A Beginners Guide to Shoreline Ecological Restoration:

Points on Soil Stabilization and Native Plant Revegetation

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1 Mulch

Mulch is a non-living material spread over the soil surface to provide protection from surface erosion by rain and retention of soil moisture. Various types of mulches are available in the form of straw, grass fibers, wood fibers, seaweed, and paper products. Proper timing of seeding may alleviate the need for mulching.

WOOD-FIBER AND PAPER-FIBER MULCH are used in hydroseeders with mechanical agitation. They provide a relatively inexpensive mulch for critical sites.

SOIL REINFORCEMENT NETTING AND MATTING provide mechanical support to surface soils and may act as a mulch. Various products include jute netting, plastic netting, vexar netting, nylon filament matting, wood fiber matting, and straw matting. Biodegradable mattings break down over a few years adding organic matter to surface soil, while non-biodegradable products do not. Non-biodegradable products remain on and within the soil surface and act as a support matrix for intertwined vegetation roots. Reinforcement materials are most effectively used for specialized erosion control on prepared slopes as a slope blanket or as a ditch liner.

2 Shrub Establishment

Shrub species selected for use must be indigenous to the area, easily propagated, adaptable to the site, and must be able to produce the desired characteristic (tall or short, browse resistant, deep rooting). Survival rate for planting of unrooted cuttings is 50-70% and rooted cuttings is 90%, provided proper species selection and time of planting are observed.

Direct planting of Populus and Salix unrooted cuttings

VEGETATION REQUIREMENTS:

- use dormant native plant's previous season's growth
- must have clean cuts with unsplit ends
- must be straight, healthy and robust

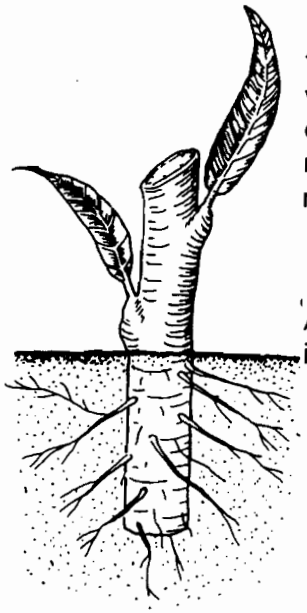
CUTTING PROCEDURES:

- cut with a sharp knife or good quality shears
- avoid the terminal top 10 cm
- keep length of 15-20 cm or more
- ensure mid-stem diameter is 2 cm minimum
- maintain at least two healthy buds

PLANTING PROCEDURES: Plant in late autumn, in early winter after buds have set (full dormancy), or in spring after snowmelt when moisture stress is low. Planting densities are based on the desired frequency: randomly at selected planting sports; in a grid pattern on a 1 m x 1 m spacing; or with a high plant density in linear rows spaced 2-10 m apart.

PLANTING DEPTH: Plant cuttings with as little stem exposed as possible, but still showing at least two buds above ground. A cutting must be firmly planted so that it cannot be readily moved or pulled out. Roots will form along the planted portion of the stem.

Planting of live plants: container or bare-root



LIVE PLANTS propagated from cuttings or seed permit the planting of a wider range of shrub species for erosion control. Plants can be grown by commercial nurseries as container and bare-root stock.

A list of native Alberta species is attached

PLANTING PROCEDURES: Plant live plants during the **dormant** season, October to March (this may be extended into May-June if moisture stress is not a limiting factor). Frozen ground prevents successful planting in northern latitudes during much of the dormant season.
TAKE PRECAUTIONS to prevent plants from drying out prior to planting.
THE PLANTING SYSTEM will depend on species selection and density desired (random, grid, or linear planting).

3 Vegetative Methods for Slope Protection and Stabilization

Vegetation protection techniques use live or dead plant parts (stem and branches) which are inserted, driven or buried in the ground to control erosion, minimize shallow sliding, protect erosion control structures, and provide a favorable environment for establishing a permanent vegetative cover. Poplar, willow and red osier dogwood are successfully used. These techniques include:

LIVE STAKING
CONTOUR WATTLING
CONTOUR BRUSH LAYERING

Live staking

PERSISTENT WET AREAS on road cut and fill slopes, and on bare soil surfaces in slumps and earth flows are suitable sites.

FLOORS AND BANKS of small incipient gullies, sediment fill behind check dams, bare gully banks, berms of water bars, and areas just below water-bar outlets.

POROUS REVETMENTS can use live stakes inserted or driven through the interstices or openings in gabions and riprap. This may also help to blend the wall into the landscape.

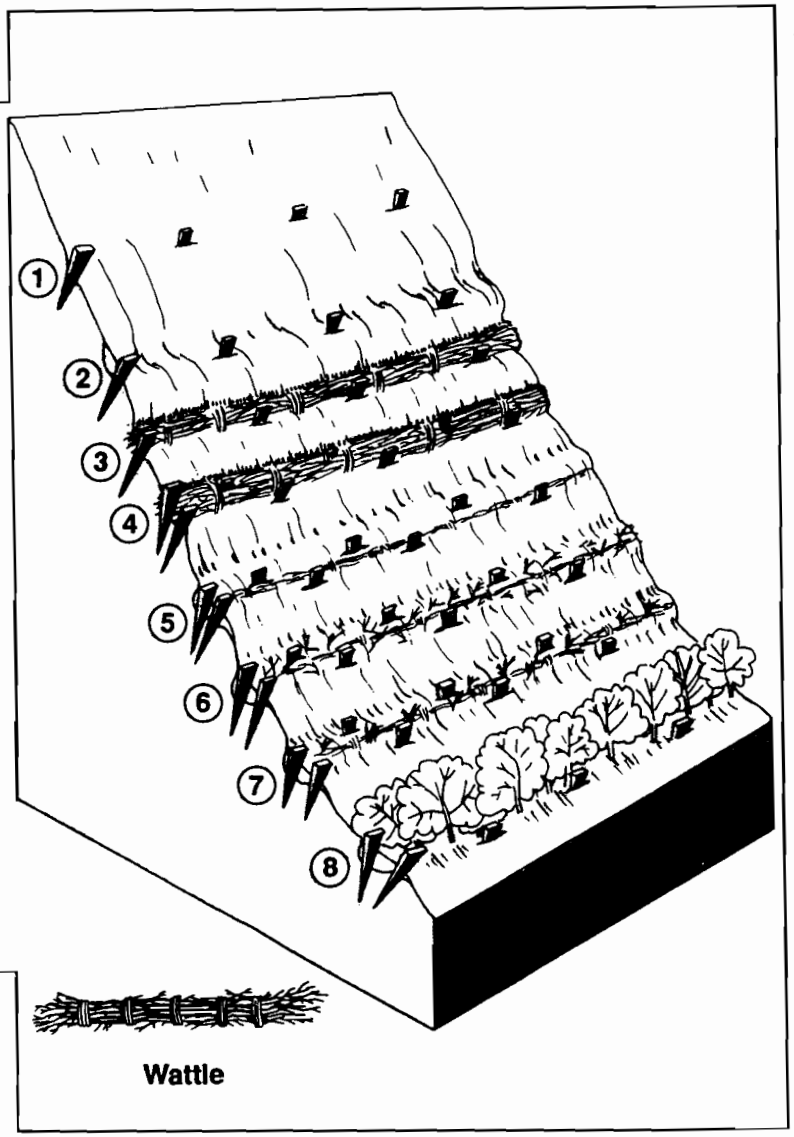
Wattling

Wattling consists of placing bundles of flexible interwoven live branches (the wattle) which root easily, into shallow trenches along consecutive horizontal or diagonal rows on an embankment (cut or fill slope). The wattle stabilizes soil layers (this stabilization effect results from the combined effect of the wattle bundle and stakes), and promotes vegetation establishment. Wattling is most effective on loose surface soil exhibiting sheet or small gully erosion.

WATTLING INSTALLATION

INSTALL WATTLES from the bottom to the top of the slope, spacing them 3-10 m apart. Actual distance apart must be determined on a site-specific basis. The more erodible a slope, the closer the wattles are spaced.

1. **STAKE ON CONTOUR,** using an Abney or Sunto type level. Contour staking is of particular importance on wide slopes with erodible soils. Stakes should be about 40-60 cm long, and driven to a firm hold.
2. **TRENCH ABOVE** the stakes to one-half the diameter of bundles. Material dug from the trench should be wasted downslope to cover lower wattles.
3. **PLACE BUNDLES** in the trench.
4. **STAKE THROUGH THE BUNDLES** close to bundle ties.
5. **COVER THE BUNDLE** with soil and tamp the soil firmly into place. Walk along bundles to add additional tamping.
6. **COMPLETED** wattling resembles a slight terrace with twigs (7-10 cm) protruding along the downslope side.
7. **PARTIALLY BURIED AND STAKED BUNDLES** protect against erosion.
8. **WATTLES ROOT AND SPROUT,** further protecting and stabilizing the slope.



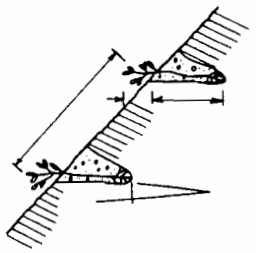
Wattle

Brush layering construction

Brush layering consists of embedding live branches on successive horizontal rows along contours on the face of a slope. Rooted plants can also be placed among the live branches. The technique is useful for rehabilitating eroded slopes and gullies and for stabilizing fills and embankments during construction.

CONTOUR BRUSH LAYER CONSTRUCTION

- **UNDERTAKE SLOPE PREPARATION,** drainage control and toe wall construction where required.
- **BEGIN WORK** at the bottom of the slope.
- **DIG TERRACES** 50-100 cm wide, manually or with machinery.
- **SPACE TERRACES** about 1 m on steep slopes.
- **ENSURE TERRACES** slope up at least 10°.
- **ENSURE BRANCHES** are at least 1 m long with a mixture of different ages, species thicknesses and length. Branches 2-5 m in length are more effectively used in constructed fills or embankments.
- **PLACE BRANCHES** along the terrace in a crosswise fashion, with only one-quarter to one fifth of their length protruding.
- **PLACE ROOTED PLANTS** 0.5-1.0 m apart among the layer of branches.
- **IN NON-COHESIVE SOILS,** prepare short terrace segments. This helps prevent ditch collapse and soil drying.
- **BACKFILL THE TERRACE DITCH** with material dug for the terrace above.
- **INTERPLANT WITH** shrubs and grass-legume seed.



WATTLE BUNDLE PREPARATION

- **A WATTLE** resembles a cigar-shaped bundle of alternating live branches that root easily, with slender tips extending 40 cm beyond the larger butt ends.
- **BRUSH STEMS** are 5 cm or larger in diameter; 1 m and longer in length (approximately 3 m long is best)
- **THE BUNDLE** is compressed to approximately 20 cm in diameter and tied every 30-40 cm.

SITE SURVEY USE

- **TO DETERMINE** the need for slope preparation.
- **TO DETERMINE** location of suitable plant materials (*Salix* or *Populus* spp.).

SLOPE PREPARATION

- **CONSTRUCT** or repair water drainage structures and ditches.
- **UNDERTAKE** slope rounding or scaling of failing materials.

4 Gully Stabilization

Gullying is the process of stream downcutting, deepening and widening of the channel, and headcutting or headward extending of the channel. Vegetation removal and increased water flows tend to be major factors contributing to gully destabilization. The main cause for gullying along forest roads can generally be traced back to blocked culverts, inadequate cross drains, or run-off permitted to spill unprotected over cut-banks and fill-slopes. These gully erosion problems, if acted upon immediately, can be stabilized with simple low-cost methods using local materials such as rocks, sandbags, boards, logs and logging slash.

Large V-notch gullies, conduits for debris torrents, become increasingly active after timber removal in headwall areas and along channel sidewalls. Once the triggering effect of debris slide and torrent activity occurs in steep gradient V-notch gullies, the gullies remain destabilized for extended periods of time. Torrent control and vegetation re-establishment in these gullies become sophisticated and costly. Control measures are justified in populated areas, but in the forest environment simple seeding with grasses and legumes is all that can be accomplished to help reduce sedimentation and to aid the natural process of revegetation and eventual pseudo-stabilization.

The goal of gully stabilization is to reduce channel downcutting and headward extension. Vegetation established in the channel and along the sidewalls provides the most permanent control–the long-term solution. Effective gully control is best accomplished using simple "temporary" structures designed for the site, combined with a combination of revegetation techniques.

GULLY STABILIZATION PROCEDURES
ASSESS THE WATER SOURCE. Correct water drainage problems, install adequate road drainage, and redirect water into its natural drainage basin or into stable drainage channels.
DESIGN SIMPLE STRUCTURES. Use local materials, coarse rock, logs, brush, logging slash, sandbags or boards.
CONSULT DESIGN SPECIALISTS for complex problem gullies. Design must consider expected storm flow, slope gradient, and soil erodibility. Designed structures must dissipate energy (water flow), reduce channel downcutting and lateral stream movement, cause suspended material deposition, and permit vegetation re-establishment.
INSTALL A ROCK BLANKET to armor a stream channel and protect the complete wetted perimeter. Rocks must be of sufficient size to stay in place during storm flows.

Simple Gully Stabilization Techniques

Three gully stabilization techniques have been effective in controlling erosion. These include:

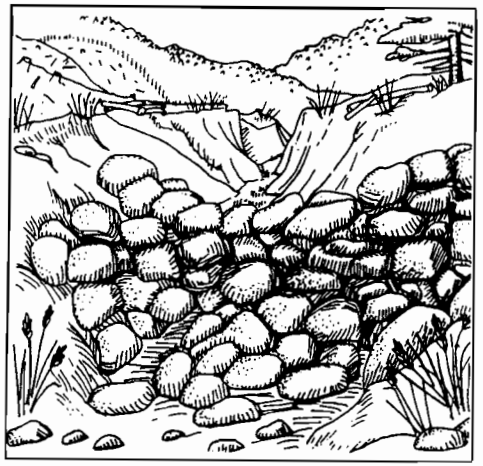
CHECK DAMS
WATER LADDERS
WATER FLUMES

Check Dams

Check dams are most effective on gentle to moderate sloping channels. Considerable design variations do exist, but simple check dam designs with rock, brush and boards should not exceed an effective dam height greater than 1 m.

Rock size in a loose rock check dam must resist displacement from storm flows. In general, large peak flows require large rock. Effective rock gradation at storm flows of less than 1 m^3/sec constitute the following size classes:

- 10-15 cm (25%)
- 15-19 cm (20%)
- 20-30 cm (25%)
- 31-24 cm (30%)

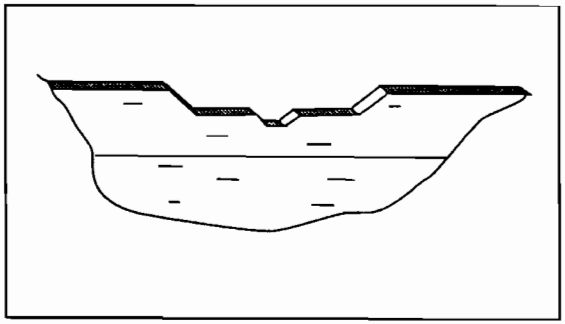


Loose rock check dam

Loose rock can be reinforced with wire, wire mesh, steel posts, and other materials. This reinforcement provides flexibility and strength in the dam to withstand pressures exerted by flows and rocks. Reinforced check dams must follow design specifications. The simple rock structures are not meant for torrent control.

Check dam spacing depends on channel slope gradient. When gully gradient increases, decrease spacing by using additional dams and/or by increasing the height of the dams. (Refer to Chapter 3 for details).

BOARD CHECK DAM INSTALLATION
USE BOARD CHECK DAMS in shallow gullies 1 m or less in depth.
CONSTRUCT DAMS from boards, logs or plywood one or two boards high.
KEY OR INSET the boards or logs in the gully bank and channel a minimum of 25% of the width or depth of the dam to prevent breaching.
STAKE THE BOARDS on the downstream side for additional support.
CUT AN ADEQUATE SPILLWAY NOTCH to accommodate high flows (leave 20 cm minimum distance from the notch to the bank) and low flows (10 cm deep and 15 cm wide).
PLACE ENERGY-DISSIPATING MATERIALS of rock, brush or debris below the spillway and firmly secure to the channel bottom. This apron should extend out from the spillway 30 cm to the next check dam.
REVEGETATE THE SITE with grasses and shrubs.



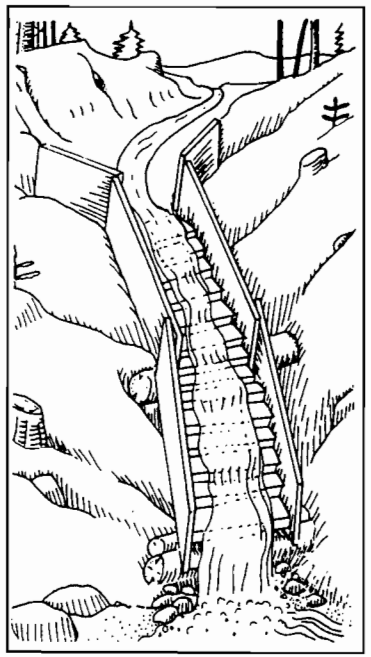
Board check dam

Water Ladder and Water Flumes

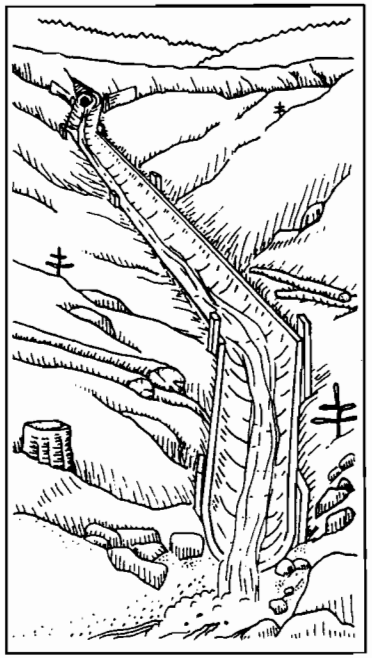
A water ladder is a stair-stepped wooden structure constructed as a staircase flume. A water flume is an analogous structure assembled with half-round metal pipe or half-box to carry water in a chute. Baffles can be added to help dissipate energy.

Water ladders and flumes are most effectively used to direct small volumes of water over steep erodible slopes, to arrest or prevent headward erosion. They are particularily useful when slope gradients are too steep for rock blanket armoring or check dams (cut banks and fill slopes).

When using water ladders or flumes, direct all water into the structure in order for it to function effectively. Wing walls of boards or rock and soil are essential to adequately contain flood flows.



Water ladder



Water flume

Select Native Plant Species of Alberta appropriate for Shoreline Restoration

Latin name	Common name	Plant form	Comment / Note
Populus balsamifera*	**Cottonwood**	Tall tree	Annual period of inundation
Betula payrifera	**Paper birch**	Medium tree	Well-drained moist soils
Larix laricina	Larch	Tall tree	Rich-well drained sites
Picea mariana	Black spruce	Tall tree	Wet – dry sites, poorly drained
Salix species*	**Willow species**	Low – tall shrub	Moist - wet soils
Cornus stolonifera	**Red-osier dogwood**	Med shrub	Moist rich soils
Alnus rugosa	**River alder**	Med shrub	Wet soils, well drained
Rosa acicularis*	**Wild rose**	Low shrub	Dry – wet soils
Betula occidentalis	Water birch	Tall shrub	Moist – wet soils, poorly drained
Myrica gale	Sweet gale	Low shrub	Moist – wet soils
Amelanchier alnifolia	Saskatoon	Low – tall shrub	Moist well-drained soils
Prunus pensylvanica*	**Pin cherry**	Med – tall shrub	Well drained moist soils
Ribes species	**Currant species**	Low – med shrub	Moist soils
Lonicera involucrate	Bracted honeysuckle	Low shrub	Moist – wet soils
Vaccinium species	**Blueberry species**	Low shrub	Moist – wet soils
Rubus idaeus*	Wild raspberry	Low shrub	Moist soils
Ledum groenlandicum	Labrador tea	Low shrub	Moist – wet, nutrient poor acidic soils

Notes:

1. Bolded text species are easy to collect and propagate.
2. Underlined species produce berries good for attracting birds and other wildlife.
3. Species with an asterisk (*) suffix are early colonizers, easiest to plant in heavily disturbed sites.
4. Generally try to plant more than 30% berry producing species.

List prepared by Sheldon Helbert. [redacted]