SECTION 31 23 00 - EARTHWORK

1. GENERAL
   * + 1. SUMMARY

Section Includes:

Channel bed construction requires installation to form compact, consolidated, well-mixed bypass channel substrate with minimal subsurface void space and minimal porosity, that maximizes surface flow in the bypass channel at all flow levels.

This item consists of furnishing and placing substrate and roughness boulders and otherwise constructing the bypass channel bed and sideslopes, as indicated.

* + - 1. QUALITY ASSURANCE
         1. Referenced Standards:

American Society for Testing and Materials (ASTM):

C127, Test Method for Specific Gravity and Absorption of Coarse Aggregate.

C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

C535, Test for Resistance to Degradation of Large-Size Course Aggregate.

* + - 1. SUBMITTALS
         1. Channel Bed Material and Boulders:

Sources and locations for Channel Bed Material and Boulders: Proposed sources and locations for supply of Channel Bed Material and Boulders shall be submitted. Contractor shall arrange for Government Representative to review the material at the source(s) prior to acceptance and transport of materials to the site.

Test Reports and certifications of compliance with material quality requirements

Channel Bed Material test results and certification of compliance.

Gradation

Specific gravity

Absorption

Abrasion

Boulders test results and certification of compliance.

Gradation

Specific gravity

Absorption

Abrasion

* + - * 1. Filter Fabric:

Product Technical Data

Certification of Compliance with referenced standards

1. PRODUCTS
   * + 1. MATERIALS
   1. Channel Bed Material.
      1. Shall be rounded to sub-angular, hard, durable, resistant to weathering and to water action, and be free from overburden, spoil, shale, limestone, structural defects and organic material. Channel Bed Material installed in place shall form a compact and consolidated streambed with limited void space, free from segregation of stone sizes. The least dimension of any piece of stone shall not be less than one-third its greatest dimension. Unless otherwise approved, the materials shall meet the following quality requirements:

|  |  |
| --- | --- |
| Quality Requirements | |
| Test and Method | Specification Limits |
| Apparent Specific Gravity,  ASTM C127, min | 2.65 |
| Absorption,  ASTM C127, % max | 3.0 |
| Abrasion,  ASTM C535, % max/500 rev | 35 |

* + 1. Channel Substrate installed in place will form a compact and consolidated, well-mixed streambed with limited void space, free from segregation of stone sizes. When installed complete and in place, Channel Substrate will meet the gradation listed below:

|  |  |  |
| --- | --- | --- |
| Channel Substrate | | |
| % Passing  Weight Basis | Median Diameter (inches) | |
| Minimum | Maximum |
| 100 | \*\* | \*\* |
| 84 |  |  |
| 50 |  |  |
| 30 |  |  |
| 16 |  |  |
| 5 |  |  |
| 1.5 |  |  |

\*\* To be provided in future submittal.

* 1. Native Substrate.
     1. Shall be as defined in Section 312300 (Earthwork).
  2. Boulders
     1. Boulders shall meet the same material quality requirements as listed for Channel Bed Material in Paragraph 313700.2.1.A.1.
     2. Boulders shall have a nominal minimum dimension of size ranging from 2-4 feet, measured across the median axis.
  3. Filter Fabric
     1. Filter Fabric shall be composed of polypropylene monofilament yarns, which are woven into a stable network such that the yarns retain their relative position, inert to biological degradation and resistant to naturally encountered chemicals, alkalis, and acids. Filter fabric shall have the following minimum material properties and be Mirafi Filterweave 500 or Approved Equal.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mechanical  Properties | Test Method | Unit | Minimum Average Roll Value | |
| Machine Direction | Cross Direction |
| Wide Width Tensile Strength | ASTM D 4595 | kN/m (lbs/in) | 35 (200) | 48.2 (275) |
| Grab Tensile Strength | ASTM D 4632 | N (lbs) | 1669 (375) | 1669 (375) |
| Grab Tensile Elongation | ASTM D 4632 | % | 15 | 8 |
| Trapezoid Tear Strength | ASTM D 4533 | N (lbs) | 534 (120) | 534 (120) |
| CBR Puncture Strength | ASTM D 6241 | N (lbs) | 5340 (1200) | |
| Apparent Opening Size (AOS) | ASTM D 4751 | mm (U.S. Sieve) | 0.3 (50) | |
| Percent Open Area | COE-02215 | % | 3 | |
| Permittivity | ASTM D 4491 | sec-1 | 0.2 | |
| Permeability | ASTM D 4491 | cm/sec | 0.15 | |
| Flow Rate | ASTM D 4491 | l/min/m2 (gal/min/ft2) | 611 (15) | |
| UV Resistance (at 500 hours) | ASTM D 4355 | % strength retained | 70 | |

|  |  |  |  |
| --- | --- | --- | --- |
| Physical  Properties | Test Method | Unit | Typical Value |
| Mass/Unit Area | ASTM D 5261 | g/m2 (oz/yd2) | 298 (8.8) |
| Thickness | ASTM D 5199 | mm (mils) | 0.8 (31) |
| Roll Dimensions (width x length) | -- | m (ft) | 4.6 (15) x 91 (300) |

1. EXECUTION
   * + 1. INSTALLATION
          1. Channel Bed Material shall be placed to form designated sections of the streambed as herein specified and as indicated on the Drawings. Channel Bed Material shall be placed to match the design grades shown on the Drawings.
          2. Native Substrate exhumed from the former streambed surface during excavation, Section 312300 (Earthwork) shall be stockpiled and reused as determined by the Engineer.
          3. Do not carry the excavation for the channel shape deeper than the typical subgrade elevation shown on the Drawings. Excavation carried below subgrade shall be replaced with Native Substrate or Channel Bed Material as appropriate. The Contractor shall bear all costs for correcting overexcavation.
          4. The finished subgrade will be reviewed by the COR and approved prior to placement of Channel Bed Material and Native Substrate.
          5. Place Channel Bed Material in a manner that prevents segregation of stone sizes. Stone shall be placed such that the constructed river bed forms a well-mixed, consolidated, compact layer, which may require mixing in place and/or water-jetting of the placed material to fill voids in the placed layers.
          6. Place Channel Bed Material according to the following method, or alternative method approved by the Engineer:

Typical sequence for construction of Channel Bed Material in the streambed portion of the installation as indicated herein is as follows. In the following sequence specification, 'framework' is used to describe the Channel Bed Material equal to or larger than 6 inches in diameter, and 'small fraction' is used to describe the Channel Bed Material smaller than 6 inches in diameter.

Grade subgrade.

Place a 4- to 6-inch thick loose layer of the small fraction as first course.

Place single layer of framework and work the rocks down so they fit securely into the underlying small fraction material.

Place stone material in an alternating sequence of framework with small fraction locally in a sufficiently small area and work sufficient volume of small fraction in to fill the voids of the framework. Small fraction shall not inhibit stone to stone contact of framework.

Hydraulic washing of small fraction into framework shall be required with each placement of small fraction to fill voids of framework. A pump discharge of sufficient volume and force to compact and settle the smaller streambed Material shall be used. Jet water onto the streambed Material to wash and settle small fraction into the voids within the framework. Recycled water collected from within the work area may be used. The method and duration of water application shall be sufficient to ensure that small fraction material penetrates to the full depth of the voids in the framework and that all of the voids are completely filled with small fraction materials at an even gradation of sizes. Contractor shall control discharge of wash water per Specifications and applicable regulations.

Repeat as necessary to meet the thickness and grades indicated on the Drawings. Place channel material in a manner that prevents segregation of stone sizes. Stone shall be placed such that the constructed stream bed form a consolidated layer.

* + - * 1. Grade tolerance for Channel Bed Material is +0.3' (no under), when considering the neat line across the installed materials
        2. Boulders shall be installed in a manner that simultaneously integrates the boulders with the surrounding channel Bed Material or native substrate, in order to prevent segregation of material sizes within the placed channel Bed Material or native substrate, and that results in tight, consolidated contact between the boulders and the surrounding materials. Boulder installation will be a field set item, installed with direct assistance of the Government Representative.
        3. In project areas where the Plans require bedrock to be graded to the finish channel bed lines and grades, the rock surface shall be left in an irregular and variable condition with periodic rock features protruding above the neat line of the excavation according to the following criteria:

In the low flow channel, bedrock roughness features shall protrude 1.5 feet (nominal) above the neat line of the finished bed surface.

ii. In the overbank area of the bypass channel, bedrock roughness features shall protrude 2.0 feet (nominal) above the neat line of the finished bed surface.

* + - 1. TOLERANCES
         1. Grade tolerance for Channel Bed Material is +0.3' (no under), when considering the neat line across the installed materials.
         2. Grade tolerance for bedrock channel bed in the low flow channel is +0.3’ (no under), when considering the neat line across the finish surface, excluding bedrock roughness features.

END OF SECTION 31 37 00