B Stabilising waterways and riverbanks

Objective

To stabilise riverbanks so that erosion and threats to cropping land and infrastructure are reduced.

Recommended management approach

Riverbank erosion is a natural process as waterways slowly meander across the landscape. However, since European settlement of Australia, the rate of streambank erosion has increased dramatically. Two main factors are responsible for this increase. First, extensive clearing of deep-rooted, natural vegetation for agricultural and urban development, and the planting of shallow-rooted crops, means that rainfall tends to move through the catchment at a much faster rate. This causes higher peak flows that waterways can no longer contain. Second, natural riparian vegetation has been disturbed, either through broadscale clearing or through uncontrolled stock grazing, fire or other effects. This has reduced the amount of stabilisation and reinforcement provided by the roots of riparian vegetation.

Problems caused by streambank erosion include:

- loss of productive cropping land;
- flood-outs and cutting in (incision) of new channels;
- stripping of topsoil from the floodplain;
- damage to infrastructure such as farm roads, pump installations and buildings;
- sedimentation, leading to blocked pumps and channels as well as degraded in-stream habitat; and,
- reduced water quality for downstream users.

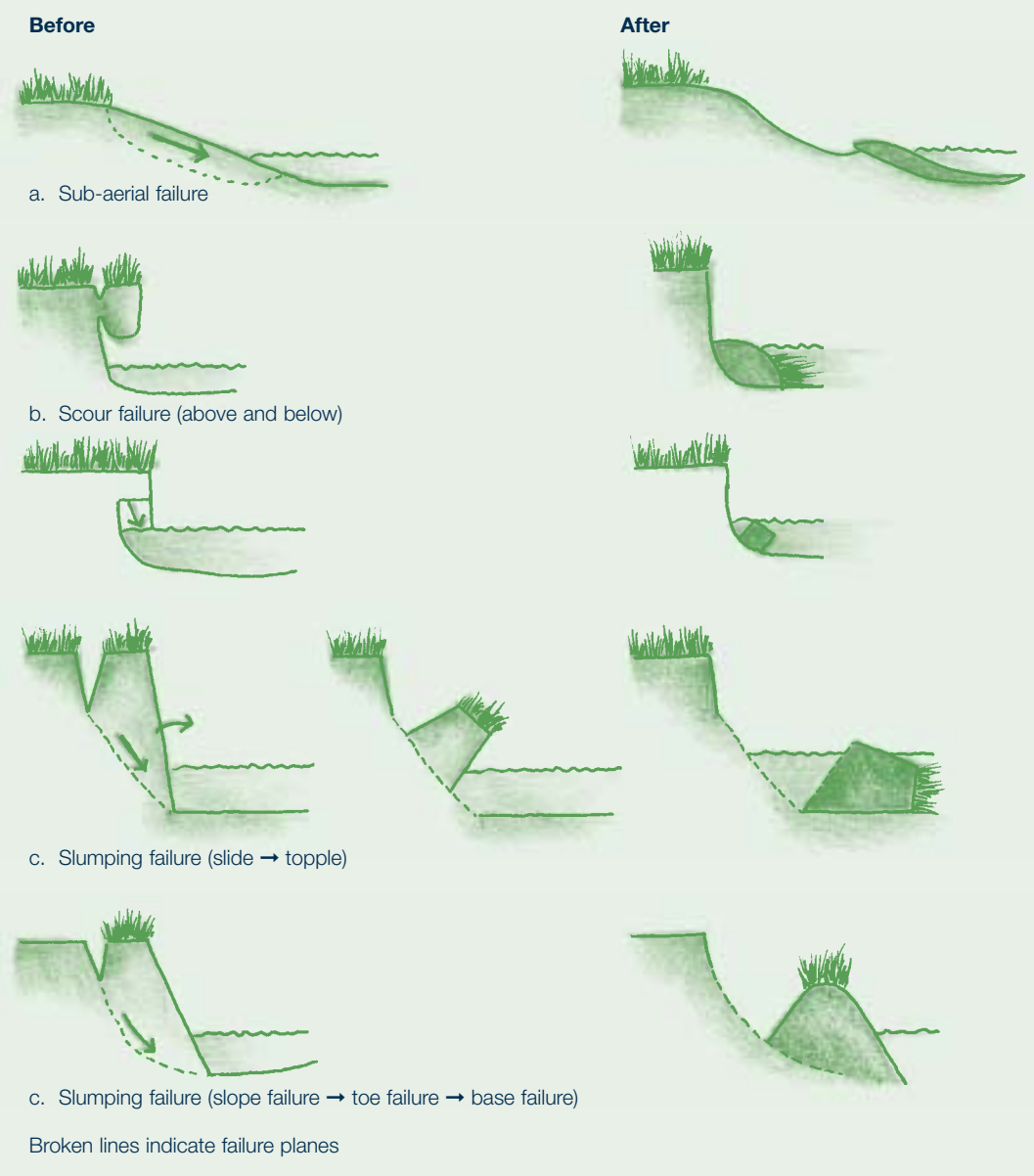
Sedimentation is the process by which the larger sand and silt particles in eroded soil that has washed into a waterway settle out within the channel. How quickly, and where these particles settle, depends mainly upon their size and the water flow rate. This sediment can block and choke stream channels, increasing flood risk, and also filling pools which once provided refuge for fish and other animals in times of low flow.

Sand accumulation and bank erosion has led to willow infestation. Photo Ian Rutherfurd.

Erosion of stream or channel banks occurs in three different ways(see Figure 6):

- *Sub-aerial erosion* — involves processes that loosen the soil of the bank, which is then carried away by the water flowing past. For example, trampling by stock and the impact of wind and rain loosens the surface of the bank, gradually eroding the soil away. The cracking clay soils common in cotton districts are particularly prone to this type of bank erosion.
- *Scour* — occurs when the force applied to a bank by flowing water exceeds the resistance of the bank surface. This often happens at the toe of the bank (at the water's edge) where the flowing water scours away the soil. It is also common on the outside bends of rivers and channels, where the flow is fastest.
- *Slumping* — occurs when blocks of the bank collapse as a result of scour processes. Slumping can also occur when the bank soil is saturated, particularly when a peak flow (e.g. a natural fresh or a dam release to meet irrigation demand) recedes quickly.

Figure 7: Illustrations of how sub-aerial erosion, scour and slumping occurs along riverbanks.



Healthy riparian vegetation can help to reduce all three processes (sub-aerial, scour and slumping) that cause bank erosion. The maintenance of a dense cover of vegetation from the water level to the top of the bank reduces the effect of sub-aerial processes, such as soil loosening by rain. Vegetation protects the bank, and when water levels rise it also works to reduce the effects of scouring. The roots of riparian vegetation bind and reinforce the bank, with recent research finding that tree roots can extend for 10–15 metres from the trunk, and to a depth of at least 1.5 metres, depending on the size of the tree. The trunk or stem of trees and shrubs can also physically buttress the bank against slumping. As well, dense riparian vegetation uses water and dries out bank soils making them less likely to slump.

The weight of trees on a waterway bank is generally not significant in comparison with the weight of the soil beneath and, contrary to popular opinion, is generally not a factor in the slumping of soil blocks into a stream.

This Eucalypt tree on the Namoi River is holding the bank together and providing protection against further erosion. Photo Guy Roth.

In situations where riparian lands need to be restored, it is best to mimic natural conditions. Healthy riparian vegetation contains a range of species — native grasses, reeds and shrubs with flexible branches often occupy the lowest parts of the bank, where they are subject to occasional inundation. Their ability to bind soil and to resist flood flows are highly-prized characteristics. Further up the bank, shrubs and small trees usually predominate, with an understorey of grass species. In many cotton-growing districts, large trees are naturally widely spaced along riverbanks, and this pattern should be followed unless there is a particular management issue to be addressed that requires closer planting.

The recommended management approaches to stabilise waterways are listed below.

1. Determine which dominant erosion process (sub-aerial soil loosening, scour or slumping) is affecting the waterway bank. This may require a simple inspection or survey of the waterway reach, or getting some professional advice. Once the key erosion processes are known, the design and implementation of revegetation works can proceed — matching the type and position of riparian vegetation to the nature of the problem and combining it, if necessary in particularly difficult situations, with structural work such as posts, wire-meshing, rock rip-rap, or groynes.

This bank has been cleared of riparian vegetation and is now slumping into the river. The clearing of riparian vegetation has also provided an opportunity for Lippia to spread along the riverbank. Photo Guy Roth.

2. Where the primary management objective is to stabilise waterway or channel banks, the aim should be to revegetate the bank itself and at least a 5–10 metre strip along its top. Wider areas of riparian vegetation may be needed to stabilise waterways on outer bends that are more susceptible to erosion. There may be statutory requirements in the development of new land for cotton growing that require a particular width of riparian lands to be recognised and managed separately (see Appendix B for details of legislation).

3. If the problem being managed is a bank eroding at its 'toe' followed by slumping, start revegetation work with water-edge grasses, sedges, rushes or similar plants. On the slope and top of the bank, match the rooting depth of the vegetation to be established with the height of the bank. If the roots of the species planted do not cross the potential slump area of the bank, they will have limited ability to reduce this form of erosion. Extending tree, shrub and grass plantings over and beyond the bank top by 10–20 metres will provide additional protection from slumping by reducing the growth of tension cracks on the top of the bank.

The grasses, reeds, logs and branches at the toe of this bank are protecting against further erosion. This site would respond well to rehabilitation as the toe is currently protected and there are some trees remaining on the riverbank to help bind the soil. Photo Guy Roth.

4. If resources are limited and erosion control is the primary aim, do not target a revegetation program at the most unstable section of the waterway (e.g. an outside bend or channel junction). Efforts are better spent targeting a part of the stream or channel where erosion may not be so severe, but where revegetation will be most successful. Once these areas have been stabilised, the more-difficult section can then be tackled with confidence.

5. Keep existing native riparian vegetation on as much of the farm as possible, as this is by far the cheapest option for stabilising waterways and channels. Where this vegetation is substantially degraded through past land uses, it may be possible to regenerate it through fairly simple means. For example, remove stock at a time when mature trees or shrubs carry a good seed-load and conditions are good for regeneration. For cotton growers who also graze cattle and wish to use feed in riparian areas, it may be possible to exclude stock from one section of the bank at a time — say, a 300–500 metre section. Excluding stock from this section for up to two years will give sufficient time for regeneration and establishment of larger shrub and tree species to a height where they are resistant to grazing by stock. The 'regenerating section', where stock are excluded, can gradually be moved along the bank over time.

The riparian area is acting as a buffer between the cotton crop and the river, as well a stabilising the river channel so that erosion does not occur. Photo Guy Roth.

6. Where erosion of banks or beds is a problem on farm irrigation and tailwater channels, apply the recommended management approaches outlined above. Most cotton growers prefer to keep channels bare in order to maintain their designed flow capacity. Where grades are low and erosion minimal, this may be acceptable, although the herbicides used to prevent weed growth may be harmful if transported to waterways by peak flows. Bare channel banks and beds are also likely to become significant sources of sediment (and possibly nutrients and pesticides) during major

Drop box incorporated into farm irrigation system. Photo Guy Roth.

flows. Channel systems should incorporate drop-boxes, stilling ponds or other devices to allow sediment to settle before waters are discharged from the property. The rapid rise and fall of water levels in waterways and delivery channels in response to irrigation demand can cause massive bank slumping when saturated soils cannot support their weight. Revegetation using the principles above can significantly reduce this problem.

Self-assessment

To check the progress of stabilisation techniques you need to measure any physical changes in the bank-slope and position. Detailed surveys of the longitudinal and cross-section of the channel can be made at the time of farm and paddock design. Repeat surveys following major events can be used to show changes in channel location and shape. An alternative (and cheaper method) is to take photographs from the same reference point or benchmark. A tree, fence post or steel peg can be used so that the photographs taken before and after rehabilitation can be compared directly. The benchmark helps to position later surveys or photographs in exactly the same spot so that results can be compared.

Things to measure or include in the photographs include:

- the bank height, slope and channel width;
- the average depth of flow during typical seasonal conditions and how depth varies along the waterway section of interest; and,
- the existence of particular channel features, such as undercuts, rock bars and pools.

CASE STUDY
chapter three B

Reducing bank slumping and pesticide contamination

John and Robyn Watson — 'Kilmarnock', Boggabri

By Guy Roth

John and Robyn Watson have been growing cotton for over 20 years on the Namoi River near Boggabri. In 1995, they started a program of improving riparian areas as they were concerned about bank slumping and pesticide contamination of the river. They identified the places where action was needed along the seven kilometres of river that runs through their property and worked to rehabilitate these areas. Most of the work involved planting a mix of native grasses, shrubs and trees to stabilise the riverbank and prevent erosion and loss of valuable land. John and Robyn also kept their cattle out of riparian areas as they were causing a lot of damage to the riverbank and increasing erosion. Some of the lessons John and Robyn wanted to share with other cotton growers are:

- do not try to do too much at once — pick your sites and do a little every year as conditions allow;
- exclude stock if you have them. Once the area has been rehabilitated light grazing is okay, but do not let in bulls!;
- do not think that you have to use expensive machinery to restore riverbanks — you can do a lot with plants and repair steep banks without spending a lot of money;
- when there is moisture in the bank, such as from a 'fresh' in the river, this is the ideal time to plant your trees. On steeper banks, use longstem stock for seedlings (up to 1 metre high see page 60 for more details about using longstem tubestock). Bore a hole with a waterjet in the bank and plant the tree so that about 20 centimetres is exposed. This will protect the tree from floods and you shouldn't need to water them as 80 centimetres will be in the ground. The species we have had most success with are River Red Gum, Casuarina and River Cooba;

River Cooba and grasses getting started despite the drought.

- planting native grasses is very important for stabilising the toe of the bank. The grasses we use are Phragmites at water level; Queensland Cane Grass in the middle of the bank and Native Vetivia a bit higher up from the Cane Grass. Once established, other grass species naturalise around them;
- weed management is important — if possible, slash the top of the banks as it encourages native grasses and reduces weeds. Do not plough the native grasses between rows. On the bank, chip out bad weeds like Nogoora Burr and Sesbania, other weeds can provide ground cover while your native species get established. Ground cover is very important, however, Lippia is not good as it dries out the bank, causes slumping and is a weed;
- do not water unless it is really dry;
- grow your own plants by collecting the seeds from those areas along the riverbank and on the property that are regenerating or protected. Use local tree stock as it is native to the area and most likely to survive; and
- use riparian buffers between the riverbank and cotton paddocks as this protects the river from spray drift as well as trapping sediments and nutrients running off the paddocks.

A final word...

'Now we have done some areas along the river and around the farm, we need to develop an overall farm plan to target our future efforts.' John Watson

Robyn Watson in a section of rehabilitated riparian land during the drought. Photo Guy Roth.

Common plant names are used throughout the guide, for the scientific names see Appendix D.