Greenville County Technical Specification

EC-04 ROLLED EROSION CONTROL PRODUCTS (RECP)

1.0 Rolled Erosion Control Products (RECP)

1.1 Description

A variety of Rolled Erosion Control Products (RECP) are available for the stabilization of seeded slopes and channel banks. Greenville County distinguishes between the different types of products using two categories; Temporary Erosion Control Blankets (ECB) and Turf Reinforcement Matting (TRM).

ECB and TRM are preferred alternatives to traditional hard channel or slope protection such as concrete, riprap, gabions and revetment mattresses. These products can improve the quality of storm water discharges by creating a strong, vegetated armorment that filters flow, allows infiltration, and provides wildlife habitat. Suggested orientations of matting are shown in the RECP Construction Details.

ECB are used for the temporary stabilization of soil immediately following seeding until the vegetative cover has grown and becomes established. They provide temporary protection and degrade over time as the vegetation becomes established. Some products are effective for several months while others degrade slowly and are effective for several years.

TRM are nondegradable products that enhance the ability of living plants to stabilize soils. They bind with roots to reinforce the soil matrix. TRMs are used in situations where vegetation alone is not capable of holding a slope or streambank. TRMs enable the use of "green" solutions in many areas where only "hard" solutions such as riprap or concrete linings were viable in the past.

1.1.1 Temporary Erosion Control Blankets (ECB)

Temporary Erosion Control Blankets are designated on the Engineering Plans or directed by the Engineer. The following criteria are followed to select the type of temporary erosion control blanket utilized.

- Install Temporary Erosion Control Blankets on slopes **2.0H:1V** or flatter only. For slopes greater than **2.0H:1V** use Turf Reinforcement Matting (TRM).
- Install Temporary Erosion Control Blankets in channels or concentrated flow areas with a maximum calculated design shear stress less than or equal to **1.75 lb/ft^2**. For channels and concentrated flow areas with design shear stresses greater than **1.75 lb/ft^2** use Turf Reinforcement Matting (TRM).

1.1.2 Turf Reinforcement Matting (TRM)

Use Turf Reinforcement Matting (TRM) in hydraulic applications such as high flow ditches, channels and shorelines, steep slopes, stream banks, and where erosive forces may exceed the limits of natural, unreinforced vegetation or in areas where limited vegetation establishment is anticipated.

Turf Reinforcement Matting are designated on the Plans or directed by the Engineer. The following criteria are followed to select the type of TRM utilized.

- Install a TRM **Type 1** on slopes **2.0H:1V** or flatter or in channels where the calculated design shear stress is **4.0 lb/ft^2** or less.
- Install a TRM **Type 2** on slopes **1.5H:1V** or flatter or in channels where the calculated design shear stress is **8.0 lb/ft^2** or less.
- Install a TRM **Type 3** on slopes **1.0H:1V** or flatter or in channels where the calculated design shear stress is up to **12.0 lb/ft^2.**

1.2 Design

When designing a permanent conveyance with a grassed or vegetative lining, the design addresses the bare condition prior to vegetation being established. A RECP may be applied to protect the conveyance during this period. It is important to use both the tractive force (shear stress) and the permissible velocity methods to determine the level of protection that is required.

The design of ECB and TRM is based on the anticipated shear stresses and maximum flow velocities the fabric will encounter. Once the design shear stresses and maximum flow velocities are calculated, a corresponding ECB or TRM that meets the conditions is selected from the most recent edition of *SCDOT Qualified Product List 55 and 56* in the appropriate category.

The following variables are required to determine maximum shear stresses in a channel:

- Design peak flow rate value in cubic feet per second (cfs) for the 10-year 24-hour storm,
- Channel dimensions designed to carry the peak flow rate. For simplicity, assume all channels are trapezoidal in shape,
- Channel bed slope,
- Manning's channel roughness coefficient (n) of the TRM or ECB or final vegetation, and
- Maximum normal channel flow depth (d_n) based on peak flow rate, channel dimensions and Manning's n value. The maximum flow depth expected is calculated for the following conditions:
    - Bare matting with no vegetation,
    - Matting with maintained vegetation, and
    - Matting with un-maintained vegetation.

The governing equation for maximum channel shear stress is:

$$\tau = \gamma \, d_n \, S$$

Where :

τ = maximum shear stress (lbs/ft2)

γ = unit weight of water = 62.4 lbs/ft3

d_n = maximum normal channel flow depth (ft)

S = channel bed slope (ft/ft)

The governing equation for maximum velocity is Manning's Equation:

$$V = (1.49 / n) \; R^{2/3} \; S^{1/2}$$

Where :

V = Maximum velocity (ft/sec)

n = Manning's channel roughness coefficient

R = Hydraulic radius of the flow based on d_n (ft)

S = Channel bed slope (ft/ft)

1.3 Materials

1.3.1 Temporary Erosion Control Blankets (ECB)

Provide Temporary Erosion Control Blankets (ECB) composed of processed degradable natural and/or polymer fibers mechanically bound together between synthetic or natural fiber nettings. **Do not use** single netted straw blankets or single netted straw blend blankets under this specification.

Provide ECB with properties derived from quality control testing listed in the American Association of State Highway and Transportation Officials (AASHTO) National Transportation Product Evaluation Program (NTPEP) for Erosion Control Products (ECP) and conforming to the performance and physical requirements shown in Table 1.

Table 1: Minimum Requirements for Temporary Erosion Control Blankets

Property	Test Method	Temporary ECB
Functional Longevity[4]	Engineer Approved Testing Methods	12 month minimum
Maximum Slope Application	Observed	2.0H:1V
Vegetation Establishment	ECTC Method #4 or ASTM D7322	200% min
Cover Factor[1]	ASTM D6459	C ≤ 0.05
Tensile Strength[2]	ASTM D6818	75 lb/ft
Shear Stress[3]	ASTM D6460	≥ 1.75 lb/ft^2

[1] "C" Factor calculated as ratio of soil loss from ECB protected slope to ratio of soil loss from unprotected (control) plot in large-scale testing using ASTM D6459 on loam soil types.

[2] Minimum tensile strength in the machine direction using ASTM D6818 .

[3] Minimum shear stress on unvegetated temporary ECB can sustain without physical damage or excess erosion (> 0.5 in soil loss) during a 30-minute flow event in large-scale testing using ASTM D6460.

[4] Functional longevity tests performed at a testing facility approved by the Engineer.

1.3.2 Turf Reinforcement Matting (TRM)

Provide Turf Reinforcement Matting (TRM) composed of non-degradable synthetic fibers, filaments, nets, wire mesh and/or other elements, processed into a permanent, three-dimensional matrix. For TRM Types 1 and 2, the non-degradable three-dimensional matrix may be infilled with degradable materials. Use TRM designed to impart immediate erosion protection, enhance vegetation establishment and provide long-term functionality by permanently reinforcing vegetation during and after maturation.

Provide TRM with properties derived from quality control testing listed in the American Association of State Highway and Transportation Officials (AASHTO) National Transportation Product Evaluation Program (NTPEP) for Erosion Control Products (ECP) and conforming to the performance and physical requirements shown in Table 2.

Table 2: Minimum Requirements for TRMs

Property	Test Method	Type 1	Type 2	Type 3[4]
General				
May Be Supplemented with Degradable Infill Components	Observed	Yes	Yes	No
Physical				
Minimum Thickness	ASTM 6525	0.25 in	0.25 in	0.25 in
Vegetation Establishment	ECTC Method #4 or ASTM D7322	200% min	200% min	200% min
UV Resistance[1]	ASTM D4355	80% @ 1000 hrs	80% @ 1000 hrs	80% @ 1000 hrs
Tensile Strength[2]	ASTM D6818	145 X 110 lb/ft	170 X 130 lb/ft	1,000 x 900 lb/ft
Performance				
Maximum Slope Application	Observed	2.0H:1V	1.5H:1V	1.0H:1V
Shear Stress[3]	ASTM D 6460	≥ 4.0	≥ 8.0	≥ 12.0

[1] Tensile strength retained of structural components after exposure.

[2] Minimum tensile strength in both machine and cross machine directions, under dry or saturated conditions using ASTM D6818.

[3] Minimum shear stress a fully vegetated TRM can sustain without physical damage or excess erosion (> 0.5 in soil loss) during a 30-minute flow event in large-scale testing using ASTM D6460.

[4] Use a TRM Type 3 with a minimum tensile strength of 2,100 X 1,800 lb/ft when field conditions exist with high loading and/or high survivability requirements as the result of maintenance, structural backfills protecting critical structures, utility cuts, potential traffic areas, abrasion, and higher factors of safety and/or general durability concerns.

1.3.3 Quality Assurance

Provide RECP listed on the most recent edition of *SCDOT Qualified Product List 55 and 56* in the appropriate category. RECP acceptance is granted based on the manufacturer's certification and testing with the American Association of State Highway and Transportation Officials (AASHTO) National Transportation Product Evaluation Program (NTPEP) for Erosion Control Products (ECP).

At the time of delivery, the Engineer will provide the RECP packing list containing complete identification, including but not limited to the following:

- Manufacturer name and location,
- Manufacturer telephone number and fax number,
- Manufacturer's e-mail address and web address, and
- RECP name, model and/or serial number.
- Certification that the specific RECP meets the physical and performance criteria of this specification.

The Engineer will provide NTPEP certification signed by a responsible representative of the RECP manufacturer within 24-hours of each RECP truckload shipment of material to the construction site.

1.4 Construction Requirements

1.4.1 Site Preparation

Grade areas to be treated with RECP and compact as indicated or as directed by the Engineer or Manufacturer's Representative.

Remove large rocks, soil clods, vegetation, and other sharp objects that could keep the RECP from intimate contact with subgrade.

Prepare seedbed by loosening the top 2 to 3 inches of soil above final grade.

Add seed, lime, and fertilizer as outlined in the Seeding Specifications.

1.4.2 General Installation

Always follow the specific manufacturer's installation procedures included with each RECP. If requested by the Engineer, ensure a manufacturer's representative is on-site to oversee and approve the initial installation of the RECP. Provide a letter from the manufacturer approving the installation when requested by the Engineer.

The maximum allowable continuous slope length for Temporary ECB slope applications is 50 feet. Provide slope interruption devices for continuous slope length longer than 50 feet. Refer to the Slope Interruption Devices Specifications for slope interruption device description, materials, and construction requirements.

Install the RECP at the elevation and the alignment indicated on the Plans or as directed by the Engineer.

Select the maximum RECP width to minimize number of RECP overlaps in the swale. If the swale width (perpendicular to the water flow) is 8 feet, then one 8-foot wide RECP is preferred over two overlapped 4-foot wide RECPs.

Use anchors (stakes, pins, or staples) with a minimum length of 6-inches to secure ECBs. Use 12-inch anchors for specific ECB installations in sandy, loose, or wet soils or as directed by the Engineer or manufacturer's representative.

Use anchors (stakes, pins, or staples) with a minimum length of 6 inches to secure permanent TRM. Use longer anchors for specific TRM installation in sandy, loose, or wet soils, or as directed by the Engineer or manufacturer's representative.

Use Table 3 to determine minimum anchoring frequency. Refer to the manufacturer's recommendation for additional information. Install anchors at the manufacturer's rate if it is greater than the minimum values listed in Table 3 to ensure the manufacturer's warranty is not violated.

Table 3: RECP Anchoring Requirements

Slope Grade	Anchoring Frequency
Up to 3H:1V	1.5 anchor/square yard
3H:1V to 2H:1V	2.0 anchors/square yard
2H:1V to 1H:1V	3.5anchors/square yard
Steeper than 1H:1V and Channel Bottoms	4.0 anchors/square yard

Obtain Engineer and manufacturer's representative approval before execution of alternate installation methods to those specified herein.

1.4.3 Slope Installation

At the top of the slope construct a 6-inch (deep) x 12-inch (wide) anchor trench to inhibit undermining from stray surface water. Extend the upslope terminal end of the RECP 30 inches past the anchor trench.

Use anchors to fasten the RECP material into the upslope anchor trench on 12-inch centers. Backfill the trench with soil and compact. Apply seed to the backfilled soil surface and cover with the remaining 12 inches of the RECP terminal end. Anchor the terminal end down slope of the anchor trench on 12-inch centers.

Securely fasten all RECP materials to the soil by installing anchors at a minimum rate of 1.5 anchors per square yard. Select anchors that have sufficient ground penetration to resist pullout. Increase the anchoring frequency if the Engineer or manufacturer's representative determines it necessary due to site conditions (i.e., loose or wet soils).

Unroll the RECP parallel to the primary direction of water flow and place in direct contact with the soil surface. Do not stretch or allow the material to bridge over surface inconsistencies. Overlap the edges of adjacent (vertically down the slope) RECPs a minimum of 3 inches with the upslope roll overlapping on top of the down slope roll in shingle style.

Overlap the edges of parallel (horizontal across the slope) blankets 3 to 6 inches depending on the type of RECP used.

1.4.4 Channel Installation

Excavate anchor trenches or install anchor check slots perpendicular to the flow direction across the entire width of the channel at 30-foot maximum intervals and at the terminal end of the channel reach.

Construct a 6-inch (deep) x 12-inch (wide) beginning anchor trench. Extend the downstream end of the RECP 30 inches past the anchor trench and use the slack RECP material to cover the backfilled soil. Fasten the RECP material into the anchor trench on 12-inch centers.

Excavate 6 inch x 6 inch check slots at a maximum of every 30 feet along the length of the channel.

An alternative installation for checks slots is a double row of anchors. For anchor check slot applications, place two rows of anchors 4 inches apart and install each row of anchors on 12-inch centers. Drive all anchors flush with the soil surface.

Beginning at the downstream end in the center of the channel, place the initial end of the first RECP in the anchor trench and secure it with ground anchor devices at 12-inch intervals.

Position adjacent rolls in the anchor trench in the same manner, overlapping the proceeding roll a minimum of 3 inches. Secure the RECP at 12-inch intervals along the anchor trench, backfill and compact with specified soil or as directed by the Engineer or manufacturer's representative.

Unroll the center strip of RECP upstream over compacted trench. Stop at the next check slot or terminal anchor trench. Unroll adjacent rolls of RECP upstream in similar fashion, maintaining a 3-inch overlap.

Fold and secure the RECP snugly into transverse check slots. Lay material in bottom of the slot, and then fold the material back against itself as indicated. Anchor through both layers of RECP at 12-inch intervals. Backfill with soil and compact. Continue unrolling the RECP widths upstream over compacted slot to next check slot or terminal anchor trench.

Secure RECP to the channel bottom with anchors at a frequency of 2.5 anchors per square yard. Select anchors that have sufficient ground penetration to resist pullout. Increase the anchoring frequency if the

Engineer or manufacturer's representative deems it necessary due to site conditions (i.e., loose or wet soils).

Cut a 4-inch x 4-inch longitudinal anchor slot at the top of each slope. Fasten the RECP material into the longitudinal anchor slots on 12-inch centers.

1.4.5 Delivery, Storage, and Handling

Follow the requirements of ASTM D4873 for RECP labeling, shipment and storage. Ensure that product labels clearly show the RECP manufacturer name, supplier name (if applicable), style or product name, and roll (item) number. Include with each shipping document a notation certifying that the material is in accordance with the manufacturer's certificate.

Wrap each RECP roll with a material that protects the RECP from damage due to shipment, water, sunlight, and contaminants. Maintain the protective wrapping during shipment and storage.

During storage, elevate the RECP rolls off the ground and adequately cover to protect them from the following:

- Site construction damage,
- Extended exposure to ultraviolet (UV) radiation,
- Precipitation,
- Chemicals that are strong acids or strong bases,
- Flames,
- Sparks,
- Temperatures in excess of 160^{o} F , and
- Other environmental conditions that can damage the physical properties RECPs.

1.4.6 Inspection and Maintenance of RECPs

Check areas protected by RECPs for dislocation or failure every seven 7 calendar days and inspections are recommended within 24-hours after each rainfall event that produces ½-inches or more of precipitation until final stabilization is achieved.

Ensure the pinning or stapling pattern is consistent with that shown on the manufacturer's installation sheet. If there is evidence that the RECP is not securely fastened to the soil, install extra pins or staples to inhibit the RECP from becoming dislodged.

Inspect regularly until grass or vegetation is firmly established.

Repair all damaged areas immediately by restoring the soil on slopes or channels to its finished grade, re-apply fertilizer and seed, and replacing the appropriate RECP material as needed.

1.4.7 Acceptance

Obtain Engineer acceptance and approval for RECP installations. When requested by the Engineer, ensure that a manufacturer's representative is on-site to oversee and approve the initial RECP installation. Obtain a letter from the manufacturer approving the installation when requested by the Engineer.