NATURAL RESOURCES CONSERVATION SERVICE

DOCUMENTATION REQUIREMENTS FOR

SUBSURFACE DRAIN

CODE 606

General

Subsurface drains for field drainage may affect potential wetlands. A certified wetland determination and delineation should be completed prior to planning and designing any subsurface drain for field drainage.

Subsurface drains for residential and other non-agricultural sites do not require a certified wetland determination and delineation for wetland conservation. These areas may require a permit from the U.S. Army Corps of Engineers in accordance with provisions of the Clean Water Act.

Planning

The extent of topographic surveys and soil investigations required will vary depending on the size and complexity of the area to be drained. Large, relatively flat areas will require a topographic survey to determine the layout and grading of subsurface drains. Sufficient soil borings should be taken to determine the extent of soil texture variations and to locate any lines of seepage, water movement, or water table elevations. Permeability or hydraulic conductivity of the soil should be determined by the auger hole or other field methods as described in National Engineering Handbook Part 650 (NEH 650), *Engineering Field Handbook*, Section 1423(e). If these tests cannot be performed, use estimated soil permeability values from the soil physical data for the soil map unit

Surveys

Topographic surveys can be accomplished using a total station and data collector, global positioning system (GPS) and data collector, or a grid survey. Record and plot the survey data according to the guidance in Chapter 1 in NEH 650 or using AutoCAD Civil 3D. Light Detection and Radar (LiDAR) information may be used to develop topographic maps. Field verification using survey grade GPS units is recommended to set control for field layout of the design and to check the accuracy of the LiDAR elevations. Accurate elevations of natural or constructed outlets are essential for proper design.

Technical Release 62 (TR 62) provides a guide for taking and recording field survey notes for design, layout, and checkout. Individual differences in note keeping are allowed, but the information shown in TR 62 shall be the minimum requirements needed for adequate note keeping. Information collected and recorded electronically using data collectors with total stations or GPS receivers shall be plotted as needed to provide the basis for quantity calculations or other design documentation. A copy of the electronic data should be kept in the electronic design folders or as part of the project case file, whichever is more applicable to the project. The electronic data shall include all reference or quality control data according to the guidance in Chapter 1 in NEH 650.

At least 1 bench mark shall be established and recorded in the field notes. All surveys shall meet the accuracy standards for rough surveys in Table 1-1 in NEH 650.

Design Criteria–Field Drainage

Design subsurface drains in accordance with the criteria listed in Conservation Practice Standard (CPS) 606, Subsurface Drain, and NEH 650, Section 650.1423. The depth and spacing of

subsurface drains can be estimated using the ellipse equation or locally developed drainage guides. Soils investigations are required to determine the depth to impermeable layer and estimated hydraulic conductivity. The equation can be solved numerically or by using graphs in NEH 650, Section 650.1423. Note that the installed depth may be restricted by the maximum trench depth for corrugated plastic pipe in Table 14-6 in NEH 650.

The size of the main conduit and laterals shall be determined using the charts and equations in NEH 650, Section 650.1423(h). Use the drainage coefficient from Table 14-5 in NEH 650 or locally developed drainage guides. A profile of each mainline conduit and a typical lateral will need to be plotted to calculate the grade of the drain to be used in determining the size of the conduit. A plan view of the site will assist in identifying which laterals need to be plotted.

Design Criteria–Foundation Drainage

Subsurface drains used in conjunction with buildings or concrete structures will normally consist of the minimum pipe size allowed and a sand or gravel envelope. The envelope serves as a filter and improves flow conditions in the immediate vicinity of the drain. The envelope should consist of a fine sand meeting the requirements of American Society for Testing and Materials (ASTM) C33 fine aggregate. This material is suitable for 95% of natural soils. For problem soils, design the envelope using criteria in NEH 650, Section 650.1424(c), or National Engineering Handbook Part 633 (NEH 633), *Soil Engineering*, Section 633.2603.

In some cases, a subsurface drain will be needed to intercept a perched water table or other high water table adjacent to a constructed fill or excavation. The envelope should be designed using criteria in NEH 650, Section 650.1424(c), or NEH 633, Section 633.2603. The conduit size shall be based on the estimated flow from the saturated materials and the contact area. Use Manning's equation or the charts in NEH 650, Section 650.1423, to determine the required conduit size. A safety factor of 2 should be used to determine the minimum conduit size due to the variability of the estimated flow from the saturated materials.

Layout and Checkout

Layout for installation of subsurface drains should consist of marking the location of each drain with stakes or flags. Mark the cut from ground surface to the planned bottom grade of the trench on the stakes or flags. Reference hubs or offset stakes may be set at a distance from the centerline to be out of the way during construction but close enough to be used for checking of grades during construction and at final checkout. The cut to the grade at the bottom of the trench from the top of the reference hub or offset stake should be shown in the notes and marked on the stakes. Cuts should be recorded to the nearest 0.1 foot. Stakeout using data collectors with total stations or GPS receivers shall be recorded in the data collectors as well as in field survey notes if desired.

Design and Plans

Develop the design in accordance with the above Design Criteria sections. The drawings and specifications should be developed in accordance with CPS 606 and Chapter 14 in NEH 650. The number of drawings required will be based on the complexity of the drainage system. At a minimum, the drawings should include a plan sheet showing the location of all subsurface drain conduits and other features, profiles of the main conduits and typical laterals, typical cross sections of trench installations, and adequate information on any structural items required.

Checkout

Checkout will consist of checking the grade and length of installed conduits. Record the standard engineering notes on Form NRCS-ENG-28 and Form NRCS-ENG-29, Loose Leaf Field Sheet, or Forms KS-ENG-37 and KS-ENG-37a, Field Notes (or equivalent).

The conduit grade should be checked at the outlet of each main conduit and at the junction of each lateral with the main conduit. The grade checks can be made by checking the top of the

installed conduit as long as a note is available showing the elevation difference between the flowline and top of the conduit. When using this method, be sure that shots for grade are not taken on the bell portion of the conduit joint. Grade shots for main and lateral conduits are recommended near each joint, but should have a maximum spacing of 50 feet. The measured length of each conduit will be noted in the survey notes and on the design plans.