4200 OPEN CHANNELS

4201 SCOPE. This section includes all work for construction of open channel lining at the location, and to the lines, grades and dimension indicated on the drawings. Grading shall have been previously completed in accordance with Sections 1000 and 1100 "Site Preparation" and "Grading". Grouted rip-rap is not allowed.

4202 MATERIALS.

A. Concrete. Concrete and materials shall conform to the requirements set forth in Section 2000, "Concrete".

B. Stone. Stone for riprap and gabion linings shall consist of quarried rock and be sound, durable, and angular in shape. No more than 10 percent shall have an elongation greater than 3:1, and no stone shall have an elongation greater than 4:1. Material shall be free from cracks, seams, or other defects. Shale and stone with shale seams are not acceptable.

1. The minimum weight of the stone shall be 155 pounds per cubic foot as computed by multiplying the specific gravity times 62.4 pounds per cubic foot.

2. Not more than 10 percent of the stone shall exhibit splitting, crumbling, or spalling when subject to 5 cycles of the sodium sulfate soundness test in accordance with AASHTO T104.

3. Stone shall be of the following gradations:

Riprap (15" Minimum Thickness)

Weight of Stone in lbs.	Percent Lighter by Weight
180	100 (minimum)
120	80 (maximum)
60	50 (maximum)
6	10 (maximum)

Gabion Fill Stone

Stone Size Inches	Percent Smaller by Weight
*	100
2 2	0

* one half of least dimension of gabion basket.
Stone shall be graded within the above limits as required to provide

a unit weight in-place of 100 pounds per cubic foot or greater.

C. Filter Blanket. Filter blanket may be either of the following types at the Contractor's option:

1. Granular Filter. Granular filter material shall consist of sound, durable rock particles conforming to the following gradation.

Sieve Size	Cumulative Percent Passing By Weight
1"	100
2"	70-100
No. 4	50-85
No.10	35-70
No.40	20-50
No.100	15-40

2. Filter Fabric. Filter fabric shall consist of woven or non-woven fabric. The synthetic fiber of either the woven or non-woven fabric shall consist of polypropylene, nylon, or polyester filaments. The percent open area shall be not less than 4 percent nor more than 10 percent. The cloth shall provide an Equivalent Opening Size (EOS) no finer than the U.S. Standard Sieve No. 70. In addition, filter fabric shall meet the following physical requirements:

a. Tensile Strength. Minimum grab tensile strength, both warpwise and fillingwise, shall be 200 pounds when tested in accordance with ASTM D 1682, using a 4 inch by 6 inch specimen and a jaw speed of 12 inches per minute.

b. Elongation. Grab elongation shall be not less than 15 percent nor more than 60 percent, both warpwise and fillingwise, when tested in accordance with ASTM D 1682.

c. Tear Strength. Minimum trapezoid tear strength shall be 100 pounds, both warpwise and fillingwise. Method of test for woven fabrics shall be in accordance with ASTM D 1117.

d. Bursting Strength. Minimum bursting strength shall be 200 psi when tested in accordance with ASTM D 3887.

e. Seam Strength. Woven fabric shall have a minimum seam-breaking strength of 180 pounds when tested in accordance with ASTM D 1683, using a jaw speed of 12 inches per minute.

f. Width. Filter fabrics shall be furnished in widths of not less than 6 feet.

D. Gabion Baskets. Baskets shall be of the dimensions indicated on the drawings and be fabricated using hexagonal triple-twist wire mesh.

1. Wire.

   a. Wire shall be galvanized-steel having a minimum tensile strength of 60,000 psi, and be zinc coated with a minimum coating weight of 0.80 oz. psf.

   b. Wire shall be plastic coated with a minimum tensile strength of 60,000 psi, and with a coating with a nominal thickness of .02165". It shall be capable of resisting deleterious effects of natural weather exposure or immersion in salt water.

2. Wire Mesh. Maximum dimension of the mesh opening shall be 4 1/2 inches or less, and the maximum area of the mesh opening shall not exceed 12 square inches. Wire shall be 0.115 inch (minimum) diameter.

3. Selvedge Wire. Selvedge wire shall be 0.150 inch (minimum) diameter. All perimeter edges of the mesh forming the gabion selvedges have a strength equal to or greater than the body of the basket.

4. Lacing and Stay Wire. Wire shall be 0.091 inch diameter or larger.

5. Diaphragms. Gabions shall be divided into cells not greater than 4 feet in width by wire mesh diaphragms. Diaphragms shall be factory secured to the base of the basket by continuous spiral wire.

4203 CONSTRUCTION DETAILS.

A. Foundation Preparation. After completion of grading in accordance with Section 1100, the area to receive channel lining shall be trimmed and dressed to conform to the cross sections indicated on the drawings within a tolerance of plus or minus 2 inches from the theoretical slope lines and grades. All deleterious materials shall be removed from the foundation area.

B. Concrete Lining.

   1. Preparation. Earth foundation subgrade shall be moistened by sprinkling. Forms shall be securely staked, braced, and set to line and grade. Reinforcement and tie bars shall be held in position by bar chairs, concrete brick, or other approved devices.

   2. Placing and Finishing. Place, consolidate, and strike off concrete to the thickness indicated on the drawings. Concrete shall be tamped or vibrated to eliminate all voids and bring sufficient mortar to the top for finishing. Surface finish shall be a wood-float finish. Round all edges and joints with a 1/4 inch radius edging tool, except contraction joints may be sawed to a depth of 30 percent of the thickness of the concrete lining after concrete has hardened but before uncontrolled cracking occurs. Apply curing membrane

as specified in Section 2000.

C. Filter Blanket.

1. Granular Filter. Place granular filter to its full thickness in a single operation. Construction methods shall be such that the material is placed without segregation. Compaction of granular filter material is not required.

2. Filter Fabric. Place filter fabric with its long dimension horizontal and lay free of tension, stress, folds, wrinkles, or creases.

a. Place to provide 18 inches minimum overlap at each joint and anchor to prevent dislocation during construction of overlaying material.

b. Fabric shall not be left exposed more than two weeks prior to placement of overlaying material. Tracked or wheeled equipment or vehicles shall not be operated on the fabric.

D. Riprap Placement. Riprap shall be placed on the prepared foundation in a manner which will provide a reasonably well-graded mass of stone with the minimum practicable percentage of voids. The entire mass of stone shall be placed so as to be in conformance with the lines, grades, and thicknesses indicated. Riprap shall be placed to full-course thickness in one operation and in such a manner as to avoid displacing the underlying material. If the underlying layer consists of filter fabric, the Contractor shall place the riprap in such a way as to not tear, puncture, or shift the fabric. Riprap shall not be dropped more than 3 feet when being placed directly on the fabric. Tears or rips in the fabric shall be repaired with fabric lapped a minimum of 12 inches in all directions.

1. Placing. Placing of riprap in layers, or by dumping into chutes, or by similar methods likely to cause segregation will not be permitted.

2. Distributing. The larger stones shall be well distributed and the entire mass of stone shall conform to the specified gradation. All material shall be so placed and distributed that there will be no objectionable accumulations of either the larger or smaller sizes of stone.

3. Hand Placing. It is the intent of these specifications to produce a fairly compact riprap protection in which all sizes of material are placed in their proper proportions. Hand placing or rearranging of individual stones by mechanical equipment may be required to the extent necessary to secure the specified results.

Damage to baskets by mechanical equipment will not be allowed. Any damaged baskets shall be repaired or replaced at the direction of the Engineer.

E. Gabion Lining.

1. Assembly. Assemble each gabion unit by binding all vertical edges together with a continuous piece of connecting wire stitched around the vertical edge with coils spaced at 3 inches or less. Set empty units to line and grade and join units by stitching with connecting wire along adjoining edges. Stainless steel Ahog rings≅ spaced no more than 6" apart and shall conform to ASTM A313-92. Installation shall be by mechanical means. Install and securely fasten internal tie wires in each cell if necessary to retain the shape of the cell during filling operations.

2. Filling. Fill gabion cells with stone carefully by hand or machine to provide a minimum of voids and avoid bulges and distortions of the gabion. After filling, secure the lid to the sides, ends, and diaphragm by stitching with connecting wire.