VIRGINIA DEPARTMENT OF TRANSPORTATION

MATERIALS DIVISION

MEMORANDUM

GENERAL SUBJECT: **Manual of Instructions Chapter III – Geotechnical Engineering**	**NUMBER:** **MD 453-23**
SPECIFIC SUBJECT: **Corrosion Testing on Soil and Water for using Steel Piles in Corrosive Environment**	**DATE:** **February 21, 2023**
	SUPERSEDES:

APPROVED:

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EFFECTIVE DATE

- This memorandum is effective upon being published.

PURPOSE

- This Memorandum notifies the users of the VDOT's Materials Division Manual of Instructions that Chapter III has been revised to provide additional requirements for corrosion testing on soil and water for using steel piles in corrosive environment regarding geotechnical activities. The revisions are shaded below.

303.04 Sampling Requirements

For projects requiring scour analyses, representative bulk samples shall be obtained from the bedload (i.e., the sediment within ±12-in of the stream bed) and also those sediments down to 20 ft below the bedload. If rock (RQD >50) is present within 20 ft of the stream bed scour in that interval is no longer a design concern. Representative samples for scour analyses shall be described according to ASTM D2487. The undrained shear strength of cohesive samples can be approximated using the pocket penetrometer. Samples for scour analyses shall also be submitted for grain-size distribution, in accordance with AASHTO T88. The following table presents the appropriate sample size depending on the maximum grain-size diameter. Bulk samples for scour analysis shall be labeled as shown above (i.e., as bulk samples for moisture-density, CBR, M_r, or UCS testing).

TABLE 3-2 - SAMPLE REQUIREMENTS FOR SCOUR ANALYSIS	
Nominal Size of Largest Particles (in.)	**Minimum Weight of Sample (lb.)**
3/8	1
1	5
2	9
3	11

When drilling below the bedload, conventional sampling equipment can often result in a grain-size bias. Such bias can have a significant effect on the resulting scour analysis. As such, field methods shall carefully document whether coarse-grained gravel, cobbles or boulders are present with depth. Field engineers and geologists shall consider the soils that are conveyed to the ground by the augers and note drilling activity when evaluating stream sediments for scour potential.

For projects using steel piles, soil samples shall be obtained from both near surface and subsurface materials and water samples in the proximity of substructures shall be obtained from the waterways (e.g., culverts, streams, rivers and tidal areas). The corrosive environment is classified in terms of the resistivity, pH, and soluble salts (sulfates and chlorides) of the soil and water. The **Manual of the Structure and Bridge Division Part 2 File No. 23.05 – Use of Steel Piles in Corrosive Environment** details the classification for corrosive potential in various environmental conditions.

Soil sampling procedure for the corrosion testing from the boreholes of each substructure location is described below.

- One soil sample shall be taken within 1 to 5 feet of the surface. For the streambed sample, the first sample shall be obtained from the bedload (i.e., the sediment within ±12-in of the stream bed). Additional samples shall be taken for each significant change in strata until the groundwater is encountered.
- A minimum of two samples per bridge substructure unit shall be obtained and tested for corrosion series. If groundwater is encountered, one soil sample shall be taken within 5 feet and one between 5 feet and 10 feet below the groundwater table.
- Composite samples from different strata of a single borehole or from more than one borehole will not be accepted for laboratory testing.
- A minimum of 7 pounds of soil sample shall be obtained for each set (resistivity, pH, sulfates and chlorides) of corrosion testing.

Water sampling procedure for the corrosion testing of each substructure location is described below.

- A minimum of one water sample should be collected from the proximity of each substructure location for corrosion testing.
- For one set (resistivity, pH, sulfates and chlorides) of testing, a minimum of one liter shall be obtained.
- The water sample container shall be either plastic or glass with an airtight lid. The sample container shall be rinsed several times with the water to be collected to avoid contamination from the container. If possible, the sample container shall be submerged below the surface of the water in order to minimize the collection of floating debris such as wood chips, trash and leaves.
- The sample container shall be completely filled with water and tightly sealed to prevent the escape of air or introduction of air to the sample.
- All water samples shall be kept in a cooler with ice after sampling and during transport to the laboratory for testing. The samples shall be stored in the refrigerator in the laboratory.

The off-site borrow soils, if used around the steel piles, also require corrosion testing. One set of corrosion testing shall be performed for each quarry site borrow materials.

Samples shall be tested in accordance with the following test procedures: soil resistivity (AASHTO T 288), pH of soil (AASHTO T 289), sulfate ion contents in soil (AASHTO T 290 or ASTM D4327 or SW-846 9056A), chloride ion contents in soil (AASHTO T 291 or ASTM D4327 or SW-846 9056A), water resistivity (ASTM D1125), pH of water (ASTM D1293), sulfate ion contents in water (ASTM D516 or ASTM D4327 or SW-846 9056A), and chloride ion contents in water (ASTM D512 or ASTM D4327 or SW-846 9056 A). Samples shall be prepared in accordance with AASHTO T 290 or AASHTO T 291 or EPA 300 method for measuring chloride ion contents and sulfate ion contents in soil.

All soil samples (including pavement subbase aggregates as recovered during the field program) shall be preserved at their original in-situ moisture content through delivery to the laboratory and queuing time for testing.

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