## SPSRW-XX: Boulder Toe

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### **DESCRIPTION**

The work covered by this section consists of furnishing, stockpiling, placing, and maintaining approved stone, backfill, and filter fabric to be utilized to construct a boulder toe, as specified in the Contract Document or as directed by the Engineer. The boulder toe is used for bank toe protection, providing bank stability.

The quantity of structures to be constructed will be affected by site conditions during construction. The type and quantity of this structure may be increased or decreased at the direction of the Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

### **MATERIALS**

Backfill material shall consist of a well-mixed gradation of, stone aggregate and earth. Earth material shall be sourced on site from stockpiled materials resulting from bank and/or channel bed excavations from channel construction activities. Earth material from channel bed excavation is preferable for well-mixed gradation placed in the channel and bank(s).

Stone aggregate shall meet the material requirements of NCDOT section 1005 General Requirements for Aggregate and NCDOT section 1042 Rip Rap Materials.

Boulders shall consist of flat-sided, durable field or quarry stone that is sound, hard, dense, angular, and resistant to the action of air and water, and free of seams, cracks, or other structural defects. The Contractor shall use boulders with a “shape factor” greater than two (length and width more than twice the thickness). The Contractor cannot use limestone or concrete waste for boulders. Boulders shall be approved by the Engineer.

The size (length, width and depth (thickness)) of boulders shall be as specified by the Engineer in accordance with the construction documents.

Filter fabric for sealing structures shall meet the Type 2 material requirements of NCDOT Section 1056 Geosynthetics.

### **METHODS**

Structure installation and channel grading sequences may vary based on structure function and design. Boulder Toe should be installed in conjunction with channel grading operations, so that flow vectors and channel alignment can be used to adjust the installation.

Prior to construction of the structure, establish elevations at the upstream and downstream end of the proposed structure. The Contractor may install additional survey control, as needed, to complete the work in accordance with the Contract Documents.

Boulder Toe

* 1. Prepare the toe of the stream bank for the placement of boulders by excavating and shaping the slopes of the trench. Backfill material shall be placed per the detail.
	2. Place the footer boulders using mechanical means that produce a job within the tolerances required in the Contract Documents.
	3. Install filter fabric per the Contract Documents and in accordance with the manufacturer’s specifications. Leave enough filter fabric to place around header boulder(s) prior to backfill as shown on detail. Filter fabric shall be neatly secured around any project elements, undisturbed trees/shrubs, and existing structures to prevent any loose or frayed edges. There shall be no visible, loose ends or unsecured filter fabric on the completed work.
	4. Place the header boulders using mechanical means that produce a job within the tolerances required in the Contract Documents.
	5. Pack down the installed boulders without breaking once in place to ensure tight fit with minimal voids. Limit handwork to the amount necessary to fill small voids or correct localized areas. If boulders are used for toe protection, backfill material and/or soil backfill may be required to complete the stream bank toe protection. Backfill material shall be placed as required in the Contract Documents.
	6. Finish grade the adjacent streambed and channel banks to provide a smooth even grade transition between project structure components (vane arms, sills, inverts, floodplain sills, etc.) and the existing and/or proposed ground surface.

Based on the size of the stream and the size (length and diameter) of the boulder, a single boulder, meeting all other material requirements, may be used in lieu of separate footer and header boulders, with the Engineer’s prior approval. For single boulder installations combine steps 1) through 3) in compliance with the Contract Documents.

In locations where exposed bedrock and/or other existing feature extends to and/or within the limits of the proposed work, the boulder toe installation shall be field adjusted to incorporate the bedrock/existing feature into the finished work. The Engineer shall be contacted as soon as the presence of bedrock and/or other existing feature is field identified to determine the appropriate method of incorporation. Site conditions may require slight deviation from the plan and shall be approved by the Engineer.

### **MEASUREMENT**

The quantity of boulder toe to be measured for payment will be the actual linear feet of toe installed and accepted by the Engineer. All measurement for boulder toe shall be made uniformly along the surface of the bank.

### **PAYMENT**

The quantity of boulder toe, measured as provided above, will be paid for at the contract unit price per linear foot of boulder toe installed and accepted. Payment will be full compensation for all work covered in this special provision, including, but not limited to grading, installation, adjusting, excavating, placing backfill, boulder, filter fabric maintaining the feature through acceptance, and for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work as specified in the Contract Documents, or as directed by the Engineer.

Payment will be made under:

**BOULDER TOE LF**