06303

GEOTECHNICAL EXPLORATION REPORT
(MARCH – 2009)

OF

MURRAY-CALLOWAY COUNTY
ECONOMIC DEVELOPMENT CORP
140-ACRE EXPANSION SITE
U.S. HIGHWAY 641 NORTH
MURRAY, KENTUCKY

Submitted By:

Geotech Engineering & Testing, Inc.

GEOTECH ENGINEERING & TESTING, INC.

March 26, 2009

Mr. Mark Manning
Murray Calloway County Economic Development Corp.
P. O. Box 1911
Murray, Kentucky 42071

Re: Geotechnical Exploration Report (March – 2009)
Murray-Calloway County EDC
140-Acre Expansion Site
U.S. Highway 641 North
Murray, Kentucky

Dear Mr. Manning:

Geotech Engineering & Testing, Inc. (GEOTECH) 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,
GEOTECH Engineering & Testing, Inc.

Christopher N. Farmer, P.E.
Principal Engineer

STATE OF KENTUCKY
CHRISTOPHER N. FARMER
19597
LICENSED
PROFESSIONAL ENGINEER
3/26/09

Attachments: Geotechnical Exploration Report

GEOTECHNICAL EXPLORATION REPORT
(MARCH – 2009)

MURRAY-CALLOWAY COUNTY EDC
140-ACRE EXPANSION
U.S. HIGHWAY 641 NORTH
MURRAY, KENTUCKY

Prepared For:

Mr. Mark Manning
Murray Calloway County Economic Development Corp.
P. O. Box 1911
Murray, Kentucky 42071

Prepared By:

GEOTECH Engineering & Testing, Inc.
500 South 17th Street
Paducah, Kentucky 42003

March 26, 2009

Table of Contents

1.0 Objective

The purpose of this preliminary 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

A preliminary subsurface exploration was originally conducted across the Murray West Industrial Park prior to any construction in March of 2007. Since that time, the site has been developed with major soil cut-and-fill operations. The goal of this exploration is to provide a basic soil characterization of the fill and natural soil material currently under the site, for proposed future developments.

2.1 Site Description

A site reconnaissance was conducted on March 10, 2009. Observations made during the site visit were used to aid in interpreting topographic, geologic and other conditions that may affect the proposed construction.

The site is located within the United States Geologic Survey, Dexter, KY 7.5-Minute Quadrangle. The general topography of the immediate area is gently rolling with moderate changes in relief near the blue-line streams located on the northern and southern property boundaries. The general elevation of the site ranges from approximately 480 to 540 feet above sea level (National Geodetic Vertical Datum of 1929).

The site was previously consisted of wooded, residential and agriculturally developed land. Since the last geotechnical exploration, a large majority of the site has been cleared and grubbed during earthwork operations. At the time of this geotechnical, the site had been recently seeded to prevent soil erosion. The property surrounds a single parcel located on the southeast portion of the site that contains water tower for the city of Murray.

The site is bordered to the north, west, and south by cropland and single-family residences. The site is bordered to the east by Highway 641 North, followed by industrially developed and vacant land.

2.2 Exploratory Method

The procedures used by GEOTECH for field and laboratory sampling and testing are in general accordance with ASTM procedures, and established engineering practice. A total of nine (9) soil test borings were advanced on site; eight (8) of the borings were advanced to 20 feet bgs. One (1) of the soil borings was advanced to approximately 30 feet bgs in an area known to have high fill placement. The soil test boring locations were established in the field by Geotech representatives.

A CME-45B track mounted rotary-drilling rig was used to advance the soil test borings and to obtain soil samples for laboratory evaluation. The test borings were conducted in accordance with geotechnical investigative procedures outlined in ASTM D-1452. Seamless steel Shelby Tubes were proposed to be advanced in some of the soil test borings from ranges of 5 - 7 feet below grade to obtain undisturbed samples for unconfined compression analysis; however, due to the coarse-grained nature of the in situ soils at that depth, undisturbed samples could not be collected.

Disturbed samples were retrieved during Standard Penetration tests (ASTM D-1586) using an automatic hammer assembly at depths of 2.0, 9.5, 14.5, 19.5, and progressively at five-foot intervals until boring termination depths were achieved. 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).

Our field geologist observed and directed the drilling operations and visually classified soil samples obtained using the Unified Soil Classification System and ASTM D-2488 as guides. Records of the conditions encountered and visual soil classification were prepared by the engineer and are incorporated in our Subsurface Boring Logs included in Appendix B.

The Subsurface Boring Logs represent our interpretation of the conditions encountered. It should be noted that strata changes may vary from those encountered, transitions may be gradual, and conditions may vary significantly at other locations. The groundwater information listed represents conditions at the time of drilling. 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 Stratigraphy

The majority of the site was immediately overlain with a mixture of brown silty clay and reddish brown sandy gravel (continental deposits); with sandy gravels encountered in the cut areas, and brown silty clay encountered mainly in the fill areas. At varying depths ranging from approximately 15 to greater than 20 feet bgs, the sandy gravels transition to the light gray fat clay with orange laminated silty sands (Wilcox Formation).

The soils underlying the site were observed to range in consistency from soft to very dense. Standard Penetration Tests produced "N" values in the ranges of 2 to 50+ in the soils encountered. The highest blow counts were encountered within the sandy gravel layers at varying depths.

3.2 Groundwater

Groundwater measurements were taken in each of the soil test borings immediately following drilling activities. Groundwater levels were found in some of the borings, at depths ranging from approximately 16 to 18 feet bgs.

The soil test borings were left open to obtained 24-hour groundwater readings. Little to no groundwater recharge was identified within the borings observed to have initial groundwater levels. Each of the soil test borings were backfilled with soil cuttings at the completion of the subsurface investigation.

3.3 Geologic Interpretation

Based on a review of the boring logs and the United States Geological Survey *Geologic Map of the Dexter, KY Quadrangle*, the site is immediately underlain by Quaternary loess deposits to an approximate depth of 3 to 7 feet bgs, followed by Quaternary and Tertiary continental deposits to an approximate depth of 15 to greater than 20 feet bgs, followed by Tertiary Porters Creek Clay. The individual formations are described below; descriptions are derived from the geologic quadrangle.

The Quaternary loess deposits are described as being composed of "Silt and clay, gray to yellowish-brown, unstratified."

The Quaternary and Tertiary continental deposits are described as being 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. Gravel commonly well cemented with iron oxide. Locally lenses of poorly sorted sand and more rarely of light-colored clay occur within the gravel."

The Tertiary Porters Creek Clay is described as being composed of "Clay, silt, and sand: Clay, dark-gray, dries light gray, slightly silty, moderately micaceous, brittle, fractures conchoidally. 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 interbedded with clay; also occur as scattered lenses."

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.

Applicable ASTM test procedures are as follows:

Dry Preparation of Soil	ASTM D 421
Natural Moisture Content	ASTM D 2216
Unconfined Compression	ASTM D 2166

4.1 Laboratory Results

Natural moisture contents

Natural moisture contents were determined for the soil samples collected. Samples from 2.0 – 3.5 feet deep ranged from 6.8 to 23.0 percent. Samples from 5.0 – 6.5 feet deep ranged from 7.3 to 18.7 percent. Samples from 9.5 – 11.0 feet deep ranged from 8.4 to 18.2 percent. Samples from 14.5 – 16.0 feet deep ranged from 13.4 to 62.5 percent. Samples from 19.5 – 21.0 feet deep ranged from 12.1 to 47.3 percent. Exact moisture contents for all samples are tabulated in the Appendix.

Atterberg Limits (Index Tests)

Atterberg Limits tests were conducted on samples collected from B-2A (2.0' – 3.5') and B-5A (5.0' – 6.5'). 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. The following table outlines the results of the index tests.

Boring No.	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	USCS Classification
B-2A (2.0'- 3.5')	35	20	14	CL
B-5A (5.0'- 6.5')	31	16	15	CL

It was determined that the soils encountered within soil test borings B-2A and B-5A were identified as silty clays. A designation of (CL) includes inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, and lean clays.

Soil samples that have a Plasticity Index <20 have a low potential for soil volume change due to changing moisture contents.

Standard Penetration Tests

Field and laboratory tests were conducted to evaluate the soil strength characteristics on site. Standard Penetration Tests conducted in the field produced "N" values (blow counts), in the soils encountered on site in the range of 2 to 50+.

The "N" values are roughly correlated with the average soil consistency and an unconfined compressive strength. The "N" values indicate that the consistencies are very soft to very dense for the soils encountered on site. The blow counts correlate to unconfined compressive strengths of approximately 500 to greater than 8,000 pounds per square foot (psf) throughout the site. Standard Penetration Test results are provided on the Subsurface Boring Logs located in the appendix.

Unconfined Compression Tests

Due to the coarse-grained, non-cohesive nature of the in situ soils, undisturbed samples could not be collected.

5.0 Geotechnical Considerations

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

A proposed site development plan or any specific structural plans were not provided to Geotech at the time of drilling activities. Therefore, this geotechnical should be considered as a general overview to the subject site or at least preliminary in its scope and nature. The sections below are provided as general recommendations. Once specific development plans or specific building locations and specific structural loadings are know then a final geotechnical exploration should be conducted in light of the new information available. Additional soil test borings would be required for more specific loading data or if deep foundations are required.

5.2.1 Silty Clay Soils / Construction Traffic / Subgrade Degradation

As stated in Section 3.1 Stratigraphy, a large majority of the upper in-situ soils consist of low to moderate plasticity silty clay (CL). It should be noted that silty clay and clay loam soils are susceptible to degrade to unsuitable soils in the presence of moisture and construction traffic. In addition, silty soils are typically more 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 more silty soils have a smaller window for acceptable moistures ranges for compaction than very clayey soils. This characteristic typically means that the silty clay soils have 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 significant 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 encountered. 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 Site Preparation

5.3.1 Stripping / Demolition (General Site Recommendations)

The site should also be stripped of any trees, topsoil, large root zones or soft soil. Stripping should extend at least 10 feet beyond proposed construction area. Any extensive soft soil deposits encountered should be evaluated by 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. <u>No debris should be allowed to be buried on site such as burned trees or stumps.</u>

5.3.2 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 engineer. The engineer may require a visual subgrade inspections and possible proof-rolling of the subgrades.

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.

After proofrolling activities the subgrade should be scarified to a depth of 8-inches below ground surface and recompacted to at least 98 percent of the standard maximum dry density (ASTM D-698) for areas under proposed structures and to a least 95 percent of the standard maximum dry density for proposed paved areas.

5.3.3 Engineered Fill Placement

The in-situ soils encountered should be suitable for use as engineered / structural fill. However, due to the moisture sensitivity, obtaining proper compaction may be difficult. Recommendations in Section 5.3.2 and 5.3.3 should be followed closely. In addition, it should be noted that the silty soils will degrade in the presence of high moisture and construction traffic.

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.

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).

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

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 5,000 square feet. All fill pads should extend laterally at least 5 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.

5.3.4 Surface Water Control

The site was observed to have moderate to good surface drainage conditions. Surface water should be directed around the project area during construction. Proper erosion and sedimentation control plans should be developed as per City and State requirement.

5.3.5 Groundwater Control

Shallow static groundwater elevations were not encountered at the time of drilling during the subsurface exploration. However, the groundwater levels will be subject to seasonal fluctuations. Dewatering of the site may be necessary during excavation of the foundations. Static groundwater or perched water encountered during construction could be controlled by sump pumps. Filter fabric should used around sumps to insure that soil "fines" are not removed which can cause settlement due to loss of ground.

5.4 Foundation Recommendations

5.4.1 Shallow Foundations

The following recommendations should be considered general in nature and should be reviewed in light of specific development plans or specific structural data.

Based on the overall general soil conditions, shallow foundations appear to be feasible for most lightly to moderately loaded commercial facilities. Any shallow foundation should be seated to a minimum depth of 24-inches below ground surface for frost depth considerations. It is anticipated that the shallow foundations will be seated in natural ground or properly compacted engineered fill. Net allowable soil bearing pressures in the ranged of 2,000 to 2,500 pounds per square feet (psf) for continuous and between 2,500 and 3,000 psf for spread foundations, respectively.

Isolated and continuous footings should have minimum widths of at least 36 inches and 24 inches respectively. The foundation bearing seats should be inspected by a geotechnical engineer prior to any steel or concrete placement. If larger structural loadings or settlement critical structures are anticipated then intermediate or deep foundations may be required such as rammed aggregate piers or cast in place piles.

5.4.2 Conventional Floor Slabs

If subgrade soils are properly compacted as described in this report then a modulus of subgrade reaction (k) of 175 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 6-inch thick layer of free-draining compacted granular aggregate (ASTM C-33 Size 9) should be placed beneath the proposed floor slab. Compacted limestone granular aggregate is preferred for the drainage layer. 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.

5.4.3 General Foundation / Slab Considerations

Shallow foundation bearing surfaces can degrade when exposed to drying, precipitation, and cold temperature for extended periods. This is most notable if the subgrade soils are left exposed. As a result, it is advisable to place concrete the same day that the footings are excavated. If this is not possible, a mud mat of lean concrete should be placed on the bearing surface.

In order to confirm that subgrade degradation has not occurred, and, in general, to confirm that suitable bearing materials are present, the geotechnical engineer or his/her representative should check each foundation excavation. Also this check will serve to confirm that the bearing materials encountered in the excavations are consistent with those found in this study. The geotechnical engineer also should be present to confirm that frozen, loose, soft, or wet materials are not present in the excavation. The geotechnical engineer's observations, therefore, should take place after the excavation has been dug and cleaned out completely. It should be noted that some local building inspectors now required that the foundation subgrade be inspected by a licensed professional engineer.

As with shallow foundation excavations, floor slab subgrades tend to be negatively affected by extended exposure to the weather. Further negative effects are experienced when long-term exposure to weather is combined with construction equipment and foot traffic. Subgrade degradation is a common cause of floor slab cracking, particularly when very silty or plastic soils are exposed at the slab subgrade level. Therefore, it is recommended that the subgrades be graded high to permit final grading immediately prior to base and slab construction. After final grading, the subgrades should be checked by the geotechnical engineer to confirm that the soils have not been severely disturbed, saturated or desiccated. The slabs should be completed as soon as possible following the subgrade checks.

5.5 Paving Recommendations

Areas that are proposed to be paved must have stable subgrades and sufficient soil strength in order for the pavement to perform satisfactory. The recommendations given below are based on the assumptions that: proofrolling activities have taken place to delineate soft and unsuitable soils; that the pavement subgrade soils have been compacted to at least 95 percent of the soil's standard maximum dry density at moisture contents as recommended in this report.

All pavement materials should conform to and be placed/compacted in accordance with the applicable sections of the Kentucky Department of Transportation (KDOT) Standard Specifications for Road and Bridge Construction, current edition.

5.5.1 Flexible (Asphalt) Pavement Design

Based upon field observations and laboratory testing of shallow soils in the parking and driveway areas, we recommend using a California Bearing Ratio (CBR) value of 5.0 in design.

5.5.2 Standard Duty Pavement - Asphalt

1.0" Compacted Depth Bituminous Concrete Surface Class I
2.0" Compacted Depth Bituminous Concrete Base Class I
8.0" Compacted Depth Dense Graded Aggregate Base

All parking lot subgrade should be proofrolled in the presence of a geotechnical engineer prior to any fill or granular backfill placement.

5.5.3 Rigid (Concrete) Pavements

For the native, untreated subgrade soils, a modulus of subgrade reaction (k) of 150 pci may be used for rigid pavement design. Concrete pavements should be supported on at least 6 inches of clean granular material to reduce pumping at the joints. Typical concrete paving section should be at least 6 inches in thickness for automobile traffic. In addition, site plans should include thickened slabs at entrances and dumpster pads.

All parking lot subgrade should be proofrolled in the presence of a geotechnical engineer prior to any fill or granular backfill placement.

5.6 Other Design Considerations

5.6.1 Seismic Site Class (2006 International Building Code)

Based on requirements of the 2006 International Building Code, site classification are required for the design of seismic elements of structures. Upon review of the 2006 International Building Code a Site Class D could be used for seismic design. This recommendation is based on the general characteristics of the site and knowledge of the general geology. A 100 feet depth boring was not conducted.

5.6.2 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.

5.6.3 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, Geotech Engineering & Testing, Inc., 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, Geotech Engineering & Testing, Inc., 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. Geotech Engineering & Testing, Inc., 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

Geotech 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 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°C ± 5°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

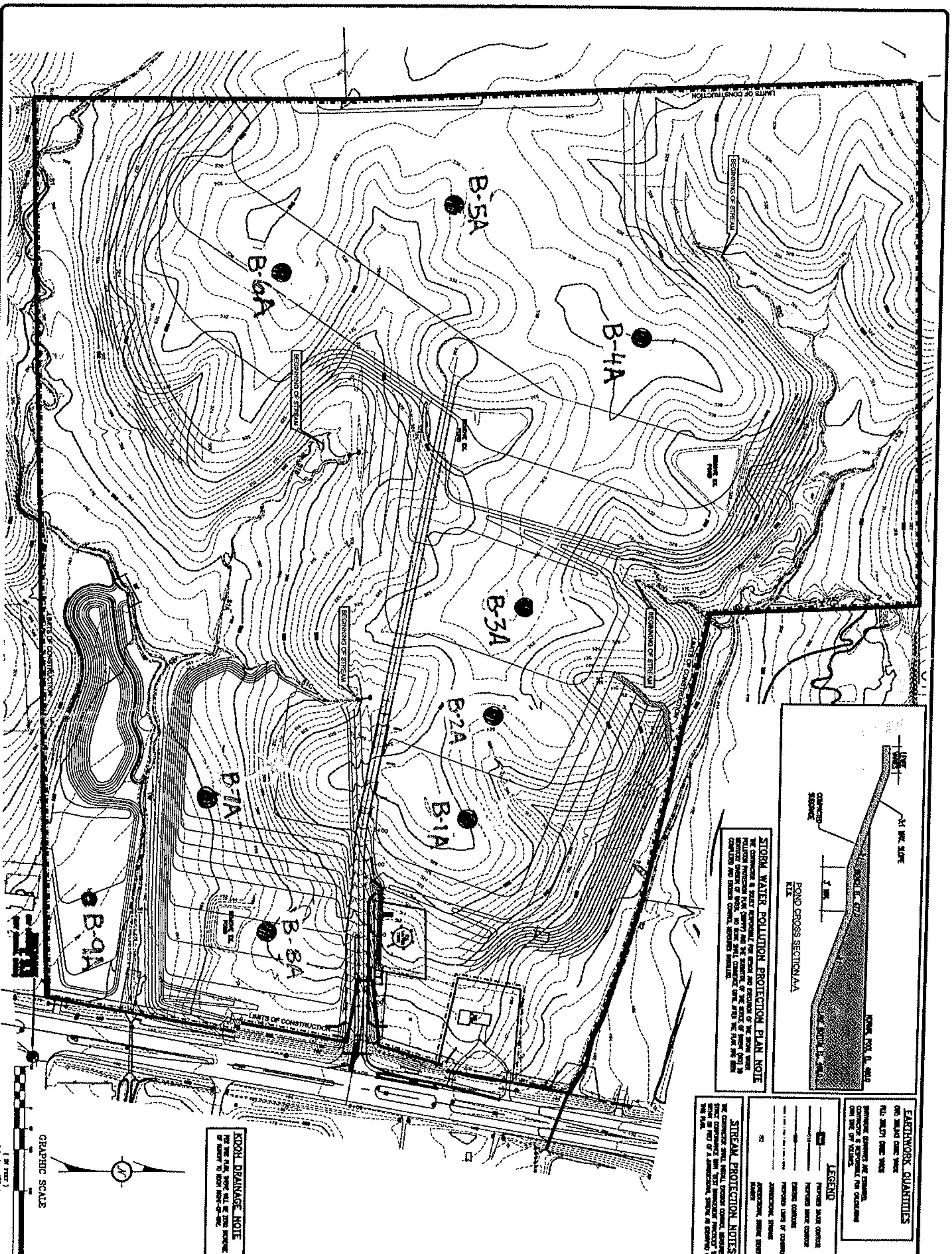
-# 200: Percent of sample passing a # 200 sieve (0.075mm)

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

GEOTECH ENGINEERING & TESTING, INC

Appendix B

Boring Location Map



POST DEV. SOIL BORING MAP

SHEET C1 OF 4

SITE GRADING PLAN

MURRAY WEST INDUSTRIAL PARK
MURRAY-CALLOWAY CO. ECONOMIC DEVELOPMENT CORP.
MURRAY, CALLOWAY COUNTY, KENTUCKY 42071

MARK MANNING, PRESIDENT

GEOTECH ENGINEERING & TESTING, INC.

801 NORTH 4th STREET, MURRAY, KY 42071, PHONE - 270.753.7307, FAX - 270.759.4900
500 SOUTH 17th STREET, PADUCAH, KY 42003, PHONE - 270.443.1995, FAX - 270.443.1904
805 W DeYOUNG ST. SUITE F, MARION, IL 62959, PHONE - 618.993.8700, FAX - 618.993.8717
www.geotechengineers.net

PROJECT NO.: 08303	DATE: JUNE, 2008		
DRAWN BY: SOS	CHECKED BY: RSB		
REV.	DESCRIPTION	BY	DATE
1	Miscellaneous	S.S.	6/18/08
2	Revised East Bank of Lake	R.J.	9/05/08
3	Added Int. Ditch along R.O.W.	B.D.	10/13/08
4			

Appendix C

Subsurface Boring Logs

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SUBSURFACE BORING LOG

Boring No. : **B-1A**

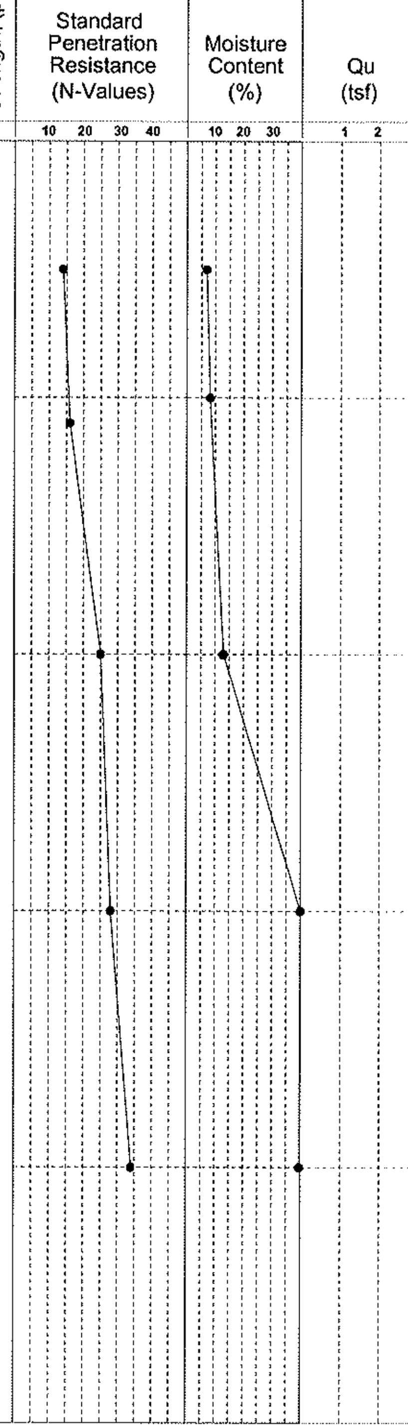
Project : Murray EDC - 140 Ac. Parcel

Project Location : Murray, KY

Boring Started :	March 10, 2009	**Boring Diameter :**	4-1/2 Inch Dia	**Driller :**	B. Watkins
Date Completed :	March 10, 2009	**Drilling Method :**	Hollow Stem Auger	**Drill Equipment :**	CME - 45B
Surface Elevation :	500	**Sampling Methods :**	SPT, Shelby Tubes		

Legend: Split spoon; Shelby Tube; Auger cuttings; GW @ drilling; GW @ 24 hrs

Depth in Feet	Elev. in Feet	Sample Type	DESCRIPTION	Lithology	Counts Blows (per 6")	#200 Wash (%)	Unconfined Strength, (psf)
0	500		GP: Reddish brown sandy GRAVEL (GP); poorly sorted, sub-rounded, very dense in consistency.				
		Shelby Tube			2 - 6 - 8		
5	495	Shelby Tube			3 - 7 - 9		
10	490	Shelby Tube			7 - 12 - 13		
			CH: Light gray fat CLAY (CH); with interlensing orange sand, stiff to very stiff in consistency.				
15	485	Shelby Tube			1 - 7 - 21		
20	480	Shelby Tube			3 - 10 - 24		
			Boring terminated at 21.0 feet bgs.				
25	475						



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SUBSURFACE BORING LOG

Boring No. : **B-2A**

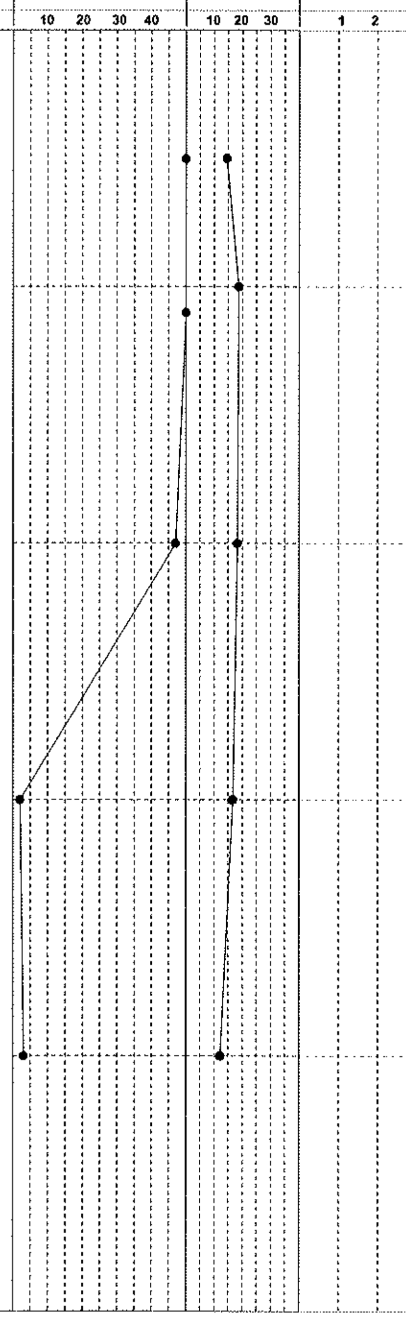
Project : Murray EDC - 140 Ac. Parcel

Project Location : Murray, KY

Boring Started :	March 10, 2009	**Boring Diameter :**	4-1/2 Inch Dia	**Driller :**	B. Watkins
Date Completed :	March 10, 2009	**Drilling Method :**	Hollow Stem Auger	**Drill Equipment :**	CME - 45B
Surface Elevation :	500	**Sampling Methods :**	SPT, Shelby Tubes		

Legend: Split spoon; Shelby Tube; Auger cuttings; GW @ drilling; GW @ 24 hrs

Depth in Feet	Elev. in Feet	Sample Type	DESCRIPTION	Lithology	Counts Blows (per 6")	#200 Wash (%)	Unconfined Strength, (psf)	Standard Penetration Resistance (N-Values)	Moisture Content (%)	Qu (tsf)
0	500		CL: Grayish brown silty CLAY (CL); with some gravel intermixed, very hard in consistency.							
					6 - 21 - 31					
5	495									
					8 - 27 - 35					
			GP: Reddish brown sandy GRAVEL (GP); poorly sorted, sub-rounded, very dense in consistency.							
10	490				20 - 19 - 28					
			CH: Light gray fat CLAY (CH); with interlensing orange sand, stiff to very stiff in consistency.							
15	485				1 - 0 - 2					
20	480				1 - 1 - 3					
			Boring terminated at 21.0 feet bgs.							
25	475									



SUBSURFACE BORING LOG

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Boring No. : **B-3A**

Project : Murray EDC - 140 Ac. Parcel

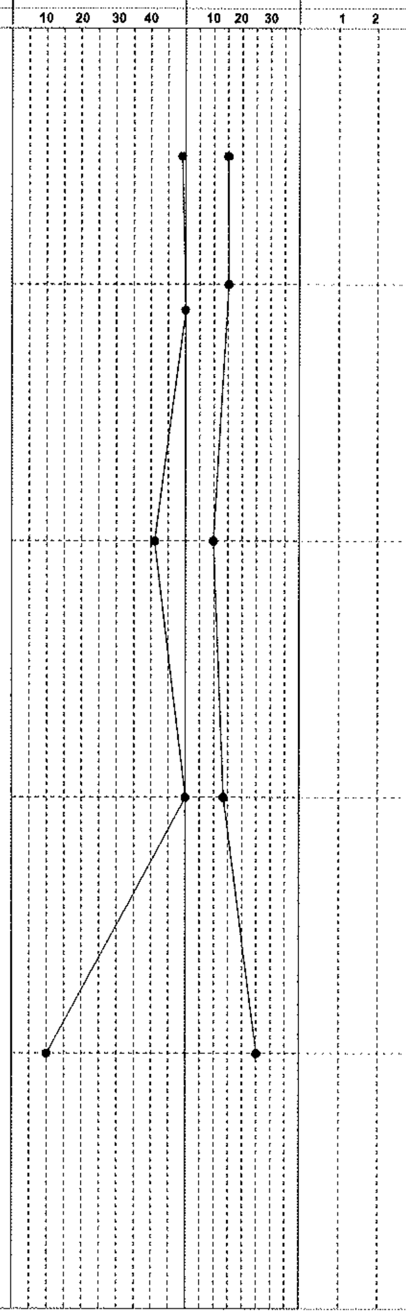
Project Location : Murray, KY

Boring Started :	March 10, 2009	**Boring Diameter :**	4-1/2 Inch Dia	**Driller :**	B. Watkins
Date Completed :	March 10, 2009	**Drilling Method :**	Hollow Stem Auger	**Drill Equipment :**	CME - 45B
Surface Elevation :	500	**Sampling Methods :**	SPT, Shelby Tubes		

Legend: Split spoon; Shelby Tube; Auger cuttings; GW @ drilling; GW @ 24 hrs

Depth in Feet	Elev. in Feet	DESCRIPTION	Counts Blows (per 6")	#200 Wash (%)	Unconfined Strength, (psf)
0	500	GP: Reddish brown sandy GRAVEL (GP); poorly sorted, sub-rounded, very dense in consistency.			
			3 - 23 - 26	21	
5	495		5 - 33 - 43	10	
10	490		1 - 16 - 25	7	
15	485		6 - 28 - 25	4	
		CH: Light gray fat CLAY (CH); with interlensing orange sand, stiff to very stiff in consistency.			
20	480		2 - 3 - 7	23	
		Boring terminated at 21.0 feet bgs.			
25	475				

Standard Penetration Resistance (N-Values) / Moisture Content (%) / Qu (tsf)



SUBSURFACE BORING LOG

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Boring No. : **B-4A**

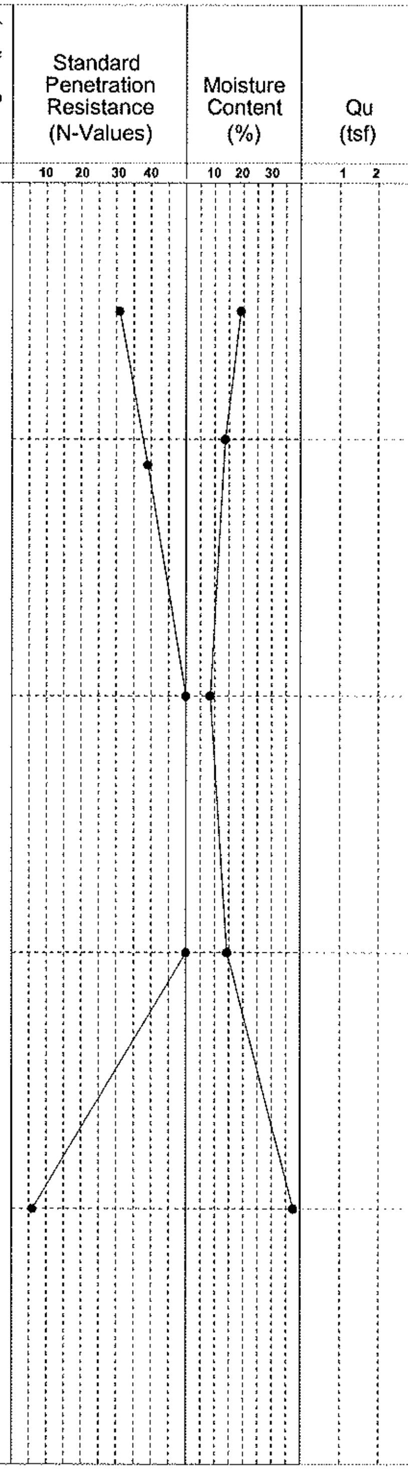
Project : Murray EDC - 140 Ac. Parcel

Project Location : Murray, KY

Boring Started :	March 10, 2009	**Boring Diameter :**	4-1/2 Inch Dia	**Driller :**	B. Watkins
Date Completed :	March 10, 2009	**Drilling Method :**	Hollow Stem Auger	**Drill Equipment :**	CME - 45B
Surface Elevation :	500	**Sampling Methods :**	SPT, Shelby Tubes		

Legend: Split spoon; Shelby Tube; Auger cuttings; GW @ drilling; GW @ 24 hrs

Depth in Feet	Elev. in Feet	DESCRIPTION	Counts Blows (per 6")	#200 Wash (%)	Unconfined Strength, (psf)
0	500	GP: Reddish brown sandy GRAVEL (GP); poorly sorted, sub-rounded, very dense in consistency.			
			3 - 11 - 20		
5	495		1 - 16 - 23		
10	490		1 - 20 - 41		
15	485		14 - 20 - 32		
		CH: Light gray fat CLAY (CH); with interlensing orange sand, stiff to very stiff in consistency.			
20	480		1 - 3 - 3		
		Boring terminated at 21.0 feet bgs.			
25	475				



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SUBSURFACE BORING LOG

Boring No. : **B-5A**

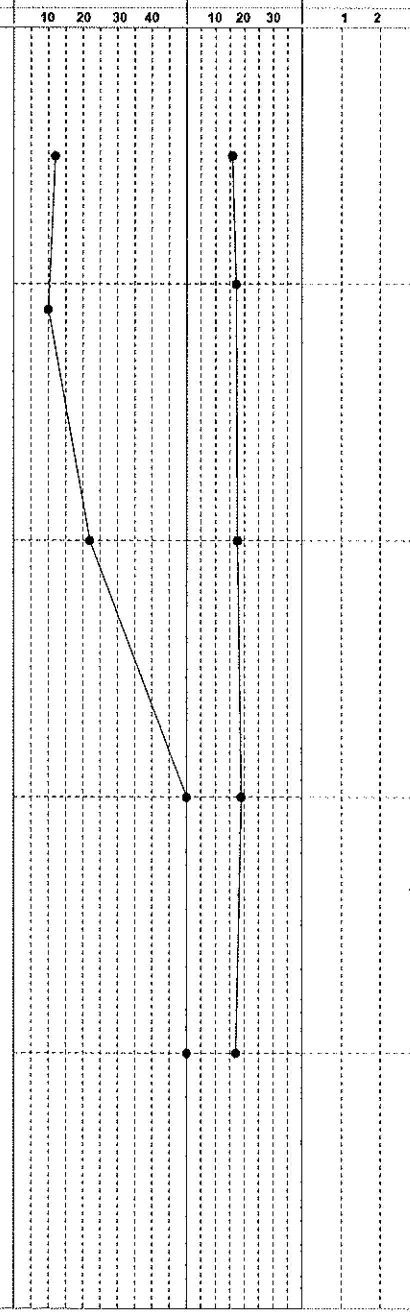
Project : Murray EDC - 140 Ac. Parcel

Project Location : Murray, KY

Boring Started :	March 10, 2009	**Boring Diameter :**	4-1/2 Inch Dia	**Driller :**	B. Watkins
Date Completed :	March 10, 2009	**Drilling Method :**	Hollow Stem Auger	**Drill Equipment :**	CME - 45B
Surface Elevation :	500	**Sampling Methods :**	SPT, Shelby Tubes		

Legend: Split spoon; Shelby Tube; Auger cuttings; GW @ drilling; GW @ 24 hrs

Depth in Feet	Elev. in Feet	Sample Type	DESCRIPTION	Lithology	Counts Blows (per 6")	#200 Wash (%)	Unconfined Strength, (psf)	Standard Penetration Resistance (N-Values)	Moisture Content (%)	Qu (tsf)
0	500		CL: Grayish brown silty CLAY (CL); with some gravel intermixed, very hard in consistency.							
		Shelby Tube			2 - 5 - 7	83				
5	495	Shelby Tube			1 - 3 - 7	74				
10	490	Shelby Tube			2 - 9 - 13	28				
			GP: Reddish brown sandy GRAVEL (GP); poorly sorted, sub-rounded, very dense in consistency.							
15	485	Shelby Tube			4 - 18 - 50+	6				
20	480	Shelby Tube			6 - 22 - 35	19				
			Boring terminated at 21.0 feet bgs.							
25	475									



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SUBSURFACE BORING LOG

Boring No. : **B-6A**

Project : Murray EDC - 140 Ac. Parcel

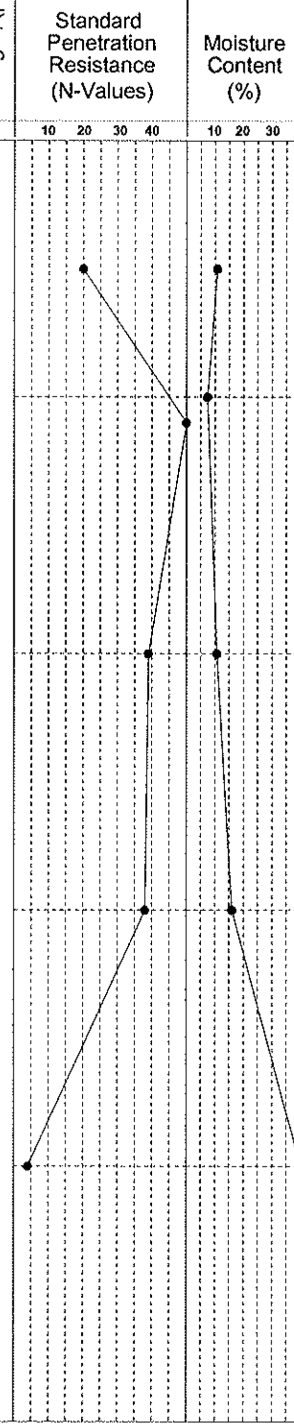
Project Location : Murray, KY

Page 1 of 1

Boring Started :	March 10, 2009	**Boring Diameter :**	4-1/2 Inch Dia	**Driller :**	B. Watkins
Date Completed :	March 10, 2009	**Drilling Method :**	Hollow Stem Auger	**Drill Equipment :**	CME - 45B
Surface Elevation :	500	**Sampling Methods :**	SPT, Shelby Tubes		

Legend: Split spoon; Shelby Tube; Auger cuttings; GW @ drilling; GW @ 24 hrs

Depth in Feet	Elev. in Feet	DESCRIPTION	Counts Blows (per 6")	#200 Wash (%)	Unconfined Strength, (psf)	Qu (tsf)
0	500	GP: Reddish brown sandy GRAVEL (GP); poorly sorted, sub-rounded, very dense in consistency.				
			1 - 3 - 17			
5	495		8 - 32 - 43			
10	490		5 - 16 - 23			
15	485		7 - 14 - 24			
		CH: Light gray fat CLAY (CH); with interlaminated orange silty sand, micaceous, soft in consistency.				
20	480		2 - 1 - 3			
		Boring terminated at 21.0 feet bgs.				
25	475					



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SUBSURFACE BORING LOG

Boring No. : **B-7A**

Project : Murray EDC - 140 Ac. Parcel

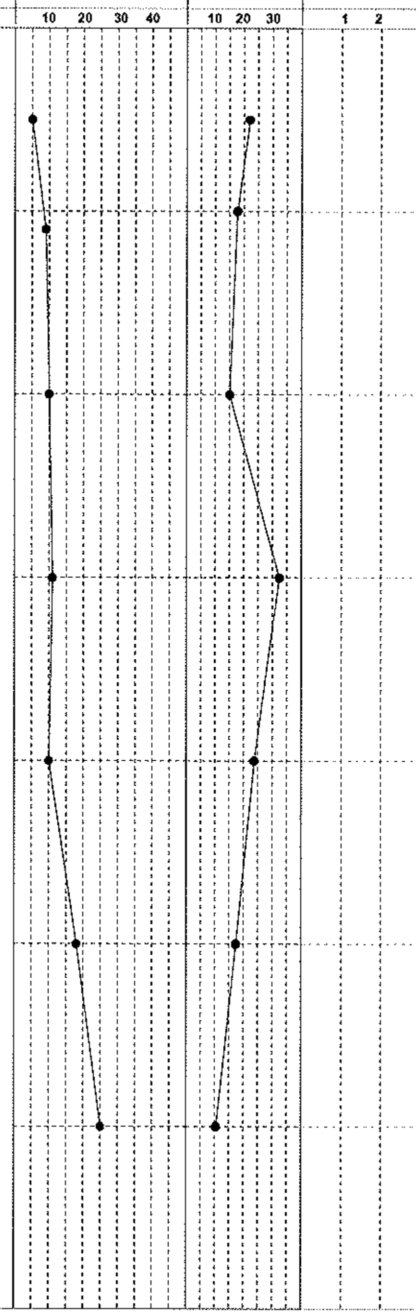
Project Location : Murray, KY

Boring Started :	March 11, 2009	**Boring Diameter :**	4-1/2 Inch Dia	**Driller :**	B. Watkins
Date Completed :	March 11, 2009	**Drilling Method :**	Hollow Stem Auger	**Drill Equipment :**	CME - 45B
Surface Elevation :	500	**Sampling Methods :**	SPT, Shelby Tubes		

Legend: Split spoon; Shelby Tube; Auger cuttings; GW @ drilling; GW @ 24 hrs

Depth in Feet	Elev. in Feet	DESCRIPTION	Counts Blows (per 6")	#200 Wash (%)	Unconfined Strength, (psf)
0	500	CL: Grayish brown silty CLAY (CL); medium plasticity, firm to stiff in consistency, moist (FILL).			
			1 - 2 - 3	53	
5	495		1 - 4 - 5	77	
10	490		1 - 5 - 5	73	
		CH: Dark gray foliated CLAY (CH); non-plastic when dry, exhibits conchoidal fracturing, micaceous, dry to moist (FILL).			
15	485		2 - 4 - 7	54	
		CL: Grayish brown silty CLAY (CL); medium plasticity, stiff to very stiff in consistency, moist.			
20	480		1 - 3 - 7	94	
25	475		5 - 7 - 11	58	
30	470		8 - 12 - 13	47	
		Boring terminated at 31.0 feet bgs.			
35	465				

Standard Penetration Resistance (N-Values) | Moisture Content (%) | Qu (tsf)



SUBSURFACE BORING LOG

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Boring No. : **B-8A**

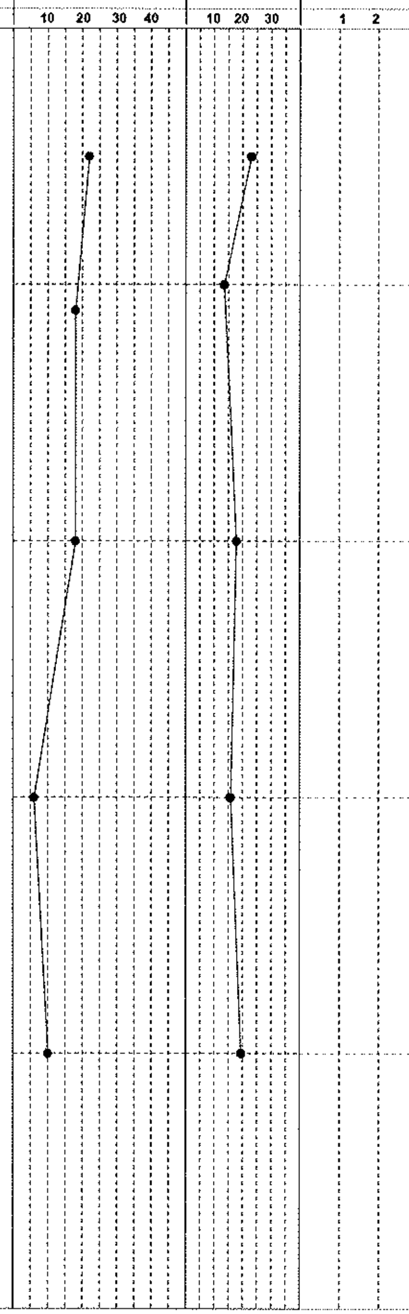
Project : Murray EDC - 140 Ac. Parcel

Project Location : Murray, KY

Boring Started :	March 11, 2009	**Boring Diameter :**	4-1/2 Inch Dia	**Driller :**	B. Watkins
Date Completed :	March 11, 2009	**Drilling Method :**	Hollow Stem Auger	**Drill Equipment :**	CME - 45B
Surface Elevation :	500	**Sampling Methods :**	SPT, Shelby Tubes		

Legend: Split spoon; Shelby Tube; Auger cuttings; GW @ drilling; GW @ 24 hrs

Depth in Feet	Elev. in Feet	Sample Type	DESCRIPTION	Lithology	Counts Blows (per 6")	#200 Wash (%)	Unconfined Strength, (psf)	Standard Penetration Resistance (N-Values)	Moisture Content (%)	Qu (tsf)
0	500		CL: Grayish brown silty CLAY (CL); with some gravel intermixed, firm to very stiff in consistency.							
					3 - 8 - 14					
5	495				1 - 7 - 11					
10	490				2 - 16 - 8					
15	485				1 - 2 - 4					
20	480				4 - 4 - 6					
			Boring terminated at 21.0 feet bgs.							
25	475									



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SUBSURFACE BORING LOG

Boring No. : **B-9A**

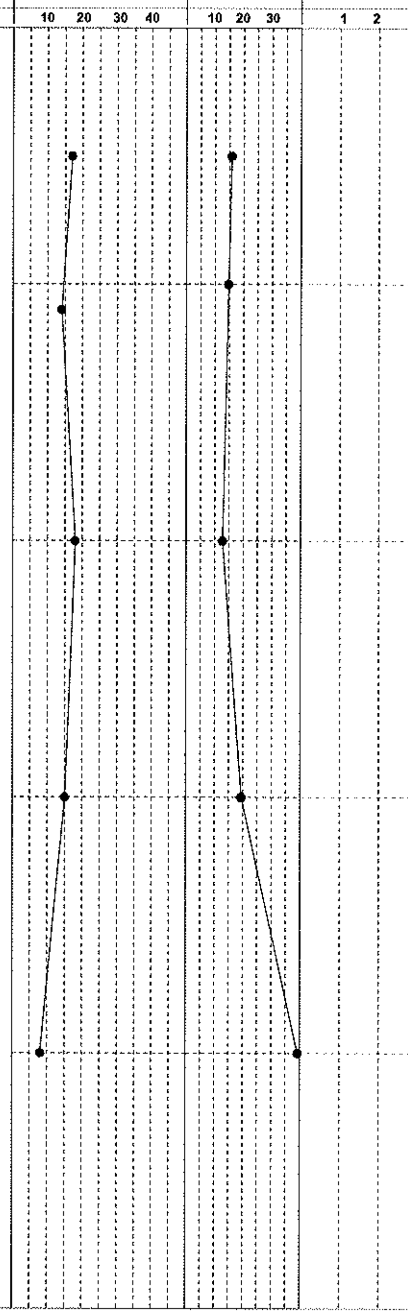
Project : Murray EDC - 140 Ac. Parcel

Project Location : Murray, KY

Boring Started :	March 11, 2009	**Boring Diameter :**	4-1/2 Inch Dia	**Driller :**	B. Watkins
Date Completed :	March 11, 2009	**Drilling Method :**	Hollow Stem Auger	**Drill Equipment :**	CME - 45B
Surface Elevation :	500	**Sampling Methods :**	SPT, Shelby Tubes		

Legend: Split spoon; Shelby Tube; Auger cuttings; GW @ drilling; GW @ 24 hrs

Depth in Feet	Elev. in Feet	Sample Type	DESCRIPTION	Lithology	Counts Blows (per 6")	#200 Wash (%)	Unconfined Strength, (psf)	Standard Penetration Resistance (N-Values)	Moisture Content (%)	Qu (tsf)
0	500		CL: Grayish brown silty CLAY (CL); with some gravel intermixed, firm to very stiff in consistency.							
		Shelby Tube			3 - 6 - 11					
5	495	Shelby Tube			3 - 5 - 9					
10	490	Shelby Tube			2 - 7 - 11					
15	485	Shelby Tube			2 - 6 - 9					
20	480	Shelby Tube			1 - 3 - 5					
			Boring terminated at 21.0 feet bgs.							
25	475									



Appendix D

Soil Laboratory Datasheets

GEOTECH ENGINEERING & TESTING, INC.

Summary of Soils Testing

Date: 3-16-2009 | Project Name: Murray Calloway Co. EDC | Job No: 06303

Boring No:	Depth (Feet)	Moisture Content %	Minus No. 200	Liquid Limit	Plastic Limit	Plasticity Index	Class	Unconfined	Wet-Unit Wt. lbs/c.f.	Dry-Unit Wt. lbs/c.f.	Blow Count	Remarks
B-1-A	2 – 3.5'	6.8					GP				14	
	5 – 6.5'	8.1					GP				16	
	9.5 – 11'	13.0					GP				25	
	14.5 – 16'	62.5					CH				28	
	19.5 – 21'	39.7					CH				34	
B-2-A	2 – 3.5'	14.5		35	20	14	CL				50+	
	5 – 6.5'	18.7					CL				50+	
	9.5 – 11'	18.2					GP				47	
	14.5 – 16'	16.6					GP				2	
	19.5 – 21'	12.1					GP				3	
B-3-A	2 – 3.5'	15.0	21				GP				49	
	5 – 6.5'	15.2	10				GP				50+	
	9.5 – 11'	9.8	7				GP				41	
	14.5 – 16'	13.4	4				GP				50+	
	19.5 – 21'	25.1	23				CH				10	
B-4-A	2 – 3.5'	19.0					GP				31	
	5 – 6.5'	13.6					GP				39	
	9.5 – 11'	8.4					GP				50+	
	14.5 – 16'	14.3					GP				50+	
	19.5 – 21'	37.5					CH				6	
B-5-A	2 – 3.5'	15.8	83				CL				12	
	5 – 6.5'	17.1	74	31	16	15	CL				10	
	9.5 – 11'	17.6	28				CL				22	
	14.5 – 16'	18.9	6				GP				50+	
	19.5 – 21'	17.0	19				GP				50+	

GEOTECH ENGINEERING & TESTING, INC.

Summary of Soils Testing

Date: 3-16-2009 Project Name: Murray Calloway Co. EDC Job No: 06303

Boring No:	Depth (Feet)	Moisture Content %	Minus No. 200	Liquid Limit	Plastic Limit	Plasticity Index	Class	Unconfined	Wet-Unit Wt. lbs/c.f.	Dry-Unit Wt. lbs/c.f.	Blow Count	Remarks
B-6-A	2 – 3.5’	10.8					GP				20	
	5 – 6.5’	7.3					GP				50+	
	9.5 – 11’	10.7					GP				39	
	14.5 – 16’	16.0					GP				38	
	19.5 – 21’	47.3					CH				4	
B-7-A	2 – 3.5’	22.0	53				CL				5	
	5 – 6.5’	17.8	77				CL,g				9	
	9.5 – 11’	15.1	73				CL				10	
	14.5 – 16’	32.4	54				CH				11	
	19.5 – 21’	23.7	94				CL				10	
	24.5 – 26’	17.4	58				CL				18	
	29.5 – 31’	10.5	47				CL				25	
B-8-A	2 -3.5’	23.0					CL				22	
	5 – 6.5’	13.5					CL				18	
	9.5 – 11’	17.8					CL,g				18	
	14.5 – 16’	15.7					CL,g				6	
	19.5 – 21’	19.5					CL,g				10	
B-9-A	2 – 3.5’	15.8					CL,g				17	
	5 – 6.5’	14.7					CL,g				14	
	9.5 – 11’	12.7					CL,g				18	
	14.5 – 16’	19.4					CL,g				15	
	19.5 – 21’	39.2					CL,g				8	

GEOTECH Engineering & Testing, Inc.

500 South 17th Street Paducah, KY 42003

Liquid Limit, Plastic Limit and Plasticity Index of Soils - ASTM D 4318

Project Murray Calloway Co. EDC | Project No. 6303

DATE :	3/13/2009
TECHNICIAN	K. Brown
BORING NO. :	B-5-A
SAMPLE DEPTH :	5 - 6.5'
DESCRIPTION OF SAMPLE :	Brown Silty Clay
☐ AIR DRIED SAMPLE	

LIQUID LIMIT =	31
PLASTIC LIMIT =	16
PLASTICITY INDEX=	15
CLASSIFICATION =	CL

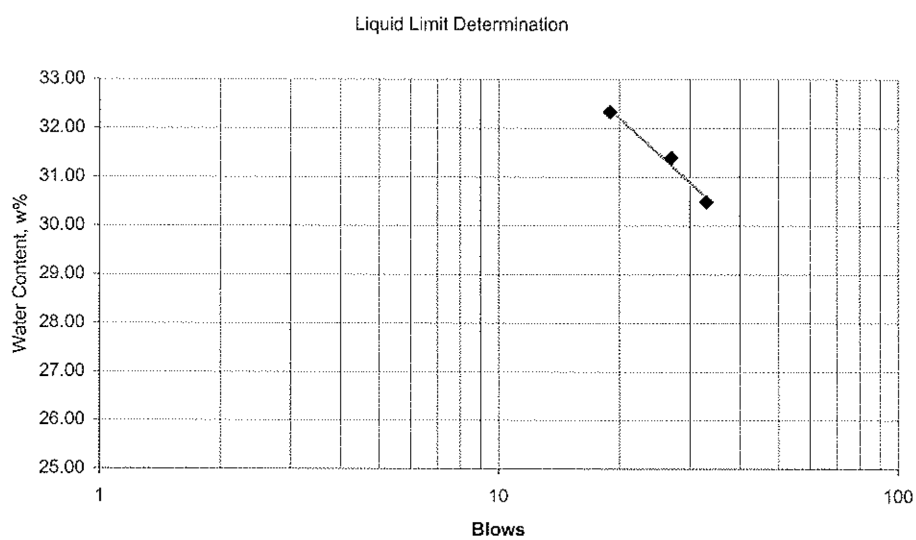
EST. OF % RETAINED ON No.40 SIEVE: 5

LIQUID LIMIT DETERMINATION

(•) Original
( ) Amended

No. of Data Sets: 3

CUP NO.	5	8	31	
MASS OF CUP + WET SOIL	27.32	26.88	28.97	
MASS OF CUP + DRY SOIL	24.11	23.70	25.22	
MASS OF CUP	13.58	13.57	13.62	
MASS OF DRY SOIL	10.53	10.13	11.60	
MASS OF WATER	3.21	3.18	3.75	
WATER CONTENT (%)	30.48	31.39	32.33	
No. OF BLOWS	33	27	19	



PLASTIC LIMIT DETERMINATION

No. of Data Sets: 2

CUP NO.	40	44		
MASS OF CUP + WET SOIL	26.95	26.53		
MASS OF CUP + DRY SOIL	25.05	24.71		
MASS OF CUP	13.60	13.60		
MASS OF DRY SOIL	11.45	11.11		
MASS OF WATER	1.90	1.82		
WATER CONTENT (%)	16.59	16.38		

COMMENTS/DEVIATIONS:

Christopher Framer, P.E. ______________________ Date: ______________________

GET-ASTM D4318 REV. 0 12/03

GEOTECH Engineering & Testing, Inc.

500 South 17th Street Paducah, KY 42003

Liquid Limit, Plastic Limit and Plasticity Index of Soils - ASTM D 4318

Project Murray Calloway Co. EDC Project No. 6303

DATE :	3/13/2009
TECHNICIAN	R. Gills
BORING NO. :	B-2-A
SAMPLE DEPTH :	2 - 3.5'
DESCRIPTION OF SAMPLE :	Light Brown Grayish
☐ AIR DRIED SAMPLE	

LIQUID LIMIT =	35
PLASTIC LIMIT =	20
PLASTICITY INDEX=	14
CLASSIFICATION =	CL

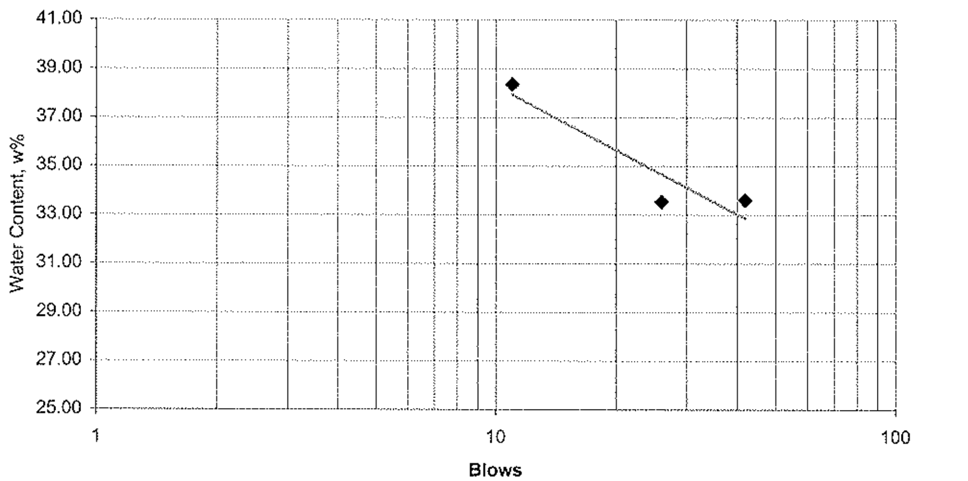
EST. OF % RETAINED ON No.40 SIEVE 5

LIQUID LIMIT DETERMINATION

◉ Original
○ Amended

No. of Data Sets: 3

CUP NO.	C-41	C-13	C-49	
MASS OF CUP + WET SOIL	43.93	41.80	47.30	
MASS OF CUP + DRY SOIL	39.28	37.64	41.23	
MASS OF CUP	25.44	25.23	25.40	
MASS OF DRY SOIL	13.84	12.41	15.83	
MASS OF WATER	4.65	4.16	6.07	
WATER CONTENT (%)	33.60	33.52	38.34	
No. OF BLOWS	42	26	11	



PLASTIC LIMIT DETERMINATION

No. of Data Sets: 2

CUP NO.	C-1	C-2		
MASS OF CUP + WET SOIL	50.03	51.07		
MASS OF CUP + DRY SOIL	48.10	49.02		
MASS OF CUP	38.50	39.06		
MASS OF DRY SOIL	9.60	9.96		
MASS OF WATER	1.93	2.05		
WATER CONTENT (%)	20.10	20.58		

COMMENTS/DEVIATIONS:

Christopher Framer, P.E. Date:

GEOTECH Engineering & Testing, Inc.

500 South 17th Street Paduah, KY 42003

Materials in Soils Finer than No. 200 Sieve - ASTM D 1140

Project Murray Calloway Co. EDC

Project No. 6303

DATE :	3/13/2009
TECHNICIAN	K. Brown

◉ Original
○ Amended

BORING NO.	B-3-A	B-3-A	B-3-A	B-3-A	B-3-A	B-5A
SAMPLE DEPTH	2 - 3.5'	5 - 6.5'	9.5 - 11'	14.5 - 16'	19.5 - 21'	2 - 3.5'
CUP NO.	W-29	W-11	W-6	W-17	W-9	W-8
MASS OF CUP (g)	6.6	6.52	7.95	6.56	7.86	7.94
MASS OF CUP + DRY SOIL (g)	125.71	96.36	147.05	198.29	95.73	165.13
MASS OF DRY SOIL (g)	119.11	89.84	139.1	191.73	87.87	157.19
MASS OF CUP + DRY SOIL (g)	100.43	86.98	137.41	191.04	75.1	34.49
MASS OF DRY SOIL (g)	93.83	80.46	129.46	184.48	67.24	26.55
MASS OF SOIL PASSING 200	21	10	7	4	23	83

BORING NO.	B-5A	B-5-A	B-5-A	B-5-A	B-7-A	B-7-A
SAMPLE DEPTH	5 - 6.5'	9.5 - 11'	14.5 - 16'	19.5 - 21'	2 - 3.5'	5 - 6.5'
CUP NO.	W-7	W-16	W-26	W-2	W-19	W-10
MASS OF CUP (g)	7.93	6.5	6.56	6.57	6.53	7.93
MASS OF CUP + DRY SOIL (g)	69.91	168.97	105.41	97.88	150.05	174.49
MASS OF DRY SOIL (g)	61.98	162.47	98.85	91.31	143.52	166.56
MASS OF CUP + DRY SOIL (g)	23.99	123.03	99.87	80.87	74.6	46.85
MASS OF DRY SOIL (g)	16.06	116.53	93.31	74.3	68.07	38.92
MASS OF SOIL PASSING 200	74	28	6	19	53	77

BORING NO.	B-7-A	B-7-A	B-7-A	B-7-A	B-7-A	
SAMPLE DEPTH	9.5 - 11'	14.5 - 16'	19.5 - 21'	24.5 - 26'	29.5 - 31'	
CUP NO.	W-22	W-12	W-20	W-28	W-25	
MASS OF CUP (g)	6.5	6.54	6.54	6.48	6.5	
MASS OF CUP + DRY SOIL (g)	158.92	124.4	111.72	161.27	163.84	
MASS OF DRY SOIL (g)	152.42	117.86	105.18	154.79	157.34	
MASS OF CUP + DRY SOIL (g)	48.27	60.89	12.58	56.56	90.07	
MASS OF DRY SOIL (g)	41.8	54.4	6.0	50.1	83.6	
MASS OF SOIL PASSING 200	73	54	94	68	47	

COMMENTS/DEVIATIONS

Christopher Farmer, P.E.

Date

GEOTECH ENGINEERING & TESTING, INC.

Field Classification of Soils

Job Name: Murray Calloway Co. EDC

Job No.: 06303 | Date: 03-13-2009 | Tech.: K. Brown

Boring No.	Depth	Compression	Sample Area (ft^2)	Shear (psf)	Comments
B-2-A	5 – 7'			13313.05	
B-5-A	9.5 – 11'			2048.161	
B-7-A	14.5 – 16'			6963.749	
	19.5 – 21'			9216.726	
B-9-A	2 – 3.5'			6144.484	
	14.5 – 16'			5734.852	

GEOTECH Engineering & Testing, Inc.

500 South 17th Street Paducah, KY 42003

Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass - ASTM D 2216

Project Murray Calloway Co. EDC

Project No. 6303

DATE : 3/12/2009

TECHNICIAN K. Brown

◉ Original
○ Amended

BORING NO.	B-1-A	B-1-A	B-1-A	B-1-A	B-1-A	B-2-A
SAMPLE DEPTH	2 - 3.5'	5 - 6.5'	9.5 - 11'	14.5 - 16'	19.5 - 21'	2 - 3.5'
CUP NO.	C-17	C-72	C-65	C-19	C-34	S-26
MASS OF CUP (g)	25.28	25.62	25.91	25.56	25.4	6.94
MASS OF CUP + WET SOIL (g)	184.75	177.53	185.09	147.75	148.74	491.63
MASS OF CUP + DRY SOIL (g)	174.6	166.09	166.78	100.77	113.68	430.39
MASS OF DRY SOIL (g)	149.32	140.47	140.87	75.21	88.28	423.45
MASS OF WATER (g)	10.15	11.44	18.31	46.98	35.06	61.24
WATER CONTENT (%)	6.8	8.1	13.0	62.5	39.7	14.5
LENGTH OF SPECIMEN (in.)						
DIAMETER OF SPECIMEN (in.)						
AREA OF SPECIMEN ($in.^2$)						
VOLUME OF SPECIMEN, C.F.						
DRY UNIT WEIGHT LBS/C.F.						

BORING NO.	B-2-A	B-2-A	B-2-A	B-2-A	B-3-A	B-3-A
SAMPLE DEPTH	5 - 6.5'	9.5 - 11'	14.5 - 16'	19.5 - 21'	2 - 3.5'	5 - 6.5'
CUP NO.	C-55	C-28	C-46	C-39	C-62	C-35
MASS OF CUP (g)	25.78	25.59	25.25	25.55	25.8	25.4
MASS OF CUP + WET SOIL (g)	158.17	203.77	213.47	207.46	162.8	129.1
MASS OF CUP + DRY SOIL (g)	137.3	176.38	186.66	187.79	144.9	115.43
MASS OF DRY SOIL (g)	111.52	150.79	161.41	162.24	119.10	90.03
MASS OF WATER (g)	20.87	27.39	26.81	19.67	17.90	13.67
WATER CONTENT (%)	18.7	18.2	16.6	12.1	15.0	15.2
LENGTH OF SPECIMEN (in.)						
DIAMETER OF SPECIMEN (in.)						
AREA OF SPECIMEN ($in.^2$)						
VOLUME OF SPECIMEN, C.F.						
DRY UNIT WEIGHT LBS/C.F.						

BORING NO.	B-3-A	B-3-A	B-3-A	B-4-A	B-4-A	B-4-A
SAMPLE DEPTH	9.5 - 11'	14.5 - 16'	19.5 - 21'	2 - 3.5'	5 - 6.5'	9.5 - 11'
CUP NO.	C-3	C-8	C-15	C-70	C-63	C-69
MASS OF CUP (g)	25.42	25.39	24.85	25.75	25.74	25.31
MASS OF CUP + WET SOIL (g)	178.32	242.85	134.88	208.6	163.89	142.88
MASS OF CUP + DRY SOIL (g)	164.64	217.21	112.83	179.41	147.38	133.72
MASS OF DRY SOIL (g)	139.22	191.82	87.98	153.66	121.64	108.41
MASS OF WATER (g)	13.68	25.64	22.05	29.19	16.51	9.16
WATER CONTENT (%)	9.8	13.4	25.1	19.0	13.6	8.4
LENGTH OF SPECIMEN (in.)						
DIAMETER OF SPECIMEN (in.)						
AREA OF SPECIMEN ($in.^2$)						
VOLUME OF SPECIMEN, C.F.						
DRY UNIT WEIGHT LBS/C.F.						

COMMENTS/DEVIATIONS

Christopher Farmer, P.E.

Date

GEOTECH Engineering & Testing, Inc.

500 South 17th Street Paducah, KY 42003

Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass - ASTM D 2216

Project Murray Calloway Co. EDC

Project No. 6303

DATE :	3/12/2009
TECHNICIAN	K. Brown

(•) Original
( ) Amended

BORING NO.	B-4-A	B-4-A	B-5-A	B-5-A	B-5-A	B-5-A
SAMPLE DEPTH	14.5 - 16'	19.5 - 21'	2 - 3.5'	5 - 6.5'	9.5 - 11'	14.5 - 16'
CUP NO.	C-67	C-22	C-53	S-53	C-14	C-10
MASS OF CUP (g)	25.32	25.6	25.44	6.68	25.47	25.56
MASS OF CUP + WET SOIL (g)	171.04	156.39	207.42	525.52	217.56	143.98
MASS OF CUP + DRY SOIL (g)	152.78	120.72	182.61	449.79	188.81	125.19
MASS OF DRY SOIL (g)	127.46	95.12	157.17	443.11	163.34	99.63
MASS OF WATER (g)	18.26	35.67	24.81	75.73	28.75	18.79
WATER CONTENT (%)	14.3	37.5	15.8	17.1	17.6	18.9
LENGTH OF SPECIMEN (in.)						
DIAMETER OF SPECIMEN (in.)						
AREA OF SPECIMEN (in.^{2})						
VOLUME OF SPECIMEN, C.F.						
DRY UNIT WEIGHT LBS/C.F.						

BORING NO.	B-5-A	B-6-A	B-6-A	B-6-A	B-6-A	B-6-A
SAMPLE DEPTH	19.5 - 21'	2 - 3.5'	5 - 6.5'	9.5 - 11'	14.5 - 16'	19.5 - 21'
CUP NO.	C-68	C-60	C-18	C-48	C-40	C-20
MASS OF CUP (g)	25.54	25.64	25.59	25.66	25.35	25.17
MASS OF CUP + WET SOIL (g)	132.49	140.53	157.49	143.53	212.5	156.38
MASS OF CUP + DRY SOIL (g)	116.95	129.31	148.57	132.15	186.72	114.24
MASS OF DRY SOIL (g)	91.41	103.67	122.98	106.49	161.37	89.07
MASS OF WATER (g)	15.54	11.22	8.92	11.38	25.78	42.14
WATER CONTENT (%)	17.0	10.8	7.3	10.7	16.0	47.3
LENGTH OF SPECIMEN (in.)						
DIAMETER OF SPECIMEN (in.)						
AREA OF SPECIMEN (in.^{2})						
VOLUME OF SPECIMEN, C.F.						
DRY UNIT WEIGHT LBS/C.F.						

BORING NO.	B-7-A	B-7-A	B-7-A	B-7-A	B-7-A	B-7-A
SAMPLE DEPTH	2 - 3.5'	5 - 6.5'	9.5 - 11'	14.5 - 16'	19.5 - 21'	24.5 - 26'
CUP NO.	C-27	C-44	C-58	C-71	C-47	C-5
MASS OF CUP (g)	25.47	25.38	25.89	25.94	25.22	24.42
MASS OF CUP + WET SOIL (g)	200.52	221.75	201.42	181.97	155.21	207.23
MASS OF CUP + DRY SOIL (g)	168.91	192.07	178.34	143.8	130.31	180.07
MASS OF DRY SOIL (g)	143.44	166.69	152.45	117.86	105.09	155.65
MASS OF WATER (g)	31.61	29.68	23.08	38.17	24.90	27.16
WATER CONTENT (%)	22.0	17.8	15.1	32.4	23.7	17.4
LENGTH OF SPECIMEN (in.)						
DIAMETER OF SPECIMEN (in.)						
AREA OF SPECIMEN (in.^{2})						
VOLUME OF SPECIMEN, C.F.						
DRY UNIT WEIGHT LBS/C.F.						

COMMENTS/DEVIATIONS

Christopher Farmer, P.E. Date

GEOTECH Engineering & Testing, Inc.

500 South 17th Street Paducah, KY 42003

Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass - ASTM D 2216

Project Murray Calloway Co. EDC

Project No. 6303

DATE: 3/12/2009

TECHNICIAN K. Brown

(•) Original
( ) Amended

BORING NO.	B-7-A	B-8-A	B-8-A	B-8-A	B-8-A	B-8-A
SAMPLE DEPTH	29.5 - 31'	2 - 3.5'	5 - 6.5'	9.5 - 11'	14.5 - 16	19.5 - 21'
CUP NO.	C-9	C-7	C-25	C-51	C-30	C-50
MASS OF CUP (g)	24.5	25.64	25.28	25.52	25.86	25.22
MASS OF CUP + WET SOIL (g)	199.01	158.57	181.97	153.89	134.21	144.81
MASS OF CUP + DRY SOIL (g)	182.43	133.73	163.32	134.53	119.49	125.26
MASS OF DRY SOIL (g)	157.93	108.09	138.04	109.01	93.63	100.04
MASS OF WATER (g)	16.58	24.84	18.65	19.36	14.72	19.55
WATER CONTENT (%)	10.5	23.0	13.5	17.8	15.7	19.5
LENGTH OF SPECIMEN (in.)						
DIAMETER OF SPECIMEN (in.)						
AREA OF SPECIMEN (in.^{2})						
VOLUME OF SPECIMEN, C.F.						
DRY UNIT WEIGHT LBS/C.F.						

BORING NO.	B-9-A	B-9-A	B-9-A	B-9-A	B-9-A	
SAMPLE DEPTH	2 - 3.5'	5 - 6.5'	9.5 - 11'	14.5 - 16'	19.5 -21'	
CUP NO.	C-56	C-36	C-59	C-16	C-4	
MASS OF CUP (g)	25.76	25.44	25.91	25.15	25.4	
MASS OF CUP + WET SOIL (g)	208.08	128.22	129.48	182.57	150.78	
MASS OF CUP + DRY SOIL (g)	183.21	115.07	117.81	157.02	115.44	
MASS OF DRY SOIL (g)	157.45	89.63	91.90	131.87	90.04	
MASS OF WATER (g)	24.87	13.15	11.67	25.55	35.34	
WATER CONTENT (%)	15.8	14.7	12.7	19.4	39.2	
LENGTH OF SPECIMEN (in.)						
DIAMETER OF SPECIMEN (in.)						
AREA OF SPECIMEN (in.^{2})						
VOLUME OF SPECIMEN, C.F.						
DRY UNIT WEIGHT LBS/C.F.						

BORING NO.						
SAMPLE DEPTH						
CUP NO.						
MASS OF CUP (g)						
MASS OF CUP + WET SOIL (g)						
MASS OF CUP + DRY SOIL (g)						
MASS OF DRY SOIL (g)						
MASS OF WATER (g)						
WATER CONTENT (%)						
LENGTH OF SPECIMEN (in.)						
DIAMETER OF SPECIMEN (in.)						
AREA OF SPECIMEN (in.^{2})						
VOLUME OF SPECIMEN, C.F.						
DRY UNIT WEIGHT LBS/C.F.						

COMMENTS/DEVIATIONS

Christopher Farmer, P.E. Date