

Ground Covers and Vegetation



Ground Covers and Vegetation

- Erosion control
- Vegetation is the long term goal
- Ground cover provides protection until germination



Steps to get Vegetation started

- Seedbed preparation
- Pre-ground cover applications
- Ground cover



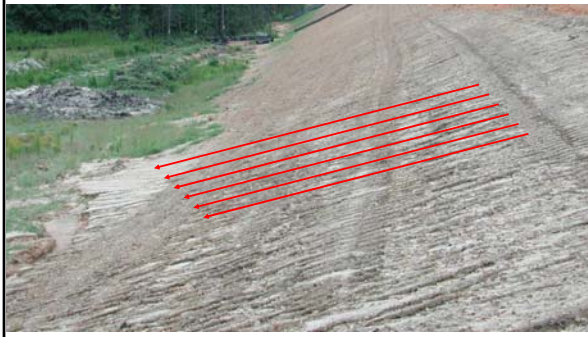
Seedbed Preparation

Grass emergence is the objective

- Smooth uneven areas
- Scarify to loosen soil to the following depths:
 - 5 inches on solid undisturbed earth
 - 3 inches on embankments or other disturbed areas where soil is loose
- Track slope



Tracking across slope creates rills!



Proper Tracking of Slope



Applications

- Lime
- Fertilizer
- Seed
- Ground cover



Lime

Why do we lime?

- Acidic soils in OK
- Al toxicity - growth limiting factor & restricts nutrient uptake



Application:

- 4,000 lbs/ac
- Prefer incorporation into soil



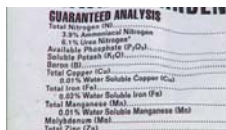
Fertilizer

10-20-10

N-P-K

- Nitrogen
- Phosphorus
- Potassium

Must be incorporated into soil



Fertilizer Application Rates

- **Establishment:**
 - x lbs/acre of 10-20-10 or analysis and rate specified



- **Fertilizer Topdressing**

What the hydro can't reach... the chopper can!



Seed

- **Temporary or Permanent**
- **Riparian Mix**

Temporary Seeding

- Warm season species in summer months
- Cool season species in remaining months
- Follow up w/temporary mulching or hydromulching

Temporary Seeding

- When work areas will not be active for more than 14 days
- Prior to anticipated precipitation



Includes: cut/fill slopes, drainage ditches, sediment basins, road beds ...

Temporary Seeding



Stage Seeding

- Establishment of vegetative cover on cut/fill slopes as grading progresses



Permanent Seeding

- Perform as soon as possible after final grade is complete



Sodding

- Follow specs for proper installation and establishment




Riparian or Native Seed Mixture

- **Native grass seeding**
- Big/Little Bluestem, Indiangrass, Switchgrass



Seeding Problems

- **Inadequate seed germination**
- **Poor seedbed preparation**
- **Wrong seed type**
- **Expired (old) seed**



Maintenance

- **Repair areas of damage or failure of grass stand establishment**
- **Mowing**
- **Maintain all measures until a permanent vegetative cover is established**
- **Supplemental Seeding**
 - No seed bed preparation may be required
 - No fertilizer or limestone may be required
- **Repair Seeding**
 - Seed bed preparation generally required
 - Fertilizer and limestone generally required





Types of Ground Cover

- Straw Mulch
- Erosion Control Blankets
- Permanent Soil (Turf) Reinforcement Mats




Straw Mulch

- 2 tons/ac (85% coverage min.)
- Slopes 2:1 or flatter
- Spread uniformly over area
- Sufficient amount to completely cover area



Straw Mulch

- Partially shade ground
- Reduce erosion
- Conserve soil moisture
- Allow air to circulate
- Allow sunlight to penetrate
- Within 24 hours of seeding



Binding Straw Mulch

- Sufficient amount of binding material to hold straw in place
- Uniform coverage


Tackifier Options

- Diluted Emulsified Asphalt
- Hydro - mulch




Straw Mulch Problems

- Not enough straw applied
- Insufficient tack on mulch
- Too steep or long of slope for straw mulch



Rolled Erosion Control Products - RECPs

- Temporary Products- used on 2:1 slopes and steeper or where grass establishment is poor
- Common types:
 - Excelsior
 - Coir (Coconut)
 - Straw



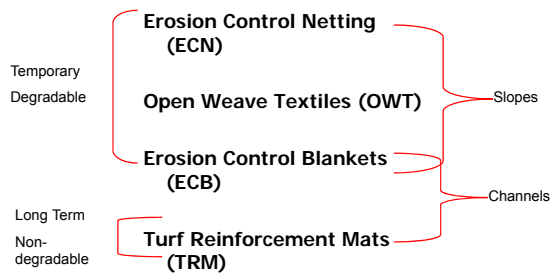
Why Use RECP's for Slopes?

Applications for slopes, channel liners, & shorelines

- **Pros**
 - Immediate erosion protection
 - More aggressive treatment
- **Cons**
 - Labor intensive
 - Added costs



RECP Types



Erosion Control Netting (ECN)

- Planar woven natural fiber or extruded geosynthetic mesh
- Used as a component in RECP's
- Used as a temporary degradable RECP to anchor loose fiber mulches



Open Weave Textiles (OWT)

- Temporary degradable
- Composed of processed natural or polymer yarns woven into a matrix



Erosion Control Blankets (ECB)

- Temporary degradable processes natural or polymer fibers
- Mechanically, structurally, or chemically bound together to form a continuous matrix



Turf Reinforcement Mats (TRM)

- Composed of non-degradable synthetic fibers, filaments, nets, wire mesh, or other elements
- Processed into a permanent, three dimensional matrix



Other Considerations

- **Hard Armor** vs. **Soft Armor**
 - Rip Rap
 - Gabions
- TRMs
 - Composite
 - Synthetic
- Geocells



Product Types

- **Type 1 - Ultra Short Term**
 - 3 months
- **Type 2 - Short Term**
 - 12 months
- **Type 3 - Extended Term**
 - 24 months
- **Type 4 - Long Term**
 - 36 months
- **Type 5**
 - permanent



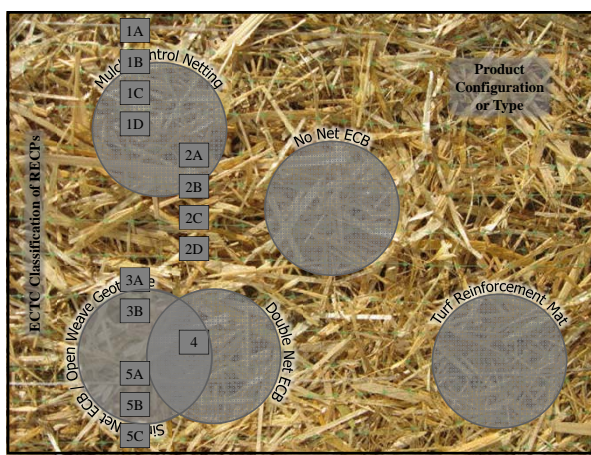
Configuration and Durability

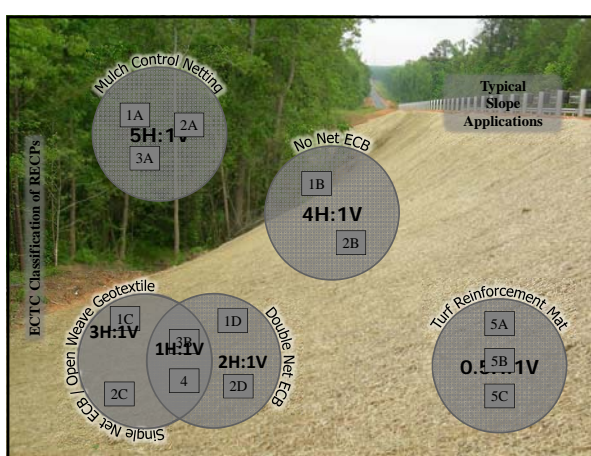
Table ECB-3 Typical Configuration and Durability of Temporary Erosion Control Blankets

Class Designation	Usual Configuration	Typical Durability
1A	Multi-control netting consisting of rapidly degrading phytodegradable synthetic mesh or woven biodegradable natural netting	3 months
1B	An erosion control blanket composed of precasted cellular degradable natural and/or polymer fibers continuously interconnected or chemically adhered together to form a continuous mat	3 months
1C	An erosion control blanket composed of precasted degradable natural and/or polymer fibers continuously interconnected or chemically adhered together to form a continuous mat. It is composed of precasted mats of 20 or more square feet or larger made from a synthetic mesh.	3 months
1D	An erosion control blanket composed of precasted cellular or fibrous natural and/or polymer fibers continuously interconnected or chemically adhered together to form a continuous mat. It is composed of precasted mats of 20 or more square feet or larger made from a synthetic mesh.	3 months
2A	Multi-control netting consisting of photodegradable synthetic mesh or woven biodegradable natural fiber netting	12 months
2B	An erosion control blanket composed of precasted degradable natural and/or polymer fibers continuously interconnected or chemically adhered together to form a continuous mat	12 months
2C	An erosion control blanket composed of precasted degradable natural and/or polymer fibers continuously interconnected or chemically adhered together to form a continuous mat. It is composed of precasted mats of 20 or more square feet or larger made from a synthetic mesh.	12 months
2D	An erosion control blanket composed of precasted degradable natural and/or polymer fibers continuously interconnected or chemically adhered together to form a continuous mat. It is composed of precasted mats of 20 or more square feet or larger made from a synthetic mesh.	12 months
3A	Multi-control netting consisting of a slow-degrading synthetic mesh or woven natural fiber netting	24 months
3B	An erosion control blanket composed of precasted slow-degrading natural and/or polymer fibers continuously interconnected or chemically adhered together to form a continuous mat. It is composed of precasted mats of 20 or more square feet or larger made from a synthetic mesh.	24 months
4	An erosion control blanket composed of precasted slow-degrading natural and/or polymer fibers continuously interconnected or chemically adhered together to form a continuous mat. It is composed of precasted mats of 20 or more square feet or larger made from a synthetic mesh.	24 months

Table ECB-4 Typical Configuration and Durability of Permanent Erosion Control Blankets

Class Designation	Usual Configuration	Typical Durability
1A	A non-degradable turf reinforcement mat with sufficient thickness, strength and root space to permit erosion prevention and vegetation re-establishment.	Permanent
1B	A non-degradable turf reinforcement mat with sufficient thickness, strength and root space to permit erosion prevention and vegetation re-establishment.	Permanent
1C	A non-degradable turf reinforcement mat with sufficient thickness, strength and root space to permit erosion prevention and vegetation re-establishment.	Permanent





Typical Slope Applications

Table ECB-1 Temporary Erosion Control Blanket Classes and Applications

Class	Application
1.A	Designed for use on geotechnically stable slopes with gradients up to 0:1 and channels with shear stresses up to 25 pounds per square foot.
1.B	Designed for use on geotechnically stable slopes with gradients up to 4:1 and channels with shear stresses up to 5 pounds per square foot.
1.C	Designed for use on geotechnically stable slopes with gradients up to 3:1 and channels with shear stresses up to 1.5 pounds per square foot.
1.D	Designed for use on geotechnically stable slopes with gradients up to 2:1 and channels with shear stresses up to 1.75 pounds per square foot.
2.A	Designed for use on geotechnically stable slopes with gradients up to 0:1 and channels with shear stresses up to 25 pounds per square foot.
2.B	Designed for use on geotechnically stable slopes with gradients up to 4:1 and channels with shear stresses up to 5 pounds per square foot.
2.C	Designed for use on geotechnically stable slopes with gradients up to 3:1 and channels with shear stresses up to 1.5 pounds per square foot.
2.D	Designed for use on geotechnically stable slopes with gradients up to 2:1 and channels with shear stresses up to 1.75 pounds per square foot.
3.A	Designed for use on geotechnically stable slopes with gradients up to 0:1 and channels with shear stresses up to 25 pounds per square foot.
3.B	Designed for use on geotechnically stable slopes with gradients up to 0:1 and channels with shear stresses up to 2 pounds per square foot.
4	Designed for use on geotechnically stable slopes with gradients up to 1:1 and channels with shear stresses up to 0.25 pounds per square foot.

Table ECB-2 Permanent Erosion Control Blanket Classes and Applications

Class	Application
5.A	Designed for use on geotechnically stable slopes with gradients up to 0:1 and channels with shear stresses up to 8 pounds per square foot.
5.B	Designed for use on geotechnically stable slopes with gradients up to 0:1 and channels with shear stresses up to 8 pounds per square foot.
5.C	Designed for use on geotechnically stable slopes with gradients up to 0:1 and channels with shear stresses up to 10 pounds per square foot.

C – Factor Performance

- Cover Factor “C”
- Effectiveness – Primary soil loss value
- Ability to minimize soil movement during rain events



Engineering Properties

Table ECB-5 Minimum Physical Requirements For Erosion Control Blankets

Class	Minimum Tensile Strength (lb/inch)	Minimum Tear Strength (lb/inch)	Minimum Thickness (inches)	Property	
				Minimum Factor for Temporary Products (ASTM D 6456) ¹	Minimum Factor for Permanent Products (ASTM D 6456) ²
1A ¹	5	0.2	0.10	0.10	0:1
1B	5	0.2	0.10	0.10	4:1
1C	30	1.1	0.15	0.15	3:1
1D	30	1.1	0.20	0.20	2:1
2A ¹	5	0.2	0.10	0.10	0:1
2B	5	0.2	0.10	0.10	4:1
2C	30	1.1	0.15	0.15	3:1
2D	30	1.1	0.20	0.20	2:1
3A ¹	25	0.2	0.10	0.10	0:1
3B	150	2.1	0.25	0.25	1.5:1
4	125	2.1	0.25	0.25	1:1
5A ¹	150	0.6	N/A	N/A	
5B ¹	100	0.6	N/A	N/A	
5C ¹	175	0.6	N/A	N/A	

1 Minimum average of values, or testing on high variability, or using other methods. 2 Minimum shear stress for other than vertical erosion control blankets should be specified using Figure C-3. 3 Values should be specified in the test methods, but not in the minimum requirements. 4 Values should be specified in the test methods, but not in the minimum requirements. 5 Values should be specified in the test methods, but not in the minimum requirements. 6 Values should be specified in the test methods, but not in the minimum requirements. 7 Values should be specified in the test methods, but not in the minimum requirements. 8 Values should be specified in the test methods, but not in the minimum requirements.

Riparian Buffer Considerations

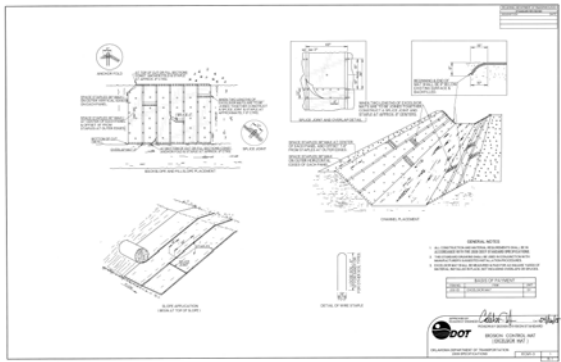
- **Netless vs. Net**



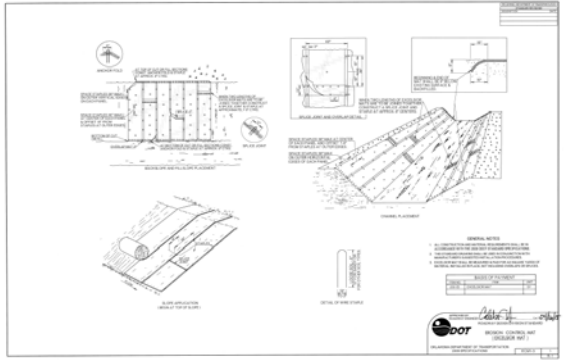
RECP Installation

- **Site Preparation**
 - Fine graded to a smooth profile
 - Free from clods, roots, stone, etc.
- **Seeding**
 - Select seed mix to the geological area
- **Trenching**
 - 6" deep by 6" wide anchor trench at top of slope
- **Staples**

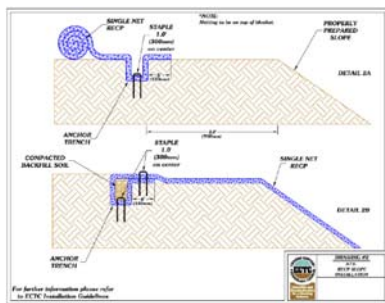
ODOT Excelsior Matting Detail



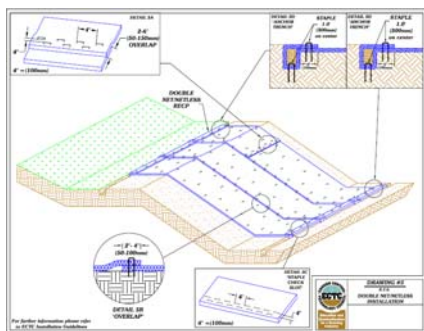
ODOT Nylon Matting Detail



Slope Installation



Slope Installation






Installed Costs


- Type 1 – \$0.50 - \$0.75/sy
- Type 2
 - Single Net - \$1.50/sy
 - Double Net - \$1.75/sy
- Type 3 - \$2.00 - \$5.00/sy
- Type 4 - \$6.00/sy
- Type 5 - \$6.00 - \$7.00/sy



Erosion Control Blankets



Erosion Control Blanket Problems



Compost Seeding

- **Alternative to Seeding and Matting**
 - Single application of compost material and seed on slopes
 - Nutrient and pH benefits



Compost Seeding



Case Studies

- **Different projects**
 - Site 1) application over Anchor Mat System on steep fill slope
 - Site 2) application on eroding loamy cut slopes
 - Site 3) application on eroding highly acidic clay soil cut slopes

Site 1

LOCATION: US 1 near RDU Airport
AREA: 22,500 square foot, 1" thick, 1.5:1 fill slope
COST: \$0.21/square foot = \$4725/acre
SEASON: Fall (October)



Site 2

LOCATION: I-540 Raleigh, NC
AREA: 3,000 square foot, 1 inch thick, 3:1 slope
COST: (DEMO)
SEASON: Winter (January)



Site 3

LOCATION: US 70 Johnston County, 20 mi. east RDU
 AREA: 4 Acres, 1" thick, 2:1 cut slopes
 COST: \$0.13/square foot, \$22,215/4 Acres
 SEASON: Winter (February)

Comparisons

- **Compost Seeding**
 - Ranges from **\$0.13/square foot to \$0.22/square foot** or \$5662/acre to \$9583/acre
- **Seeding and Matting**
 - Ranges from **\$0.17/square foot** (\$0.03/square foot for seeding + \$0.14/square foot for matting) **to \$0.22/square foot** (\$0.03/ square foot for seeding + \$0.19/square foot for matting) or \$7405/acre to \$9583/acre

Benefits

- **Access to slope**
 - Large truck and hose operation can make application to steep slopes easier than traditional seeding and matting effort
- **Seed bed preparation**
 - Not as critical because seed will germinate in compost material. Have gone with ~ 2 inches and seen success.
- **Long term benefit to soil**
 - As compost leaches and decomposes it improves quality of existing soil and root zone of developing vegetation.
- **Efficiency**
 - Compost seeding provides seed and groundcover in one application

Drawbacks

- **Access to slope**
 - Large truck and hose operation
- **Seed bed preparation**
 - Must be done as a separate operation
- **Material Stockpile**
 - Area needed is relative to area to be seeded. ~130 cubic yards for 1 acre coverage at 1 inch thickness

Why use HECP's

Hydraulic Erosion Control Products

- **Easy to Install**
- **Better contact with soil**
- **Site prep savings**



Characteristics

- **Quality raw materials – no germination inhibitors**
- **Long fiber lengths provide excellent erosion control and moisture absorption**
- **Thermally refined fibers provide greater moisture retention and ground coverage**

HECP Types

- Hydraulic Mulch (HM)
- Stabilized Mulch Matrix (SMM)
- Bonded Fiber Matrix (BFM)
- Fiber Reinforced Matrix (FRM)

Hydraulic Mulch

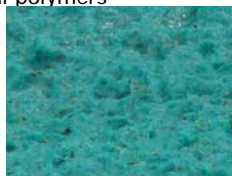
- Contains defibrated paper, wood and/or natural fibers
- May or may not contain tackifiers
- Use on mild slopes



Stabilized Mulch Matrix

- Contains defibrated organic fibers with at least one of the following:
 - Soil flocculants
 - Cross linked hydro-colloidal polymers
 - Cross linked tackifiers

- Use on moderate slopes



Bonded Fiber Matrix

- Matrix containing organic defibrated fibers and cross-linked insoluble hydro-colloidal tackifiers
- Use on steep slopes



Fiber Reinforced Matrix

- Matrix containing organic defibrated fibers
- Cross linked insoluble hydro colloidal tackifiers and reinforcing natural or synthetic fibers
- Use on very steep slopes



Application Rates

Hydraulic Erosion Control						
Type	Functional Longevity	Typical Application Rates (lbs/ac)	Typical Maximum Slope Gradient (H:V)	Maximum Uninterrupted Slope Length (ft)	Maximum C Factor	Minimum Vegetation Establishment
HM	up to 3 mo.	2000-3000	≤ 3:1	25	0.5	150%
SMM	min. 3 mo.	2000-3500	≤ 2:1	50	0.15	200%
BFM	min. 6 mo.	2500-4000	≤ 1:1	75	0.1	300%
FRM	min. 12 mo.	3000-4500	≤ 0.5:1	100	0.02	400%

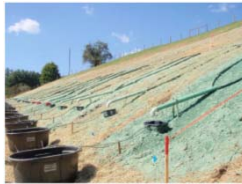
Mixing Techniques

- **Mechanically Agitated Machines**
 - Have paddles to mix slurry in tank
 - Can use a wide range of fiber mulch materials

- **Jet Agitated Machines**
 - Generally smaller machines that mix slurry with jets
 - May have difficulty pumping wood based fiber mulch materials

HECP Research

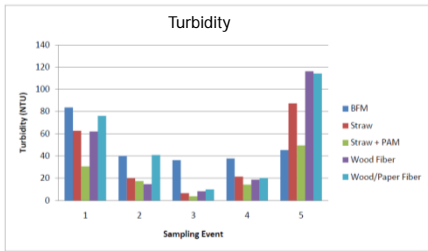
- 30' x 200' area
- 20 plots
- 5 treatments were applied
- Each treatment replicated 4 times



Hydromulch Research

Plot Type	HM subsample weight (g)	DOT recommended rate (lb/ac)	Actual application rate (lb/ac)
100% wood	6.7	2000	3300
100% wood	8.4	2000	4100
100% wood	12.6	2000	6200
100% wood	11.8	2000	5800
BFM	17.3	3500	8500
BFM	7.7	3500	3700
BFM	10.1	3500	4900
BFM	11.2	3500	5500
70/30	6.8	2500	3300
70/30	6.5	2500	3200
70/30	9.3	2500	4500

Hydromulch Research

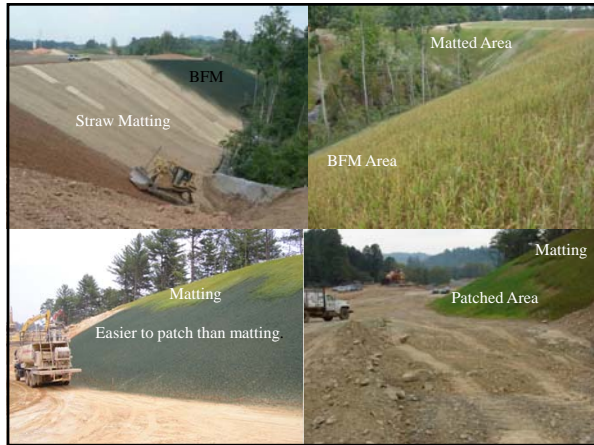


- Event 1 - 3.87" rainfall
- Event 2 - 1.55" rainfall
- Event 3 - 2.07" rainfall











Installed Costs

- Hydraulic Mulch - \$1500-\$3000/ac
- Stabilized Mulch Matrix - \$3000-\$4000/ac
- Bonded Fiber Matrix - \$4000-\$5000/ac
- Fiber Reinforced Matrix - \$5000-\$6000/ac

HECP Summary

- A right tool/product for every job!
- Select product based on engineering properties and site/slope warrants
- HECP's may serve as equivalent to some RECP's at a cost savings

Borrow and Waste Sites

- Stockpile topsoil for plating
- Initiate Stage S&M w/1 acre exposure
- Stabilize perimeter cuts and fills



Borrow and Waste Sites



Questions