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SS Coordinator: Add section 76-3 with:

76-3 BOREHOLES

## 76-3.01 GENERAL

### 76-3.01A Summary

Section 76-3 includes specifications for drilling boreholes to log subsurface materials, obtain subsurface material samples, and perform in-situ test or monitoring.

### 76-3.01B Definitions

**borehole:** Drilled to obtain subsurface material samples for logging or testing or to perform in-situ testing or monitoring.

**spoil return**: Mixture of in-situ soil, drill cuttings, groundwater, and cementitious and additive materials. Spoil return may be liquids, semi-solids, or solids.

### 76-3.01C Submittals

#### 76-3.01C(1) General

Reserved

#### 76-3.01C(2) Qualifications

Submit:

1. List of at least 5 projects completed in the last 3 years that demonstrate the contractor's ability to perform geotechnical drilling, rock coring and soil, rock, and groundwater sampling with similar objectives and conditions to this job

2. For each project include:

2.1. Project description

2.2. Project location

2.3. Project owner’s name, email address, and phone number

2.4. Project completion date

2.5. Work performed

2.6. Personnel performed the work

3. Your C-57 license

4. Certification of your authorized AASHTO Accredited laboratory for soil and rock laboratory test

5. Name of accredited laboratory under State Water Resources Control Board Environmental Laboratory Accreditation Program for groundwater sampling and test

6. Name and qualification of the company and personnel performing geophysical or hydrologic tests

#### 76-3.01C(3) Work Plan

Submit:

1. Your company name, address, telephone number, and email address

2. Layout, numbering, and northing and easting coordinates of boreholes

3. Top and bottom elevations of boreholes

4. Description, make, model, type, year, and condition of drilling equipment capable of retrieving samples at the locations described and to the depths specified

5. Certificate of hammer efficiency calibration

6. Drilling schedule

7. Drilling method and equipment

8. Sampling method and equipment

9. Testing method and equipment

10. Monitoring method and instrument

11. Water management plan

12. Spoil return management plan, including method and equipment for containment, treatment, test, and disposal of spoil return

13. Traffic control plan

14. Site access plan

15. Example daily drilling report

16. Well permits from local enforcement agency

17. Underground Service Alert ticket number

#### 76-3.01C(4) Daily Drilling Report

Submit daily drilling record by noon, in digital data and pdf formats, of the next day's work shift. Include:

1. Date, start and end time

2. Drilling equipment ID, type, model number

3. Description of obstructions, interruptions, or other difficulties during drilling and how they were resolved

4. For each borehole

4.1. Identification number

4.2. Start and end time

4.3. Latitude/Longitude and Northing/Easting

4.4. Top and bottom elevations accurate to ±0.1 feet

4.5. Top and bottom elevations of each drilling type and method used

4.6. Quantities of consumable materials used

4.7. Quantity of grout used for destroying borehole

4.8. Groundwater elevation

4.9. Energy efficiency ratio of standard penetration test hammer

5. For each subsurface material sample

5.1. Identification number

5.2. Top and bottom elevations accurate to ±0.1 feet

5.3. Type and method used to retrieve the sample

6. For each in-situ test

6.1. Identification number

6.2. Top and bottom elevations of the test accurate to ±0.1 feet

6.3. Type and method of test

6.4. Equipment used

#### 76-3.01C(5) Laboratory Test Report for Soil and Rock

Submit laboratory test report, in digital data and pdf formats, by noon a day after the test is completed. Include:

1. Test date

2. Sample ID

3. Sample depth, length, diameter

4. Test result

5. Digital photos of sample before and after test

Laboratory test report for soil and rock must be reviewed, digitally signed by an engineer who is registered as a civil engineer in the State.

#### 76-3.01C(6) Borehole Log

Submit borehole log in electronic database file format within 15 days after completing a borehole and required laboratory tests. The borehole log must:

1. Be compatible with the Department’s borehole database

2. Comply with the Department’s Soil and Rock Logging, Classification, and Presentation Manual

Each borehole log must be reviewed, sealed, and signed or digitally locked by an engineer who is registered as a civil engineer in the State or a geologist who is registered as a professional geologist in the State.

#### 76-3.01C(7) Geophysical Logging Report

Submit geophysical logging report, in digital data and pdf formats, by noon a day after the test is completed. Include:

1. Date, start and end time

2. Borehole ID

3. Top and bottom elevations accurate to ±0.1 feet

4. Test result

Geophysical logging report must be sealed and signed by a professional geophysicist who is registered as a professional geophysicist in the State.

#### 76-3.01C(8) Hydrogeology Report

Submit hydrogeology report, in digital data and pdf formats,.

Hydrogeology report must be sealed and signed by a certified hydrogeologist who is registered as a hydrogeologist in the State.

#### 76-3.01C(9) Groundwater Test Report

Submit groundwater test report, in digital data and pdf formats,.

Groundwater test report must include tests for:

1. pH

2. Corrosivity

3. Other properties as described

#### 76-3.01C(10) Well Completion Report

Submit Well Completion Report under Department of Water Resources requirements.

Submit a copy of the Department of Water Resources Well Completion Report within 20 days after the completion of each borehole or inclinometer, as informational submittal.

### 76-3.01D Quality Assurance

Not Used

## 76-3.02 MATERIALS

### 76-3.02A General

Comply with section 76-6.02

### 76-3.02B Inclinometer

#### 76-3.02B(1) Casing

Casing must be made of ABS plastic or fiberglass.

Casing must have 4 internal grooves spaced 90 degrees apart. Each groove must have a consistent and flat surface for the wheels of the inclinometer probe. Groove spiral must be less than 0.3 degrees per 10 feet.

Top and bottom caps of casing must be watertight and made of ABS. Top cap must be removable.

Casing connections must be watertight.

Casing must comply with the requirements shown in the following table:

|  |  |  |
| --- | --- | --- |
| **Inclinometer Casing** | | |
| Quality characteristic | Test method | Requirement |
| Collapse strength (min, psi) | ASTM D1599 | 155 |
| Load strength (min, psi) | ASTM D2412 | 900 |
| Temperature rating (°F) | ASTM D1525 | -20–190 |

#### 76-3.02B(2) Protective Cover

Above-ground protective cover must be aluminum or steel casing with a lockable cover at the top.

Above-ground protective cover must be constructed using steel casing with at least 5-foot-long and at least 4-inch in diameter. Protective cover must extend at least 2 feet above ground and with a lockable hinged cover.

Flush-mounted protective cover must be 12-inch-long steel casing with at least 4-inch in diameter with a cast-iron cover. The cover must be with AASHTO H-20 load rating and fixed down with threaded stainless-steel bolts with lubricant and waterproof gasket.

#### 76-3.02B(3) Grout

Grout must be non-shrink that comply with ASTM C1107 and consist of Portland cement, additives, bentonite, and water.

Composition of grout must produce grout that is not stiffer than surrounding subsurface materials after cure and must allow casing to accurately reflect displacement of the surrounding subsurface materials.

Refer to the following grout mix guide to produce grout that is compatible with surrounding subsurface materials.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Grout Mix Guide** | | | | |
| Installation Environment | Soft soils | | Hard soils and rock | |
| Material | Common ratio | Ratio by weight | Common ratio | Ratio by weight |
| Portland cement and additives | 94 lb | 1 | 94 lb | 1 |
| Bentonite | 39 lb | 0.4 | 25 lb | 0.3 |
| Water | 75 gallons | 6.6 | 30 gallons | 2.5 |

## 76-3.03 CONSTRUCTION

### 76-3.03A General

Log boreholes under the Department's *Soil and Rock Logging, Classification, and Presentation Manual.* Collect and store samples as directed.

### 76-3.03B Equipment

#### 76-3.03B(1) Drilling and Sounding Equipment

Provide drilling equipment that is capable of drilling through hard rock and to the depth described.

Standard penetration test hammer must be tested for energy efficiency within last 12 months.

Electronic cone penetration test cone must be calibrated within last 12 months.

#### 76-3.03B(2) Sampling Equipment

Provide sampling equipment that can retrieve soil, rock, and water samples with the least disturbance to the sample and subsurface condition. Sampler assemblies, including liners, drive shoe, retainers, core barrel, core liners must comply with section 76-3.03C.

#### 76-3.03B(3) In-situ Test Instruments

Reserved

#### 76-3.03B(4) Monitoring Instruments

Reserved

### 76-3.03C Drilling, Sampling, Testing, and Sounding

Drill borehole under ASTM D420, D653, D3740, D6169, D6286, and D6914.

Drill borehole in soil under ASTM D1452, D5784, and D5872.

Drill borehole in rock under ASTM D2113, D5781, D5782, D5783, D5875, and D5876.

Perform geotechnical sampling, in-situ test and instrumentation under ASTM D1586, D2573, D3550, D4403, D4719, D8359, D6519, and D6907.

Perform cone penetration test under ASTM D5778.

Perform groundwater sampling under ASTM D4448, D5903, D6089, and D7069

### 76-3.03D Borehole Geophysical Logging

Perform borehole geophysical logging under ASTM D5753, D6167, D6727, D6274, D6820.

### 76-3.03E Install Inclinometer

Install inclinometer under ASTM D6230, and D7299.

Clean the borehole before installing inclinometer casing. Attach bottom cap to the first section of inclinometer casing and insert the casing into the borehole. Add remaining casing sections. Fill the casing with clear water to counter buoyancy if needed.

Align the top of the casing so that one of the grooves is oriented in the downslope direction or as directed by the Engineer. Do not rotate casing when subsequent casing sections are added.

Inclinometer casing must be centered in the borehole to allow grout to surround and support the casing.

After installing inclinometer casing, fill the annulus between the casing and borehole wall with grout using a tremie pipe. Grout surface must be 6 to 8 inches lower than the top of design casing elevation.

Separation of solid ingredients and water during and after placement is not allowed.

Place a dead weight at the top of the casing or insert a retrievable dead weight inside the casing to secure casing in place during curing. Place additional grout 48 hours after placing the initial grout.

Cover the casing with inclinometer top cap.

Install protective cover.

For above-ground protective cover, install weather resistant keyed brass padlock to secure the cover. Key the lock to the Department key code. Provide the padlock key.

### 76-3.03F Abort Borehole

If you need to abort an borehole due to unexpected conditions such as obstruction, notify the Engineer. Destroy the borehole under section 76-6.

Drill a substitute borehole near the aborted borehole and at location determined by the Engineer.

If samples collected from the aborted borehole are accepted, start sampling in the substitute borehole immediately below the lowest elevation of the accepted samples.

### 76-3.03C Destroy Borehole

Destroy borehole under section 76-6.

## 76-3.04 PAYMENT

Not used