GEOTECHNICAL REQUIREMENTS
for the preparation of
Design Build Solicitation Packages for the
Louisville District COE
04-07

Purpose: The purpose of this document is to outline the geotechnical requirements for the preparation of Design Build (DB) solicitation packages for Louisville District's military construction projects. This document is to assist the AE with preparation of the geotechnical portion of the 01 02 10.00 06 Guide Specification and to provide direction to his geotechnical specialist/subcontractor. Clarifications about this guidance can be obtained from Chris Karem (502) 315- 6370.

1.0 Applicability of Guide Specification 01 02 10.00 06

The AE will use the 01 02 10.00 06 Guide Specification for preparation of DB solicitation packages (RFPs) for most Military Construction projects for the Louisville District Corps of Engineers (COE). One exception to this is Army Reserve DB Projects. Army Reserves projects generally follow this same procedure; but use a slightly different guide specification. The guidance herein details geotechnical requirements that the AE and his geotechnical specialist/subcontractor should be familiar with it at very early stages of the project. Besides Army Reserve projects, there may be other projects that require another version of a guide specification that addresses geotechnical requirements. With use of any Guide Specification format, the geotechnical requirements described in this document and in Guide Specification 01 02 10.00 06 are applicable; therefore, specific language within Guide Specification 01 02 10.00 06 is given below. Any deviations from the requirements presented herein must be approved through the COE AE manager for all Louisville District Projects. It should be noted that the guidance herein is changed on a regular basis (based on lessons learned), please verify that you access the Louisville Design Guide Website for each job to assure you are using the most up to date guidance. Also, standard DB templates such as the Army Reserves template often take longer to update; therefore, the guidance herein generally takes precedence over templates. Please verify that the most current version of this document is considered even when a standard template is used.

2.0 Discussion of Geotechnical Studies (General):

For DB solicitation packages (RFPs), in general, the geotechnical report in the RFP package **shall not include recommendations**, just appropriate background information, boring logs and laboratory testing. This is so the DB Contractor's Designer of Record (DOR) is responsible for the extraction of design parameters from the data given and thus is responsible for the design. This requires the DB Contractor to have a geotechnical team member involved early.

Defining the subsurface conditions at a site is most complete if the RFP package includes a "Full Geotechnical Characterization Report" (that is enough boring and laboratory information to get complete coverage and representation of the site). A Full Characterization Report is most appropriate to avoid differing site conditions and thus claims. Sometimes, for whatever reason

(generally the reason is we don't know where the building is going on the site), the RFP will only contain a "Preliminary Geotechnical Characterization" (that is fewer borings). In this case we require the DB Contractor to base his bid on the preliminary information then to verify that the data is representative by performing additional investigation after award and prior to his design. This requirement is described in the Guide Specification 01 02 10.00 06 (and the verbiage is included in Section 4.0 of this document). Make sure you get with your COE AE manager to discuss the approach he/she wishes to take on each individual project (see Section 3. of this document for more detail).

Please understand that all the standard language below is not cut in stone (it is guidance). It is primarily applicable if we don't anticipate problems with foundation and pavement support conditions or unknowns such as large quantities of unexpected rock removal. If the geotechnical data obtained for the DB solicitation package indicates problem conditions such as soft soils, uncontrolled fills, shallow or unpredictable bedrock removal quantities, we may want to modify the DB solicitation packages to try to proactively avoid potential issues we may encounter after award (such as modifications due to differing site conditions). For example, if we know the soils are not suitable for shallow foundations based on the borings, we may want to specify a foundation type in the DB solicitation package; therefore, we expect our AE to not just plug the language we give below without considering the geotechnical ramifications. We require that the geotechnical borings be done in a timely manner so if there are indications of problems; our AEs shall call us and tell us that there may be issues and get our input to the solution.
Sometimes, we may want to direct bidders to design the foundation system or pavements or other geotechnical features we want them to use based on customer preference or other reasons. This is okay to do as long as the language makes it clear in the RFP package. Communication with the Corps of Engineer's AE manager is key.

Pavements: It is important that expected traffic loading criteria for the design of proposed roads and parking lots is gathered by the preparer of the solicitation package so potential design-build contractors have the correct parameters on which to base there bid. Traffic loading criteria shall include the exact vehicle types and the number of passes for each vehicle over the design life of the pavement. The "basis" for this information must be obtained from the customer by an experience pavement designer who can make sound judgments to interpret the customer information and translate it into a reasonable traffic loading criteria on which the DB contractor can base his bid. In addition, the desired design life of the pavement (generally 20 years) must be obtained from the customer and specified in the DB RFP.

Background information: For projects within and outside the Louisville Districts traditional military boundaries, such as many of the Reserves Projects, the AE (or his geotechnical subcontractor) shall to contact the project's nearest Military Corps of Engineer District (known as the Servicing Corps Geographic-District), Geotechnical Engineering Department and the engineering authority (such as the base civil engineer) at the facility the construction will be performed and inquire about standard construction techniques relative to foundations, pavements and earthwork in the area and incorporate applicable requirements into the DB specifications. In addition, Pavement Minimums for projects outside the Louisville District boundaries will be obtained from the project's Servicing Corps Geographic-District. Take this opportunity to get background information relative to experience within the area, such as know swelling soil

potential where bell shaped drilled piers are typically used instead of shallow spread footings and where lime stabilization is typically used beneath paving or if known seismic conditions requiring remediation are encountered, etc….

Specific Information Relative to Frost Penetration and use of the UFC:
Paragraph 1-6.6 of UFC 3-310-01: 1-6.6 IBC Section 1805.2.1 – Frost Protection. The minimum depth of footings below the undisturbed ground surface shall be 305 mm (12 inches) or as determined by the local building code, whichever is greater. Protect foundation walls, piers and other permanent supports of buildings and structures from frost as described in the IBC as modified by UFC 1-200-01.

The minimum frost protection depths prescribed by the local building code shall be used where available. Depths to the frost line have been identified in table C-1 for locations within the United States, territories and possessions, and in table D-1 for specific locations outside of the United States. Use the best available locality information at locations where frost depth values are not provided. The design frost depth shall be the lesser of the values prescribed in the local building code or these tables. In some unusual cases, it may be necessary to run thermal models to substantiate that the frost will not penetrate below the foundation. For additional guidance contact the authorizing design agency.

3.0 AE Submission of Drilling Program.

The AE shall complete the “Proposed Geotechnical Exploration Data" sheet (see Exhibit 44 of this document) outlining the proposed scope of exploration and return it as an attachment to the fee proposal before negotiation of the original contract. The character and extent of the exploration shall be designed in consideration of the importance of the structure to be constructed. The submission shall contain enough information such that the AE demonstrates he understands the guidance and requirements presented herein. The “Proposed Geotechnical Exploration Data” sheet is merely a guide for the exploration and is flexible; the final program shall be developed as information accumulates in order to obtain the greatest amount of useful information in the most cost effective manner.

4.0 Guide Specification (01 02 10.00 06). Specific language associated with Geotechnical Studies within Guide Specification 01 02 10.00 06 is presented below **(notes are bolded)**. Paragraph numbering below is consistent with 01 02 10.00 06 and will have to be rearranged for projects where other Guide Specification formats are used.

4.8 GEOTECHNICAL STUDIES

4.8.1 Subsurface Characterization Report:

Note: Use the 1st paragraph below (Example 1) as a guide if a “Full Characterization Report” as described in the under Section 2 above is being provided in the solicitation package and use the 2nd paragraph below (Example 2) if a “Preliminary Characterization Report” as described in Section 2 above is being

provided in the solicitation package. Appropriately modify the language below if other than a "Full Characterization Report or Preliminary Characterization Report" is being provided in the solicitation package.

Example 1.
A report has been prepared to characterize the subsurface conditions at the project site and is appended to these specifications. The report provides a general overview of the soil and geologic conditions with detailed descriptions at discrete boring locations. The Contractor's team shall include a licensed geotechnical engineer (with at least 10 years experience specializing in geotechnical engineering) to interpret the report and develop earthwork and foundation requirements and design parameters on which to base the Contractor's proposal. Foundation type, pavement and earthwork requirements on which the Contractor's bid is based shall be presented in his proposal along with the resume of the geotechnical engineer. If any additional subsurface investigation or laboratory analysis is required to better characterize the site or develop the final design, it shall be performed subsequent to the award under the direction of a licensed geotechnical engineer and shall be the full responsibility of the Contractor.

Example 2.
A preliminary report has been prepared to characterize the subsurface conditions at the project site and is appended to these specifications. The report provides a general overview of the soil and geologic conditions with detailed descriptions at discrete boring locations. The Contractor's team shall include a licensed geotechnical engineer to interpret the subsurface conditions (assuming they are consistent with the site subsurface conditions) and develop earthwork and foundation requirements and design parameters on which to base the Contractor's proposal. Foundation type, pavement and earthwork requirements on which the Contractor's bid is based shall be presented in his proposal along with the resume of the geotechnical engineer. Subsequent to award, the Contractor is required to perform and provide a complete geotechnical exploration of the proposed site to develop the final design. The geotechnical exploration shall be performed under the direction of a licensed professional engineer with at least 10 years experience specializing in geotechnical engineering. This exploration shall be the full responsibility of the Contractor and detailed requirements are outlined below. It is possible that site specific subsurface conditions encountered by the Contractor will differ from those appended herein. Therefore, it is the responsibility of the Contractor to establish a meeting with the COR subsequent to completion and evaluation of his site specific geotechnical exploration to outline any differences encountered that are not consistent with the information provided herein. Should those differences require changes in the foundation type, pavement and earthwork requirements proposed with the bid that result in more cost, these differences shall be clearly outlined for the meeting.

4.8.2 Contractor's Geotechnical Report**:**

A final geotechnical evaluation report shall be prepared by the Contractor's licensed geotechnical engineer and submitted along with the first foundation design submittal (Note: add the following statement to the end of this sentence if a full characterization

report is performed: “using the data in RFP package”). This report shall summarize the subsurface conditions; provide requirements for the design of appropriate foundations, floor slabs, retaining walls, embankments, and pavements. The Contractor’s Geotechnical Report shall specify the type foundation system to be used, lateral load resistance capacities for foundation systems, allowable bearing elevations for footings, grade beams, slabs, etc. An assessment of post-construction settlement potential including total and differential shall be provided. Requirements regarding lateral earth pressures (active, at-rest, passive) to be used in the design of retaining walls shall be provided. The report shall include the required spectral accelerations and Site Class for seismic design along with an evaluation of any seismic hazards and requirements for mitigation, if necessary. Calculations shall be included to support the requirements for bearing capacity, settlement, and pavement sections. Supporting documentation shall be included for all required design parameters such as Site Class, shear strength, earth pressure coefficients, friction factors, subgrade modulus, California Bearing Ratio (CBR), etc. In addition, the report shall provide earthwork requirements, expected frost penetration, expected groundwater levels, requirements for dewatering and groundwater control, possible presence of any surface or subsurface features that may affect the construction of the project such as sinkholes, boulders, shallow rock, old fill, old structures, soft areas, or unusual soil conditions.

The DB Contractor and the professional geotechnical engineer consultant shall certify in writing that the design of the project has been developed consistent with the Contractor’s final Geotechnical Report. The certification shall be stamped by the consulting professional geotechnical engineer and shall be submitted with the first design submission. If revisions are made to the initial design submission, a new certification shall be provided with the final design submission.

4.8.2.1 Pavements: The Contractor’s Geotechnical Report shall contain flexible and rigid pavement design(s) including design CBR and modulus of subgrade reaction and the required compaction effort for subgrades. Information shall be offered on the types of base course materials available in the area and design strengths. Pavement designs shall be included in the report. Pavement Designs shall be in accordance with appropriate Army Technical Manuals. Specifically: TM 5-809-12 (slab on grade), TM 5-822-2 (general Provisions) and TM 5-822-5 (flexible and rigid pavement designs and drainage). TM 5-822-12 (Design of Aggregate Surfaced Roads, Airfield Areas, etc) and ETL 1110-1-189 (Geogrids). See attached important notes for Use of TM 5-822-5. PCASE software is also an acceptable method. Regardless of the pavement design, a minimum flexible pavement section shall consist of 3.5 inches of asphalt (1.5 inches of surface course and 2 inches of base course) and 8 inches of aggregate subbase and/or base. Regardless of the pavement design, a minimum rigid pavement section shall consist of 6 inches of concrete and 8 inches of aggregate subbase and/or base. The minimum subbase/base can be neglected if the subgrade has a CBR greater than 30. Here is a hot link to Corps Guidance Documents: http://www.usace.army.mil/inet/usace-docs/.

Pavement designs over specific cohesive soil subgrades (CL, CH or ML in accordance with the Unified Soil Classification System (USCS) and soils with 15% or more passing the #200 sieve) require underdrain systems and the pavement sections shall consist of an open graded free draining aggregate that serves as a drainage layer directly below the asphalt or concrete underlain by a densely graded aggregate. The densely graded aggregate must also act as a separation layer such that subgrade soils do not migrate into it. An evaluation of the grain size of the subgrade soils and the proposed aggregate that interfaces with it shall be performed to verify migration will not occur. Alternatively, a geotextile can be used for separation. The drainage layer shall be choked off (if necessary to accommodate paving equipment). Underdrains shall be provided as necessary to collect and remove infiltration from beneath the pavement (see Exhibit 44.5 of this document for typical underdrain details).

Pavement designs over granular soils (less than 15% passing the #200 sieve) shall generally have a single aggregate base consisting of an open graded free draining aggregate. This aggregate must also act as a separation layer such that subgrade soils do not migrate into it. An evaluation of the grain size of the subgrade soils and the proposed aggregate that interfaces with it shall be performed to verify migration will not occur. Alternatively, a geotextile can be used for separation. This aggregate shall be choked off, if necessary, to accommodate paving equipment.

Plans and specifications shall detail all of the specific aggregates proposed in the pavement design per state DOT designations and gradations including the aggregate used to choke off drainage layer aggregates to accommodate paving equipment.

Important Note Regarding Use of TM 5-822-5 for Flexible Pavement Frost Design for the Louisville District Corps of Engineers: When the "Design Index" from Table 3-1 (TM 5-822-5) is less than 4 and an underdrain system is provided for cohesive soils, the applicable "Support Index" from Table 18-3 (TM5-822-5) can be raised to the next highest Support Index (from Table 18-3) to determine the Frost Design Thickness of the pavement. For example, if the "Design Index" (Table 3-1) is less than 4 and an underdrain system is provided because the subgrade is Silty Clay soil (CL in accordance with the Unified Soil Classification System (USCS)) the "Frost Group" from Table 18-2 would be F4. The corresponding Soil Support Index to a Frost Group of F4 is 3.5 (Table 18-3). Because the underdrain system is provided, the next highest Support Index (6.5) can be used to determine the Frost Design Thickness of the pavement.

Important Note Regarding use of TM5-822-5 for Rigid Pavement Frost Designs for the Louisville District Corps of Engineers: When the "Design Index" from Table 3-1 (TM 5-822-5) is less than 4 and an underdrain system is provided for cohesive soils, the applicable Frost Group from Table 18-2 can be modified for use in Figure 18-5 as follows. Frost Groups F3 and F4 can be changed to Frost Groups F2 and S2 and Frost Groups F2 and S2 can be changed to F1 and S1.

Pavement designs for roads and parking areas will be based on the following traffic loading conditions and design life **[NOTE: The AE preparing the DB RFP will put site specific traffic loading criteria here: Traffic loading criteria shall include the exact vehicle types and the number of passes for each vehicle over the design life of the pavement. The "basis" for this information must be obtained from the customer by an experience pavement designer who can make sound judgments to interpret the customer information and translate it into a reasonable traffic loading criteria in which the DB contractor can base his bid. In addition, the desired design life of the pavement (generally 20 years) must be obtained from the customer and specified in the DB RFP in this location]**

This paragraph is to inform the DB contactor that often SUPERPAVE is the method used for pavement projects. It is our experience on several occasions that "selected binder grade" (SUPERPAVE Terminology) used has been incorrect resulting in rutting and/or excessive cracking. Often the State DOT specifications do not appropriately address this issue and therefore can not be singularly depended on for an acceptable product. Therefore, if SUPERPAVE is utilized, it is essential that the DB contractor use appropriate SUPERPAVE design techniques.

4.8.2.2 Cathodic Protection and Grounding Systems. The report shall include pH tests, salinity tests, resistivity measurements, etc., required to design corrosion control and grounding systems. The raw field data shall be provided in the report. The Contractor shall design all corrosion control and grounding systems required for the project.

4.8.2.3 Dewatering: The report shall determine project dewatering requirements. If temporary construction dewatering is required due to a high water table, the Contractor shall prepare and present a dewatering plan. The Contractor shall be responsible for securing all the required information necessary for the design of the system.

4.8.2.4 Additional Borings: Any additional borings shall be sampled with a splitspoon sampler in accordance with ASTM D-1586, with samples visually classified at 1.5 foot intervals in accordance with the Unified Soil Classification System (ASTM D 2487). The depth to water shall be recorded. Standard Penetration Blow counts shall be recorded. A dated drilling log shall be provided for each boring drilled. Soils information obtained from field logs, laboratory tests and geologist's logs shall be presented on the contract drawings in the form of boring plan, final boring logs and explanatory notes. See Exhibit 45 attached to this document for an example of boring logs.

4.8.3 Soil Compaction and Foundation Excavations:

Soil Compaction shall be achieved by equipment approved by a professional geotechnical engineer. Material shall be moistened or aerated as necessary to provide the moisture content that shall readily facilitate obtaining the compaction specified with the equipment

used. Each layer of fill placement shall be no greater than **[usually 8]** inches thick. Compact each layer to not less than the percent of maximum density specified in Table 4-1, determined in accordance with ASTM D-1557}.

Table 4-1 Soil Compaction	
Foundations	**[95%]**
Concrete Work and Pavements	**[90%]**
Landscaping	**[85%]**
Retaining Wall Backfill	**[85 – 90%]**

The requirements shall be verified or modifications recommended by the consulting professional geotechnical engineer in the report whenever engineering, soils or climatic factors indicate the necessity. Any modifications to the stated compaction requirements shall require approval from the COR.

Subgrade suitability (by proof rolling operations), fill placement and compaction operations shall be observed and tested on a full time basis by a qualified independent testing agency as directed by the Contractor's project geotechnical engineer.

During construction, all foundation excavations shall be inspected and approved by the Contractor's project professional geotechnical engineer prior to placing concrete.

Date_____

PROPOSED GEOTECHNICAL INVESTIGATION DATA

FY:_____Project:_____

Location:_____

Project Number:_____Programmed Amount:_____

A-E Name:_____

A-E Location:_____

Geotechnical Consultant:_____

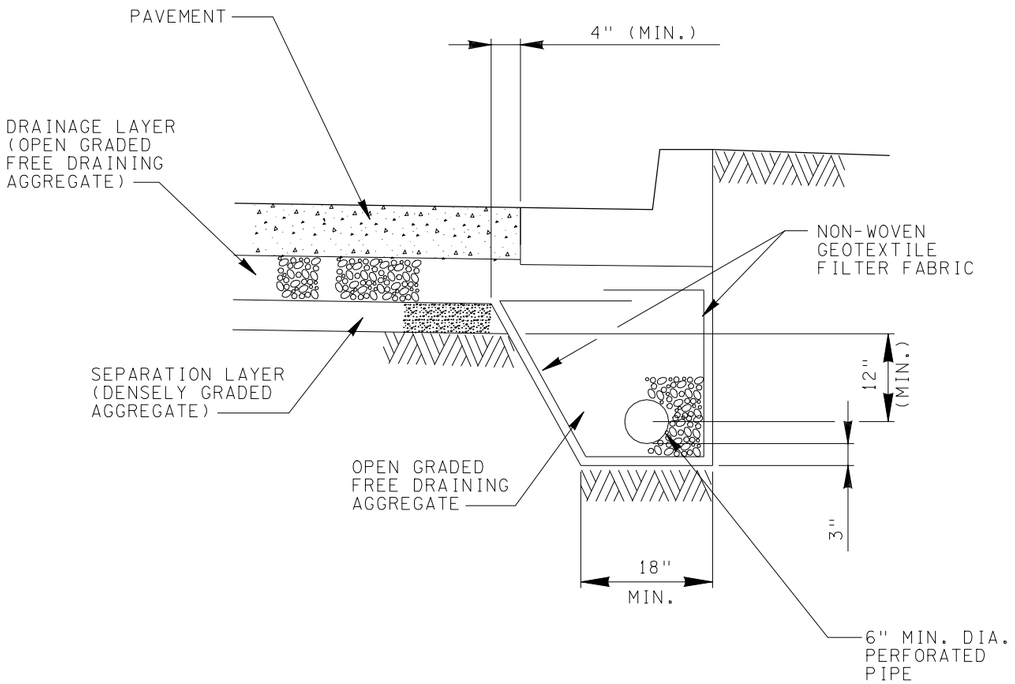
Geotechnical Consultant Location:_____

1. In the space below, draw a footprint of the proposed facility as depicted in the Project Design Brochure/Requirements and Management Plan. Indicate approximate locations where borings, test pits. etc. will be taken. Also, indicate to what approximate depth the borings will be taken (i.e. 20'. 50', refusal, etc.). Approximate dimensions and adjacent major buildings or other site features should be shown.

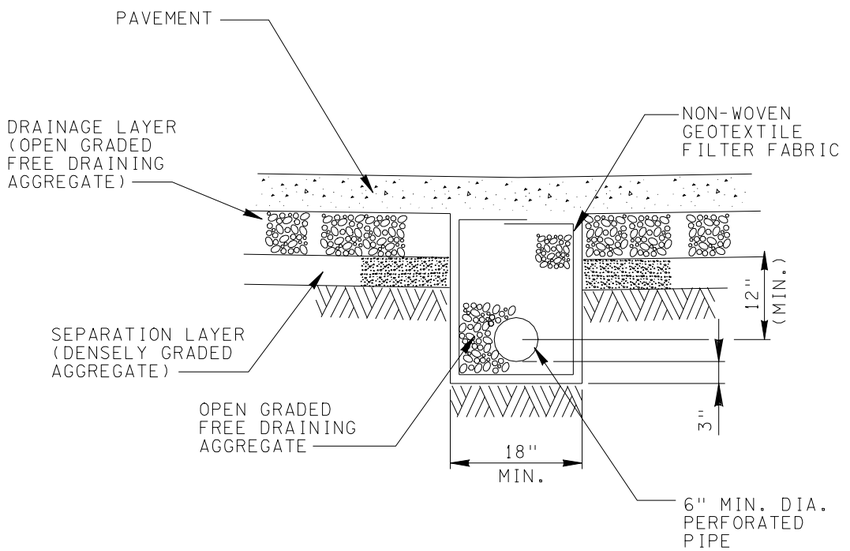
_____

2. Indicate below, by checking the appropriate column, which of the items listed will be included in your proposed geotechnical investigation program (i.e. sampling, testing, etc.)

Yes	No	Qty.	Item Description
			A. Field Sampling
____	____	____	1. Standard Penetration Test
____	____	____	2. Test Pits
____	____	____	3. Bag Samples
____	____	____	4. Shelby Tubes
____	____	____	5. Rock Coring (Size)
			B. Field Testing
____	____	____	1. Pressuremeter
____	____	____	2. Cone Penetrometer
____	____	____	3. Vane Shear
____	____	____	4. Geophysical (e.g. electrical resistivity)
____	____	____	5. Plate Bearing
			C. Laboratory Testing
____	____	____	1. Moisture Contents
____	____	____	2. Atterberg Limits
____	____	____	3. Unit Weights
____	____	____	4. Particle Size Analysis
____	____	____	5. Unconfined Compression Test
____	____	____	6. Consolidation Test
____	____	____	7. Modified Proctor
____	____	____	8. CBR
____	____	____	9. Triaxial
____	____	____	10. Direct Shear
____	____	____	11. Permeability
____	____	____	12. Swell
____	____	____	13. Relative Density



TYPICAL SHOULDER UNDERDRAIN DETAIL



TYPICAL INTERIOR UNDERDRAIN DETAIL

EXHIBIT 44.5

BORING NO. AD-6

PROJECT FT CAMPBELL - ENLISTED BARRACKS
DATE START 11/05/92 COMPLETE 11/05/92
LOCATION: AS SHOWN
DRILLING AGENCY C of E BK 897 PG 80
DRILLER: B HOWARD INSPECTOR: HB
DRILL TYPE: CME 75
DRILL METHOD: 6 5/8" HSA & SPT
THICKNESS OF OVERBURDEN: 15.0
DEPTH CORED INTO ROCK: 0.0
TOTAL DEPTH OF BORING: 15.0'
DIR. OF BORING X VERT. _INCLINED__ DEG

INSTRUMENT INSTALLED NONE
SURFACE ELEVATION: 552.5'
DATUM FOR ELEVATION CONTOUR

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
552.5	SURFACE COVER-									
551.5	No Topsoil - Plowed Hay - Wheat field	T CL				A			SPT-Auto Hammer	1
	Lt tan sl silty CLAY, moist, MED STIFF	CL	4 3 4	1.50	1	J				2
548.5						A				3
	Lt gry to tan mottled sl silty CLAY, moist, STIFF	CL	3 5 9	1.50	2	J	21			4 5
545.5						A				6
	Rusty red to brn sl silty CLAY, moist, STIFF	CL	4 5 6	1.50	3	J	23			7 8
542.5						A				9
	Rusty red sl silty CLAY, moist to damp, STIFF TO V. STIFF	CL	4 6 10	1.50	4	J	30			10 11
						A				12 13
537.5	BORING TERMINATED		6 6 8	1.50	5	J	23		No Groundwater	14

SHEET 1 OF 1

BORING NO. AD-6

EXHIBIT 45