

STRUCTURE SPECIFICATION

HARDENED RIFFLE

1. Description

Hardened riffles are in-stream structures constructed for the purpose of grade control and/or habitat improvement. Hardened Riffles are constructed as shown in the Project Plans and the following specifications. Hardened Riffles shall consist of rocks of the specified size, placed below the invert of the proposed channel, and in the proposed stream channel at the elevations and locations shown on the Plans or as directed by the Engineer or designee.

2. Materials

Hardened riffles shall be constructed of angular, flat or cubed rock obtained from a source that is approved by the Engineer or designee prior to execution of a contract for the project. When possible, consideration should be given to obtaining rock that is similar in color and texture to the native stone in the project area. Shape is important and should mimic the shape of rock found naturally in the stream. Rock that is too flat or too round will be rejected. Rock should be of sufficient hardness to resist weathering and shall be free of cracks and other blemishes. Porous rock, soft rock and rock with seams are not allowed. In some cases, native rock present on the site may be authorized by the Engineer or designee. In no instance will concrete or other "debris" be allowed. All rock under this specification shall meet the conditions of Material Specification NRCS MS-523 Rock Riprap.

3. Rock Size

Rock used for the construction of Hardened Riffles shall meet the following size requirements. All units are shown in feet (ft.). Rock used shall weigh approximately 165 pounds per cubic foot. Rock that does not meet the specified size requirements will not be accepted by the Engineer or designee and shall be removed from the site. No payment will be made for rock that does not meet the size requirements. **These specifications will be strictly enforced.**

- 3.1 Rock Size - Rock shall be sized in accordance with the table in Section 7 of this specification and as shown on the project drawings if so shown.
- 3.2 The owner will not pay for those materials which do not meet the size specification. Loose rock rubble shall not exceed five percent (5%) of the total tonnage on each load delivered to the site. In the event the rubble exceeds the allotted percentage, the Contractor shall not be paid for that material.
- 3.3 Any rock material which fails to meet the Engineer's or designee's approval for size and weight will be returned to the source by the Contractor.

4. Source of Materials

Prior to execution of a Contract, the Contractor shall identify all potential sources of rock. The Contractor and Engineer or designee will jointly visit the site(s) to determine whether the rock meets the requirements as set forth in these specifications. A site visit may be waived by the Engineer or designee when rock will come from a source that has been approved in the past, or

if it is obtained from a current approved supplier used by the New York State Department of Transportation.

5. Construction Methods

Hardened Riffle

- 5.1 Hardened Riffles shall be installed according to the locations, lines, grades, and elevations as shown on the Project Drawings, the construction sequence, any details as shown on the Project Drawings, and the following specifications, or as directed by the Engineer or designee. All Hardened Riffle installation shall be done in the presence of the Engineer or designee.
- 5.2 Hardened Riffles shall be constructed so that the rocks slope upwards in an upstream direction at the elevations and grade as shown in the Plans or as directed by the Engineer or designee.
- 5.3 Footer Rocks may be required. If they are required, they will shown on the Project Plans and their construction will be defined in Section 7 of these specifications. Footer Rocks shall be firmly keyed into the streambed.
- 5.4 Hardened Riffles shall be constructed by starting at the downstream end of the riffle and proceeding upstream. Rocks shall be placed in successive lifts to the specified elevations, and locations. Rocks shall be placed in such a manner as to produce a riffle at the specified grade, and they shall be placed in such a way as to mimic the action of a natural riffle by producing turbulent flow. The Engineer or designee will determine if the appropriate flow characteristics have achieved, and if the rock placement has achieved the design objectives.
- 5.5 After the rocks are placed and their construction has been accepted by the Engineer or designee, the Contractor shall cover the rocks with native stream material. Material shall be placed evenly and in such a way that mimics the appearance of the natural stream bottom. Acceptance or rejection of the native material placed will be solely at the discretion of the Engineer or designee.
- 5.6 The Contractor shall upon completion of the work, reshape the slopes and stream bottom to the specified elevations. All unsuitable and surplus rocks will be removed from the site unless otherwise designated by the Engineer or designee.

6. Measurement and Method of Payment

Payment for Hardened Riffles will be at the Contract Lump Sum price with the exception of related items as may be described in Section 7 of this specification. The lump sum price shall include all excavation, rock and native material to the locations, lines, grades and elevations as shown on the Plans or as directed by the Engineer or designee. Payment shall be full compensation for the transport of materials, excavation, installation, grading and materials costs associated with the construction of Hardened Riffles and for all labor, equipment, tools and incidentals necessary to complete the work as specified.

7. Items of Work and Special Conditions

BID ITEM, HARDENED RIFFLES

This item of work shall consist of the excavation necessary to construct the hardened riffles to the lines, grades and elevations as shown on the Project Drawings, reform disturbed channel as necessary, and all materials, labor, equipment, tools and incidentals necessary for performing the work required under the Contract.

- 7.1 Rock Size shall meet the following requirements, where D(i) refers to the diameter for which the i percent of the gradation is equal to or less than:

Weight Limits for Specified Size Fraction - Lbs.

	Max	Min
D100	3704	1482
D50	1098	741
D15	549	232

And diameters of: (note minimum and maximum diameters)

D30 = 1.7 feet (min)
D90 = 2.47 feet (min)
D100 = 3.5 feet (max)

- 7.2 Rocks that do not meet the length, and/or volume and/or weight requirements will be rejected. Rejected rocks must be removed from the project site.
- 7.3 Method of payment shall be as described in Section 6.