# Surface Roughening

**EROSION CONTROL TECHNIQUE**

| | | | | | |
|---|---|---|---|---|---|
| Revegetation | | Temperate Climates | ✓ | Short-Term | ✓ |
| Non Vegetation | ✓ | Wet Tropics | ✓ | Long-Term | |
| Weed Control | | Semi-Arid Zones | ✓ | Permanent | |

**Symbol**


**Photo 1 – Tracked vehicle walking up and down slope**


**Photo 2 – Corrugated (roughened) surface**

### Key Principles

1. Surface roughening is an erosion control technique of which the benefits can vary significantly from region to region, soil to soil, and climate to climate.
2. The appropriate application of surface roughening is possibly best resolved on a site by site basis. However, in most cases exposed soil surfaces should be left in a suitably roughened state, even if they are about to be vegetated or topped with another layer of soil.
3. In general, clayey soils should **not** be finished with a glassy smooth surface, especially if they are to be revegetated using such techniques as hydroseeding or hydromulching, or any of the hydraulically applied erosion control blankets.

### Design Information

On exposed or recently vegetated surfaces, erosion protection can be increased by roughening the soil surface to increase water infiltration, delay the formation of rilling, and reduce dust generation. Surface roughening can be applied to both subsoils and topsoils, either before and/or after seeding.

A roughened soil surface is, however, not always desirable. In some cases it may be undesirable to promote the infiltration of water into the soil, such as stockpiled soil immediately prior it being used as embankment fill. Also, on steep slopes, loose surface soil can present an increased risk of sediment runoff, especially during periods of high rainfall intensity.

Table 1 provides general guidelines on the application of surface roughening to cut and fill slopes. This information must be applied in association with site specific geotechnical advice.

**Table 1 – Typical application of surface roughening on slopes**

| Slope condition | Treatment |
|---|---|
| Cut slope steeper than 3:1(H:V) | • Stair-stepping with a vertical cut of 50 to 100mm can be used to aid in the anchorage of topsoil on steep slopes.<br>• In situations where the stair-stepping is to be a permanent feature of the slope, the vertical cut should be less than 600mm high in soft material, or 1000mm high in rocky material. The width of each step should be greater than the cut height. Such stepping usually does not involve the subsequent placement of topsoil, and thus is only done on good, fertile subsoils, and rocky slopes that are not intended to be seeded.<br>• The horizontal surface of each step should slope inwards towards the vertical face. |
| | • Grooving is generally limited to slopes less than 2:1.<br>• Grooves should be at least 75mm deep, and not more than 400mm apart. |
| Fill slope steeper than 3:1(H:V) | • On slopes to be vegetated, ensure the face of the fill slope consists of firm, but not hard, fill 100 to 150mm deep; otherwise use grooving as described above.<br>• On non-vegetated slopes (e.g. arid and semi-arid areas) achieve a soil compaction similar to natural slopes in the region. |
| Cut and fill slopes no steeper than 3:1(H:V) | • Application of shallow grooves/ploughing (along the contour) using normal tilling, discing, harrowing, or other suitable means.<br>• Grooves should be spaced no less than 250mm, and not less than 25mm deep.<br>• On slopes intended to be mown, ensure surface roughening is appropriate for the intended mowing procedures. |
| Sandy soils no steeper than 2:1(H:V) | • Roughen using tracked machinery (track walking). |

**(a) Stair-stepping:**

Stair-stepping is achieved during the formation of cut slopes. It involves cutting the slope to form a series of steps formed along the contour. Each step slopes inward towards the slope to aid in the capture and pooling of water and seed.

Stair-stepping can be applied to very steep slopes to reduce the risk of topsoil slippage (Photo 6).


**Photo 3 – Stair-stepping**

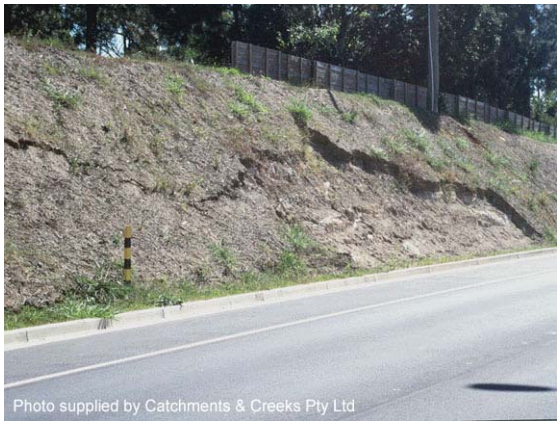


**Photo 4 – Slippage of topsoil from steep cut batter**

**(b) Track walking:**

This is achieved by walking a tracked vehicle up and down the slope.

- Generally limited to a maximum 2:1 (H:V) slope.
- Best used on sandy soils that are not likely to compact under the weight of the vehicle.
- When used on some clayey soils, recessed track marks (similar to Photo 5) can be left in the soil resulting in the concentration of stormwater runoff.

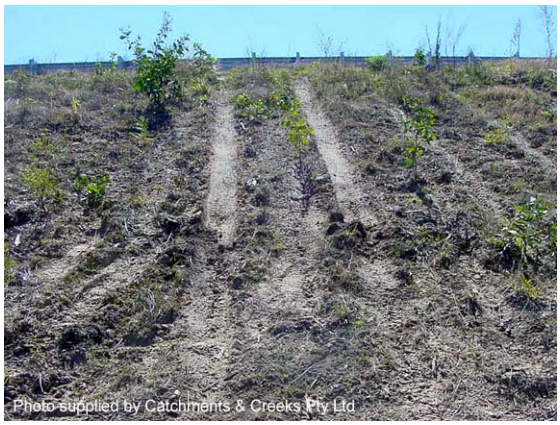


**Photo 5 – Wheel track marks down a slope potentially causing concentrated runoff**


**Photo 6 – Rilling down newly vegetated slope cutting through surface roughening**

**(c) Contour ploughing:**

Contour ploughing involves the ripping of mild slopes using a chisel plough or similar tined implement.

- Plough depth of around 200mm is typical, but 300 to 350mm can be achieved with heavy duty tines.
- Typically used to prepare land surfaces prior to revegetation.
- Generally limited to slopes of less than about 10:1 (10% or approximately 6 degrees).


**Photo 7 – Contour ploughing**


**Photo 8 – Contour ploughing**

**(d) Grooving:**

Grooving involves the formation of a series of minor surface grooves aligned with the contour of a slope. These grooves can be formed using disks, tillers, spring harrows, chisel ploughs, scarifiers, rippers, or by attaching a serrated edge to a grader blade (commercially available attachment), the latter being useful when trimming road batters.

Grooves can also be formed by walking modified drum rollers up and down a slope. The drum rollers are modified by welding triangular sections to the drum (known also as “land imprinters”).

**(e) Contour furrowing:**

Contour furrowing involves the construction of a series of small, level channels (furrows) designed to capture and hold rainwater on moderately steep land, thereby reducing runoff and the potential erosion hazard. The distance between the furrows depends on the soil type and slope. Contour furrowing is typically applied to moderately steep grazing land.

- The furrows generally penetrate at least 300mm, spaced 1 to 10m apart. It is usually carried out on hard packed soils to improve water infiltration, or on overburden immediately prior to topsoiling to assist bonding between the two soil layers.
- Contour furrowing should be employed only with extreme caution on dispersive soils. Always seek expert (soil science) advice.

Contour furrowing is generally not considered a part of *surface roughening*, instead it is a land management technique typically used in rural areas.

**(f) Contour ripping:**

Contour ripping is the formation of 600 to 900mm deep furrows along the contour of slopes. The deep furrows capture and infiltrate stormwater thus making best use of limited rainfall. In semi-arid areas subject to occasional heavy rainfall (e.g. parts of northern Australia), soil saturation following such heavy rain can lead to concentrated runoff down the slope damaging the rip lines, and potentially resulting in high sediment runoff (similar to Photo 6).

- Formed using machinery such as single or multi-tine ripper (600–900mm deep) attached to a heavy tractor or bulldozer.
- Typical ripping with two tines spaced about 1m apart. Each twin-furrow being spaced 2 to 6m apart depending on the slope grade.
- Generally limited to slopes of less than 6:1 (10 degrees).
- Generally limited to a maximum 3:1 (H:V) slope.
- Contour ripping should be employed only with extreme caution on dispersive soils. If soils are dispersive, then contour ripping may increase the erosion risk.

Contour ripping is generally not considered a part of *surface roughening*, instead it is a land management technique typically used in rural areas, and for mine site rehabilitation within arid and semi-arid areas.

**Description**

The roughening of exposed soil slopes with horizontal groves running across the slope. It is different from ‘contour furrowing’ and ‘contour ripping’, which are often used as a land management tools in rural areas.

Surface roughening can be achieved by a number of methods including walking a tracked vehicle up and down the slope.

It can also be produced by attaching a serrated edge to a grader blade (especially when trimming road batters), or by using a chisel plough, scarifier or ripper.

**Purpose**

Surface roughening can be used on exposed and recently seeded surfaces to:

- increase stormwater infiltration;
- delay the formation of rilling;
- reduce wind-induced soil erosion;
- promote faster seed germination within the dozer cleat marks by trapping and holding small pools of water, as well as seed and fertiliser.
- reduce runoff velocity (up to a given rainfall intensity, beyond which rilling may begin to occur resulting in concentrated, high-velocity flow)

**Limitations**

Each treatment method is limited to a different maximum bank slope.

Surface roughening produced by dozer track marks is generally best used on sandy soils. On clayey soils there is the risk of soil compaction leading to the formation of minor channel depressions that may concentrate runoff.

**Advantages**

The benefits of increased slope roughness include:

- increased retention of water on slopes;
- increased water infiltration into the soil;
- reduced runoff volume;
- reduced dust generation.

Inexpensive to implement, but may not be a cost-effective use of heavy machinery on a construction site.

Can improve the stabilisation of topsoil on steep slopes if surface roughening has been applied to the subsoil.

Aids in the establishment of vegetation by allowing water to collect and pool within the cleat marks (track walking).

**Disadvantages**

Generally of limited value during periods of heavy rainfall.

Questionable benefit on construction sites given the cost and effort of application.

**Common Problems**

Problems can occur once the soils are saturated and surface runoff begins to move down the slope across the grooves and furrows causing erosion.

**Special Requirements**

Immediately seed and mulch roughened areas to optimise seed germination and growing conditions.

Existing rutting and gullies should be filled or suitably contoured.

Up-slope runoff should be diverted around treated area if such run-on water is likely to cause erosion.

Seek expert (soil science) advice before deep ripping or furrowing land containing dispersive subsoils.

**Site Inspection**

Inspect the area for the formation of rill or gully erosion, and where necessary, repeat the surface treatment or improve up-slope drainage control.

Check the furrows/cleat marks are deep enough.

Check the furrows/cleat marks are aligned with the contour.

**Application**

1. Refer to approved plans for location, extent, and application details. If there are questions or problems with the location, extent, or method of application contact the engineer or responsible on-site officer for assistance.
2. Fill or suitably contour any existing rutting, rilling or gullies.
3. Suitably divert up-slope stormwater runoff around treated area as directed within the approved plans, or otherwise as directed by the site engineer.
4. Apply treatment to the area to the depth and frequency (spacing) specified on the approved plans, or otherwise as directed by the site engineer.
5. Immediately seed and mulch roughened areas to optimise seed germination and growing conditions.

**Maintenance**

1. During the construction period, inspect the treated area prior to forecast rainfall, daily during extended periods of rainfall, after significant runoff producing rainfall, or otherwise on a weekly basis.
2. Fill erosion rills slightly above the original grade, or regrade the slope as directed to remove the rills.