

**SECTION 02011**  
**SUBSURFACE INVESTIGATION**

**02011.01 GENERAL**

**A. Description**

Subsurface investigation shall include, but not necessarily be limited to, drilling test holes (in soil and rock), auguring holes, obtaining samples, digging test pits or driving rods (where drilling or auguring is impractical) as a means of verifying the type and suitability of existing material for foundation purposes, for use as embankment or backfill material, and/or for determining the means and methods for support of excavation, dewatering, and/or grading operations.

**B. Related Work Included Elsewhere**

1. Protection of the environment; Section 01500.
2. Clearing and grubbing; Section 02110.
3. General Excavation; Section 02210.
4. Portland Cement Concrete; Section 03310.

**C. Quality Assurance**

The Engineer will inspect the work to ensure compliance with the Contract Documents.

**D. Submittals**

1. Submit final driller's reports within one (1) week after boring, indicating neatly and clearly the information for each boring including the depths of stratum by elevations, classification of materials, length and number of soil samples and rock cores, driving records, sample recoveries, and any other pertinent information recorded.
2. Submit a report recommending construction methods, construction recommendations, foundation preparation requirements, limits and types of borrow and/or selected fill required, optimum moisture contents, gradation, permeability, binders in the soil, reasonable compaction limits using native soils, and any recommendations on further in-situ or laboratory tests needed.
3. Submit rock cores and soil samples to the Engineer within 24 hours of completion of each boring.

**02011.02 MATERIALS**

**A. Materials Furnished by the County**

The Contractor will be furnished with the locations and the designated points of exploration, marked with suitable stakes and with the ground elevation indicated clearly thereon.

**B. Contractor's Options**

Not applicable.

**C. Detailed Material Requirements**

1. Portland Cement

Portland cement shall meet the requirements of Section 03310.02.C.1.

2. Fine Aggregate

Fine aggregate shall meet the requirements of Section 03310.02.C.2.

3. Water for Grout

Water for Grout shall meet the requirements of Section 03310.02.C.5.

**02011.03 EXECUTION**

**A. General**

1. Test holes shall be drilled or augured as indicated on the Plans or in the “Special Provisions”, or as directed by the Engineer. The Engineer will be the final authority concerning the location, depth, direction, and number of holes to be drilled or augured.
2. The size and length of rods to be driven will be designated by the Engineer. The Contractor shall mark rods as directed by the Engineer and maintain the blow counts as a written record.
3. This work shall be considered a minor construction item, and the Proposal quantities may be increased or decreased, or the item eliminated at the Engineer's discretion, without otherwise altering the Contract.
4. Throughout the boring operations, the Contractor shall keep a continuous and accurate boring log of all sampling, coring, materials encountered during the drilling of each hole, and groundwater readings. He shall include a record of rods driven including number, size, length, and location. He shall also keep a complete

record of the operations of installing the casing, recording the size and weight of the casing, weight and fall of the hammer and number of blows per foot required to drive the casing. A draft copy of the field driller's report shall be delivered to the Engineer within 24 hours after completion of the boring. The final copy of the field driller's report shall be submitted per Paragraph 2011.01.D.1.

## **B. Site**

1. When the Engineer considers the conditions at the site unsuitable for the prosecution of the work, he may order the Contractor, in writing, to suspend work until suitable conditions exist. Should work be thus suspended, on written order, additional time will be allowed for completion equal to the period during which the work was suspended. In accordance with Section GP-8.07, no additional compensation shall be paid the Contractor on account of such suspension.
2. It is the Contractor's responsibility to verify the location of underground utilities, whether or not they are shown on the Plans, in the immediate vicinity of each boring in the subsurface investigation so as to prevent damage to the utilities. At a minimum, notify "Miss Utility" a minimum of 48 hours prior to the start of drilling work and excavate test pits in accordance Section 02012. In addition, the Contractor shall perform other means of verification to satisfy himself of underground utility locations. Should any damage to such utilities occur, the Contractor shall be required to bear the full cost of repairs and/or replacement of the utilities.
3. The Contractor shall be required to do all necessary clearing and any other work necessary to move his equipment to, around and from the site. Each test hole drilled by the Contractor shall be suitably backfilled and leveled upon its completion and acceptance by the Engineer. At the completion of the work, the Contractor shall remove his equipment and leave the site in a clean condition acceptable to the Engineer.

## **C. Soil Sampling**

1. The soil sampling shall be performed in accordance with ASTM D1586 Standard Test method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils, which shall be consulted for description of equipment required, preparation for and method of boring, care of samples, logging and data required, and groundwater determination. Soil sampling shall be carried to the proposed depths shown on the Plans unless otherwise directed by the Engineer. Auguring between samples will be permitted if, in the opinion of the Engineer, subsurface conditions allow.
2. Soil samples recovered from wash water commonly called "wash samples" will be unacceptable.
3. In general, the use of water for cleaning out the casing will be permitted; however, if the moisture content of the material below the casing might be altered by water

in the casing, such water shall be removed by an approved method prior to advancing the borehole.

4. Test holes drilled through overburden shall be suitably cased to recover "dry samples", i.e., samples unaffected by water used to clean out the casing, of the sizes specified or directed by the Engineer.
5. Provide suitable means of advancing beyond boulders or other obstructions. Blasting is prohibited.
6. A continuous record shall be kept of the number of hammer blow per foot of penetration required in driving the casing. All drilling rigs used by the Contractor throughout the work shall use the same weight and fall of casing hammer to drill casings of the same size to maintain casing penetration data on a comparative basis.
7. During the sinking of the casing, observations shall be made to determine the elevation of the water surface in the hole. On any day in which a boring is not completed, the hole shall be pumped as nearly dry as practicable and permitted to stand overnight. Before resuming work the next day the elevation of the water surface in the hole shall be determined.
8. The use of drilling mud may be permitted only with prior approval from the Engineer. Mud rotary drilling shall be performed in accordance with ASTM D5783 Standard Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for GeoEnvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices.
9. Place the bottom 6 inches, or less if recovery is less than 6 inches, in a sample jar and label with the date, project name, boring number, sample number, blow count, and recovery. Place sample jars in jar boxes and label boxes with date, project name, boring numbers, and sample numbers. Sample jar boxes shall be labeled as "Complete" if all the sample jars are contained in one box, or "Continued" if the sample jars are continued in the next sample jar box.

#### **D. Core Drilling**

1. Core drilling shall be performed in accordance with ASTM D2113 Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration. Core drilling shall be made using a rotary drilling machine having a hydraulically actuated feed or thrust with size NX or NWM diamond double tube swivel type core barrel. Core drilling shall begin at refusal, which shall be considered to have been reached when the rate of advance is less than one (1) inch for 50 blows.
2. Casing shall be firmly seated upon the hard formation to prevent loose material from entering the hole and to prevent loss of drilling fluid. If soil seams, fissures, cavities or broken rock prevents the advance of the boring, auxiliary casing shall be used inside the borehole and the coring shall continue using the next smaller series WM or WX core barrel and bit.

3. When soft materials are encountered, a split-spoon sample or other type sample as specified by the Engineer shall be taken. Resume diamond core drilling when hard materials are again encountered. Casing shall be extended through the soft layer if necessary, in the opinion of the Engineer.
4. Maximum effort shall be exercised to obtain 100 percent recovery in core drilling. Drill fluid pressure and rate of flow, speed of bit rotation, and pressure on the bit shall at all times be carefully controlled. The initial coring run below the top of rock and in very badly broken or shattered rock shall not exceed two (2) feet. Coring runs in rock established as being firm where core recovery exceeds 80 percent, may be increased to five (5) feet, or ten (10) feet with approval of the Engineer. Under no circumstances shall the maximum core run exceed ten (10) feet.
5. The Contractor shall provide core boxes of wood or other durable material for protection and storage of the cores. The boxes shall be provided with hinged covers and with longitudinal spacers that will form separate compartments for each core run. Small blocks fit between the spacers shall be provided to mark the beginning and end of each run or pull of core barrel. The cores shall be placed from left to right beginning at the top hinged side of the core box. The wood block shall be securely fastened, and the depth clearly marked at the top and bottom of the core and at each noticeable gap in the formation.
6. Permanently and neatly label the top of each core box lid with the project name, site name, boring number, date, start and end depths of the material in the box, and name of the Contractor. On the inside of each core box lid, duplicate this information and also provide the start and end depths of each run, the percent recovery (REC), and the percent of rock quality designation (RQD). The Contractor shall deliver the core boxes, complete with all recovered cores, to the Engineer at the project site for permanent storage. The Contractor shall be responsible for temporary weather protected storage of cores until delivery to the Engineer.

#### **E. Groundwater Levels and Backfilling**

1. Upon completion of a boring, measure and record the zero-hour and 24-hour groundwater levels in the borehole. The 24-hour groundwater reading may be reduced or omitted with written approval of the Engineer.
2. Tremie grout the borehole with neat cement and water or a cement grout. Neat cement and water grout shall be composed of one (1) bag of Portland cement to five (5) to eight (8) gallons of water. Cement grout shall be comprised of not more than two (2) parts fine aggregate and one (1) part cement (per bag of cement) to five (5) to eight (8) gallons of water. Control testing of backfill grouts is not required.

**02011.04 METHOD OF MEASUREMENT**

Except as otherwise provided, measurement for subsurface investigation shall be started at normal ground line. At water locations, measurement shall be started at the streambed elevation. False starts will not be measured or allowed unless the boring has penetrated at least five (5) feet before being abandoned, in which case five (5) feet will be measured and allowed.

Measurement for subsurface investigation will be made of the total length of holes drilled, augured, or rods driven as directed by the Engineer.

**02011.05 BASIS OF PAYMENT**

Payment for subsurface investigation will be made at the price bid per linear foot irrespective of whether carried out from land or water locations. The price bid shall include furnishing all labor, material, equipment, keeping of records, the restoring of the terrain to its condition prior to the beginning of the work, all necessary insurance and incidentals required to satisfactorily complete the work as specified including mobilization of drilling equipment, final soils reports, including recommendations, analysis of data and delivery of soil samples and/or rock cores to the Engineer.

END OF SECTION