

SECTION 5.11

REVEGETATION AND SITE STABILIZATION

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SECTION 5.11

REVEGETATION AND SITE STABILIZATION

Stabilizing a site with vegetation following any drainage improvement project is a critical component in reducing sedimentation and armoring the site against future erosion. This section addresses revegetation techniques as well as practices to protect exposed soil while vegetation is becoming established.

Techniques discussed in Vegetative Stabilization (Practice 1102) are most often used in conjunction with other drainage improvement activities, or alone when conditions permit. Vegetative Stabilization complements the practices listed in Section 5.5 (Eroded Streambank Repair). Temporary, dormant, or permanent seedings should follow any soil-displacing activity. Wheat, rye, and oats are often used as temporary cover crops. Native plant species are recommended for permanent seedings. Native plants have extensive root systems well-suited for bank stabilization, and provide better habitat for wildlife than introduced species. Native plants also tend to be hardier than introduced species, and require less maintenance.

Using vegetation alone to stabilize the banks of streams and ditches should only take place in areas with moderate sideslopes and where the scouring forces of high velocity flows will not preclude the establishment of plants. A good rule of thumb is as follows: If the sideslopes support rigorous vegetation prior to implementing improvement activities, then that stretch is a good candidate for armoring with vegetation. Sideslopes with scoured banks supporting little or no vegetation likely contain water with flows too high and fast to support vegetation.

The installation of mulch, erosion control blankets and matting, and/or a bonded fiber matrix is often necessary in conjunction with seeding. Mulch is the least expensive, but is not appropriate in areas subject to high concentrated flows. Erosion control blankets and matting work well in areas with high concentrated flows, but are expensive to install and are prone to erosion beneath the mat if not installed properly. Bonded fiber matrices are a good choice along very steep banks and in areas with low to moderate concentrated flows.

Regular maintenance is critical in achieving final site stabilization. Recently planted or sodded areas usually require watering. Fertilizer should only be used if a soil test indicates it is necessary. Care should be taken that the fertilizer does not leach into a stream or ditch. To enhance the establishment of native grasses, the newly planted areas need to be mowed, burned, or weeded periodically. When burning is impractical and mowing is necessary, it should be done after August 1 to protect ground-nesting wildlife. Erosion control blankets, mats, mulch, and fiber bonded matrices should be monitored and repaired as necessary following storm events until vegetation has a chance to become established.

PRACTICE 1101 MULCHING

- DESCRIPTION**
- Application of plant residues or other suitable materials to the soil surface. (Note: this practice is also included in the Indiana Erosion Control Handbook.)



Exhibit 1101a: Mulching (Source: North Carolina Erosion Control Manual)

PURPOSE	<ul style="list-style-type: none"> ● To prevent erosion. ● To reduce the velocity of overland water flow. ● To foster growth of vegetation by preserving soil moisture and insulating soil from extreme heat or cold. ● To reduce rain drop impact (splash erosion).
WHERE APPLICABLE	<ul style="list-style-type: none"> ● Areas that recently have been seeded. ● Areas that require soil protection but cannot be seeded because of the time of year or other reasons. ● Areas that require mud and dust control.
ADVANTAGES	<ul style="list-style-type: none"> ● Controls erosion in recently seeded areas. ● Conserves soil moisture thereby promoting seed germination and seedling growth. ● Reduces soil surface compaction or crusting by protecting the soil surface from raindrop impact. ● Moderates temperature and moisture extremes.
CONSTRAINTS	<ul style="list-style-type: none"> ● Added cost to seeding.
DESIGN AND CONSTRUCTION GUIDELINES	<p>Materials</p> <ul style="list-style-type: none"> ● Straw, hay, wood fiber, cellulose, or excelsior.

Installation

- Prior to Application
 1. Shape and grade as required.
 2. Remove all rocks, clods, or debris larger than 2" in diameter that will prevent contact between the mulch and soil surface.
 3. When using erosion control blankets, lime, fertilizer, and seed may be applied either before or after laying the blanket. The preferred method is to seed and add amendments before installing the blanket.

- Time of Application
 1. Immediately after seeding, or planting by conventional methods or by hydroseeding. May be applied with seeding as hydromulching.
 2. Immediately after seedbed preparation when dormant seedings are to be made by seeding over the mulch.

- Application and Anchoring
 1. Apply mulch at recommended rate.
 2. Spread uniformly by hand, hay fork, mulch blower, or hydromulcher. No more than 25% of ground surface should be visible following application.
 3. If straw or hay is used, anchor immediately (See Exhibit 1101b).

Anchoring Method	How to Apply
Mulch anchoring tool <u>OR</u> Farm disk (dull serrated, and set straight)	Crimp or punch straw or hay into soil 2-4". Operate machinery on the contour of slope.
Cleating with dozer tracks	Operate dozer up and down slope
Wood hydromulch fibers	Apply 0.5 ton/acre using a hydromulcher at a rate of 750 lbs/acre with a tacking agent. Do not use in areas of concentrated flow.
Asphalt emulsion	Should conform to ASTM Spec. #977. Apply at rate of 0.05 gal./sq.yd. Do not use in areas of concentrated flow.
Synthetic tackifier, binder or soil stabilizer	Apply according to manufacturers recommendations.
Biodegradable netting	Apply over mulch and staple with 6-8" wire staples. Follow manufacturers recommendations.

Exhibit 1101b: Mulch anchoring methods. (Source: Indiana Erosion Control Handbook)

- Rate
See Exhibit 1101c.

Material	Rate	Comments
Straw or hay	1.5-2 tons/acre	Should be dry and unchopped Should be free of undesirable seeds Spread by hand or machine Must be crimped or anchored
Wood fiber cellulose	1 ton/acre	Apply with hydromulcher and use tacking agent
Long fiber wood	0.5-0.75 tons/acre	Anchor in areas subject to wind

Exhibit 1101c: Mulch Materials Rates (Source: Indiana Erosion Control Handbook)

Special Considerations

- Choice of materials should be based on the type of soil to be protected, season, and economics.
- Organic mulch materials such as straw and hay have been found to be the most effective.
- Chemical soil stabilizers and binders work best when used in conjunction with organic mulches.

MAINTENANCE

- Inspect and reapply mulch as necessary after storm events.
 - Continue inspections until vegetation becomes established.
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REFERENCES

Related Practices

- Practice 104 Temporary Diversion.
- Practice 105 Silt Fencing.
- Practice 106 Straw Bale Filter.
- Practice 1102 Vegetative Stabilization.

Other Sources of Information

- Indiana Erosion Control Handbook.
 - Illinois Urban Manual.
 - North Carolina Erosion Control Manual.
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PRACTICE 1102 VEGETATIVE STABILIZATION AND SEEDING

DESCRIPTION ● Stabilization and protection of streambanks with selected vegetation.



Exhibit 1102a: Vegetative Stabilization (Source: North Carolina Erosion Control Manual)

PURPOSE

- To protect streambanks from the erosive forces of flowing water and provide a natural, pleasing appearance.
- To restabilize areas disturbed during construction.
- Shade provided by woody vegetation maintains lower water temperatures and provides wildlife habitat.

WHERE APPLICABLE

- Generally applicable along streams and ditches where bankfull flow velocity does not exceed 5 ft/sec., and soils are erosion resistant.
- Vegetative techniques usually should be incorporated with structural techniques if the bankflow velocity exceeds 5 ft/sec. (See referenced sources.)

ADVANTAGES

- Often less expensive than structural techniques.
- Natural appearance.
- May create or enhance wildlife habitat.
- Self repairing in many cases.

CONSTRAINTS

- May not be applicable in high flow ditches and streams.
- Full stabilization may not be achieved until plants become established.
- Often requires limited but regular maintenance such as burning, and in some situations, herbiciding or even mowing.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Appropriate plant species selected from following Exhibit 1102b or other referenced sources. Note that not all species listed are suitable for every region or soil.
- Mulch, erosion control blankets, and/or bonded fiber matrix.

Partial Sunlight (Half Day) to Full Sunlight

<u>Common Name</u>	<u>Botanic Name</u>	Plugging	
		<u>Rate On Center</u>	<u>Seeding Rate</u>
<u>Banks and Slopes (Stabilizing Matrix Species)</u>			
Big Bluestem	Andropogon gerardii	18-24"	5 lb/ac
Brown Fox Sedge	Carex vulpinoidea	18-24"	0.25 lb/ac
Canada Wild Rye	Elymus canadensis	18-24"	5 lb/ac
Streambank Rye	Elymus riparius	18-24"	1 lb/ac
Silky Wild Rye	Elymus villosus	18-24"	1 lb/ac
Virginia Wild Rye	Elymus virginicus	18-24"	3 lb/ac
Torrey's Rush	Juncus torreyi	18-24"	0.01 lb/ac
Evening Primrose	Oenothera biennis	18-24"	0.25 lb/ac
Switch Grass	Panicum virgatum	18-24"	1 lb/ac
Indian Grass	Sorghastrum nutans	18-24"	5 lb/ac
Prairie Cord Grass	Spartina pectinata	18-24"	N/A
Blue Vervain	Verbena hastata	18-24"	1 lb/ac
<u>Toe, Lower Banks (Stabilizing Species)</u>			
Sweet Flag	Acorus calamus	18-24"	N/A
Water Plantain	Alisma subcordatum	18-24"	N/A
Bluejoint Grass	Calamagrostis canadensis	18-24"	N/A
Creeping Spike Rush	Eleocharis acicularis	18-24"	N/A
Blue Flag Iris	Iris virginica	18-24"	N/A
Torrey's Rush	Juncus torreyi	18-24"	N/A
Switch Grass	Panicum virgatum	18-24"	N/A
Arrowhead	Sagittaria latifolia	18-24"	N/A
Hardstem Bulrush	Scripus acutus	18-24"	N/A
Chairmaker's Rush	Scirpus americanus	18-24"	N/A
Dark Green Rush	Scirpus atrovirens	18-24"	N/A
River Bulrush	Scirpus fluviatilis	18-24"	N/A
Prairie Cord Grass	Spartina pectinata	18-24"	N/A
Blue Vervain	Verbena hastata	18-24"	N/A
<u>Cover Crops (Hydroseeding, Hand or Machine Planted Species)</u>			
Annual Ryegrass	Lolium multiflorum	N/A	60 lb/ac
Perennial Ryegrass	Lolium perenne	N/A	24 lb/ac
Smartweed	Polygonum punctatum	N/A	5 lb/ac
Yellow Coneflower	Ratibida pinnata	18-24"	0.25 lb/ac
Black-Eyed Susan	Rudbeckia hirta	18-24"	0.25 lb/ac
<u>Brush for live stakes, brush mattress, live fascine, branch packings, live cribwall and vegetated geogrid. (North bank may have to be planted by shade-tolerant species.)</u>			
Buttonbush	Cephalanthus occidentalis		
Silky Dogwood	Cornus amomum		
Red-Osier Dogwood	Cornus stolonifera		

Exhibit 1102b : Plant species for Vegetative Stabilization (Source: DuPage County Streambank Stabilization Program)

Partial Sunlight (Half Day) to Full Sunlight (continued)

<u>Common Name</u>	<u>Botanic Name</u>	<u>Plugging</u>	
		<u>Rate On Center</u>	<u>Seeding Rate</u>
<u>Brush ... (continued from last page)</u>			
White Willow	Salix alba		
Peach-Leaved Willow	Salix amygdaloides		
Pussy Willow	Salix discolor		
Sandbar Willow	Salix interior		
Black Willow	Salix nigra		
Elderberry	Sambucus canadensis		
<u>Non-Stabilizing Decorative and Screening</u>			
<u>Plants</u>			
Swamp Milkweed	Asclepias incarnata		
Joe-Pye Weed	Eupatorium maculatum		
Spiderwort	Tradescantia ohiensis		
Culver's Root	Veronicastrum virginicum		
Golden Alexanders	Zizia aurea		
<u>Shrubs (Plant sparsely to prevent overshadowing banks)</u>			
Eastern Ninebark	Physocarpus opulifolius		
Arrowwood Viburnum	Viburnum dentatum		
Nannyberry Viburnum	Viburnum lentago		
<u>Trees (Plant lightly to prevent overshadowing banks)</u>			
White Ash	Fraxinus americana		
Green Ash	Fraxinus pennsylvanica		
Quaking Aspen	Populus tremuloides		
Swamp White Oak	Quercus bicolor		
White Cedar	Thuja occidentalis		
Basswood	Tilia americana		
<u>Buffer Zone/Filter Strips</u>			
Big Bluestem	Andropogon gerardii	N/A	5 lb/ac
New England Aster	Aster novae-angliae	N/A	2 oz/ac
Oats*	Avena sativa	N/A	25 lb/ac
Daisy*	Chrysanthemum		
	leucanthemum	N/A	0.25 lb/ac
Chicory*	Cichorium intybus	N/A	0.1 lb/ac
Barley*	Hordeum vulgare	N/A	25 lb/ac
Annual Ryegrass*	Lolium multiflorum	N/A	25 lb/ac
Wild Bergemont	Monarda fistulosa	N/A	0.5 oz/ac
Switch Grass	Panicum virgatum	N/A	1 lb/ac
Yellow Coneflower*	Ratibida pinnata	N/A	0.25 lb/ac

Exhibit 1102b (continued):

Plant species for vegetative Stabilization (Source: DuPage County Streambank Stabilization Program)

Partial Sunlight (Half Day) to Full Sunlight (continued)

<u>Common Name</u>	<u>Botanic Name</u>	<u>Plugging Rate On Center</u>	<u>Seeding Rate</u>
<u>Buffer Zone/Filter Strips (continued)</u>			
Black-Eyed Susan*	Rudbeckia hirta	N/A	0.25 lb/ac
Indian Grass	Sorghastrum nutans	N/A	5 lb/ac
Alsike Clover*	Trifolium hybridum	N/A	0.1 lb/ac
Red Clover*	Trifolium pratense	N/A	0.1 lb/ac
Hoary Vervain	Verbena stricta	N/A	0.5 oz/ac

* Transition species to be planted in the outer 5 feet of buffer to blend into existing landscape.

Full Shade

Bank and Slopes

Sideflowering Aster	Aster lateriflorus	18-24"	0.25 lb/ac
Gray Sedge	Carex amphibola	18-24"	N/A
Common Wood Sedge	Carex blanda	18-24"	N/A
Fowl Manna Grass	Glyceria striata	18-24"	0.25 lb/ac

Non-Stabilizing Decorative Plants

Jack-in-the-Pulpit	Arisaema triphyllum	10'	N/A
Green Dragon	Arisaema dracontium	10'	N/A
Turtlehead	Chelone glabra	10'	N/A
Shooting Star	Dodecatheon meadia	10'	N/A
Spotted Jewelweed	Impatiens capensis	10'	N/A
Cardinal Flower	Lobelia cardinalis	10'	N/A
Virginia Bluebells	Mertensia virginica	10'	N/A
Solomon's Seal	Polygonatum Canaliculatum	10'	N/A
Ostrich Fern	Pteretis pennsylvanica	10'	N/A
Swamp Buttercup	Ranunculus septentrionalis	10'	N/A

Not Recommended

Box Elder	Acer negundo
Garlic Mustard	Allilaria officinalis
Tartarian Honeysuckle	Loicera tatarica
Reed Canary Grass	Phalaris arundinacea
Common Buckthorn	Rhamnus cathartica
Glossy Buckthorn	Rhamnus frangula
Multiflora Rose	Rosa multiflora

Exhibit 1102b (continued): Plant species for vegetative Stabilization (Source: DuPage County Streambank Stabilization Program)

Installation

- Site Preparation
 1. Selected vegetative stabilization measure should be compatible with improvements planned or carried out by others.
 2. Protective measures should be started at a stabilized or controlled point on the stream and extended to a stabilized or controlled point downstream.
 3. The grade of the channel must be controlled, either by natural or artificial means, before any vegetative measure can be used, unless live stakes can be installed below the anticipated depth of the bottom scour.
 4. The substrate should have enough silt and clay material to maintain adequate moisture and nutrient supply, and sufficient pore space to permit root penetration. The bulk density should be 1.2-5 grams per cubic centimeter. Clay content should not exceed 35%.
 5. Soil depth appropriate for plant growth should be at least 12", except where adding soil material is not feasible because of steep grades.
 6. pH should be in a range between 5.5 and 6.5.
 7. Substrate should be free of toxins harmful to plant growth.

- Seedbed Preparation
 1. Apply fertilizer or other required amendments prior to final seedbed preparation.
 2. Prepare seedbed to a minimum depth of 3" by disking or other means. All tillage should follow the contour of the land.

- Seeding/Plugs (Exhibit 1102b)
 1. All permanent seed mixes should be installed with a rangeland drill seeder. Temporary mixes may be applied with a drill seeder, cultipacker, or a hydraulic sprayer. Hydro seeders are also good for larger areas.
 2. All seed, if possible, should be certified for viability.

- Timing
 1. Dormant seedings should take place between Dec. 1-Feb. 28 (north of U.S. 40), Dec. 10-Jan 15 (south of U.S. 40).
 2. Permanent seedings should take place between March 1 and September 30. Permanent seeding done between May 10 and August 10 may need irrigation.
 3. Temporary seeding should take place between March 1 and April 15 (oats), September 15 to October 30 (cereal rye and wheat), and March 1 to May 1 or August 1 to September 1 (perennial ryegrass).
 4. Plugs should be installed during spring.

Special Considerations

- Use of native species is always preferable to invasive introduced species such as Tall Fescue. However, the use of such species is sometimes inevitable where immediate and effective erosion control is essential. Indiana Erosion Control Handbook includes the listing of more traditional permanent seeding species applicable to many of these situations.
 - All seedings should be protected with stabilization methods during the period of establishment (Practices 1101, 1103, and 1104).
 - A listing of vendors who regularly carry native species noted in Exhibit 1102b may be obtained from the U.S. Fish and Wildlife Service.
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MAINTENANCE

- Areas of inadequate cover after dormant seedings should be reseeded with a temporary or permanent matrix after mid- to late-April.
 - Areas seeded with a permanent or temporary matrix should be fertilized as necessary. Damaged, eroded, bare, or sparsely covered areas should be repaired and reseeded.
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REFERENCES

Related Practices

- Practice 1101 Mulching.
- Practice 1103 Bonded Fiber Matrix.
- Practice 1104 Erosion Control Blankets and Matting.
- Practice 1201 Wetland Replacement.
- Practice 1202 Stream Environment Enhancement.
- Practice 1204 Tree Replacement.

Other Sources of Information

- Indiana Erosion Control Handbook.
 - DuPage County Streambank Stabilization Program.
 - NRCS Standard Specifications.
 - COE Engineering Manual.
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PRACTICE 1103 BONDED FIBER MATRIX

- DESCRIPTION**
- Continuous matrix of elongated wood strands held together by a water-resistant bonding agent.



Exhibit 1103a: Bonded Fiber Matrix (Source: Weyerhaeuser Products Brochure)

PURPOSE	<ul style="list-style-type: none"> ● To prevent erosion and enhance germination.
WHERE APPLICABLE	<ul style="list-style-type: none"> ● Usually on very steep slopes. ● Areas where access prohibits installation of more traditional erosion control methods.
ADVANTAGES	<ul style="list-style-type: none"> ● Holds on near-vertical surfaces. ● Reduces labor requirements. ● Provides immediate, temporary surface stabilization. ● Provides immediate erosion and water quality benefits. ● Reduces soil crusting. ● Conserves moisture and increases seed germination and seedling growth. ● Usually incorporated with fertilizer and a seed mix.
CONSTRAINTS	<ul style="list-style-type: none"> ● Not recommended on sandy soils. ● Not recommended for areas of high concentrated flows. ● Requires special training and a hydraulic applicator.
DESIGN AND CONSTRUCTION GUIDELINES	<p>Materials</p> <ul style="list-style-type: none"> ● 3,000-4,000 pounds of bonded fiber matrix per acre. ● Approved hydraulic applicator.

Installation

- Should be installed according to manufacturers recommendations by a certified contractor.
- Spray apply at a minimum of 3,000-4,000 pounds per acre using standard hydraulic seeding equipment. Material should be sprayed in successive layers to achieve 100% coverage of all exposed soil.

Special Considerations

- Should not be applied immediately before, during, or after rainfall.
 - Material should have 24 hours to dry prior to any rain event.
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MAINTENANCE

- Inspect for erosion after each storm event during vegetation establishment. Reapply as necessary.
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REFERENCES**Related Practices**

- Practice 1101 Mulching.
- Practice 1102 Vegetative Stabilization.
- Practice 1104 Erosion Control Blankets and Matting.

Other Sources of Information

- Weyerhaeuser Products Brochure.
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PRACTICE 1104

EROSION CONTROL BLANKET

- DESCRIPTION**
- Biodegradable organic or synthetic mulch incorporated into a polypropylene or similarly netting material. (Note: this practice is also included in the Indiana Erosion Control Handbook.)



Exhibit 1104a: Erosion Control Blanket (Source: CBBEL Files)

PURPOSE	<ul style="list-style-type: none"> ● To prevent erosion.
WHERE APPLICABLE	<ul style="list-style-type: none"> ● Usually on slopes or in areas of concentrated flow. ● Area with high potential for erosion.
ADVANTAGES	<ul style="list-style-type: none"> ● Provides temporary surface stabilization. ● Provides immediate erosion and water quality benefits. ● Reduces soil crusting. ● Conserves moisture and increases seed germination and seedling growth. ● Applicable in areas of concentrated flow and steep slopes (where mulch alone often fails).
CONSTRAINTS	<ul style="list-style-type: none"> ● Expensive.
DESIGN AND CONSTRUCTION GUIDELINES	<p>Materials</p> <ul style="list-style-type: none"> ● Organic (straw, excelsior, coconut fiber, etc.) or synthetic mulch material incorporated into a polypropylene or similar netting. Material may be biodegradable, photodegradable, or permanent. <p>Installation</p> <ul style="list-style-type: none"> ● Select type and weight of blanket to fit site conditions (e.g. slope, channel, flow velocity). ● Install necessary erosion control devices. ● Grade site as specified on plans. ● Add topsoil where appropriate.

- Prepare seedbed, fertilize, and seed immediately after grading.
- Lay blankets on seeded areas following manufacturers directions. Blankets should be laid so they are in continuous contact with the soil, and upslope or upstream ones should overlap the lower ones by at least 8".
- Tuck the uppermost edge of the upper blankets into a check slot (slit trench) and backfill with soil. Tamp down.
- Anchor blankets as specified by the manufacturer. This usually involves driving 6"-8" wood or metal staples into the ground in a pattern determined by site conditions. Wood staples are preferable to metal staples. Wood staples will swell and hold better.



Exhibit 1104b: Proper installation of erosion control blankets in a drainageway
(Source: Indiana Erosion Control Handbook)

Special Considerations

- Maximum life varies with material.
- Poor contact between the soil and the blanket resulting from improper stapling, or not using check slots, may cause water to flow under the blanket.

MAINTENANCE

- Inspect for erosion after each storm event during vegetation establishment.
- If any areas show erosion, pull back that portion of the blanket, add soil, re-seed, and re-lay and staple the blanket.
- Check area periodically after vegetation establishment.

REFERENCES

Related Practices

- Practice 1101 Mulching.
- Practice 1102 Vegetative Stabilization.
- Practice 1105 Bonded Fiber Matrix.

Other Sources of Information

- Indiana Erosion Control Handbook.
 - NRCS Standard Specifications.
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