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.
4.3.11 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

<table>
<thead>
<tr>
<th><strong>ASSESS THE WATER SOURCE.</strong> Correct water drainage problems, install adequate road drainage, and redirect water into its natural drainage basin or into stable drainage channels.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DESIGN SIMPLE STRUCTURES.</strong> Use local materials, coarse rock, logs, brush, logging slash, sandbags or boards.</td>
</tr>
<tr>
<td><strong>CONSULT DESIGN SPECIALISTS</strong> 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.</td>
</tr>
<tr>
<td><strong>INSTALL A ROCK BLANKET</strong> to armor a stream channel and protect the complete wetted perimeter. Rocks must be of sufficient size to stay in place during storm flows.</td>
</tr>
</tbody>
</table>

## 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 m³/sec constitute the following size classes:

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

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](image)

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**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 particularly 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.
When constructing flumes or water ladders, install energy dissipators, such as rock, debris and vegetation, at the flume outlet to prevent channel erosion. Water ladders and flumes can be constructed from locally available materials: boards, logs, flume culverts. It is important to revegetate the site with grass and shrubs following construction.
APPENDIX 1. General hydraulic seeder mixing instructions

1. Mulch must be used only in the proper equipment. Mulch cannot be used in hydroseeders providing only hydraulic agitation and should only be used in units equipped with strong mechanical agitation. Mulch is applied during the seeding operation or on a second pass, after the seeding operation is completed. Area coverage per tank is reduced by one-half.

2. Mixing requirements and application rates for binders and mulches are product- and equipment-specific. Always refer to the manufacturer’s operating instructions.

3. Begin filling the tank with water, under continuous agitation, and add the fertilizer.

4. Start feeding in the soil binder (or mulch). As the tank continues to fill, agitator must be in operation. Slowly add the binder or mulch to avoid lumps.

5. Add the seed last, under continuous agitation.

6. After the tank is full and all materials are added—and before spraying starts—agitation should continue for at least 10 minutes to ensure mixing occurs to a uniform suspension.

7. The nozzle should be operated in a fan-like motion when the slurry is applied, so the material falls gently on the ground surface.

8. Completely flush the tank and pump with clean water after use.

Helicopter hydroseeding application

1. Test-run with water in the seeding bucket to ensure proper application rate. Make sure proper tools are available for adjusting the seed bucket orifice.

2. The hydroseeding slurry should be pre-mixed in a tank with hydraulics or mechanical agitation.

3. General hydraulic seeder mixing instructions apply.

4. Binder or a suspension agent must be added to the slurry if application is to be by conventional dry seeding buckets.

5. Ground coverage is controlled by the helicopter pilot observation of ground wetness.

6. The pre-mix tank should be located a full hose length (30 m) from the helicopter seed bucket filling operation.

7. The helicopter seed bucket is filled from the pre-mixed tank. One large volume hose will make the bucket refill operation fast and efficient.

8. Completely flush tanks and seed bucket with clean water after use.