

**City Of Glenwood Springs  
Purchasing Department  
101 West 8<sup>th</sup> Street  
Glenwood Springs, Colorado 81601**

### **1.13 IMPORTED BOULDERS**

**Imported Boulders may be quarried or excavated and generally smooth in shape with the largest rock faces being approximately flat. The minor axis (shortest dimension or “C”-Axis) shall not be less than 18 inches. Boulder Gradations of the intermediate axis (“B”-Axis) shall be 10% greater than or equal to 72 inches, with at least 75% between 72 inches and 42 inches, and 0% less than 36 inches by number. Boulders exposed in the weirs and vanes and keyed into the toe of each structure shall have a minimum intermediate axis (B-Axis) of 45 inches. (See Details for explanation of B-Axis & C-Axis).**

**Boulders shall consist of hard, dense durable natural stone, resistant to weathering. Granitic and Basaltic boulders subjected to glacial or alluvial flows will be preferred. Sandstone boulders shall not be acceptable below the ordinary high water line. Boulders shall have a minimum specific gravity of 2.65.**

**Boulders may be approved by the Engineer if, by visual inspection, the rock is determined to be sound and durable. The Engineer may require Contractor to furnish laboratory results if, in the Engineer’s opinion, the material is marginal or unacceptable. At the request of the Engineer, the Contractor shall furnish laboratory test results indicating that the material meet the requirements including those for abrasion resistance and soundness as indicated below:**

**---Abrasion resistance by Los Angeles Machine; Test Method ASTM C535; Specification Requirement: 30% loss, maximum.**

**--Soundness by use of Sodium/Magnesium Sulfate, Test Method ASTM D5240-04 Standard Test Method for Testing Rock Slabs to Evaluate Soundness of Riprap by Use of Sodium Sulfate or Magnesium Sulfate; Specification Requirement: 5% loss, maximum.**

**--Soundness by Freezing and Thawing, Test Method ASTM D5312-04 Standard Test Method for Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions; Specification Requirement: 5% loss, maximum.**

**Cross Section Average Variance: The sum of the variances, measured at each station of a cross section. ; Conformance will be double checked by the upstream water surface elevation at a known discharge.**

### **1.11 CONSTRUCTION OF IN-CHANNEL BOULDER STRUCTURES**

All Boulder Structures constructed In-Channel or below the Ordinary High Water Line (OHWL) shall be constructed with Footer Rocks and Keying Techniques (See Drawing Details). Construction of Boulder Structures shall include rotation, placement and adjustment of each individual rock to minimize void spaces and maximize interlocking of boulders. The ENGINEER shall approve each imported Boulder and the placement of each in-stream boulder that may affect surface flow.

Boulder Structures shall be constructed by placing individual boulders in designed cross-sections of the channel. Each cross-section has specific elevations and alignments for the placement of rock as shown on the Project Drawings. Each structure shall include footer boulders extending a minimum of 4 feet of depth below the bed elevation in the channel cross-section. Stacked boulders shall have a minimum 0.5:1 horizontal to vertical slope with the footer offset in the downstream direction when buried and footer offset in all directions when exposed.

Each individual boulder shall be set with the "B" axis in the direction of flow when exposed or the "A" or "B" axis when the boulder is interlocked between other boulders (See Drawing Details). Minimum acceptable boulder size is 3 feet along the B-axis.

### **1.12 CONSTRUCTION OF BANK TERRACING BOULDER STRUCTURES**

Boulder Structures shall be constructed by placing individual boulders in designed sections of the bank. Each boulder shall include rotation, placement and adjustment of each individual rock to minimize void spaces and maximize interlocking of boulders. Each section has specific elevations and alignments for the placement of rock as well as spot elevations as shown on the Project Drawings. Each Surface Boulder shall include footer boulders placed at least to depth shown on Project Drawings and at a minimum of 3 feet of depth below the existing grade and placed on Filter Fabric. Filter Fabric shall not be torn or ripped and preventative measures such as 6 inches of washed gravel bedding material shall be used. Boulders placed at the toe of the slope shall be a minimum of 36 inches along the B-axis.

In-Channel Boulder Structures shall require careful placement of smaller rocks between the boulders as a "chinking" filling the voids between the rocks with smaller and smaller rocks.