

Soil Erosion Control

Vegetative Methods



Description

Vegetative stabilization is the process of establishing vegetation on a construction site to prevent erosion. The first step in erosion control on construction sites is to limit vegetation clearing. The next step is to reestablish vegetation as quickly as possible. This practice should be applied to all exposed soils that would not be otherwise permanently stabilized with structures. For example, cut and fill slopes, soil stock piles, dikes, denuded landscapes, and vegetated waterways.

Temporary seeding of annual grasses like oats or rye provides erosion control on areas in between construction operations. Grasses which are quick to germinate are seeded and mulched to provide prompt, temporary soil stabilization. Seeding effectively minimizes the area of a construction-site prone to erosion and should be used everywhere the sequence of construction operations allows vegetation to be established. Annual grasses such as oats, annual rye and winter wheat are recommended for use in Minnesota.

Vegetation Stabilization and Function

Vegetation protects soil from erosion by raindrops, runoff, water currents and wind. Plants decrease the amount of rainfall directly impacting the ground surface by intercepting and holding a portion of the water on the leaves and stems. As vegetation is removed and soil is compacted by construction equipment, the volume of runoff increases. Runoff volumes in undisturbed vegetated areas are typically between 10 to 20 percent of the average annual rainfall. In urban areas, where surfaces are highly impervious and soils are compacted, typical runoff volumes are 60 to 70 percent of the average annual rainfall.

Runoff velocities are decreased as water flows over stalks, stems, branches and foliage. Shrub species such as sumac, grey dogwood, wild rose, fragrant sumac and hazelnut are most effective in preventing erosion because of their dense, low, spreading growth pattern.

Purpose

	Water Quantity
Flow attenuation	<input type="checkbox"/>
Runoff volume reduction	<input type="checkbox"/>
	Water Quality
Pollution prevention	
Soil erosion	<input type="checkbox"/>
Sediment control	<input type="checkbox"/>
Nutrient loading	<input type="checkbox"/>
Pollutant removal	
Total suspended sediment (TSS)	<input type="checkbox"/>
Total phosphorus (P)	<input type="checkbox"/>
Nitrogen (N)	<input type="checkbox"/>
Heavy metals	<input type="checkbox"/>
Floatables	<input type="checkbox"/>
Oil and grease	<input type="checkbox"/>
Other	
Fecal coliform	<input type="checkbox"/>
Biochemical oxygen demand (BOD)	<input type="checkbox"/>

<input type="checkbox"/>	Primary design benefit
<input type="checkbox"/>	Secondary design benefit
<input type="checkbox"/>	Little or no design benefit

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Vegetative cover will also modify the soil microclimate by reducing variations in soil and air temperature and moisture content, thereby reducing aggregate breakdown of the soil.

Root Systems

Plant root systems play a major role in the mechanical properties of soil by increasing soil strength and stability, and by increasing the porosity of soil porosity. Deep-rooted species are preferable for stabilizing soil and increasing resistance to sliding on slopes.

- Root networks are flexible linear reinforcements that hold soil particles in place, significantly increasing soil tensile strength and shear strength. Root systems tend to be self-repairing and -regenerating.
- Roots interweave to form dense, laterally spreading mats that effectively reduce soil erosion. Many field and laboratory tests have demonstrated the effect of root reinforcement on the shear strength of soils. These tests show that the shear strength of soils increases directly in relationship to the volume of roots in the soil.
- Roots of trees and ground covers generally grow horizontally in the top layers of the soil (2 to 3 feet). Roots of native grasses grow from 5 to 10 feet deep. Grasses, such as big bluestem, have fibrous roots reaching almost 6 feet deep and other native prairie grasses may reach as deep as 9 to 15.5 feet.
- Root channels settle out sediment by intercepting water. They also enhance infiltration.
- If soils are compacted, root depths will only reach to where oxygen is available. Gas exchange is essential for root growth. In general, plants do not *de*-compact soil.

Above-Ground Vegetation

- Evapotranspiration and interception by foliage moderate the buildup of soil-moisture stress. Vegetation also affects the rate of snowmelt, which in turn affects the soil moisture regime.
- Interception and transpiration by trees in a forest tends to moderate soils and mitigate or delay the onset of overly dry or waterlogged soil conditions.
- Conversely, clear-cutting or felling of selected trees tends to produce wetter soils, more erosion and runoff, and faster recharge times following intense rainstorms and during droughts.

Native Vegetation

Grasses introduced from Europe and Asia have traditionally been used to establish vegetative cover on construction sites in the Midwest. However, many experts are now specifying native grasses for critical area seedings. Although slower to establish, native species require less maintenance in the long run than nonnative species. They are also better for water quality because they do not require the fertilizer that introduced species require.

Native grasses will grow on poor soils because they can gain access to nutrients and water that shallower-rooted grasses cannot reach. Therefore, native grasses are desirable for stabilizing soils. See *Standard Specifications for Construction* (MnDOT, 2000) or *Lakescaping for Wildlife and Water Quality* (Henderson et al, 1999) for seed mixes and plant list, respectively. Native grasses establish somewhat slowly. Cover crops such as oats or winter wheat should be seeded with native grasses to provide short-term erosion control while they are becoming established. Wildflowers could be added to the seed mixes on many projects. Because they develop very deep root systems, native grasses and wildflowers provide very good long-term erosion control.

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Smooth brome

- Root system reaches 10-15 inches in depth.
- Plant height is 2-3 ft.

Kentucky bluegrass

- Root system reaches 6-8 inches in depth.
- Plant height is about 1 ft.

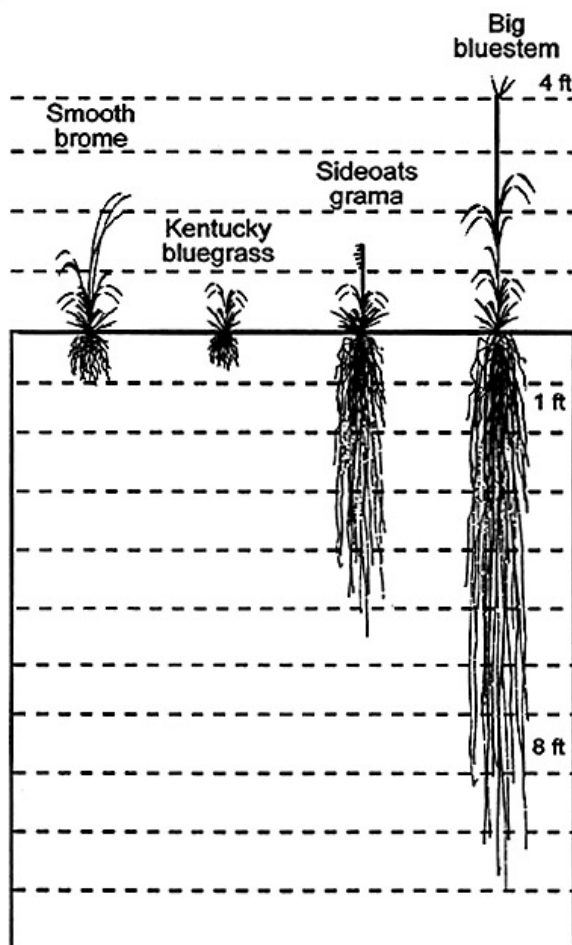
Grasses introduced from Europe and Asia have been traditionally used to establish vegetative cover on roadsides in the midwestern United States. However, many experts are now specifying native grasses for critical area seedlings.

While they establish quickly, introduced grasses frequently deteriorate when planted on poor soils. Often their sod opens up and weeds invade.

Introduced grasses may provide good erosion control under favorable soil and moisture conditions.

Introduced Grasses

Native Grasses



Sideoats grama

- Root system reaches to 5 ft in depth.
- Plant height is 12-18 inches.

Big bluestem

- Root system reaches down to 9 ft in depth.
- Plant height is 4-8 inches.

Because they develop very deep root systems, native grasses provide very good long-term erosion control. And, they will often grow on poor soils because they can gain access to nutrients and water that shallower rooted grasses cannot reach. Native grasses are therefore desirable for stabilizing soils.

Their drawback is that they establish somewhat slowly. Cover crops may be seeded with them to provide short-term erosion control while the native grasses establish. Mulching newly planted sites is also a good idea.

Figure 1

Source: MPCA, 2000

Mulching newly planted sites, with hydro mulch or straw, is also a good idea. Native plantings should never be fertilized, nor are soil amendments necessary, unless soils are compacted. If so, soils should be deep tilled or “ripped” to a depth of 18 to 24 inches, in addition to 6 inches of compost tilled in to a depth of 12 inches or more. This will allow for deeper root penetration.

Advantages

- Improvement in infiltration and water-retaining capacity of the soil.
- Reduction in the volume of stormwater runoff through evapotranspiration.

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Advantages (continued)

- Provision of shade and protection from wind.
- Induces the building of soil structure.
- Increased production, nesting and feeding habitat for birds, animals and insects.
- Reduction of air and water pollution, and reduction of urban heat island affect.
- Using plants whenever appropriate, rather than hard-surface materials, may reduce costs and maintenance and lead to a more self-sustaining landscape.
- Vegetation improves aesthetic and environmental values by providing a more natural cover to the soil, and at less expense than most structural methods.
- Plants enrich the character and diversity of the landscape by adding form, texture, harmony, color and contrast. They also can screen out unsightly views.
- Plants can heal the wounds of the land caused by erosion or human activity, blending construction with the natural landscape.
- Plants are self repairing and regenerating.
- Relatively inexpensive.
- Up to 99 percent erosion reduction, depending upon the situation.
- Adds value to both commercial and residential development sites.

Limitations

- Can not be implemented during off-season. When construction continues into the fall season, a heavy mulch application is preferable to vegetative stabilization.

Requirements

Design

A choice must be made whether vegetation will be established by seeding or sodding.

Seeding

- Selection of species for a specific site should be based on soils, moisture conditions, light levels, whether or not concentrated flows will occur, land use, and level of maintenance.
- Seeding has advantages including lower establishment costs, wide selection of seed mixes (both native and nonnative) and is easier to install on different sites.
- The use of seeding mixtures that includes native grass species should be considered for improving wildlife habitat and aesthetics.

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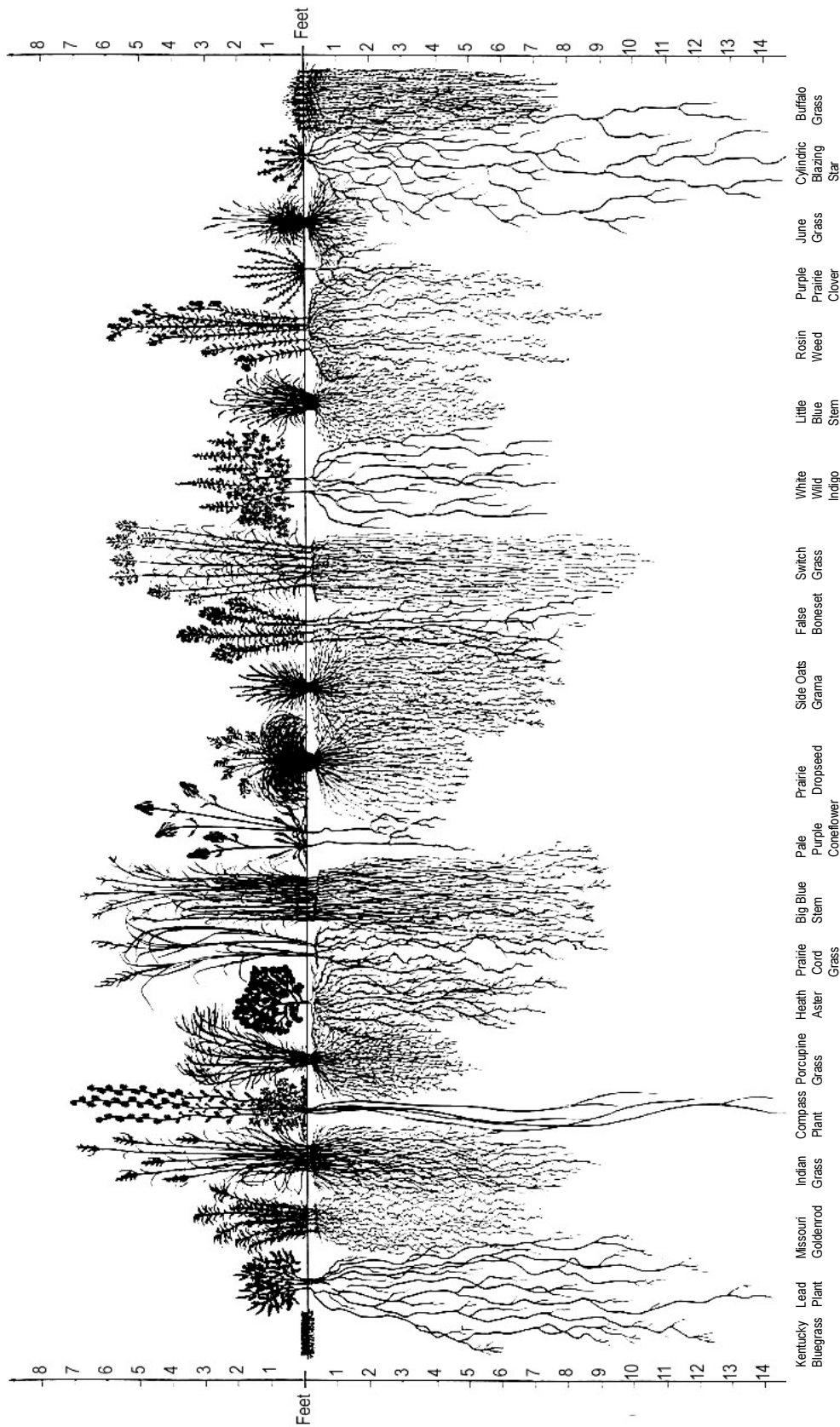


Figure 2
Source: Conservation Research Institute, 1995.

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Requirements

Design (continued)

- Seed should be applied uniformly with a cyclone seeder, drill or cultipacker seeder, or hydroseeder. When feasible, seed that has been broadcast shall be covered by raking or dragging and then lightly tamped into place using a roller or cultipacker. If hydroseeding is used, the seed and mulch must be applied in separate applications.
- Refer to MnDOT Standards (Sections 3861-3876) for seed mix types and specific planting information.

Sodding

- Sodding has advantages including immediate erosion control, reduced chance of failure, few weed problems and shorter time interval until site can be used.
- Sodding can be used for final landscaping and in drainageways, where high velocities would prevent grass seed from establishing.

Implementation

Two options available for establishing vegetation are seeding and sodding. Regardless of which technique is used, some basic requirements need to be met to ensure good vegetative establishment.

- In hydroseeding, often used on larger areas, seeds are mixed with water and fertilizer where necessary, and a fiber mulch is sprayed onto the soil in a second separate layer.
- Temporary seeding should be applied on exposed soil where additional work (grading, etc.) is not scheduled for more than 45 days. Temporary seedings of annual grasses may be used for up to 12 months to temporarily stabilize exposed areas. Soil amendments may be needed to establish vegetation on some construction areas.
- Permanent seeding should be applied if the areas will be idle for more than a year.
- Structural erosion and sediment control practices such as diversions and sediment traps shall be installed and stabilized with temporary seeding prior to grading the rest of the construction site.
- Idle areas should be seeded as soon as possible after grading or shall be seeded within 7 days. Several applications of temporary seedling are necessary on typical construction projects.
- The seedbed should be pulverized and loosened to ensure the success of establishing vegetation. However, temporary seeding should not be postponed if ideal seedbed preparation is not possible. Disturbed sites require seedbed preparation to loosen the soil surface for water infiltration and root penetration.
- Establishing nonnative planting sometimes requires a fertilizer application to initiate growth. Apply these nutrients according to soil test recommendations.

Soil Compaction

Most construction site soils become compacted. It is important that they are loosened before planting begins. Compacted soils should be deep tilled or "ripped" to a depth of 18 to 24 inches, or deeper if possible. Next, six or more inches of organic compost should be applied and tilled into the top 10 inches of soil.

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Maintenance

Seedings

- Seeded areas must be kept consistently moist for the first three weeks after planting. Mulch aids in retaining soil moisture.
- Areas seeded in nonnative grasses should be mowed once or twice a year to prevent establishment of woody plants.
- Native grass seedings should be mowed two to three times the first year at a height of six inches to reduce competition from annual weeds. They should be mowed once the second year, and burned or mowed every other year thereafter.

Sod

- Turf sod should be kept evenly moist for the first three weeks after being put down.
- After establishment, turf sod need not be watered during dry periods. It can be left to go dormant.
- Turf sod will likely need to be fertilized once yearly. Use an organic fertilizer, apply according to directions, and apply a week or two after Labor Day.

Sources

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