

THE LANDHOLDER'S GUIDE TO LOOKING AFTER WATERWAYS IN THE RICHMOND CATCHMENT

Presented by
Rous County Council

In association with:
**North Coast Local Land Services
and Richmond Landcare Inc.**

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The Landholder's Guide to **LOOKING AFTER WATERWAYS IN THE RICHMOND CATCHMENT**

Presented by:



In association with:



With assistance from:



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1

INTRODUCTION

Rous County Council is pleased to present, in association with North Coast Local Land Services and Richmond Landcare Inc., *The Landholder's Guide to Looking after Waterways in the Richmond Catchment*.

The waterways of the Richmond catchment are vital living ecosystems supporting thousands of species of fish, frogs, aquatic plants and insects, while yielding water for drinking, agriculture, industry and recreation.

Farming and other land uses within the catchment have a direct impact on the health of our waterways and our region's drinking water supply, land, wildlife and people.

Sustainable land management practices in our catchments are vital to ensure the health of waterways and water quality are maintained at acceptable levels.

We all have a role to play in looking after waterways.

Whether you are a resident, farmer, land manager or prospective property owner, your actions can help protect the water, soil, vegetation and wildlife resources of our drinking water catchments.

This booklet aims to provide landholders in the Richmond catchment with practical guidelines for waterway management that seek to balance land use with resource protection.

Rous County Council, North Coast Local Land Services and Richmond Landcare Inc. invite you to work with us to ensure the protection of our waterways now and into the future.



FIGURE 1: Map of the Richmond catchment and its tributaries



We all have a role to play in looking after waterways

2 CONTEXT

The Richmond catchment comprises a variety of landscapes from World Heritage rainforests to rich agricultural valleys and coastal estuaries. In the north of the catchment lie the Border Ranges National Park and other reserves associated with the World Heritage listed Tweed volcanic caldera and its associated Gondwanan rainforests. The Clarence River catchment runs to the west and south of the Richmond, while to the north-east lie the Tweed and Brunswick River catchments.

2.1 Location

The Richmond catchment is in north-eastern New South Wales. The Richmond River rises in the Border Ranges National Park, on the NSW-Queensland border, and flows south-east for around 170 kilometres to the Pacific Ocean at Ballina. The coastal extent of the catchment reaches from Evans Head in the south to just south of Cape Byron in the north.

The Richmond catchment drains an area of over 7,000 square kilometres from the Border Ranges in the north to the Richmond Range in the west and south. The upland ranges and the plateau north of Lismore remain mostly forested while the lower coastal plains have been cleared for agriculture. Elevations range from over 1000 metres in the Border Ranges to near sea level on the coastal floodplain.

2.2 Rivers and tributaries

The main tributary of the Richmond River is the Wilsons River, which contributes around 60 per cent of the flows in the lower part of the catchment. The Wilsons River enters the Richmond on the coastal plain at Coraki. Another major tributary is Bungawalbin Creek, which drains the southern part of the catchment and enters the tidal reach of the Richmond River. The Richmond has an extensive tidal zone, which extends beyond Tatham on the Richmond River and Lismore on the Wilsons River.

The small coastal catchment of the Evans River is connected to the Richmond River by a canal at Woodburn. This canal is operated to mitigate flooding and improve drainage in the mid-Richmond River area. The Evans River flows for around 20 kilometres and enters the ocean at Evans Head.

2.3 Major water storages

A small section of the upper Richmond River is regulated by Toonumbar Dam on Iron Pot Creek. It stores water from a 98 square kilometre catchment for irrigation, stock, domestic and town water supplies. Two other water storages are at Rocky Creek Dam and Emigrant Creek Dam – both are operated by Rous County Council to provide town water for Lismore and Ballina. There are other minor water storage areas at Nimbin, Mullumbimby, Wardell and Casino.

2.4 Natural habitat

The waterways and forests of the Richmond catchment are important habitat for vulnerable and endangered fauna species including the wompoo fruit-dove (*Ptilinopus magnificus*), rose-crowned fruit dove (*Ptilinopus regina*), eastern freshwater cod (*Maccullochella ikei*), giant barred frog (*Mixophyes iteratus*), spotted-tailed quoll (*Dasyurus maculatus*) and the grey-headed flying-fox (*Pteropus poliocephalus*).

2.5 Aboriginal significance

The Richmond catchment is in a landscape that is part of the identity, spirituality, cultural responsibility and resource base of several tribes and clans that form part of the Bundjalung Nation.

Rous County Council, North Coast Local Land Services and Richmond Landcare Inc. acknowledge, with great appreciation, the traditional custodians of the Richmond catchment and recognise the strength, resilience and capacity of these peoples. We acknowledge the traditional custodians are the original custodians of the lands, waters,

animals and plants of our water catchment areas. Despite the significant landscape changes of the past 200 years, Aboriginal people still maintain a responsibility and deeply felt association with the water, land and skies of our catchment areas.

We respect this relationship and the traditional laws, customs, beliefs and culture of the Aboriginal community. We consider that the recognition and conservation of local Aboriginal culture in partnership with local Aboriginal people is an important part of the management of our water supply catchments.

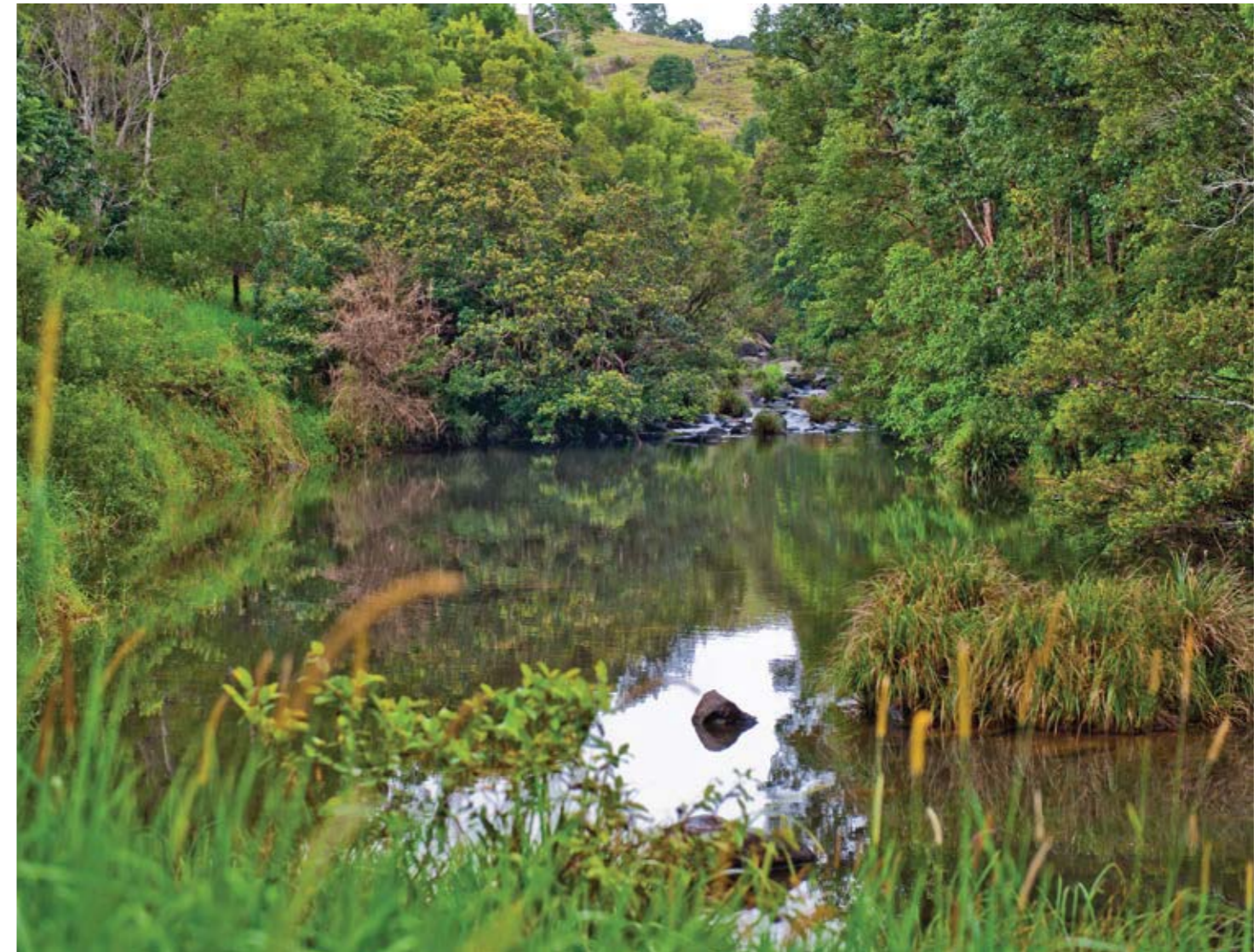
Aboriginal people have been connected to what is now known as the Richmond catchment for over 50,000 years. We recognise and respect the knowledge that Aboriginal people have in managing land and conserving biodiversity, and consider Aboriginal people as equal partners in managing our land and water. Caring for country is a cultural obligation and a birthright. Cultural knowledge supports sustainable living practices and strengthens identity and connection.

This guide will help you, as a land manager, to care for country.

2.6 Recent history

The first Europeans to arrive in the region in the mid-1800s were runaway convicts, followed by the cedar getters who came to harvest the majestic red cedar (*Toona ciliata*). This in turn opened the way for land selection in the area. Most of the lowland subtropical rainforest was cleared for agriculture by 1890.

Currently, the main agricultural activity is cattle grazing with some orchards and cropping. Land use practices such as clearing have resulted in a loss of native vegetation and erosion. A degraded river channel and banks leads to an increase in the velocity of flood waters, causing increased erosion and sedimentation in-stream. Subsequent weed invasion has an impact on the biodiversity of native vegetation and causes loss of fauna across the catchment.



The Wilsons River (shown here at Federal) is the main tributary of the Richmond River

3 THE NATURAL ENVIRONMENT

3.1 Climate

This region has a humid subtropical climate with mild winters and hot summers. The Northern Rivers has a high level of rainfall; average rainfall each year is over 180 centimetres compared to an Australia wide average of only 60 centimetres.¹

Historically, the months between January and May are the wettest while September and October are the driest. This means that more water is collected in late summer and autumn than in the rest of the year.

The immediate coastal strip (e.g. Broadwater area) is generally frost-free. Further inland, frosts can occur several times a year.

3.2 Geology and soils

The Richmond catchment contains significant areas of volcanic derived soils and basalt rocks, mixed with older layers of sedimentary rocks (especially slate). The basalt was laid down by sequences of lava flow 20 million years ago from a huge ancient volcano, of which Mt Warning (Wollumbin) is its remaining core. Rainwater flows across these soils as 'run-off' and filters down through the soils and porous rock layers into the groundwater that feeds waterways. This water dissolves minerals from the volcanic geology, producing water with high levels of iron and manganese.

The complex geology and parent rock material of the Richmond catchment have resulted in a variety of soil types, depending on location. In the lower reaches of the catchment, acid sulphate soils are common in extensive back-swamp wetlands.

3.3 Riparian vegetation

Vegetation along waterways and around wetlands is named 'riparian' vegetation. A riparian zone is land alongside creeks, streams, gullies, rivers and wetlands. These areas are unique and diverse, and are often the most fertile parts of the landscape. This booklet covers riparian vegetation in particular. Details of our local riparian vegetation types are contained in the appendix and section 6.

In a natural or well-managed state, riparian areas are important for many reasons. They can support diverse

vegetation, help maintain bank stability and increase ecological and economic productivity. These conditions support cleaner water, better habitat for wildlife and help to retain important nutrients and soil.

Nature has designed riparian vegetation to withstand strongly flowing water and long-term inundation, but riparian areas are vulnerable and easily degraded. Damage can be caused by uncontrolled stock access, clearing for agriculture or urban development, invasion by plant and animal pests, such as broad-leaf privet (*Ligustrum lucidum*) or the European rabbit (*Oryctolagus cuniculus*) or through recreational activities. Waste from livestock can contribute to pollution, and trampling can destroy vegetation, harm soil structure and result in loss of valuable soil and land.

The importance of managing riparian land well is increasingly being recognised and protection, rehabilitation and restoration work is being undertaken across the Richmond catchment.

3.4 Vegetation corridors

Riparian vegetation in our catchment forms corridors which link to well-forested areas under National Parks and State Forest tenure, contributing to the conservation of biodiversity at the landscape scale.

Vegetation corridors are important wildlife habitat, allowing animals to travel from one patch of native forest to another. A corridor provides shelter, food and protection from predators. Birds, reptiles, amphibians, mammals and insects that would otherwise be isolated in one native forest patch can utilise corridors to move across the landscape with relative ease and safety.

3.5 Native vegetation type

Each sub-catchment of the Richmond has a specific suite of riparian vegetation which is determined by various factors such as river flow, geology, rainfall, slope and adjacent vegetation types.

The main riverbank vegetation of the streams in the north-eastern, mid and lower Richmond catchment consists of subtropical and floodplain rainforest plant species. The rainforest communities adjoining the riverbanks have been extensively cleared in the past and now have the conservation status of Endangered Ecological

Communities. Remaining stands are often small and isolated remnants that require weed management and protection.

Some rainforest trees grow to 20–30 metres tall and produce a shady canopy cover of 70 per cent or more. The subtropical and floodplain rainforests are very diverse and may contain more than 40 tree species at some locations. Typical large canopy trees include figs (*Ficus* species), lilly pillies (*Syzygium* species), black bean (*Castanospermum australe*), silky oak (*Grevillea robusta*), pepperberry (*Cryptocarya obovata*) and other native laurels. Trees emerging out of the main canopy, such as fig species, may be up to 50 metres tall with large, spreading crowns.

Understorey trees, shrubs and groundcovers include creek sandpaper fig (*Ficus coronata*), cheese tree (*Glochidion ferdinandi*), lomandra and dianella species, and shield ferns (*Lastreopsis* species).

The riverbank vegetation in the drier western areas of the Richmond catchment has a more mixed species composition with eucalypt species, such as forest red

gum (*Eucalyptus tereticornis*), casuarina species, tea-trees (*Leptospermum* species) and bottlebrushes (*Callistemon* species) occurring with rainforest trees.

The far north-western reaches of the upper Richmond River (above Kyogle) will support a riparian forest of water gum (*Tristaniopsis laurina*), lilly pillies (*Syzygium smithii* and *Syzygium australe*), flooded gum (*Eucalyptus grandis*) and blue gum (*Eucalyptus saligna*).

The south-eastern reaches of the Richmond catchment (below Coraki) are affected by the influences of tidal water from the Richmond estuary. Riverbank species show an ability to tolerate brackish conditions and consist of a mixture of coastal rainforest, floodplain and wetland species.

Remember, when restoring riverbank vegetation it is important to plant species suitable for the location and in the correct position on the riverbank i.e. toe, middle or upper bank. To check which species suit your riverbank, please refer to Table 1: Species by stream and location on page 19.



Riparian vegetation at Emigrant Creek acts as a buffer between waterways and adjacent farms

¹ Source: Australian Bureau of Statistics

4 WHY REHABILITATE WATERWAYS?

4.1 The impact of vegetation on water quality

Lack of vegetation along waterways can lead to accelerated run-off, increased stream bank erosion, greater impacts from catchment land uses, decline in important wildlife habitat, reduced water quality and damage to in-stream ecosystems.

On a catchment scale, vegetation influences the volume and rate of run-off into the waterways and traps and filters sediments washed from the soil surface. Depending upon the intensity and duration of rainfall, vegetation in the catchment can reduce flood peaks by slowing down the entry of the water into the stream, thus reducing flow velocities, stream energy and erosion potential.



The condition of the adjacent land and vegetation influences river health and water quality. Lack of vegetation has contributed to bank erosion on the far bank

4.2 How a healthy riparian zone works

A healthy riverbank (riparian zone) is covered with a diverse range of native vegetation including ground covers, rushes, shrubs and medium to tall trees (see Figure 5: The sections of the riparian zone on page 18). Good continuity of native vegetation and their root systems lock the riverbank together, minimising the risk of erosion.

Common river rehabilitation measures are the management of stock access through fencing and the provision of off-stream watering points and regeneration of native vegetation using weed control, natural regeneration and revegetation plantings.

These measures provide the following benefits:

Bank stabilisation

- Retention of riverbank vegetation reduces damage by stock grazing and hooves that cause soil compaction.
- Fibrous roots of native vegetation are intertwined and bind soil in place.
- Vegetation creates channel roughness and slows down high flows, thereby reducing the force of water flow on banks.

Improved water quality

- Vegetation traps sediment which would otherwise run into waterways.
- Vegetation traps moisture which improves soil health and decreases erosion resulting from dry soil.
- Vegetation filters out animal effluent, fertilisers and chemicals which would otherwise run into waterways and lead to the growth of nuisance plants and algae.
- Vegetation shades waterways, reducing light and water temperature levels, limiting the growth of nuisance plants and algae.
- Riverbank vegetation flexes in fast flows to cover riverbanks and thereby protects the banks. Water moves quickly over the plants and slower between the plants.

Improved farm productivity and land values

- Retained topsoil by erosion control for stock and crops
- Improved water quality
- Healthier stock due to reduced exposure to waterborne parasites and diseases, and less incidence of hoof disease such as foot rot
- Reduced distance for stock access to paddock watering points, rather than stock having to travel long distances, often over rougher ground, to access river water
- Vegetation provides shade for stock and reducing the impact of high winds on stock and crops
- Vegetation provides habitat for insect-eating birds, which help protect stock, pastures and crops from insect damage

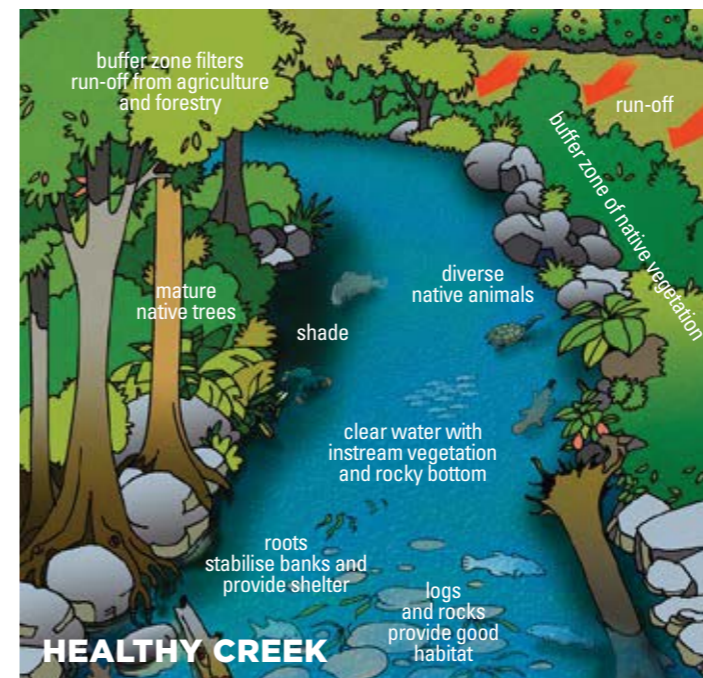
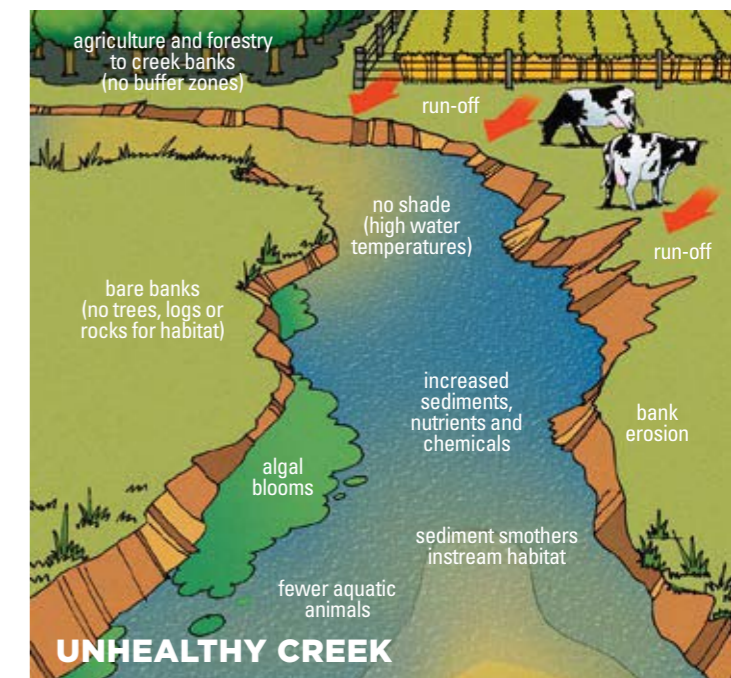


FIGURE 2: Features of healthy and unhealthy creeks

- Improved aesthetic quality of landscapes with riverbanks vegetated with diverse native vegetation
- Well-vegetated riparian frontage adds to the market value of a rural property.

Improved biodiversity conservation

- Weed control protects existing native vegetation and new seedlings by removing smothering weeds
- Revegetation planting reinforces areas of native vegetation (using local native plants propagated from seed collected from the district), enhancing vegetation corridors along waterways and along fence-lines and connecting to well-forested slopes in National Parks and State Forests
- Reduced light and temperature levels in waterways,



- Maintaining good habitat for aquatic animals, including water bugs and the fish that feed on them
- Improved wildlife habitat, allowing ease of movement by native animal species through corridors.

Vegetation buffer zones

- Filters sediments and nutrients contained in run-off from up-slope
- Improved stream bank stability
- Shade of stream and foreshore areas reducing stream water temperature
- Decreased algal growth
- Provides improved habitat for a range of plants and animals (including fish).

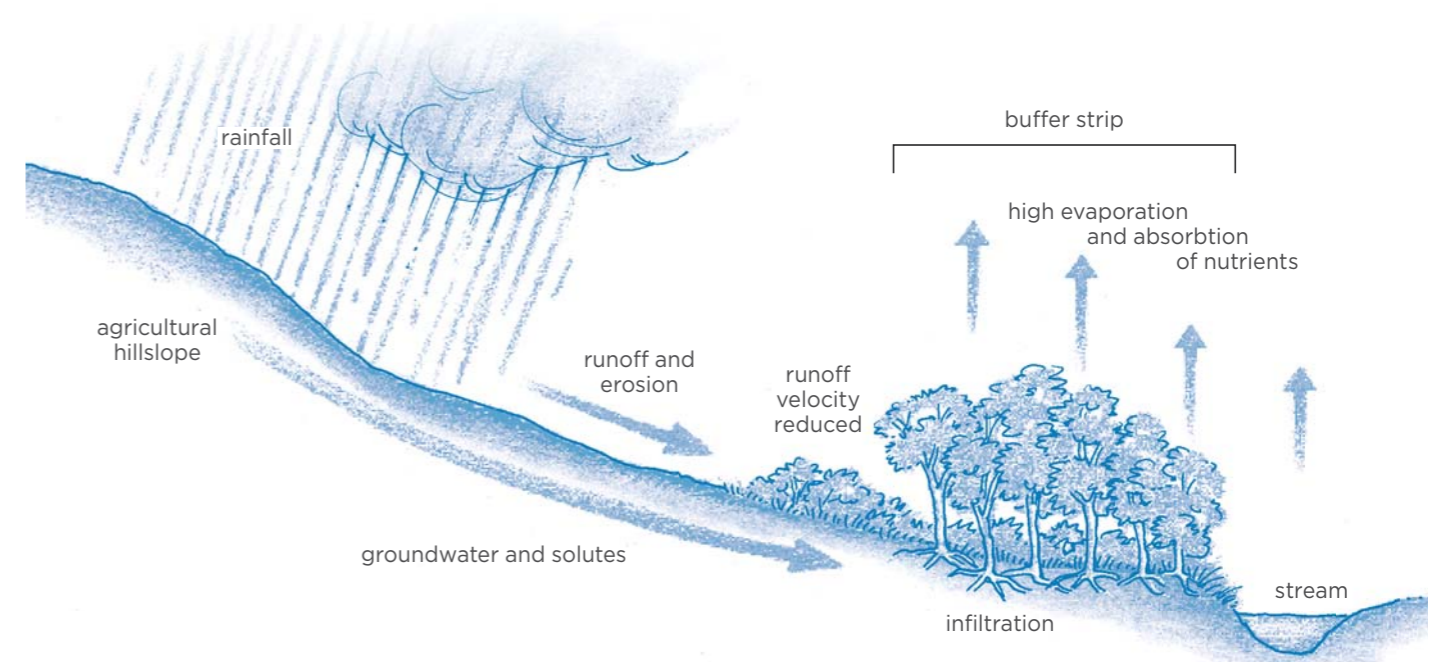


FIGURE 3: How a riparian buffer strip functions to protect the stream from contaminants

5 STRATEGIES FOR RIPARIAN REHABILITATION

Protecting our waterways is a responsibility shared by industry, business, landholders, communities and individuals. We can't work successfully in isolation but together we can look after waterways. Every control measure counts and contributes to the health of waterways in the long term.

5.1 What can landholders do?

Landholders can protect waterways by:

- improving the condition of waterway frontages with vegetation
- protecting, restoring and regenerating native vegetation on farms
- creating buffer zones between agricultural activity and the waterways flowing through our catchments.

Support may be available to protect and restore riparian vegetation in our catchment areas. This is because there is increasing recognition that healthy catchments have benefits for the wider community as well as for landholders. Contact Landcare, Rous County Council or Local Land Services for further information.



Landholders can protect waterways

5.2 On-ground riparian work

Site assessment

Determine which restoration options are appropriate. Managing any area of land begins with an assessment of the site specifically to identify existing vegetation, landscape features and degradation characteristics. These characteristics will dictate the most appropriate restoration methods to be used on the site. Advice and assistance from professionals may be beneficial or required.

Planning your riparian restoration activities should take into account seasonal factors, which will influence when you carry out site preparation and the timing of weeding, regeneration and revegetation activities. If required, earthworks will need a permit and may best be carried out during periods of low flows or no flows (e.g. drought). They should be completed before any revegetation is done and with sufficient time to consolidate before the next flood.

Site assessment steps

- ✓ Map the site, identifying the condition of the site on a scale of good to bad areas.
- ✓ Assess riverbank and bed stability, erosion and other structural features of the riparian area.
- ✓ Identify the cause of problems and determine the need for any physical structures to control actively eroding areas. If possible, tackle the cause of the problem rather than just the end result.
- ✓ Document existing native vegetation – species present, health and structure of vegetation, plant community type – does it differ from original type and what is its recovery potential?
- ✓ Assess the presence of weed species and their impact on the site.
- ✓ Consider land uses, grazing and the need for stock fencing.
- ✓ Consider other issues and impacts at the site, such as flood, frost, drought and aquatic plants.
- ✓ Re-assess the site as the project is implemented to monitor progress and possibly modify actions to ensure a positive outcome.

Site selection

To maximise the benefits of healthy riparian vegetation, wherever possible:

- Maintain sites over 20 metres in width.
- Avoid too narrow an area as it will be easily invaded by weeds and impacted by flooding and farm run-off. At the very least, the area should be a minimum of 10 metres wide. The broader the area, the more resilient the vegetation will be.
- Remember that for an east-to-west running stream most shade is provided from the northern bank so, if possible, prioritise this bank for work.
- Undertake revegetation planting to reinforce areas in good condition or areas where you have already begun work.
- Maximise effectiveness by building upon existing stands of vegetation and areas where natural regeneration is already occurring.
- Consider site maintenance requirements, such as maintenance of fences and follow-up weed control.
- Avoid overstretching your time and resources. In areas of heavy weed infestation you will need to consider working over a much smaller area at the outset, gradually working over a larger area.

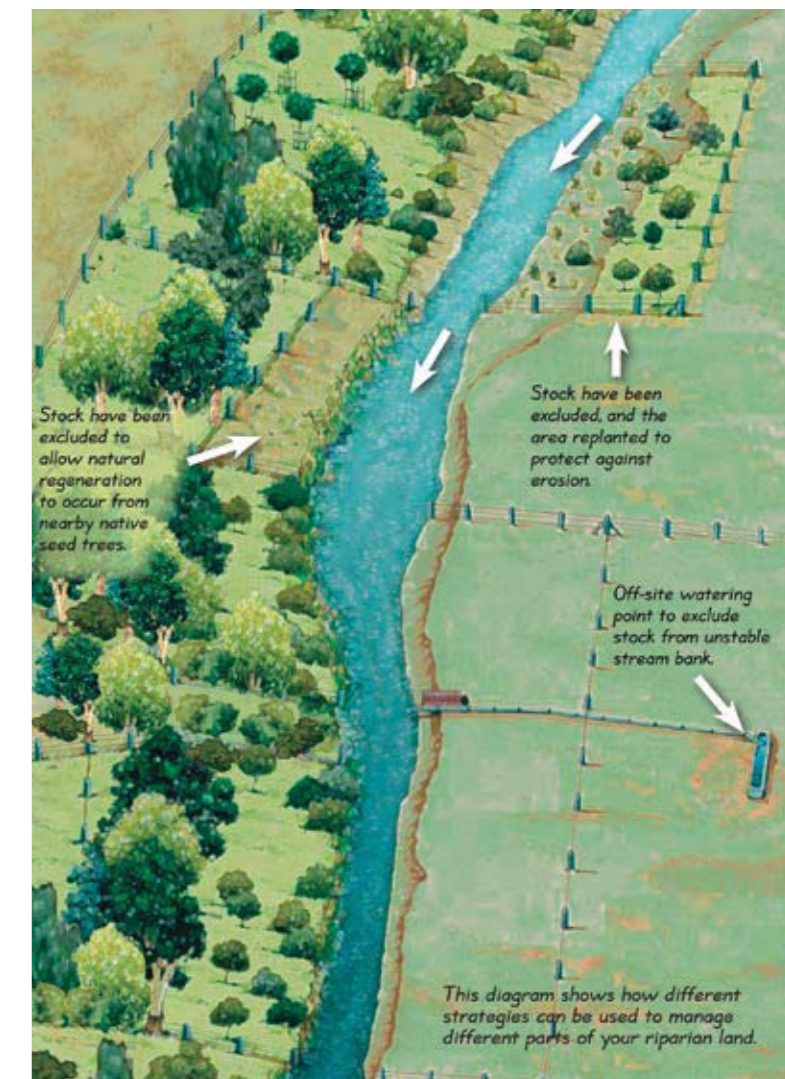


FIGURE 4: Different strategies that can be used to manage different parts of riparian land

5.3 Vegetation regeneration

The process of vegetation regeneration

There are several methods of vegetation regeneration practiced in the Richmond catchment. The following method provides one example:

1. Retain and protect existing vegetation.
2. Control weeds to allow the natural regeneration of seedlings from the existing seed bank in the soil and from nearby seed sources.
3. Do revegetation planting in areas where natural regeneration is not taking place, using plant species of local provenance grown from seed collected from the local area.

Target condition

Every site is different so a good way of assessing the target condition for your site is by comparing it to a nearby remnant of intact native vegetation.

Generally, vegetation will be considered to be in target condition when:

- the immediate seed sources of major infesting weeds are removed and there are no seed producing mid/upper canopy weed species within the zone
- stock impacts to the site are reduced or minimised to the point where understorey native plants (such as lomandra species) can establish without being continually grazed
- there is sufficient existing native canopy cover (50–100 per cent) to shade out and suppress weed infestation (e.g. if the native canopy is thick enough, juvenile privet will stay suppressed as an understorey ground cover and will not produce seed), and
- areas that have been replanted with native seedlings, or where native regeneration has occurred as a result of increased light availability (e.g. the removal of introduced canopy species) and weed control, the survival rate is at least one plant per 5 square metres after two seasons. Plantings must survive at least two winters to be considered suitably established and must be progressing towards a canopy cover to reduce weed regeneration (i.e. 50–100 per cent at 2 metres high).

Natural regeneration

Natural regeneration refers to the natural regrowth of native species from seeds within the existing soil profile or seeds brought in by birds, bats or the wind from nearby vegetation in good condition.

Basic principles of natural regeneration

- ✓ **Work from areas with vegetation in good condition (with the least weeds) to areas in worse condition (the fewest natives) for more effective long-term results.**
- ✓ **Disturb the soil as little as possible. This principle recognises the fact that disturbed ground favours the growth of weeds.**
- ✓ **Carry out gradual weed control in response to the rate of natural regeneration, so that weeds do not regrow in areas exposed to light by excessive weed control completed before natural regeneration occurs.**
- ✓ **Smaller areas under frequent weed control often display better progress towards target condition in the long term than infrequent weed control in larger areas.**
- ✓ **If working in a large area, divide it into management zones to make the work more efficient and manageable.**

This results in the regeneration of vegetation composed of locally appropriate and often diverse plant species. Natural regeneration preserves local genetics and helps maintain biological diversity.

For these reasons natural regeneration, in areas likely to have a soil seed bank, is always preferred over revegetation.

5.4 Weeds and their control

Environmental weeds are plants that invade natural areas. They are common beside watercourses in the Richmond catchment. They cause major problems on a range of private, public reserve and riparian lands, and can lead to high levels of degradation and loss of biodiversity.

Weeds are commonly spread by livestock, birds or mammals, through dumping of garden waste, from garden escapees, or via wind dispersal. Floods also carry and spread weed seeds.

Remember to identify weeds correctly. Seek advice if in doubt and do not remove them if you are unsure about their identification as they may be native plants.



Part of your property management plan, a weed control program should be included specifically for riparian areas

Weed control methods

As part of your property management planning, a weed control program should be included specifically for riparian areas. If an area is fenced to control livestock access, follow-up weed maintenance will be vital to control initial weed growth.

Weed control programs may involve one or more of the following options:

- strategic slashing of the area
- herbicide treatment to kill weeds and their seed source
- physical removal by hand or machinery
- biological control methods
- promoting native regeneration to increase competition with target weeds
- revegetation to shade out germinating weeds
- cover crops (e.g. millet) to suppress weed regrowth on bare areas
- controlled short-term grazing after young trees establish (usually after 5 years) and emerging native plants are protected.

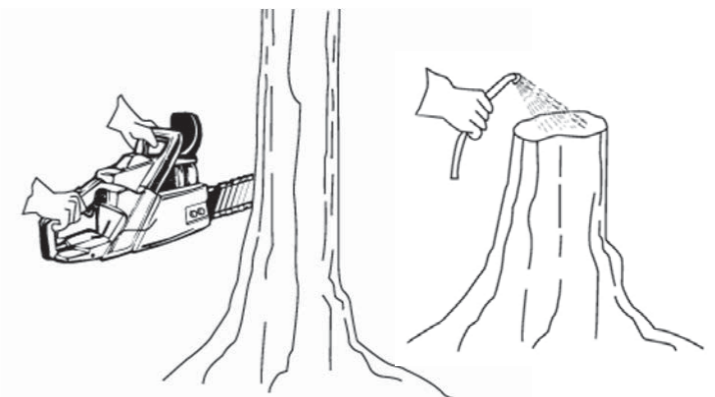
Control techniques

There is no single control technique applicable for all riparian weeds but rather a variety of approaches is likely to target the most number of weeds and achieve the best results. For some species there are several appropriate control methods which may vary according to the season and the stages of the weed's growth.

Where there are no viable alternatives, herbicides are commonly used for controlling weeds in agricultural and

non-agricultural situations. Numerous forms of application techniques and equipment are available to apply herbicides. The appropriate option will be determined by the size of the infestation, the available resources, access and personal preferences. The most commonly used application techniques are listed and described below. Always remember to read the product label and get relevant permits before using herbicides.

Cut and paint



Here the plant is cut off completely at its base (no higher than 15 centimetres from the ground) using a chainsaw, axe, brush cutter or machete (depending on the thickness of the stem/trunk). The herbicide solution is then sprayed or painted onto the exposed surface of the cut stump that emerges from the ground, with the objective of killing the stump and the root system.

It is imperative that the herbicide solutions are applied as soon as the trunk or stem is cut. A delay of more than 15 seconds between cutting and applying the chemical will give poor results as the plant will 'seal' its cut quickly. Two operators working as a team can use this method

effectively. The herbicide can be applied from a knapsack, or with a paintbrush, drench gun or a hand-spray bottle. It is a good idea to use a brightly coloured dye in the solution to mark the stumps that have been treated.

This method has the appeal of removing the weed immediately and is used mainly for trees and woody weeds.

Scraping down the sides of the cut stump and then applying herbicide may increase the success rate of this treatment for more robust weeds (this method is called 'cut, scrape and paint').

Note: Cut the stem as close as possible to ground level to achieve best results.

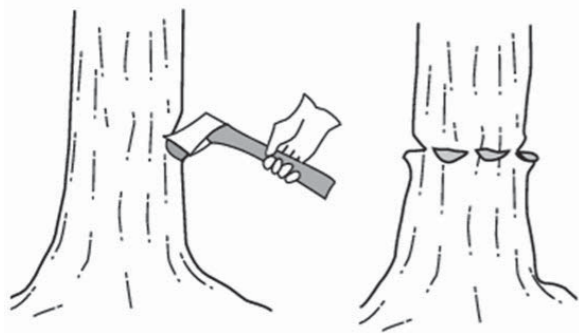
Stem inject

This method involves drilling or cutting through the bark into the sapwood tissue in the trunks of woody weeds and trees. Herbicide is immediately placed into the hole or cut. The aim is to reach the sapwood layer just under the bark (the cambium growth layer) which will transport the chemical throughout the plant.

It is essential to apply the herbicide immediately (within 15 seconds of drilling the hole or cutting the trunk) as stem injection relies on the active uptake and growth of the plant to move the chemical through its tissues.

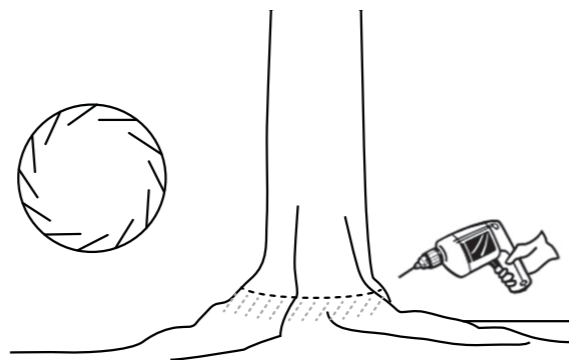
Stem injection methods kill the tree or shrub where it stands. Only trees and shrubs that can be safely left to die and rot should be treated this way. If a tree is to be felled allow it to die before completely felling.

Stem injection – axe cut (or tree frilling method)



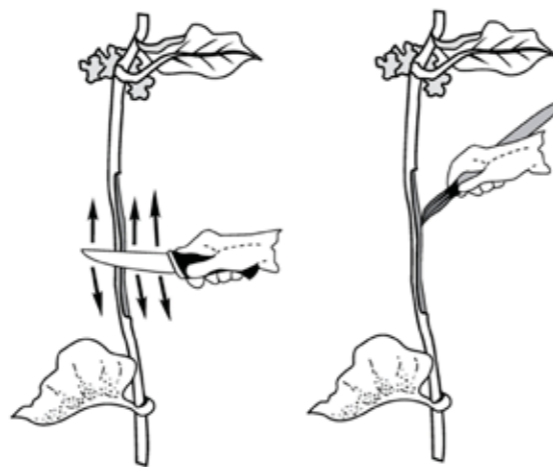
Use a heavy tomahawk to make 3-centimetre-deep cuts into the trunk at waist height or lower. While the tomahawk is still in the cut, lean the top outwards (away from the tree) to open up a pocket. Fill the pocket with herbicide immediately after inflicting each cut (i.e. in less than 15 seconds). Repeat these steps as you circle around the trunk at two levels, with pockets offset from each other.

Stem injection – drill and fill method



The stem injection method is used for trees and woody weeds with stems or trunks greater than 5 centimetres in circumference and in practice gives a more reliable result than the frilling method. The method uses a battery-powered drill with an 8 millimetre drill bit to make downward-angled 3-centimetre-deep holes into the sapwood, approximately 5 centimetres apart. Then immediately fill the holes with herbicide (i.e. in less than 15 seconds).

Stem scrape



Stem scraping is used for vines. A sharp knife is used to scrape a very thin layer of bark from a 15–30 centimetre section of the stem. Herbicide is then immediately applied to the exposed soft underlying green tissue. This method is also called bark stripping or stem painting. With some woody weeds you can also peel away the bark surface and paint the exposed wood or spray it with herbicide.

Foliar spraying

Foliar spraying is the use of herbicide diluted with water at a specific rate and sprayed over the foliage to the point of run-off (until every leaf is wet but not dripping). This method is most suited to shrubs, grasses and dense vines less than 6 metres tall so that complete coverage is achieved.

Advantages include quickness and economy. Disadvantages include the potential for spray drift and off-target damage. Foliar spraying can be done a number of ways, depending on the size of the weed plant and/or the infestation. Take extra care to avoid herbicide run-off and spray drift when working near waterways.



Crowning

Crowning is a suitable weeding technique for plants that don't regrow from their roots. Hold leaves and stems in one hand and cut through all the roots below the crown with the other.

Common weed species

Some of the most common weeds occurring in the Richmond catchment are listed in the appendix. Refer to NSW WeedWise (www.weeds.dpi.nsw.gov.au) or the Department of Primary Industry's Noxious and Environmental Weed Control Handbook – A Guide to Weed Control in Non-crop, Aquatic and Bushland Situations for detailed advice and other options for control.

Helpful hints

- ✓ Target highly destructive weeds (e.g. madeira vine, cat's claw, balloon vine or climbing asparagus fern) first.
- ✓ Minimise site disturbance as you work.
- ✓ Do not over-clear; only tackle areas you can maintain.
- ✓ Work with the weather and seasons; spray weeds when they are most actively growing.
- ✓ Tackle minor weed infestations, where limited efforts afford high chance of eradication (and therefore satisfaction), as well as high priority areas with major weeds that will require a longer-term control program.
- ✓ Vary the work, remain flexible in your methods and be aware of the weed cycle as you progress.
- ✓ Keep in mind birds and other fauna which make use of certain weeds; replace weeds with appropriate alternative native plants for animal food and habitat.



Riparian vegetation at Emigrant Creek acts as a buffer between waterways and adjacent farms

6 REVEGETATION PLANTING, SITE PREPARATION & MAINTENANCE

In areas where natural regeneration does not occur, planting of locally indigenous plant species is recommended. Replanting is suitable or necessary for degraded areas that have been severely overgrazed, on sites where there is little or no existing native vegetation and on sites that are too far away from other remnant patches that could supply a seed source for natural regeneration.

Try to use plants propagated from seed collected from the local area in order to maintain local genetic diversity.

Please note that the lists provided in this booklet are not exhaustive but show plants which are readily available

from local nursery suppliers. If in doubt about what to plant where, please contact Rous County Council, North Coast Local Land Services, Richmond Landcare Inc. or your local native plant nursery.



In areas where natural regeneration does not occur then planting of locally indigenous plants is recommended.

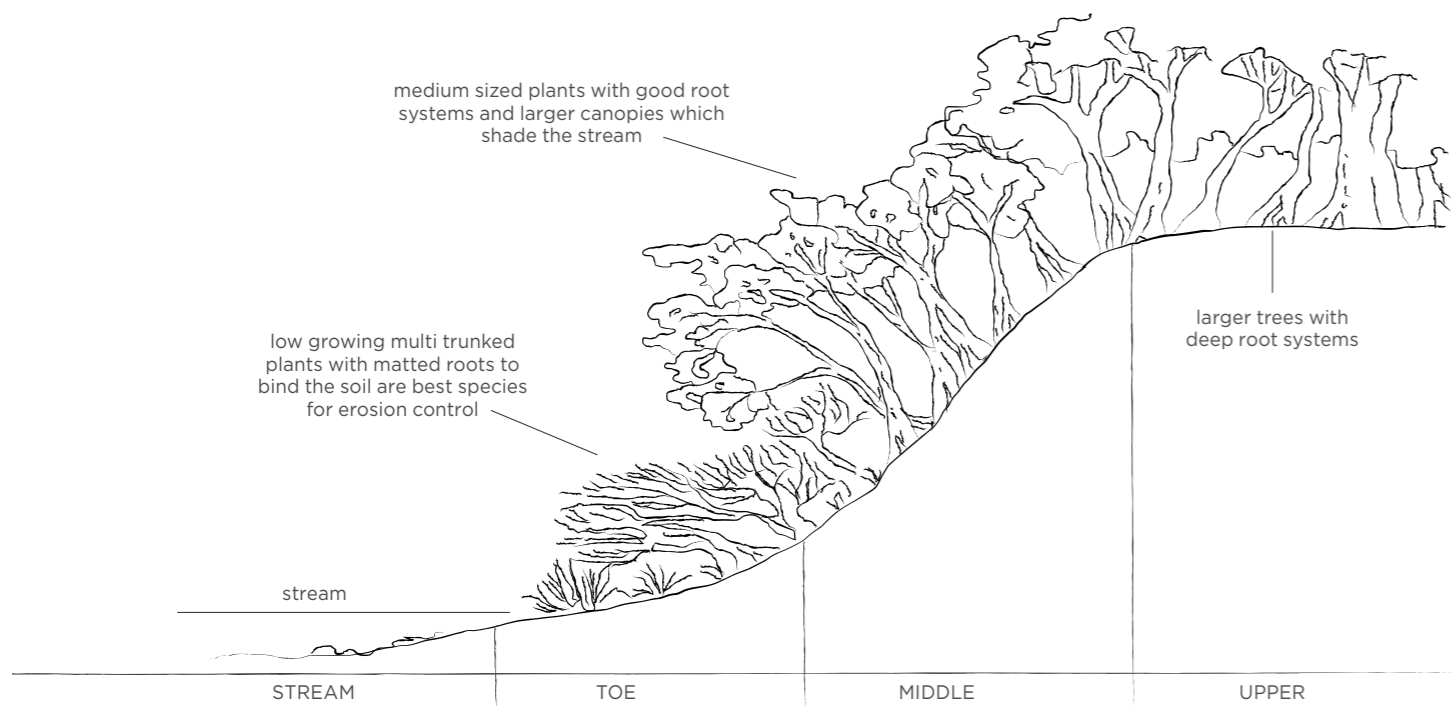


FIGURE 5: The sections of the riparian zone

6.1 Native plants for riverbanks or creek lines (species by stream and location)

Table 1 indicates suitable plants for your location and the correct position of the plants in the riparian area. These lists are not exhaustive but are a good starting point. More information on each plant can be found in the Appendix, section 9.2 'Description of riverbank plants for the Richmond catchment'.

STREAM	TOE	MIDDLE	UPPER
<p>SOUTHERN TRIBUTARIES Including Camira, Myall, Bungawalbin, Myrtle, Busby, Battens Bight, Four Mile and Six Mile creeks.</p> <p>* poorly drained sites ** Busbys Creek only *** Myall and Camira creeks only **** Myrtle and Bungawalbin creeks only</p>	<p><i>Callistemon viminalis</i> *** <i>Casuarina cunninghamiana</i> <i>Casuarina glauca</i> * <i>Ficus coronata</i> <i>Leptospermum brachyandrum</i> <i>Lomandra hystrix</i> <i>Lomandra longifolia</i> <i>Melaleuca alternifolia</i> * <i>Melaleuca quinquenervia</i> * <i>Tristaniopsis laurina</i> <i>Syzygium floribundum</i> **** <i>Syzygium smithii</i> var. <i>minor</i></p>	<p><i>Alphitonia excelsa</i> <i>Castanospermum australe</i>** <i>Casuarina cunninghamiana</i> <i>Casuarina glauca</i>* <i>Dianella caerulea</i> <i>Eucalyptus tereticornis</i> <i>Glochidion ferdinandi</i> <i>Grevillea robusta</i> <i>Lomandra longifolia</i> <i>Melaleuca alternifolia</i>* <i>Melaleuca quinquenervia</i>*</p>	<p><i>Acacia disparrima</i> <i>Acacia irrorata</i> <i>Callistemon salignus</i> <i>Corymbia intermedia</i> <i>Dianella caerulea</i> <i>Duboisia myoporoides</i> <i>Eucalyptus seeana</i> <i>Eucalyptus siderophloia</i> <i>Lophostemon suaveolens</i></p>
<p>NORTH-WESTERN TRIBUTARIES Including Mongogarie, Doubtful, Iron Pot, Eden, Fawcetts, Lynchs, Gradys and Findon creeks and Shannon Brook and Richmond River.</p> <p>* absent from upper reaches ** plant only on streams where already present *** only on upper reaches, on rocky, well-watered streams</p>	<p><i>Callistemon viminalis</i> ** <i>Casuarina cunninghamiana</i> <i>Elaeocarpus grandis</i> *** <i>Ficus coronata</i> <i>Lomandra hystrix</i> <i>Lomandra longifolia</i> <i>Melaleuca bracteata</i> <i>Potamophila parviflora</i> <i>Syzygium smithii</i> var. <i>minor</i> <i>Tristaniopsis laurina</i></p>	<p><i>Acacia melanoxyylon</i> <i>Aphananthe philippinensis</i> <i>Araucaria cunninghamii</i> <i>Archontophoenix cunninghamiana</i>*** <i>Castanospermum australe</i> * <i>Casuarina cunninghamiana</i> <i>Dianella caerulea</i> <i>Elaeocarpus obovatus</i> <i>Glochidion ferdinandi</i> <i>Grevillea robusta</i> <i>Hymenosporum flavum</i> <i>Podocarpus elatus</i> <i>Streblus brunonianus</i> <i>Syzygium australe</i></p>	<p><i>Acacia melanoxyylon</i> <i>Angophora subvelutina</i> <i>Dianella caerulea</i> <i>Duboisia myoporoides</i> <i>Eucalyptus tereticornis</i> <i>Lophostemon suaveolens</i></p>
<p>NORTH-EASTERN TRIBUTARIES Including Back, Websters, Leycester, Jiggi, Terania, Goolmangar, Coopers, Byron, Skinners, Upper Maguires, Duck, Tucki Tucki and Marom creeks and Wilsons River.</p> <p>* only on streams west of and including Goolmangar Creek ** upper reaches of streams only *** for protected sites</p>	<p><i>Syzygium smithii</i> var. <i>minor</i> <i>Syzygium smithii</i> <i>Callistemon viminalis</i> * <i>Casuarina cunninghamiana</i> * <i>Elaeocarpus grandis</i> ** <i>Ficus coronata</i> <i>Lomandra hystrix</i> <i>Sloanea australis</i> *** <i>Tristaniopsis laurina</i></p>	<p><i>Aphananthe philippinensis</i> <i>Archontophoenix cunninghamiana</i>*** <i>Castanospermum australe</i> <i>Cryptocarya obovata</i> <i>Dianella caerulea</i> <i>Diploglottis australis</i> <i>Elaeocarpus obovatus</i> <i>Glochidion ferdinandi</i> <i>Grevillea robusta</i> <i>Heritiera trifoliolata</i> *** <i>Hibiscus heterophyllus</i> <i>Sloanea woollsii</i> ** <i>Streblus brunonianus</i> <i>Syzygium australe</i> <i>Syzygium francisii</i> *** <i>Toona australis</i></p>	<p><i>Acacia melanoxyylon</i> <i>Alphitonia excelsa</i> <i>Araucaria cunninghamii</i> <i>Commersonia bartramia</i> <i>Dianella caerulea</i> <i>Duboisia myoporoides</i> <i>Elaeocarpus obovatus</i> <i>Eucalyptus grandis</i> <i>Ficus species</i> <i>Flindersia schottiana</i> <i>Grevillea robusta</i> <i>Guioa semiglaucula</i> <i>Jagera pseudorhus</i> <i>Macaranga tanarius</i> <i>Mallotus philippensis</i> <i>Melia azedarach</i> var. <i>australasica</i> <i>Toona australis</i></p>
<p>COASTAL FLOODPLAIN AND TIDAL TRIBUTARIES Including lower Richmond below Coraki, lower Bungawalbin, Emigrant, Maguires and Rocky Mouth creeks, Broadwater, North Creek, Swan Bay and the Evans River</p>	<p><i>Crinum pedunculatum</i> <i>Hibiscus tiliaceus</i> <i>Lomandra longifolia</i></p>	<p><i>Austromyrtus dulcis</i> <i>Dianella caerulea</i> <i>Callistemon salignus</i> <i>Commersonia bartramia</i> <i>Cupaniopsis anacardioides</i> <i>Hibiscus tiliaceus</i> <i>Macaranga tanarius</i> <i>Melaleuca quinquenervia</i></p>	<p><i>Araucaria cunninghamii</i> <i>Casuarina glauca</i> <i>Eucalyptus robusta</i> <i>Eucalyptus tereticornis</i> <i>Lophostemon suaveolens</i> <i>Glochidion sumatranum</i> <i>Syzygium smithii</i> <i>Elaeocarpus reticulatus</i> <i>Ficus species</i> <i>Livistona australis</i></p>

TABLE 1: Species by stream and location

6.2 Site Preparation

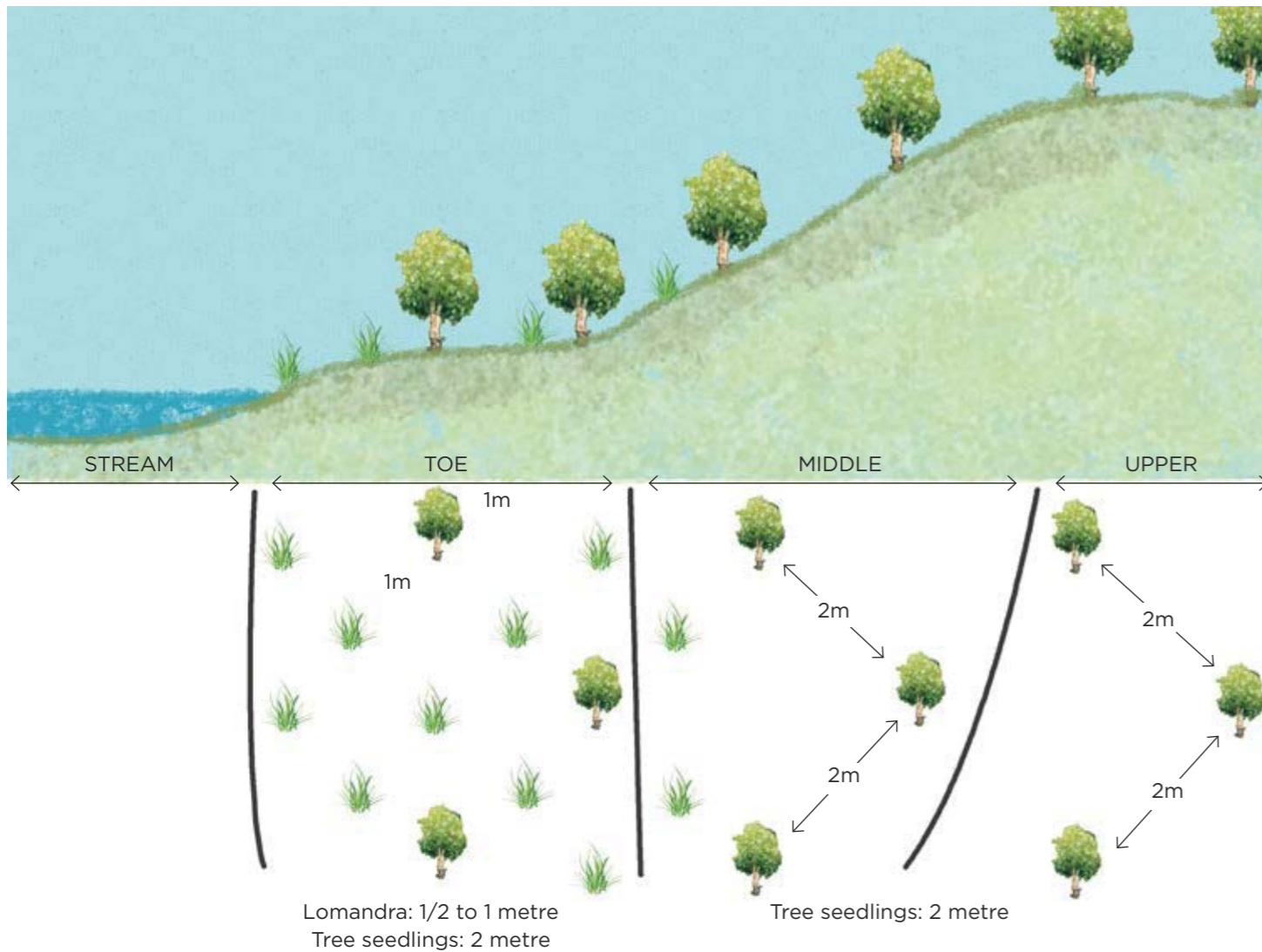
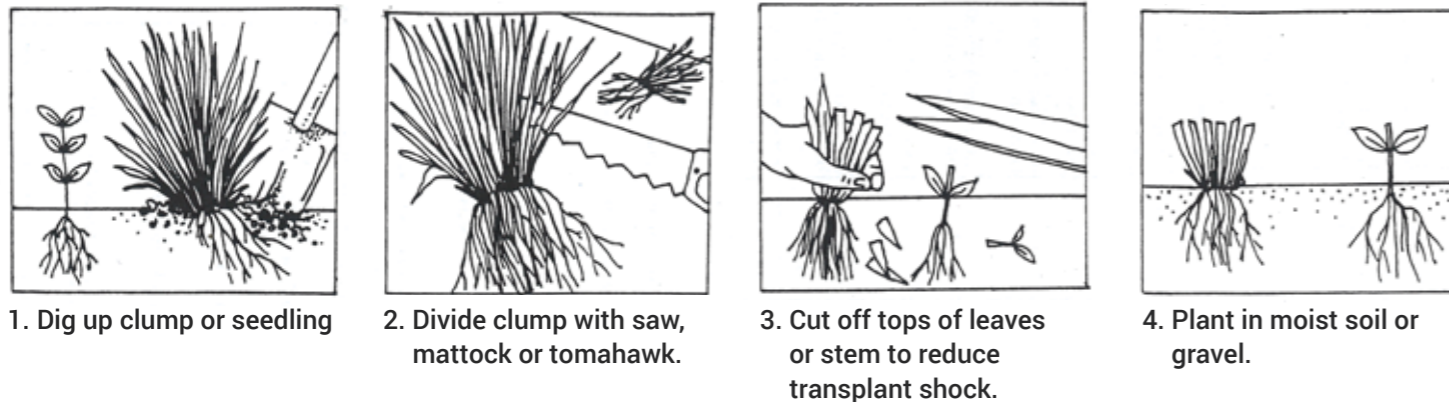


FIGURE 6: Plant Spacing, Streambanks (note: diagram is not indicative of species diversity)

6.3 Planting

Division or direct transplant

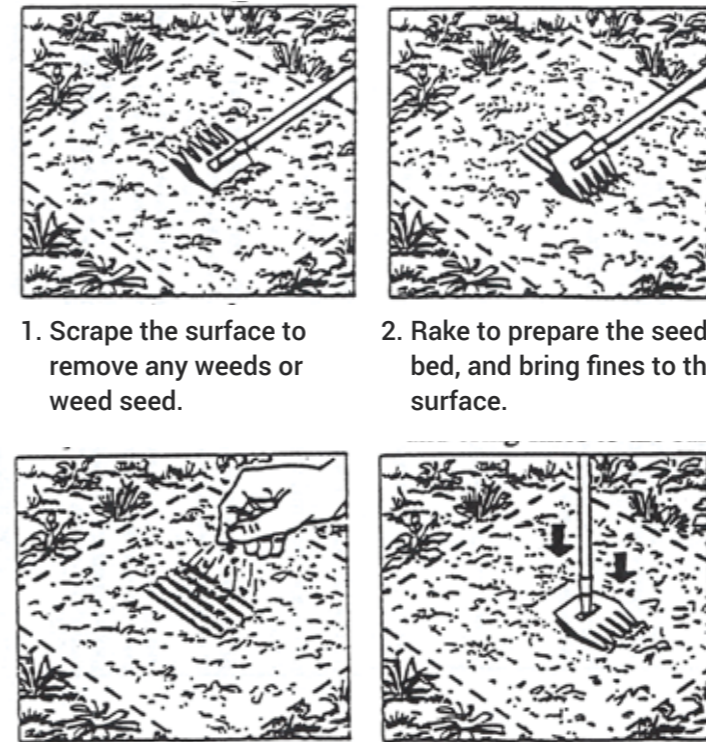
Mature clumps of lomandra or river grass can be dug up, divided and directly transplanted to moist soil or gravel. Seedlings of bottlebrush or tea-tree can also be directly transplanted from site to site. This method is most suitable for toe plantings.



Planting steps for division or direct transplant

Direct seeding

The seed of some species (e.g. bottlebrush, tea-tree, lomandra and water gum) can be directly sown on site. Seed must be sown in moist, weed-free sand or gravel. The gravel is levelled no higher than 100 millimetres above water level against the bank toe. Using this method we are reproducing the natural conditions that allow plants such as river oaks, tea-tree and bottlebrush to densely colonise gravel bars. The aim is to achieve dense colonisation, so sowing rates of up to 0.5 grams per square metre of gravel can be used. This method is most suitable for toe plantings (gravel needs to be moist).

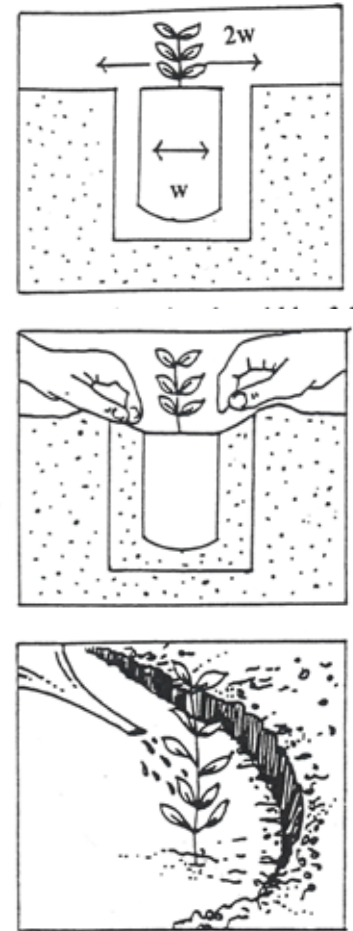


Planting steps for direct seeding

Standard tube stock

This method is most suitable for upper bank/floodplain (flat to undulating land) plantings.

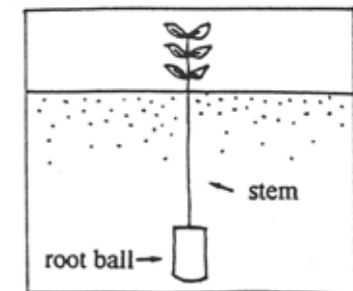
1. Plant when soil is moist and there is no danger of frost.
2. Dig hole twice the width of the pot.
3. After planting, firm the soil to remove air pockets. If planting in coarser materials, place some fine soil in the planting hole.
4. Water in. A slight depression left around the plant will allow water to get where it is needed.
5. Give follow-up water and weed control where needed (weeds slow growth by taking water and nutrients).
6. Check trees regularly for damage by animals. Stake and guard where needed.
7. Mulching helps conserve water.



Other specialised methods

The use of specialised long-stem tube stock involves the growth of seedlings in standard forestry tubes in a nutrient solution, and encouragement of stem elongation. Trees are planted using a water lancing jet to a depth of 1 metre or more. Root growth is achieved much more rapidly. Species tolerant of sediment build up around the stem are used. This method is most suitable for toe or middle bank plantings.

Long-stemmed tube planted in sand. Root growth occurs from the nodes located along the stem.



6.4 Maintenance

Controlling weeds

While some weeds, such as tobacco bush (*Solanum mauritianum*), may protect new plantings from excessive sun exposure and frost, it is essential to keep stock and smothering weeds away from new plantings. If weeds are retained for shelter of young plantings, longer weeding follow-up periods will be required.

Protecting seedlings

It is best to use tree guards where grazing by wallabies is likely. It is also important to use tree guards when planting during and just before the cooler months of the year when frosts are likely. Remove the tree guards when they are no longer required so they do not litter the landscape or wash away during a flood.

An application of slow release, native fertiliser in early spring gives a worthwhile boost to plant growth. Re-apply mulch regularly to inhibit the growth of weeds. Take note of which species thrive on your site and which do not. This information will help you improve your approach to your next planting.

Expanding your revegetated area

If you are considering planting a very large area, it may be possible to plant small groups of trees together and gradually plant outwards from these areas as the original plantings establish. Once your planting has matured, you may encourage natural regeneration to occur around the margins of the planting by simply controlling weeds and limiting stock access in the area immediately adjacent to the planting.

Helpful Hints

- ✓ **Smaller sites** – weed control can be carried out through the careful application of herbicides around the new plants, hand pulling, and regular mulching.
- ✓ **Larger sites** – weed control around plantings can be carried out by spacing plants sufficiently to allow the use of your mower or slasher to maintain areas around the plants, and then weed control can be carried out in close proximity to the new plants through the careful application of herbicides, hand pulling, and regular mulching.



Try to use plants propagated from seed collected from the local area

7 STOCK MANAGEMENT

Livestock that are allowed uncontrolled access to stream banks can directly foul the water with their waste. They also increase soil erosion by over-grazing and forming bare walking tracks and camping areas. This leads to excessive run-off, bank erosion, depleted vegetation, decline in important wildlife habitat, reduced water quality and damage to in-stream ecosystems.

Stock accessing waterways affects river health and water quality by introducing:

- pathogens from stock faeces or stock carcasses, causing an increased risk of disease
- nutrients from stock faeces and urine, causing an increased risk of blue-green algal blooms (some of which can be toxic)

- sediment from erosion and disturbance of stream banks, which harm aquatic life, clog streams and burden the drinking water treatment process.

Furthermore, it is not uncommon for livestock to fall down steep riverbanks or become bogged along the water's edge, resulting in injury or death. This is not only expensive for the livestock owner but can also lead to further pollution of water supplies for downstream users.

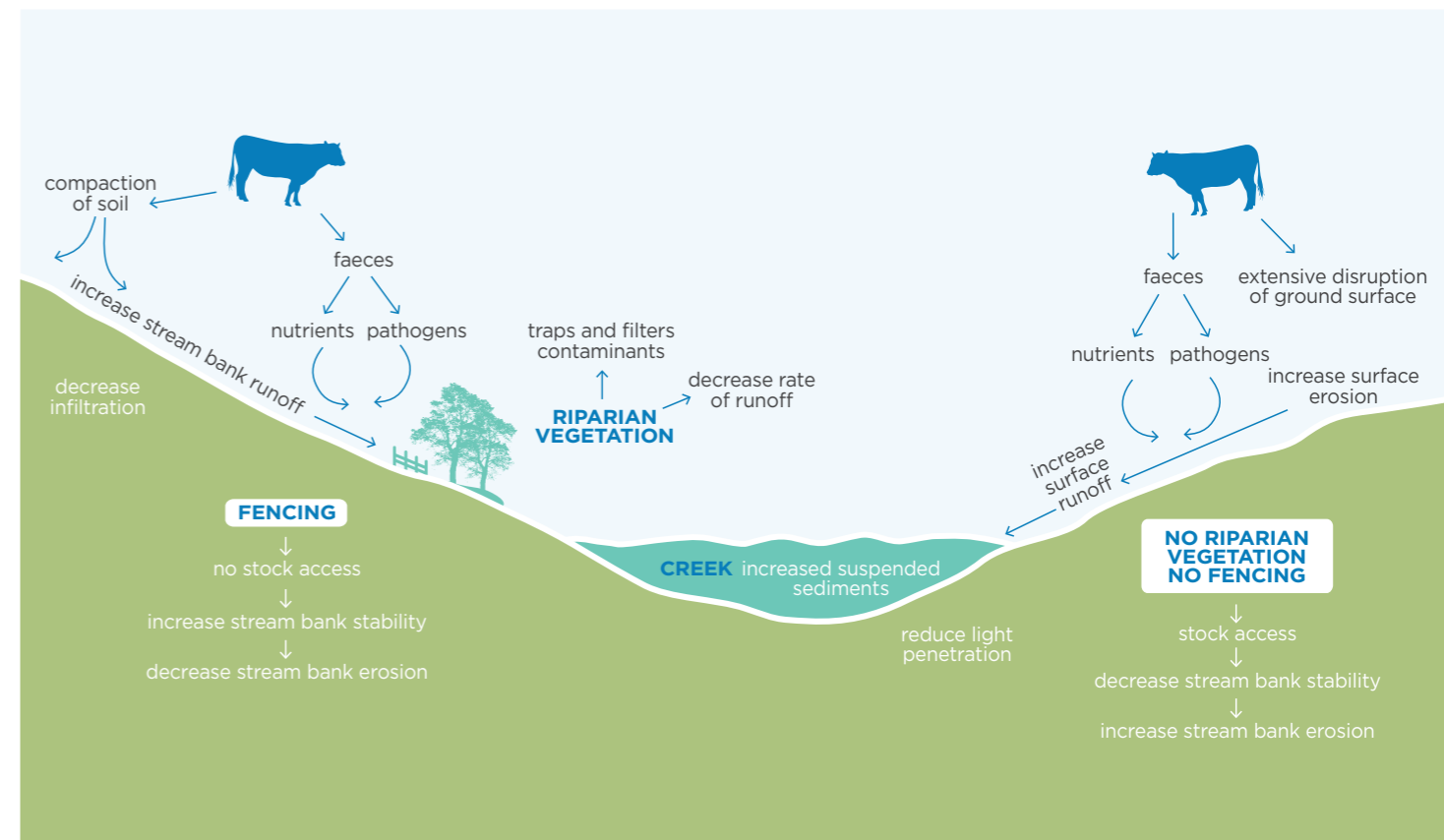


FIGURE 7: Diagram showing landholder management options and impacts on catchment health

7.1 Fencing

Locating fences

Fences too close to waterways are liable to flood damage, so it is best to place fences at least 10–20 metres from the top of the bank. By doing so, you can also take out some of the bends and curves of the stream, reducing the number of end assemblies used. This can help to reduce the cost of the fence.

Fences are best installed parallel to river flow, so that they are less vulnerable to flood damage. If fences are required perpendicular to the flow, then it is best to consider placing a temporary electric fence at these locations so that it can be easily retrieved before flood events and replaced once flood waters recede.

The wider the fenced riparian zone the larger the area covered by vegetation which holds banks in place and increases the resilience of the system to withstand flooding and erosion. Remember to keep riverbank rehabilitation areas at a manageable scale so that weed control can be realistically incorporated with stock management. Temporary grazing of riverbanks can be managed as a method of weed control as long as native vegetation is mature enough to withstand some grazing.

Post and wire fence

Conventional fences built from wooden posts, star pickets and wire are suitable for areas away from the flow of flood waters so that they are not in a position to catch flood debris. Fences which catch debris and with large posts that obstruct water flow are more likely to be washed away in floods.

It is important to attach wire on the downstream side of posts when fencing across flow paths. Using barbed wire is not recommended as it is a particular trap for debris, and wire washed away creates hazards downstream.

Permanent electric fence

Electric fences are much cheaper to construct initially and also much cheaper to repair following unexpected floods. A fence style which has proved to be particularly successful on the floodplain is constructed of star pickets and two live electric metal wires. The wires are ideally charged with a stand-alone solar battery pack to reduce the cost of electricity supply.

Multiple cut-out switches in electric fences are useful to be able to retain power in the sections of the fence that aren't submerged during a flood.

Design considerations for fencing in floodplain areas

Rapidly flowing flood waters can destroy houses, bridges, roads ... and fences! So is it possible to design a fence that will withstand flood waters? The answer is 'probably not' – but it is possible to design one that will suffer minimal damage and that will be easy to repair once the flood waters recede. This section presents some design options for low-maintenance, flood damage resistant fencing.

It is advisable to use materials that are affordable but also durable, suitable for the animal that you are trying to contain or exclude and relatively easy to assemble. Each situation is different and you are best placed to understand what will be the ideal materials and fencing method for your site. Please be aware that fencing technology and materials advance regularly. Your local fencing contractor or the internet may be able to provide you with additional advice.

The text and images in this section represent a few options out of the many options available.



IMAGE 1: The fence protecting this wetland has been designed to be flood resistant. Very strong end assemblies of recycled railway iron support a minimal framework of three electrified plain wires powered by a stand-alone solar-powered energizer.

Fence damage from flood waters is usually caused by the build-up of flood debris against the fence (sometimes called flood wrack). The accumulated debris provides a wide surface area for the flowing water to push against – and the fence fails. If there was no debris in the flood water creating a wall against the fence, the water would most likely pass through the fence and cause little harm (strands of wire offer little resistance to flow). Therefore floodplain fencing should be designed to minimise the collection of flood wrack. This section provides two options for floodplain fencing.

Floodplain fencing – option 1

In this design (see image 1) each section of fence is wired separately so that if one panel does fail it will not pull the rest of the fence with it. The plain wire is much easier to recover post-flood than barbed wire, and the simple three wire panels can be replaced quickly and cheaply should the need arise.

Stand-alone solar power units provide a cheap and easy way of powering-up floodplain fences that are located in areas remote from mains power. Prices start from about \$350 for a 2-kilometre unit (see image 1). Remember – quality construction and good earthing are vital to get the maximum performance out of your electric fence.

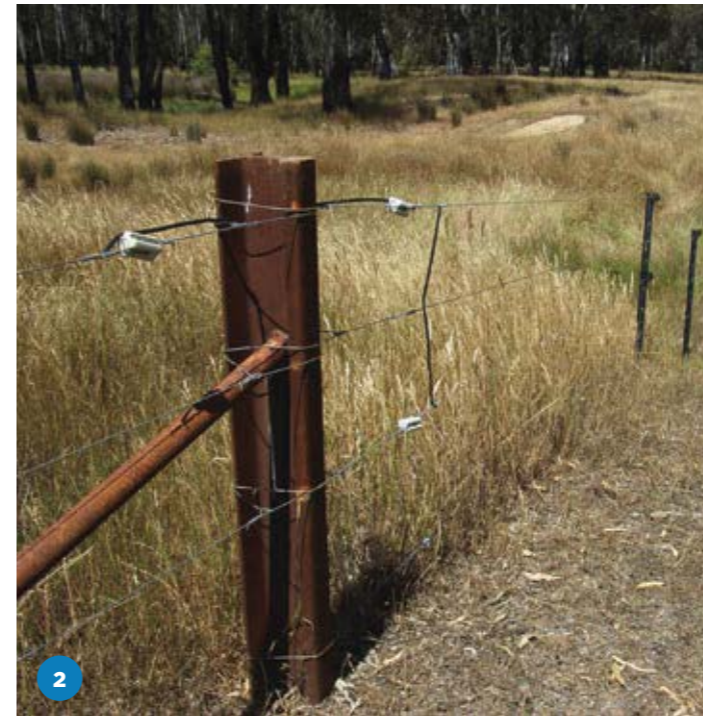


IMAGE 2: End assemblies are the most expensive part of a fence to install. A flood channel crosses this fence from left to right, and this length has been wired as a separate 'sacrificial' section (note the end assemblies each side of the channel). Each section of the fence between the posts have been wired separately (note the wiring at the post in the foreground).

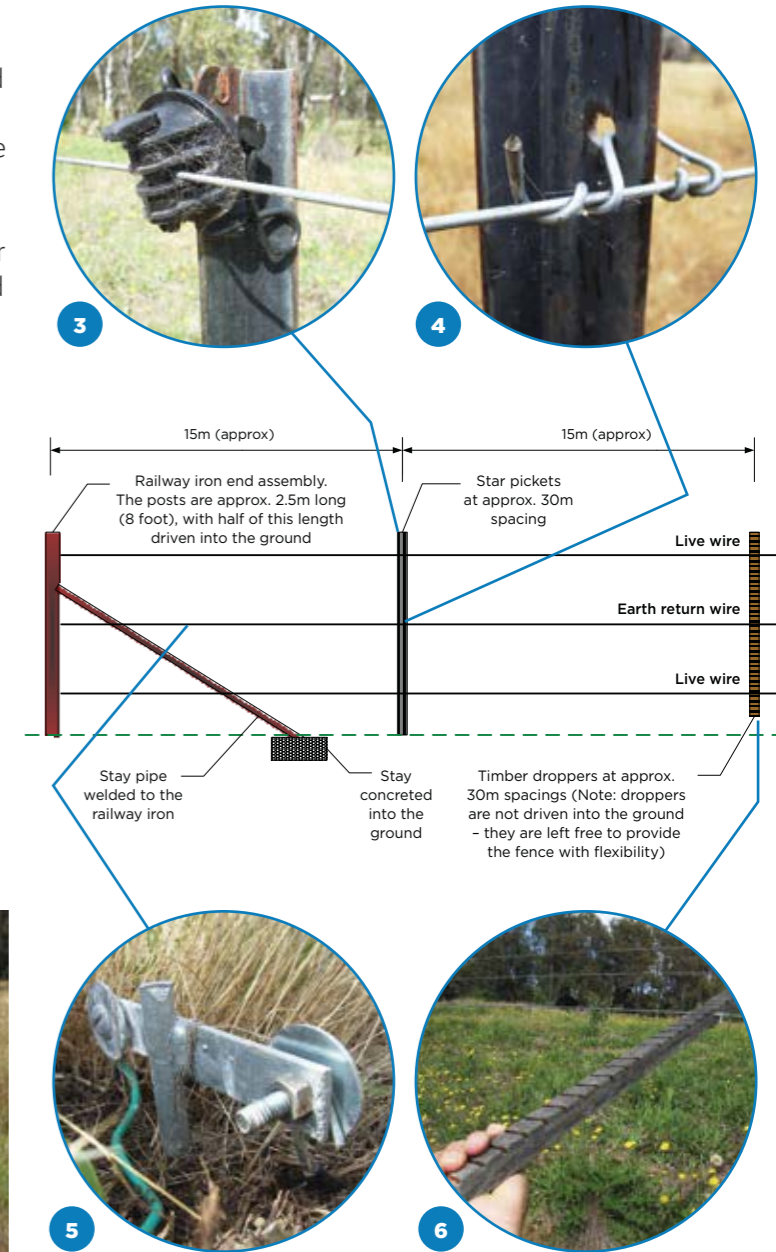


FIGURE 8: Floodplain Fencing – Flexible Electric Fence (option 1)

IMAGES 3 AND 4: Wires are not run through the star pickets themselves, but are attached to the pickets on the downstream side of expected flood flows. The wire will be more likely to release from the picket if it is struck by debris, rather than pulling the star picket out.

IMAGE 5: A close-up of a galvanized earth spike. Proper earthing of electric fencing is vital to ensure maximum performance and a minimum of three, inter-connected 2m long earth spikes should be fitted.

IMAGE 6: Shows how flexible the fence is where droppers are used – this allows debris to flow through the fence with less likelihood of it snagging the wires. This type of fence is ideal for situations where flood flow direction is unpredictable.

Floodplain fencing – option 2

This design (figure 9) involves constructing separate panels of fencing that are attached to hinged end assemblies. This enables the whole fence panel to be folded to ground level, allowing flood waters to pass harmlessly over the prone fence.

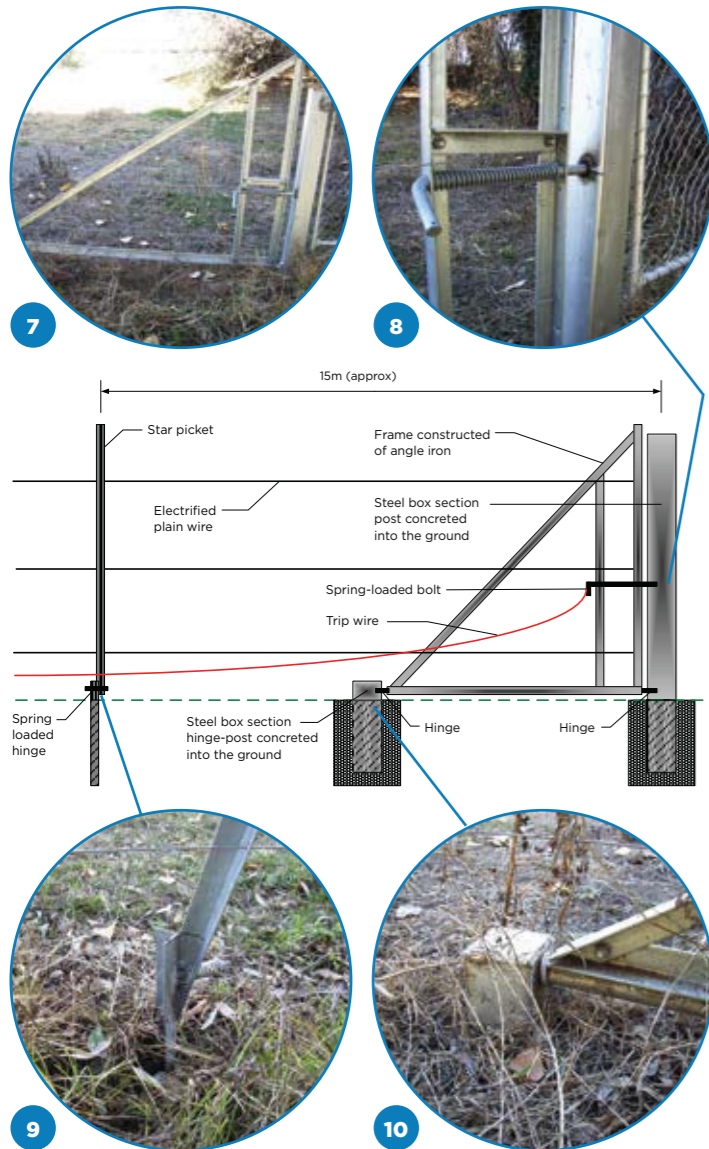


FIGURE 9: Floodplain Fencing – Drop Fence (option 2)

IMAGE 7: The key component of the ‘drop-fence’ is the hinged triangular end assembly.

IMAGE 8: A close-up of the locking bolt that holds the end assembly in place. A trip wire is attached to the spring-loaded bolt (not yet attached in the photo, but note the pre-drilled hole to attach the wire). When flood debris/ flood flows pull on the trip wire the bolt is pulled out of the post and the fence falls to the ground. Alternatively, if a flood is expected, the fence can be laid down manually.

IMAGE 9: Intermediate star pickets are also hinged at ground level with spring loaded bolts.

IMAGE 10: The hinge at the left hand end of the end assembly. This type of fence is best suited to sites where flood flows will reliably hit the fence at right angles (to trigger the trip wire).

Post and end-assembly options

The post and end-assemblies of a fence tend to be the most expensive sections. Material availability and prices can fluctuate considerably so exploring a range of options is worthwhile (e.g. timber, steel, concrete filled heavy-duty galvanized pipe or pre-fabricated concrete posts, although the latter are brittle and prone to damage if struck by large logs during floods). Experience has shown that concreting posts into the ground is the best option. Driven posts, with no concrete, tend to work loose over time in flood-prone areas.

Barbed or plain wire?

Electrified plain wire is recommended for floodplain fencing. The number of wires and their configuration will depend on the type of animal the fence is intended to contain. (The fences displayed in this brochure are typical cattle fence set-ups). Barbed wire tends to pick up flood wrack leading to fence failure. It is also difficult to clean up post-flood, has a reputation for killing wildlife (see image 12) and can lead to hide damage. A barbed wire-damaged hide will fetch less when an animal is finally processed at the abattoir.

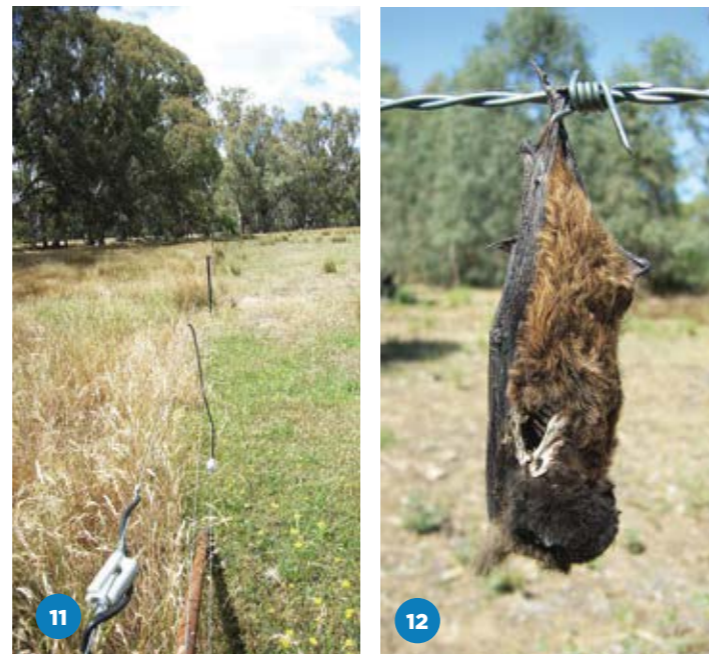


IMAGE 11: This fence has been positioned well away from overhanging trees. This has two benefits: first, damage from falling limbs is greatly reduced and, second, by moving the fence further back from the creek straighter runs of fence are possible. This reduces the number of expensive corner assemblies that are required.

IMAGE 12: Another reason not to use barbed wire; it has a well-earned reputation as a killer of native wildlife. This bat became entangled when the barb pierced its wing membrane.

Fence position

Fences need to be positioned with the long-term maintenance of the fenced area in mind. For example, if stock are to be used to crash-graze an area then it needs to be a sufficient width and well positioned gates will be required to make mustering easy. Fencing further back from a meandering creek line, rather than closely following the bank, means that the number of expensive corner assemblies can be greatly reduced.

7.2 Stock watering

Water troughs

Once a stream bank has been fenced, it will be necessary to provide paddock water troughs. The careful siting of troughs and supplementary feeding stations can also sometimes be used as an alternative to fencing to effectively encourage stock away from waterways.

Landholders have demonstrated that providing shade away from rivers and providing access to clean water in a trough high in paddocks, or providing a trough closer to preferred pastures, significantly reduces the amount of time stock spend on the riverbank without the need for fences. It also helps to place protein and mineral blocks away from waterways.

Ready access to clean, unpolluted water is an important factor in optimising animal health, growth rates and productivity. Hence, the costs of providing alternative water sources for stock, other than through unrestricted access to rivers or streams, may be more than repaid through increased production.



Off-stream watering trough

Dams

In some cases, it may be practical to construct a small dam to provide off-stream watering. When building a farm dam, it is important to make sure that the appropriate consent or licence has been obtained. Make sure that the dam is carefully located so that it is effective, safe and has minimal impacts on neighbours and the environment.

Unless a farm dam is part of your harvestable right, you will need a licence or consent from the NSW Office of Water. To find your harvestable rights, see www.water.nsw.gov.au and search ‘harvestable right calculator’.

The Office of Water has the discretion to approve dams in writing if they are constructed for a specific environmental management purpose, such as providing off-stream stock watering.

Seek expert advice regarding farm dam design and location before commencing construction of any farm dam. Even if you do not require a licence for your farm dam, it is still your responsibility to minimise impacts on your neighbours and the environment. Discuss the matter with your neighbours before constructing a new dam.

Also ensure that during all stages of construction you provide adequate erosion control and minimise disturbance to waterways, areas of native vegetation, and sites of cultural significance.

Apart from determining whether your new farm dam needs a state government licence/approval, consent from local government is required for dams:

- with a maximum surface area of more than 0.5 hectares located:
 - in or within 40 metres of a natural waterbody, wetland or an environmentally sensitive area, or
 - In an area of high water table, or acid sulphate, sodic or saline soils, or
- with a surface area of water of more than 20 hectares or a maximum total water volume of more than 800 megalitres.

Local planning regulations

In many local government areas local environment plans and other planning regulations require consent for construction of dams.

Designated floodplains

If you are considering construction on a designated floodplain you will need to seek consent from the NSW Office of Water regarding flood flow diversion impacts.

Fish passage

Under the *Fisheries Management Act 1994*, any new dam or modification to an existing dam may require the owner to provide for fish passage. Contact your local NSW Department of Primary Industries Fisheries Officer for further advice.

Dams can be used to gravity feed water troughs, or can be constructed with a formed access point to allow planting around the dam for improved water quality.

Formed access point

A less desirable alternative to fencing and water troughs is a formed access point for stock to drink water from the river at a carefully selected section of the bank. It is important to avoid boggy areas and the outsides of river bends where flow speed is high and banks are subject to increased erosive forces.

Cross-stream fencing may be required to prevent animals wandering along the bank. A graded slope into the river is selected or constructed as the site for a formed access point. Its surface is then protected by using concrete, compacted gravel, logs or similar materials to form a walkway.

It is important to consider likely changes in the depth of flow in order to make sure that access to water is available for as much of the year as possible. When dealing with steep, difficult riverbanks, it is important to recognise that stock show marked preference for using a more comfortable access point to drink, so a site with a gently sloping bank is preferable.

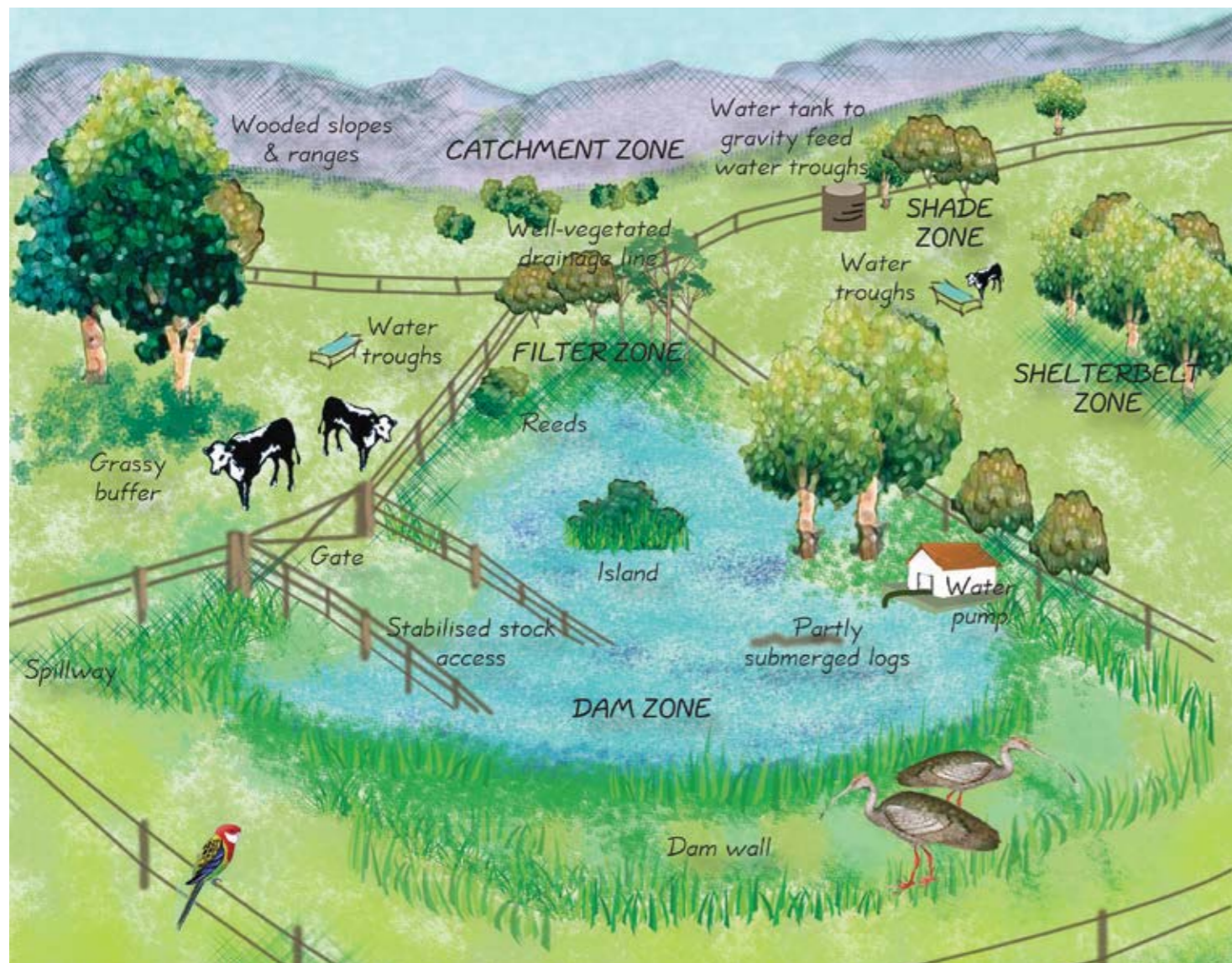


FIGURE 10: The farm dam and its immediate surrounds image

8

FURTHER INFORMATION, RESOURCES & CONTACTS

For specific information or assistance on looking after waterways in the Richmond catchment contact Rous County Council, Richmond Landcare Inc. or North Coast Local Land Services.

8.1 Further information

Rous County Council

Rous County Council has three main functions: Bulk water supply, being the regional water supply authority providing water in bulk to the Council areas; Weed biosecurity, undertaking a wide range of activities to combat the spread of noxious weeds across the local area; and flood mitigation operating across the local government areas of Ballina, Byron, Lismore and Richmond Valley.

Ph: (02) 6623 3800

Web: www.rous.nsw.gov.au

Local Land Services (NSW Government)

North Coast Local Land Services helps secure the future of farming and the environment for North Coast communities. Its projects and partnerships grow farm productivity and healthy environments and play a vital role in helping protect against pests, diseases and environmental threats.

Ph: 1300 795 299

Web: www.northcoastlls.nsw.gov.au

Richmond Landcare Inc.

Formed to support community Landcare groups and natural resource management projects. RLI acts as an umbrella and lobby group for regional Landcare groups, provides information on natural resource management issues, and provides environmental training and educational opportunities.

Ph: (02) 6619 0115

Web: www.richmondlandcare.org

Department of Primary Industries (NSW Government)

DPI manages a broad range of initiatives from resource to industry, including natural resource management, research and development, pest and disease management, food safety, industry engagement, and market access and competition.

Ph: (02) 6391 3100

Web: www.dpi.nsw.gov.au

Spatial Information Exchange

The SIX Portal is the official source of NSW geospatial information. It also provides access to authoritative land and property information. A useful tool providing cadastral and topographical information, satellite data and aerial photography for your location.

Web: www.six.nsw.gov.au

8.2 Resources

River and Riparian Management Series: Fact Sheets 1–13

Managing riparian land; Stream bank stability; Improving water quality; Maintaining in-stream life; Managing stock; Riparian habitat for wildlife; Managing woody debris in rivers; Inland rivers and floodplains; Planning for river restoration; River flows and blue-green algae; Managing phosphorous in catchments; Managing riparian widths; Riparian ecosystem services

Web: www.rrc.com.au

Soil Erosion Solutions: Helping North Coast Landholders Reduce Soil Erosion: Fact Sheets 1-7

Types of erosion; Indicators of erosion; Monitoring erosion; Groundcover; Gully Erosion; Roads and Tracks; Planning your erosion project.

Web: www.dpi.nsw.gov.au

My Local Native Garden Guide: A planting guide to promote biodiversity in the Lismore region, Rous County Council and Lismore City Council (2016).

A guide to what species to plant by location across the Lismore region.

Web: www.rous.nsw.gov.au

Stock and waterways: A Manager's Guide, Land and Water Australia (LWA) (2006).

A guide to recognise your riparian land and its multiple values, identify how stock access and grazing in and around your riparian land can be improved, and develop a strategy to manage your riparian land productively and sustainably.

Web: www.rrc.com.au

Noxious and environmental weed control handbook – A guide to weed control in non-crop, aquatic and bushland situations 6th Edition. State of New South Wales through Department of Trade and Investment, Regional Infrastructure and Services 2014.





A comprehensive handbook for noxious and environmental weed control in non-crop, aquatic and bushland situations.





Web: www.dpi.nsw.gov.au






9 APPENDIX






9.1 Table 2: Common weed species in the riparian zones of the Richmond catchment, their features and control techniques

Note: Under the *NSW Biosecurity Act 2015*, certain weeds have associated mandatory control measures. Please consult Rous County Council or refer to NSW WeedWise (www.weeds.dpi.nsw.gov.au) for more information.

NAME	FEATURES	IMAGE	CONTROL TECHNIQUE NOTES										
Asparagus species (e.g. <i>Asparagus aethiopicus</i> , <i>Asparagus africanus</i>)	<ul style="list-style-type: none"> Grow quickly and produce dense, vigorous thickets of foliage that smother native herbs and shrubs Can form monocultures, displace native plants and ecosystems Form extensive, impenetrable root mats below ground 		<ul style="list-style-type: none"> When crowning, ensure all pieces of the crown are removed from the ground When hand-pulling seedlings, be sure to remove whole crown <table border="1"> <tr> <td>Hand-pull seedlings</td> <td>Crown</td> <td>Cut & paint</td> <td>Foliar spray</td> <td>Stem inject</td> </tr> <tr> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td></td> </tr> </table>	Hand-pull seedlings	Crown	Cut & paint	Foliar spray	Stem inject	✓	✓	✓	✓	
Hand-pull seedlings	Crown	Cut & paint	Foliar spray	Stem inject									
✓	✓	✓	✓										
Balloon vine (<i>Cardiospermum grandiflorum</i>)	<ul style="list-style-type: none"> Perennial climber Balloon-like fruit, formed after flowering. This 'balloon' is a thin-walled capsule that contains several large black seeds 		<ul style="list-style-type: none"> Spray regrowth up to 0.5 m only <table border="1"> <tr> <td>Hand-pull seedlings</td> <td>Crown</td> <td>Cut & paint</td> <td>Foliar spray</td> <td>Stem inject</td> </tr> <tr> <td>✓</td> <td></td> <td>✓</td> <td>✓</td> <td></td> </tr> </table>	Hand-pull seedlings	Crown	Cut & paint	Foliar spray	Stem inject	✓		✓	✓	
Hand-pull seedlings	Crown	Cut & paint	Foliar spray	Stem inject									
✓		✓	✓										
Broad-leaf paspalum (<i>Paspalum mandiocanum</i>)	<ul style="list-style-type: none"> Tufted grass up to 1m tall Broad, somewhat glossy leaves (8–10mm wide) with spreading or low-growing stems Seed-heads are composed of 3–10 branches, with a tuft of hairs at the base of each branch 		<ul style="list-style-type: none"> Shade tolerant <table border="1"> <tr> <td>Hand-pull seedlings</td> <td>Crown</td> <td>Cut & paint</td> <td>Foliar spray</td> <td>Stem inject</td> </tr> <tr> <td>✓</td> <td>✓</td> <td></td> <td>✓</td> <td></td> </tr> </table>	Hand-pull seedlings	Crown	Cut & paint	Foliar spray	Stem inject	✓	✓		✓	
Hand-pull seedlings	Crown	Cut & paint	Foliar spray	Stem inject									
✓	✓		✓										
Camphor laurel (<i>Cinnamomum camphora</i>)	<ul style="list-style-type: none"> Evergreen tree up to 20m Rough greyish brown bark (red flush on new growth) Leaves are glossy green, alternate, 5–10cm long and 2.5–5cm wide Pungent camphor smell from crushed leaves and cut wood 		<table border="1"> <tr> <td>Hand-pull seedlings</td> <td>Crown</td> <td>Cut & paint</td> <td>Foliar spray</td> <td>Stem inject</td> </tr> <tr> <td>✓</td> <td></td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> </table>	Hand-pull seedlings	Crown	Cut & paint	Foliar spray	Stem inject	✓		✓	✓	✓
Hand-pull seedlings	Crown	Cut & paint	Foliar spray	Stem inject									
✓		✓	✓	✓									

NAME	FEATURES	IMAGE	CONTROL TECHNIQUE NOTES										
Castor oil plant (<i>Ricinus communis</i>)	<ul style="list-style-type: none"> Tall spreading shrub Stems are dull, pale green tinged with red Leaves are divided into 7–9 lobes with toothed edges 		<ul style="list-style-type: none"> Highly toxic to humans and livestock, exercise caution when controlling and wear protective clothing Basal bark with Triclopyr 1:60 diesel for stems up to 5cm diameter Mature stems may be hollow; take care when injecting <table border="1"> <tr> <td>Hand-pull seedlings</td> <td>Crown</td> <td>Cut & paint</td> <td>Foliar spray</td> <td>Stem inject</td> </tr> <tr> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> </table>	Hand-pull seedlings	Crown	Cut & paint	Foliar spray	Stem inject	✓	✓	✓	✓	✓
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✓	✓	✓	✓	✓									
Cat's claw creeper (<i>Dolichandra unguis-cati</i>)	<ul style="list-style-type: none"> Perennial woody vine with multiple stems, extensive roots with multiple tubers and adventitious roots that adhere to host tree Small, opposite leaflets and terminal leaf modified to three-pronged tendril (shaped like a cat's claw) Bright yellow trumpet-shaped flowers, long narrow seedpods with two-winged seeds 		<ul style="list-style-type: none"> Difficult to control; see NSW WeedWise for detailed advice Regrows from tubers and seeds Dig out small seedlings, remove whole tuber and roots, dispose of off-site <table border="1"> <tr> <td>Hand-pull seedlings</td> <td>Crown</td> <td>Cut & paint</td> <td>Foliar spray</td> <td>Stem inject</td> </tr> <tr> <td></td> <td></td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> </table>	Hand-pull seedlings	Crown	Cut & paint	Foliar spray	Stem inject			✓	✓	✓
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		✓	✓	✓									
Cockspur coral tree (<i>Erythrina crista-galli</i>)	<ul style="list-style-type: none"> Deciduous shrub/tree to 10m high Showy red flower clusters Cone shaped prickles on trunks, branches, stems, petioles and underside of leaves Leaves are made up of three leaflets 3–6 cm long and 2–5 cm wide Reproduces vegetatively and by seed 		<ul style="list-style-type: none"> Remove any broken plant stems/branches from site Stem injection requires multiple rings, as high as possible Better to inject than cut and paint. Cut and paint small seedlings only <table border="1"> <tr> <td>Hand-pull seedlings</td> <td>Crown</td> <td>Cut & paint</td> <td>Foliar spray</td> <td>Stem inject</td> </tr> <tr> <td></td> <td></td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> </table>	Hand-pull seedlings	Crown	Cut & paint	Foliar spray	Stem inject			✓	✓	✓
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		✓	✓	✓									
Crofton weed (<i>Ageratina adenophora</i>)	<ul style="list-style-type: none"> Erect perennial shrub with numerous woody stems to 2m Broad, slightly crinkled, trowel-shaped, toothed leaves with chocolate-coloured petioles (leaf stems) White flowers in spring 		<ul style="list-style-type: none"> Poisonous to horses Mattcock out mature plants Can be controlled by slashing and grazing management practices (before seed set) Biological control agents have been released locally with some effect Slash, then spray regrowth <table border="1"> <tr> <td>Hand-pull seedlings</td> <td>Crown</td> <td>Cut & paint</td> <td>Foliar spray</td> <td>Stem inject</td> </tr> <tr> <td>✓</td> <td>✓</td> <td></td> <td>✓</td> <td></td> </tr> </table>	Hand-pull seedlings	Crown	Cut & paint	Foliar spray	Stem inject	✓	✓		✓	
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✓	✓		✓										

NAME	FEATURES	IMAGE	CONTROL TECHNIQUE NOTES				
Giant devil's fig (<i>Solanum chrysotrichum</i>)	<ul style="list-style-type: none"> • Shrub or small tree to 4m high • Prickly stems and leaves • Tomato-like flower and orange-yellow berries • Young growth densely hairy 		Hand-pull seedlings ✓	Crown ✓	Cut & paint	Foliar spray ✓	Stem inject ✓
Golden rain tree or Chinese rain tree (<i>Koelreuteria elegans subsp. Formosana</i>)	<ul style="list-style-type: none"> • Small, deciduous tree to 5m • Compound leaf, alternate, darker green above, irregularly toothed edges • Small yellow flowers in branched clusters • Three-sided paper seed pods, pinkish maturing to brown 		Hand-pull seedlings ✓	Crown	Cut & paint ✓	Foliar spray ✓	Stem inject ✓
Green cestrum (<i>Cestrum parqui</i>)	<ul style="list-style-type: none"> • Medium-sized perennial shrub 2–3 m high • Many light-green, brittle stems • Leaves are alternate, up to 12 cm long, 2.5 cm wide. • Flowers are greenish-yellow, in clusters at ends of branches, unpleasant odour by day, fragrant at night 		Hand-pull seedlings ✓	Crown ✓	Cut & paint ✓	Foliar spray ✓	Stem inject
Groundsel bush (<i>Baccharis halimifolia</i>)	<ul style="list-style-type: none"> • Densely-branched shrub, usually 1.5–3 m high • Leaves are dull or pale green, waxy to touch, alternate, 2.5–5cm long, 1–2.5cm wide, wedge-shaped and prominently-toothed • Flowers are white or cream • Seeds are very small and light, with tufts of white hairs (can look like cotton wool) 		Hand-pull seedlings ✓	Crown	Cut & paint ✓	Foliar spray ✓	Stem inject ✓
Lantana (<i>Lantana camara</i>)	<ul style="list-style-type: none"> • Heavily branched, scrambling, thicket-forming shrub • Produces a strong, aromatic odour when crushed • Square stems with short, hooked prickles. • Rough bright green leaves, 2–10cm long and 2–8cm wide • Dense clusters of flowers, variable colours 		Hand-pull seedlings ✓	Crown	Cut & paint ✓	Foliar spray ✓	Stem inject ✓

NAME	FEATURES	IMAGE	CONTROL TECHNIQUE NOTES				
Madeira vine (<i>Anredera cordifolia</i>)	<ul style="list-style-type: none"> • Twining vine with wide, fleshy, heart-shaped leaves that are 2–15 cm long • Fragrant, cream-coloured flower spikes up to 30 cm long • Fleshy stem with many aerial tubers ('potatoes') • Grows from underground tubers 		Hand-pull seedlings ✓	Crown	Cut & paint ✓	Foliar spray ✓	Stem inject
Morning glory species – coastal, common, purple, moonflower (<i>Ipomoea cairica, I. purpurea, I. indica, I. alba</i>)	<ul style="list-style-type: none"> • Vigorous perennial climbers • Very long pale grey-green stems with milky sap • Purple, violet and white flowers depending on species 		Hand-pull seedlings ✓	Crown	Cut & paint ✓	Foliar spray ✓	Stem inject
Privet species (<i>Ligustrum lucidum and Ligustrum sinense</i>)	<ul style="list-style-type: none"> • Evergreen shrub or small tree to 4–10m high • Small, glossy leaves in opposite pairs • Small cream-white flowers and green berries ripening to purplish black 		Hand-pull seedlings ✓	Crown ✓	Cut & paint ✓	Foliar spray ✓	Stem inject ✓
Tobacco bush (<i>Solanum mauritanium</i>)	<ul style="list-style-type: none"> • Densely woody shrub or small tree to 4m high • Flowers are violet and berries mature to a dull yellow • Berries commonly eaten and spread by pigeon species 		Hand-pull seedlings ✓	Crown	Cut & paint ✓	Foliar spray ✓	Stem inject ✓
Tropical soda apple (<i>Solanum viarum</i>)	<ul style="list-style-type: none"> • Upright, branching, perennial shrub growing to 2m high • Straight, cream-coloured prickles scattered on most plant parts • Hairy leaves 10–20cm long and 6–15cm wide with cream veins • Small white flowers and mature fruit are yellow and golf ball sized 		Hand-pull seedlings ✓	Crown	Cut & paint ✓	Foliar spray ✓	Stem inject

9.2 Table 3: Description of riverbank plants for the Richmond catchment

HEIGHT – refers to the maximum height in an OPEN situation. Some species may grow taller in protected areas.

FROST RESISTANT – refers to the frost resistance of newly planted seedlings. 1 = none or very little frost resistance; 2 = some resistance (light frosts); 3 = frost resistant

PROTECTION WHEN YOUNG – 1 = plant requires watering and protective canopy of taller plants; 2 = may require some watering and protection in exposed sites; 3 = requires no protection

R.F. = abbreviation for rainforest **X** = fast growing

COMMON NAME	BOTANICAL NAME	BRIEF DESCRIPTION	MAX. HEIGHT	FAST GROWING	PROTECTION WHEN YOUNG	FROST RESISTANT	OTHER USES/COMMENTS	WILDLIFE
Brush ironbark wattle	<i>Acacia disparrima</i>	Medium-sized wattle with bluish-grey phyllodes, grey-black furrowed bark and pale yellow flowers in late summer/autumn. Hardy	10	X	3	3	Fast-growing screen plant	Attracts insect-eating birds
Green wattle	<i>Acacia irrorata</i>	Small, fern-leaved wattle with pale yellow flowers. Very hardy	6	X	3	3	Good canopy species for protecting R.F. plantings	Attracts insect-eating birds
Blackwood	<i>Acacia melanoxylon</i>	Medium-sized bushy wattle with pale yellow flowers. Very hardy	10	X	3	3	Useful buffer tree for protecting streamside and R.F. plantings	Seeds attract birds
Lilly pilly	<i>Acmena smithii</i>	Medium-sized R.F. tree with a dense habit and pink to purple fruit. Two main forms – narrow-leaved form (var. minor) for drier inland streams	10		2	2	Some forms make useful windbreaks if given sufficient water	Fruit attracts birds
Red ash	<i>Alphitonia excelsa</i>	A medium-sized tree with some drought tolerance, leaves have a white underside. Hardy	12	X	3	2	Good rainforest regeneration tree	Seeds attract birds
Broad-leaved apple	<i>Angophora subvelutina</i>	A medium to tall, rough-barked tree with broad leaves and characteristically gnarled or twisted growth. Hardy	18		3	3	Often retained on farms as a shade tree. It is a useful pollen tree for bees	Provides nesting sites for birds
Rough-leaved elm	<i>Aphananthe philippinensis</i>	Small to medium-sized R.F. tree with stiff elm-like leaves and dense dark crown. Hardy	12		2	2	Edible fruit useful R.F. regeneration species	Fruit attracts birds
Hoop pine	<i>Araucaria cunninghamii</i>	A tall, straight R.F. tree with scaly bark and dark green pine-type leaves. Large cones are produced in summer	30		2	2	Used in park and homestead landscaping. Frost tolerant	
Bangalow palm	<i>Archontophoenix cunninghamiana</i>	Single-stemmed, feather-leaved palm. Needs plenty of water. Best for well-watered, protected sites	8	X	1	1	Commonly used as landscaping in yards and around commercial centres. Best for protected sites	Fruit attracts birds
Midgenberry	<i>Austromyrtus dulcis</i>	Spreading, low shrub, attractive lilly pilly-like foliage. Useful hardy ground cover	1	X	3	2	Good groundcover and understorey species. Edible fruit	Fruit attracts birds
Willow bottlebrush	<i>Callistemon salignus</i>	Small tree with papery bark, pink new growth and white bottlebrush flowers. Very hardy	6	X	3	3	Good windbreak species. Grows in a wide range of soils including poorly drained sites	Fruit attracts birds
Weeping bottlebrush	<i>Callistemon viminalis</i>	Multi-stemmed tree with hard furrowed bark and red bottlebrush flowers. Very hardy	5	X	3	3	Excellent erosion control species. Used for direct seeding	Flowers attract honeyeaters
Black bean	<i>Castanospermum australe</i>	A dense-crowned R.F. tree with dark green leaves. Produces orange/red flowers on branches followed by large pods	18		2	1	Good decorative species	Attracts honey-eating birds
River oak	<i>Casuarina cunninghamiana</i>	Tall pine-like species. Very common on the north coast. Hardy. Needs management as may contribute to erosion	20	X	3	3	Fixes nitrogen. Good canopy cover species for R.F. regeneration. Direct seeding. Used for drought fodder	Larger, older trees used as roosting sites
Swamp oak	<i>Casuarina glauca</i>	Medium pine-like species. Common on poorly drained sites or brackish rivers	15	X	3	3	Fixes nitrogen. Useful drought fodder. Direct seeding	Larger, older trees used as roosting sites
Brown kurrajong	<i>Commersonia bartramia</i>	Small tree, with large, toothed, rusty haired leaves and attractive sprays of small white flowers in summer	15	X	3	2	Very hardy regeneration species for rainforests	
Red bloodwood	<i>Corymbia intermedia</i>	Medium to tall, densely crowned tree, with rough greyish-brown, scaly bark and large woody fruit capsules	20	X	1	1	Very hardy, prolific flowering tree which attracts insects, birds and bats	Flowers attract birds. Excellent habitat tree. Useful pollen source for bees
Crinum lily	<i>Crinum pedunculatum</i>	Strap-like foliage, attractive large and fragrant flowers	1	X	1	2	Good groundcover and understorey species. Saline soil tolerant	Attracts butterflies and moths
Pepperberry tree	<i>Cryptocarya obovata</i>	Medium to tall densely-crowned R.F. tree with hairy new growth and dark leaves	18		1	1	Good shade tree	Fruit attracts birds
Tuckeroo	<i>Cupaniopsis anacardioides</i>	Broad glossy deep green foliage, provides very shady crown cover	8		1	2	Iconic coastal rainforest tree. Popular street-scaping tree.	Birds attached to fleshy covering (aril) of seeds

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R.F. = abbreviation for rainforest **X** = fast growing

COMMON NAME	BOTANICAL NAME	BRIEF DESCRIPTION	MAX. HEIGHT	FAST GROWING	PROTECTION WHEN YOUNG	FROST RESISTANT	OTHER USES/COMMENTS	WILDLIFE
Blue flax lily	<i>Dianella caerulea</i>	Useful ground cover, needs well drained site	1	X	3	2	Good habitat for ground fauna. Extensive mat like root system	
Native tamarind	<i>Diploglottis australis</i>	Attractive, tall R.F. tree with very large compound leaves and rusty hairy new growth.	15		1	1	Attractive tree used for landscaping. Edible fruit. Best planted in protected sites	Fruit attracts birds
Corkwood	<i>Duboisia myoporoides</i>	Small R.F. tree with yellow corky bark. Produces small black fruits in summer	5	X	3	3	Very fast-growing tree. Very frost tolerant	Fruit attracts birds
Blue quandong	<i>Elaeocarpus grandis</i>	Tall, buttressing R.F. tree with sparse canopy and large blue fruits in spring/summer	30	X	2	1	Provides fruit for rainforest pigeons	Fruit attracts birds
Hard quandong	<i>Elaeocarpus obovatus</i>	Tall R.F. tree, tolerant of wet soils. Hardy. Produces masses of small blue fruit	15		2	2	Useful shade tree	Fruit attracts birds
Blueberry ash	<i>Elaeocarpus reticulatus</i>	Small rainforest tree with attractive white/soft pink frilly flowers and small blue fruit	4	X	2	2	Common at margins of rainforest and eucalypt forest on low-lying seasonally wet sites	Attracts insects
Flooded gum	<i>Eucalyptus grandis</i>	Very tall eucalypt with smooth white bark	40	X	3	2	Good flowering and pollen tree	Flowers attract birds, habitat tree
Swamp mahogany	<i>Eucalyptus robusta</i>	Medium to tall, densely crowned tree with large broad leaves, large woody fruit capsules and rough rich brown, soft stringy bark	20	X	3	2	Very hardy, prolific flowering tree which attracts insects, birds and bats	Important koala food tree in coastal areas. Flowers attract birds and are a useful pollen source for bees
Narrow-leaved red gum	<i>Eucalyptus seeana</i>	A medium to tall eucalypt with patchy white-greyish bark and narrow leaves. Hardy	20	X	3	3	Useful pollen source for bees	
Grey ironbark	<i>Eucalyptus siderophloia</i>	Medium to tall eucalypt with tough hard furrowed bark	20		3	2	Good source of nectar for bees	Attracts insect-eating birds
Forest red gum	<i>Eucalyptus tereticornis</i>	Medium to tall eucalypt with patchy white-greyish bark often grows on alluvial floodplains. Very hardy	30	X	3	3	Useful pollen source for bees	Koala food tree
Creek sandpaper fig	<i>Ficus coronata</i>	Small bushy tree with sandpapery leaves and hairy fruits produced on the trunk and branches. Hardy	6		2	2	Excellent riparian species with edible fruit	Fruit attracts birds
Other figs	<i>Ficus species</i>	Large trees with buttress roots and spreading canopy.	20		1	1	Excellent shade tree. Edible fruit	Fruit attracts birds
Cudgerie	<i>Flindersia schottiana</i>	Tall tree with open canopy. Very hardy	20	X	2	1	Very fast growing tree which is ideal for rainforest regeneration	
Cheese tree	<i>Glochidion ferdinandi</i>	Small to medium R.F. tree with spreading canopy and attractive foliage fruit which looks like small cheeses. Hardy	10		2	2	Excellent riparian regeneration species and small shade tree	Fruit attracts birds
Umbrella cheese tree	<i>Glochidion sumatranum</i>	Small to medium R.F. tree with spreading canopy	6	X	2	1	Common at margins of coastal rainforest and eucalypt forest on low-lying seasonally wet sites	
Silky oak	<i>Grevillea robusta</i>	Tall, sparse canopied species with golden flowers. Drought tolerant. Very hardy	15	X	3	3	Excellent species for R.F. regeneration. Minor to medium value for bees	Flowers attract honey eaters
Guioa	<i>Guioa semiglauc</i>	Small R.F. tree; leaves have silvery underside. Hardy	10		2	2	Attractive tree for landscaping. Useful for rainforest regeneration	Fruit attracts birds
White booyong	<i>Heritiera trifoliolata</i>	Medium to tall R.F. tree with leaflets arranged in threes and a bronze under-surface. Winged fruit are produced in autumn	30		1	1	Iconic R.F. species and ornamental tree	
Cottonwood hibiscus	<i>Hibiscus tiliaceus</i>	Small to medium R.F. tree with spreading canopy, attractive yellow/orange hibiscus flowers	6	X	3	3	Grows at margins of mangroves, tolerates salty and waterlogged areas	Good cover and habitat for estuary and coastal forest birds
Native frangipani	<i>Hymenosporum flavum</i>	Small R.F. tree producing numerous yellow and white flowers in spring. Hardy	10	X	3	2	Useful species for R.F. regeneration	Flowers attract birds
Foambark	<i>Jagera pseudorhus</i>	Small R.F. tree with attractive ferny foliage and hairy yellow brown fruits. Hardy	12		2	2	Very attractive tree for landscaping. Useful for rainforest regeneration	Fruit attracts birds
Thin-fruited tea tree	<i>Leptospermum brachyandrum</i>	Small, multi-trunked tree. The bark peels in spring, turning from a copper colour to white. Very hardy	4	X	3	3	Good erosion control species. Can be used for direct seeding	Good habitat species for shading the stream edge

HEIGHT – refers to the maximum height in an OPEN situation. Some species may grow taller in protected areas.

FROST RESISTANT – refers to the frost resistance of newly planted seedlings. 1 = none or very little frost resistance; 2 = some resistance (light frosts); 3 = frost resistant

PROTECTION WHEN YOUNG – 1 = plant requires watering and protective canopy of taller plants; 2 = may require some watering and protection in exposed sites; 3 = requires no protection

R.F. = abbreviation for rainforest **X** = fast growing

COMMON NAME	BOTANICAL NAME	BRIEF DESCRIPTION	MAX. HEIGHT	FAST GROWING	PROTECTION WHEN YOUNG	FROST RESISTANT	OTHER USES/COMMENTS	WILDLIFE
Cabbage tree palm	<i>Livistona australis</i>	Attractive native palm with broad rounded leaf blade and long thorny stems. Hardy	10		3	2	Feature tree in coastal and estuary areas. Tolerates wet, sandy and peaty soil conditions	Fruit important for rainforest pigeons and bats
Spiny mat-rush	<i>Lomandra hystrix</i>	Small, tussocky rush forming thick clumps. Hardy	1		3	3	Good for erosion control if planted in sufficient density. Large, spreading root system	Good stream-edge habitat species
Spiny mat-rush	<i>Lomandra longifolia</i>	Small, tussocky rush forming thick clumps. Hardy. Grows in more open areas than <i>L. hystrix</i>	1		3	3	Good for erosion control if planted in sufficient density. Large, spreading root system	Good stream-edge habitat species
Swamp turpentine	<i>Lophostemon suaveolens</i>	Medium tree with large leaves and fibrous, furrowed persistent bark. Hardy	15	X	2	2	Grows in poorly drained and heavy floodplain soils	Useful habitat tree when large
Macaranga	<i>Macaranga tanarius</i>	Small to medium R.F. tree with spreading canopy	6	X	2	2	Excellent pioneer cover species. Cut back if later competing with other plants	Attractive to insects and small birds
Tea tree/paperbark	<i>Melaleuca alternifolia</i>	Small to medium-sized tree with small narrow bluish-green leaves and whitish papery bark. Cream brush flowers in summer/autumn	6		3	3	Useful screen and windbreak species for poorly drained areas. Tea-tree oil extracted from the leaves	Flowers attracts honey-eating birds
Black tea-tree	<i>Melaleuca bracteata</i>	A tall, bushy shrub or small tree with small linear leaves, hard furrowed bark and numerous white brush flowers in summer	6		3	3	Useful screen and windbreak species. Can be direct-seeded	Flowers attract honey-eating birds
Broad-leaved paperbark	<i>Melaleuca quinquenervia</i>	Medium-sized tree with five-veined leaves and whitish papery bark. Cream brush flowers in summer/autumn	10	X	3	3	Useful screen and windbreak species for poorly drained sites	Flowers attract honey-eating birds
White cedar	<i>Melia azedarach var. australasica</i>	Very hardy deciduous tree producing yellow fruit in autumn/winter. Drought tolerant	15	X	3	2	Good shade tree and fragrant flowers	Fruit attracts birds
Brown pine	<i>Podocarpus elatus</i>	Slow-growing, dense-crowned tree with dark green leaves and brown scaly bark. Fruit is dark bluish/black	15		2	2	Fruit is edible	Fruit attracts birds
River grass	<i>Potamoiphilia parviflora</i>	Dense, tussocky grass that occurs on larger rivers. Usually growing within the stream	1.5		3	3	Excellent erosion control species which can be easily grown by division of mature plants	In-stream habitat
Yellow carabeen	<i>Sloanea woollsii</i>	Medium R.F. tree with large toothed leaves. Likes plenty of water	15		1	1	Needs well-watered, protected site	Fruit attracts birds
Whalebone tree	<i>Streblus brunonianus</i>	Small to medium R.F. tree with glossy, toothed leaves. Wiry branches and small green fruit in summer/autumn. Slow growing	8		2	2	Hardy rainforest understorey tree. Has a dense compact form when planted in the open	Fruit attracts birds
Brush cherry	<i>Syzygium australe</i>	Small dense crowned R.F. tree with dark green leaves and red fruit from summer to early winter	10		2	1	Edible fruit. Good riparian R.F. regeneration species	Fruit attracts birds. Good host for epiphytic ferns
Weeping myrtle	<i>Syzygium floribundum</i>	Medium to large tree, densely crowned with weeping foliage and round green fruit in summer/autumn. Hardy	15	X	2	1	Excellent erosion control species with extensive mat-like root system	Roots provide habitat for stream dwelling animals
Giant water gum	<i>Syzygium francisii</i>	Medium, dense crowned R.F. tree with dark green leaves. Pale brown bark with dark brown blotches and purple fruit in summer/autumn	15		1	1	Good shade tree, with large, spreading crown	
Red cedar	<i>Toona australis</i>	Large R.F. tree with large compound leaves and spreading canopy. Semi-deciduous. Hardy	20	X	2	2	Good shade tree. Subject to attack by tip moth	
Water gum	<i>Tristaniopsis laurina</i>	Medium-sized tree, with light flaky bark and yellow flowers produced in summer. Hardy	10	X	2	2	Useful erosion control species. Good nectar and pollen species. Used for direct seeding	Roots provide habitat for stream dwelling animals

NOTES

CREDITS

1 INTRODUCTION

- 4 **FIGURE 1:** Map of the Richmond Catchment and its tributaries. Source: Rous County Council
- 5 We all have a role to play in looking after waterways. © Department of Primary Industries

2 CONTEXT

- 7 The Wilsons River (shown here at Federal) is the main tributary of the Richmond River. © Rous County Council

3 THE NATURAL ENVIRONMENT

- 9 Riparian vegetation at Emigrant Creek acts as a buffer between waterways and adjacent farms. © Rous County Council

4 WHY REHABILITATE WATERWAYS?

- 10 The condition of the adjacent land and vegetation influences river health and water quality. © North Coast Local Land Services
- 11 **FIGURE 2:** Features of healthy and unhealthy creeks. Source: Rous County Council
- 11 **FIGURE 3:** How a riparian buffer strip functions to protect the stream from contaminants. Source: Riparian Land Management Technical Guidelines. Volume One: Principles of Sound Management. Land & Water Resources – Research & Development Corporation (1999)

5 STRATEGIES FOR RIPARIAN REHABILITATION

- 12 Landholders can protect waterways. © Lismore City Council
- 13 **FIGURE 4:** Different strategies that can be used to manage different parts of riparian land. Source: The Interpretive Design Company
- 15 Part of your property management plan, a weed control program should be included specifically for riparian areas. © Landcare NSW
- 17 For some weed species there are several appropriate control methods. © Rous County Council

6 REVEGETATION PLANTING, SITE PREPARATION & MAINTENANCE

- 18 In areas where natural regeneration does not occur then planting of locally indigenous plants is recommended. Image left © Landcare Australia. Image centre © Richmond Landcare Inc. Image right © Rous County Council
- 18 **FIGURE 5:** The sections of the riparian zone. Source: Adapted by Rous County Council from Rivercare: Guidelines for Ecologically Sustainable Management of Rivers and Riparian Vegetation. Raine and Gardiner 1995.
- 20 **FIGURE 6:** Plant Spacing, Streambanks (note: diagram is not indicative of species diversity). Source: Adapted by Rous County Council from Interpretive Design Company
- 20 Planting steps for division or direct transplant. Source: Adapted by Rous County Council from Landcare Australia, Land & Water Conservation and the Land & Water Resources – Research & Development Corporation
- 21 Planting steps for direct seedling. Source: Adapted by Rous County Council from Landcare Australia, Land & Water Conservation and the Land & Water Resources – Research & Development Corporation
- 22 Try to use plants propagated from seed collected from the local area. © Rous County Council

7 STOCK MANAGEMENT

- 23 **FIGURE 7:** Diagram showing landholder management options and impacts on catchment health. Source: Adapted by Rous County Council from Emigrant Creek Water Monitoring Program, SKM (2004)
- 24 **IMAGE 1:** The fence protecting this wetland has been designed to be flood resistant. Very strong end assemblies of recycled railway iron support a minimal framework of three electrified plain wires powered by a stand-alone solar-powered energizer. © Riparian Management Services
- 25 **IMAGE 2:** End assemblies are the most expensive part of a fence to install. A flood channel crosses this fence from left to right, and this length has been wired as a separate 'sacrificial' section (note the end assemblies each side of the channel). Each section of the fence between the posts have been wired separately (note the wiring at the post in the foreground). © Riparian Management Services

- 25 **FIGURE 8:** Floodplain Fencing – Flexible Electric Fence (option 1). Source: Riparian Management Services

- 25 **IMAGES 3 AND 4:** Wires are not run through the star pickets themselves, but are attached to the pickets on the down-stream side of expected flood flows. The wire will be more likely to release from the picket if it is struck by debris, rather than pulling the star picket out. © Riparian Management Services

- 25 **IMAGE 5:** A close-up of a galvanized earth spike. Proper earthing of electric fencing is vital to ensure maximum performance and a minimum of three, inter-connected 2m long earth spikes should be fitted. © Riparian Management Services

- 25 **IMAGE 6:** Shows how flexible the fence is where droppers are used – this allows debris to flow through the fence with less likelihood of it snagging the wires. This type of fence is ideal for situations where flood flow direction is unpredictable. © Riparian Management Services

- 26 **FIGURE 9:** Floodplain Fencing – Drop Fence (option 2). Source: Riparian Management Services

- 26 **IMAGE 7:** The key component of the 'drop-fence' is the hinged triangular end assembly. © Riparian Management Services

- 26 **IMAGE 8:** A close-up of the locking bolt that holds the end assembly in place. A trip wire is attached to the spring-loaded bolt (not yet attached in the photo, but note the pre-drilled hole to attach the wire). When flood debris/ flood flows pull on the trip wire the bolt is pulled out of the post and the fence falls to the ground. Alternatively, if a flood is expected, the fence can be laid down manually. © Riparian Management Services

- 26 **IMAGE 9:** Intermediate star pickets are also hinged at ground level with spring loaded bolts. © Riparian Management Services

- 26 **IMAGE 10:** The hinge at the left hand end of the end assembly. This type of fence is best suited to sites where flood flows will reliably hit the fence at right angles (to trigger the trip wire). © Riparian Management Services

- 26 **IMAGE 11:** This fence has been positioned well away from overhanging trees. This has two benefits: first, damage from falling limbs is greatly reduced and, second, by moving the fence further back from the creek straighter runs of fence are possible. This reduces the number of expensive corner assemblies that are required. © Riparian Management Services

- 26 **IMAGE 12:** Another reason not to use barbed wire; it has a well-earned reputation as a killer of native wildlife. This bat became entangled when the barb pierced its wing membrane. © Riparian Management Services

- 27 Off-stream watering trough. © Rous County Council.

- 28 **FIGURE 10:** The farm dam and its immediate surrounds image. Source: The Interpretive Design Company

9 APPENDIX

- 30 Asparagus species. © Department of Primary Industries
- Balloon vine. © Department of Primary Industries
- Broad-leaf paspalum. © Rous County Council
- Camphor laurel. © Department of Primary Industries
- 31 Castor oil plant. © Department of Primary Industries
- Cat's claw creeper. © Rous County Council
- Cockspur coral tree. © Rous County Council
- Crofton weed. © Rous County Council
- 32 Giant devil's fig. © Richmond Landcare Inc.
- Golden rain tree or Chinese rain tree. © Rous County Council
- Green cestrum. © Rous County Council
- Groundsel bush. © Rous County Council
- Lantana. © Department of Primary Industries
- 33 Madeira vine. © Rous County Council
- Morning glory species. © Department of Primary Industries
- Privet species. © Rous County Council
- Tobacco bush. © Rous County Council
- Tropical soda apple. © Rous County Council

This booklet aims to provide landholders in the Richmond catchment with practical guidelines for waterway management that seek to balance land use with resource protection.

It provides a starting point in understanding the Richmond catchment and the role riparian land plays in maintaining a healthy waterway. It offers practical advice for sustainable land management in our catchments and describes strategies for riparian rehabilitation, revegetation, site preparation, plant selection, weed control, stock management and maintenance.

This booklet will help you to care for your land, the health of waterways, your local drinking water supply, wildlife and people.