is added to the remainder of the specimen, and the grooving process and cam action process repeated. After the third trial, the number of blows versus moisture content is plotted on semi-logarithmic graph paper. The moisture content corresponding to 25 blows is designated as the Liquid Limit.

The **Plastic Limit** is the lowest moisture content at which the soil is sufficiently plastic to be manually rolled into threads 3 mm in diameter. It is determined by taking a pat of soil remaining from the liquid limit test, and repeatedly rolling, kneading, and air drying the specimen until the soil breaks into threads about 3 mm in diameter and 3 to 10 mm long. The moisture content of these soil threads is then determined, and is designated the Plastic Limit.

A **PARTICLE SIZE ANALYSIS** determines the distribution of particles sizes in soils. Distribution of particle sizes larger than the No. 200 sieve is determined by the sieving process, while the distribution of particles smaller than the No. 200 sieve are determined by a sedimentation process, using a hydrometer. In the sieving process the soil is prepared by air drying and crushing, to separate clusters that clump together. A series of sieves, that consist of a square mesh woven-wire cloth having different size openings as per ASTM specifications are each weighed individually. They are stacked with the greatest size opening at the top with each successive lower sieve having smaller openings. A pan is placed on the bottom of the stack to catch soil finer that the # 200 sieve (0.75 mm). The soil is placed into the top sieve of the stack and is covered. The nest of sieves is placed and locked into a sieve shaker which is then agitated for approximately 10 minutes. Each sieve is reweighed with the retained soil. A semi-logarithmic graph is created showing the percent passing each specific sieve size.

The **UNCONFINED COMPRESSIVE STRENGTH TEST, (ASTM D 2166)** is a relatively quick method to obtain the approximate compressive strength of soils that possess sufficient cohesion to allow testing in the unconfined state. An undisturbed sample is obtained from the borehole with a Shelby Tube sampler. The tube is sealed in the field to retain natural moisture content. Once in the laboratory the undisturbed sample is extruded from the tube and cut to a specified length. The sample measurements are recorded. The sample is placed in its natural state in a compressive strength load frame. The sample is compressed under increasing load. Measurements of the load applied and the sample strain are recorded. Upon specimen failure the test is concluded and a graph of stress versus strain is plotted. The maximum stress applied is defined as the unconfined compressive strength.

Subsurface Boring Log Legend

Standard Penetration Test (N-Value Tables)

Fine Grained Soils (Silts & Clays)

N	Consistency	Qu, (KSF) Estimate Only
0 - 1	Very Soft	0 – 0.25
2 – 4	Soft	0.25 – 0.5
5 – 8	Firm	0.5 – 1.0
9 – 15	Stiff	1.0 – 2.0
16 – 30	Very Stiff	2.0 – 4.0
Over 30	Hard	> 4.0

Coarse Grained Soils (Sands & Gravels)

N	Relative Density
0 – 4	Very Loose
5 – 10	Loose
11 – 20	Firm
21 – 30	Very Firm
31 – 50	Dense
Over 50	Very Dense

Particle Sizes

Boulders	Greater than 300 mm (12 in)
Cobbles	75 mm to 300 mm (3 to 12 in)
Gravel	4.74 mm to 75 mm (3/16 to 3 in)
Coarse Sand	2 mm to 4.75 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.075 mm to 0.425 mm
Silts & Clays	Less than 0.075 mm

Relative Proportions

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

Boring Log Symbols / Abbreviations

N: Blows per foot of a 140 lb. hammer falling 30-inches on a 2 inch O. D. split spoon

Qp: Unconfined compressive strength, hand penetrometer, tsf

Qu: Unconfined compressive strength, Shelby tube sample, ksf

Mc: Percent of water in sample (%)

Dd: Sample Dry Density, pcf

LL: Liquid Limit

PL: Plastic Limit

PI: Plasticity Index

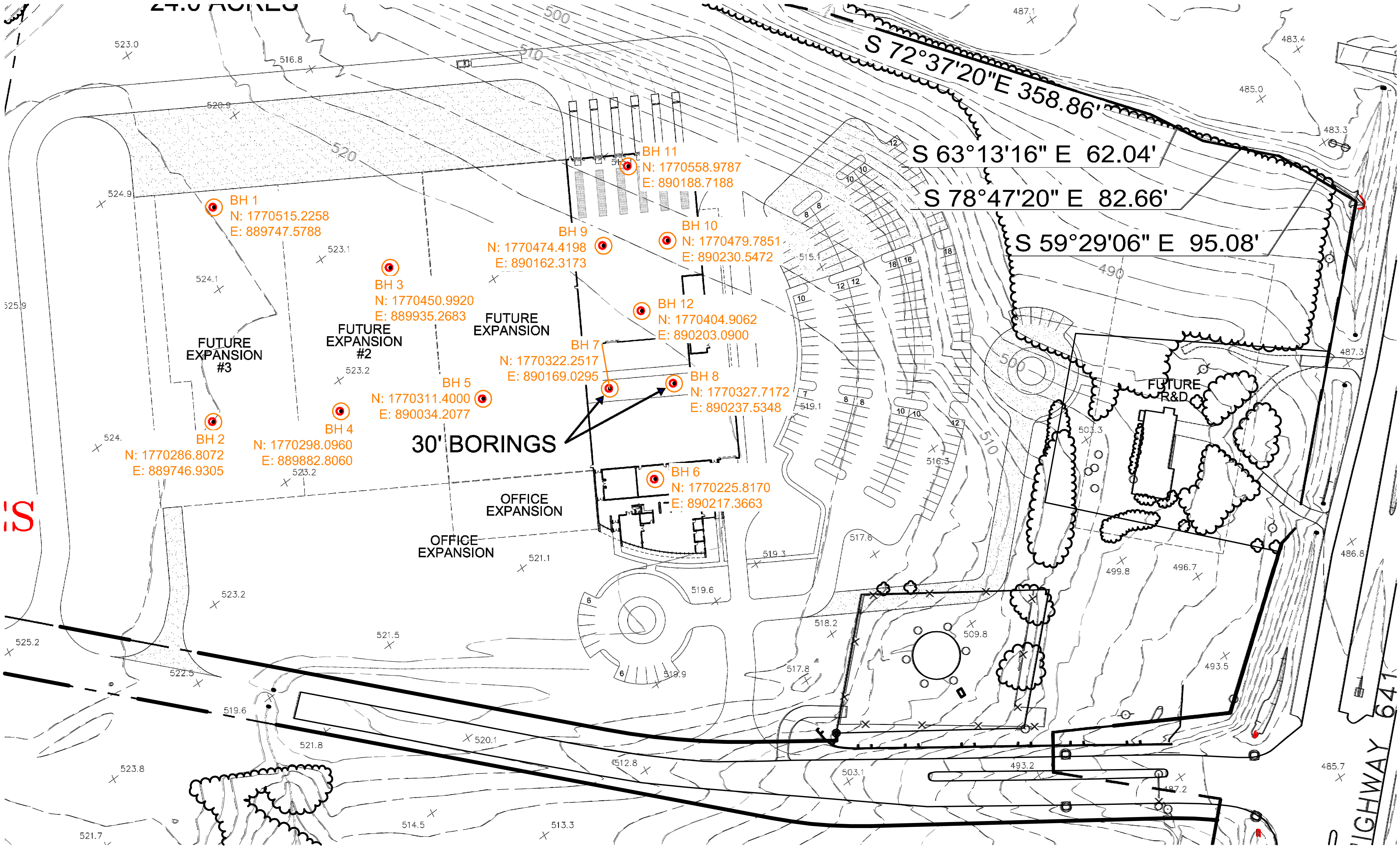
-# 200: Percent of sample passing a # 200 sieve (0.075mm)

-#4: Percent of sample passing a # 4 sieve

BFW BACON | FARMER | WORKMAN ENGINEERING & TESTING, INC.

Appendix B

Maps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N: 1770515.2258
E: 889747.5788
BH 2
N: 1770286.8072
E: 889746.9305
BH 3
N: 1770450.9920
E: 889935.2683
BH 4
N: 1770298.0960
E: 889882.8060
BH 5
N: 1770311.4000
E: 890034.2077
BH 6
N: 1770225.8170
E: 890217.3663
BH 7
N: 1770322.2517
E: 890169.0295
BH 8
N: 1770327.7172
E: 890237.5348
BH 9
N: 1770474.4198
E: 890162.3173
BH 10
N: 1770479.7851
E: 890230.5472
BH 11
N: 1770558.9787
E: 890188.7188
BH 12
N: 1770404.9062
E: 890203.0900
30' BORINGS
FUTURE EXPANSION #3
FUTURE EXPANSION #2
FUTURE EXPANSION
OFFICE EXPANSION
OFFICE EXPANSION
FUTURE R&D
S 72°37'20"E 358.86'
S 63°13'16" E 62.04'
S 78°47'20" E 82.66'
S 59°29'06" E 95.08'
HIGHWAY 64

Appendix C

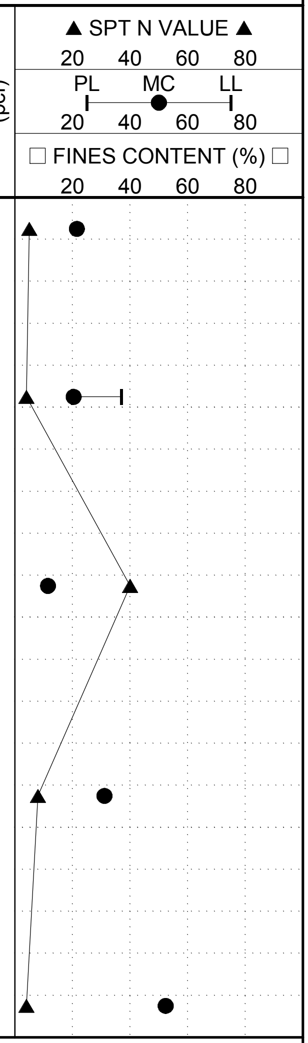
Subsurface Boring Log

BACON | FARMER | WORKMAN ENGINEERING & TESTING INC.
500 SOUTH 17TH STREET
PADUCAH, KY 42003
Telephone: 270-443-1995
Fax: 270-443-1904

BORING NUMBER B-01

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071
DATE STARTED 11/14/12 **COMPLETED** 11/14/12
GROUND ELEVATION **HOLE SIZE** 4.25 inches
DRILLING CONTRACTOR BFW
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger 6.25" OD
AT TIME OF DRILLING ---
LOGGED BY Bret Watkins **CHECKED BY** Chris Farmer
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		FILL - composed of a mixture of brown-red brown silty clay with gravel	SS 01	56	1-2-3 (5)		
5		LEAN CLAY, SILTY, (CL) gray, moist, firm, medium plasticity	SS 02	100	2-2-2 (4)		
10		POORLY GRADED GRAVEL, SANDY, (GP) reddish brown, poorly graded, subangular, fine to coarse grained, moist, medium dense to very dense	SS 03	67	1-10-30 (40)		
15		SILTY SAND, CLAYEY, (SM) light reddish orange to light gray, fine grained, moist to saturated, loose to firm, laminated, some mica	SS 04	100	2-3-5 (8)		
20			SS 05	100	2-2-2 (4)		



Bottom of borehole at 20.0 feet.

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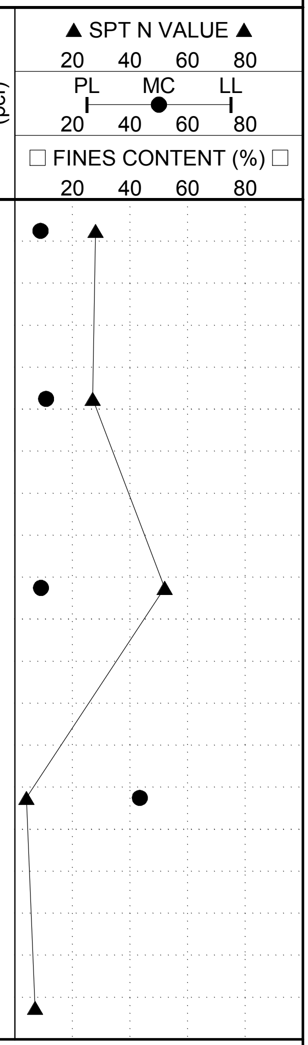
500 SOUTH 17TH STREET
PADUCAH, KY 42003
Telephone: 270-443-1995
Fax: 270-443-1904

BORING NUMBER B-02

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071
DATE STARTED 11/14/12 **COMPLETED** 11/14/12
GROUND ELEVATION **HOLE SIZE** 4.25 inches
DRILLING CONTRACTOR BFW
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger 6.25" OD
AT TIME OF DRILLING ---
LOGGED BY Bret Watkins **CHECKED BY** Chris Farmer
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		Approximately 3 inches thick					
		POORLY GRADED GRAVEL, SANDY, (GP) reddish brown, poorly graded, subangular, fine to coarse grained, moist, medium dense to very dense	SS 01	89	2-11-17 (28)		
5			SS 02	33	3-8-19 (27)		
10			SS 03	100	3-18-34 (52)		
		SILTY SAND, CLAYEY, (SM) light reddish orange to light gray, fine grained, moist to saturated, loose to firm, laminated, some mica					
15			SS 04	11	2-2-2 (4)		
20			SS 05	0	3-3-4 (7)		



Bottom of borehole at 20.0 feet.

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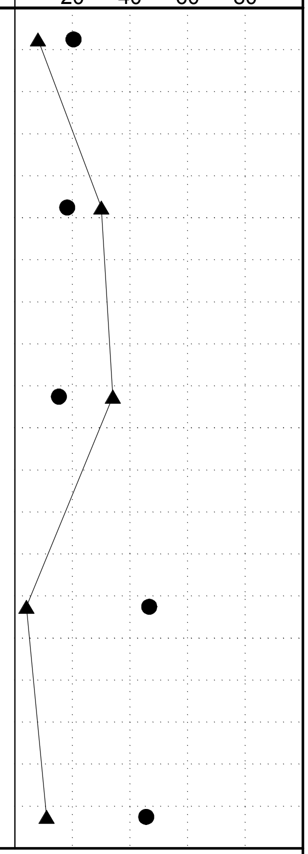
500 SOUTH 17TH STREET
PADUCAH, KY 42003
Telephone: 270-443-1995
Fax: 270-443-1904

BORING NUMBER B-03

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071
DATE STARTED 11/14/12 **COMPLETED** 11/14/12
GROUND ELEVATION **HOLE SIZE** 4.25 inches
DRILLING CONTRACTOR BFW
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger 6.25" OD
AT TIME OF DRILLING ---
LOGGED BY Bret Watkins **CHECKED BY** Chris Farmer
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		FILL - composed of gray-brown silty clay mixed with gravel and sand	SS 01	78	2-3-5 (8)		
4		POORLY GRADED GRAVEL, SANDY, (GP) reddish brown, poorly graded, subangular, fine to coarse grained, moist, medium dense to very dense	SS 02	67	6-12-18 (30)		
10			SS 03	89	10-14-20 (34)		
13		SILTY SAND, CLAYEY, (SM) light reddish orange to light gray, fine grained, moist to saturated, loose to firm, laminated, some mica	SS 04	78	1-2-2 (4)		
20			SS 05	67	3-3-8 (11)		

▲ SPT N VALUE ▲ (20 40 60 80); PL — MC ● — LL (20 40 60 80); □ FINES CONTENT (%) □ (20 40 60 80)



Bottom of borehole at 20.0 feet.

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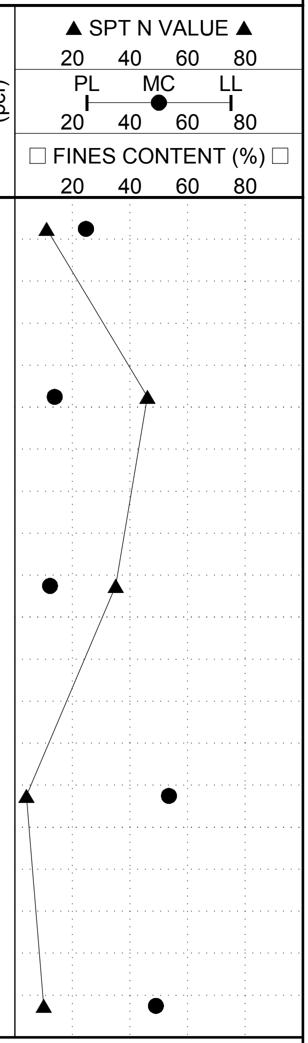
500 SOUTH 17TH STREET
PADUCAH, KY 42003
Telephone: 270-443-1995
Fax: 270-443-1904

BORING NUMBER B-04

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071
DATE STARTED 11/14/12 **COMPLETED** 11/14/12
GROUND ELEVATION **HOLE SIZE** 4.25 inches
DRILLING CONTRACTOR BFW
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger 6.25" OD
AT TIME OF DRILLING ---
LOGGED BY Bret Watkins **CHECKED BY** Chris Farmer
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		FILL - composed of gray-brown clay with gravel and some organic root matter	SS 01	100	3-4-7 (11)		
3		POORLY GRADED GRAVEL, SANDY, (GP) reddish brown, poorly graded, subangular, fine to coarse grained, moist, medium dense to very dense					
5			SS 02	100	8-20-26 (46)		
10			SS 03	100	8-17-18 (35)		
13		SILTY SAND, CLAYEY, (SM) light reddish orange to light gray, fine grained, moist to saturated, loose to firm, laminated, some mica					
15			SS 04	100	2-2-2 (4)		
20			SS 05	100	2-4-6 (10)		



Bottom of borehole at 20.0 feet.

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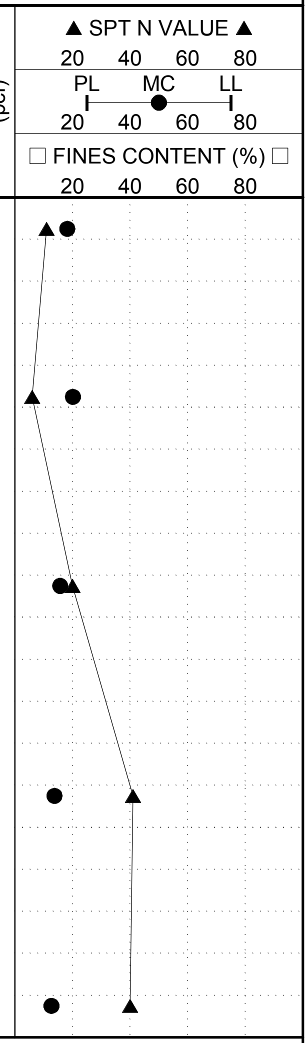
PADUCAH, KY 42003
Telephone: 270-443-1995
Fax: 270-443-1904

BORING NUMBER B-05

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071
DATE STARTED 11/14/12 **COMPLETED** 11/14/12
GROUND ELEVATION **HOLE SIZE** 4.25 inches
DRILLING CONTRACTOR BFW
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger 6.25" OD
AT TIME OF DRILLING ---
LOGGED BY Bret Watkins **CHECKED BY** Chris Farmer
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		FILL - composed of brown-gray silty clay with some metallic debris	SS 01	11	3-5-6 (11)		
5		LEAN CLAY, SILTY, (CL) gray to brown, moist, firm to stiff, medium plasticity	SS 02	44	1-3-3 (6)		
10		POORLY GRADED GRAVEL, SANDY, (GP) grayish brown to reddish brown, poorly graded, subangular, fine to coarse grained, moist, firm to very dense	SS 03	100	3-7-13 (20)		
15			SS 04	83	7-20-21 (41)		
20			SS 05	78	5-18-22 (40)		



Bottom of borehole at 20.0 feet.

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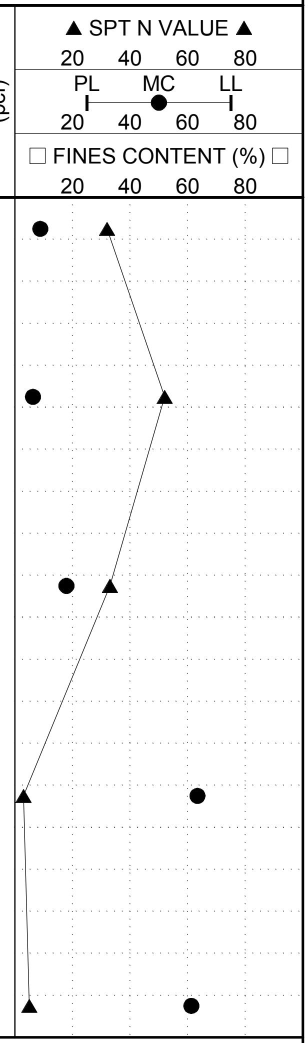
Telephone: 270-443-1995
Fax: 270-443-1904

BORING NUMBER B-06

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071
DATE STARTED 11/15/12 **COMPLETED** 11/15/12
GROUND ELEVATION **HOLE SIZE** 4.25 inches
DRILLING CONTRACTOR BFW
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger 6.25" OD
AT TIME OF DRILLING ---
LOGGED BY Bret Watkins **CHECKED BY** Chris Farmer
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		TOPSOIL - approximately 4 inches thick					
		POORLY GRADED GRAVEL, SANDY, (GP) reddish brown, poorly graded, subangular, fine to coarse grained, moist, medium dense to very dense	SS 01	67	5-12-20 (32)		
5			SS 02	56	11-24-28 (52)		
10			SS 03	67	8-14-19 (33)		
		SILTY SAND, CLAYEY, (SM) light reddish orange to light gray, fine grained, moist to saturated, loose to firm, laminated, some mica					
15			SS 04	67	1-1-2 (3)		
20			SS 05	78	2-2-3 (5)		



Bottom of borehole at 20.0 feet.

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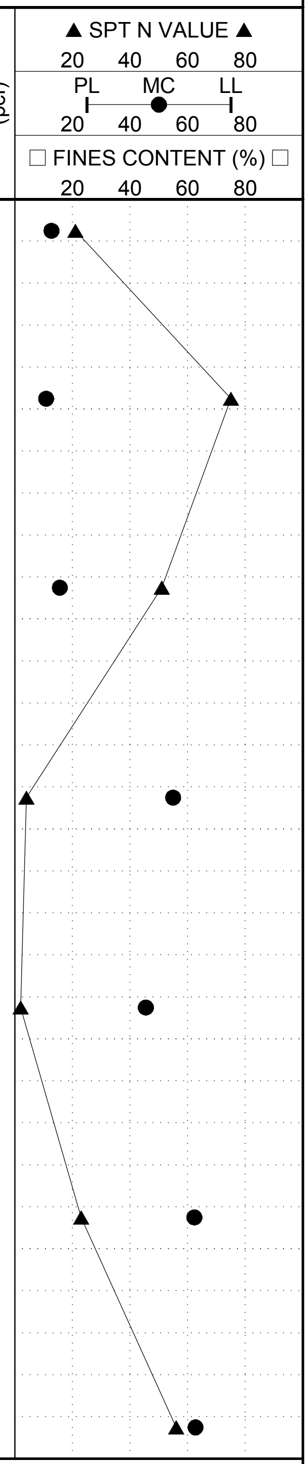
PADUCAH, KY 42003
Telephone: 270-443-1995
Fax: 270-443-1904

BORING NUMBER B-07

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071
DATE STARTED 11/15/12 **COMPLETED** 11/15/12
GROUND ELEVATION **HOLE SIZE** 4.25 inches
DRILLING CONTRACTOR BFW
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger 6.25" OD
AT TIME OF DRILLING ---
LOGGED BY Bret Watkins **CHECKED BY** Chris Farmer
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	TOPSOIL - approximately 4 inches thick					
	POORLY GRADED GRAVEL, SANDY, (GP) reddish brown, poorly graded, subangular, fine to coarse grained, moist, medium dense to very dense	SS 01	67	2-8-13 (21)		
5		SS 02	56	25-32-43 (75)		
10		SS 03	78	18-26-25 (51)		
	SILTY SAND, CLAYEY, (SM) light reddish orange to light gray, fine grained, moist to saturated, loose to firm, laminated, some mica					
15		SS 04	44	1-2-2 (4)		
20		SS 05	44	1-1-1 (2)		
25		SS 06	67	5-10-13 (23)		
30		SS 07	78	10-24-32 (56)		
	FAT CLAY, SANDY, (CH) dark gray, dry, very hard, blocky, high plasticity					



Bottom of borehole at 30.0 feet.

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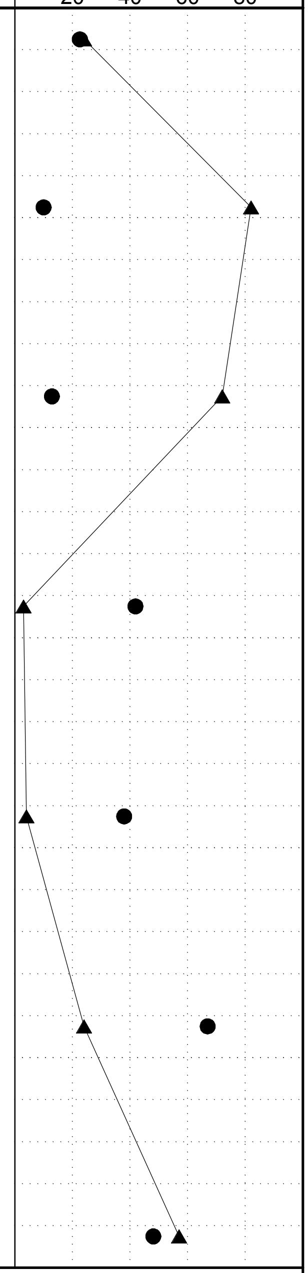
500 SOUTH 17TH STREET
PADUCAH, KY 42003
Telephone: 270-443-1995
Fax: 270-443-1904

BORING NUMBER B-08

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071
DATE STARTED 11/15/12 **COMPLETED** 11/15/12
GROUND ELEVATION **HOLE SIZE** 4.25 inches
DRILLING CONTRACTOR BFW
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger 6.25" OD
AT TIME OF DRILLING ---
LOGGED BY Bret Watkins **CHECKED BY** Chris Farmer
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		TOPSOIL - approximately 4 inches thick					
		POORLY GRADED GRAVEL, SANDY, (GP) reddish brown, poorly graded, subangular, fine to coarse grained, moist, medium dense to very dense	SS 01	67	3-9-15 (24)		
5			SS 02	78	30-37-45 (82)		
10			SS 03	67	20-30-42 (72)		
		SILTY SAND, CLAYEY, (SM) light reddish orange to light gray, fine grained, moist to saturated, loose to firm, laminated, some mica					
15			SS 04	33	1-1-2 (3)		
20			SS 05	67	1-2-2 (4)		
25			SS 06	78	4-9-15 (24)		
30		FAT CLAY, SANDY, (CH) dark gray, dry, very hard, blocky, high plasticity	SS 07	67	11-23-34 (57)		

▲ SPT N VALUE ▲ (20 40 60 80)
PL ● MC ● LL (20 40 60 80)
☐ FINES CONTENT (%) ☐ (20 40 60 80)



Bottom of borehole at 30.0 feet.

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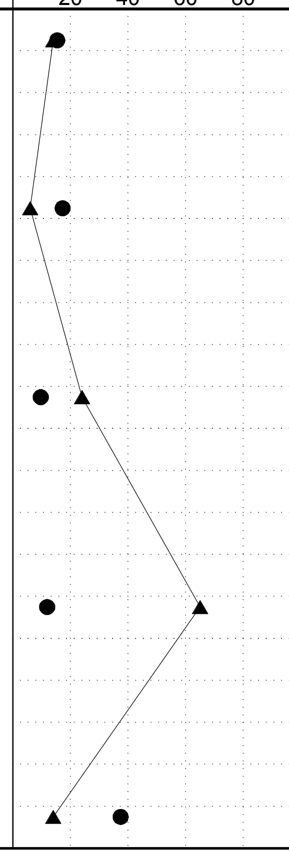
500 SOUTH 17TH STREET
PADUCAH, KY 42003
Telephone: 270-443-1995
Fax: 270-443-1904

BORING NUMBER B-09

CLIENT	Murray Calloway EDC	**PROJECT NAME**	Special K Drilling No. 2
PROJECT NUMBER	12325	**PROJECT LOCATION**	Murray, KY 42071
DATE STARTED	11/16/12 **COMPLETED** 11/16/12	**GROUND ELEVATION**	**HOLE SIZE** 4.25 inches
DRILLING CONTRACTOR	BFW	**GROUND WATER LEVELS:**	
DRILLING METHOD	Hollow Stem Auger 6.25" OD	**AT TIME OF DRILLING**	---
LOGGED BY	Bret Watkins **CHECKED BY** Chris Farmer	**AT END OF DRILLING**	---
NOTES		**AFTER DRILLING**	---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		TOPSOIL - approximately 4 inches thick					
		POORLY GRADED GRAVEL, SANDY, (GP) reddish brown, poorly graded, subangular, fine to coarse grained, moist, medium dense to very dense	SS 01		3-7-7 (14)		
5			SS 02		3-3-3 (6)		
10			SS 03		10-11-13 (24)		
15			SS 04		23-31-34 (65)		
		SILTY SAND, CLAYEY, (SM) light reddish orange to light gray, fine grained, moist to saturated, loose to firm, laminated, some mica					
20			SS 05		4-6-8 (14)		

▲ SPT N VALUE ▲ (20 40 60 80)
PL MC LL (20 40 60 80)
☐ FINES CONTENT (%) ☐ (20 40 60 80)



Bottom of borehole at 20.0 feet.

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500 SOUTH 17TH STREET
PADUCAH, KY 42003
Telephone: 270-443-1995
Fax: 270-443-1904

BORING NUMBER B-10

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071
DATE STARTED 11/16/12 **COMPLETED** 11/16/12
GROUND ELEVATION **HOLE SIZE** 4.25 inches
DRILLING CONTRACTOR BFW
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger 6.25" OD
AT TIME OF DRILLING ---
LOGGED BY Bret Watkins **CHECKED BY** Chris Farmer
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / □ FINES CONTENT (%) □ 20 40 60 80
0		FILL - Composed of brown sandy gravel	SS 01	33	4-7-7 (14)			
5		LEAN CLAY, SILTY, (CL) brown to reddish brown, moist, firm to stiff, medium plasticity	SS 02	100	2-2-3 (5)			
10		POORLY GRADED GRAVEL, SANDY, (GP) brown to reddish brown, poorly graded, subangular, fine to coarse grained, moist, dense to very dense	SS 03	56	1-2-4 (6)			
15			SS 04	44	24-18-11 (29)			
20			SS 05	33	16-50			

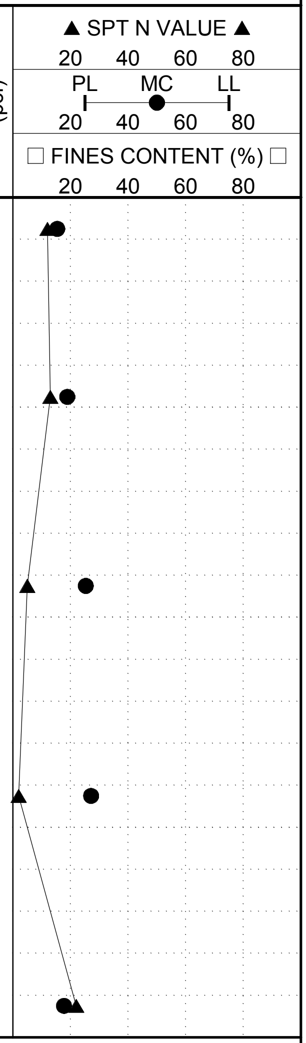
Bottom of borehole at 20.0 feet.

BACON | FARMER | WORKMAN ENGINEERING & TESTING INC.
500 SOUTH 17TH STREET
PADUCAH, KY 42003
Telephone: 270-443-1995
Fax: 270-443-1904

BORING NUMBER B-11

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071
DATE STARTED 11/16/12 **COMPLETED** 11/16/12
GROUND ELEVATION **HOLE SIZE** 4.25 inches
DRILLING CONTRACTOR BFW
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger 6.25" OD
AT TIME OF DRILLING ---
LOGGED BY Bret Watkins **CHECKED BY** Chris Farmer
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		FILL - Composed of brown sandy gravel	SS 01	67	2-6-6 (12)		
5		LEAN CLAY, SILTY, (CL) brownish gray, moist, soft to stiff, medium plasticity, some organics	SS 02	67	7-6-7 (13)		
10			SS 03	89	2-2-3 (5)		
15			SS 04	100	1-1-1 (2)		
17		(GP)					
20			SS 05	100	8-10-12 (22)		



Bottom of borehole at 20.0 feet.

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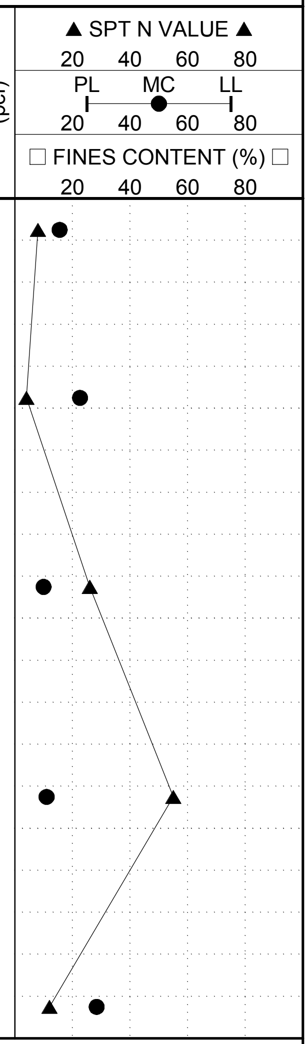
BORING NUMBER B-12

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071
DATE STARTED 11/16/12 **COMPLETED** 11/16/12
GROUND ELEVATION **HOLE SIZE** 4.25 inches
DRILLING CONTRACTOR BFW
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger 6.25" OD
AT TIME OF DRILLING ---
LOGGED BY Bret Watkins **CHECKED BY** Chris Farmer
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		TOPSOIL - approximately 4 inches thick					
		LEAN CLAY, SILTY, (CL) gray, moist, firm, medium plasticity	SS 01	11	2-3-5 (8)		
5			SS 02	33	2-2-2 (4)		
		POORLY GRADED GRAVEL, SANDY, (GP) reddish brown, poorly graded, subangular, fine to coarse grained, moist, medium dense to very dense					
10			SS 03	72	11-13-13 (26)		
15			SS 04	56	26-27-28 (55)		
		SILTY SAND, CLAYEY, (SM) light reddish orange to light gray, fine grained, moist to saturated, loose to firm, laminated, some mica					
20			SS 05	67	5-5-7 (12)		



Bottom of borehole at 20.0 feet.

GEOTECH BH PLOTS - GINT STD US LAB.GDT - 11/20/12 10:57 - G:\PROJECTS\2012 PROJECTS\12325 - MCCEDC - KEMMERICH PROJECT - GEOTECHNICAL EXPLORATION\GT\GINT\12325 - SPECIAL K DRILLING NO. 2.GPJ

Appendix D

Soil Laboratory Data

BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

Bacon | Farmer | Workman
Engineering & Testing, Inc.
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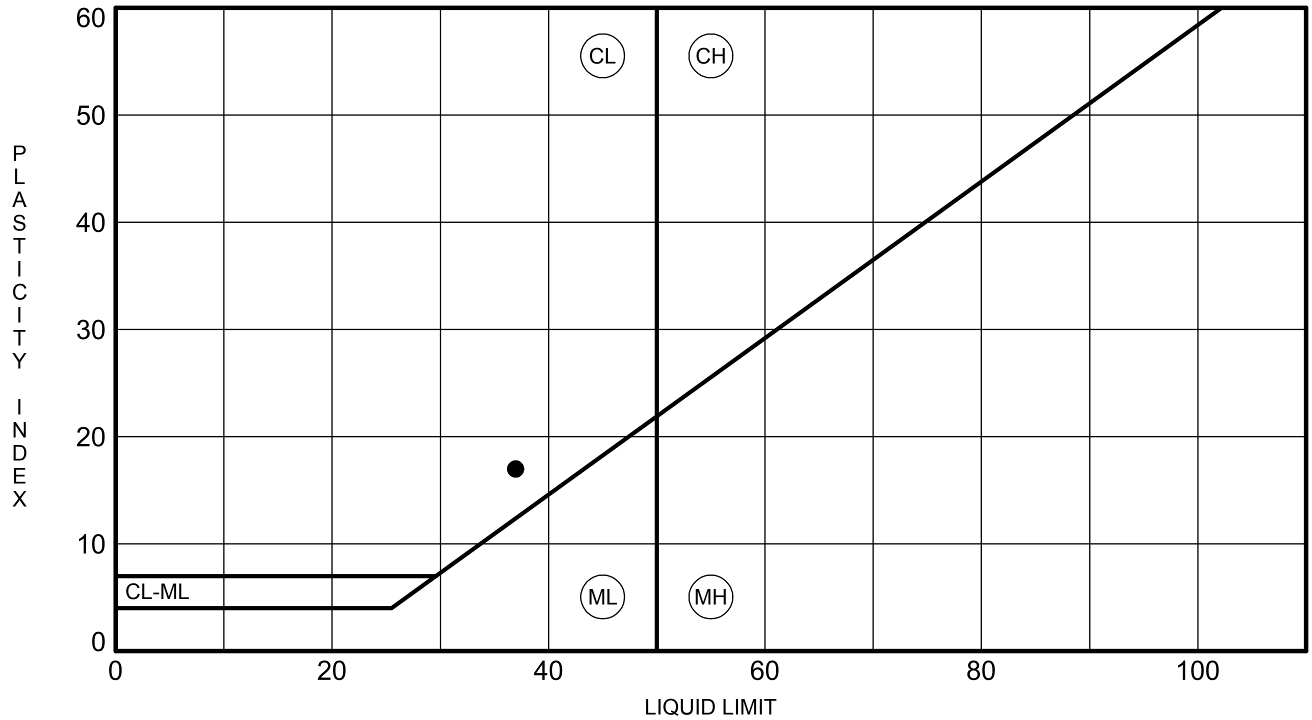
Fax: 270443-1904

ATTERBERG LIMITS' RESULTS

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-01**	**4.0**	**37**	**20**	**17**		

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SUMMARY OF LABORATORY RESULTS

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-01	0.0							21.5			
B-01	4.0	37	20	17				20.4			
B-01	8.5							11.5			
B-01	13.5							31.1			
B-01	18.5							52.3			
B-02	0.0							8.9			
B-02	4.0							10.8			
B-02	8.5							9.0			
B-02	13.5							43.4			
B-03	0.0							20.3			
B-03	4.0							18.2			
B-03	8.5							15.3			
B-03	13.5							46.6			
B-03	18.5							45.6			
B-04	0.0							24.7			
B-04	4.0							13.8			
B-04	8.5							12.2			
B-04	13.5							53.5			
B-04	18.5							49.0			
B-05	0.0							18.2			
B-05	4.0							20.1			
B-05	8.5							15.7			
B-05	13.5							13.8			
B-05	18.5							12.7			
B-06	0.0							8.8			
B-06	4.0							6.3			
B-06	8.5							17.9			
B-06	13.5							63.4			
B-06	18.5							61.3			
B-07	0.0							12.7			
B-07	4.0							10.9			
B-07	8.5							15.6			
B-07	13.5							54.9			
B-07	18.5							45.5			
B-07	23.5							62.3			
B-07	28.5							62.7			
B-08	0.0							22.6			
B-08	4.0							10.0			
B-08	8.5							12.9			
B-08	13.5							41.9			
B-08	18.5							37.9			
B-08	23.5							66.9			
B-08	28.5							48.1			

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SUMMARY OF LABORATORY RESULTS

CLIENT Murray Calloway EDC
PROJECT NAME Special K Drilling No. 2
PROJECT NUMBER 12325
PROJECT LOCATION Murray, KY 42071

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-09	0.0							15.4			
B-09	4.0							17.3			
B-09	8.5							9.7			
B-09	13.5							11.9			
B-09	18.5							37.4			
B-10	0.0							15.0			
B-10	4.0							26.2			
B-10	8.5							20.0			
B-10	13.5							13.8			
B-10	18.5							9.4			
B-11	0.0							15.4			
B-11	4.0							18.9			
B-11	8.5							25.3			
B-11	13.5							27.1			
B-11	18.5							17.8			
B-12	0.0							15.5			
B-12	4.0							22.6			
B-12	8.5							10.0			
B-12	13.5							11.0			
B-12	18.5							28.4			

BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

Laboratory Testing Summary

Project No: 12325

Project Name: Special K Drilling No. 2

Date: November 19, 2012

Minimum & Maximum Moisture Content

Depth	Minimum	Maximum
0’	8.8	24.7
4.0’	6.3	26.2
8.5’	9.0	25.3
13.5’	11.0	63.4
18.5’	9.4	61.3
23.5’	62.3	66.9
28.5’	48.1	62.7

Atterberg Limits

Boring	Depth	LL	PL	PI	Classification
B-01	4.0’	37	20	17	CL