FACT SHEET 3

Improving water quality

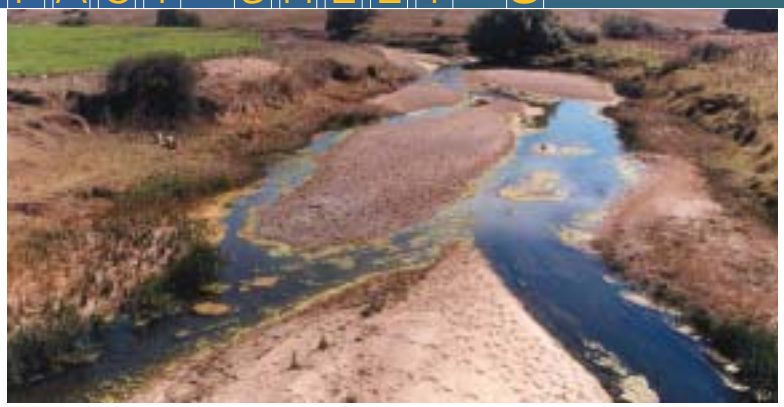
3

Riverlandscapes

This Fact Sheet is the third in a series dealing with the management of riparian land.

Streams can be contaminated by a range of material from adjacent land. This can include soil particles (sediment), nutrients such as nitrogen and phosphorus, salt, plant material from crops, chemicals, and microbes. In rural regions, eroding soil and associated nutrients are the most important and widespread causes of reduced water quality.

Sediment and some nutrients, particularly phosphorus, are carried to streams primarily in the overland flow of water. This flow can range from thin threads to broad sheets of water, and may be concentrated in dips and gullies in the landscape. Dissolved nutrients such as nitrogen, salt, and other materials (including dissolved organic carbon) can also move through the soil in underground flows and contaminate streams as they enter them as base flow.

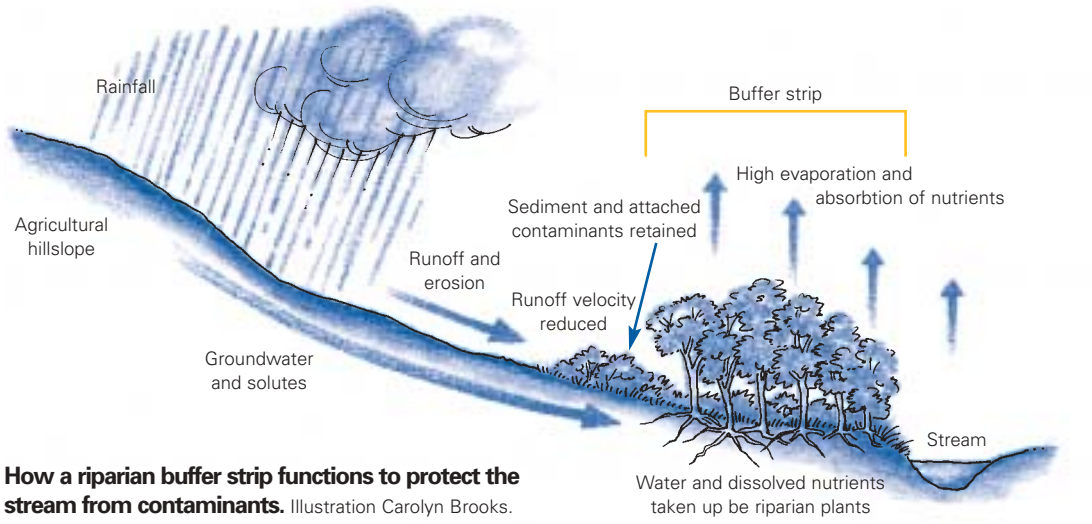


A poorly managed riparian zone. Almost no trees remaining, bank erosion, cattle grazing along the river bank, algal blooms and sand slugs that smother in-stream habitat for fish. Photo Ian Prosser.

The clearing of catchments for agricultural land, soil disturbance during forestry operations or urban development, and bare areas such as gravel roads and stock tracks, have led to substantial increases in the amounts of sediment (gravel, sand, silt and clay) entering ours streams and rivers. This sediment and its associated nutrients and chemicals can contaminate human and stock water supplies, smother breeding sites for fish and other in-stream animals and, by filling up stream pools, deprive these animals of the deeper waters that are a vital refuge in dry seasons and prolonged droughts. Whatever the specific impact, the end result is likely to be significantly decreased water quality.

How does riparian vegetation affect water quality?

Vegetation within a riparian zone can slow the overland movement of water, and cause sediment and attached nutrients to be deposited on the land before they can reach the stream channel. Riparian vegetation can also take up and remove some of the nutrients being transported. Trees and deep-rooted shrubs and grasses use significant quantities of sub-surface waters. As the diagram below shows, these processes mean that riparian vegetation can influence underground water flows and the nutrients, salt or other contaminants that may be entering the stream by this route.



How a riparian buffer strip functions to protect the stream from contaminants. Illustration Carolyn Brooks.

Increased nutrients entering rivers can cause algal blooms. Riparian vegetation can help reduce the amount of sediments and nutrients entering rivers. Photos this page Ian Prosser.

Riparian vegetation also provides shade to streams and regulates stream temperature. Both act to prevent excessive growth of macrophytes and filamentous green algae in the stream, even when nutrient levels are increased. Such growth causes major changes in aquatic habitat and reduces oxygen levels through plant respiration and the accumulation of organic matter.

The sediment and nutrient trapping effectiveness of riparian vegetation mean that well-located strips can act as a buffer between land areas developed for agriculture or urban use, and adjacent streams. In recent years, there has been significant work in Australia to understand the processes involved in buffer strip functions, and how to design them for maximum effectiveness.

Do riparian buffer strips work?

Recent studies in Australia have shown that under favourable conditions, both natural vegetation and grassy filter strips can trap around 90% of the sediment moving from upslope. These strips can be just as effective in trapping or absorbing nutrients. Vegetation (for example most grasses) can quickly grow over and through the trapped sediments, thereby protecting them from future storms.

It is important to recognise that, although riparian filter strips can be effective in preventing sediment and nutrients from reaching streams, and thereby help to protect and improve water quality, they are not a substitute for good land management elsewhere in the catchment.

A grass riparian buffer trapping sediment downslope of a ploughed paddock.

Preparing land for potatoes upslope of a riparian forest. Photo Peter Hairsine.

Maintaining adequate vegetation cover, use of contour banks and contour cropping, as well as maintenance of general soil cover elsewhere within the catchment, remain critical components of sound land management to maintain good water quality. Narrow riparian filter strips alongside streams will not be effective on their own if poor management practices leading to excessive soil erosion elsewhere are permitted on the broader lands of the catchment.

Designing an effective riparian filter strip

Where to place filter strips

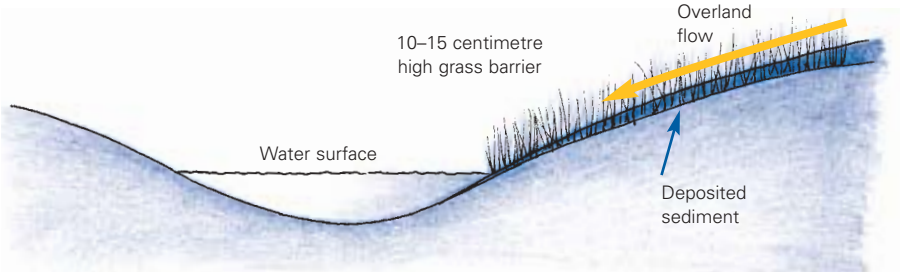
To be effective, a filter strip needs to be established or maintained at points where overland waters enter small river channels. In most catchments, this does not mean a strip of set width along both sides of a stream. Consideration needs to be given to those parts of the landscape where folds and dips collect water which then flows into the tributary stream.

There may be large parts of the landscape where little or no overland flow enters the stream channel. You may decide to maintain healthy riparian vegetation in these areas to improve bank stability or provide wildlife habitat, but they are less important if your primary objective is to reduce sediment and nutrient movement. Instead, attention should be focused on any landscape depressions where flow concentrates. In such areas, you should aim for a broad, well-grassed filter zone that covers the entire area of flow concentration. This is because a concentrated flow may break through a narrow grass buffer in times of heavy rain.

It is also possible to combine natural riparian vegetation with a planted grass filter strip between it and intensively-used agricultural land. The grass strip provides an initial slowing of overland flow and trapping of sediment and attached nutrients, and this process is continued in the natural vegetation along the streambank. Such natural riparian vegetation has an important additional benefit in providing shade to the stream (thereby reducing water temperatures and growth of nuisance plants) as well as helping in bank stability.

How to use filters

It is not always necessary to take filter strips out of production, but it is important to maintain them so that there is almost complete ground cover and a good height of vegetation. This will maximise their potential to trap sediment and nutrients. As these areas are often highly-productive, it is important to work out how you can maintain productivity while at the same time keeping grass cover for sediment trapping. In many cases, it would be possible to build this requirement into your farm plan. For example, a wide, grassy area in a depression next to the stream channel could be left for grazing during a cropping sequence, or grazed only lightly for that season of the year when high rainfall is anticipated. Generally, grasses should be kept to a height of at least 10–15 centimetres, with a high density of stems and leaves at ground level, for maximum trapping effect.



How a grass buffer strip functions to trap sediment. Illustration The Idea to Here.

Some landholders are experimenting with the establishment of riparian agroforestry plantations, comprising widely-spaced trees and a good grass understorey. The grass provides feed for stock, especially during the early years of the plantation. Such tree crops often have excellent growth rates, but care needs to be taken to minimise soil disturbance when the trees are harvested, especially if the ground is wet. Such production systems, whether in the south or the sub-tropics or tropics, offer the potential for farm diversification and significant income, while at the same time making a positive contribution to improved water quality.

How wide do filter strips need to be?

The most commonly-asked question in relation to the design of filter strips refers to their width. If your prime objective is to trap sediment and nutrients, the appropriate width and management practice for riparian filter strips depends on the volumes of water and sediment being transported, and the nature of the landscape adjacent to the stream channel.

Factors affecting the amount and type of sediment moving in overland flow include soil type, intensity of land use, presence of stock, vehicle tracks or gullies which generate sediment, and the likelihood of the overland flow being concentrated into a narrow pathway. Recently, information on several of these factors has been brought together to produce a set of look-up tables that assist landholders in designing effective filter strips. This publication is titled "Designing filter strips to trap sediment and attached nutrient" and full reference details are provided at the end of this fact sheet.

Farmer combining grass filter strip with riparian strip to trap sediment coming off crop paddock. Photo Ian Prosser.

In general, as the volume of flow or the amount of sediment increases, the wider the filter strip needs to be. It is recommended that a combination of 10 metres of grass buffer and 10 metres of natural vegetation adjacent to a stream will be effective in many situations. Wider filter strips may be required where factors such as intense source of pollutants, steep gradients adjacent to streams, high rainfall and poor vegetation cover, combine to decrease sediment-trapping efficiency.

Whether the filter strip required is narrow or wide, it is important that its use and management is incorporated into your farm or your local government's plan. In many cases, a little thought and planning will enable you to use the filter strip for productive purposes while maintaining its integrity and effectiveness.

Other ways of limiting stream contamination

Timing and placement of fertiliser

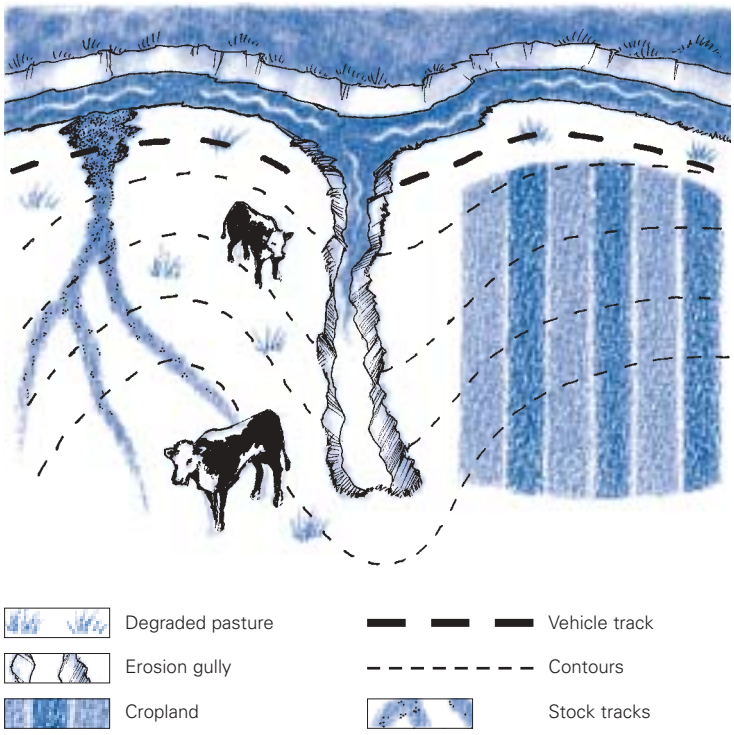
The timing and placement of fertilisers used on agricultural lands should be such as to maximise the return from investment and to minimise off-site losses. Wherever possible, timing of fertiliser application should aim to avoid periods of intense run-off. Placement of fertiliser within the soil or under surface vegetation is preferable to broadcast application.

Land forming, the use of contour banks, and careful timing of irrigation applications to meet crop requirements and current soil moisture levels, will all help to reduce the amount of soil and nutrients lost from paddocks. Many agricultural industries use stubble mulching, trash blanketing and other methods to help protect soils from water and wind erosion. This also helps to keep the nutrients where they should be: on the paddock, waiting for the next crop or supporting increased pasture growth.

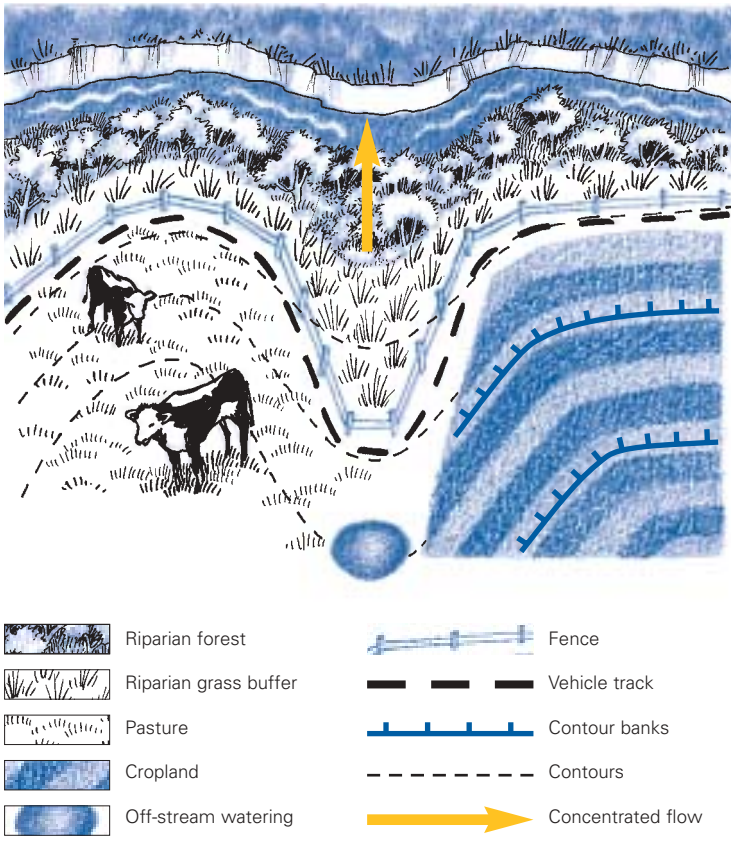
Green cane trash blanketing. Photo CANEGROWERS.

Managing stock access

Uncontrolled use of riparian lands by stock contributes significantly to the amount of sediment and nutrients moving into streams. If not managed carefully, domestic stock (especially cattle) will often spend long periods along streambanks, leading to over-grazing and baring of the soil surface. Stock tracks up and down or along banks are major sources of soil erosion into the stream during rain. Stock congregating along the edge of the water break up and pug the soil surface, which then washes away easily during the next flow event. Direct inputs of nutrients from stock through manure



A degraded catchment and riparian land. Significant sediment and nutrient is derived from degraded pasture, poor crop management, unlimited stock access and gully erosion. Illustrations Carolyn Brooks.



A combination of good on-farm management and good riparian land. Riparian forest provides ecological benefits and absorbs nutrients, variable width grass buffers trap sediment and stock access is controlled.

and urine add substantially to the loads of nitrogen and phosphorus within the stream, and these nutrients can then support excessive growth of nuisance plants and algae. The loss of animals in steeply-sided channels, as well as mustering costs, can be a significant economic cost. These issues mean that there may be significant benefits to landholders who use fencing or other methods to enable them to better manage stock access to riparian lands and thereby to improve water quality.

For further information

Prosser, I. & Karssies, L. 2001, 'Designing filter strips to trap sediment and attached nutrients', *Riparian Land Management Technical Guideline Update*, Land & Water Australia, Canberra.

Prosser, I., Bunn, S., Mosisch, T., Ogden, R. & Karssies, L. 1999, 'The delivery of sediment and nutrient to streams' in S. Lovett & P. Price (eds), *Riparian Land Management Technical Guidelines, Volume One: Principles of sound management*, Land & Water Australia, Canberra.

Prosser, I., Karssies, L., Ogden, R. & Hairsine, P. 1999, 'Using buffers to reduce sediment and nutrient delivery to streams', in P. Price & S. Lovett (eds), *Riparian Land Management Technical Guidelines, Volume Two: On-ground management tools and techniques*, Land & Water Australia, Canberra.

FACT SHEET 3
BACK PAGE

These **Fact Sheets** are grouped according to whether they deal with riparian land, in-stream issues, river contaminants or other matters. They aim to set out the general principles and practices for sound management. Other information that focuses on local conditions and management issues is available from state government agencies, local governments, catchment management authorities, rural industry bodies and community organisations. Together, this information should assist users to understand the key issues in river and riparian management, and enable them to adapt general management principles to their particular situation, and to know where to go for advice specific to local conditions.

Other relevant Fact Sheets

1 Managing riparian land
2 Streambank stability
4 Maintaining in-stream life
5 Riparian habitat for wildlife
6 Managing stock
7 Managing woody debris in rivers
8 Inland rivers and floodplains
9 Planning for river restoration
10 River flows and blue-green algae
11 Managing phosphorus in catchments
12 Riparian ecosystem services
13 Managing riparian widths

Numbers 1–7 of these Fact Sheets are based on the previous *Riparian Management* series produced in the 1990s. The authors involved in the development of the earlier series were: Michael Askey-Doran, Stuart Bunn, Peter Hairsine, Ian Prosser, Ian Rutherfurd, Brian Finlayson, Ian O'Neill, Chris Gippel and Wendy Tubman.

Further information on river and riparian management can also be found at the Land & Water Australia 'River Landscapes' website.

www.rivers.gov.au

This website provides access to projects, fact sheets, guidelines and other information designed to assist people to better manage river and riparian areas across Australia.

River Landscapes

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