

Attachment A

**2018 Exploratory Diamond-Core-Hole Drilling Program
Borehole CAM023_0581
Bureau of Topographic and Geologic Survey
Pennsylvania Department of Conservation and Natural Resources
State Game Lands 293
Rathbun 7.5-Minute Quadrangle, Cameron County, Pennsylvania**

Technical Specifications

1. PRIMARY WORK-SITE MOBILIZATION AND DEMOBILIZATION

1.1 CONTRACTOR RESPONSIBILITY

For the drilling site, the work covered by this section consists of the delivery to the work site by the Contractor of all equipment, material, and supplies; acquisition of any permits; installation of any needed erosion and sediment control devices (Attachment C); removal from the site of all equipment, material, and supplies after the completion of work; standard cleanup of the site, unless waived or postponed by the Representative of the Bureau of Topographic and Geologic Survey (BTGS), Pennsylvania Department of Conservation and Natural Resources (PADCNR), hereafter referred to as the Department Representative (see **Contract Item 2.1, under “Secondary Work-Site Mobilization and Demobilization,”** in case cementing is postponed); delivery of records; and final inspection by the Department Representative. Part of standard clean up may include cementing (sealing) the borehole, but cementing itself is separate **Contract Item 5, “Sealing (Cementing) Borehole,”** which covers contractor responsibility, procedure, and measurement and payment for this work.

1.2 PROCEDURE

Mobilization by the Contractor shall consist of the delivery to the work site of all equipment, material, and supplies to be furnished by the Contractor; installation of any needed erosion and sediment control devices (Attachment C); the complete assembly in satisfactory working order of all such equipment on the job; and the satisfactory storage at the site of all such material and supplies.

Demobilization by the Contractor shall consist of removal of all equipment, material, and supplies from the Project site and standard cleanup of the site, which includes the removal of all trash and debris and the restoration of any damaged areas (e.g., deep ruts, holes, sedimentation pits, etc.) to as good or better condition than that which existed prior to the commencement of work. This standard cleanup work will include

spreading of straw to reduce erosion and regrading and/or reseeded of areas if designated by the Department Representative. However, with the approval of the Department Representative, some aspects of site cleanup and restoration may be postponed if “**Secondary Work-Site Mobilization and Demobilization**” are required. If more than standard cleanup is required to restore the area surrounding the borehole and the access route to the borehole to a condition equal to or better than that which existed prior to the start of the Project work, the Contractor may be able to seek additional compensation under **Contract Item 6, “Ancillary Restoration of Borehole Site,”** subject to the direction, approval, and acceptance by the Department Representative.

All equipment and methods to be used by the Contractor shall be subject to prior approval by the Department Representative. However, approval of the equipment shall not be construed as approval of the performance thereof. The Contractor shall furnish any additional or “special” equipment necessary for him to obtain the desired end results.

The Contractor, at his expense, shall obtain all permits, of whatever nature, necessary for the completion of the work, and the Contractor shall comply with all existing laws, ordinances, rules, and regulations relating to his operations. Easements from property owners will be obtained by the Department or its designated representative.

In consultation with and as required by the Departmental Representative, the Contractor will have to provide and maintain sedimentation control of water exiting the borehole during drilling and flushing operations (see **Contract Items 3 and 4**) in order to prevent soils and pulverized rock (turbid water) from entering into the headwaters of the Pigeon Hollow water basin. Water channelization beyond the drill site is discouraged at all times. Acceptable sediment-control devices may include, but not be limited to, trench-and-pump water-filter bags, compost sock sediment traps, straw-bale barriers, and sedimentation pits and sumps. Although not to downplay the need and importance of sedimentation control, based on past experience in the topographic setting of the core-hole site, it is fairly likely that at some depth the returning water in the borehole during drilling or flushing may be lost to one or more thieving fractures, and therefore returns may not make it to the surface at all.

Every effort shall be made by the Contractor to minimize damage incidental to site access and to the drilling operations. Maximum use shall be made of existing roads and lanes for access. Where it is necessary to deviate from roads and lanes, such deviation shall be by one track, at a location causing the least damage.

The Contractor shall be liable to the property owners for any damage to vegetation, crops, and/or property, irrespective of whether the damage was caused by his negligence or was an unavoidable consequence of drilling operations. The Contractor shall be liable for any and all damage, including damages for necessary access. The Contractor shall be required to consult with the Department Representative as to when he intends to move equipment to the drilling location.

1.3 DELIVERY OF RECORDS

The Contractor shall be responsible for furnishing the following records for the work site within the following time constraints:

1. One pencil copy of the boring description (log), not later than 48 hours after the completion of drilling the borehole.
2. Two typed copies of the borehole description (log), in either hard-copy (paper) or electronic format as specified by the Department Representative, not later than seven (7) days after completion of the drilling of the borehole. The log shall provide pertinent information such as, but not limited to (**see Contract Item 4.4 for more details**):
 1. Borehole number.
 2. Borehole completion date.
 3. Elevation of surface.
 4. Beginning and end of each core run.
 5. Rock types.
 6. Rock colors.
 7. Water elevations.
3. Copies of any other records kept by the Contractor, which in the opinion of the Department Representative will aid in the interpretation of the core boring, may be requested at any time during the course of the enforcement of the Contract.

No additional payment will be made for the delivery of records, as delivery is included in **Contract Item No. 1.1, under “Primary Work-Site Mobilization and Demobilization, Contractor Responsibility.”**

1.4 MEASUREMENT AND PAYMENT

Measurement, when accepted and approved, will be made on the basis of a complete unit Work Site, but only to the extent directed by the Department Representative.

Payment will be made at the Contract Unit Price bid of Work Site for Contract Item, “Primary Work-Site Mobilization and Demobilization,” for which price and payment shall constitute full compensation for furnishing all labor, material, equipment, supplies, and other necessary incidentals required to satisfactorily complete these items of work. Payment, including mobilization, will be paid upon completion of the hole.

2. SECONDARY WORK-SITE MOBILIZATION AND DEMOBILIZATION

2.1 CONTRACTOR RESPONSIBILITY

If the Department or its Representative determines that the borehole is to remain open

upon completion of drilling for long-term tests and measurements, possibly for a period of time of up to several months, it will be necessary for the Contractor to return to the site at a later date to cement (seal) the borehole and restore the site. This process, excluding the cementing itself which is separate **Contract Item 5**, is herein referred to as “**Secondary Work-Site Mobilization and Demobilization.**” For the site, the work covered by this section consists of the delivery to the work site by the Contractor of all equipment, material, and supplies; removal from the site of all equipment, material, and supplies after the completion of work; standard cleanup of the site; and final inspection by the Department Representative. Part of clean up includes cementing (sealing) the borehole, but cementing itself is separate **Contract Item 5, “Sealing (Cementing) Borehole,”** which covers contractor responsibility, procedure, and measurement and payment for this work.

2.2 **PROCEDURE**

Mobilization by the Contractor shall consist of the delivery to the work site of all equipment, material, and supplies to be furnished by the Contractor; the complete assembly in satisfactory working order of all such equipment on the job; and the satisfactory storage at the site of all such material and supplies.

Demobilization by the Contractor shall consist of removal of all equipment, material, and supplies from the Project site and standard cleanup of the site, which includes the removal of all trash and debris and the restoration of any damaged areas (e.g., deep ruts, holes, sedimentation pits, etc.) to as good or better condition than that which existed prior to the commencement of work. This standard cleanup work will include spreading of straw to reduce erosion and regrading and/or reseeded of areas if designated by the Department Representative. However, with the approval of the Department Representative, some aspects of site cleanup and restoration may have already been undertaken and completed under “**Primary Work-Site Mobilization and Demobilization.**” If more than standard cleanup is required to restore the area surrounding the borehole and the access route to the borehole to a condition equal to or better than that which existed prior to the start of the Project work, the Contractor may be able to seek additional compensation under **Contract Item 6, “Ancillary Restoration of Borehole Site,”** subject to the direction, approval, and acceptance by the Department Representative.

All equipment and methods to be used by the Contractor shall be subject to prior approval by the Department Representative. However, approval of the equipment shall not be construed as approval of the performance thereof. The Contractor shall furnish any additional or “special” equipment necessary for him to obtain the desired end results.

The Contractor, at his expense, shall still have in force all permits, of whatever nature, necessary for the completion of the work, and the Contractor shall comply with all existing laws, ordinances, rules, and regulations relating to his operations. The Department or its designated representative shall ensure that the easements from

property owners that it was responsible for obtaining in the first place will still be in force.

Every effort shall be made by the Contractor to minimize damage incidental to site access and to the drilling/cementing operations. Maximum use shall be made of existing roads and lanes for access. Where it is necessary to deviate from roads and lanes, such deviation shall be by one track, at a location causing the least damage.

The Contractor shall be liable to the property owners for any damage to vegetation, crops, and/or property, irrespective of whether the damage was caused by his negligence or was an unavoidable consequence of drilling/cementing operations. The Contractor shall be liable for any and all damage, including damages for necessary access. The Contractor shall be required to consult with the Department Representative as to when he intends to move equipment to the drilling/cementing location.

2.3 MEASUREMENT AND PAYMENT

Measurement, when accepted and approved, will be made on the basis of a complete unit Work Site, but only to the extent directed by the Department Representative.

Payment will be made at the Contract Unit Price bid of Work Site for Contract Item, "Secondary Work-Site Primary Mobilization and Demobilization," for which price and payment shall constitute full compensation for furnishing all labor, material, equipment, supplies, and other necessary incidentals required to satisfactorily complete these items of work. Payment, including mobilization, will be paid upon completion of the hole.

3. OVERBURDEN DRILLING

3.1 CONTRACTOR RESPONSIBILITY

The work covered by this section consists of furnishing all labor, material, equipment, supplies, and other necessary incidentals required to drill boring through the overburden.

3.2 TEST BORING LOCATION

The site of the work to be performed shall be at the location within the boundary of the map area in Attachment B, Figure 1. The test-boring location for the work site is approximate and may be revised up to a distance of a mile or so from where it is shown in Attachment B, Figure 1, prior to the starting date of primary work-site mobilization. The test-boring site will be exactly located in the field by the Department Representative, and the Department Representative will furnish the Contractor with the surface elevation of the borehole. It is the Contractor's responsibility to ascertain exact locations of utilities from the appropriate utility companies and to verify all measurements in the field in order to ensure that the boring is made at a location that will not interfere with or harm existing surface or

subsurface utilities. The Contractor shall notify the Department Representative when a conflict occurs. The Contractor shall bear sole responsibility for any damage to existing utilities resulting from his operations. The number of test borings proposed for a work site will be noted in the Department's instructions to the Contractor and outlined on the drawing accompanying the site-work order.

3.3 PROCEDURE

The Contractor shall make one boring into earth and material other than rock for the purpose of penetrating to the top of solid rock or for ascertaining the depth and thickness of the overburden material. Sampling of overburden material will not be necessary, but if anything of interest is encountered, the information will be documented and shared with the Departmental Representative. The Contractor may decide what method of boring to use in approaching bedrock and the type of metal surface (overburden) casing to set once the top of solid rock is reached. However, the surface casing must be of a kind at the work site so that a locking cap or lid can and will be fastened to the top of the casing. (This shall be done so that no material can fall into the hole, which could potentially bridge it, after drilling is completed but prior to cementing and backfilling. During this interim period, the hole is to remain open to total depth so that the Department or its representatives can conduct tests or measurements in the borehole, such as geophysical logging.) Furthermore, bentonite pellets or similar material shall be added to the annular spacing between the overburden borehole wall and surface casing and especially around the shoe of the casing to provide a tight seal to isolate the inside of the cased borehole from any surface water and shallow groundwater infiltration. If the Contractor penetrates weathered bedrock to any depth, the depth and thickness of said weathered bedrock shall be carefully documented. Samples of this weathered bedrock, if recovered, shall be saved and placed in a separate core box, unless designated otherwise by the Department Representative.

It may be necessary to leave the surface casing in place at the completion of the project if the upper part (upper 250 feet or so) of the core hole is left open and converted to a long-term monitoring well (see **Contract Item 4.3, "Equipment and Supplies,"** for more details). If the Department Representative informs the Contractor that such is the case, the Contractor will be separately compensated for the cost of the surface casing itself.

3.4 MEASUREMENT AND PAYMENT

3.4.1 Overburden Drilling

Measurement, when accepted and approved, will be made on the basis of the linear feet of borehole actually drilled in overburden, but only to the extent directed by the Department Representative. No separate payment will be made for coring or other methods of advancing overburden drilling through boulders or other obstructions unless said obstructions are cored and greater than five (5) feet in thickness, in which case payment shall be made as "Core Drilling."

Payment will be made at the Contract Unit Price bid per Linear Foot for Contract Item,

“Overburden Drilling,” for actual quantities used, which price and payment shall constitute full compensation for furnishing all labor, material, equipment, supplies and other necessary incidentals required to satisfactorily complete this item of work.

3.4.2 Surface Casing

Measurement, when accepted and approved, will be made on the basis of the linear feet of surface casing actually used in overburden drilling, but only to the extent directed by the Department Representative.

Payment will be made at the Contract Unit Price bid per Linear Foot for Contract Item, “Surface Casing,” for actual quantities used, which price and payment shall constitute full compensation for furnishing the surface casing, as all other labor, material, equipment, supplies and necessary incidentals required to satisfactorily complete this item of work has already been compensated for under **Contract Item 3.4.1, “Overburden Drilling.”** The locking cap for the surface casing is considered incidental, and no separate payment shall be made.

4. CORE DRILLING

4.1 CONTRACTOR RESPONSIBILITY

The work covered by this section consists of furnishing all labor, materials, equipment, supplies, and other necessary incidentals required to drill core borings through bedrock.

4.2 DRILLING PERFORMANCE STANDARDS

In order to demonstrate that the Contractor has the capabilities and experience to undertake and complete the BTGS exploratory core-drilling project in a satisfactory and timely manner, the Contractor must meet the following **Drilling Performance Standards** and include proof thereof by providing a minimum of three (3) references of clients (names, mailing addresses, telephone numbers, and email addresses) for whom the Contractor has worked at least once during the last ten (10) consecutive calendar years and who can verify and confirm that the Contractor has met these **Drilling Performance Standards** to their (the clients’) satisfaction:

The Contractor must have proven in-house capabilities (not subcontracted) to (1) complete a borehole by continuous core drilling in bedrock, with core of at least 2 inches in diameter (NQ/NX), to a depth of 1000 feet or more; (2) continuously core drill (NQ/NX) in normal bedrock (i.e., barring unusual geologic conditions such as highly weathered or fractured rock, highly dipping rock strata, multiple underground mine voids or natural voids such as in limestone, etc.) at an average drilling rate of 150 feet or more per day to a depth of at least 1000 feet; and (3) extract continuous core (NQ/NX) from a borehole in a single drilling run in

lengths of up to 15 feet or more (i.e., have core barrels for retrieving NQ/NX core in lengths of up to 15 feet or more).

Failure to meet any or all of the preceding Drilling Performance Standards will result in automatic rejection of the bid.

4.3 EQUIPMENT AND SUPPLIES

Equipment for core drilling shall include hydraulic-feed core-drilling machinery of a type or types approved by the Department Representative, complete with pressure gauge for measuring down pressure, water-pressure gauge, and relief-valve assembly, together with all other necessary accessories for taking complete and continuous rock cores of at least 2 inches (NQ/NX size) in diameter. **In no event will a core size of less than 2 inches (NQ/NX size) be acceptable, unless pre-approved by the Department Representative.**

Unless otherwise directed by the Department Representative, the Contractor shall use a standard ball-bearing, swivel-type, double-tube core barrel, equipped with diamond core bits and standard core lifters.

Supplies for core drilling shall include all casing and casing caps, drill rods, core barrels, diamond coring bits, reaming shells, piping, pumps, water, tools, and power, and all other items not included herein but required for satisfactory performance of required work. Bits shall be set with the proper size stones for the kind of rock being cored. Note, however, that core boxes (bottoms, dividers, and lids) will be supplied by the Department.

If the Contractor believes that the core size will have to be reduced during the drilling of the core hole, the Contractor shall initiate the drilling with a larger size core. In no event will a core size less than 2 inches (NQ/NX size) in diameter be acceptable, unless specifically approved in advance by the Department Representative.

All equipment and methods to be used by the Contractor shall be subject to prior approval by the Department Representative. However, approval of the equipment shall not be construed as approval of the performance thereof. The Contractor shall furnish any additional or "special" equipment necessary to obtain the desired end results.

The Contractor shall provide a secure, firm, and level work platform at the borehole location. The boring shall not be offset from the location shown on the boring layout plan (map) without prior approval of the Department Representative. Water for the drilling will be the responsibility of the Contractor. No separate payment will be made for obtaining water. Transporting water to the work site by tanker (water truck) will be required.

4.4 PROCEDURE

The Contractor shall be responsible for drilling a plumb borehole. From the surface to the depth (elevation) where the test boring encounters rock (i.e., the bottom of the overburden), casing—commonly referred to as surface casing, overburden casing, or drive pipe—shall be installed to prevent possible collapse of the hole, and the casing shall be seated tightly in the rock to a depth of at least one (1) foot, provided that the rock is stable. If the rock is unstable, the casing shall be seated tightly in the rock to a depth of at least two (2) feet. In either case, the casing shall be thoroughly cleaned out preparatory to commencement of rock coring. All drill-rod sections shall be tightly sealed to each other by means of commercial seals made for the purpose or by the application of wicking to the joints. In coring rock (including coal, shale, and indurated clays), the Contractor shall operate the drills at such speeds, feeds, and water pressures as will ensure maximum core recovery. The individual drill runs in the coring operation shall, in no case, be in excess of fifteen (15) feet, unless otherwise approved in advance by the Department Representative. Bottom discharge bits shall be used to increase recovery in soft and broken rock. The Contractor shall frequently check the condition of the core lifter, reaming shell, and rotation of the inner barrel to avoid any grinding of the core. Whenever blockage of the core barrel occurs, the “run” shall be terminated immediately and the rods and barrel pulled. The core barrel shall then be removed from the borehole. The core barrel shall be dismantled horizontally and the core pushed out into a trough when, in the opinion of the Department Representative, such steps are necessary for the protection of the core during its removal from the barrel (i.e., to keep the core from disintegrating or falling apart). In any case, prior to placing the core into core boxes, the Contractor shall lay the core out in proper order on a bench, in troughs, or on another suitable flat surface, protected by plastic tarps or similar material underneath the core, for inspection by the Department Representative. Thereafter, the recovered core shall be placed in the core box in proper order. However, before commercial (minable) coals are placed in core boxes with the rest of the rock core, they will be wrapped and sealed in plastic film.

The Contractor shall ensure a minimum core recovery of ninety percent (90%) for each run, unless unusual subsurface conditions exist, since high recovery is considered necessary for any proper interpretation of the subsurface conditions. In addition, the Contractor shall ensure a minimum core recovery of ninety percent (90%) of each coal over six (6) inches in thickness. It is unlikely, however, that coals of minable thickness will be encountered in the borehole at Drilling Site 1 (Borehole CAM023 0581). When a “run” is made that results in complete core loss, the tools shall be checked for damage or malfunction and a second attempt made to recover the material by coring an additional few inches.

Failure to comply with the foregoing procedure shall constitute justification for the Department to require redrilling, at the Contractor's expense, if over ten percent (10%) of the total core length in a run is lost without any unusual circumstances being present.

When the borehole is completed to the final total depth as determined by the Department Representative, the Contractor will remove the last of the core from the

hole. Unless directed otherwise by the Department Representative, the Contractor will then proceed to flush (clean) out the hole with fresh water for a minimum of two (2) hours by pumping such water to the bottom of the hole through the drill-stem rods. It is imperative that the water in the borehole be as clear and clean as possible and free of suspended cuttings and other material so that the Department Representative or his proxy can obtain the maximum information during subsequent tests and measurements within the hole. After flushing is completed, the Contractor will remove the hollow drill-stem rods (i.e., NQ/NX “casing,”) and all other equipment from the borehole. Only the overburden casing shall remain in the hole. In removing these items, the Contractor shall take every reasonable precaution to prevent any rocks or other materials from falling back into the open borehole so that the hole will remain open to total depth for subsequent tests and measurements that the Department or its Representatives may make.

4.5 LOGS

The Contractor shall keep accurate logs and records of all core borings, which shall include the following information:

1. Project name and contract number, borehole number, location of borehole, ground (surface) elevation, total depth of borehole, time and date of starting, time and date of completion, driller's name, and logger's name.
2. Size and depth of surface casing and size and type of drilling tools used to advance the borehole.
3. Depth of top and bottom of each run, and core recovery of each run.
4. Color changes in drill-water returned.
5. Depths at which sudden losses or gains of drill-water return occur and estimated quantities involved.
6. Visual classification of rock, including color, grain size, and inclination of beds or layers as measured from the horizontal.
7. Depth of top of firm or fresh rock and all other contacts between dissimilar materials.
8. Depth of water at completion of borehole and, where possible, after 24 hours.
9. Notes, remarks, and other information on pertinent incidents occurring during drilling operations.

4.6 CONTAINERS

All cores shall be arranged neatly in partitioned boxes provided by the Department (i.e., the Contractor is not required to provide core boxes), in a sequence consistent with that in which they were drilled. Facing the side of the open box, the cores shall be arranged in descending sequence, from back to front. Wood or cardboard spacers (blocks) shall be inserted at beginning and end of each run, and depths shall be shown on the spacers. If voids are encountered, a spacer block shall be inserted, on which is clearly noted that a void occurred and the depth to the top and bottom of the void. The top and bottom of the core placed in each core box shall be labeled on the ends of each core box as instructed by the Department Representative.

During the course of the drilling at the work site, the Contractor shall have the responsibility for storing the cores/core boxes and shall take adequate precautions to protect the cores from mechanical damage as well as from rain and other forms of precipitation and from extreme temperature changes. Once recovered and cleaned, the core shall not again be allowed to become wet. The Contractor has the responsibility to have all Project cores on the work site during normal work hours for logging and review by Department personnel.

The Department's representatives, and not the Contractor, shall be responsible for transportation and delivery of the core/core boxes to the Department's (BTGS's) core library at 3240 Schoolhouse Road, Middletown, Pennsylvania 17057-3534 or its core storage facility in Hollywood, Pennsylvania.

4.7 ABANDONED BORINGS

Except with the permission of the Department Representative, the Contractor shall not abandon or complete any boring, or remove any casing or drilling equipment, without first affording the Department Representative the opportunity to obtain the position and the depth of the boring to abandonment or completion, to secure samples of material already penetrated, and to make any other tests and measurements, or collect any other information, which the Department Representative may require.

No payment will be made for any boring, which has been abandoned by the Contractor before reaching the depth, elevation, or condition specified, unless the Department Representative approves and accepts the boring as being completed. Any boring abandoned by the Contractor without the Department Representative's approval shall be sealed at the Contractor's expense. The Department Representative may, at his option, accept a boring that fails to reach the required depth due to an unusual obstruction, which, in his opinion, could not reasonably have been anticipated.

4.8 MEASUREMENT AND PAYMENT

4.8.1 Core Drilling

Measurement, when accepted and approved, will be made on the basis of the linear feet of borehole actually drilled into rock and coal beds, but only to the extent directed

by the Department Representative.

Payment will be made at the Contract Unit Price bid per Linear Foot, for Contract Item, "NQ/NX Core Drilling," for actual quantities used, which price and payment shall constitute full compensation for furnishing all labor, material, equipment, supplies, and other necessary incidentals required to satisfactorily complete this item of work. (For purposes of this Contract, NQ/NX core shall be defined as a size having a minimum of 2 inches in diameter in cross section.)

4.8.2 Flushing (Cleaning) Out Borehole

Measurement, when accepted and approved, will be made on the basis of hours a drill rig and crew are ordered to flush (clean) out the borehole with fresh water, but only to the extent directed by the Department Representative.

Payment will be made at the Contract Unit Price bid per Hour for Contract Item, "Flushing (Cleaning) Borehole," for actual quantities used, and will be divided no finer than by one-quarter-hour increments, which price and payment shall constitute full compensation for the use of a drill rig and crew for this item of work.

5. SEALING (CEMENTING) BOREHOLE

5.1 CONTRACTOR RESPONSIBILITY

The work covered by this section consists of furnishing all labor, material, equipment, supplies, and other necessary incidentals required to cement the borehole completely from bottom to top.

5.2 PROCEDURE

There is a low risk that natural gas (high pressure, low volume) may be encountered entering into the lower (deeper) part of the borehole. If found, special sealing procedures will have to be followed to prevent possible gas migration up the borehole from the deeper zone(s) to freshwater-bearing zones (see **Contract Item 5.2.2**).

5.2.1 Cementing When No High-Pressure, Low-Volume Gas Encountered

At the direction of the Department Representative, the Contractor shall be required to seal the borehole in the following manner (standard procedure), if no high-pressure, low-volume gas is encountered and characterized during the drilling:

1. Upon completion of the borehole and acceptance by the Department Representative (after the Department Representative or its proxies have completed any planned tests or measurements made in the open borehole and/or in the borehole still containing the hollow drill-stem rods), the Contractor shall fill the open hole by tremie methods (i.e., grout pump and

tremie pipe) with a cement approved by the Department's representative, from the bottom of the hole to within two (2) feet of the surface, unless directed otherwise by the Department Representative (no drill rods or casing shall be deliberately left in the borehole after completion of cementing). The Contractor is only required to provide an ordinary Portland cement (OPC) such as ASTM Standard Specification C150—Type I, II, or III (equivalent to API Specification 10A—Class A, B, and C, respectively). If a specialty cement having a shorter transition time is required, all such labor, material, equipment, supplies, and other necessary incidentals required to cement the borehole completely from bottom to top with specialty cement will be obtained by the Department under a separate contract and will not be the responsibility of the Drilling Contractor.

2. The surface (overburden) casing shall be withdrawn, unless directed otherwise by the Department Representative.
3. In the event the casing cannot be recovered, it shall be cut off one (1) foot below the ground surface, unless directed otherwise by the Department Representative, and the borehole shall be sealed as indicated in item 1 above of this list.
4. The top two (2) feet of the borehole shall be filled with topsoil or refuse material.
5. The surface shall be restored to as good as or better than original condition.
6. If so directed by the Department Representative, the borehole shall not be sealed (cemented) or only partly sealed (see item 1 of this list) and the surface casing with locking cap will be left in the hole in order for the Department or its Representatives to conduct long-term tests and measurements.

5.2.2 Cementing When High-Pressure, Low-Volume Gas Encountered

1. The general procedures outline under **Contract Item 5.2.1** shall be followed. However, sealing will proceed in stages (special procedure), based upon the findings and recommendations of the Departmental Representative, in consultation with colleagues of the Pennsylvania Department of Environmental Protection (PADEP) and the U.S. Geological Survey (USGS), regarding the identification and characterization of high-pressure, low-volume gas at some depth in the borehole.
2. Based on the characterization of the gas coming into the borehole and determination of its depth of entry (using geophysical logs, imaging, and other methods), the Department Representative, in consultation with the PADEP, USGS, and Contractor, will direct the initial depth (from bottom of hole up to a certain depth) to be cemented. After the cement sets up (cures) adequately, on

the order of 12 to 24 hours if an ordinary Portland cement (OPC), a mechanical bridge plug or other suitable mechanical packer (e.g., Van Ruth cementing and wedging bottom packer and hold down plug or equivalent) shall be inserted into the open borehole (approximately 3 inch diameter) and placed just above the top of the cement where it will be set (permanently expanded) in place. Thereafter, the next 20 to 40 feet or so of the borehole will be cemented immediately above the packer. After that cement cures, the remainder of the borehole, up to whatever depth is directed by the Department Representative, will be cemented in accordance with the procedures outlined under **Contract Item 5.2.1**. If so directed by the Department Representative, deviations from the preceding outlined procedure will be permitted.

5.3 MEASUREMENT AND PAYMENT

Part of the sealing of the borehole may include the placement and setting of one or more packers, but as this is a separate activity from cementing itself, the cost of the packer and the cost of labor to install the packer are separate **Contract Items 5.3.2 and 5.3.3**, respectively, which cover contractor responsibility, procedure, and measurement and payment for this work.

5.3.1 Cementing of Borehole

Measurement, when accepted and approved, will be made on the basis of the linear feet of borehole actually sealed (cemented) before final demobilization of the Project is complete, but only to the extent directed by the Department Representative.

Payment will be made at the Contract Unit Price bid per Linear Foot for Contract Item, "Sealing (Cementing) Borehole," for actual quantities used, which price and payment shall constitute full compensation for furnishing all labor, material, equipment, supplies, and other necessary incidentals required to satisfactorily complete this item of work.

5.3.2 Mechanical Packer

Measurement, when accepted and approved, will be made on the basis of the unit cost for each mechanical packer as described under **Contract Item 5.2.2**, such as a Van Ruth cementing and wedging bottom packer and hold down plug, 3 inch by 3-1/2 inch by 1-1/2 inch, or equivalent, that can fit securely into an approximately 3-inch diameter open borehole, but only to the extent directed by the Department Representative.

Payment will be made at the Contract Unit Price bid per Each for Contract Item, "Mechanical Packer," for actual quantities used, which price and payment shall constitute full compensation for furnishing the mechanical packer.

5.3.3 Installation of Mechanical Packer

Measurement, when accepted and approved, will be made on the basis of hours a drill crew is required to install a mechanical packer, but only to the extent directed by the Department Representative.

Payment will be made at the Contract Unit Price bid per Hour for Contract Item, "Installation of Mechanical Packer," for actual quantities used, and will be divided no finer than by one-quarter-hour increments, which price and payment shall constitute full compensation for furnishing all labor, material, equipment, supplies, and other necessary incidentals required to satisfactorily complete this item of work, except for the mechanical packer itself, which is separate **Contract Item 5.3.2, "Mechanical Packer."**

6. ANCILLARY RESTORATION OF BOREHOLE SITE

6.1 CONTRACTOR RESPONSIBILITY

The ancillary work covered under this section, which goes beyond the scope of what is required for standard cleanup of the borehole site under **Contract Item 1 and Contract Item 2**, consists of providing all labor, material, equipment, machinery, supplies, and other incidentals necessary to restore the area surrounding the borehole and the access route to the borehole to a condition equal to or better than that which existed prior to the start of Project work. The work included in this section is considered discretionary and must first be directed, approved, and accepted by the Department Representative, since standard cleanup and restoration are considered incidental to and included in Contract Items, "Primary Work-Site Mobilization and Demobilization" and "Secondary Work-Site Mobilization and Demobilization."

6.2 PROCEDURE

In the case of a borehole located on developed private property, restoration includes, but is not limited to, repairing or replacing any sidewalks, fences, lawns (including landscaping with topsoil), and other improvements to the property which may have been damaged or removed as a result of the work, but only to the extent directed, approved, and accepted by the Department Representative. Note that for purposes of this contract, the borehole is expected to be situated on State Game Lands along a trail in an unpopulated areas. Clean up is expected to be minimal and not require ancillary restoration of the borehole site.

6.3 MEASUREMENT AND PAYMENT

Measurement, when accepted and approved, for restoration of the borehole site and/or access route to the site at the specified location, will be made on the basis of hours to complete restoration, but only to the extent directed, approved, and accepted by the Department Representative. For purposes of this Contract, the Contact Unit Price (or cost per hour equivalent) is the sum of unit costs of all labor, material, equipment, machinery, supplies, and other necessary incidentals to satisfactorily complete the restoration of the site and/or access route prorated for a period of one (1) hour.

Payment will be made at the Contract Unit Price bid per Hour for Contract Item, “Ancillary Restoration of Borehole Site,” for actual quantities used, which price and payment shall constitute full compensation for furnishing all labor, material, equipment, machinery, supplies, and other necessary incidentals required to satisfactorily complete this item of work. At its discretion, the Department or its Representative may request an itemized list (in writing) of the charges that comprise the hourly rate for any restoration of the borehole site and/or access route to the site for its review, approval, or record keeping/audit functions. This list shall be made available no later than five (5) business days after the request is made in writing. No payment will be made for ancillary restoration of the borehole site and/or access route to the site that has not been first directed, approved, and accepted by the Department Representative (i.e., in terms of what work is approved and the number of hours required to accomplish it), since standard cleanup and restoration are considered incidental to and included in Contract Items, “Primary Work-Site Mobilization and Demobilization” and “Secondary Work-Site Mobilization and Demobilization.”

7. STAND-BY TIME

7.1 CONTRACTOR RESPONSIBILITY

The work item covered by this section is intended to address any delays in drilling in which a drill rig and crew are ordered by the Department Representative to stand idle.

7.2 PROCEDURE

When the Contractor is ordered by the Department Representative to delay the drilling of the boring or other activities occurring at the work site, the Contractor will be reimbursed for any such delays, provided that the delays are the sole responsibility of the Department Representative and the delays are in excess of one-half hour in duration.

Stand-by time shall not be used for payment to the Contractor of delays caused by equipment breakdown and malfunctions or for delays caused by non-availability of necessary equipment and supplies. Such delays shall be considered the sole responsibility of the Contractor and shall be incidental to other items of work, and no additional compensation will be allowed. No payment for stand-by time will be made for items of equipment other than a complete drill rig and crew in full operating condition. A crew shall consist of a driller and helper and if any delay does occur, the Department Representative will record it on a daily basis with dates and times directed to be idle.

7.3 MEASUREMENT AND PAYMENT

Measurement, when accepted and approved, will be made on the basis of hours a drill rig and crew are ordered to stand idle, but only to the extent directed by the Department

Representative.

Payment will be made at the Contract Unit Price bid per Hour for Contract Item, “Stand-by Time,” for actual quantities used, and will be divided no finer than by one-quarter-hour increments, which price and payment shall constitute full compensation for the delay of a drill rig and crew.

8. INSPECTIONS

Ample opportunity shall be furnished at all times to the Department Representative for inspecting the work. If any imperfect work is performed at any time, the defects therein shall be remedied by the Contractor, at his expense, to the full satisfaction of the Department Representative. No drilling or field testing shall be done except in the presence of the Department Representative, unless specific permission has been granted to the contrary by the Department Representative. The keeping of separate drilling records and other notes by the Department Representative shall not relieve the Contractor of the responsibility for work specified in the Contract.

9. DESCRIPTIONS OF CONDITIONS TO BE ENCOUNTERED

The following description of the borehole, referenced in more detail in Attachment B, is approximate, and the Department assumes no liability for the accuracy thereof:

Hole No.	Estimated Total Depth
1. Borehole CAM023_0581 (Drilling Site 1)	1,400 lineal feet

For the purposes of this Contract, the footage for the hole listed above shall be used in making bid calculations. Depending upon the actual distance (depth) to target horizons as determined by the Department Representative, the total depth of the hole may deviate from the estimate listed above. Therefore, the Department Representative reserves the right to shorten the total depth of the drill hole by any amount, if required, or to lengthen (deepen) the total depth of the drill hole by up to 100 feet below the estimated depth of 1,400 lineal feet, keeping to the Contract Unit Price bid per Linear Foot for NQ/NX core drilling as used in making bid calculations. It is estimated that the total amount of drilling for this Project will be between 1,400 and 1,500 lineal feet.