

## Ravine Stabilization

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**Document Purpose** – This fact sheet is a companion to BWSR's Native Vegetation Establishment and Enhancement Guidelines and provides detailed considerations for project planning and design with an emphasis on vegetation selection, installation and management.

**Introduction** – Stabilization of eroding ravines and bluff slopes often involves both engineering and re-vegetation strategies and plans. In addition to reducing sediment loss, restoration of severely eroded areas often provides important water quality and wildlife habitat benefits. Thorough analysis of watershed and site conditions is needed to identify appropriate restoration strategies.

**Site Selection** – Ravine restoration projects are often selected based on identified threats to human safety, infrastructure, homes, and impairment of water quality. When multiple eroding ravines are being assessed for water quality projects, potential sediment reduction, cost-effectiveness and long-term sustainability are important considerations.

**General Planning Considerations** – Uncontrolled stormwater runoff is the biggest source of ravine and slope erosion, making it important that sources of water from agricultural fields and developed areas be managed with appropriate best management practices (such as vegetated swales, raingardens, biofiltration, and stormwater detention) before slopes are restored to ensure their long-term stability.

**Structural Design Considerations** – Engineering solutions often involve re-grading to decrease the angle of slope, stabilization of the toe slope, as well as a variety of solutions to manage water flow including terraces, swales, pipes and check dams. Early successional and shallow rooted trees such as elm, boxelder, ash, cottonwood and buckthorn are sometimes removed from the edges of ravine restoration projects to allow access of earth moving equipment and to allow sufficient light levels to promote seedling germination and growth, but tree removal should be limited to the extent possible to prevent further erosion.

**Plant and Seed Selections** – A combination of fast establishing species, and species that will persist into the future are needed for slope stabilization. Deep rooted plants are also needed to promote future slope stability. Native legumes that add nitrogen and promote plant growth are also commonly planted and can have an added benefit of supporting pollinators. For severely eroding slopes, non-native legumes such as red clover and alfalfa that establish quickly and have deep root systems are sometimes used in combination with native species to add nitrogen and anchor the slope with deep roots, though the proportion of these species should be carefully considered in mixes to ensure that they do not out-compete native species that are planted. In many cases, these non-native species will decrease



Eroding ravine following flooding in northeast Minnesota

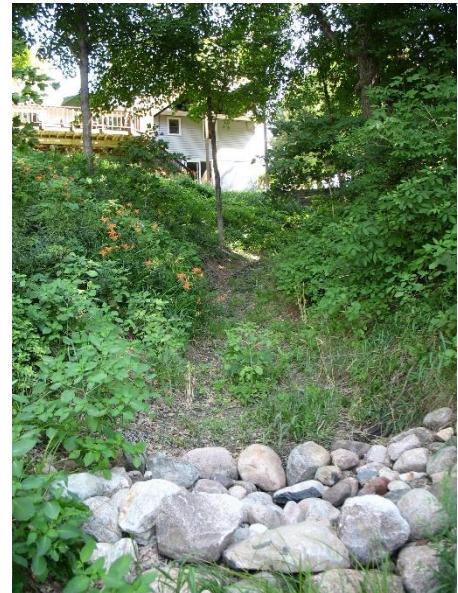
in abundance as woody plants establish in ravines or riverbanks. Many trees and shrubs can play an important role in providing slope stability. Species with tap roots such as bur oak, hickory, pines and walnut can be effective at anchoring slopes. Species such as willow and dogwoods that establish from cuttings can also be used as part of bioengineering methods (branch packing, brush layering, brush mattress, live fascines, live stakes, etc.) but rooting of these species will be most successful in areas where soils stay saturated for most of the growing season.

### Commonly Used Native Species for Ravine Stabilization

<b><i>Cover Crops</i></b>	Oats ( <i>Avena sativa</i> ), Winter wheat ( <i>Triticum aestivum</i> )
<b><i>Fast growing native grasses and forbs:</i></b>	Side oats grama, Fringed brome, Nodding wild rye, Slender Wheat grass, Virginia wild rye, Fowl bluegrass,
<b><i>Long lived deep rooted native grasses and forbs:</i></b>	Big bluestem, Indian grass, Switch grass, Little bluestem, Hairy grama, Blue grama, Western wheat grass, Prairie dropseed
<b><i>Native legumes:</i></b>	Canada milk vetch, Partridge pea, American vetch, Prairie clovers, Lupine
<b><i>Deep rooted native trees and shrubs:</i></b>	Bur oak, White Oak, Northern pin oak, Red oak, Walnut, Butternut, Hickory, Red oak, Basswood, Pines, Ironwood, Blue beach, Hazelnut, Paper birch, Hackberry, Hawthorn, Red cedar, Black cherry, American basswood
<b><i>Plants that establish from cuttings:</i></b>	Dogwoods, Willows, Viburnum

**Plant Source Considerations** – The source sequence included in this guide is recommended for slope stabilization projects, particularly if perennial species are planted near natural communities. Source is less of a concern for short lived cereal grains, and native cover species that are used for stabilization, such as wild ryes and slender wheatgrass.

**Vegetation Establishment** – Slopes may be heavily compacted after the earthwork is completed, requiring loosening of compaction a few inches deep where possible with light disks, tillers, and harrows to allow for the establishment of vegetation from seed. A variety of methods may be used to plant steep eroding slopes, including hydroseeding, broadcast seeding, tree planting, and promoting natural succession. Erosion fabrics are often used in combination with seeding to prevent erosion, ensure good seed to soil contact, prevent the loss of seed, suppress weeds and maintain soil moisture. Upland portions of restored slopes are typically broadcast or hydroseeded, as are slopes too steep for drill seeding. Seed to soil contact is very important for successful establishment, so the use of rollers or erosion control fabric to cover seed will aid establishment. Seed should be applied to the steepest slopes with water followed by the application of a tackifier to aid seed to soil contact. Trees and shrubs are commonly planted into slopes (in areas where trees and shrubs would have historically occurred) to aid stabilization and establishment. It is important to loosen compaction in planting holes as trees and shrubs are planted to allow their roots to spread.



Ravine stabilized with stone, seeded grasses and flowers and planted shrubs

**Operations and Maintenance** – Upland portions of plantings may be mowed with mechanical or hand-held equipment during the first couple of years to suppress annual and biennial weeds and promote seedling growth. Hand weeding can be conducted for smaller patches of weeds. Spot herbicide treatment may be used for perennial non-native plants, but it is important that aquatic safe herbicides be used near water. Supplemental watering may be needed for seeding herbaceous and woody plants. A water truck with a fine spray nozzle may be needed to apply water from the top of the slope.

**Information Sources –**

Slope and Site Stabilization <http://www.pca.state.mn.us/index.php/view-document.html?gid=7421>  
A Soil Bioengineering Guide for Streambank and Shoreline Stabilization [www.fs.fed.us/publications/soil-bio-guide/](http://www.fs.fed.us/publications/soil-bio-guide/)  
Restore Your Shore <http://www.dnr.state.mn.us/restoreyourshore/index.html>