BELLINGER RIVER SYSTEM LANDHOLDER BOOKLET

BEST PRACTICE FOR A HEALTHY RIVER

Bellinger Landcare Inc.

NSW Environmental TRUST

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- Bellinger River Freshwater Action Group
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- Western Sydney University
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Contact: www.bellingerlandcare.org.au

Bellinger Landcare Inc. (BLI)
1a Oak Street,
Bellingen NSW 2454
Phone: (02) 6655 0588

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Compiled and edited by Natasha English, Amanda Norman and Kylie Brooks
Design and layout: Dee Rogers and Kylie Brooks

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THE BELLINGER RIVER

Location

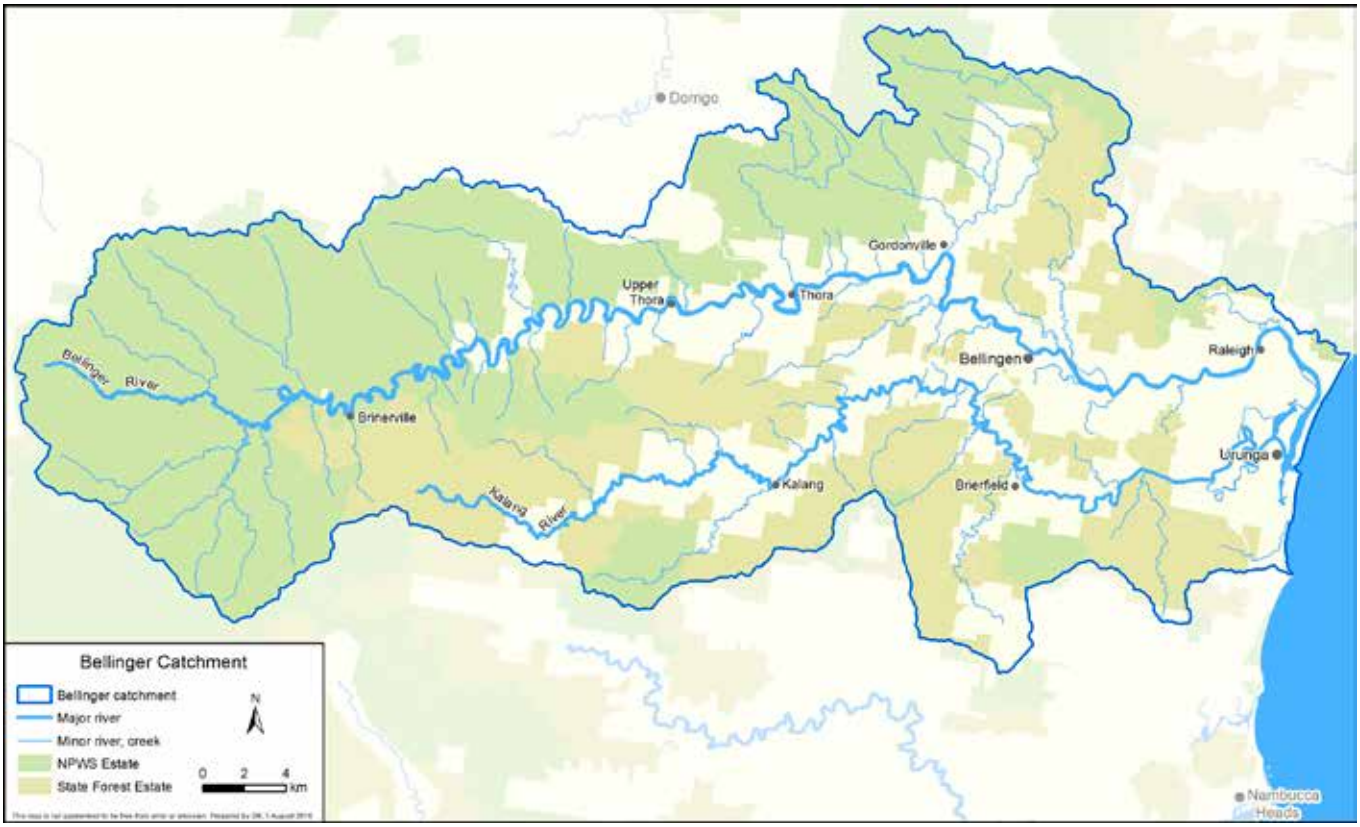
The Bellinger River rises below Point Lookout, within the Great Dividing Range, southwest of Ebor. The river descends over 1150 metres and is over 109 kilometres in length, in a south-east direction through an extensive coastal floodplain to Urunga, where it meets the Kalang River and flows out to the Pacific Ocean.

The Bellinger River is predominately freshwater, then becomes an estuary where the freshwater and saltwater mix. The tidal influence extends about 20 kilometres upstream of the Bellinger River mouth.

Some of the main rivers and creeks within the catchment include: Kalang River, Boggy Creek, Woods Creek, Hydes Creek, Bishops Creek, Never Never River and Rosewood River.

Climate

The regional climate is sub-tropical with warm, wet, humid summers and mild, dry winters. Rainfall in Bellingen averages 1517mm per year. The rain falls mainly in the summer and autumn in the form of showers and thunderstorms moving off the plateau to the west and south west. The heaviest rain, however, occurs when a low pressure area forms off the east coast or moves down from the north, northwest. This situation can bring periods of extremely heavy rain that can cause rapid flooding of the Bellinger Valley as water pours down the valleys from the mountains behind the town (bellingenweather.org 2016).



Geology and Soil

The Bellinger Valley comprises flat to gently undulating floodplains, levees, prior channels and swamps associated with the Bellinger River. Major soil types are Alluvial Soils, Brown Earths and structured Brown Earths on Holocene alluvium; and Humic Gleys and Gleyed Podzolic Soils in swamps (Milford, H.B. 1999; Belwitt, n.d).

Riparian Zone

The land that immediately surrounds waterways is known as the riparian zone. The riparian zone has a direct influence on the water and aquatic systems within it, so it is important to manage land sensitively, as downstream effects impact on both production and biodiversity.

Aboriginal Significance

The Bellinger River is situated in the Gumbaynggirr Nation. The Gumbaynggirr word for river is 'Bindarray'. 'Baligin', the Gumbaynggirr word for Bellingen, may come from 'Baalijin' which means 'quoll' or native cat (Morelli, 2008). Indigenous Australians have used the Bellinger River sustainably for thousands of years. The river was their livelihood, as a source of food, recreation and bathing. The Bellinger River was also their migratory path, as they followed the food source down to the coast as seasons changed.

Background of the Bellinger River

When Europeans arrived in the Bellinger Valley, the river channel was narrower and deeper with more bends than now. Clearing led to cutting of the river-bends and increased bank erosion via fast-flowing floodwaters, which were no longer slowed down by riparian and flood-plain vegetation. This resulted in significant shortening of the overall length of the river.

The Bellinger River bank condition is characterised by undercutting and bank slumping in places, which contributes to increased suspended sediment loads in the system (Ryder et al. 2011). Clearing, cattle grazing and agricultural cropping have had major impacts upon the riparian ecosystem. These activities have, in some instances, created disturbance, opening up areas to weeds and accelerated soil erosion. These impacts have resulted in a loss of flora and fauna diversity, simplified vegetation canopy structure, a lack of shading of watercourses, and degraded aquatic habitat due to decreased in-stream organic litter and woody debris. The loss of flora and fauna species has compromised the integrity of the ecosystem as a whole. Biodiversity, as in all areas in nature, is vital to river health. Loss of riparian vegetation and hence loss of shade, can contribute to increased water temperature. Rivers and creeks in the Bellinger catchment have also seen a significant increase in water temperature in the last decade, along with 3-4 years of significant drying with a decline in river levels (pers.comm. Spencer 2016).

WHAT MAKES A HEALTHY RIVER?

What Does A Healthy River Look Like?

Trees overhanging the water provide extremely important habitat for insects, fish, frogs, turtles, reptiles, platypus and birds. Turtles climb partially submerged tree limbs to get out of the water to bask. Platypus require stable river banks for their breeding dens and need cover from predators. Birds perch over water, watching for prey. Insects fall from branches into the water, providing a food source for fish, reptiles and amphibians.

River Roughness

In-stream debris in the river itself plays an important role in river health. Fallen trees and logs provide in-stream habitat for spawning sites and areas for fish to hide from predators and to avoid intense sunlight and high current velocities (Crook and Robertson 1999 in Ryder et al. 2011). Logs also provide habitat for biofilm and invertebrates that maintain essential links in the food web for fish (Ryder 2004 in Ryder et al. 2011).

River roughness plays an important role in river processes, particularly during floods. Roughness (debris, rocks of different sizes, tree trunks and roots) slows flow and promotes sediment deposition and is the river's natural method of maintaining a balance in a dynamic system. Removing roughness speeds flows up and leads to accelerated erosion. Most erosion control projects involve increasing roughness by re-introducing rocks and or debris on the bank and in-stream.

River Health for Turtles

River health in the Bellinger River is particularly important for the Bellinger River Snapping Turtle (*Myuchelys georgesi*) which, as a species, experienced a severe mortality event, first detected in February 2015, almost wiping out the entire population. The species is endemic to the area, being only found in a 60 kilometre stretch of the Bellinger River.

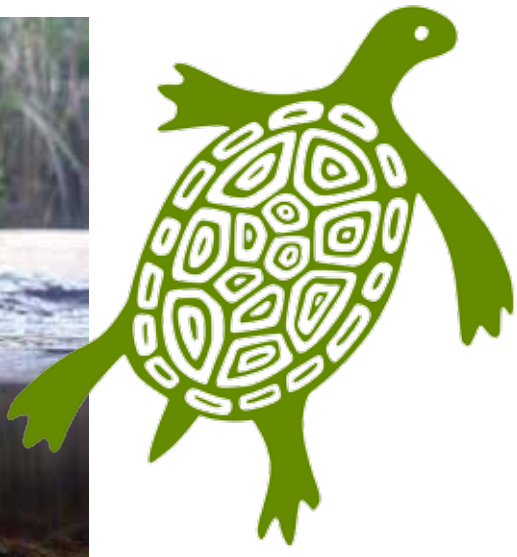
The mortality event has been linked to a virus. Being a virus, Biosecurity NSW are promoting river hygiene through their fact sheet: *Keep a 'Clean' Routine, Bellinger River Snapping Turtle Mortality*.

River Hygiene:

- *Wash down canoes and water equipment with soapy water and dry thoroughly before re-use.*
- *Drain all water from canoes and boats when leaving a location – ensure waste water does not enter any other NSW waterway.*
- *Pay particular attention to where biological material tends to accumulate such as boots, wheel arches, undersides of kayaks and fishing gear.*
- *Dispose of any biological material collected during cleaning in the general waste (DPI, 2015).*

Changes in the environment, including water quality and temperature, can affect turtle habitat. Turtles love deep pools and rocky substrates in the river. They feed on macroinvertebrates, terrestrial fruit and aquatic vegetation. Turtle nesting sites can be found on river banks in areas of sand and fine gravel. Turtle nests are often at risk from fox and goanna predation.

Myuchelys georgesi can be identified by its serrated hind edge to the shell, a dark belly with black seams, two distinct barbels (short spikes) on the chin, a distinct head shield, and silver eyes. There is another short-necked freshwater turtle (*Emydura macquarii*) which also lives in the Bellinger River. It appears to be unaffected by the virus and seems to be the dominant turtle in the river. Please refer to the *Myuchelys georgesi* and *Emydura macquarii* Identification Sheet located on the Bellinger Landcare website at www.bellingerlandcare.org.au.



'George' - the turtle mascot by local artist; Jackson Rae

Vegetation Corridors

As part of the Great Eastern Ranges Initiative, the following areas are identified as priority corridors.

- The western most reaches, upstream from Thora Bridge, provide vegetation connectivity along the margins of the Dorrigo Gondwana Rainforest World Heritage Area, to the well-forested hill slopes within the Diehappy and Scotchman State Forests.
- The Never Never River reach provides connectivity between the Dorrigo Gondwana Rainforest World Heritage Area, to the well forested hill slopes within the Never Never and Tuckers Nob State Forests.

Ecological Community

The Bellinger River riparian vegetation includes Lowland Subtropical Rainforest, listed as an "Endangered Ecological Community" under the Threatened Species Conservation Act 1995 as Lowland Rainforest on Floodplain. Lowland Subtropical Rainforest grows along riverine corridors and alluvial flats with rich, moist soils supporting an abundant diversity of plants and animals. Many of the native plants found along creeks and riverbanks are lowland species (Bellingen Island is a good example of Lowland Rainforest). Threats to the survival of this community include clearing, burning and weed invasion.

Lowland Subtropical Rainforest covers less than 1,000 hectares on floodplains in NSW. Remaining stands are small and isolated. Generally it comprises a 20-30m tall forest with a closed canopy of 70% cover or more. The forest is very rich and can contain more than 40 tree species at some locations. Trees emerging out of the main canopy may be up to 40-50m tall with large spreading crowns. Typical emergent trees include Figs, Pepperberries, Yellow Carrabeens and Flooded Gums.

LOWLAND SUBTROPICAL RAINFOREST

The following is a list of species characteristic to Lowland Subtropical Rainforest:

River Bank Species

Water Gum (*Tristaniopsis laurina*)

Weeping Lilli Pilly (*Waterhousea floribunda*)

Ringwood (*Anetholea anisata*)

River Oak (*Casuarina cunninghamiana*)

Lilli Pilli (*Syzigium smithii*)

Brush Cherry (*Syzigium australe)*

Creek Sandpaper Fig (*Ficus coronata*)

Canopy Species

Black Booyong *(Argyrodendron actinophyllum***)**

Bolly Gum *(Neolitsea australiensis*)

Brush Cherry *(Syzigium australe)*

Cudgerie *(Flindersia schottiana*)

Flooded Gum *(Eucalyptus grandis*)

Giant Water Gum *(Syzigium francisii*)

Guoia *(Guoia semiglauca*)

Hairy Walnut *(Endiandra pubens*)

Hard Quandong *(Elaeocarpus obovatus*)

Jackwood *(Cryptocarya glaucescens*)

Maidens Blush *(Sloanea australis*)

Native Tamarind (*Diploglottis australis*)

Oliver's Sassafras *(Cinnamomum oliveri*)

Pepperberry *(Cryptocarya obovata*)

Red Bean *(Dysoxylum mollissimum*)

Red Cedar *(Toona australis*)

Rose Walnut (*Endiandra discolor*)

Rosewood *(Dysoxylum fraserianum*)

White Beech *(Gmelina leichhardtii*)

White Booyong *(Argyrodendron trifoliolatum*)

Yellow Carabeen *(Sloanea woollsii*)

INTERESTING FACT: The river system is famous for the Aniseed Myrtle or Ringwood (*Anetholea anisata*) which is only found locally, usually near streams. The leaves have an aniseed scent and flavour and can be used in cooking.

WHY REHABILITATE THE RIVER

The cumulative impacts of increased sediment loads, clearing, agricultural and urban run-off and increased water temperature from loss of riparian vegetation are particularly detrimental to aquatic biodiversity. Healthy rivers support a healthy environment and are vital for our social and economic well-being.

By adopting best practice techniques in the riparian zone you can improve bank stabilisation, water quality, farm productivity and increase land values and biodiversity.

Bank Stabilisation

- Riparian vegetation protects the bank from stock hooves compacting exposed soil.
- Fibrous roots of native vegetation binds soil together.
- Riparian vegetation slows down floodwaters to reduce the force of water flow on banks.

Improved Water Quality

- Riparian vegetation can trap sediment which would otherwise run into creeks and rivers.
- Riparian vegetation can trap moisture to improve soil health and decrease erosion due to soil drying.
- Riparian vegetation filters out animal effluent, fertilizers and chemicals which would otherwise run into watercourses and lead to the growth of nuisance plants, bacteria and algae.
- Riparian vegetation shades watercourses, reducing light and water temperature levels, which can prevent the growth of nuisance plants and algae.
- Riparian vegetation provides food for in-stream life forms.

Improved Farm Productivity and Land Values

- Riparian vegetation can act as a buffer trapping sediment, pollutants and nutrients in run-off. This reduces the incidents of water borne parasites and disease that may affect stock.
- Riparian vegetation provides shade for stock and reduces the impact of high winds on stock and crops.
- Riparian vegetation provides habitat for insect-eating birds which help protect stock, pastures and crops from damage.
- Diverse native vegetation on river banks enhances the aesthetic quality of landscapes.
- Anecdotal evidence from real estate agents suggests that well vegetated riparian frontage can add up to 10% to the market value of a rural property.

Improved Biodiversity

- Protection of native vegetation and seedlings by removing smothering weeds increases the diversity of emerging plants.
- Expansion of areas of native vegetation by planting local native plants propagated from seed collected from the district results in a healthier ecosystem.
- Riparian vegetation shades the river, reducing light and temperature levels, which maintains good habitat for aquatic animals, including water bugs and the fish that feed on them.
- Riparian vegetation can create corridors which improve wildlife habitat by providing shelter, food and protection from predators and allowing native animals ease of movement between vegetated areas.

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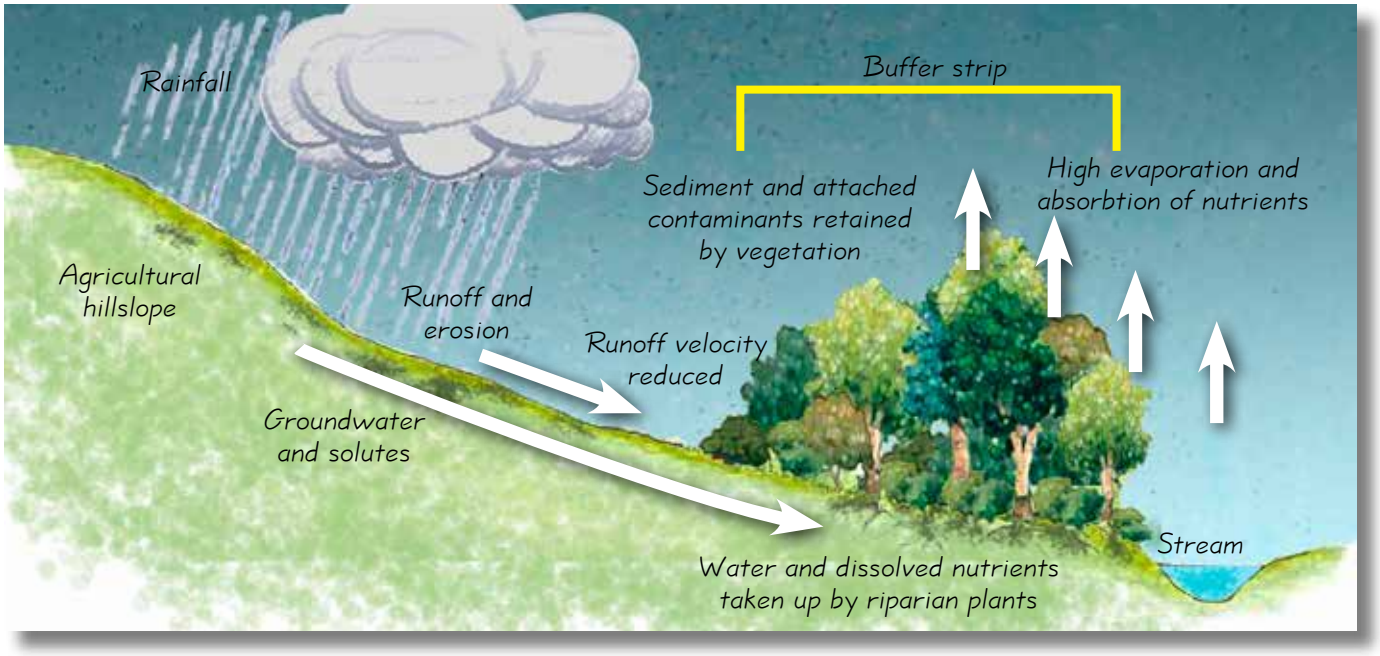
How a riparian buffer strip functions to protect the stream from contaminants



Management of your riparian zone can be achieved through best practice in:

- Bush regeneration
- Stock management

BUSH REGENERATION

What is Bush Regeneration?

Bush regeneration is the practice of restoring degraded bushland, particularly where there are weeds present. Bush regeneration aims to regenerate the bush in order for it to return to its natural state and is able to look after itself. Natural regeneration refers to the natural regrowth of native species from seeds within the existing soil profile or seeds (from nearby vegetation) brought by birds, bats or the wind. This results in the regeneration of vegetation composed of locally appropriate and often diverse plant species. Natural regeneration preserves local plant genetics and helps maintain biological diversity. For these reasons natural regeneration, where conditions indicate it will be successful, is always preferred over revegetation (tree planting).

Aims of Bush Regeneration

- Retain and protect existing vegetation.
- Use weed control to allow the natural regeneration of native seedlings from the existing soil seed bank and from nearby seed sources.
- Revegetate areas where natural regeneration is not taking place, using local provenance plant species grown from seed collected within the valley.

Principles of Bush Regeneration

- Work from areas with vegetation in good condition (least amount of weeds) to areas in worse condition (least amount of 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 created 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.

- Prioritise vine weed control in the riparian zone over other weeds.

Good Condition

Vegetation will be considered to be in good condition when:

- The immediate seed sources of major infesting weeds are removed and there are no mid to upper canopy weed species producing seed.
- Stock impacts to the site are reduced or minimised to the point where understorey native plants (such as Lomandra) can establish without being continually grazed.
- There is sufficient existing native canopy cover (50-100%) 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).
- Plantings must survive at least two winters to be considered suitably established and must be able to provide enough canopy cover to reduce weed regeneration (i.e. 50-100% at 2 metres high).

Site Selection for On-Ground Works

- Maintain sites over 20 metres in width. Avoid a too narrow area which is 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 wider the area the more resilient the vegetation will be to edge effects.
- Achieve 75% shade across watercourses. Remembering that for an east to west running stream, most shade is provided from the northern bank, so if possible prioritise this bank for work.
- Start stock management and weed control in areas in good condition or close by. To maximise effectiveness, build upon existing stands of vegetation and areas where natural regeneration is already occurring.
- Carefully consider site maintenance requirements, such as maintenance of fences and follow up weed control, so that you do not overstretch 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.

WEED CONTROL METHODS

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 weed species and 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 and follow the product label and acknowledge if a permit is required, before use.

The following section has been taken from the *Noxious and Environmental Weed Control Handbook* published by the DPI (2014). Please refer to that booklet for more in-depth information on environmental weed control as well as *Weeds of the North Coast of NSW: a guide to identification and control* (Dollmann 2015), available at www.bellingerlandcare.org.au

Cut and Paint

Here the plant is cut off completely at its base (no higher than 15cm from the ground) using a chainsaw, axe, brush cutter or machete (depending on the thickness of the stem/trunk). 100% glyphosate is then painted on to the exposed surface of the cut stump emerging 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. 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. For trees with large circumferences, it is only necessary to place the solution around the edge of the stump (as the objective is again to target the cambium layer inside the bark). 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.

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

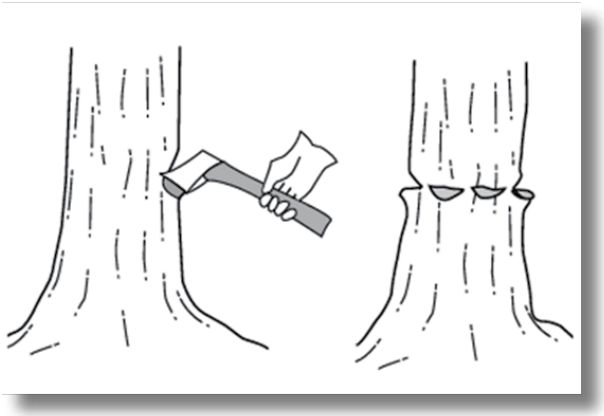
Stem Inject

These methods involve drilling or cutting through the bark into the sapwood tissue in the trunks of woody weeds and trees. 100% glyphosate 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.

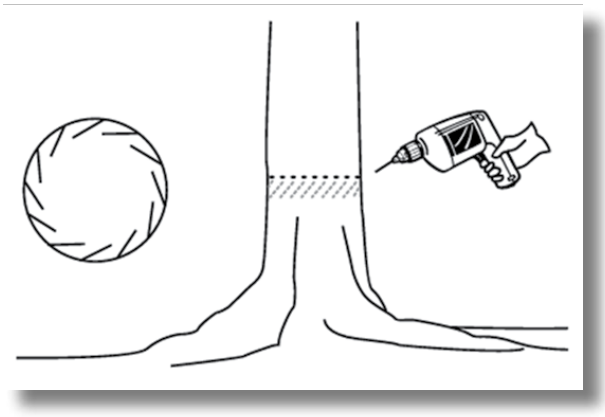
Stem injection methods kill the tree or shrub where it stands. Only trees and shrubs that can be safely left to die and rot should be treated this way. If a tree is to be felled, allow it to die before completely felling.

Stem Injection – Axe Cut (Frilling) Method



Use a heavy tomahawk to make deep cuts into the trunk (depth of the cuts is relative to the species of plant) below the lowest branch if possible and approximately 10cm apart. While the tomahawk is still in the cut, lean the top outwards (away from the tree) to open up pockets. Fill the pocket with herbicide immediately after inflicting each cut, i.e. in less than 15 seconds. Refill the pocket once the herbicide is absorbed for improved results. Repeat these steps as you circle around the trunk for at least two rows (more for larger stems) with pockets offset from each other, as per the illustration. Do not ringbark the stem as that will promote suckering from the tree roots.

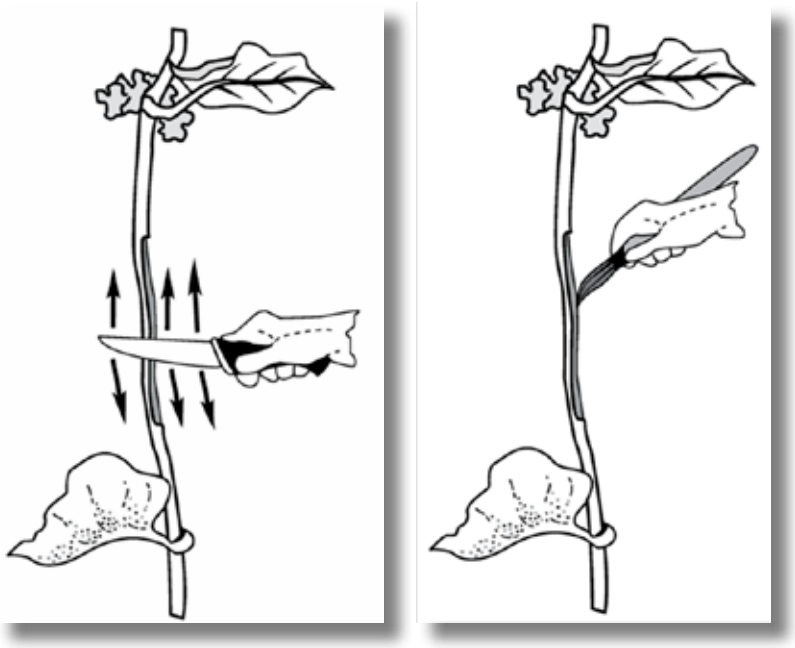
Stem Injection – Drill and Fill Method



Stem injection is used for trees and woody weeds with stems or trunks greater than 50cm in circumference. This method uses a battery powered drill with an 8mm drill bit to make downward angled 3cm deep holes into the sapwood, approximately 5cm apart. For larger trees, 6-8cm holes are preferred. Then immediately fill the holes with herbicide, i.e. in less than 15 seconds. Repeat these steps as you circle around the trunk for at least two levels, more is better, with holes offset from each other, as per the illustration.

Stem Scrape

Stem scraping is used for vines. A sharp serrated knife is used to scrape a very thin layer of bark from a 15–30cm section of the stem.100% glyphosate 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 runoff (until every leaf is wetted, but not dripping). This method is most suited to shrubs, grasses and dense vines less than 6m 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.

WEED LIST

Balloon Vine *(Cardiospermum grandiflorum)*

Origin: Tropical America, West Indies and Africa.

Habit: Plants spread along the ground or climb trees and shrubs. Common in moist gullies along the warm temperate to tropical coast of QLD and NSW.

Distinguishing Features:

- Leaves are compound 6-16cm long.
- White flowers, four petals in clusters.
- Fruit is an inflated papery membranous capsule (balloon), 6-ribbed, 4-8cm long, covered with short stiff hairs, each containing three blackish round seeds.

Control Methods:

- Hand-pull/dig, scrape and paint with 100% glyphosate or foliar spray with glyphosate at 10ml/L. Best approach is to cut vines and spray re-growth.

Fruit

Leaves

Flowers

NATIVE LOOK ALIKE:

Slender Grape: Often mistaken for the Balloon Vine weed.

Fruit

Leaves

Bamboo *(over 70 genera with 1450 species)*

Origin: Asia and tropical America

Habit: Woody grass of varying heights 2-15m

Distinguishing Features:

- Perennial, tall, woody grasses of varying heights (2-15m).
- Woody stems, hollow centres and nodes at regular intervals.
- Leaves are alternate, thick and grass-like.
- Bamboo can be divided into clumping (which grow at the one location) and running (which spread more rapidly by underground runners).

Control Methods:

- Manual control is difficult due to vigorous root system. Digging the entire root system out is necessary, possibly using machinery.
- The spread of clumping and running bamboo can be controlled with an effective root barrier material. Regrowth can be sprayed with 20ml/L glyphosate.
- For the cut and paint method, each cane should be cut close to the ground, just below the first node. After cutting, use 100% glyphosate and pour into the hollow stem.

Leaves

Habit

Stems

Small Leaf Privet *(Ligustrum sinense)*

Origin: China

Habit: Shrub to 5m

Distinguishing Features:

- Leaves (2-4cm), oppositely arranged, thickened, leathery, similar colour on both upper and underside.
- Flowers, small (4-6mm) white with 4 petals and clustered.
- Fruit a berry (4-6mm), purple/black when mature.

Control Methods:

- Cut saplings to ground level and paint immediately with 100% glyphosate.
- Stem inject large trees with 100% glyphosate.

Leaves

Flowers

Mature Fruit

Camphor Laurel *(Cinnamomum camphora)*

Origin: East Asia

Habit: Tree to 20m

Distinguishing Features:

- Leaves (5-11cm long; 2-5cm wide), alternately arranged, glossy on upper surface, with aromatic camphor smell when crushed.
- Bark greyish, with numerous fissures.
- Flowers, small (approx 3mm) white with 6 petals.
- Fruit a berry (approx 10mm) shiny black when mature.

Control Methods:

- Cut saplings to ground level and paint immediately with 100% glyphosate.
- Stem inject large trees with 100% glyphosate.

Leaves

Flowers

Mature Fruit

Madeira Vine *(Anredera cordifolia)*

Origin: South America

Habit: Ground cover

Distinguishing Features:

- Vigorous climber.
- Heart-shaped leaves are wide, fleshy, and light green.
- Flower spikes are 10cm long, with numerous individual small flowers, resembling a lamb's tail, producing dense blankets of creamy flower spikes from December to April.
- Produces thousands of small light-brown or green potato-like tubers along the stems which fall to the ground and sprout.

Control Methods:

- Avoid pulling or cutting the vine stems as this results in fertile tubers dropping to the ground**.**
- Firmly scrape sections about 30cm long along the vine, exposing the inner part of the stem. Start from ground level and work on all stems as high as can be reached.
- As you scrape, immediately paint each exposed section with 100% glyphosate.
- Vines and aerial tubers can then be left to decompose in the canopy.
- Most importantly, follow up this procedure for any vine stems that have been omitted.
- Sprouted tubers on the ground, can be carefully (and painstakingly) collected and bagged, ensuring the entire tuberling is collected.
- For ground regrowth, spray the tuberling leaves on a regular basis, 1 part glyphosate to 50 parts water. The addition of metsulfuron-methyl to glyphosate solutions is very effective.
- Large tubers can be poisoned in the ground by gouging a hole in the tuber and filling this with 100% glyphosate.
- To reduce further spread move vine and tubers onto a tough plastic sheet, cover tightly and check periodically. Spraying vine pieces with the above glyphosate water mix is an option, or decompose in a covered drum of water.
- Avoid rubbish dumping or taking contaminated soil or material to the tip - this only spreads Madeira Vine.

Habit

Leaves

Tubers

WEEDS TO LOOK OUT FOR :

- Palm Grass *(Setaria palmifolia)*
- Castor Oil *(Ricinus communis)*
- Taro/Elephants Ears *(Colocasia esculenta)*
- Seeded Banana *(Musa balbisiana)*
- Broad Leaf Paspalum *(Paspalum mandiocanum)*
- Cat's Claw Creeper *(Macfadyena unguis-cati)*
- Tropical Soda Apple *(Solanum viarum)*
- False Sicklepod *(Cassia multijuga)*
- Kidney-leaf Mud Plantain *(Heteranthera reniformis)*
- Long-leaf Willow Primrose *(Ludwigia longifolia)*
- Giant Devil's Fig *(Solanum chrysotrichum)*

For further info please see info on the Look, Learn, Act website www.looklearnact.com and the NSW DPI site http://weeds.dpi.nsw.gov.au/

Palm Grass

Castor Oil

Taro/Elephants Ears

Seeded Banana

Broad Leaf Paspalum

Cat's Claw Creeper

When to Revegetate

Riverbank erosion is where soils and other bank materials are moved by water or gravity and transported downstream. This can cause a loss of productive land, for yourself and potentially your neighbours. This loss can lead to impacts on water quality (turbidity and pollution) and aquatic habitats (filling up pools, covering over sea grasses) and life downstream. Whilst rivers naturally experience erosion, there are many human factors that have accelerated the rates of erosion we see today.

Revegetation planting should be considered when there is:

- Erosion in the riparian zone or the need for greater bank stability.
- Insufficient natural vegetation.
- Natural regeneration of native plants after weed control is minimal.

Outcomes of Revegetation

Revegetation planting in the riparian zone can have the following beneficial outcomes:

- Slowing down water movement, protecting the bank by reducing the force of water.
- Stabilising the river bank, reducing bank erosion, as roots of native vegetation binds soil together.
- Prevent slumping, as planted trees can soak up water from the riverbank and tree roots provide a scaffold.
- Reduce weed seed sources, whilst increasing native seed stocks.
- Provide a shelter belt for neighbouring paddocks by reducing wind velocity and moderating extreme temperatures.
- Create shade and hence assist in maintaining healthy water temperatures (increases in water temperature can promote weeds and excess algal growth and result in lower levels of oxygen).
- Improve the ability of the land to trap and use available rainfall.
- Continuity in healthy riparian vegetation has the additional benefit of creating vital protective vegetation corridors.
- Vegetation corridors along the riparian zone lead to more resilient and connective native vegetation, to the conservation of biodiversity at the landscape scale and provides routes for dispersal of native seeds and wildlife.

Role of Vegetation in the Landscape

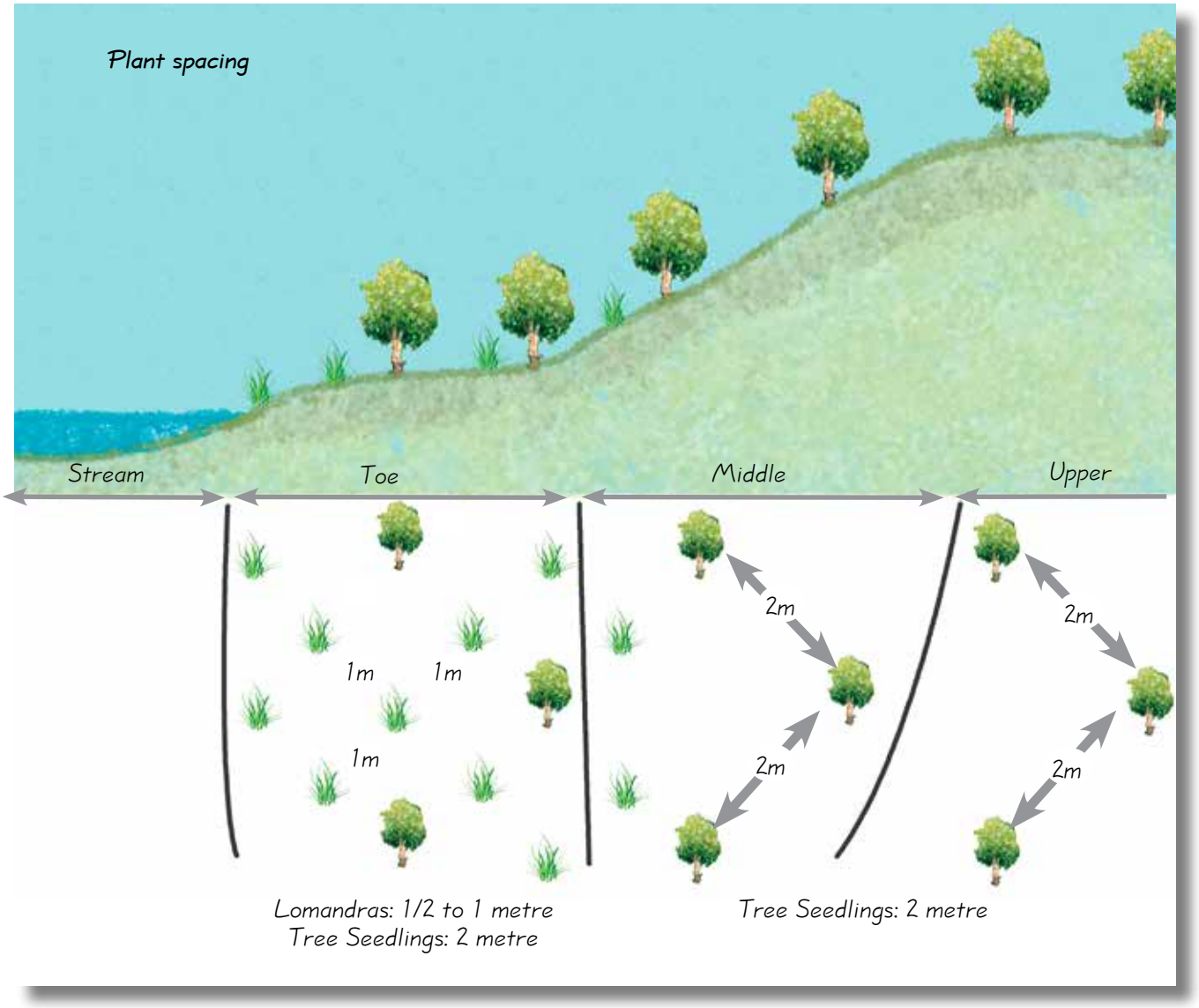
Plant Spacing

It is essential to plant at the toe of the bank, in, or at the water's edge. Planting on the bank toe, middle and upper bank leads to greater stability as roots become interwoven, holding bank material together, with large trees anchoring the upper bank.

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.

It is essential to keep stock and smothering weeds away from new plantings. For example on:

- **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, 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.



Native Plants For The Riparian Zone

The following plant species suggestions can be referred to when you are revegetating areas of your riparian zone.

NATIVE PLANTS FOR RIVER BANKS AND CREEK LINES

Fast growing species such as River Mat Rush (*Lomandra hystrix*) can be useful to slow erosion sufficiently until the slower growing species take off.

The following species list is suggested for the river bank toe, mid bank and upper bank:

Waters Edge (Bank Toe) and Islands

River Mat Rush (*Lomandra histrix*)

River Oak (*Casuarina cunninghamiana*)

Water Gum (*Tristaniopsis laurina*)

Mid Bank

Water Gum (*Tristaniopsis laurina*)

Brush Cherry (*Syzigium australe*)

Lilly Pilly (*Syzigium smithii*)

Creek Sandpaper Fig (*Ficus coronata*)

Guoia (*Guoia semiglauca*)

Upper Bank and Floodplain

Jackwood (*Cryptocarya glaucescens)*

Black Apple (*Planchonella australis*)

Native Tamarind (*Diploglottis australis*)

Giant Water Gum *(Syzigium francisii*)

Olivers Sassafras (*Cinnamomum oliveri*)

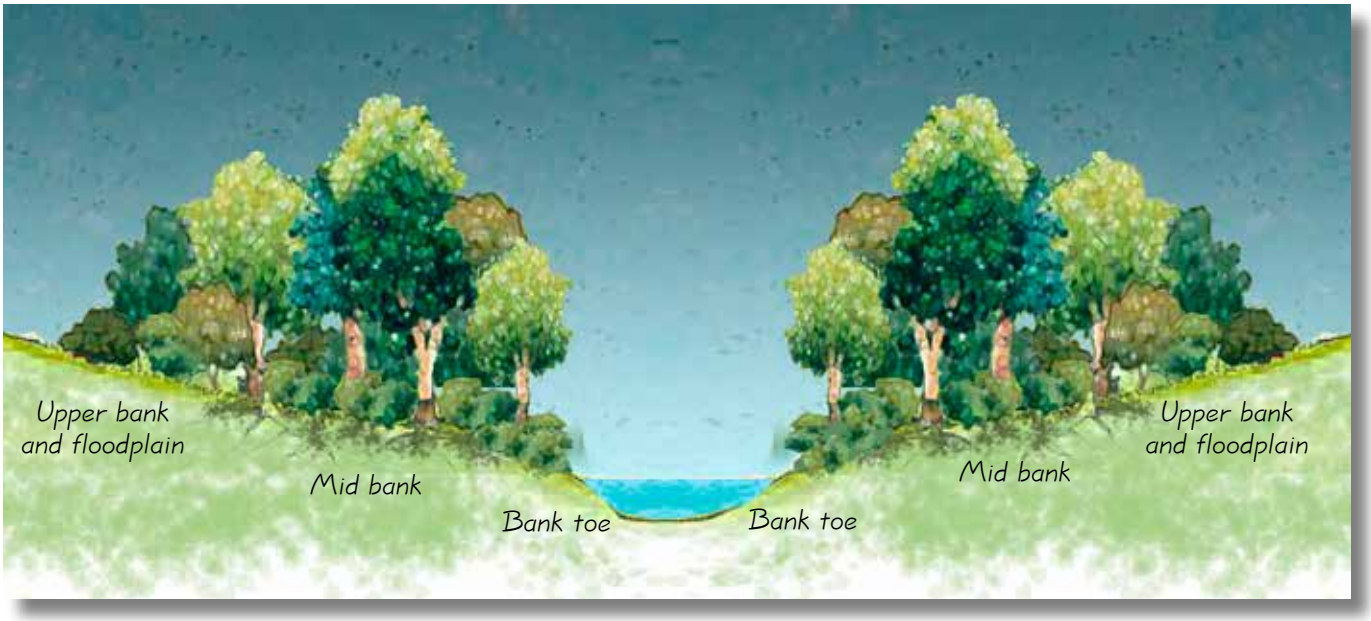
White Beech (*Gmelina leichhardtii*)

Pepperberry (*Cryptocarya obovata)*

Rose Walnut (*Endiandra discolor*)

Small Leaved Fig (*Ficus obliqua*)

Cross section of river bank



NATIVE PLANTS FOR FARM DAMS, WETLANDS AND DEPRESSIONS IN PADDOCKS

The following species thrive in damp soil and like 'wet feet':

Bangalow Palm (*Archontophoenix cunninghamiana)*
Brush Cherry (*Syzigium australe*)
Creek Sandpaper Fig (*Ficus coronata*)
Giant Water Gum (*Syzigium francisii*)
Guoia (*Guoia semiglauca*)
Lilly Pilly (*Syzigium smithii)*
Native Daphne (*Pittosporum undulatum*)
Paper Bark (*Melalueca ericifolia*)
River Mat Rush (*Lomandra hystrix*)
River Oak (*Casuarina cunninghamiana*)
Water Gum (*Tristaniopsis laurina*)

PADDOCK TREES AND WIND BREAKS

Paddock trees are best planted in clumps so that growing plants provide protection for each other and are more resilient to frost, flooding, and insect attack. Here are some suggestions:

Brush Cherry (*Syzigium australe*)
Giant Water Gum (*Syzigium francisii*)
Guoia (*Guoia semiglauca*)
Lilly Pilly (*Syzigium smithii)*
Native Daphne (*Pittosporum undulatum*)
River Oak (*Casuarina cunninghamiana*)
Shiny Sandpaper Fig (*Ficus fraserii*)
Water Gum (*Tristaniopsis laurina*)
White Booyong (*Argyrodendron trifoliolatum)*
Jackwood (*Cryptocarya glaucescens*)

Caring For New Plantings

It is best to use tree guards to protect new plantings from animal grazing. It is also beneficial to use tree guards to find your trees in the high grass and to protect them from spray drift when weeds are sprayed. Maintenance and weed control are critical for plants to establish optimally.

An application of slow release fertilizer in early spring gives a worthwhile boost to plant growth.

Revegetated riparian zone using tree guards

STOCK MANAGEMENT

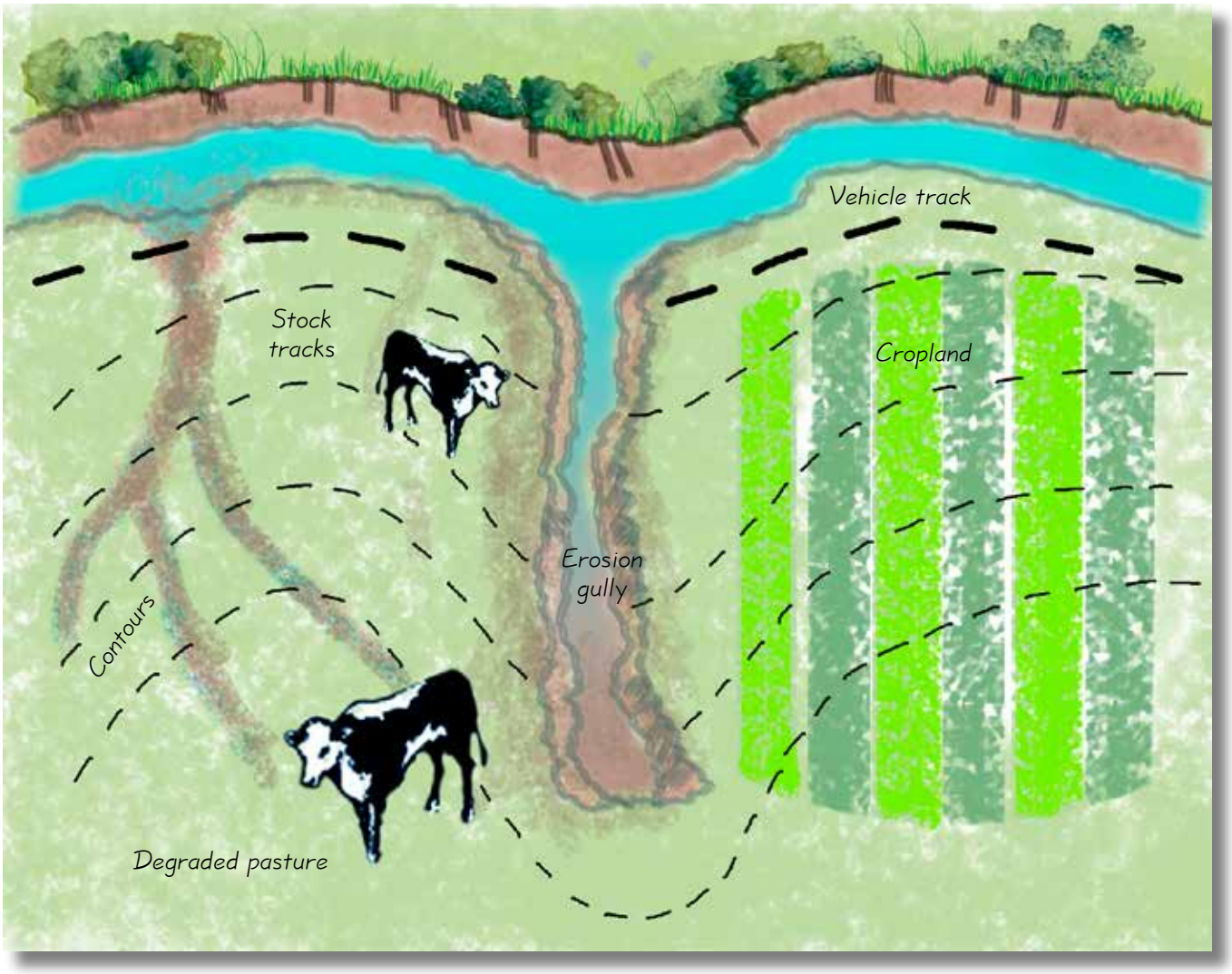
Why is Stock Management vital for Riparian Health?

Stock management has a great influence on river health. It is important to manage stock access to the riparian zone to reduce:

- Damage to riparian vegetation from grazing and trampling, leaving banks exposed.
- Compaction of soil by hard hooves, subsequent erosion and degradation of the river structure.
- Pollution resulting from sediment washing into the water course from erosion sites.
- Stirring of sediment and damage to aquatic habitats caused by cattle loitering in streams.

Comparison of poorly managed and well managed stock access to riparian areas.

Poorly Managed: degraded catchment and riparian land. Significant sediment and nutrient loss is derived from degraded pasture, poor crop management, unlimited stock access and gully erosion.



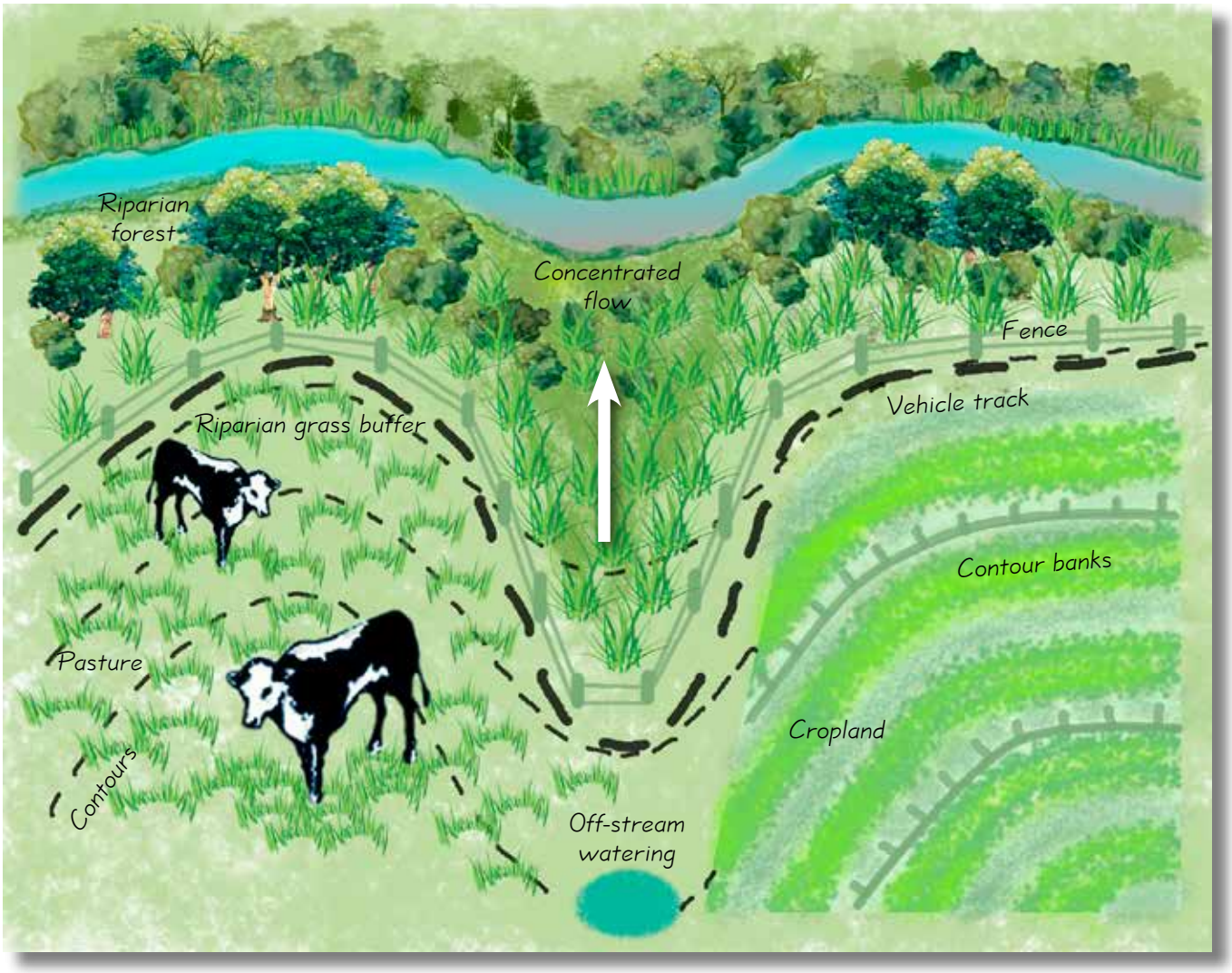
- Pollution resulting from cattle defecation.
- Weed growth, through high nutrient loads from dung.
- Stock exposure to water borne parasites, disease, and foot rot.

Best Practice Stock Management

Best practice for stock management should address the following aspects:

- Fencing
- Stock watering points
- Formed access points

Well Managed: best practice stock management and healthy riparian zone. Riparian vegetation provides ecological benefits and absorbs nutrients, variable width grass buffers trap sediment and stock access is controlled through fencing and off-stream watering.



FENCING

Fences too close to watercourses 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 used as a method of weed control.

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 where they catch 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. It is not recommended to use barbed wire as this is a particular trap for debris and wire washed away creates hazards downstream and wildlife entanglement.

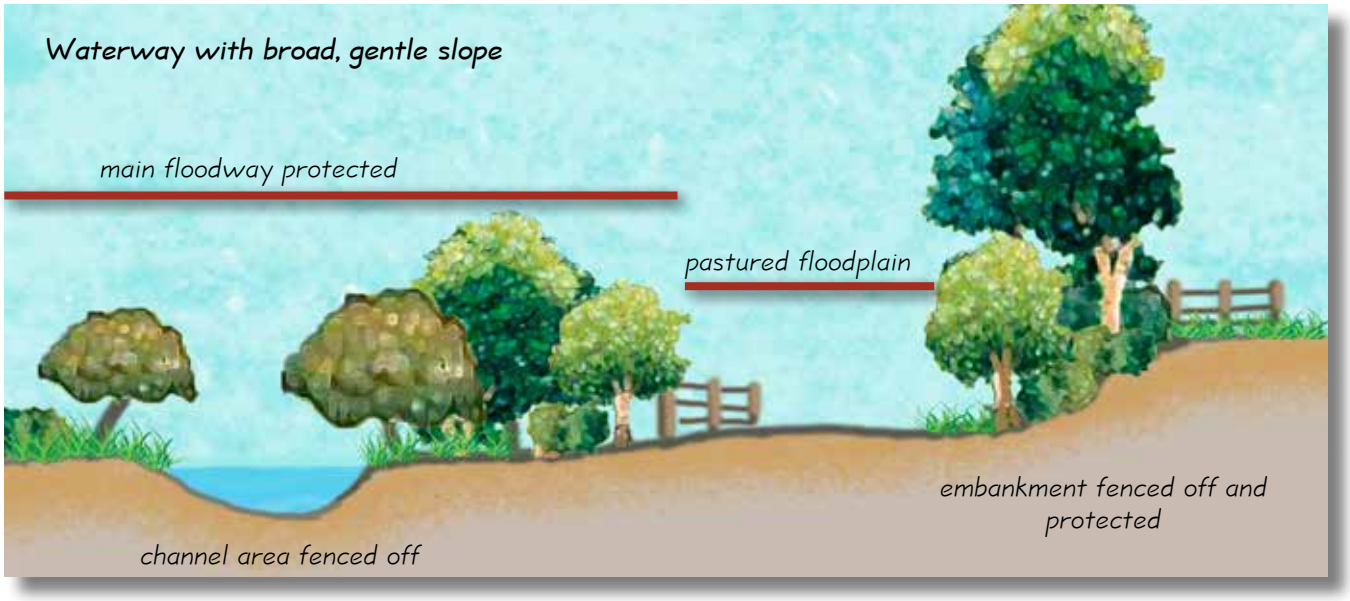
Permanent Electric Fence

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.

Portable Electric Fence

In areas particularly prone to flooding, portable electric fences can also be quickly moved if there is advance notice of a likely flood peak, and then re installed after flood waters recede.

Locate fences as far back from the watercourse as possible and above flood level



STOCK WATERING

Off-stream watering options can increase farm productivity through stock access to clean water. Clean water helps maintain stock condition. Off-stream watering can also reduce health problems, such as foot rot and water-borne parasites and diseases. Stock watering can be managed through water troughs or dams.

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 rivers and creeks.

Landholders have demonstrated that providing shade away from rivers and providing access to clean water in a trough 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 rivers and creeks.

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 is a positive investment, repaid through increased production.

Water trough in paddock

Dams

In some cases it may be practical to construct a small dam to provide off-stream watering. 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.

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 and Energy. To find your harvestable rights, see http://www.farmdamscalculator.dnr.nsw.gov.au.

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 also required for:

- Dams with a maximum surface area of more than 0.5 hectares located:
  (i) in or within 40 metres of a natural waterbody, wetland or an environmentally sensitive area
  (ii) in an area of high watertable, or acid sulfate, sodic or saline soils.
- Dams with a surface area of water of more than 20 hectares or a maximum total water volume of more than 800 megalitres.
- 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 Fisheries office for further advice.

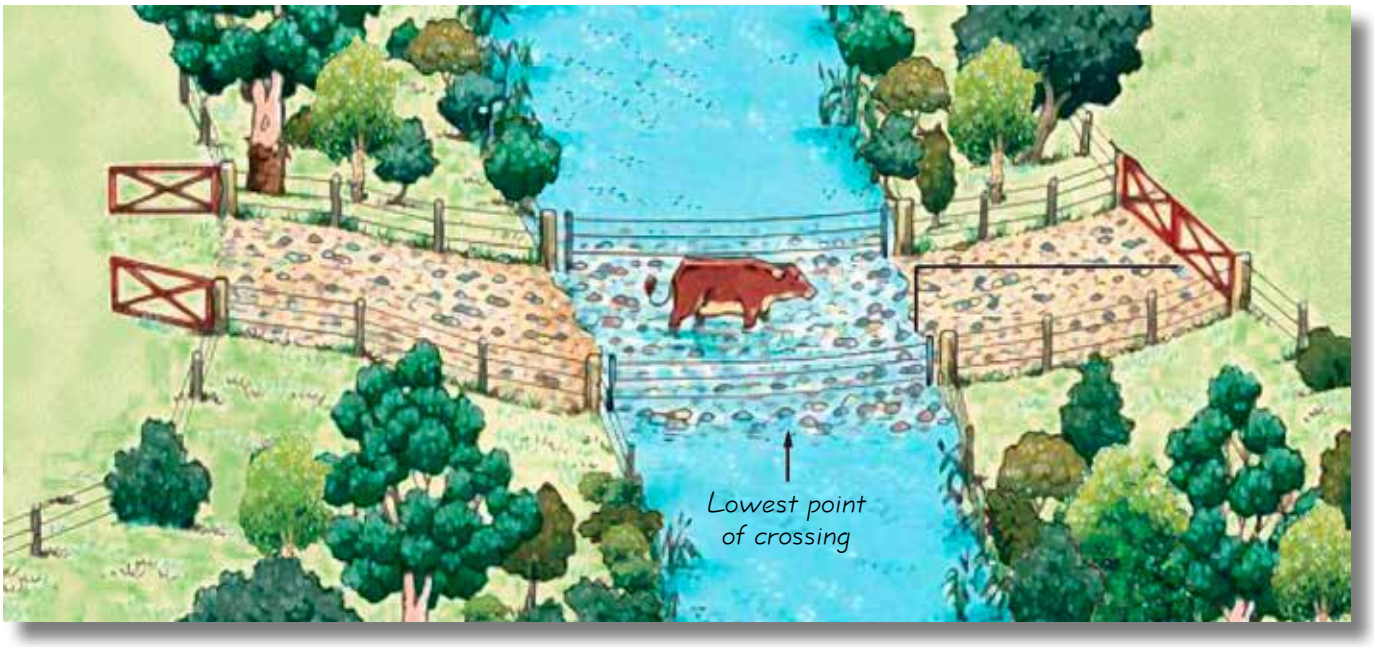
Formed Access Points

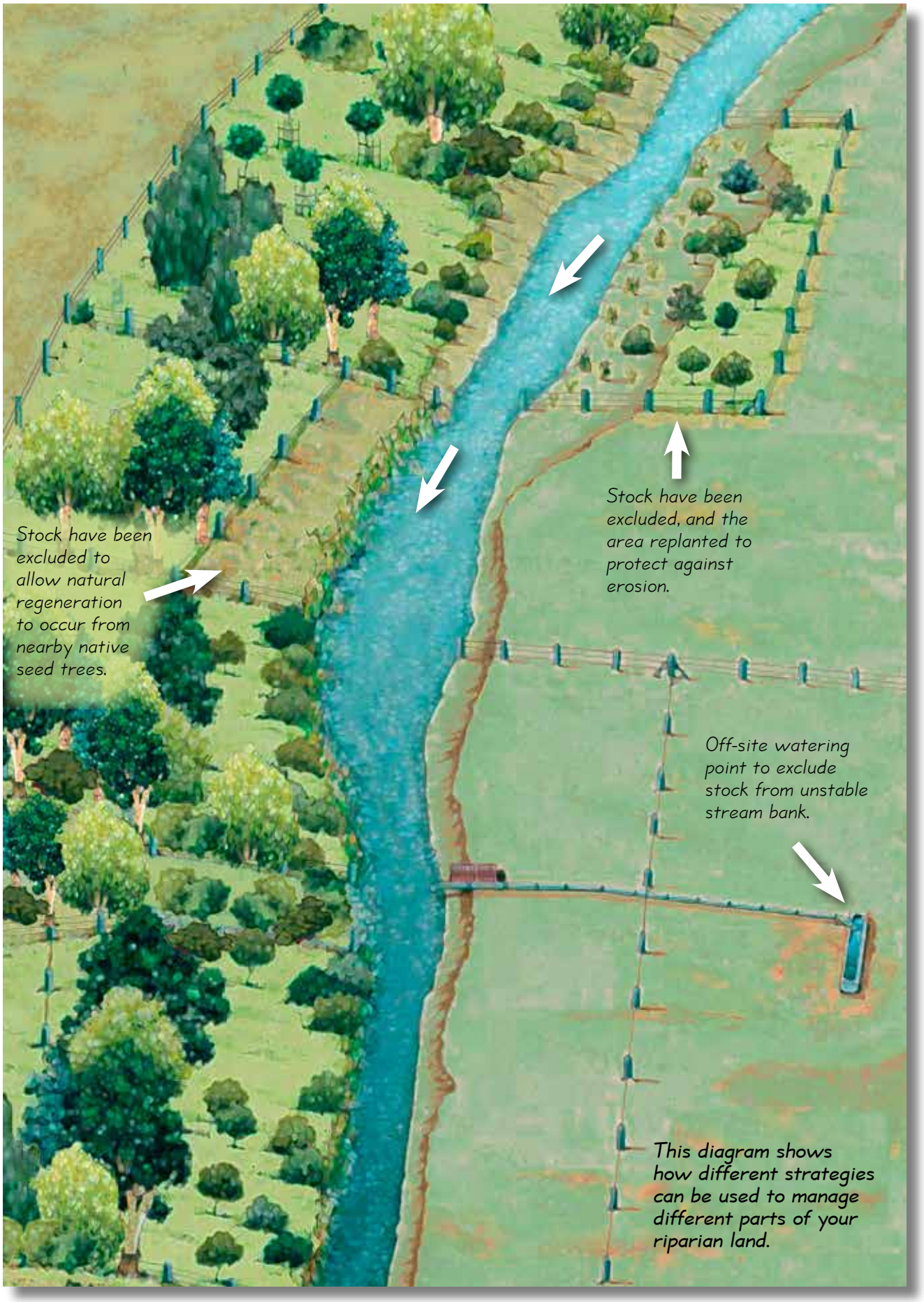
A less desirable alternative to fencing and water troughs is a formed access point for stock to water from the river at a carefully selected section of the bank. It is important to avoid boggy areas, and the outsides of river bends where flow speed is high and banks are subject to increased erosive forces.

Cross-stream fencing may be required to prevent animals wandering along the bank. A graded slope into the river is selected or constructed at 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 an easier access point to drink, so a site with a gently sloping bank is preferable. Experience has shown that hardened formed access points for livestock watering from creeks usually fail in our climate of high rainfall and that repair is costly and time consuming.

An example of how a stock crossing can be constructed to minimise damage to the waterway.





This diagram shows how different strategies can be used to manage different parts of your riparian land.

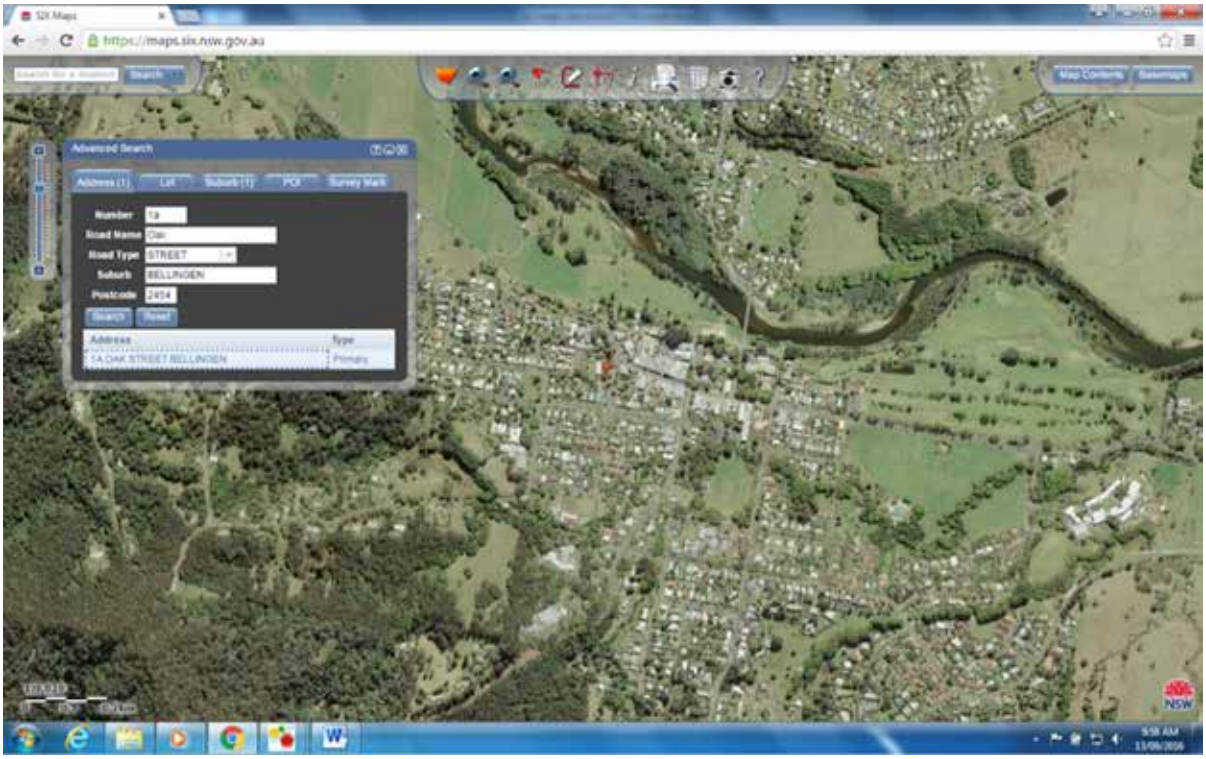
USEFUL ONLINE MAPPING TOOL

Six Maps is a useful online mapping tool, accessible by the public. Use it to see where your property is located within the catchment area, obtain lot numbers, measure distances and areas and obtain map coordinates for funding grant applications.

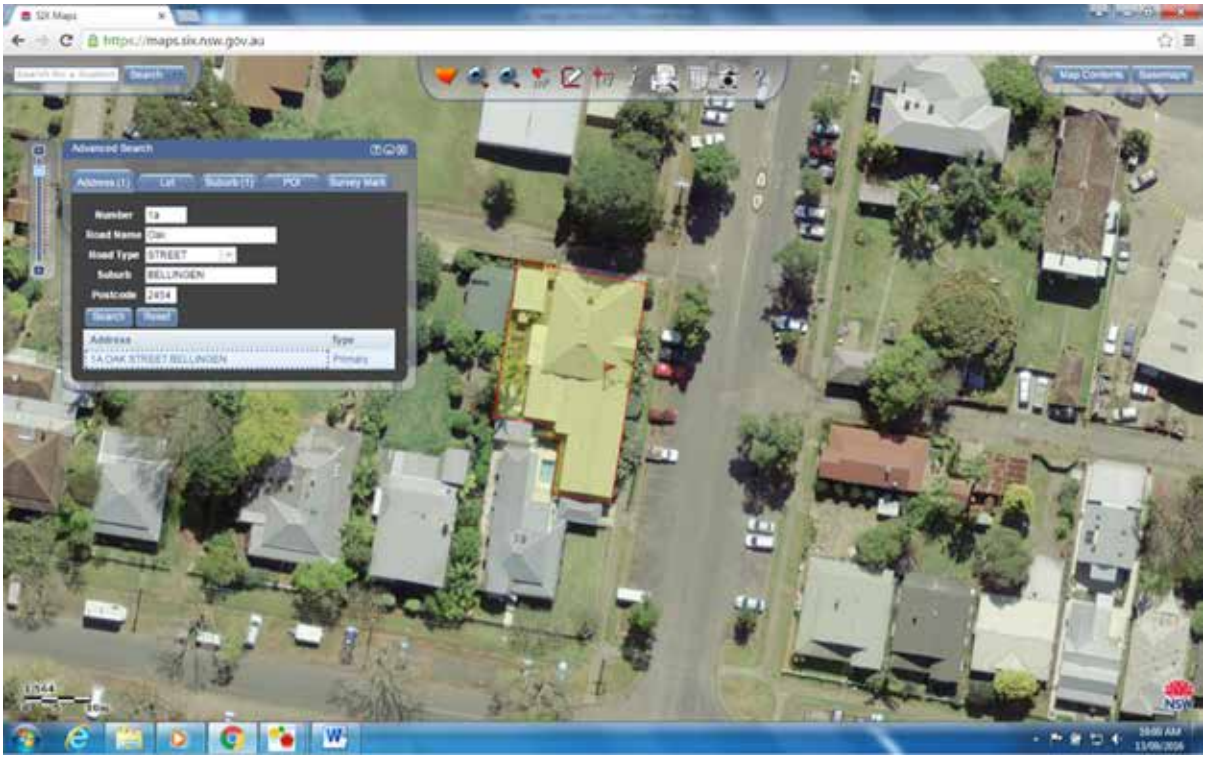
INSTRUCTIONS

Search for http://maps.six.nsw.gov.au on the internet.

In the top left corner go to 'Search' and select 'Advanced' from the drop down menu. Enter your address details and click on the correct address when it appears in the table below. (Your screen may not have the same image when you search initially – this is an example only).



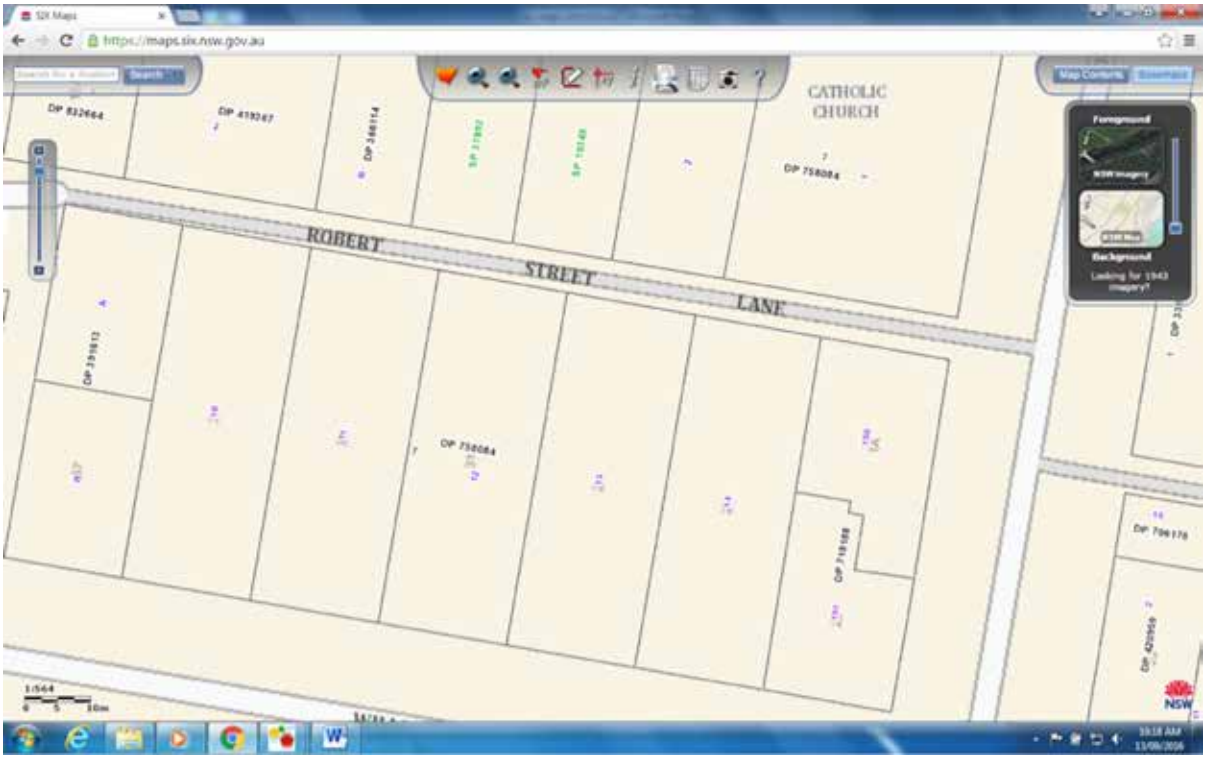
Use the scale on the left side of the screen to zoom in (or out).



Use the distance, area or xy tools along the top of the screen to measure length (e.g. of a river bank), area (e.g. of a proposed weed control site) and get site coordinates (may be required for some funding grant applications).

Click on 'Map Contents' in the top right corner of the screen to select Lot boundaries and Lot labels.

Click on 'Basemaps' in the top right corner of the screen to select NSW Imagery (aerial photography, shown in above images) or NSW Map (topographic map, shown below).



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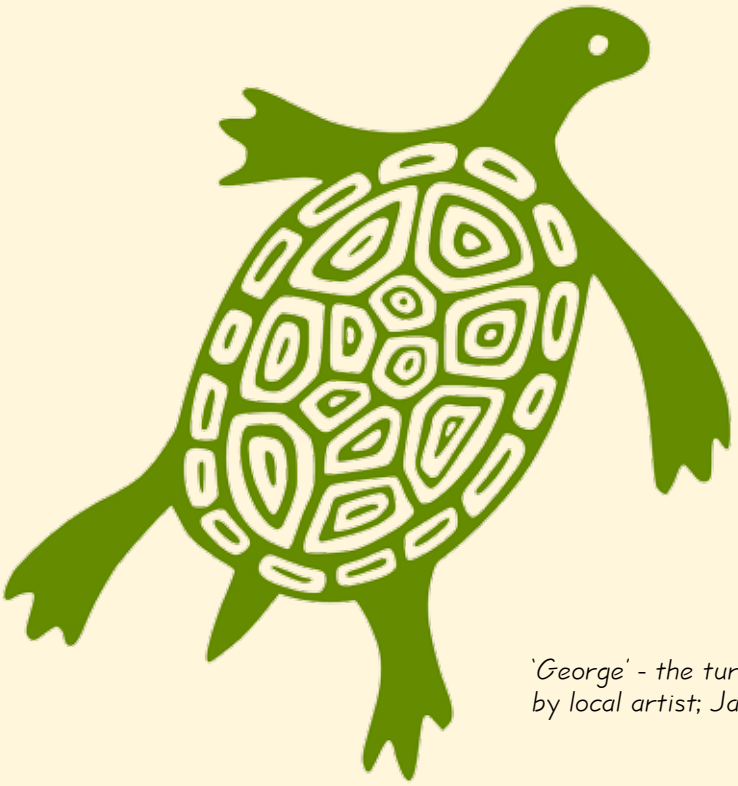
Managing River Oaks in Gravel Bed Rivers on the NSW North Coast http://www.bellingerlandcare.org.au/resources/brochures-and-fact-sheets/

Revegetating streams in the Bellinger and Coffs Harbour Catchments http://www.bellingerlandcare.org.au/resources/brochures-and-fact-sheets/

BELLINGER RIVER SYSTEM

LANDHOLDER BOOKLET



'George' - the turtle mascot
by local artist; Jackson Rae

BEST PRACTICE
FOR A HEALTHY RIVER

Bellinger Landcare Inc.

NSW Environmental TRUST