



**REQUEST FOR PROPOSALS  
PROFESSIONAL SERVICES**



RFP Number: **1876\*** et al.

**SUBSURFACE INVESTIGATION SERVICES**

Submission Due Date/Time: **Thursday, November 30, 2017 at 2:00 P.M. Local Time**

Three (3) year Term with two (2) possible one-year extensions.

Agreement Type: State (On-Call)

\*Multiple agreements may be awarded from this solicitation.

The resulting agreements will utilize State funding.

The anticipated methods of payment are cost per unit of work

29 Del.C. §6981, §6982(b)

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**PROJECT INFORMATION**

This Request for Proposal (RFP) issued by the Delaware Department of Transportation is for the purpose of acquiring proposals from interested firms to provide the necessary materials, labor, and equipment, including mobilization and maintenance of traffic, to perform geotechnical investigations, and other incidentals in accordance with the location, notes, and details, provided by and as directed by the Department.

**PROJECT DESCRIPTION**

**General Description:            Location and Work Area Conditions**

The work shall be performed in locations Statewide and in any terrain. The work may be located within riverbeds, canals, fat clay areas, marshes, bedrock, weathered rock, sandy areas, etc. The anticipated equipment required to perform work under this Agreement may include: barge mounted equipment - utilized approximately 0-5% of the time; all-terrain vehicles - utilized approximately 30-45% of the time; rock drilling - utilized approximately 20-25% of the time; and all other will be standard penetration testing (SPT), including undisturbed sampling (55-70%).

**Testing Measures A:            Drilling**

Subsurface investigations shall be advanced through unconsolidated, partly consolidated sediment, and/or rock, or rock core drilling. In addition to these disturbed samples, undisturbed samples shall be taken as designated by the Engineer through the use of a thin walled metal tube, also referred to as a Shelby tube. geo-probes shall be used when needed and as designated by the Engineer.

**Testing Measures B:            Miscellaneous Testing**

This Agreement may also include the following tests: observation wells (for visual groundwater level purposes); infiltration testing through the use of the double-ring or borehole infiltration (to measure vertical infiltration rates for storm water management design purposes); and piezometer testing (to measure groundwater levels and pore water pressure.) The exact testing will be designated by the Engineer. Other testing that may be requested under this agreement may include Soil Index, Triaxial, Direct Shear, Unconfined Compressive Strength of Intact Rock Core and pH Resistivity.

**Time Schedule: Typical Schedule**

The completion time for a subsurface investigation varies depending upon the conditions and the scope of work. The steps that occur are as follows: selected firm notified of work, initial field meeting, budget proposal submitted by selected firm to Engineer, Engineer reviews budget (changes/modifications as needed), utility call-in by the selected firm, utility meeting held by the selected firm (based on the utilities involved in the drilling location), drilling and other tests, and sample and reporting drop-off. The exact time it takes for the above process to occur will depend upon the complexity of the work.

**Other Requirements A: Maintenance of Traffic (MOT)**

The selected firm shall be responsible for setting up MOT as defined in DelDOT’s Traffic Control Manual for drilling and other testing procedures unless otherwise directed by the Engineer. The exact locations will dictate which type of MOT set-up is necessary (e.g. two lane roadway (one lane closed) vs. shoulder closure). Department personnel will review the MOT plan. The selected firm is responsible for notifying the Transportation Management Center (TMC).

**Other Requirements B: Skill Set, Experience, and Special Equipment**

Selection criteria includes experienced staff in drilling throughout Delaware in sandy, rock, and clay soil conditions, as well as the testing methods mentioned above.

**Other Requirements C: Licenses and Permits**

Any employee of the selected firm that drills under this contract must possess a Delaware Well Driller’s License. This is obtained through the State of Delaware’s Department of Natural Resource and Environmental Control. Any required permits for drilling are the sole responsibility of the selected firm(s).

**Item Descriptions: Appendices A, B**

The Item Descriptions in Appendix A define the work and equipment included in each listed Item. Appendix B is to be submitted indicating the proposed pricing for each of the Items.

**QUESTIONS**

Questions are to be emailed to [DOT.Profservices@state.de.us](mailto:DOT.Profservices@state.de.us). In order to ensure a timely response, questions must be submitted according to the Procurement Schedule section of this RFP. The Department’s response to questions, along with this RFP and related information, are posted on the State of Delaware Bid Solicitation Directory Website: <http://www.bids.delaware.gov/>.

**PROCUREMENT SCHEDULE**

| Action Item                                | Date   | Time                 |
|--|--|----------------------|
| Deadline for Questions to ensure response: | Seven (7) business days prior to the proposal due date | 2:00 P.M. Local Time |
| Final Response to Questions posted by:     | Five (5) business days prior to the proposal due date  | 2:00 P.M. Local Time |
| Proposals Due by:*                         | Thursday, November 30, 2017                            | 2:00 P.M. Local Time |

**NOTE:** Only asterisk (\*) marked date changes will be communicated (via posted Addendums).

## **PROPOSAL REQUIREMENTS**

Interested firms must submit the material required herein or they may not be considered for the project:

1. Proposals must be received prior to the Submission due date and time indicated above.

Facsimile and E-mail responses to this RFP are not acceptable. No response hand-delivered or otherwise will be accepted after the above date and time. It is the responsibility of the submitter to ensure the Proposal is received on time. DelDOT's time is considered the official time for determining the cut-off for accepting submissions. To be considered for this agreement, firms must submit the Proposal as set forth herein. Any variation, including additions, may negatively impact the scoring.

### **Proposals are to be delivered to:**

Contract Administration – RFP 1876\*  
Delaware Department of Transportation  
800 Bay Road, Dover, DE 19901

Should the office be closed at the time responses are due (such as an unexpected event or inclement weather) the submission due date shall be the following business day, at the time originally scheduled.

2. **The Prime Consultant must be Registered**, or submit application for registration with DelDOT at or before the time of submission in order to be considered. For registration information, click [here](#).
3. **Submit one (1) original and five (5) hard copies** of the Proposal and Appendix B Pricing. Receipt of insufficient copies or non-compliance with providing the requested information in the desired format, may negatively impact the scoring.
4. **Submit two (2) pdf format electronic copies** (e.g. CD, flash drive) of the Proposal; one original and one a redacted copy. The original must be a .pdf file of the original signed proposal as submitted and should be clearly marked “Original”. The redacted copy must be a .pdf file of the original signed proposal with any proprietary or confidential information redacted, and this copy should be clearly marked as “Redacted”. Electronic copies are to be submitted with the printed Proposal. The electronic redacted copy is required even if the submission contains no proprietary or confidential information.

Firms should review Delaware’s Freedom of Information Regulations [here](http://regulations.delaware.gov/AdminCode/title8/1400.shtml#TopOfPage); <http://regulations.delaware.gov/AdminCode/title8/1400.shtml#TopOfPage> to determine what information may be considered proprietary or confidential and may be redacted from their SOQ.

5. **Submit one (1) spreadsheet format electronic copy** (e.g. CD, flash drive) of the Appendix B Pricing Worksheet (printed copies are also to be submitted per paragraph 3 above).
6. **Architect-Engineer Qualifications; GSA SF330:** <http://www.gsa.gov/portal/forms/download/116486>

Follow instructions for the SF330, and add the following Individual Agency Instructions:

#### **A. Part I Section E, Resumes of Key Personnel Proposed for this Contract;**

- Provide resume information for each employee that will work on this contract. Indicate if employee has a current Delaware Well Driller’s License.

#### **B. Part I Section F, Example Projects;**

- Example Projects provided are limited to ten (10).
- List experience in the following areas including; private companies, federal and/or state work, rock coring, cohesive boring, and running sand boring.
- The submittal must include the customer, contact person and telephone number, amount of contract, services provided, and brief summary of work provided.

**C. Part I Section H 30, Additional Information;**

- Submit an equipment list of both drilling and auxiliary equipment and indicate if equipment is owned or intended to be rented. Common required equipment includes; Infiltration testing equipment (especially double-ring infiltrometer), GPS locator for exact location of boring holes (for design purposes), Backhoe, Dozer, Track-hoe, among other equipment.
- Firms may include "Rating Criteria Support Information" limited to four (4) pages on two (2) sheets of paper within Section H that covers any information that directly relates to your ability to meet the specific rating criteria cited within the RFP document.
- Letters of Interest should not be included.

7. **Joint venture** submissions will not be considered.
8. **DelDOT reserves the right to reject** any and all submissions. Submissions become property of the Department and shall be retained electronically for a minimum period of three (3) years from the date of receipt. DelDOT reserves the right to any and all ideas included in this response without incurring any obligations to the responding firms or committing to procurement of the proposed services.
9. **Required Certification Form.** All firms responding to the RFP must complete and return the Certification of Eligibility form for this document.

No promotional materials or brochures are to be included as part of the submission.

**RATING CRITERIA**

| #       | Criteria Description:                           | Weight       |
|---------|---|--------------|
| 1       | Vendor Pricing Worksheet                        | 40 %         |
| 2       | Experience of Contractor                        | 20 %         |
| 3       | Skill and Experience of Employees               | 20 %         |
| 4       | Equipment List, Access to Equipment when needed | 10 %         |
| 5       | Completeness of Submitted Log Form              | 10 %         |
| TOTAL : |   | <b>100 %</b> |

**OVERVIEW OF SELECTION PROCESS – STATE (ON-CALL)**

- This is an On-Call agreement utilized for the performance of services for a number of projects under task orders issued on an as-needed basis.
- The Selection Committee will determine all applicants that meet the minimum qualifications to perform the required services based upon the listed criteria and evaluation of each firm’s submitted proposal.
- Selection Committee members will individually score each firm’s submitted proposal which determines individual ranking. The Department’s ranking is the combined ranking of all Committee members.
- Pursuant to 29 Del. C. § 6986, the Department may award a contract to two or more vendors if the agency head makes a determination that such an award is in the best interest of the State of Delaware.
- The Department notifies via email the awarded firm(s) of the opportunity to enter into an agreement with the Department. This notification also includes information on the next steps for the negotiation and agreement process.
- Awarded firms will have the opportunity to negotiate an agreement with the Department. The Department may negotiate with one firm without terminating negotiations with another firm and may negotiate with one or more firms during the same period. At any point in the negotiation process, the agency may, at its discretion, terminate negotiations with any or all firms.

- As part of the negotiation process, applicable price information will be requested from the awarded firm(s), such as; salary rates for various classifications of personnel; and an indirect cost derivation for the most current accounting period.
- Indirect cost rates will be computed on direct salary costs only (when applicable, and not including overtime) at the consultant's audited rate, as per Federal Acquisition Regulations Part 31, and Department policies. Computer and CADD costs are not allowable as a direct cost to this project. Rate determination and applicability is subject to audit by the Department. Additionally, candidates should be prepared for the Department to work with your current accounting firm to provide information and backup documentation. Full and immediate cooperation is required to avoid delays in execution of an agreement. Failure to cooperate may result in breaking off of negotiations.
- Selection Committee membership appointments are confidential. The Department's Professional Services Procurement Manual may be viewed [here](#).

### **MISCELLANEOUS**

The Department is not liable for any cost incurred by the consultant in the preparation or presentation of the Proposal.

Any individual, business, organization, corporation, consortium, partnership, joint venture, or any other entity including subconsultants currently debarred or suspended is ineligible to participate as a candidate for this process. Any entity ineligible to conduct business in the State of Delaware for any reason is ineligible to respond to the RFP.

The Department of Transportation will affirmatively insure individuals and businesses will not be discriminated against on the grounds of race, creed, color, sex, or national origin in consideration for an award. Minority business enterprises will be afforded full opportunity to submit bids/proposals in response to this invitation.

Department of Transportation  
State of Delaware  
By: Jennifer Cohan  
Secretary  
Dover, DE

**CERTIFICATION OF ELIGIBILITY**

**Delaware Department of Transportation**

**1876\* SUBSURFACE INVESTIGATION SERVICES**

We have read Request for Proposal and fully understand the intent of the RFP as stated, certify that we have adequate personnel and knowledge to fulfill the requirements thereof, and agree to furnish such services in accordance with the contract documents as indicated should we be awarded the contract.

**NON-COLLUSION STATEMENT:**

This is to certify that the undersigned Vendor has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal,

It is agreed by the undersigned Vendor that the signed delivery of this proposal represents the Vendor's acceptance of the terms and conditions of this solicitation including all specifications and special provisions.

**AFFIRMATION:**

Within the past five years, has your firm, any affiliate, any predecessor company or entity, owner, Director, officer, partner or proprietor been the subject of a Federal, State, Local government suspension or debarment?

YES \_\_\_\_\_ NO \_\_\_\_\_ if yes, please explain \_\_\_\_\_

COMPANY NAME \_\_\_\_\_

NAME OF AUTHORIZED REPRESENTATIVE: (Please print) \_\_\_\_\_

SIGNATURE \_\_\_\_\_ TITLE \_\_\_\_\_

COMPANY ADDRESS \_\_\_\_\_

PHONE NUMBER \_\_\_\_\_ FAX NUMBER \_\_\_\_\_

EMAIL ADDRESS \_\_\_\_\_

NOTE: Signature of the authorized representative **MUST** be of an individual who legally may enter his/her organization into a formal contract with the State of Delaware, Department of Transportation.

**THIS PAGE SHALL HAVE ORIGINAL SIGNATURE, BE NOTARIZED AND RETURNED WITH YOUR PROPOSAL**

SWORN TO AND SUBSCRIBED BEFORE ME this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_

Notary Public \_\_\_\_\_ My commission expires \_\_\_\_\_

City of \_\_\_\_\_ County of \_\_\_\_\_ State of \_\_\_\_\_

**Item #1 Description**  
**SOIL BORING, WATER (605539)**

**Description:**

This work consists of advancing soil borings (drillings) through unconsolidated or partly consolidated sediments or decomposed rock by use of Hollow Stem Augers (HSA) or Drive Casing and sampling with a split barrel sampling spoon at locations designated on the Plans or as directed by the Engineer. Those soil borings made over "deep" water requiring a barge or other special equipment, or in wet areas that cannot be accessed by an All-Terrain Vehicle (ATV) or a truck mounted rig, will be considered Soil Borings, Water.

Standard Penetration Tests (SPT) and Split Barrel Sampling of the soils shall be taken at the ground surface and at 5 foot intervals thereafter in all hollow stem auger and drive casing holes.

**Materials and Construction Methods:**

**Hollow Stem Auger Method**

The Contractor shall use a power-driven, continuous, hollow-stem auger casing to advance and maintain the hole. The clear inside diameter of the hollow stem must be large enough to allow for the insertion of a 3.0 inch OD Shelby Tube soil sampler and attached rods through the in-place auger casing when elevations are reached for securing soil samples.

When using auger casings, the relative resistance to penetration, general feel and performance of the auger operation, and the cuttings obtained from the auger shall be observed and recorded for detection of changes in the materials encountered.

The plug point shall be withdrawn through the hollow stem, the sampler lowered through the full length of the auger, then driven or pressed below the auger bit and withdrawn. After replacing the plug point, the auger shall proceed to the next point of sampling. When the use of hollow stem augers is not feasible because of site conditions, the use of drive casings will be permitted.

All boreholes shall be preserved from collapse and bottom instability during advancement and sampling operations. When drilling below the natural ground water level, water shall be maintained inside the augers at a level above the ground water level at all times. If it is required to prevent bottom instability, water should be added to maintain a positive static water head inside the augers during drilling and withdrawal of the drilling rods. Cleaning out of the augers shall be required if the accumulation of material within the hollow-stem, between sampling intervals, is of a degree that is detrimental to the purpose of the sampling operation. Cleaning out the augers shall be performed with wash rods and a roller or side discharge chopping bit.

**Drive Casing Method of Advancing Borings**

All sampling and other procedures referencing the HSA method will also apply where drive casing is employed.

Casing shall be extra-strong steel pipe or flush-coupled casing with a nominal inside diameter of 4 inches.

## Appendix A – ITEM DESCRIPTIONS:

Casing shall be sunk vertically through earth and other materials, including boulders and rock veins, to rock or, if not to rock, to such depth below ground as the Engineer may order. They shall be driven down without washing to the depth at which a sample is to be taken, after which the material shall be cleaned out to the bottom of the casing and the sampler driven or pushed below the bottom of the cleaned casing. After sampling, casing driving shall be resumed.

The use of clean water for cleaning out the casing between sample elevations will be required. Recirculated water shall not be used. The Contractor shall make suitable arrangements for properly procuring and disposing wash water.

The weight of hammer to be used in driving the casing shall be 300 pounds with a 24 inch height of free fall. The hammer shall be raised by means of a rope having one end wrapped (not more than three loops) around a winch head. Wire rope will not be permitted. A continuous record of the blows per 1 foot required for the driving of the casing shall be kept.

Simultaneously washing and driving of the casing will not be permitted except when the Engineer judges the driving requires the use of water. Where the use of water is permitted, borings shall be advanced by saw tooth, chopping, fishtail, or rollerbits, all having side discharge jets. In advancing the boring, return water circulation, resistance to penetration and general performance of the drill shall be observed for detection of change in material. The casing shall next be advanced, if needed for retaining the hole open, to the point of maximum penetration of the washed pilot hole. The casing shall be cleaned in a manner to result in minimum disturbance of the soil below the casing shoe. All sampling shall be performed in advance of the casing shoe. A record must be kept of the depths between which simultaneous washing and driving occurred.

In some cases where the characteristics of the soil are suitable, the Engineer may permit the Contractor to discontinue driving the casing and accept advancing the boring by means of wash rods with a roller bit or side discharge chopping bit to the elevations at which samples are to be taken. This procedure shall be noted in the boring record. Should there be any indication of the sides of the hole collapsing, thus blocking normal progress of the boring, driving of the casing shall be resumed.

When a boulder or a stratum of ledge rock is encountered before the required depth of boring has been reached, it shall be the Contractor's responsibility to carry the boring through or past these obstacles but only by methods approved by the Engineer. The Contractor may, in some cases, be permitted to core the boulder or rock stratum to determine its size and characteristics. The required size of sampler to be used below the obstacle shall determine the size of boring to be made. A log of the nature of the obstacle and the method used to carry the boring through the obstacle shall be recorded.

### **Sampling Device**

The sampling device for ordinary, dry samples from Soil Borings shall be a standard split barrel sampler meeting the requirements of the "Penetration Test and Split-Barrel Sampling of Soils" AASHTO T206. The sampler shall be a split barrel tube with an outside diameter of 2 inches, an inside diameter of 1-3/8 inches, a minimum length of 18 inches between the driving shoe and the smaller head, and a minimum total length of



## Appendix A – ITEM DESCRIPTIONS:

27 inches. The drive shoe shall be hardened steel and shall be replaced or repaired when it becomes dented or distorted. The sampler head shall have a 1/2 inch minimum diameter vent ports and shall contain a reliable ball check valve.

Core retainers shall be used with the sampler, when necessary, to avoid loss of the sample. In cases where the material encountered is not sufficiently cohesive to permit the standard sampler to recover a sample on the first trial, a flapper valve, basket retainer, or other approved device shall be used to recover a sample. The use of such a device shall be noted on the boring log.

Should the Contractor, in securing samples, fail to provide the proper types of samplers, valves, traps and other special sampling devices, these samples will be deemed unacceptable by the Engineer.

### **Sampling Procedure**

The HSA or casing shall be advanced to the sampling depth and the loose material within the casing cleaned to its bottom before driving the sampler. Clean out shall be roller bit or chipping bit.

The sampler shall be driven into the soil below the HSA or casing for a distance of 18 inches or until further penetration is impossible with a 140 pound hammer falling freely through a vertical distance of 30 inches. The number of blows of the hammer shall be recorded for each 6 inches of penetration and, if 6 inches is not penetrated in one hundred (100) blows, the sampler will be considered to have met refusal and the blows shall be recorded as 100/number of inches penetrated. The hammer shall be raised by the use of a manila rope which the driller shall pull by hand with the assistance of a power operated spool or drum about which the rope will freely slip during the drop of the hammer. Wire rope will not be permitted to lift the hammer. All sampling devices, including driving mechanisms, used by the Contractor shall be approved by the Engineer.

Samples of the soil retained in the split barrel sampler shall be taken from that portion of the soil column between 6 and 18 inches below the bottom of the casing. The sample so obtained shall be representative of the material from which it is taken and shall be in an unwashed condition. Samples recovered from wash water, commonly termed "wash samples" will be unacceptable. If less than 9 inches of soil is retained in the sampler, a second sample shall be taken immediately below the deficient sample, after first advancing the boring. If more than one soil type is present in the sampler, a sample shall be taken of each type, and the length of each type of soil in the sampler shall be noted on the boring log.

### **Preservation and Identification of Samples**

The disturbed samples obtained with the split barrel sampler shall be removed with as little disturbance as possible, and immediately placed in a suitable approved container. Samples which retain form upon removal from the sampling spoon, shall not be jammed or forced into the approved container. Each approved container shall be clearly and permanently labeled to show the project and section numbers, boring number, station location, elevation or depth at which the sample was taken, the kind of material and the number of blows of the sampler.

## Appendix A – ITEM DESCRIPTIONS:

If two or more materials are encountered in a sampler, separate approved containers shall be used for each material. The letters "A", "B", etc. shall be added to the sample number on each to designate the different materials.

The Contractor shall provide the sample containers, keeping a sufficient supply on hand to prevent any delay in the work.

The Contractor shall pack all samples in containers that are acceptable to the Engineer and of sufficient durability to withstand handling without breakage of the sample containers. On the top and one end of each container, the Contractor shall neatly and legibly paint or stencil, using waterproof paint, the following identifying data: title of project and designation of section thereof; location of site by name and/or survey station; boring numbers; and name of Contractor; all as required or directed by the Engineer.

During the period of active work in the field, the Contractor shall be responsible for storing all soil samples in a warm, dry, locked, temporary storage facility convenient to the work areas.

### **Determination of Running Sand**

In order to determine whether the water pressure on sand is sufficient to cause the sand to run when unconfined, the Engineer may order a test for running sand.

The test shall consist of obtaining a sample of the sand with a split barrel sampler as specified in the sampling procedure. The casing shall then be drilled into the sand 2 feet below the elevation at which the sand was encountered, and carefully washed out to the bottom. The hole shall then be allowed to stand ten (10) minutes, and the elevation at which the sand then stands in the casing shall be measured. The water in the casing shall then be removed to a point 5 feet above the bottom of the casing to produce an unbalanced hydrostatic condition and the elevation of the top of the sand shall again be measured.

No more than one such test will be required at each structure when sand is encountered at depths near or above the anticipated elevation of the bottom pier or abutment excavation.

### **Ground Water**

Depth to ground water shall be determined when initially encountered and upon completion of the boring. The Contractor shall also take a water level reading 24 hours after the augers are removed. In the event the hole collapses before the ground water is observed, the depth to the collapsed portion shall be recorded. For Soil Borings, ground water level measurements will not be made unless unusual circumstances are encountered.

### **Records and Logs**

The Contractor shall keep a complete and accurate record of all details of the Soil Boring operations in a field book and on suitable boring log forms provided by the Contractor. Upon completion of each boring, two copies of the field log, on 8-1/2 x 11 inch paper, shall be given to the Engineer. The description of the soil, rock and other material encountered in the boring shall be made by the Contractor or the Engineer's

Appendix A – ITEM DESCRIPTIONS:

Representative. Each boring log shall record the information pertinent to the boring work being accomplished as outlined in the following sections. The following general information shall be recorded on each boring log:

1. Contract number, title of project and section designation
2. Location of boring by survey station, and offset, right or left of survey baseline
3. Boring number as specified on the Plans or as furnished by the Engineer
4. Names of the Engineer, Contractor, Inspector, and drilling crew
5. Date of starting and completing each boring
6. Ground elevation of the top of the hole as provided by the Engineer
7. Depth to the top of ground water, if present.

The following information shall be recorded on the boring logs for that portion of the boring penetrating unconsolidated or partly consolidated sediments or decomposed rock by drilling and sampling with a split barrel sampler:

1. Type of drill rig used
2. Size, type and length of augers used in each hole
3. Method used to clean out casing between sampling intervals
4. Size of split barrel sampler, weight of hammer, height of drop, and number of blows of the hammer for each 6 inches of penetration of the sampler out of a total minimum penetration of 24 inches for each sample. Where 6 inches is not penetrated in one hundred (100) blows of the hammer, the distance penetrated in one hundred (100) blows shall be recorded
5. Depth to beginning and end of sampling drive, and the length of sample recovered from the sampler
6. Depth to the top of each change or stratum of material
7. Description of the material encountered shall be in accordance with standard practice and shall include:
  - a. Type - topsoil, sand, silt, clay, gravel, silty clay, sandy silt, etc.
  - b. Color - light brown, dark reddish brown, etc.
  - c. Moisture - dry, moist, wet, saturated,
  - d. Consistency - soft, loose, medium, firm, stiff, etc. as determined by "N" values in Table 1 below.

| <b>TABLE 1</b>                          |  |                                    |  |
|---|--|------------------------------------|--|
| <b>DEGREE OF DENSITY OR CONSISTENCY</b> |  |                                    |  |
| Non-Cohesive Soils<br>Descriptive term  | (Sand) Standard<br>Penetration "N" -<br>Blows/1 foot | Cohesive Soils<br>Descriptive Term | (Clay) Standard<br>Penetration "N" -<br>Blows/1 foot |
| Very loose                              | 0-4  | Soft                               | 0-4  |
| Loose                                   | 5-10   | Firm                               | 5-8  |
| Medium                                  | 11-30  | Stiff                              | 9-15   |
| Dense                                   | 31-50  | Very Stiff                         | 16-30  |
| Very Dense                              | 51+  | Hard                               | 31+  |

## Appendix A – ITEM DESCRIPTIONS:

### **False Starts**

The Contractor is to verify the exact location of all known utilities prior to drilling. If the Contractor is unable to complete any boring due to encountering underground utilities or structures, the existence and location of which could not have been previously known, or because obstacles or obstructions are encountered which the Engineer considers are of an unusual nature and that failure to penetrate them is not the fault of the Contractor's methods or equipment, a false start will be measured and paid for at the applicable Contract unit price. The record of false starts shall be forwarded to the Engineer. For the new hole, bored to replace the abandoned hole, the Contractor shall operate as if a completely new hole was bored obtaining soil samples, standard penetrations tests, etc., in the depths reached by the abandoned hole.

### **Backfilling and Restoring**

All holes from work performed shall be backfilled and acceptably restored.

### **Method of Measurement:**

The quantity of soil borings will be measured as the total depth in linear feet of each boring actually made either by use of driven casing or augured casing and accepted by the Engineer. Measurement will be from the surface of existing ground or ground level below water (i.e. streambed) to the bottom of the hole, or to the depth at which Rock Core Drilling starts. The bottom of the hole shall include the depth of the last ordinary disturbed sample when obtained below the bottom of the drilled hole. When the last sample is an undisturbed sample, the bottom of the hole shall not include the depth of such last undisturbed sample.

If the Contractor abandons a hole prior to approval of the Engineer, no measurement or payment will be made for the hole that has been abandoned.

Any method used to carry the boring through the obstacle other than rock core drilling in excess of 1 foot, shall be considered as Soil Boring.

If the Contractor abandons a boring before adequate information is obtained and starts another boring adjacent to it in preference to carrying the boring through the obstacle, or because of a shattered or misaligned casing, no measurement or payment will be made for the work done on the abandoned boring.

### **Basis of Payment:**

The quantity of soil borings will be paid for at the Contract unit price per linear yard for the type of soil boring performed. Price and payment will constitute full compensation for the cost of all labor and materials necessary for furnishing and sinking of casing, as required; the cost of taking, packing, storing, and delivering ordinary dry samples; the cost of determination of running sand; the cost of taking and recording ground water observations; the cost of filling holes and surface restoration; and all else in connection with or incidental to the drilling.

**Item #2 Description**

**ADDITIONAL STANDARD PENETRATION TESTS (SPT) (605540)**

**Description:**

The Engineer may require additional Standard Penetration Tests (SPT's) be taken at defined depths between the specified 5 foot intervals. These are Additional Standard Penetration Tests.

**Basis of Measurement and Payment:**

Payment for additional Standard Penetration Tests (SPT) required by the Engineer, other than those taken at 5 foot intervals which are included in the soil boring price, shall be made on a per sample basis.

**Item #3 Description**

**UNDISTURBED SAMPLING (605541)**

**Description:**

This work consists of taking undisturbed soil samples from soil borings at locations and depths designated by the Engineer. An undisturbed sample shall be obtained by manually or mechanically pressing an acceptable thin walled stainless steel tube meeting the requirements for thin walled tubes in AASHTO T207 "Thin-Walled Tube Sampling of Soils", to obtain soil samples which, on testing, will show properties as close to in-place properties as possible. The sampled soil shall be subjected to a minimum degree of disturbance. The samples shall represent, as accurately as practical, the natural condition of the soil and shall be suitable in all respects for the conduction of consolidation and other tests in the laboratory. The Engineer will direct the Contractor to obtain a sample when the results of the standard split barrel sampling makes the undisturbed sample feasible and practical. A split spoon sample shall be obtained 1 foot prior to and immediately after each undisturbed sample.

**Materials and Construction Methods:**

**Sampling Device**

The sampling device to be used for obtaining undisturbed samples shall be a seamless, thin walled, metal tube meeting the requirements for thin walled tubes in AASHTO T207 "Thin-Walled Tube Sampling of Soils". The tube shall have a 16 or 18 gauge wall thickness, a minimum outside diameter of 3 inches, and a length of 30 inches. The tube shall be round and smooth without bumps, dents, or scratches and shall be clean and free from rust, dirt or corrosion. The end of the tube shall be machined into a cutting edge with an inside diameter that is 1/64 inch less than the inside diameter of the sampler tube. The top of the sampling tube shall be equipped with a coupling head with a check valve. Plastic materials too soft to be recovered by the thin wall sampler shall be sampled with a Stationary Piston Type Sampler or approved equivalent. Where the clayey soils are too stiff to be sampled with Shelby Tubes or a Piston Type Sampler, a Denison sampler shall be used.

**Sampling Procedure**

Before an undisturbed sample is to be taken, the auger casing shall be cleaned out to the bottom by any means acceptable to the Engineer that provides a reasonably clean hole, and does not disturb the soil to be sampled. The water level in the hole shall be maintained at or above the ground water level during the entire sampling operation. The sampling tube shall be connected to the string of drill rods and lowered slowly to the bottom of the hole. The tube shall then be pushed into the soil at a uniform rate by a continuous motion,

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without impact or twisting, to the depth necessary to obtain an undisturbed sample of soil at least 24 inches in length. In no case shall the tube be pressed to a depth in excess of the space available in the tube to accommodate the sample plus any disturbed material that may not have been cleaned from the hole.

To prevent distorting the upper portion of the sample by excessive pressure, particular care shall be taken to avoid a rate of penetration which exceeds the rate at which air or water can escape from the venting device at the top of the sampler. A maximum penetration rate of 1 inch per second will usually be satisfactory. Penetration shall be effected by hydraulic pressure approved by the Engineer. In no case shall the sampler be driven with a drop hammer.

When a Stationary Piston-Type Sampler is used, the sampling procedure shall be as recommended by the manufacturer and approved by the Engineer. Typically, the casing is cleaned out and the sampler, with the piston set flush with the bottom cutting edge, is carefully lowered to rest on the bottom of the hole. The piston rod is then rigidly clamped to the top of the casing, and the sampling tube forced into the soil to the proper depth. The piston rod and drill pipe are then locked together at the top prior to removal.

After penetration, allow sampler to set for at least 10 minutes. Rotate the sample tube 2 or 3 revolutions and withdraw slowly using moderate pull of the drill rod, avoiding sudden acceleration, shock or vibration. Piston samplers shall be capable of recovering a nominal 3 inch diameter sample.

When a Denison Sampler is used, the sampling procedure shall be as recommended by the manufacturer and approved by the Engineer. Samples shall be obtained by means of a Denison Sampler with a nominal inside diameter of 3 inches. The stationary inner tube shall project beyond the outer rotating tube with the length of the projection to be determined by the Engineer. Samples of the soil penetrated shall be obtained by rotary drilling with downward pressure in one smooth, continuous push. Alternate halting and starting the advance of the sampler will not be permitted. The actuating rod shall be removed prior to withdrawing the drill rods and sampler. Upon completion of the rotating pressing action, the Contractor will wait 10 minutes or whatever time is necessary, in the opinion of the Engineer, to permit the soil sample to swell inside the tube. During such time, the tube will remain undisturbed in the ground. After this period of time has elapsed, the drill rods shall be tightened and then rotated at least once to shear the soil at the bottom of the sampler.

### **Preservation and Identification of Sample**

Immediately upon recovery, the sampling tube with sample shall be detached from the head of the mechanism in a manner to cause as little disturbance as possible to the sample. The undisturbed sample shall then be trimmed, measured, and sealed in the following manner:

1. The cutting edge of the tube shall be inspected. Any material extending beyond the cutting edge shall be trimmed away. The cutting edge end shall then be temporarily capped and wrapped with electrical tape. If the sample has sheared off inside the tube to a depth of 1/2 inch or more, insert packing material into the tube. If a porous material such as paper or rags is used for packing material, it shall be completely wrapped in impervious material (such as plastic food wrap material).
2. The top of the tube shall be inspected and all wash or other disturbed material shall be carefully removed.
3. The inner wall of the top of the tube shall be wiped clean of all soil and water.

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4. The overall length of the tube and distance from the top of the tube to the top of the sample shall be measured and recorded to the nearest 1/16 inch.
5. The top of the tube shall be sealed using a mixture of equal parts of paraffin and micro-crystalline wax such as Petrowax (Gulf Oil Corp.) or Product 2300 (Socony Vacuum Oil Corp.) or an approved equal. The wax shall be heated to slightly above its melting point. It shall then be poured into the tube to a thickness of approximately 1/2 inch and allowed to harden. A second layer of the same thickness shall then be poured and allowed to harden.
6. Damp soil shall be used for packing the space between the top of the seal and the top of the tube. If this is not available, paper or rags may be used provided they are wrapped in an impervious material or dipped in molten wax before being inserted.
7. The top of the tube shall be capped, wrapped with plastic electrical tape and dipped in wax to coat the cap and tape.
8. The temporary cap shall then be removed from the bottom of the tube and the material cleaned out to a minimum depth of 1/2 inch.
9. The distance between the bottom of the sample and the bottom of the tube shall be measured and recorded to the nearest 1/16 inch.
10. The tube bottom shall be sealed and capped in the same manner as the top, except that a single 1/2 inch thickness of seal will suffice, if the space is no more than 1/2 inch.
11. After sealing is completed, the tube shall be kept vertical with cutting edge down at all times, both in storage and transportation.

The sample tubes shall be permanently and clearly labeled to show the date, the location of boring, the boring number, the sample number, top and bottom depth of sample, top end of sample, and recovery.

The sample tubes and crates used for transporting the undisturbed samples shall be labeled "Do Not Jar or Vibrate" and "Store and Transport in a Vertical Position", and if necessary, shall be well packed in excelsior or other equal material to prevent movement, vibration and freezing.

Particular care shall be taken at all times in the handling of undisturbed samples to avoid dropping, jarring or rolling so as to eliminate the possibility of any shock or sudden movement altering the original condition of the sample.

The Contractor shall properly store the sample tube in a vertical position until delivered to the Engineer.

### **Acceptable Sample**

Undisturbed soil samples shall have a minimum recovery of 75 percent to be acceptable. If an acceptable sample cannot be obtained on the first attempt in any particular stratum, the Contractor shall make a second attempt and, if still unsuccessful, further attempts to obtain an acceptable sample shall be made until discontinuance is ordered by the Engineer.

If the Contractor does not obtain an acceptable sample due to improper sampling procedures, another boring shall be performed by the Contractor near the initial boring location in order to obtain an acceptable sample at the same depth as the initial boring at no additional cost to the Department.

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After an acceptable undisturbed soil sample is obtained, the hole shall be cleaned out and a split spoon sample shall be taken.

Representative trimmings from each undisturbed sample shall be preserved in an approved sample container and packaged in sequence with the respective ordinary, dry samples.

The Engineer reserves the right to reject and refuse payment for any sample which received excessive disturbance due to the Contractor's carelessness or method of operation.

### **Record Data**

A complete description of the sample and pertinent sampling data shall be recorded on the boring log. This information shall include the rate of penetration of the sampler, method used to advance the sampler, the pressure used if advanced hydraulically, the total depth of penetration, and the length of sample recovered.

### **Method of Measurement:**

The quantity of undisturbed samples will be measured as the actual number of undisturbed samples obtained and accepted.

### **Basis of Payment:**

The quantity of undisturbed samples will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for all cost of securing the samples and providing tubes, caps, etc., necessary for preservation of samples, labels, records, storage, and delivery of the samples.

## **Item #4 Description**

### **AUGER DRILL WITHOUT SAMPLING (605542)**

#### **Description:**

Drilling to certain depths from previous drilling to continue sampling, or starting at certain depth for sampling.

#### **Method of Measurement:**

The quantity of linear feet drilled will be measured.

#### **Basis of Payment:**

The quantity of linear feet drilled (added to another Item Description) will be paid for at the Contract unit price per foot. Price and payment will constitute full compensation for all additional feet drilled with no sampling. All other costs are covered in the original Item.

## **Item #5 Description**

### **ROCK CORE DRILLING (NXM) (605543)**

#### **Description:**

This work consists of core drilling rock by any approved standard and accepted method of rotary diamond core drilling capable of obtaining continuous and complete cores not smaller than NX size from any



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subsurface interval or rock or boulders designated for investigation. Coring shall begin where it is impractical or impossible to advance the hole by driving the standard split barrel sampler or at refusal on the roller bit, as determined by the Engineer. Fragments of rock, large gravel, hard strata, or boulders that require one foot or less of drilling will not be considered as Rock Core Drilling and payment for such footage will be made at the Contract unit price per linear foot for Soil Borings. Rock coring shall be carried to the depths directed by the Engineer and will usually go a minimum of 10 feet into competent rock below the bottom of structure founding elevation.

Where material capable of being sampled or tested is encountered below a rock stratum, boulder, etc., the Engineer may direct the Contractor to enlarge the bore hole through the rock stratum, boulder, etc., to permit sampling and/or testing of such material.

The use of clean water for core drilling will be required. Recirculated water shall not be used. The Contractor shall make suitable arrangements satisfactory to the Engineer for the procuring and disposing of this water.

### **Materials and Construction Methods:**

#### **Equipment**

All core drilling shall be done with a hydraulic feed, rotary core drill using a "M" series double tube core barrel with diamond-set, bottom discharge core bits.

#### **Casing**

In order to prevent the overburden from seeping into the hole from which the core is to be taken, the hollow stem auger or drive casing, as required for Soil Borings, shall be seated tightly on the rock or boulder at the elevation where rock or a boulder is encountered prior to beginning the coring operation. If a stratum of bedrock material is encountered, which in the opinion of the Engineer required penetration and subsequent soil sampling below, blasting with small charges of dynamite will be permitted for the removal of this stratum and small boulders or other obstructions which cannot be conveniently removed otherwise. Before blasting, the augers shall be pulled up at least 8 feet to avoid damage. Blasting will be approved by the Engineer only where it is definitely known that there are no subsurface or surface structures in the vicinity that may be affected and it shall be performed strictly at the Contractor's responsibility. Any damages occurring to any surface or underground structure caused by such blasting will be repaired by the Contractor at no cost to the Department.

Any method used to carry the boring through the obstacle other than rock core drilling as required by the Engineer and in excess of 1 foot, shall be considered as Soil Boring and will be measured and paid for at the unit price per linear yard bid in the proposal. If rock core drilling is required, it will be measured and paid for at the unit price per linear yard bid in the proposal for Rock Core Drilling, when the obstacle drilled is in excess of 1 foot.

If the Contractor abandons a boring before adequate information is obtained and starts another boring adjacent to it in preference to carrying the boring through the obstacle, or because of a shattered or misaligned casing, no payment will be made for the work done on the abandoned boring.

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### **Coring Procedure**

Drilling shall be done to assure maximum percentage of core recovery from both hard and soft rocks. Should it be impracticable at any depth of penetration of rock to obtain a core, or should a seam of disintegrated rock or filled voids be encountered, particular care shall be taken to obtain the best samples possible of the material. Drilling shall be stopped, the core barrel shall be removed from the hole, and the standard 2 inch O.D. drive sampler, described hereinafter, shall be used to obtain samples and penetration resistance blow counts as specified in the section entitled "Soil Borings". Correct measurement of the interval or depth for which no core is obtainable shall be carefully determined and recorded. The core shall be pulled at intervals not exceeding 5 feet. The Contractor shall control his/her drill fluid pressure and rate of flow, speed of bit rotation and pressure on the bit at all times in such a manner to assure maximum core recovery in whatever kind of rock being drilled. Where soft or broken rock is encountered, the Contractor shall reduce the length of "runs" in order to reduce core loss and core disturbance to a minimum. Failure to comply with the foregoing procedures shall constitute justification for the Engineer to require redrilling at the Contractor's expense of any boring from which the core recovery is unsatisfactory. If solid rock is encountered (recovery 80% or greater), 10 feet of coring shall usually be sufficient. When soft or broken rock is encountered, the borings shall go to depths greater than the 10 feet. The Contractor shall exercise particular care in recording water losses, rod jerks, drips, changes in rotation speed and other unusual coring experiences that may help identify the nature and the extent of any fracturing, soft seams, voids, and any other characteristics of the formation being cored.

### **Ground Water**

The Contractor shall remove the core and all tools at the end of each day's drilling and measure and record water levels just prior to resumption of drilling operations. The Engineer may also require water level determinations at any time during the drilling operations when such measurements will not interfere with normal work such as between "core runs". The Contractor shall also take a water level reading 24 hours after the auger/casing is removed. In the event the hole collapses before the ground water is observed, the depth to the collapsed portion shall be recorded. Ground water determinations as described in this paragraph will not be paid for separately, but will be considered incidental to the work.

### **Preservation and Identification of Cores**

All cores of rock and consolidated material shall be carefully handled to insure their proper identification and sequence and shall be placed in suitable core boxes in the exact order of their removal from the bore hole. Boxes shall be of uniform size, shall be substantially constructed of dressed lumber, and shall have hinged number lids with suitable hook and eye or hasp and staple fastenings so as to prevent accidental opening of the lid during handling and shipment. Suitable partitions or rigid division strips shall be inserted in the box and permanently fastened in place to prevent the possibility of any section of core from becoming dislocated from its proper sequence. Blocks shall be placed at the top and bottom of each "core run" in the box, and shall be securely fastened in place and marked at the time the core is placed in the box directly from the core barrel. Cavities and large fractures shall also be recorded in the boxes. The cores shall be placed from left to right, beginning at the top hinged side of the core box, as in writing. Only the samples from one hole shall be packed in any one box unless otherwise authorized by the Engineer. No core drilling shall begin without having core boxes on hand at the boring site.

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In the top and at one end of each core box, the Contractor shall clearly and legibly paint or stencil, using waterproof paint the following identifying data: title of project, location of site by name/or survey station and offset, boring number and name of Contractor.

During the period of active work in the field, the Contractor shall provide and be responsible for storing all core boxes in a warm, dry, locked, temporary storage facility convenient to the work areas. Within 72 hours after the completion of boring work at the project site, the Contractor shall transport all boxed samples to the Engineer.

### **Records and Logs**

The Contractor shall keep a complete and accurate record of all details of the Rock Core Drilling operations in a field book and on suitable boring log forms provided by the Contractor. Upon completion of each boring, two copies of the field log, on 8-1/2 x 11 inch paper shall be given the Engineer. The description of the soil, rock, and other material encountered in the boring shall be made by the driller with the assistance of the Engineer. Each boring log shall record the information pertinent to the type of boring work being accomplished as outlined in the following sections. The following general information shall be recorded on each and every boring log:

1. Title of project and section designation
2. Location of site by name, and/or survey station and offset, if any, right or left of survey baseline
3. Hole number as specified on the Plans, or as furnished by the Engineer.
4. Names of the Engineer, Contractor, Inspector and drilling crew.
5. Date of starting and completing each boring
6. Ground elevation of the top of the hole as provided by the Engineer.
7. Depth to the top of ground water, if present.
8. Diameter and description of casing used.
9. Depth to which casing is advanced.

The following information shall be recorded on the boring logs for that portion of the boring penetrating rock or boulders more than 1 foot thick by the diamond bit rock core boring method:

1. Size and depth of core barrel used
2. Depth at which rock or boulder was encountered
3. Depth of each change in rock
4. Length of coring run in feet, length of rock recovered, and percentage of core recovery (equal length of core recovered divided by the length of the coring run).
5. Rate at which run was cored in minutes per 1 foot.
6. Depth to top and bottom of all voids, cavities and soft seams
7. Description of the rock encountered shall be in accordance with standard geologic terms and shall include:
  - a. Type - shale, sandstone, gneiss, schist, diabase, granite, etc.
  - b. Color - red, brown, gray, dark gray, light yellowish brown, etc.
  - c. Hardness - soft, medium soft, medium hard, hard and very hard
  - d. Fracturing - very badly broken, badly broken, broke, slightly broken and solid.

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- e. Texture - fine grained, medium grained, coarse grained, brecciated, porous, dense, etc.
  - f. Bedding - thin bedded, medium bedded, thick bedded, massive, layered (banding, schistosity, fissility)
  - g. Weathering - fresh, slightly weathered, moderately weathered, highly weathered and completely weathered.
8. Description of any unusual incidents encountered during the drilling operations such as caving, loss of water and where possible, and explanation for poor core recovery.
  9. Rock quality designations (RQD) - an indirect measure of fractures and other imperfections of the rock mass. It is calculated by summing up the total length of core recovered but counting only those pieces of core 4 inches in length or longer, and which are hard and sound. It is expressed as a percentage of the total run.

### **Method of Measurement:**

The quantity of rock core drilling will be measured in feet as the actual length of rock cored and accepted. The length will be measured from the top of the boulder or rock to the lowest elevation penetrated exclusive of all intervals of depth where actual drilling was not performed.

### **Basis of Payment:**

The quantity of rock core drilling will be paid for at the Contract Price and payment will constitute full compensation for the cost of providing labor, materials and plant necessary for rock core drilling as required; the cost of securing, packing, storing, and delivering all rock core samples; the cost of moving plant and equipment within the site, the cost of taking and recording ground water observations; the cost of surface restoration; and all else in connection with or incidental to the drilling operation. Payment will not be made for rock cores in excess of the required depth.

Fragments of rock, large gravel, hard strata or boulders that may require drilling in the amount of 1 foot or less and intervals of depth not actually covered as excluded above will not be considered as rock, and measurement for payment for such length will be made as specified for soil borings.

### **Item #6 Description**

#### **OBSERVATION WELLS (605544)**

### **Description:**

This work consists of installing observation wells in borings selected by the Engineer. Notice to install an observation well will be given prior to the time of completion of the borings selected.

### **Materials:**

1. Main pipe shall be solid 2 inch minimum outside diameter, straight, rigid polyethylene or PVC, Schedule 40.
2. Open pipe shall be 5 feet long, slotted 2 inch minimum outside diameter, straight, rigid polyethylene or PVC, Schedule 40.
3. External couplings, capable of tight connections without causing twisting, kinking, or collapsing the main and open pipes shall be used to connect the pipes.

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4. A bottom cap shall be used to tightly close off the bottom end of the connected pipes.
5. A metal, lockable cover shall be cemented to the top end of the connected pipes.
6. Clean granular sand shall be used around the outside of the pipe below and along the length of the slotted pipe.
7. Bentonite pellets shall be used on top of the sand above the slotted pipe.

### **Construction Methods:**

#### **Installation**

The installation shall be protected at all times so that water and debris cannot enter the boring or the pipe from the surface. If the pipe does not extend to the bottom of the borehole, then the borehole shall be backfilled to the required bottom elevation of the pipe.

The slotted PVC pipe shall extend to the depth directed by the Engineer. The assembled pipe shall be lowered into the cased boring and the casing withdrawn from the hole. The pipe shall be kept centered in the boring while the casing is withdrawn.

The annulus between the pipe and the borehole shall be filled with clean granular material. The granular material shall extend 1 foot below and 1 foot above the section of the slotted pipe. A 1 foot thick layer of bentonite pellets shall be placed on top of the granular material above the section of slotted pipe.

Installation of the granular material and bentonite pellets shall be performed while withdrawing the drill casing. Care shall be taken to minimize the increments of casing withdrawal so that collapse of the borehole does not occur. Sand and bentonite pellets shall be placed slowly enough so that bridging does not occur and the pipe is not lifted as the casing is withdrawn.

Backfill above the bentonite pellets may consist of available material and must be placed so that no voids or bridging occurs above the pellets. A cover shall be cemented to the top of the pipe, flush with the ground surface.

#### **Observation**

The groundwater elevation at these borings is to be observed by the Engineer 24 hours after completion of the boring and daily thereafter until the groundwater elevation has stabilized. The groundwater observation wells shall be maintained during the duration of the Contract and shall be left in place at the end of the Contract period.

### **Method of Measurements:**

The quantity of observation wells will be measured as the actual number of linear feet of PVC pipe (solid and slotted) installed and accepted.

### **Basis of Payment:**

The quantity of observation wells will be paid for at the Contract unit price per linear yard. Price and payment will constitute full compensation for furnishing and installing all materials, maintaining the wells, and for all labor, equipment, tools and incidentals necessary to complete the work.

**Item #7 Description**  
**SOIL BORINGS, LAND (605545)**

**Description:**

This work consists of advancing soil borings (drillings) through unconsolidated or partly consolidated sediments or decomposed rock by use of Hollow Stem Augers (HSA) or Drive Casing and sampling with a split barrel sampling spoon at locations designated on the Plans or as directed by the Engineer. Those soil borings made over any areas that can be accessed by a truck mounted rig, will be considered Soil Borings Land.

Standard Penetration Tests (SPT) and Split Barrel Sampling of the soils shall be taken at the ground surface and at 5 foot intervals thereafter in all hollow stem auger and drive casing holes.

**Materials and Construction Methods:**

**Hollow Stem Auger Method**

The Contractor shall use a power-driven, continuous, hollow-stem auger casing to advance and maintain the hole. The clear inside diameter of the hollow stem must be large enough to allow for the insertion of a 3.0 inch OD Shelby Tube soil sampler and attached rods through the in-place auger casing when elevations are reached for securing soil samples.

When using auger casings, the relative resistance to penetration, general feel and performance of the auger operation, and the cuttings obtained from the auger shall be observed and recorded for detection of changes in the materials encountered.

The plug point shall be withdrawn through the hollow stem, the sampler lowered through the full length of the auger, then driven or pressed below the auger bit and withdrawn. After replacing the plug point, the auger shall proceed to the next point of sampling. When the use of hollow stem augers is not feasible because of site conditions, the use of drive casings will be permitted.

All boreholes shall be preserved from collapse and bottom instability during advancement and sampling operations. When drilling below the natural ground water level, water shall be maintained inside the augers at a level above the ground water level at all times. If it is required to prevent bottom instability, water should be added to maintain a positive static water head inside the augers during drilling and withdrawal of the drilling rods. Cleaning out of the augers shall be required if the accumulation of material within the hollow-stem, between sampling intervals, is of a degree that is detrimental to the purpose of the sampling operation. Cleaning out the augers shall be performed with wash rods and a roller or side discharge chopping bit.

**Drive Casing Method of Advancing Borings**

All sampling and other procedures referencing the HSA method will also apply where drive casing is employed.

Casing shall be extra-strong steel pipe or flush-coupled casing with a nominal inside diameter of 4 inches.

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Casing shall be sunk vertically through earth and other materials, including boulders and rock veins, to rock or, if not to rock, to such depth below ground as the Engineer may order. They shall be driven down without washing to the depth at which a sample is to be taken, after which the material shall be cleaned out to the bottom of the casing and the sampler driven or pushed below the bottom of the cleaned casing. After sampling, casing driving shall be resumed.

The use of clean water for cleaning out the casing between sample elevations will be required. Recirculated water shall not be used. The Contractor shall make suitable arrangements for properly procuring and disposing wash water.

The weight of hammer to be used in driving the casing shall be 300 pounds with a 24 inch height of free fall. The hammer shall be raised by means of a rope having one end wrapped (not more than three loops) around a winch head. Wire rope will not be permitted. A continuous record of the blows per 1 foot required for the driving of the casing shall be kept.

Simultaneously washing and driving of the casing will not be permitted except when the Engineer judges the driving requires the use of water. Where the use of water is permitted, borings shall be advanced by saw tooth, chopping, fishtail, or rollerbits, all having side discharge jets. In advancing the boring, return water circulation, resistance to penetration and general performance of the drill shall be observed for detection of change in material. The casing shall next be advanced, if needed for retaining the hole open, to the point of maximum penetration of the washed pilot hole. The casing shall be cleaned in a manner to result in minimum disturbance of the soil below the casing shoe. All sampling shall be performed in advance of the casing shoe. A record must be kept of the depths between which simultaneous washing and driving occurred.

In some cases where the characteristics of the soil are suitable, the Engineer may permit the Contractor to discontinue driving the casing and accept advancing the boring by means of wash rods with a roller bit or side discharge chopping bit to the elevations at which samples are to be taken. This procedure shall be noted in the boring record. Should there be any indication of the sides of the hole collapsing, thus blocking normal progress of the boring, driving of the casing shall be resumed.

When a boulder or a stratum of ledge rock is encountered before the required depth of boring has been reached, it shall be the Contractor's responsibility to carry the boring through or past these obstacles but only by methods approved by the Engineer. The Contractor may, in some cases, be permitted to core the boulder or rock stratum to determine its size and characteristics. The required size of sampler to be used below the obstacle shall determine the size of boring to be made. A log of the nature of the obstacle and the method used to carry the boring through the obstacle shall be recorded.

### **Sampling Device**

The sampling device for ordinary, dry samples from Soil Borings shall be a standard split barrel sampler meeting the requirements of the "Penetration Test and Split-Barrel Sampling of Soils" AASHTO T206. The sampler shall be a split barrel tube with an outside diameter of 2 inches, an inside diameter of 1-3/8 inches, a minimum length of 18 inches between the driving shoe and the smaller head, and a minimum total length of

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27 inches. The drive shoe shall be hardened steel and shall be replaced or repaired when it becomes dented or distorted. The sampler head shall have a 1/2 inch minimum diameter vent ports and shall contain a reliable ball check valve.

Core retainers shall be used with the sampler, when necessary, to avoid loss of the sample. In cases where the material encountered is not sufficiently cohesive to permit the standard sampler to recover a sample on the first trial, a flapper valve, basket retainer, or other approved device shall be used to recover a sample. The use of such a device shall be noted on the boring log.

Should the Contractor, in securing samples, fail to provide the proper types of samplers, valves, traps and other special sampling devices, these samples will be deemed unacceptable by the Engineer.

### **Sampling Procedure**

The HSA or casing shall be advanced to the sampling depth and the loose material within the casing cleaned to its bottom before driving the sampler. Clean out shall be roller bit or chipping bit.

The sampler shall be driven into the soil below the HSA or casing for a distance of 18 inches or until further penetration is impossible with a 140 pound hammer falling freely through a vertical distance of 30 inches. The number of blows of the hammer shall be recorded for each 6 inches of penetration and, if 6 inches is not penetrated in one hundred (100) blows, the sampler will be considered to have met refusal and the blows shall be recorded as 100/number of inches penetrated. The hammer shall be raised by the use of a manila rope which the driller shall pull by hand with the assistance of a power operated spool or drum about which the rope will freely slip during the drop of the hammer. Wire rope will not be permitted to lift the hammer. All sampling devices, including driving mechanisms, used by the Contractor shall be approved by the Engineer.

Samples of the soil retained in the split barrel sampler shall be taken from that portion of the soil column between 6 and 18 inches below the bottom of the casing. The sample so obtained shall be representative of the material from which it is taken and shall be in an unwashed condition. Samples recovered from wash water, commonly termed "wash samples" will be unacceptable. If less than 9 inches of soil is retained in the sampler, a second sample shall be taken immediately below the deficient sample, after first advancing the boring. If more than one soil type is present in the sampler, a sample shall be taken of each type, and the length of each type of soil in the sampler shall be noted on the boring log.

### **Preservation and Identification of Samples**

The disturbed samples obtained with the split barrel sampler shall be removed with as little disturbance as possible, and immediately placed in a suitable approved container. Samples which retain form upon removal from the sampling spoon, shall not be jammed or forced into the container. Each sample container shall be clearly and permanently labeled to show the project and section numbers, boring number, station location, elevation or depth at which the sample was taken, the kind of material and the number of blows of the sampler.



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If two or more materials are encountered in a sampler, separate approved containers shall be used for each material. The letters "A", "B", etc. shall be added to the sample number on each container to designate the different materials.

The Contractor shall provide the sample containers, keeping a sufficient supply on hand to prevent any delay in the work.

The Contractor shall pack all samples in containers that are acceptable to the Engineer and of sufficient durability to withstand handling without breakage of the sample containers. On the top and one end of each container, the Contractor shall neatly and legibly paint or stencil, using waterproof paint, the following identifying data: title of project and designation of section thereof; location of site by name and/or survey station; boring numbers; and name of Contractor; all as required or directed by the Engineer.

During the period of active work in the field, the Contractor shall be responsible for storing all soil samples in a warm, dry, locked, temporary storage facility convenient to the work areas.

### **Determination of Running Sand**

In order to determine whether the water pressure on sand is sufficient to cause the sand to run when unconfined, the Engineer may order a test for running sand.

The test shall consist of obtaining a sample of the sand with a split barrel sampler as specified in the sampling procedure. The casing shall then be drilled into the sand 2 feet below the elevation at which the sand was encountered, and carefully washed out to the bottom. The hole shall then be allowed to stand ten (10) minutes, and the elevation at which the sand then stands in the casing shall be measured. The water in the casing shall then be removed to a point 5 feet above the bottom of the casing to produce an unbalanced hydrostatic condition and the elevation of the top of the sand shall again be measured.

No more than one such test will be required at each structure when sand is encountered at depths near or above the anticipated elevation of the bottom pier or abutment excavation.

### **Ground Water**

Depth to ground water shall be determined when initially encountered and upon completion of the boring. The Contractor shall also take a water level reading 24 hours after the augers are removed. In the event the hole collapses before the ground water is observed, the depth to the collapsed portion shall be recorded. For Soil Borings, ground water level measurements will not be made unless unusual circumstances are encountered.

### **Records and Logs**

The Contractor shall keep a complete and accurate record of all details of the Soil Boring operations in a field book and on suitable boring log forms provided by the Contractor. Upon completion of each boring, two copies of the field log, on 8-1/2 x 11 inch paper, shall be given to the Engineer. The description of the soil, rock and other material encountered in the boring shall be made by the Contractor or the Engineer's

Appendix A – ITEM DESCRIPTIONS:

Representative. Each boring log shall record the information pertinent to the boring work being accomplished as outlined in the following sections. The following general information shall be recorded on each boring log:

1. Contract number, title of project and section designation
2. Location of boring by survey station, and offset, right or left of survey baseline
3. Boring number as specified on the Plans or as furnished by the Engineer
4. Names of the Engineer, Contractor, Inspector, and drilling crew
5. Date of starting and completing each boring
6. Ground elevation of the top of the hole as provided by the Engineer
7. Depth to the top of ground water, if present.

The following information shall be recorded on the boring logs for that portion of the boring penetrating unconsolidated or partly consolidated sediments or decomposed rock by drilling and sampling with a split barrel sampler:

1. Type of drill rig used
2. Size, type and length of augers used in each hole
3. Method used to clean out casing between sampling intervals
4. Size of split barrel sampler, weight of hammer, height of drop, and number of blows of the hammer for each 6 inches of penetration of the sampler out of a total minimum penetration of 24 inches for each sample. Where 6 inches is not penetrated in one hundred (100) blows of the hammer, the distance penetrated in one hundred (100) blows shall be recorded
5. Depth to beginning and end of sampling drive, and the length of sample recovered from the sampler
6. Depth to the top of each change or stratum of material
7. Description of the material encountered shall be in accordance with standard practice and shall include:
  - a. Type - topsoil, sand, silt, clay, gravel, silty clay, sandy silt, etc.
  - b. Color - light brown, dark reddish brown, etc.
  - c. Moisture - dry, moist, wet, saturated,
  - d. Consistency - soft, loose, medium, firm, stiff, etc. as determined by "N" values in Table 1 below.

| <b>TABLE 1</b>                          |  |                                    |  |
|---|--|------------------------------------|--|
| <b>DEGREE OF DENSITY OR CONSISTENCY</b> |  |                                    |  |
| Non-Cohesive Soils<br>Descriptive term  | (Sand) Standard<br>Penetration "N" -<br>Blows/1 foot | Cohesive Soils<br>Descriptive Term | (Clay) Standard<br>Penetration "N" -<br>Blows/1 foot |
| Very loose                              | 0-4  | Soft                               | 0-4  |
| Loose                                   | 5-10   | Firm                               | 5-8  |
| Medium                                  | 11-30  | Stiff                              | 9-15   |
| Dense                                   | 31-50  | Very Stiff                         | 16-30  |
| Very Dense                              | 51+  | Hard                               | 31+  |

## Appendix A – ITEM DESCRIPTIONS:

### **False Starts**

The Contractor is to verify the exact location of all known utilities prior to drilling. If the Contractor is unable to complete any boring due to encountering underground utilities or structures, the existence and location of which could not have been previously known, or because obstacles or obstructions are encountered which the Engineer considers are of an unusual nature and that failure to penetrate them is not the fault of the Contractor's methods or equipment, a false start will be measured and paid for at the applicable Contract unit price. The record of false starts shall be forwarded to the Engineer. For the new hole, bored to replace the abandoned hole, the Contractor shall operate as if a completely new hole was bored obtaining soil samples, standard penetrations tests, etc., in the depths reached by the abandoned hole.

### **Backfilling and Restoring**

All holes from work performed shall be backfilled and acceptably restored.

### **Method of Measurement:**

The quantity of soil borings will be measured as the total depth in linear feet of each boring actually made either by use of driven casing or augered casing and accepted by the Engineer. Measurement will be from the surface of existing ground or ground level below water (i.e. streambed) to the bottom of the hole, or to the depth at which Rock Core Drilling starts. The bottom of the hole shall include the depth of the last ordinary disturbed sample when obtained below the bottom of the drilled hole. When the last sample is an undisturbed sample, the bottom of the hole shall not include the depth of such last undisturbed sample.

If the Contractor abandons a hole prior to approval of the Engineer, no measurement or payment will be made for the hole that has been abandoned.

Any method used to carry the boring through the obstacle other than rock core drilling in excess of 1 foot, shall be considered as Soil Boring.

If the Contractor abandons a boring before adequate information is obtained and starts another boring adjacent to it in preference to carrying the boring through the obstacle, or because of a shattered or misaligned casing, no measurement or payment will be made for the work done on the abandoned boring.

### **Basis of Payment:**

The quantity of soil borings will be paid for at the Contract unit price per linear yard for the type of soil boring performed. Price and payment will constitute full compensation for the cost of all labor and materials necessary for furnishing and sinking of casing, as required; the cost of taking, packing, storing, and delivering ordinary dry samples; the cost of determination of running sand; the cost of taking and recording ground water observations; the cost of filling holes and surface restoration; and all else in connection with or incidental to the drilling.

**Item #8 Description**  
**SOIL BORINGS, ATV (605555)**

**Description:**

This work consists of advancing soil borings (drillings) through unconsolidated or partly consolidated sediments or decomposed rock by use of Hollow Stem Augers (HSA) or Drive Casing and sampling with a split barrel sampling spoon at locations designated on the Plans or as directed by the Engineer. Those soil borings made in mud or wet areas require an All-Terrain Vehicle (ATV) that cannot be accessed by a truck mounted rig, will be considered Soil Borings ATV.

Standard Penetration Tests (SPT) and Split Barrel Sampling of the soils shall be taken at the ground surface and at 5 foot intervals thereafter in all hollow stem auger and drive casing holes.

**Materials and Construction Methods:**

**Hollow Stem Auger Method**

The Contractor shall use a power-driven, continuous, hollow-stem auger casing to advance and maintain the hole. The clear inside diameter of the hollow stem must be large enough to allow for the insertion of a 3.0 inch OD Shelby Tube soil sampler and attached rods through the in-place auger casing when elevations are reached for securing soil samples.

When using auger casings, the relative resistance to penetration, general feel and performance of the auger operation, and the cuttings obtained from the auger shall be observed and recorded for detection of changes in the materials encountered.

The plug point shall be withdrawn through the hollow stem, the sampler lowered through the full length of the auger, then driven or pressed below the auger bit and withdrawn. After replacing the plug point, the auger shall proceed to the next point of sampling. When the use of hollow stem augers is not feasible because of site conditions, the use of drive casings will be permitted.

All boreholes shall be preserved from collapse and bottom instability during advancement and sampling operations. When drilling below the natural ground water level, water shall be maintained inside the augers at a level above the ground water level at all times. If it is required to prevent bottom instability, water should be added to maintain a positive static water head inside the augers during drilling and withdrawal of the drilling rods. Cleaning out of the augers shall be required if the accumulation of material within the hollow-stem, between sampling intervals, is of a degree that is detrimental to the purpose of the sampling operation. Cleaning out the augers shall be performed with wash rods and a roller or side discharge chopping bit.

**Drive Casing Method of Advancing Borings**

All sampling and other procedures referencing the HSA method will also apply where drive casing is employed.

Casing shall be extra-strong steel pipe or flush-coupled casing with a nominal inside diameter of 4 inches.

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Casing shall be sunk vertically through earth and other materials, including boulders and rock veins, to rock or, if not to rock, to such depth below ground as the Engineer may order. They shall be driven down without washing to the depth at which a sample is to be taken, after which the material shall be cleaned out to the bottom of the casing and the sampler driven or pushed below the bottom of the cleaned casing. After sampling, casing driving shall be resumed.

The use of clean water for cleaning out the casing between sample elevations will be required. Recirculated water shall not be used. The Contractor shall make suitable arrangements for properly procuring and disposing wash water.

The weight of hammer to be used in driving the casing shall be 300 pounds with a 24 inch height of free fall. The hammer shall be raised by means of a rope having one end wrapped (not more than three loops) around a winch head. Wire rope will not be permitted. A continuous record of the blows per 1 foot required for the driving of the casing shall be kept.

Simultaneously washing and driving of the casing will not be permitted except when the Engineer judges the driving requires the use of water. Where the use of water is permitted, borings shall be advanced by saw tooth, chopping, fishtail, or rollerbits, all having side discharge jets. In advancing the boring, return water circulation, resistance to penetration and general performance of the drill shall be observed for detection of change in material. The casing shall next be advanced, if needed for retaining the hole open, to the point of maximum penetration of the washed pilot hole. The casing shall be cleaned in a manner to result in minimum disturbance of the soil below the casing shoe. All sampling shall be performed in advance of the casing shoe. A record must be kept of the depths between which simultaneous washing and driving occurred.

In some cases where the characteristics of the soil are suitable, the Engineer may permit the Contractor to discontinue driving the casing and accept advancing the boring by means of wash rods with a roller bit or side discharge chopping bit to the elevations at which samples are to be taken. This procedure shall be noted in the boring record. Should there be any indication of the sides of the hole collapsing, thus blocking normal progress of the boring, driving of the casing shall be resumed.

When a boulder or a stratum of ledge rock is encountered before the required depth of boring has been reached, it shall be the Contractor's responsibility to carry the boring through or past these obstacles but only by methods approved by the Engineer. The Contractor may, in some cases, be permitted to core the boulder or rock stratum to determine its size and characteristics. The required size of sampler to be used below the obstacle shall determine the size of boring to be made. A log of the nature of the obstacle and the method used to carry the boring through the obstacle shall be recorded.

### **Sampling Device**

The sampling device for ordinary, dry samples from Soil Borings shall be a standard split barrel sampler meeting the requirements of the "Penetration Test and Split-Barrel Sampling of Soils" AASHTO T206. The sampler shall be a split barrel tube with an outside diameter of 2 inches, an inside diameter of 1-3/8 inches, a minimum length of 18 inches between the driving shoe and the smaller head, and a minimum total length of

## Appendix A – ITEM DESCRIPTIONS:

27 inches. The drive shoe shall be hardened steel and shall be replaced or repaired when it becomes dented or distorted. The sampler head shall have a 1/2 inch minimum diameter vent ports and shall contain a reliable ball check valve.

Core retainers shall be used with the sampler, when necessary, to avoid loss of the sample. In cases where the material encountered is not sufficiently cohesive to permit the standard sampler to recover a sample on the first trial, a flapper valve, basket retainer, or other approved device shall be used to recover a sample. The use of such a device shall be noted on the boring log.

Should the Contractor, in securing samples, fail to provide the proper types of samplers, valves, traps and other special sampling devices, these samples will be deemed unacceptable by the Engineer.

### **Sampling Procedure**

The HSA or casing shall be advanced to the sampling depth and the loose material within the casing cleaned to its bottom before driving the sampler. Clean out shall be roller bit or chipping bit.

The sampler shall be driven into the soil below the HSA or casing for a distance of 18 inches or until further penetration is impossible with a 140 pound hammer falling freely through a vertical distance of 30 inches. The number of blows of the hammer shall be recorded for each 6 inches of penetration and, if 6 inches is not penetrated in one hundred (100) blows, the sampler will be considered to have met refusal and the blows shall be recorded as 100/number of inches penetrated. The hammer shall be raised by the use of a manila rope which the driller shall pull by hand with the assistance of a power operated spool or drum about which the rope will freely slip during the drop of the hammer. Wire rope will not be permitted to lift the hammer. All sampling devices, including driving mechanisms, used by the Contractor shall be approved by the Engineer.

Samples of the soil retained in the split barrel sampler shall be taken from that portion of the soil column between 6 and 18 inches below the bottom of the casing. The sample so obtained shall be representative of the material from which it is taken and shall be in an unwashed condition. Samples recovered from wash water, commonly termed "wash samples" will be unacceptable. If less than 9 inches of soil is retained in the sampler, a second sample shall be taken immediately below the deficient sample, after first advancing the boring. If more than one soil type is present in the sampler, a sample shall be taken of each type, and the length of each type of soil in the sampler shall be noted on the boring log.

### **Preservation and Identification of Samples**

The disturbed samples obtained with the split barrel sampler shall be removed with as little disturbance as possible, and immediately placed in a suitable approved container. Samples which retain form upon removal from the sampling spoon, shall not be jammed or forced into the container. Each sample container shall be clearly and permanently labeled to show the project and section numbers, boring number, station location, elevation or depth at which the sample was taken, the kind of material and the number of blows of the sampler.

## Appendix A – ITEM DESCRIPTIONS:

If two or more materials are encountered in a sampler, separate approved containers shall be used for each material. The letters "A", "B", etc. shall be added to the sample number on each container to designate the different materials.

The Contractor shall provide the sample containers, keeping a sufficient supply on hand to prevent any delay in the work.

The Contractor shall pack all samples in containers that are acceptable to the Engineer and of sufficient durability to withstand handling without breakage of the sample containers. On the top and one end of each container, the Contractor shall neatly and legibly paint or stencil, using waterproof paint, the following identifying data: title of project and designation of section thereof; location of site by name and/or survey station; boring numbers; and name of Contractor; all as required or directed by the Engineer.

During the period of active work in the field, the Contractor shall be responsible for storing all soil samples in a warm, dry, locked, temporary storage facility convenient to the work areas.

### **Determination of Running Sand**

In order to determine whether the water pressure on sand is sufficient to cause the sand to run when unconfined, the Engineer may order a test for running sand.

The test shall consist of obtaining a sample of the sand with a split barrel sampler as specified in the sampling procedure. The casing shall then be drilled into the sand 2 feet below the elevation at which the sand was encountered, and carefully washed out to the bottom. The hole shall then be allowed to stand ten (10) minutes, and the elevation at which the sand then stands in the casing shall be measured. The water in the casing shall then be removed to a point 5 feet above the bottom of the casing to produce an unbalanced hydrostatic condition and the elevation of the top of the sand shall again be measured.

No more than one such test will be required at each structure when sand is encountered at depths near or above the anticipated elevation of the bottom pier or abutment excavation.

### **Ground Water**

Depth to ground water shall be determined when initially encountered and upon completion of the boring. The Contractor shall also take a water level reading 24 hours after the augers are removed. In the event the hole collapses before the ground water is observed, the depth to the collapsed portion shall be recorded. For Soil Borings, ground water level measurements will not be made unless unusual circumstances are encountered.

### **Records and Logs**

The Contractor shall keep a complete and accurate record of all details of the Soil Boring operations in a field book and on suitable boring log forms provided by the Contractor. Upon completion of each boring, two copies of the field log, on 8-1/2 x 11 inch paper, shall be given to the Engineer. The description of the

Appendix A – ITEM DESCRIPTIONS:

soil, rock and other material encountered in the boring shall be made by the Contractor or the Engineer's Representative. Each boring log shall record the information pertinent to the boring work being accomplished as outlined in the following sections. The following general information shall be recorded on each boring log:

1. Contract number, title of project and section designation
2. Location of boring by survey station, and offset, right or left of survey baseline
3. Boring number as specified on the Plans or as furnished by the Engineer
4. Names of the Engineer, Contractor, Inspector, and drilling crew
5. Date of starting and completing each boring
6. Ground elevation of the top of the hole as provided by the Engineer
7. Depth to the top of ground water, if present.

The following information shall be recorded on the boring logs for that portion of the boring penetrating unconsolidated or partly consolidated sediments or decomposed rock by drilling and sampling with a split barrel sampler:

1. Type of drill rig used
2. Size, type and length of augers used in each hole
3. Method used to clean out casing between sampling intervals
4. Size of split barrel sampler, weight of hammer, height of drop, and number of blows of the hammer for each 6 inches of penetration of the sampler out of a total minimum penetration of 18 inches for each sample. Where 6 inches is not penetrated in one hundred (100) blows of the hammer, the distance penetrated in one hundred (100) blows shall be recorded
5. Depth to beginning and end of sampling drive, and the length of sample recovered from the sampler
6. Depth to the top of each change or stratum of material
7. Description of the material encountered shall be in accordance with standard practice and shall include:
  - a. Type - topsoil, sand, silt, clay, gravel, silty clay, sandy silt, etc.
  - b. Color - light brown, dark reddish brown, etc.
  - c. Moisture - dry, moist, wet, saturated,
  - d. Consistency - soft, loose, medium, firm, stiff, etc. as determined by "N" values in Table 1 below.

| <b>TABLE 1</b>                          |  |                                    |  |
|---|--|------------------------------------|--|
| <b>DEGREE OF DENSITY OR CONSISTENCY</b> |  |                                    |  |
| Non-Cohesive Soils<br>Descriptive term  | (Sand) Standard<br>Penetration "N" -<br>Blows/1 foot | Cohesive Soils<br>Descriptive Term | (Clay) Standard<br>Penetration "N" -<br>Blows/1 foot |
| Very loose                              | 0-4  | Soft                               | 0-4  |
| Loose                                   | 5-10   | Firm                               | 5-8  |
| Medium                                  | 11-30  | Stiff                              | 9-15   |
| Dense                                   | 31-50  | Very Stiff                         | 16-30  |
| Very Dense                              | 51+  | Hard                               | 31+  |



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### **False Starts**

The Contractor is to verify the exact location of all known utilities prior to drilling. If the Contractor is unable to complete any boring due to encountering underground utilities or structures, the existence and location of which could not have been previously known, or because obstacles or obstructions are encountered which the Engineer considers are of an unusual nature and that failure to penetrate them is not the fault of the Contractor's methods or equipment, a false start will be measured and paid for at the applicable Contract unit price. The record of false starts shall be forwarded to the Engineer. For the new hole, bored to replace the abandoned hole, the Contractor shall operate as if a completely new hole was bored obtaining soil samples, standard penetrations tests, etc., in the depths reached by the abandoned hole.

### **Backfilling and Restoring**

All holes from work performed shall be backfilled and acceptably restored.

### **Method of Measurement:**

The quantity of soil borings will be measured as the total depth in linear feet of each boring actually made either by use of driven casing or augured casing and accepted by the Engineer. Measurement will be from the surface of existing ground or ground level below water (i.e. streambed) to the bottom of the hole, or to the depth at which Rock Core Drilling starts. The bottom of the hole shall include the depth of the last ordinary disturbed sample when obtained below the bottom of the drilled hole. When the last sample is an undisturbed sample, the bottom of the hole shall not include the depth of such last undisturbed sample.

If the Contractor abandons a hole prior to approval of the Engineer, no measurement or payment will be made for the hole that has been abandoned.

Any method used to carry the boring through the obstacle other than rock core drilling in excess of 1 foot, shall be considered as Soil Boring.

If the Contractor abandons a boring before adequate information is obtained and starts another boring adjacent to it in preference to carrying the boring through the obstacle, or because of a shattered or misaligned casing, no measurement or payment will be made for the work done on the abandoned boring.

### **Basis of Payment:**

The quantity of soil borings will be paid for at the Contract unit price per linear yard for the type of soil boring performed. Price and payment will constitute full compensation for the cost of all labor and materials necessary for furnishing and sinking of casing, as required; the cost of taking, packing, storing, and delivering ordinary dry samples; the cost of determination of running sand; the cost of taking and recording ground water observations; the cost of filling holes and surface restoration; and all else in connection with or incidental to the drilling.

**Item #9 Description**

**MAN-HOURS OF MISCELLANEOUS WORK (763587)**

**Description:**

The work of this item includes non-management work such as performing percolation tests, coring bridge decks or roadways to gain access to soil, recording observation well water levels, preparing sites for access when such preparation requires more than incidental preparation (less than one hour of crew time is considered incidental; this miscellaneous work does not include reconnaissance, utility clearance, planning, or equipment movement work). Temporary Traffic Control planning and execution, protection and delivery of samples, and other work specifically included in other items of work are not included in this work item.

**Method of Measurement:**

The quantity of man hours will be measured as the actual number of man-hours approved by the Engineer.

**Basis of Payment:**

The quantity of man-hours will be paid for at the contract price per hour. Price and payment will constitute full compensation for wages, all employment expenses, and necessary incidentals.

**Item #10, 11 and 12 Description**

**MOBILIZATION FOR TRUCK MOUNTED BORING RIG (763589)**

**Description:**

This work includes mobilization to project sites that are accessible by a truck mounted boring rig. Clearing to access a project site shall be included in this item.

**Basis of Measurement and Payment:**

The item, mobilization for truck mounted boring rig, will be paid for at the Contract unit price per each mobilization for truck mounted boring rig which price and payment shall constitute full compensation for furnishing all equipment, material, and manpower required to acceptably perform all the work involved.

**Item #13, 14 and 15 Description**

**MOBILIZATION FOR ALL TERRAIN VEHICLE OR SKID MOUNTED BORING RIG (763590)**

**Description:**

This work includes mobilization to project sites requiring an all-terrain, skid mounted, or other boring rig, as determined by the Engineer. Work areas may include wetland sites, marshes, low lying areas, or the "shallow" water locations. Wetland maps may be used to delineate wetland areas. Also included under this item shall be mobilization to steep embankment areas, or other areas that are inaccessible to truck mounted rigs.

**Basis of Measurement and Payment:**

The item, mobilization for all terrain vehicle or skid mounted boring rig, will be paid for at the Contract unit price per mobilization for all terrain vehicle or skid mounted boring rig which price and payment shall constitute full compensation for furnishing all equipment, material, and manpower required to acceptably perform all the work involved.

**Item #16, 17 and 18 Description**

**MOBILIZATION FOR BARGE MOUNTED BORING RIG (763591)**

**Description:**

This work includes mobilization to project sites over water requiring a barge or a platform. Typical work shall include drilling in areas of "deep" water such as navigable waterways, ponds, lakes, and other location inaccessible to all terrain or skid vehicles.

**Basis of Measurement and Payment:**

The item, mobilization for barge mounted boring rigs, will be paid for at the Contract unit price per mobilization for barge mounted boring rigs which price and payment shall constitute full compensation for furnishing all equipment, material, and manpower required to acceptably perform all the work involved.

**Item #19 Description**

**MAN-HOURS OF PROJECT MANAGEMENT**

**Description:**

The work of this item includes management related work such as initial site review, scoping of jobs, special requests from Engineer, vendor manager additional time, etc. (less than one hour of time is considered incidental). Previous approval of the Engineer is required.

**Method of Measurement:**

The quantity of man hours will be measured as the actual number of man-hours used and approved by the Engineer.

**Basis of Payment:**

The quantity of man-hours will be paid for at the contract price per hour. Price and payment will constitute full compensation for wages, all employment expenses, and necessary incidentals.

**Item #20 – 34 Description**

**TEMPORARY TRAFFIC CONTROL (TTC) DESCRIPTIONS**

- 763605 – Two Lane, Two-Way with Shoulder Closure (TA-3)**
- 763606 – Two Lane, Two-Way with Lane Closure (TA-10)**
- 763607 – Multilane Divided Highway with Shoulder Closure (TA-3A)**
- 763608 – Multilane Divided Highway with Lane Closure (TA-33)**
- 763609 – Interstates and Freeways, Shoulder Closure (TA-5A)**
- 763664 – Two Lane, Two-Way with Shoulder Closure, Mobile Operation (TA-4)**
- 763665 – Two Lane, Two-Way with Lane Closure, Mobile Operation (TA-17)**
- 763666 – Multilane Divided Highway with Shoulder Closure, Mobile Operation (TA-4A)**
- 763667 – Multilane Divided Highway with Lane Closure, Mobile Operation (TA-35)**
- 763668 – Multilane Divided Highway with Double Lane Closure (TA-37)**
- 763669 – Multilane Divided Highway with Double Lane Closure, Mobile Operation (TA-35A)**
- 763670 – Work in the Vicinity of an Exit Ramp on a Multilane Divided Highway (TA-42)**
- 763671 – Work in the Vicinity of an Entrance Ramp on a Multilane Divided Highway (TA-44)**
- 763672 – Partial Exit Ramp Closure (TA-43)**
- 763673 – Surveying Along a Two-Lane Road (TA-16)**

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### **Description:**

This work shall consist of all work performed by the Contractor to maintain vehicular, bicycle and pedestrian traffic through the location's work zone, including, but not limited to, the passage through the area of persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA) Title II, paragraph 35.130. All work shall be performed in a manner that will reasonably provide the least practicable obstruction to all road users, including vehicular traffic, bicycle traffic and pedestrian traffic. All temporary traffic control and temporary traffic control devices shall comply with the contract documents and with the latest edition of the manual titled "Delaware Manual on Uniform Traffic Control Devices (MUTCD)," hereafter referred to as the "DE MUTCD", including all revisions as of the date of advertisement of this Contract.

The Department reserves the right to stop the Contractor's operations, if in the opinion of the Engineer the Contractor's operations are not in compliance with the Delaware MUTCD or the Contractor's operations are unsafe and present a hazard to road users or workers.

Prior to the beginning of any work in a particular location, the Contractor shall first place temporary traffic control devices so as to effectively close that area to the passage of unauthorized vehicles, pedestrians or bicycles, and protect the work and personnel until the area is ready for public use.

**The safety measures outlined herein and in the DE MUTCD shall be considered as elementary only, and not necessarily sufficient in every instance to guarantee the protection of the traveling public. The final responsibility for the installation of adequate safety precautions, and for the protection of the traveling public, and its own personnel shall rest with the Contractor.**

### **Schedule and Construction Control:**

A temporary traffic control plan and construction schedule shall be required for all operations affecting the flow of traffic on all roadways where work is to be performed. The temporary traffic control plan shall be submitted to the engineer seven days in advance of the proposed work for approval. The plan must show all methods and devices the Contractor proposes for temporary traffic control.

The contractor shall plan the work such that no lanes of traffic are closed from Friday 3:00 P.M. until Monday 9:00 A.M., with the exception of any weekend work to be allowed on Saturday and Sunday with prior approval from the Engineer. The contractor shall plan his work such that no lane closure occurs without approval during the following periods:

1. December 24 through December 27 (Christmas Day)
2. December 31 through January 3 (New Year's Day)
3. Friday prior to Easter through Easter Sunday
4. Thursday prior to Memorial Day through the Tuesday following Memorial Day
5. Dover International Speedway Race Weekends (Thursday prior to the race event through the day after the race event)
6. July 3 through July 5 (Independence Day)
7. Thursday prior to Labor Day through the Tuesday following Labor Day

## Appendix A – ITEM DESCRIPTIONS:

8. Wednesday prior to Thanksgiving Day through Monday following Thanksgiving Day.
9. Exceptions to these restrictions can be made on a case by case basis with the approval of the Traffic Engineer and Chief Engineer.

No lane closures shall be allowed on multilane roadways between 6:00 A.M. and 7:00 P.M. on standard weekdays, i.e. Monday through Friday without prior permission from the Engineer. Consideration must be given to the duration of the closure, the number of lanes on the highway, the number of lanes affected by the closure and the conditions created by the closure. When prior permission is granted, the contractor shall ensure that lane closures are removed prior to peak periods on the roadway, typically from 6:00 A.M. to 9:00 A.M. and from 3:00 P.M. to 7:00 P.M. No lane closure on Two-lane roadways with AADT greater than or equal to 5000 vehicles shall occur between 6:00 A.M. to 9:00 A.M. and/or 3:00 P.M. to 7:00 P.M. on a standard weekday, i.e. Monday through Friday without prior permission from the Engineer. For Two-lane roadways with AADT less than 5000 vehicles per day lane closures typically will be allowed at any time. The contractor shall ensure that disruption to traffic is minimized at all times in all cases. Summer weekend operations may occur on non-beach route roadways subject to determination by the Engineer, but no summer weekend work shall take place on major beach routes. Nighttime work may occur on congested major roadway corridors and/or at locations as determined by the Engineer where day time lane closures will cause excessive disruption to traffic flow. Questions regarding the timing of lane closures on a particular roadway shall be directed to the DeIDOT District Safety Officer. It shall be noted that the provisions above are for general guidance and that the Department can be more restrictive at its discretion.

### **Materials:**

The contractor shall supply all temporary traffic control devices as necessary to protect the work area as provided for in the DE MUTCD.

Temporary traffic control devices shall be maintained in good condition in accordance with the brochure entitled “Quality Guidelines for Temporary Traffic Control Devices”, published by the American Traffic Safety Services Association (ATSSA). Any temporary traffic control devices that do not meet the quality guidelines shall be removed and replaced with acceptable devices. Failure to comply will result in work stoppage.

Temporary traffic control devices used on all highways open to public travel in this State shall conform to the Delaware MUTCD. All devices shall be crashworthy in accordance with the National Cooperative Highway Research Program (NCHRP) Report 350, the memorandum issued August 28, 1998 by the USDOT Federal Highway Administration, and/or in accordance with the latest edition of the Manual for Assessing Safety Hardware (MASH), published by the American Association of State Highway and Transportation Officials (AASHTO). The Contractor shall submit certification for temporary traffic control devices used specifically on this project at or prior to work commencing in a particular location.

### **Construction Methods:**

**The method of installation shall be as prescribed in the DE MUTCD. For each of the temporary**

## Appendix A – ITEM DESCRIPTIONS:

**traffic control cases presented below, the Typical Application reference from the Delaware MUTCD is provided in parenthesis. The Temporary Traffic Control shall be distinguished based on the following roadway types and closures:**

- Two Lane, Two-Way with Shoulder Closure (TA-3)
- Two Lane, Two-Way with Lane Closure (TA-10)
- Multilane Divided Highway with Shoulder Closure (TA-3A)
- Multilane Divided Highway with Lane Closure (TA-33)
- Interstates and Freeways, Shoulder Closure (TA-5A)
- Two Lane, Two-Way with Shoulder Closure, Mobile Operation (TA-4)
- Two Lane, Two-Way with Lane Closure, Mobile Operation (TA-17)
- Multilane Divided Highway with Shoulder Closure, Mobile Operation (TA-4A)
- Multilane Divided Highway with Lane Closure, Mobile Operation (TA-35)
- Multilane Divided Highway with Double Lane Closure (TA-37)
- Multilane Divided Highway with Double Lane Closure, Mobile Operation (TA-35A)
- Work in the Vicinity of an Exit Ramp on a Multilane Divided Highway (TA-42)
- Work in the Vicinity of an Entrance Ramp on a Multilane Divided Highway (TA-44)
- Partial Exit Ramp Closure (TA-43)
- Surveying Along a Two-Lane Road (TA-16)

### **Method of Measurement:**

The quantity for Temporary Traffic Control shall be measured per Each for each case described in the DE MUTCD. The quantity of flaggers, portable light assemblies, portable changeable message signs, truck-mounted attenuators and traffic officers will be measured under separate applicable pay items.

The Temporary Traffic Control shall be distinguished based on the following roadway types and closures:

- Two Lane, Two-Way with Shoulder Closure (TA-3)
- Two Lane, Two-Way with Lane Closure (TA-10)
- Multilane Divided Highway with Shoulder Closure (TA-3A)
- Multilane Divided Highway with Lane Closure (TA-33)
- Interstates and Freeways, Shoulder Closure (TA-5A)
- Two Lane, Two-Way with Shoulder Closure, Mobile Operation (TA-4)
- Two Lane, Two-Way with Lane Closure, Mobile Operation (TA-17)
- Multilane Divided Highway with Shoulder Closure, Mobile Operation (TA-4A)
- Multilane Divided Highway with Lane Closure, Mobile Operation (TA-35)
- Multilane Divided Highway with Double Lane Closure (TA-37)
- Multilane Divided Highway with Double Lane Closure, Mobile Operation (TA-35A)
- Work in the Vicinity of an Exit Ramp on a Multilane Divided Highway (TA-42)
- Work in the Vicinity of an Entrance Ramp on a Multilane Divided Highway (TA-44)
- Partial Exit Ramp Closure (TA-43)
- Surveying Along a Two-Lane Road (TA-16)

### **Basis of Payment:**

## Appendix A – ITEM DESCRIPTIONS:

The quantity for Temporary Traffic Control will be paid for at the Contract unit price per Each. Price and payment will constitute full compensation for set up, removal, furnishing and placing all materials, labor, equipment, tools, appurtenances, drums, resetting of drums if required, signs, arrow panels and all incidentals necessary to complete the work. Each temporary traffic control item for the fifteen types of installations will be paid per one set up-take down cycle and shall cover all temporary traffic control required by the DE MUTCD. Each job order will indicate the number of allowable set up-take down cycles. Flaggers, portable light assemblies, portable changeable message signs, truck mounted attenuators and traffic officers will be paid for separately under the applicable pay items.

The Basis of Payment is applicable to the following types of installations:

- Two Lane, Two-Way with Shoulder Closure (TA-3)
- Two Lane, Two-Way with Lane Closure (TA-10)
- Two Lane, Two-Way with Shoulder Closure, Mobile Operation (TA-4)
- Two Lane, Two-Way with Lane Closure, Mobile Operation (TA-17)
- Multilane Divided Highway with Shoulder Closure (TA-3A)
- Multilane Divided Highway with Lane Closure (TA-33)
- Multilane Divided Highway with Shoulder Closure, Mobile Operation (TA-4A)
- Multilane Divided Highway with Lane Closure, Mobile Operation (TA-35)
- Interstates and Freeways, Shoulder Closure (TA-5A)
- Multilane Divided Highway with Double Lane Closure (TA-37)
- Multilane Divided Highway with Double Lane Closure, Mobile Operation (TA-35A)
- Work in the Vicinity of an Exit Ramp on a Multilane Divided Highway (TA-42)
- Work in the Vicinity of an Entrance Ramp on a Multilane Divided Highway (TA-44)
- Partial Exit Ramp Closure (TA-43)
- Surveying Along a Two-Lane Road (TA-16)

**Each of the above items shall include payment for the following:**

1. Providing, transporting, locating, setting up and maintaining of all necessary temporary traffic control devices as prescribed above.
2. Removal and transporting of all devices back to the storage yard upon completion of the job task.

### **Item #35 Description**

#### **PIEZOMETER INSTALLATION & REMOVAL**

##### **Description:**

The work of this item includes placement of instrument at specified depth, initial and final reading of results, recording of initial and final readings, recovery of instrument and closing of sample hole. Time spent recording readings of instruments beyond the day of installation and prior to day of removal are billed at Man-Hour of Miscellaneous Work Item Description rates.

##### **Method of Measurement:**

The quantity of piezometer installation and removal will be measured as each.

**Basis of Payment:**

The quantity of piezometer installation and removal will be paid for at the contract price per each.

**Item #36, 37 and 38 Description**  
**DOUBLE-RING INFILTRATION TEST**

**Description:**

To provide in situ infiltration rates for design of storm water management systems. The apparatus consists of two concentric rings, driving caps, two graduated Mariotte tubes, depth gauges, and metal tamp for soil. The two rings are driven into the ground in an already prepared site to a predetermine depth by Engineer. Both ring areas are filled with water and the outer ring acts as a barrier to encourage only vertical flow from the inner ring. The information gathered from this test is converted by the consultant into an infiltration rate. Testing shall be done in accordance with ASTM D5126 “Comparison of Field Methods for Determining Hydraulic Conductivity in the Vadose Zone.”

This test includes the above mentioned equipment, water source, mobilization, use of a backhoe to dig and prepare the testing area, site remediation, data collection by a trained technician, all labor associated with this test, any and all associated mathematical computations and conversions, and other incidentals. The test is expected to last at least six (6) hours (or until after a relatively constant rate is obtained.) Readings from the Mariotte tubes shall be recorded on an approved worksheet that has the project title and contract number, technicians who performed the test, date, weather conditions, location of test (GPS coordinates and initial ground elevation), ID number (of test), depth of test, any abnormal conditions during test, and all relevant data collection. A bulk sample shall be collected at the test depth and given to the central Dover laboratory for index testing.

**Payment:**

Payment for this item is per test, per County and includes all equipment, labor, and incidentals as mentioned above.

**Item #39 Description**  
**BACKHOE OPERATION**

**Description:**

Mobilization and operation of a “backhoe” as needed and deemed by the Engineer.

**Basis of Payment:**

Payment for this item is per day (nine (9) hours).

**Item #40 Description**  
**DOZER OPERATION**

**Description:**

Mobilization and operation of a “dozer” as needed and deemed by the Engineer.



Appendix A – ITEM DESCRIPTIONS:

**Basis of Payment:**

Payment for this item is per day (nine (9) hours).

**Item #41 and 42 Description**  
**HAND AUGER SAMPLING**

**Description:**

Soil sampling in areas where drill rigs cannot access (poor vehicle access), utility conflicts that cannot be resolved, and/or determining initial soil conditions through the use of a hand operated device. Generally, this type of soil sampling is limited to shallower depths than depths with a drill rig. The type of hand auger depends on the type of soil encountered and shall be directed by the Engineer. Soil samples shall be collected per 6” or 12” as directed by the Engineer. Testing procedure shall follow ASTM D4700 “Standard Guide for Soil Sampling from the Vadose Zone”.

**Basis of Payment:**

Payment for this item shall include a mobilization to site, a per lineal foot price from top of ground elevation to end of sampling depth, and site remediation. Mobilization shall not be charged if existing drill rigs have already been mobilized at the site at the time of hand auguring.

**Item #43 Description**  
**BOREHOLE ABANDONMENT**

**Description:**

All labor and material associated with filling borehole with a cement and bentonite mixture. Generally used for deep borings and need to grout and is also based on keeping the quality of the aquifer intact.

**Basis of Payment:**

Price is per linear foot and for all counties.

**Item #44 Description**  
**TEST PITS, GREATER THAN 10’ IN DEPTH**

**Description:**

Includes heavy equipment rental and labor associated with performing test pits greater than 10’ in depth.

**Basis of Payment:**

Price is per linear foot and includes all counties.

**Item #45 Description**  
**MAN-HOUR, WEEKEND/OVERTIME RATE**

**Description:**

Man-hour, weekend/overtime pay rate.

**Basis of Payment:**

Per hour rate for weekend or overtime work per person per hour.

**Item #46 Description**  
**QUALIFIED LOGGER**

**Description:**

This covers field logging by a Qualified Logger pre-approved by the **DEPARTMENT**. The Qualified Logger is applicable only upon direct request of the **DEPARTMENT**. The drilling crew is still required to perform their normal logging responsibilities. This procedure shall follow ASTM D5434-09. These include the description of the material encountered with origin or formation name, if possible of soil with professional judgment and shall follow ASTM D-2488-09a.

**Basis of Payment:**

The quantity of man- hours will be paid for at the contract price per hour. Price and payment will constitute full compensation for wages, all employment expenses, and necessary incidentals.

**Item #47 Description**  
**WELL DEVELOPMENT**

**Description:**

Includes labor and equipment to clean out the well of any sediment and water until clear so that monitoring of well is accurate.

**Basis of Payment:**

Price is per hour and is for all counties.

**Item #48 Description**  
**SLOPE INCLINOMETERS, 3” OR GREATER**

**Description:**

Includes pipe, pipe fittings, and grout, furnished and installed. Testing equipment and readings (monitoring) by others.

**Basis of Payment:**

Price is per linear foot and is for all counties.

**Item #49 Description**  
**SETTLEMENT PLATES**

**Description:**

Includes steel plate and initial pipe to initial depth, furnished and installed.

**Basis of Payment:**

Price does not include any other instrumentation or readings (monitoring).

**Item #50 Description**

**STANDPIPES OR CURB-BOXES FURNISHED AND INSTALLED**

**Description:**

Includes steel pipe with cap (or metal curb-box) and lock to protect well from damage or vandalism.

**Basis of Payment:**

Price is per each and for all three counties.

**Item #51, 52 and 53 Description**

**BOREHOLE INFILTRATION TEST**

**Description:**

This test method covers field measurement of limiting values for vertical and horizontal hydraulic conductivities (also referred to as coefficients of permeability) of porous materials using the two-stage, cased borehole technique. These limiting hydraulic conductivity values are the maximum possible for the vertical direction and minimum possible for the horizontal direction. Testing procedure shall follow ASTM D6391 - 06 Standard Test Method for Field Measurement of Hydraulic Conductivity Limits of Porous Materials Using Two Stages of Infiltration from a Borehole. This test includes the use of any associated equipment, water source, mobilization, use of necessary equipment for test preparation, site remediation, data collection by a trained technician, all labor associated with this test, any and all associated mathematical computations and conversions, and other incidentals. The test is expected to last at least six (6) hours (or until after a relatively constant rate is obtained). Readings shall be recorded on an approved worksheet that has the project title and contract number, technicians who performed the test, date, weather conditions, location of test (GPS coordinates and initial ground elevation), ID number (of test), depth of test, any abnormal conditions during test, and all relevant data collection.

**Basis of Payment:**

Payment for this item shall include a mobilization to site and all service and will be as lump sum.

**Item #54 Description**

**MOBILIZATION FOR CONE PENETROMETER EQUIPMENT**

**Description:**

This work includes mobilization to project sites that are accessible by a truck mounted cone penetrometer. Clearing to access a project site shall be included in this item.

**Basis of Measurement and Payment:**

The item, mobilization for truck mounted cone penetrometer, will be paid for at the Contract unit price per each mobilization for truck mounted cone penetrometer which price and payment shall constitute full compensation for furnishing all equipment, material, and manpower required to acceptably perform all the work involved.

**Item #55 Description**  
**SOIL BORING “CPT”**

**Description:**

This work consists of advancing to detriment of the end bearing and side friction drive the Cone penetration tests “CPT” through unconsolidated or partly consolidated sediments or soft rock by use of mechanical or electric type at locations designated on the Plans or as directed by the Engineer. Those soil borings made over "deep" water requiring a barge or other special equipment, or in wet areas that cannot be accessed by a truck mounted CPT, will be considered Soil Borings CPT.

Cone Penetration Tests (CPT) shall be continues reading every two centimeter at the ground surface and drive to the requested depth.

**Materials and Construction Methods:** Hollow Stem Auger Method

The Contractor shall use equipment met the standard specification of the test method ASTM D-3441-04, contractor is response to detriment and calculate all the data as follow:

1. Cone resistance  $q_c$
2. Friction Resistance  $f_s$
3. Friction Ratio  $R_f$
4. Pore pressure  $U_o$

**Records and Logs**

The Contractor shall keep a complete and accurate record of all details of the Soil Boring operations in a field book and on suitable boring log forms provided by the Contractor. Upon completion of each boring, two copies of the field log, on 8-1/2 x 11 inch paper, shall be given to the Engineer. The description of the soil, rock and other material encountered in the boring shall be made by the Contractor or the Engineer's Representative. Each boring log shall record the information pertinent to the boring work being accomplished as outlined in the following sections. The following general information shall be recorded on each boring log:

1. Contract number, title of project and section designation
2. Location of boring by survey station, and offset, right or left of survey baseline
3. Boring number as specified on the Plans or as furnished by the Engineer
4. Names of the Engineer, Contractor, Inspector, and drilling crew
5. Date of starting and completing each boring
6. Ground elevation of the top of the hole as provided by the Engineer
7. Depth to the top of ground water, if present.

The following information shall be recorded on the boring logs for that portion of the boring penetrating unconsolidated or partly consolidated sediments or soft decomposed rock by the CPT method:

1. Type of CPT used
2. Size, type and length of rods used in each hole
3. Method used to clean out after finish.

## Appendix A – ITEM DESCRIPTIONS:

4. Description of the material encountered shall be in accordance with standard practice and shall include:
  - a. Type - topsoil, sand, silt, clay, gravel, silty clay, sandy silt, etc.
  - b. Moisture - dry, moist, wet, saturated,
  - c. Consistency - soft, loose, medium, firm, stiff, etc.
5. graph and data to meet the report section at ASTM D-3441-04

### **False Starts**

The Contractor is to verify the exact location of all known utilities prior to drive the CPT. If the Contractor is unable to complete any boring due to encountering underground utilities or structures, the existence and location of which could not have been previously known, or because obstacles or obstructions are encountered which the Engineer considers are of an unusual nature and that failure to penetrate them is not the fault of the Contractor's methods or equipment, a false start will be measured and paid for at the applicable Contract unit price. The record of false starts shall be forwarded to the Engineer. For the new hole, bored to replace the abandoned hole, the Contractor shall operate as if a completely new hole was bored obtaining soil samples, standard penetrations tests, etc., in the depths reached by the abandoned hole.

### **Backfilling and Restoring**

All holes from work performed shall be backfilled and acceptably restored.

### **Method of Measurement:**

The quantity of soil borings will be measured as the total depth in linear feet of each boring actually made use the CPT. Measurement will be from the surface of existing ground or ground level below water (i.e. streambed) to the bottom of the hole, or to the depth at which Rock Core Drilling starts

If the Contractor abandons a hole prior to approval of the Engineer, no measurement or payment will be made for the hole that has been abandoned.

Any method used to carry the boring through the obstacle other than rock core drilling in excess of 1 foot, shall be considered as Soil Boring.

If the Contractor abandons a boring before adequate information is obtained and starts another boring adjacent to it in preference to carrying the boring through the obstacle, or because of a shattered or misaligned casing, no measurement or payment will be made for the work done on the abandoned boring.

### **Basis of Payment:**

The quantity of soil borings will be paid for at the Contract unit price per linear feet. Price and payment will constitute full compensation for the cost of all labor and materials necessary for furnishing and sinking of casing, as required; the cost of determination of running sand; the cost of taking and recording ground water observations; the cost of filling holes and surface restoration; and all else in connection with or incidental to the test.

**Item #56 Description**  
**LIGHT DUTY SUPPORT VEHICLE**

**Description:**

Mobilization and operation of a light duty vehicle as needed and deemed by the Engineer to support drilling operations. Examples of this item include but are not limited to: ATV's and small boats.

**Basis of Payment:**

Payment for this item is per day (nine (9) hours).

**Item #57 Description**  
**MOT (WEEKEND/OVERTIME) RATE**

**Description:**

MOT, weekend/overtime pay rate.

**Basis of Payment:**

Per hour rate for weekend or overtime work.

**Item #58 Description**  
**ROADWAY PAVEMENT CORING**

**Description:**

This work consists of coring and obtaining a full depth sample of the roadway pavement. This can include bituminous concrete, Portland cement concrete, and composite pavements.

**Materials, Equipment and Construction Methods:**

This work will occur by an approved and accepted method of rotary drilling capable of maintaining a smooth road surface. The Contractor will backfill the core hole to the existing elevation with the same material.

**Basis of Payment:**

The quantity of Roadway Pavement coring will be paid for at the Contract Price and payment will constitute full compensation for the cost that may require drilling in the amount of 6 inch intervals of depth. Depths where cores are obtained between 6 inch intervals will be rounded up to the nearest 6 inch interval for payment.

Should the Department request the core sample be retained and returned to the Department for additional testing, the Contractor will be paid under the separate items for backfilling the core hole and GPS location.