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### Section 21 Erosion Control

#### 4-2101 General

Erosion control is covered in Section 21, “Erosion Control,” of the *Standard Specifications*. Erosion control materials are applied to roadside and median areas where sediment control, slope stabilization and vegetation establishment is necessary.

For questions about the acceptability of materials and work for erosion control, resident engineers may consult with landscape architects and landscape specialists in the district. Check for erosion control materials that may have special submittal requirements in the special provisions.

Properly applied erosion control is critical for preventing water pollution. The success of erosion control work often depends on the time of year of application and the progress of construction for the project. Consult with the district landscape architect or project landscape architect and landscape specialists when a construction completion schedule that affects the application of the erosion control is delayed longer than 45 days and before changing the order of work and the dates specified for erosion control. Also consult with them if the project spans a winter and requires temporary management practices that may not be in the original scope of work.

#### 4-2102 Materials

The following provides general information on materials used for erosion control. For specific information on materials regarding submittals, quality characteristics, and other requirements, refer to the *Standard Specifications* and special provisions for the project.

##### 4-2102A Imported Topsoil

Topsoil requires a balance of organic matter, sand, clay, and nutrients to support healthy plant life. Refer to Section 21-2.02C, “Imported Topsoil,” of the *Standard Specifications* for technical details. Topsoil that contains too large a percentage of sand or clay may be deficient in organic matter and be a poor medium for growing plants. High sand content tends to promote drier soils. High clay content limits aeration and drainage, promoting water-logged roots and wetter soils.

For good plant growth, the pH, or measure of acidity or alkalinity, should be 6.0 to 7.0, and the soluble salt content of topsoil should not exceed 500 parts per million. If the topsoil’s composition is questionable, a soil test can determine the pH and salt content.

Reject any topsoil that contains deleterious substances defined in the *Standard Specifications*, and if it has too much clay or sand, or lacks organic matter. Evidence of poor weed growth is a good indicator that the topsoil will not support healthy plant growth. If the topsoil is questionable, consider obtaining a soil test from a local

laboratory with the assistance of the district landscape architect and request documentation on where the soil originated.

#### 4-2102B Fertilizer

Section 20-3.01B(4), “Fertilizers,” of the *Standard Specifications*, and the special provisions provide the requirements for fertilizer, which is expressed as percentages of nitrogen, phosphoric acid, soluble potash, and sulfur. Fertilizer may be spread with other materials using hydroseeding equipment.

#### 4-2102C Mycorrhizae Inoculant

Section 20-3.01B(5), “Root Stimulants,” of the *Standard Specifications* and Section 20-3.01B(5)(b), “Mycorrhizae Inoculant,” of the special provisions provide the requirements for mycorrhizae.

#### 4-2102D Straw

Requirements for straw are in Sections 21-2.01C(1), “General,” and 21-2.02H, “Straw,” of the *Standard Specifications*. Straw has proved to be an effective method of controlling slope erosion. Check the special provisions for any certifications needed to demonstrate the quality, such as weed-free, and type of straw.

Straw provides the following benefits:

- Protects soil surface from wind, rain, sun, and birds that eat seed
- Conserves surface moisture and maintains uniform soil surface temperatures, promoting seed germination and early growth
- Slows the velocity of water runoff

#### 4-2102E Fiber

Requirements for fiber are in Sections 21-2.01C(1), “General,” and 21-2.02D, “Fiber,” of the *Standard Specifications*. Fiber is derived from wood, paper, or other natural products.

When properly used and at the proper rate, fiber provides the following benefits:

- Protects and cushions seed within hydroseeding equipment from the action of pumps and discharge through the nozzle
- Acts as a seed carrier enabling more uniform seed distribution
- Enhances a visual inspection of seed coverage when dye is added
- Covers and anchors seed to the slope
- Enables seed, stabilizing emulsion, and commercial fertilizer to be applied together
- Is applied by means of a hose to slopes not accessible by other mulching equipment

The most common method of applying fiber is with hydroseeding equipment.

#### 4-2102F Seed

Sections 21-2.01B, “Definitions”; 21-2.01C(3), “Seed”; 21-2.01D(3), “Seed”; and 21-2.02F, “Seed,” of the *Standard Specifications*, provide the requirements. Minimum seed purity and germination are usually specified for seed on the project plans. The purity of seed is defined as the percentage of a specified seed in relation to the total quantity, which includes inert matter, weed seed, and dead seed. Seed germination is the percentage of pure seed that will grow when tested under laboratory conditions. The percentage of pure live seed is the percentage of purity multiplied by the percentage of germination. Pure live seed is expressed as a percentage.

Seed arriving on the job site must come in separate unopened packages. Each package must have a seed tag that shows test results performed by a seed laboratory certified by the Association of Official Seed Analysts or by a seed technologist certified by the Society of Commercial Seed Technologists. Seed testing must be within 12 months before application. This tag will also show quantities of other seeds present in the bag including weed seed. Verify that seed delivered matches previous seed orders and testing submittals. The district landscape architect may request a review of tags before application.

#### 4-2102G Tackifier

Section 21-2.02E, “Tackifier,” of the *Standard Specifications*, provides the requirements for tackifier. Tackifier serves as a glue or binder for the other erosion control materials in the hydroseed application. Tackifier is often applied with fiber and fertilizer. Tackifier forms a surface crust to protect the soil and hold the hydraulically applied erosion control materials in place. It is important to not walk or run any equipment over the finished surface because it will lose its integrity.

The tackifier manufacturer will typically specify the amount of water that must be added to assure the proper consistency. Too much tackifier can inhibit seed germination and successful plant establishment.

#### 4-2102H Compost

Requirements for compost are in Sections 21-2.01C(2), “Compost”; 21-2.01D, “Quality Assurance,” and 21-2.02K, “Compost,” of the *Standard Specifications*. There may be a compost standard special provision when compost is used on the project.

Before delivery, the contractor must submit a Compost Technical Data Sheet with the Seal of Testing Assurance from the US Composting Council. The compost must have been tested within the past 12 months. The data sheet shows test results for all the components, such as moisture content, organic matter, and maturation, listed in the compost standard special provision. Verify the size of the compost particles. Reject compost delivered to the job site without an STA certification and material sample approval.

#### 4-2102I Duff

Requirements for duff are shown in Sections 21-2.02B, “Duff,” and 21-2.03B, “Duff,” of the *Standard Specifications*. Duff must be stockpiled in accordance with specifications to assure that microorganisms will be alive when the material is applied to the slope. Duff is collected for the preservation and reapplication of the site’s microorganisms, organic material, and a site-specific seed bank, which accelerates vegetation establishment in disturbed areas. Make sure duff is identified and handled separately to avoid mixing it with other excavation work materials. Height limitations for the stockpiling is to maintain pile oxygenation and reduce heat build-up, which kills the microorganisms.

#### 4-2102J Fiber Reinforced Matrix

Fiber reinforced matrix differs from other erosion control mixes in that its fiber is chemically and mechanically bonded. Requirements for fiber reinforced matrix are shown in Section 21-2.01C(5), and 21-2.03K, “Fiber Reinforced Matrix,” of the *Standard Specifications*, and Section 21-2.02L, “Fiber Reinforced Matrix,” of the special provisions. Manufacturer’s directions and rate of application are printed on the packaged product.

#### 4-2102K Bonded Fiber Matrix

Bonded fiber matrix differs from other erosion control mixes in that it has fiber that is chemically bonded to the tackifier. Requirements for bonded fiber matrix are shown in Section 21-2.02J, “Bonded Fiber Matrix,” of the *Standard Specifications*. Manufacturer’s directions and rate of application are printed on the packaged product. Bonded fiber matrix can be applied with or without seed for soil stabilization. It is often used for temporary soil stabilization during long duration phased projects. Applications that are too thick may inhibit seed germination.

#### 4-2102L Rolled Erosion Control Products

Rolled erosion control products are manufactured textiles designed to reduce soil erosion by covering and holding sediment in place. They may be jute mesh, netting, erosion control blankets, or turf reinforcing mat. Photodegradable polypropylene netting used for constructing erosion control blankets is not allowed because of wildlife entrapment concerns. See Detail H51, “Erosion Control Details – Fiber Roll and Compost Sock,” of the *Standard Plans*, for fiber roll and compost sock construction. See Section 21-2.02O, “Rolled Erosion Control Products,” of the *Standard Specifications* for material requirements.

#### 4-2102M Fiber Rolls

Fiber rolls are composed of natural netting filled with rice or wheat straw, rice hull, wood excelsior, cotton or coconut fiber. Check Section 21-2.02P in the contract special provisions for any fiber roll fill materials that are not allowed by PLACs or the project biologist. Photodegradable polypropylene netting used for constructing fiber rolls is not allowed because of wildlife entrapment concerns. They are typically laid parallel to the contours of a slope to reduce sediment movement down the slope.

See Detail sheet H51 of the *Standard Plans* for fiber roll construction. See Section 21-2.02P, “Fiber Rolls,” of the *Standard Specifications*.

#### 4-2102N Compost Socks

Compost socks are long rolls of natural netting filled with compost. Photodegradable polypropylene netting used for constructing compost socks is not allowed because of wildlife entrapment concerns. See Detail sheet H51 of the *Standard Plans* for fiber roll construction. There will be a compost sock standard special provision on the project when it is used. Check that the diameter of the sock matches what is specified.

#### 4-2102O Turf Reinforcement Mats

Turf reinforcement mats typically are used along stream channel conditions and areas at high risk for erosion. They contain human-made materials, have longer lifespan than natural erosion control blankets, and can handle higher hydraulic velocity and pressure. See Section 21-2.02O(5), “Turf Reinforcement Mats,” of the *Standard Specifications*, about the systems of cells or webbing made of plastic or polypropylene to hold soil in place.

### **4-2103 Before Work Begins**

Before work begins, do the following:

- Review the project contract documents to determine the specified type of erosion control material and the time of application.
- Verify that Form DOT CEM-3101, “Notice of Materials to Be Used,” includes erosion control materials. Refer to Section 6-202, “Responsibilities for Acceptance of Manufactured or Fabricated Materials and Products,” of this manual for additional information.
- When Bid Item 190123, “Roadway Excavation (Topsoil)” is specified, examine the topsoil to determine that sufficient quantity is available and that it is suitable for the planned use. If the topsoil appears inadequate, consult with the project landscape architect or landscape specialists. Verify that sufficient area exists on the job site and designated stockpile locations to stockpile topsoil. Verify the topsoil is available during the construction phase for application. Some projects will use protective measures to maintain topsoil during construction. Verify that these protection measures are maintained during construction.
- The contractor must provide the seed vendor’s order and lab test results. Make sure the test results are complete and received in a timely manner. Testing may need to be repeated if more than 1 year has passed since the previous one.
- Erosion control materials are applied at a specified rate, in pounds or tons per acre. Before installation of the erosion control, measure and compute areas and verify the bid item so that spread rates may be checked during application and the contractor is aware of anticipated area of payment.

- Examine equipment to be used in erosion control work to determine if it meets specified requirements.
- Observe as all materials are placed in the hydroseeder. Collect and retain seed tags for each hydroseed load.
- Check the weather for the days of application and shortly after them because excess wind and rain will blow or wash away erosion control materials.

#### **4-2104 During the Course of Work**

As work items commence and erosion control materials arrive on the project, and before application, do the following:

- Through examination, verify that topsoil collection has been done in the correct locations to the specified depth. Verify that stockpiles meet the specified requirements to assure optimal health. Verify protection measures have been implemented as specified.
- Verify that imported topsoil meets the specified requirements.
- To determine if fertilizer meets specifications, check the chemical analysis on the label of the fertilizer bag. This label generally is sufficient information to determine that the fertilizer meets the requirements. Verify that the label matches the fertilizer that is applied. If organic fertilizer is specified, it is not acceptable for the contractor to switch out with a commercial fertilizer and cutting the commercial fertilizer rate to match the specified organic fertilizer.
- In addition to furnishing certified daily summary weigh sheets, require the contractor to furnish weighmaster certificates with each load of straw delivered to the project. Keep records for the mass of straw delivered to stockpiles. Based on specifications, check for county agricultural certification if out-of-county straw is used. Verify weed-free certification and type of straw specified and retain as a record.
- Verify the receipt of a certificate of compliance for fiber. Check the labeling on the package for moisture content.
- Verify the species of seed listed on the seed label for consistency with the species listed on the erosion control plans.
- Compare the percentage total viability stated on the vendor seed label with the percentage total viability on the seed vendor's lab test results.
- Check that the percentage of total weed identified on the seed label is less than the percentage stated in the special provisions.
- Verify that no California-prohibited noxious weeds are identified on the vendor seed label.
- Check the seed lot test date. For purity and germination, the seed must have been tested within the past 12 months. Make sure seed is not stored in metal containers in the sun, which will reduce its ability to germinate.

- Check seed package labels and other required documentation. Calculate the weight of pure live seeds in each sack.
- When approving the use of seed with a germination rate lower than the minimum rate specified, application rates must be sufficient to attain the specified amount of pure live seed. Before approving a lower germination rate, consult with the project landscape architect.
- Look for the following when inspecting seed labels and seed laboratory reports:
  - Species of seed on the seed label does not match the species in the contract plans.
  - The percentage total viability of the seed is lower than what is specified in the contract plans.
  - The percentage total weed identified on the vendor seed label is greater than what is specified in the *Standard Specifications*.
  - The presence of California-prohibited noxious weeds is identified on the vendor seed label or test results.
- Verify the receipt of a certificate of compliance for tackifier.

During the application of erosion control materials, do the following:

- Verify that the contractor prepares areas to receive erosion control as required in the specifications.
- Check that topsoil, duff, or compost is spread uniformly at the specified rate or depth. Make sure the contractor loosens any compacted topsoil.
- Verify that the contractor applies erosion control materials in the specified sequence and application rate. Check that most of the seed is in direct contact with soil to assure a high probability of germination.
- Verify the contractor incorporated materials to the specified depth.
- When straw is required, determine the spread rate by counting bales and using average bale weights. If the contractor applies the straw pneumatically, suspend the operation if wind conditions cause the straw or visible dust to be blown onto public roadways or onto private property.
- When compost is required, examine a test sample for physical contaminants, such as glass, plastic, and film plastics, moisture content, appropriate particle size, and any unusual odors. Also verify that the material technical data sheet matches the specification and is STA Certified. If the contractor applies the compost pneumatically, suspend the operation if wind conditions cause the compost or visible dust to be blown onto public roadways or onto private property.
- Observe the amounts and proportions of materials spread or entered into the hydroseeder. You may use sack counts and weights to determine the weights of seed, stabilizing emulsion, fiber, and commercial fertilizer. The best method for



using sack counts and weight is to have the empty bags tossed down to you after the contents have been added into the hydroseeder.

- Compute and record the spread rates of the various materials applied. For each day of operation, compute and record the spread rates at least once.

#### **4-2105 Labor Related Bid Items during Course of Work**

##### 4-2105A Move-in or Move-out Erosion Control

This bid item is used when there may be phases to the work that affect the timing of the application of erosion control. When this bid item is used, the contractor may be eligible to be paid each time they mobilize for erosion control with the moving in or out of equipment to the construction site. Standard Special Provision 21-2.04 lists what is eligible for payment.

##### 4-2105B Incorporate Materials

Section 21-2.03J, "Incorporate Materials," of the *Standard Specifications*, provides the requirements for work usually required with compost to provide the mixing-in of the compost into the soil. Equipment, such as a disk, drives the compost deeper into the soil where it will improve the material that the plant roots will grow in.

##### 4-2105C Permanent Erosion Control Establishment Work

Section 21.3, "Permanent Erosion Control Establishment Work," of the standard special provisions, requires the contractor to document weekly inspections of the erosion control for one year after the construction is complete using construction Form DOT CEM-2032 or Form DOT CEM-2032SW, "Permanent Erosion Control Establishment (PECE) Report," along with forms used for stormwater work to develop a list of work items that need attention or repair. A change order is used to complete the repair work found in the inspections. Examples of the repair work might be: re-application of hydroseeding in areas with low germination rates, minor grading of slopes that have significant sediment movement, or repair of rolled erosion control products. The change order repairs for this item should be limited to items that are damaged or failing through no fault of the contractor.

#### **4-2106 Level of Inspection**

Suggested level of inspection for typical erosion control work activities, including applying temporary and permanent erosion control measures to the soil surface, is benchmark inspection.

#### **4-2107 Quality Control**

Verify that erosion control materials used on the project are sampled and tested under Section 21, "Erosion Control," of the *Standard Specifications*, using the test methods specified and meeting the requirements for each quality characteristic described.

#### **4-2108 Payment**

From the weight shown on the certified scale sheets, deduct any straw not used in the work. If a “weigh back” certified weight is not available, you may use bale counts and average bale weights for this purpose.

To determine pay quantities, you may use sack counts and sack weights. Make accurate counts and record them in the project records.

Determine the pay quantity of pure live seed using the germination and purity rates of the bulk seed.

To determine the pay quantity for erosion control items that are paid for by area, field measure the area that receives the erosion control.

To determine the pay quantity for erosion control items paid by volume, measure the vehicle or container they are delivered in at the point of delivery, before unloading.