

Tunnel gully erosion control

Where do tunnel gullies occur?

Tunnel gullies, also known as under-runners occur in soils derived from loess. (Loess is wind borne silt deposited during glacial periods). Tunnel gullies commonly occur on sites where deep loess has accumulated on rolling to moderately steep slopes.

How do tunnel gullies form?

Some loessial subsoils are weakly held together meaning they can disperse or "melt" away if the material becomes excessively wet.

Tunnel gullies form when runoff water enters the subsoil through soil cracks, old tree root holes, or down rabbit burrows. Water can also be channelled by the hard, fragipan layer which some loessial soils exhibit.

Water carries the dispersed material away, scouring out ever-enlarging underground tunnels. Sections of the tunnel roof periodically fall in, creating the characteristic holes.

Some of the eroded material will be redeposited down-slope where collapsed tunnel gully material restricts the passage of water. There will be natural cycles of erosion, deposition and back filling occurring in severely tunnel gullied areas, depending on rainfall and control measures.

Impacts of tunnel gullies

- Silt-laden water flows out of tunnel gullies, depositing sediment in waterways and estuaries. Farm dams can be filled up with silt.
- Salt water in estuaries causes silt particles to stick together and settle out, impacting the habitats and food sources of aquatic life.
- Good soil on paddocks below tunnel gully areas can be covered with infertile silt.
- Stock that fall down the holes can go unnoticed and die of starvation.



Guidelines to prevent and treat tunnel gullies

- Maintain a dense, drought-hardy grass cover to help prevent soil cracking during hot, dry weather. This makes it more difficult for water to get directly to the unstable subsoil.
- Maintain a high level of rabbit control as burrows can channel water into the subsoil.
- Divert any runoff water away from under-runner entrances. (Use a single plough furrow, or create a hump with a back-blade, excavator or shovel.)
- Plant trees right in the bottom of under-runner holes because this is where moisture will collect on dry slopes (see over page).
- Do not subsoil or deep rip areas where even small tunnel gully holes occur. These holes may indicate an unstable subsoil. Subsoiling could make tunnel gullies worse.

Stabilisation using trees

- Trees planted right in the underground tunnel will usually be the most effective stabilisation measure.
- Use tree varieties that sucker or have fibrous root systems. Three metre long poplar and willow poles are ideal. (Poles are giant sized unrooted cuttings, about 40 to 70 mm in diameter, and about 3 meters long. They are planted with protective sleeves to prevent stock eating the bark).
- Use the more drought-tolerant poplar varieties such as Veronese, Argyle, Lombardy and Yeogi 1 (which suckers); Tangoio willows; Robinia pseudoacacia, which is deciduous, thorny and suckers; or Australian Blackwood (Acacia melanoxylon), which is hardy and suckering. The latter is suitable for light frost areas.
- The fibrous roots of poplars and willows should stop silt flowing out of under-runners in four to six years.
- Wide-spaced Radiata pine and eucalypts are not ideal as they can dry out the soil excessively, causing pasture death, soil cracking and piping of water along root lines. (Their roots are not fibrous like those of poplars and willows.)
- Close-planted Radiata pine wood-lots will reduce but not eliminate tunnel gullies. Sediment may continue to wash out below the depth of the pine roots. If pines have to be used, ensure they are planted in the bottom of tunnel gully holes. Keeping stock out will prevent the mulch of pine needles being disturbed, and so help reduce soil cracking.

Bulldozing/cultivation without trees is usually unsuccessful

- Bulldozing and cultivation without tree planting is usually ineffective long term as the tunnel gullies often re-activate.
- The fill pushed down the holes by these machines will not be properly compacted, so water continues to flow down the underground tunnels, washing away the new material.
- Regrassing these areas is often difficult because there is usually insufficient top-soil left to establish a strong sward of grass. Soil cracks soon develop without a protective grass cover. Water runs down the cracks and the tunnel gully reactivates.

Stabilisation using an excavator and trees

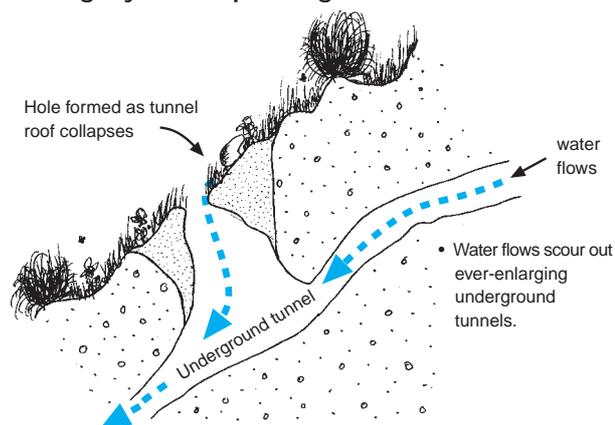
- If mechanical stabilisation is essential, try an excavator rather than a bulldozer. An excavator enables the subsurface holes to be dug out properly; Compact the fill material firmly with the bucket so any underground tunnels are properly sealed up.
- Keep the top soil separate from the subsoil, so it can be respread on top to ensure strong grass growth.
- Plant poles when the digger is working so tree roots will be located where the old subsurface tunnels were. Compact well round the pole. The pole will develop roots right where they are needed ensuring long term stabilisation. Regrass the area as soon as possible to avoid future soil cracking.



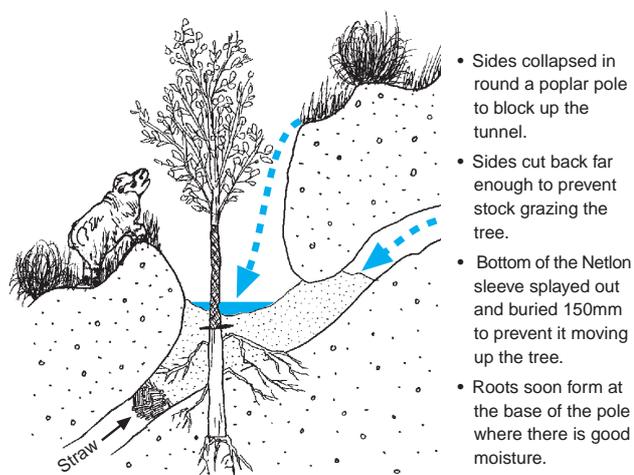
Pole planting procedures for tunnel gullies

- Plant a 3 metre pole in each under tunnel gully hole at 5 to 10 metre spacings (use 3 to 5 metre spacings on areas with severe problems or on steep slopes).
- Seal off the underground tunnel by firmly ramming in some fresh straw.
- Collapse in the edges of the surface hole with a spade, and use the material to further block up the underground tunnel. Progressively compact firmly with a post rammer.

Tunnel gully before planting



Tunnel gully stabilised with a poplar pole



- Collapse in more of the soil from the edge of the hole and ram well around the pole so it is planted 1 to 1.2 metres deep.
- To prevent the Netlon protective sleeve climbing up the pole in the wind, cut 150mm along the two folds at the bottom of the sleeve. Lay out the cut section of sleeve horizontally and bury under about 150mm of well compacted earth.
- Cut away sufficient material from the sides of the tunnel gully hole so stock will not be able to reach over and graze the tree.
- Cut steps to allow stock to climb out of deep holes should they fall in.
- Poles grow very well if planted deep in under-runner channels, because there is often good moisture available there. They will not thrive on adjacent dry areas.
- Use rooted poplar or willow cuttings as an alternative, with a stake and individual tree protectors for better establishment under dry conditions.