Transition Mat: Post-construction BMP

A. Description:

A transition mat is a biotechnical alternative for rip rap. It is a mechanically-anchored 4 ft. x 4 ft. x .5 inch semi-rigid, polymer mat designed with voids throughout the structure which enable vegetative growth. Specified anchors and anchor configuration are essential to performance.
Transition mats provide mechanical protection over highly-erosive areas, like stormwater pipe outfalls, curb outfalls, over-flow structures, and shorelines. Transition mats provide resistance against much greater shear stress and velocities than vegetation alone or rock rip rap; and are comparable in performance to Articulated Concrete Blocks. Vegetation provides many aesthetic, functional, and synergistic benefits, but is not required for transition mat performance.

Transition mats must be used in combination over other soil covers: 1) sod, 2) sod and turf reinforcement mats (TRMs), or 3) hybrid TRMs, such as a geo-textile/TRM combinations. Transition mats do not dissipate energy by impact, but mechanically protect the critical area until the high energy forces have dissipated via expansion/widening of the scour area. The resulting downstream forces are managed by appropriate soil covers calculated and specified as part of the transition mat engineered system.

B. Longevity: Permanent and temporary (non-vegetated mats can be relocated).

C. Typical Uses: As a replacement for rock rip rap at culvert outlets, parking lot discharge areas, and occasional-overflow structures. Additional applications would be stream bed protection, stream bank stabilization, and shoreline protection from boat and/or wind erosion.

D. Limitations and Avoidances:

- In a continuous, low-flow drainage situation, saturated soils may not support vegetation or may be too unstable to resist erosive flows. A sub-surface drainage system may be required to stabilize the soil for vegetation.
- Do not install at slope changes greater than 25% between the discharge area and the downstream channel which create impact or waterfall erosion.

E. Maintenance:

Transition mats are generally permanent installations, and maintenance should not be necessary. Utilized in a temporary installation, the transition mats and TRMs can be picked up and moved when appropriate.

F. Performance Parameters:

Proven performance – At the scour area of a pipe outlet: 16 fps over fresh-cut sod; 14 fps over High-Performance TRM.
Proven performance – On steep slopes up to 2H:1V: 12 fps and 13 lbs. of shear [over fresh cut sod].
Proven performance – On a 23% Slope: 20 fps and 8 pounds of shear [over both a combination geotextile / TRM installation and over fresh cut sod installation].
The mechanical anchoring system enables these flow velocities and shears, up to and beyond full vegetation. Check www.scourstop.com under resources for full research reports.

G. Installation Modes:

The transition mat has several installation types: type A - over sod, type B - over sod / TRM combination, type C – over a TRM, and type D – over hybrid TRM, like a geotextile / TRM combination.

Type A – Most storm water pipe outlets and parking lot outlets are good applications for transition mats over sod. Sod provides immediate soil protection and eliminates any risk of poor seed germination. Additional uses include occasional overflow structures and streambank protection preserving the natural landscape aesthetics. Transition mats over sod are proven at velocities greater than 21 feet per second (fps) on a 23% slope.

Type B - Transition mats over a sod and TRM combination for a higher level of protection, especially on slopes greater than 10%. Vegetated TRMs have proven shear force resistance of 12 pounds per sq. ft. Sod eliminates the germination issue of a plain TRM installation, even though it adds a slight cost of material and labor, as well as potential short term irrigation needs. Appropriate locations would be 24-72+ inch storm water pipes, high flow parking lot outlets, and streambank restoration.

Type C – Transition mats and TRMs over bare soil (including composite TRMs). The flows should be less than 3 feet per second and the area fairly level to minimize concentrated erosive forces. A rural culvert outlet might be an appropriate application, or erosion protection at a temporary construction outlet. Maximum pipe size would generally be 24 inches for an open-weave TRM, and up to 48 inches for a high-performance composite TRM.

Type D – Transition mats and a combination geotextile / TRM over bare soil. This installation generally applies to highway construction and semi-arid conditions where healthy vegetation may be a challenge. Use of a 3-4 oz. geotextile under may be appropriate to improve the soil retention and soil protection properties on an installation. The mats would collect small gravel and sediment in the voids, appear naturally stabilized, and offer long term protection. See construction details.
In a stream bed or shoreline application where vegetation is unlikely, use a 10-12 oz. geotextile for soil retention and soil protection under the transition mats. Above the normal-water line, use Type A or B to protect the slope from boat and/or wind wave erosion.

See specification detail for further installation guidelines. Caddetails.com or ScourStop.com

Quick Reference Table

PIPE DIAMETER	DISCHARGE (CFS)	ScourStop WIDTHxLENGTH	QUANTITY MATS
12 "	8	4' x 4'	1
24 "	30	4' x 8'	2
36 "	75	8' x 12'	6
48 "	100	12' x 16'	12
60+ "	150	12' x 20'	15

This table provides a quick reference for installation quantity and configuration. Colorado State University has provided a technical calculator where pipe slope and size are inputs for the calculation of quantity and configuration.

H. Design Requirements:

Very important to read and understand the design manual for maximum performance.

1. ScourStop is an engineered system of erosion control. ScourStop protects the scour / high stress areas, and other soil cover BMPs protect the downstream area.
2. Follow installation guidelines, including use of the installation worksheet for each stormwater outlet. Transition mats require manufacturer's anchor system for proper installation and long term effectiveness.
3. Design for the use of sod when feasible, to achieve the benefits of vegetation immediately. Design parameters prefer sod, or combination sod and TRM, in regions with adequate rainfall to ensure the best installation and performance possible. Semi-arid regions generally require a high-performance TRM / geotextile under the transition mats.
4. See specific specifications for both cohesive and non-cohesive soils.
5. Grade a level, smooth surface at the scour area to avoid water concentration and to create an appropriate base for the scour prevention measures.
6. Grade and install materials at or below the surface of outlet. (The transition mat may be permanently attached over the surface of the discharge outlet.)
7. Design for as much channel expansion as possible to help reduce velocities and increase infiltration potential. Channel slopes restricting expansion require protection.
8. Design the downstream slope as long and flat as possible.
9. Anchor transition mats for consistent contact over the entire surface. It is essential to minimize seepage flow between the mat and ground surface. **Specified anchors are essential to performance – alternates are not acceptable.**
10. Consider sub-surface drainage for trickle flows, such as irrigation overcharge. Installations with continuous low flows, such as irrigation over charge, should utilize a sub-surface drainage system directly downstream of the outlet to drain that low flow from the surface, thus allowing vegetation to properly establish. An adequate slope is required for a sub-drain system.

I. Product failure identification and alternative solutions:

1. Effective failure occurs when a rill or channel forms under the transition mats. Once a rill starts, erosion typically continues under the product system thus indicating failure. However, transition mats are not physically destroyed with a failure, and often can be re-used with a proper installation and/or higher level of installation. Installation worksheets are provided to document and help insure proper installation.
2. Alternative solutions may be articulated blocks or articulated concrete blankets.

J. Benefits:

- Bio-technical replacement for rock rip rap utilizing vegetation and mechanical soil protection.
- Vegetation creates greater site amenity, and filters pollutants.
- Immediate soil protection at installation – there is no lag time for performance.
- 50-100% higher performance specifications than rock rip rap; especially on slopes.
- 10 times lighter per sq. ft. than hard armor alternatives; transition mats minimize weight-transference problems which de-stabilize sub-soils.
- 7 times more 'ballast' capacity than hard armor alternatives (avg. 8 anchors per mat).
- No maintenance required, especially important for municipalities as end owners of storm water conveyances.
- Complies and promotes Phase II minimum requirements.
- Increases infiltration and groundwater recharge by promoting vegetation in storm water conveyances.
- Longer functional life than rock rip rap – rip rap erodes away and disintegrates; is not available everywhere.
- Increases safety for children in residential settings by eliminating debris, vermin, and weeds in rock rip rap.
- Can be re-installed should there be an installation problem or site change.