## SPSRW-XX: BOULDER CLUSTER

Version Date: 05/22/2015 Revision Date: XX/XX/XXXX by XXX

### Description

The work covered by this section consists of furnishing, stockpiling, placing and maintaining an approved stone to be utilized to construct the boulder cluster in the locations specified in the Contract Documents or as directed by the Engineer. Boulder clusters are used to direct stream flow and maintain stream bed diversity.

The quantity of structures to be constructed will be affected by actual conditions that occur during the construction of the project. 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.

### Material

ENGINEER TO UPDATE IF THEY FEEL THAT THIS SPECIFICATION IS INADEQUATE FOR SITE CONDITIONS.

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 stone pieces with a “shape factor” greater than two (length and width more than twice the thickness). The Contractor cannot use limestone or concrete waste for stone. Stone shall be approved by the Engineer.

The size (length, width and depth (thickness)) of the boulder material shall as specified by the Engineer. Stone shall be approved by the Engineer.

Boulders for in-stream structures shall conform to the specifications for boulders shall conform to their respective specifications as shown on the plans.

Coarse backfill material shall consist of durable field or quarry stone that is sound, hard, dense, slightly rounded, resistant to the action of air and water, and free of seams, cracks, or other structural defects. The Contractor shall use stone pieces with a “shape factor” less than two (length and width less than twice the thickness). The Contractor cannot use limestone or concrete waste for stone. Stone shall be approved by the Engineer.

The type, size and gradation of the Coarse Backfill Material shall be specified by the Engineer to be mobile or non-mobile as the conditions in the channel warrant, and in accordance with the construction documents.

Coarse backfill material shall meet the material requirements of NCDOT section 1042 Rip Rap Materials.

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

### Methods

ENGINEER TO UPDATE IF THEY FEEL THAT THIS SPECIFICATION IS INADEQUATE FOR SITE CONDITIONS.

Structure installation and channel grading sequences may vary based on structure function and design. Boulder clusters are intended to re-direct flows and should be installed after channel grading operations, so that flow vectors and channel alignment can be used to adjust the installation.

* 1. Place boulders, flat-side up, at the location and elevation shown on the plans. If the elevation is not provided by the Engineer and/or the boulder cluster was a field change, the boulders shall be placed such that the top of the boulder is near or directly below the normal (base flow) water surface.
	2. Placement and spacing of boulders, in the boulder cluster, are based on boulder dimensions and the following criteria:
		1. Do not block the straight, downstream flow vectors in the stream’s riffle section. The minimum spacing (distance) between boulders shall be at least 1/2 of the boulders intermediate axis measurement. Maximum spacing shall not exceed twice the maximum axis measurement of the boulders.
		2. Avoid placing boulders directly adjacent to the toe of the stream bank, to prevent the possible re-direction and/or acceleration of flow near the bank.
		3. Place the boulders to a minimum depth equaling 1/3 of the boulder thickness.
	3. If the boulder cluster is installed in dry conditions, adjustments to the height, angle and location of the boulder may be required after the flow of the stream is resumed. The boulder cluster shall be reviewed by the Engineer after the water flow has resumed.

In locations where exposed bedrock and/or other existing feature extends to and/or within the limits of the proposed work, the boulder cluster 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 cluster structures to be measured for payment will be the actual linear feet of structures installed and accepted by the Engineer. The payment will be considered as full compensation for all work covered in this special provision, including, but not limited to installing and adjusting boulder material, 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

The quantity of boulder cluster structures, measured as provided above, will be paid for at the contract unit price per linear foot of boulder cluster installed and accepted. Payment will be full compensation for all work covered in this special provision, including, but not limited to installing and adjusting boulder material, 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 CLUSTER LF