



rivers and
water quality

arteries of the Australian environment

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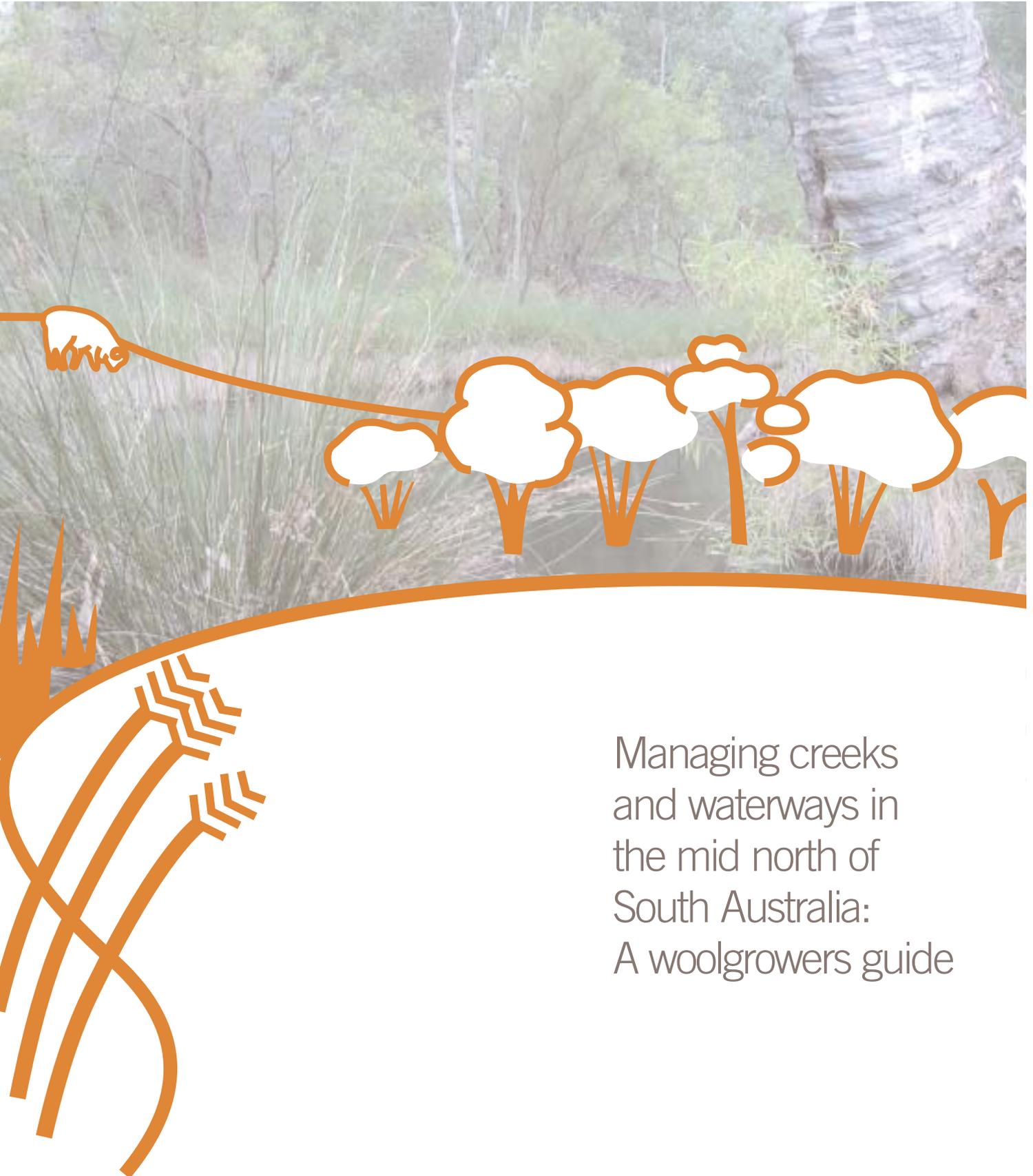
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Managing creeks
and waterways in
the mid north of
South Australia:
A woolgrowers guide



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Managing creeks and waterways in the mid north of South Australia: A woolgrowers guide

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Land, Water & Wool is a research partnership between Australian Wool Innovation Limited and Land & Water Australia.

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Government of South Australia

South Australian Murray-Darling Basin
Natural Resources Management Board



Photo Kylie Nicholls.

Land, Water & Wool

— productive resource management

Land, Water & Wool is a national research program initiated by Australian Wool Innovation Limited and Land & Water Australia aimed at providing wool producers with practical tools for managing natural resources sustainably and profitably.

Across the country, groups of wool producers have been actively involved in research and development projects and demonstration sites to address specific natural resource management issues.

Land, Water & Wool comprises seven areas of research and development based around the major issues facing sustainable wool production:



Sustainable grazing on saline lands



Rivers and water quality



Native vegetation and biodiversity



Managing pastoral country



Managing climate variability



Future woolscapes



Benchmarking and evaluation

Healthy waterways and creeks are the arteries of the Australian environment — they provide the water to sustain many different plant and animal communities and agricultural industries.

The Land, Water & Wool project, *Optimising wool production and profitability in mid north South Australian riparian areas*, located near Burra, is one of three projects in the Rivers and Water Quality sub-program. The other two projects are located in the midlands of Tasmania and the southern tablelands of New South Wales.

The Rivers and Water Quality sub-program is helping woolgrowers find profitable, productive management options for land around rivers and streams. With 78% of Australian woolgrowers having properties which adjoin at least one waterway, managing these water systems and keeping them healthy is a crucial part of running a profitable wool producing enterprise.

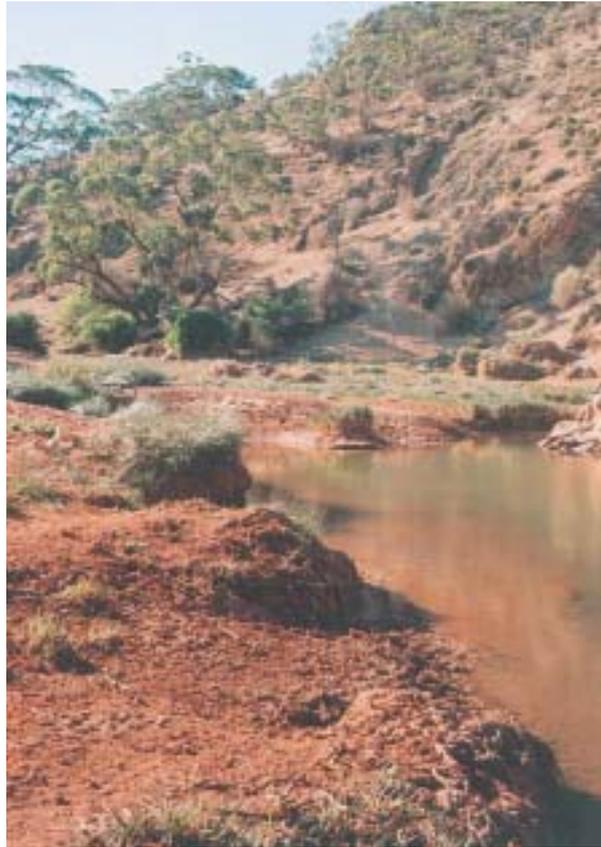
In order to achieve this, the sub-program emphasised the importance of working with woolgrowers to understand, identify and invest in research that addresses their needs, as they relate to improving river and riparian management within the context of a commercial wool growing property.



Whilst the focus of projects of this kind is generally on physical outcomes such as the kilometres of fencing completed, area of trees planted or the success of regeneration treatments, the Land, Water & Wool – Rivers sub-program believes that the real success of any natural resource project is when the mind or hearts of the farmers involved have been changed, and they have a long-term commitment to the project outcomes.

To do this, the program has studied issues such as gully and streambank erosion, water quality, weed management, and riparian zone management within a total grazing system. This research has then been used to develop simple and effective tools which can be used by woolgrowers working along all waterways across Australia.

The innovative Land, Water & Wool – Rivers sub-program is helping woolgrowers find profitable and productive management options for land around creeks. Photo Kylie Nicholls.



Waterways in South Australia are often dry for parts of the year. These are called ephemeral systems and are important for both biodiversity and production values. Photo Kylie Nicholls.

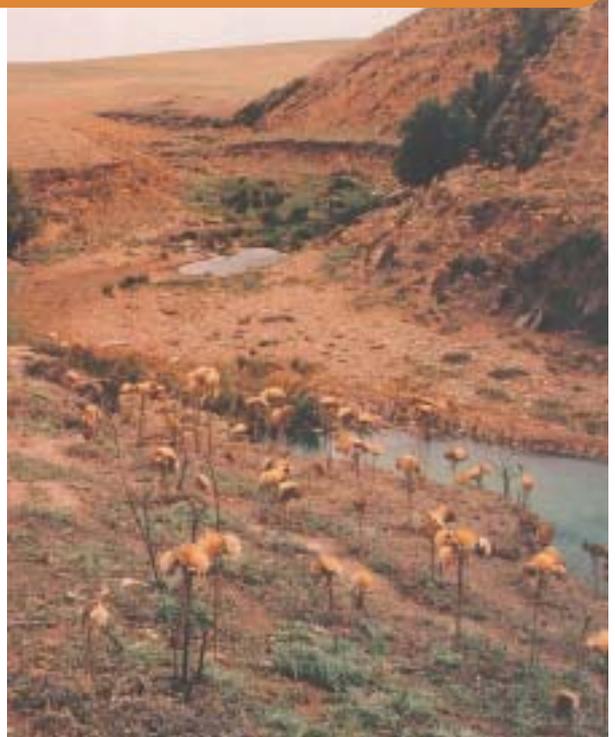
Droughts and flooding rains

In 1845, a shepherd, William Stclair, found an outcrop that indicated copper at the site of the Princess Royal Mine. Shortly after, another shepherd, Thomas Pickett, discovered a large mass of red copper oxide at what was to become Burra in the mid north of South Australia.

Burra became the site of one of the world's major copper mines, the income from which did much to save the young colony from financial disaster. By the time the mine closed in 1877, Burra was already also serving as a transport centre for the north-east of the colony and parts of western New South Wales and south-west Queensland.

In the late 19th century and early 20th century Burra was South Australia's main centre for the sale of sheep and was the largest town in an area famed throughout Australia for stud merino sheep breeding. The Burra region was, and still is, home to many well known Merino and Poll Merino studs and large pastoral properties. The annual SA Merino field days held every March in Burra are testament to the rich wool heritage of the region.

Creeks and their adjacent riparian areas throughout the mid north of SA were once prime grazing country, typified by native grasslands and fresh water. These areas are now showing increasing sign of stress and degradation, including rising salinity, reduced pasture productivity and increased areas of either bare ground or weed infestations.



Weeds take hold when vegetation is cleared. The artichoke weed shown in this photo is a significant problem in the Burra region. Photo Kylie Nicholls.

Many of the wool properties in the Burra region are in a transition zone between sown pastures, cropping land and native grass pastures, and the semi-arid, pastoral, chenopod-dominated lands.

Summers are hot and very dry, winters are cool to mild and rainfall can be low and unreliable. The average annual rainfall across the region varies from 200 millimetres up to 500 millimetres.

But despite the vagaries of the season which can often bring devastating droughts or flooding rains, there is a great sense of history and pride in the Burra region and the local woolgrowers remain stoic and optimistic of the continuing sustainability of their wool producing properties.



Burra Gorge. Photo Kylie Nicholls.

Local knowledge and experience

Listening and responding to the woolgrowers' individual wants and needs has increased their enthusiasm, commitment and feeling of ownership for this project, which is critical for its long-term success.

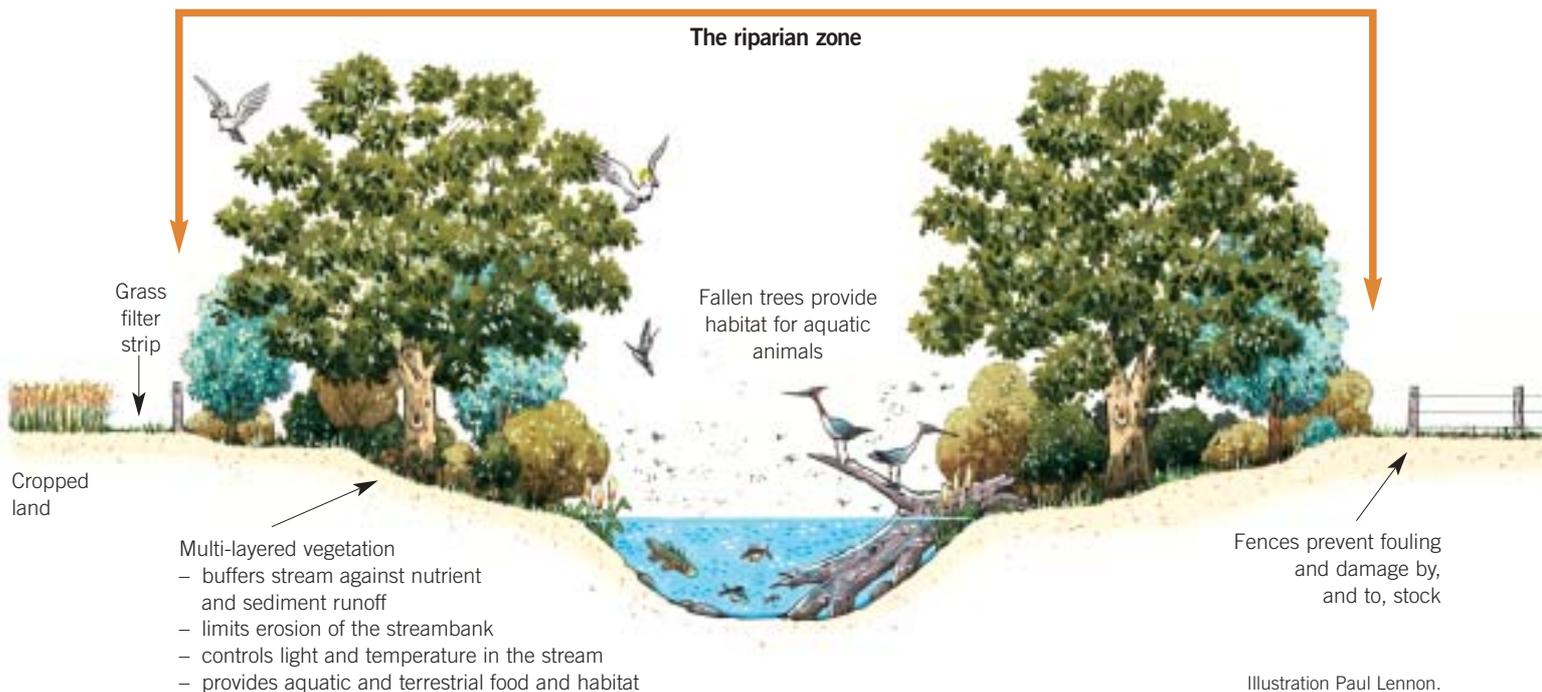
The starting point for the Burra project was to survey local woolgrowers and find out what they considered to be the main riparian management issues facing them. The results of this survey, plus individual discussions with local woolgrowers formed the basis of the work undertaken by the project, and has played a key part in developing practical management methods for riparian restoration.

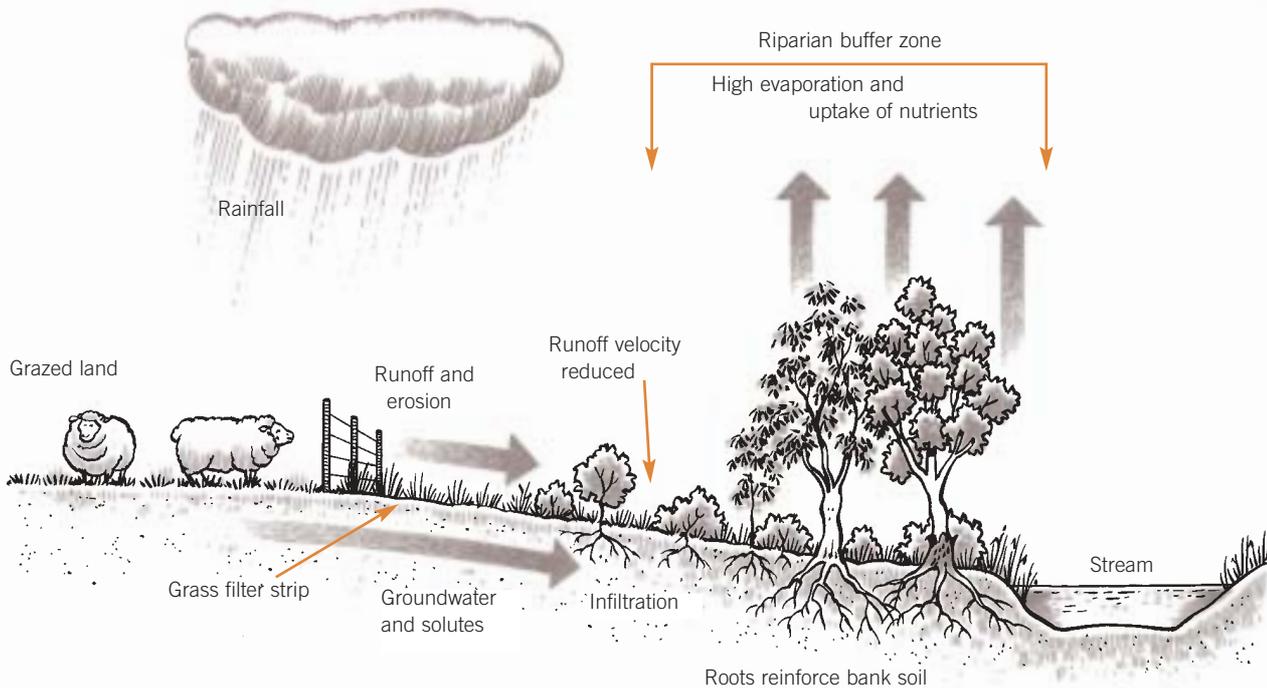
During June 2004, a survey was posted to 109 woolgrowers in the Burra region seeking data about their grazing practices and riparian area management.

The woolgrowers were identified as owning riparian land through Local Government Assessment records that showed them living along the Burra, Brady, Baldina, Newikie and Wonna Creeks.

A survey was also sent to the Goyder Council and the National Parks and Wildlife Service which both own land and conservation parks in the Burra region.

Riparian means any land which adjoins, directly influences or is influenced by a body of water. This includes creeks, billabongs, lakes, wetlands and channels that sometimes flood.





Maintaining good vegetative cover is the key to preventing soil erosion. Fences can be used to control stock access to riparian areas so that the timing, frequency and duration of grazing can be managed. Fencing also enables woolgrowers to keep stock out during times when the creek is in flood. Illustration Paul Lennon.

The 25 responses received (22% response rate) formed the basis of the project research and demonstration studies and provided local knowledge and experience on the key issues impacting on riparian condition and management in the region.

The main riparian management issues identified by the surveyed woolgrowers were: weed infestation (84% of respondents); followed by erosion of creek banks (48%); managing total grazing pressure (40%); and reduction in creek flows (36%).

The main weed problems were: Artichokes (72%); Boxthorn (68%); Salvation jane (40%); Bathurst burr (37%); and Onion weed (36%). Other problem weeds included Horehound, Pepper trees and Ward's weed.

More than 90% of the surveyed woolgrowers carried out regular weed control using a range of methods including herbicide treatments, hand removal, stem injection and bulldozing.

Woolgrowers cited the main difficulties in managing riparian areas as being the cost of fencing and weed management (76% of respondents); the cost of providing alternative stock water (44%); and they were unsure of how to access funding for on-farm works (36%). More than 70% of the respondents had not completed any fencing along their riparian areas.

All the woolgrowers rated their riparian areas as having medium or low production compared with their farm's total production, and nearly 100% of the surveyed woolgrowers grazed their riparian areas. Sheep stocking rates varied from 0.5–1 sheep per acre up to 1 sheep/16 acres. Eight woolgrowers grazed their riparian areas at a stocking rate of 1 sheep/10 acres.

When asked whether they assess the health of their creek, 62% of woolgrowers answered yes using a range of visual indicators such as experience, ground cover, condition of native vegetation such as reeds, pasture growth, bank stability and the presence of frogs, birds or fish.

Fast facts on Burra woolgrowers

The survey collected general farm information which showed:

- Average farm size was 6988 hectares. Farm sizes ranged from 400 hectares up to 52,000 hectares.
- Average annual rainfall was 338 millimetres. This ranged from 200 millimetres up to 500 millimetres.
- Average number of sheep run was 3017. Sheep flock numbers ranged from 400 up to 16,000.
- Average wool micron was 22. Values ranged from 21 up to 23.5.
- Average amount of greasy wool produced annually was 19,378 kilograms. Annual wool clips ranged from 2000 kilograms up to 90,000 kilograms.
- Average wool vegetable matter was 7%. Measurements ranged from 0.8% up to 70%.
- Average creek frontage length was 8 kilometres.

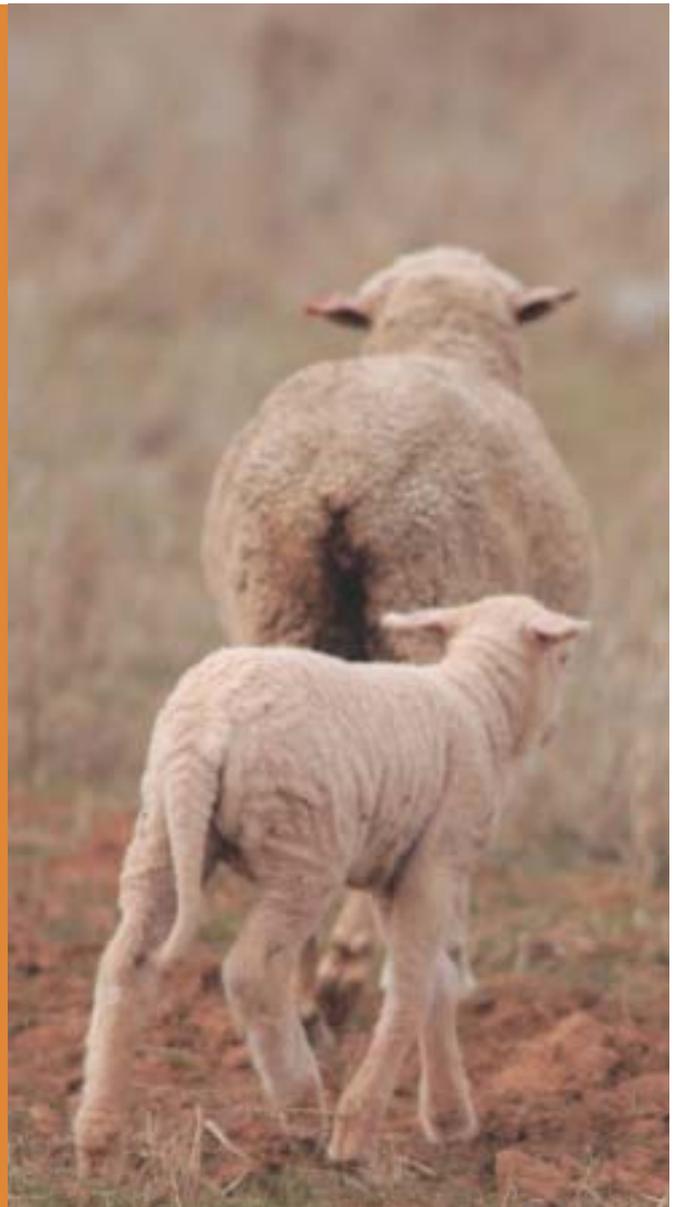
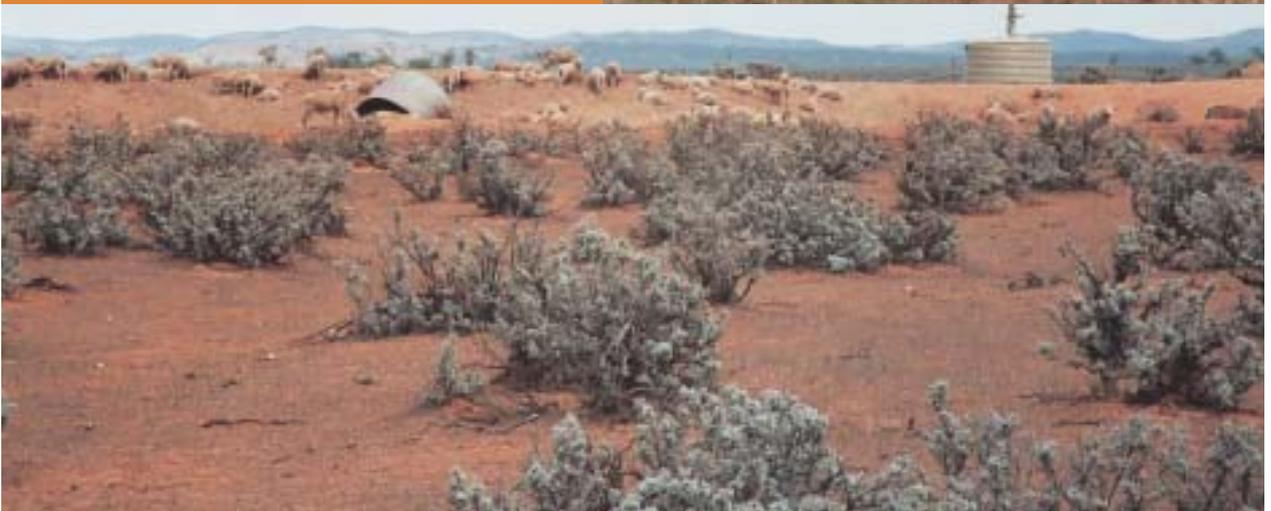


Photo courtesy Australian Wool Innovation.



Uncontrolled sheep grazing impacts upon vegetation cover. Research through Land, Water & Wool has been working out how to improve pasture productivity at the same time as improving environmental condition. Photo Phil Price.



When asked if they received any information about natural resource management, particularly riparian area management, 72% of woolgrowers said they did not, which highlighted the need for increased farmer awareness and educational material. More than 80% of the surveyed woolgrowers expressed an interest in receiving information on the Land, Water & Wool project and other natural resource management information.

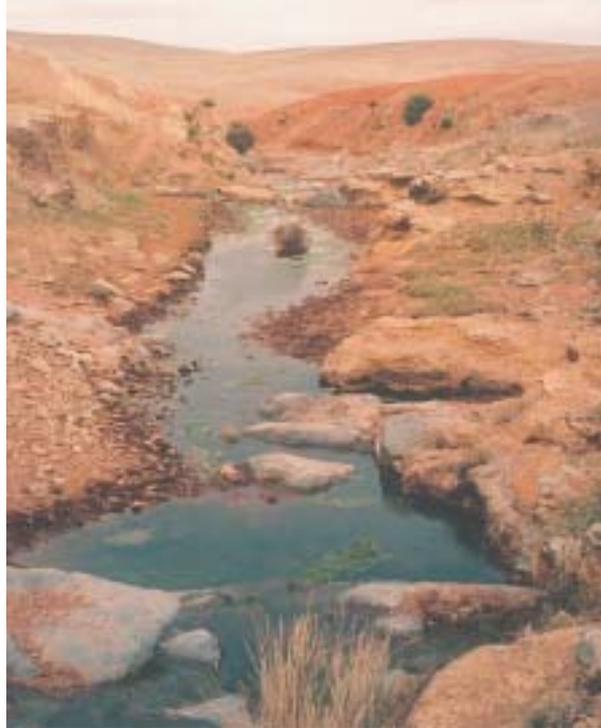
Other woolgrower comments from the survey included:

“More effort into pest plant control and grazing management by all land owners is required along riparian systems — we need a coordinated approach to managing creek systems around Burra.”

“I would like to see more information on methods to improve water quality and reduce threatening processes, e.g. pest plants. Information on grazing techniques to improve overall management could be presented through field days and newsletters.”

“We would like to fence off creeks where practical, plant more trees and fill in some creeks but the cost is an issue.”

“The Burra Creek in our area used to run about 10 times per year, now it only runs about once every 10 years. If we wanted underground water we just dug a well 10 feet deep and we had all the fresh water we needed, now even the deep bores have dried up.”



Different riparian environments around the Burra region.

Photos Kylie Nicholls.

Getting science into the paddock

The aim of this project was to help woolgrowers in the mid north region of SA determine the most cost-effective way to rehabilitate and manage riparian areas to optimise production and profit, while also achieving improved environmental health.

A combination of different management methods were tested on five properties to evaluate the relationships that may exist between grazing management, weeds, riparian plant cover, wool productivity and creek bank stability.

In higher rainfall regions, the management of riparian areas has mainly focused on fencing off streams to manage livestock access, together with natural regeneration or replanting of native riparian vegetation. But this may not be a practical option for woolgrowers in pastoral areas where floodplain paddocks can be more than 500 hectares in size and the cost of fencing is high in comparison with profit per hectare.

The project investigated alternative management, such as planned grazing according to plant growth rates and best practice weed control, to integrate riparian paddocks as part of a whole farm approach.

The use of on-farm sites to demonstrate alternative management approaches was seen as very important for the long-term success of the project, as farmers traditionally look at what their neighbours and other peers are doing as a source of new information and practices.

A strong focus of the project was on preparing and providing training and education which would deliver practical information that helps local woolgrowers improve riparian condition and contribute to overall on-farm productivity and profitability.

Project funding was provided by Land, Water & Wool and the South Australian Murray-Darling Basin Natural Resources Management Board.

The project also has links to the Mid North Grasslands Working Group, the South Australian Department of Water, Land and Biodiversity Conservation, Burra Creek Landcare Group, Department of the Environment and Heritage (DEH), Rural Solutions SA, Greening Australia and Rangelands NRM Group.

Pastoral scene. Photo Kylie Nicholls.





These two sites were assessed with the Rapid Appraisal of Riparian Condition method (top site being in better condition than the bottom site) that uses indicators to work out how 'healthy' a waterway is. This information can then be used to develop management strategies to protect, maintain or improve waterway condition. Photos Kylie Nicholls.

A snapshot of creek health

An important component in the initial stages of the project was an assessment of riparian health in the Burra region.

This was carried out using a Rapid Appraisal of Riparian Condition (RARC) developed by Jansen and Robertson (2004). The RARC is made up of five sub-indices, each with a number of indicators. This includes Habitat (riparian vegetation continuity and width), Cover (tree, shrub and ground cover), Debris (leaf litter, dead trees and fallen logs), Natives (the amount of native trees, shrubs and ground cover versus exotic species), and Features (tree and shrub regeneration, the presence of native tussock grasses and reeds). The highest score which can be achieved using the RARC assessment is 50.



A site in good condition along the Hopkins Creek near Burra. This healthy riparian area has a diversity of vegetation for both aquatic and terrestrial animals. Note the continuous canopy of native trees, native shrub understorey, reeds and tree regeneration. Photo Kerri Muller.

The surveys were aimed at providing a snapshot of the current condition and health of riparian habitats in the Burra region, as well as to test the RARC methodology and its suitability for use in low rainfall areas.

More than 40 sites in the Burra region were surveyed and these varied significantly, including grazed pastoral land, ungrazed conservation park land, on-farm fenced off sites and grazed floodplain country. Sites were located along the Burra, Baldina, Newikie, Caroonna, Dust Hole, Wandillah, Stone Chimney, Tooralie, Firewood, Read and Hopkins Creeks.

As the sites were being assessed it soon became clear that modifications to the RARC were needed to suit the Burra region due to the lack of tree cover.



A site in very poor condition in the mid north near Burra. Note the lack of canopy cover, little shrub cover and small amounts of leaf and plant litter. Photo Phil Price.



This included reducing the heights of the vegetation cover layers and expanding the leaf litter indicator to include other plant material (such as grass and shrub litter).

The results showed the current condition of riparian sites in the Burra region were generally very poor. Total condition scores varied from 6 (very poor) at a grazed site up to 38 (good) at a conservation park site which has not been grazed for more than 10 years.

There was a significant difference in total condition scores between grazed and ungrazed sites, with the ungrazed sites generally scoring higher than the grazed sites (see Figure 1). The average total condition score of the ungrazed sites was 27 while the average total condition score of the grazed sites was 19.

The results indicate that past and present management has resulted in significant degradation of riparian habitats. Clearing of vegetation, past and present grazing practices, and rabbits and native wildlife such as kangaroos have significantly impacted on the current condition of riparian areas. A long-term drought in parts of the Burra region where assessments were carried out also contributed to the low condition scores.

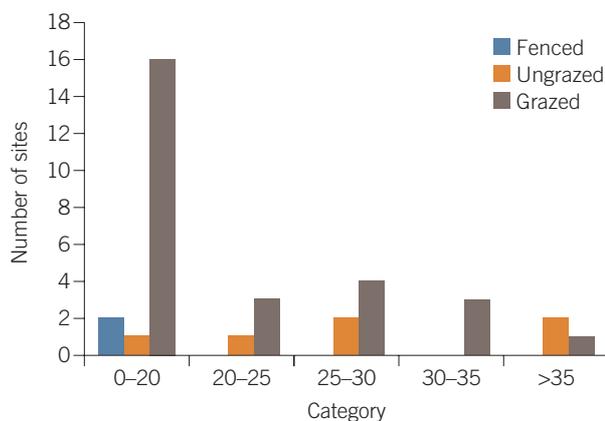


Figure 1. Frequency of total condition index scores for riparian sites under different management in the Burra region.



Photos this page and opposite Kerri Muller, Kylie Nicholls.

But the highest condition score of 38.2 was achieved in a conservation park site which has had livestock removed for only 10 years, indicating a significant potential for regeneration, even in lower rainfall areas. This relatively pristine site could be used as a benchmark for what may be expected for the Burra catchment.

Riparian sites in grazed paddocks were generally in very poor condition but there was also a wide variation in condition scores between sites. Condition scores in the grazed sites ranged from 6 (very poor) up to 38 (good) which was very close to the highest scoring ungrazed site. This is an important finding and indicates grazing of riparian areas can be carried out while maintaining or moving toward a healthy riparian condition.

The main reason for the high score at the best grazed site was the abundant canopy and native plant regeneration, both of which scored highly compared with many of the other grazed sites. The lower-scoring grazed sites had little or no tree or shrub canopy, little understorey and ground cover and an abundance of weeds, indicating a general lack of biodiversity when grazing is not controlled.



Riparian habitats across the Burra region vary significantly in health and biodiversity.

Following this trial, it was felt that a modified RARC was required for more arid environments and a Land, Water & Wool Technical Guideline has been developed which incorporates modifications to the method to suit this region. The modified RARC suits drier regions with ephemeral streams and where riparian areas would naturally have had no more than 30% tree cover.

Scientists and historians have long argued as to whether trees were ever a feature of the hills and watercourses in the Burra region. Many landholders in the area state that trees have never been a feature along the creek banks due to low annual average rainfall and the ephemeral nature of the creeks. But it is difficult to know whether there would have been trees present along the riparian areas.

Extracts from early explorers such as Edward John Eyre (1845) state: “June 27. Here too, we found the first gum trees seen upon any of the watercourses for many miles, as all those we had recently crossed, traversed open plains which were quite without either trees or shrubs of any kind as there is not enough historical information available.”

But local historians state that the Burra hills were cleared of trees during the early years of copper mining in Burra by Cornish miners for both structures in the mines and wood for fires. However some riparian areas in this region may have naturally lacked trees. These riparian areas which may only be able to be identified by a botanist familiar with the region, cannot be assessed using the standard RARC method. The new Technical Guideline also includes possible approaches to deal with this issue.

Development of the *RARC Technical Guideline for the mid north of South Australia* also involved the training of local agency staff from the SA Murray-Darling Basin NRM Board, Rural Solutions SA, the Northern & Yorke NRM Board and Greening Australia in the use of the RARC. Their contact details are available in the Guideline along with other useful contacts and publications. See page 29 for more resources.

Hard copies of the *RARC Technical Guideline for the mid north of South Australia* are available from CanPrint Communications on freecall 1800 776 616 or the SA Murray-Darling Basin NRM Board Senior Project Officer Sarah Kuchel on telephone 08 8582 4477 or can be downloaded from www.landwaterwool.gov.au or www.rivers.gov.au



Above: Land, Water & Wool project participants Jane (left) and Greg Kellock (right) of Thistlebeds Station, Burra, discuss the results of pasture monitoring with AIMS researchers Judi Earl and Lewis Kahn. Below: An AIMS monitoring site at Thistlebeds.
Photos Kylie Nicholls.



Increase farm profits through planned grazing

Three wool producing properties near Burra were involved in the component of the project which focused on alternative management using planned grazing according to plant growth rates.

These farms received some financial and technical assistance to upgrade livestock watering supplies or subdivide existing paddocks. On these areas, smaller mobs of sheep were aggregated to form larger mobs, and grazing plans and feed budgets were developed to minimise grazing and maximise rest periods.

Typically, grazing periods (excluding lambing) were planned to provide rest periods for pastures that were grazed shortest during the peak spring pasture growth season (approximately 60–80 day rest periods) and longest over summer/autumn (approximately 150–180 day rest periods).

Advantages of planned grazing:

- Increased pasture productivity
- Reduced bare ground
- Increased stocking rates
- Fewer mobs and watering points to check
- Increased confidence about future livestock movements
- Available feed produced can be maximised

Dr Lewis Kahn and Dr Judi Earl from Agricultural Information and Monitoring Services (AIMS) were responsible for the pasture monitoring and establishment of grazing plans with each producer.

AIMS collected a range of information from each property including plant species presence and absence, available feed, the number of perennial grass plants, ground cover, and bush cover and health.

Sheep movement data, including date in and out of each paddock, number of sheep and class of sheep, were also recorded to allow AIMS to determine the annual stocking rates in terms of DSE/ha/year and rest and graze periods.

The pasture monitoring results were hampered by the continuing dry conditions. There has been below average annual rainfall for the past eight years in the region and only half of average rainfall during 2006, with no falls during the growing season of August to October.

The results obtained so far represent the baseline vegetation measurements and changes that occurred after one year. Available feed and ground cover declined at most sites and the dry conditions meant that any management induced improvements expected to have occurred were not yet detected.

The change in vegetation could best be summarised as a dominance of perennial shrubs and grasses with a temporary loss of fleshy annual forbs.

But for local woolgrowers involved in the project, Greg and Jane Kellock, being involved in the Land, Water & Wool project has had a significant range of benefits.



Above: The Spear grass species (*Austrostipa* species) are well adapted to withstand the very dry conditions frequently experienced in the pastoral areas.

Right: Wallaby Grass (*Austrodanthonia* species) is a prolific seeder which enables it to quickly recolonise areas after favourable rainfall.

Photos David Sloper.



A planned grazing trial at North Kings Well significantly improved perennial grass populations in only eight months.

Photo Kylie Nicholls.



Greg and Jane Kellock, Thistlebeds Station, Burra

For local woolgrowers Greg and Jane Kellock, adopting a change in grazing management through the Land, Water & Wool – Rivers project has already had a range of benefits on their family's 10,049 hectare pastoral properties, near Burra.

According to Greg, despite the continuing dry conditions, the productivity and health of the land has significantly improved, with lambing percentages more than doubling, along with an increase in ground cover and the perennial grass population.

The Kellock family run three farms totalling about 10,000 hectares in the mid north. This includes the adjoining pastoral properties Thistlebeds and North Kings Well, and a further 640 hectares which they lease.

The Kellock family's main enterprise on their higher rainfall country between Farrell Flat and Burra is a self-replacing Kelvale Poll Merino stud and commercial flocks of 6600 sheep, with about 3500 breeding ewes. They crop about 1000 hectares of wheat, barley, oats, triticale, peas, canola and beans. Greg and Jane also run a small off-farm party hire business in Burra.

At Thistlebeds and North Kings Well the sole enterprise is a commercial self-replacing Merino flock. The current average micron is 22.5 and the wool cut is 6.5 kilograms per head.

In the past, these properties had been run at a set stocking rate of one sheep/4 hectares giving a carrying capacity of 1200 sheep across the grazed area. In 2004, 950 ewes were run and lambing percentages were 60%.

After attending a Resource Consulting Services Grazing for Profit course in 2004, Greg convinced his family to trial planned grazing in the pastoral country at North Kings Well.

With only four paddocks on the property sheep were moved every fortnight, which Greg admitted was not really a sufficient rest period but the improvement in the land has been unbelievable.

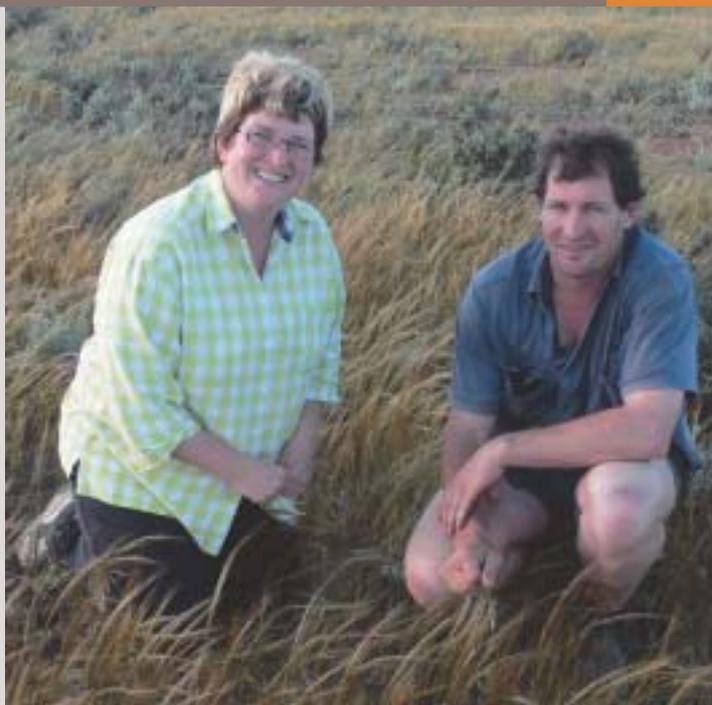
The 2005 lambing percentage at North Kings Well increased to 86% and the increase in ground cover and perennial grasses has been significant, according to Greg and Jane. After seeing these results, Greg and Jane were keen to become involved in the Land, Water & Wool project and apply planned grazing principles across both Thistlebeds and North Kings Well.

Financial assistance was provided to upgrade the livestock stock watering supplies as the Kellocks decided this was more of a priority than paddock subdivision.

Water has been a major issue for Thistlebeds with a heavy reliance on dams, but with the dry conditions in the past few years, dams have started to dry up and water levels have dropped in the bores.

Through the Land, Water & Wool funding, the water resources on Thistlebeds have been significantly increased which will ensure the Kellock family can continue with planned grazing and have the confidence that they have sufficient water to supply the larger mobs. They have been able to link all their water supplies together on Thistlebeds and plans are now underway to link Thistlebeds and North Kings Well water supplies.

As part of the Land, Water & Wool project, livestock are being grazing according to pasture growth rates, with emphasis on an adequate rest periods to allow the perennial plants to recover.



“Our plan for our pastoral properties, Thistlebeds and North Kings Well, is a plan for our sustainable future. We want to be able to improve the land and do it in a way that is good for our profits, management and environment and to encourage others to look at planned grazing and hopefully benefit from it too. Our long-term goal is to leave the property in a better state for our children and future generations than its previous condition.”

Currently both properties comprise a total of 18 paddocks. On these areas, smaller mobs of sheep were aggregated to form larger mobs and Greg and Jane worked closely with the project researchers from Agricultural Information and Monitoring Services (AIMS) to develop grazing plans and feed budgets to minimise grazing and maximise rest periods.

Making a change to planned grazing has helped South Australian wool growers Jane and Greg Kellock, to increase ground cover and perennial grass numbers on their pastoral properties, near Burra. Photo Kylie Nicholls.



Typically, grazing periods (excluding lambing) were planned to provide rest periods which were shortest during the peak pasture growth season (about 60–80 day rest periods) and longest over summer and autumn (about 110–140 day rest periods).

The lambing time was also changed from the traditional two lamb drops in April and August, to a single lambing in the first week of July to make management easier and the shearing has been switched from February to April.

In 2005, two mobs of approx. 1100 ewes each were run, one on Thistlebeds and one on North Kings Well in 2005. However with less than 90 millimetres of rainfall recorded for 2006, which was significantly less than the long-term annual average of 200 millimetres, lambs were weaned earlier, cull ewes sold and the remaining sheep combined into a single mob to use the 18 paddocks and the rest period. The rest period has also increased to more than 140 days and if the dry conditions continue, will be further extended.

In the future, Greg and Jane are planning to subdivide some of the larger paddocks on both properties to better control the sheep grazing and provide each paddock with a longer rest period.

The Baldina Creek channel, which runs through Thistlebeds will also be fenced off to provide improved weed control and reduce the risk of creek bank erosion.

Despite the tough conditions, Greg and Jane are still enthusiastic and encouraged by the results they have had, although they realise it will take a long time to see significant improvements in perennial grass populations and ground cover.

The lamb marking rate further increased in 2006, up to 90%, while Greg said the planned grazing has significantly improved their management with less time required to inspect water troughs and move stock.

They believe that grazing management tools such as the grazing chart which has been used to better plan and record grazing periods and stocking rates in each paddock has given them increased confidence in their management.

Greg said the way they look at their grazing management and the pasture has changed, as they now check the plants and their growth rates, rather than watching the sheep and their performance.

Planned grazing principles:

1. Match stocking rate to carrying capacity.
2. Minimise the number of mobs while accounting for animal needs.
3. Create a grazing plan to ensure recovery periods are what are required by the plants — focus on the most desirable species present.
4. Use the graze plan to ensure the graze period minimises repeated grazing of the same plant.
5. Remember that the grazing plan has to work for the woolgrower and their family.
6. Plan conservatively at every stage.
7. If there are fewer than 15 paddocks per mob then consider creating more paddocks by subdivision
8. Monitor the performance of the paddock and animals to determine if the plan is meeting the specific goals.

For more information on planned grazing and how to get started, visit www.landwaterwool.gov.au to download your free copy of the project's *Planned grazing fact sheet* or telephone the Murray-Darling Basin NRM Board Senior Project Officer Sarah Kuchel on 08 8582 4477. Other useful contacts and publications are listed at the end of this report.

Manage weeds for improved riparian health

In the second part of the project, weed management of on-property riparian areas has focused on best practice control options for three key weeds in the Burra region that had been identified in the survey of local woolgrowers. These were:

1. Wild artichoke thistle (*Cynara cardunculus*)
2. Pepper trees (*Schinus molle*)
3. African boxthorn (*Lycium ferocissimum*)

Pepper trees, Wild artichoke and African boxthorn are some of the more prolific weed species in the region, which as well as costing significant money to control, also reduce total grazing area, hinder mustering of stock and degrade the environmental and production value of land.

Four wool producing properties were involved in this component of the project which focused on best practice weed control. These farms received financial and technical assistance to effectively control the target weeds using chemical applications. For each property, weed treatment plans were written to specify treatment areas, methods and chemical rates and application.

Typically, control of the Wild artichoke thistle and African boxthorn was carried out in spring using a mix of two herbicides, specified as safe for use in riparian areas.

The best practice weed control of Pepper trees in the riparian area was carried out when the trees were actively growing using a mix of herbicide and diesel applied using the basal bark method.



The Pepper tree (*Schinus molle*) has drooping fern-like leaves and can grow into a large spreading tree up to 12 metres in height. Photo Roger Charlton.



Best practice weed control and follow up treatments were limited at several properties due to the dry conditions and lack of the active growth by the target weeds necessary for effective control.

The Rural Solutions SA Animal and Plant Control team were responsible for the baseline weed mapping, weed control schedule and treatments and ongoing monitoring to determine any changes in target weed species distribution and abundance.

Weed and other vegetative cover were measured seasonally in winter 2005, summer 2006, winter 2006 and summer 2007 using the Braun-Blanquet cover abundance scale. Where results allowed, statistical analysis was conducted to determine if there was a significance difference in weed cover between successive seasons (i.e. winter 2005 versus winter 2006 and summer 2006 versus summer 2007).



Top: The Wild artichoke thistle (*Cynara cardunculus*) is very invasive and can quickly spread along creeks. Photo Heidi Nicholson. **Above: African boxthorn (*Lycium ferocissimum*) is extremely tough and has an extensive, deep root system.**

Photo Leah Feuerherdt.

The results showed there were significant differences in weed cover found at sites that were subject to weed treatment, however, differences were also found for sites and weed species that weren't subject to weed treatment.

Other factors such as temperature, precipitation, population dynamics or changed grazing regimes may be responsible for the change in weed cover.

Drought conditions experienced in 2006 may also have affected the results. The mean cover of bare ground increased at all sites in summer 2007 but it is hard to quantify if this is a result of the drought or actions undertaken for this project.

Weed occurrence generally declined on all sites from winter 2005 to summer 2007 regardless of weed treatment being undertaken or not. The drought conditions experienced in 2006 are possibly a good explanation of this finding. Weed cover was lowest in summer 2007, and this season also recorded an increase of bare ground at all sites. It seems where weed cover decreased, bare ground increased. Reduction of weed cover should provide an opportunity for native species to grow but the drought conditions may have reduced or prevented this regeneration.

The drought conditions appear to have also had a negative influence on weed growth, however it may also have exerted a positive influence on weed species by assisting their spread. For example, during the summer 2007 monitoring session it was found that emu scats were largely made up of Pepper tree seeds. During drought conditions, the Pepper trees still provide a source of food when other species are scarce.

The Rural Solutions SA team recommended that ongoing weed control and adaptive grazing regimes are applied for the health and production value of riparian areas. Ongoing monitoring is also important, as three years may not be long enough to reflect changes in these arid, rangeland situations.

To reduce the risk of weed infestation:

1. Maintain a mix of different native vegetation types and ground cover, preferably a mix of trees, shrub understorey and grass.
2. Maintain native riparian vegetation widths of at least 25–50 metres.
3. Avoid excessive human disturbance in riparian areas, such as repeated vehicle and equipment access.
4. Exclude stock from riparian lands or use fencing to control the timing and length of grazing.
5. Where weeds have already invaded riparian vegetation, control them by a combination of chemical, mechanical and cultural methods.
6. When controlling weeds using herbicides, only those registered for use in riparian lands and near water courses should be used.
7. Work with neighbours to prevent re-infestation of riparian areas after treatment.
8. Where large tracts of weeds have been controlled/removed, sowing the areas with pasture or native species will prevent re-invasion, as well as stabilising soil.
9. Develop a property biosecurity plan. Ensure vehicles, machinery and fodder are free of weed seeds before allowing on the property.

Gill Strachan believes trial work at The Gums, Burra, using an excavator has shown it to be the best practice method, particularly on larger trees as the land has recovered quickly and there has been significant regeneration of native shrub and perennial grass species. Photo Kylie Nicholls.

Gill Strachan, The Gums, Burra

Reducing a significant Pepper tree weed infestation in the floodplain areas of their pastoral property near Burra is a major priority for owners Gill and Ruth Strachan.

The Strachan family run a self-replacing flock of 3000 Merino ewes, averaging about 21 micron, on their 12,493 hectare property, The Gums, along with 100 head of cattle.

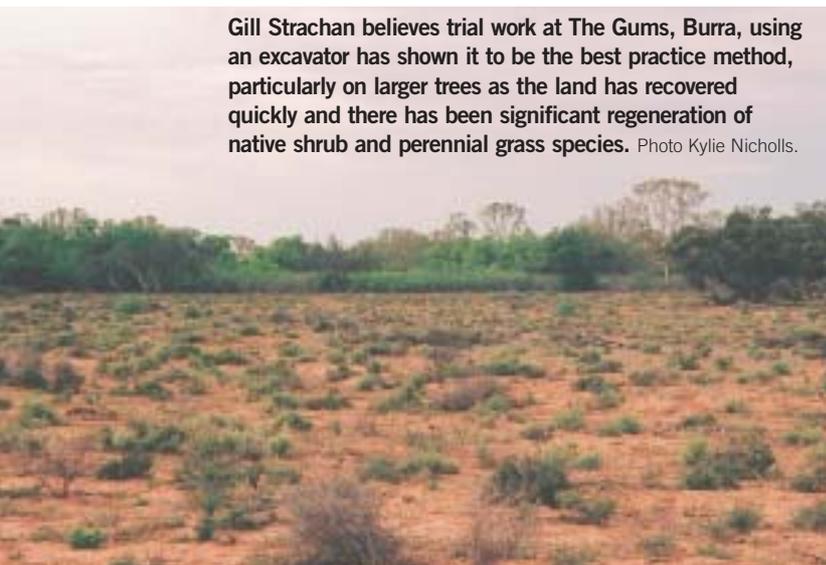
The average annual rainfall is 250 millimetres however they have not received this average for the past eight years.

Part of The Gums is a floodplain zone for the Burra Creek and heavy summer rains in 1992 caused a major flow of water dispersing Pepper tree seed across an area of about 289 hectares in a 650 hectare paddock known as The Swamp.

The Pepper tree infestation has had some significant problems for the Strachan family as this weed is highly invasive and competes strongly with native plants for water and nutrients. According to Gill it has significantly reduced the area of productive pasture in this paddock and also created a habitat for the spread of other weeds such as Bathurst burr and the Castor oil bush.

In some areas it has grown to a large spreading tree up to 12 metres in height and established in dense stands which Gill said made it very difficult to access the areas for mustering and grazing, particularly by sheep. During the past few years, only cattle have been run in this area.

Early on, The Gums received funding from the Rangelands Action Program and Rural Solutions SA to carry out management trials on the Pepper tree infestation.





A combination of treatments was used including mechanical methods such as bulldozer, blade plough and excavator to physically push out the Pepper trees. Herbicide treatments were also carried out, when the trees were actively growing, using the basal bark method which involves making small cuts in the tree stem and placing herbicide in these cuts. According to Gill this method is most effective on younger plants.

These treatment methods have reduced the Pepper tree infestation to less than 155 hectares. However continuing dry conditions in the past eight years have restricted any further control of the Pepper trees.

From Gill's long term experience on the property and previous weed treatments, he believes the excavator is the best practice method, particularly on larger trees as the areas which were excavated have recovered quickly and there has been significant regeneration of the native shrub and perennial grass species.

The areas treated with a bulldozer or blade plough were left very disturbed which has reduced the rate of regeneration and left areas of bare ground which could potentially create further weed and erosion problems. Gill would like to continue excavation of the dense areas of Pepper trees however the expense of the method, which costs about \$110 per hour, limits its use.

Gill said follow up treatment of young Pepper trees using herbicide applications is also vital as plants can re-shoot and it may take several years to completely kill the plant. Sheep could also be used as a control method as Gill and Ruth have observed that they will graze young Pepper trees under about 1 metre in height.

As part of the Land, Water & Wool project, funding was provided to subdivide the Pepper tree infested paddock into smaller paddocks which will allow sheep to graze some of the areas with a light scattering of the weed.



"Although the floodplain country is only a small part of our property, we believe we have a responsibility to try and eradicate the Pepper trees, both for the long-term health of the Burra Creek and for properties which are located downstream from us."

Best practice herbicide treatment was planned in this area, however the continuing dry conditions had prevented any chemical applications. Recent summer rain in January 2007 has now allowed the Pepper tree treatment to be undertaken.

For more information on weeds and how to control them, visit the website www.landwaterwool.gov.au to download your free copy of the project's *Managing weeds in riparian areas fact sheet* or telephone Murray-Darling Basin NRM Board Senior Project Officer Sarah Kuchel on 08 8582 4477. Other useful contacts and publications are listed at the end of this report.

South Australian wool grower Gill Strachan, The Gums, Burra, has had a long battle with a Pepper Tree infestation in his floodplain country. Photo Kylie Nicholls.

Stabilise creek banks to reduce erosion

One property was involved in the creek bank erosion component of the project.

The management options that were tested included:

- creek fenced off and livestock excluded, best practice weed control of Wild artichoke and African boxthorn, natural regeneration only,
- a control was established on the neighbouring property downstream which included current management, i.e. not fenced and livestock allowed unrestricted access, no weed control.

The project used an already fenced off creek system and the property owner, Paul Besanko, received some financial and technical assistance to effectively control the target weed species.

Australian Water Environments were responsible for monitoring the creek bank stability and recording any changes in vegetative cover and composition.



An example of sub-aerial erosion occurring along a creek at Burra, South Australia. Photo Emma MacKenzie.

A migrating erosion head (nick point) and undercut banks were identified as areas of active erosion along the project site. As there were no significant rainfall or flow events during the time of the monitoring program, no erosion or effects of the management options has yet been detected.

The vegetation cover and diversity varied along the sites but the results indicate that in fenced off riparian areas it may be difficult to increase ground cover and diversity by managing stock access and relying on natural regeneration due to the slow process of change in low rainfall environments. Revegetation (by direct seeding or planting of tubestock) would be needed if improvements are to be achieved in a short time frame.

The project has established a simple creek bank erosion monitoring program which will ensure measurements can continue to be taken into the future so that long term trends can be identified.



Repeated scouring along a creek will cause undercutting of the bank. An example of undercutting occurring along a creek at Burra. Photo Emma MacKenzie.



The monitoring points are designed to be used by the woolgrower and/or natural resources management agencies to continue to monitor the stability of the stream and vegetation cover.

When planning creek rehabilitation in low rainfall areas, consider the following management principles:

1. Maintain ground cover of at least 50–70%, ideally more than 70%, to prevent soil loss through erosion.
2. It is not always necessary to permanently exclude livestock from riparian areas but it is important to control their movement and to manage grazing pressure. Consider using planned grazing where livestock only graze these areas for short periods of time according to plant growth rates.
3. Maintain a well-grassed filter strip adjacent to the creek.
4. Native vegetation should be retained wherever possible along the bank and for at least 5 metres from the flood level. If there is no vegetation present, encourage natural regeneration of this area.
5. Regeneration or replanting of larger native species of trees and shrubs should be considered on the upper level of the bank, especially where slumping is a problem. Use a mixture of native species to protect the bank and channel.
6. Remember to consult local experts, such as Greening Australia, when developing a plan for creek rehabilitation. Aim to select a mix of plant species focusing on early stage or pioneer species that have fast growth rates and are drought tolerant.
7. Implement a weed control strategy to protect the area being rehabilitated. Proclaimed weeds must be controlled.

8. Avoid tidying up fallen timber and other debris in riparian areas as this wood is important habitat for plants and animals.
9. When fencing off creeks, remember to place the fence as far back from the bank edge as possible. This distance should at least equal the depth of the watercourse.
10. Seed trapping structures aid in natural regeneration. These can include contour ripping on salt pans, hay bales placed across water flow lines, branches laid across the ground and matting placed to cover bare soil.
11. Control rabbits in gully and creek systems. Care must be taken if warrens are ripped to ensure that this ripping will not produce a new source of erosion.

Maintaining good ground cover is the key to preventing soil erosion. Native perennial grasses such as Lemon grass (*Cymbopogon ambiguus*) will hold the soil together and self seed along creeks over time. Photo Kylie Nicholls.



Paul Besanko, Saffron Downs, Burra

Fencing off creeks to reduce erosion and encouraging the regeneration of riparian areas is an important part of Paul Besanko's long-term goals for his pastoral property in the mid north of South Australia.

Paul and his family purchased Saffron Downs, a 2300 hectare grazing property near Burra, in 2001, fulfilling a childhood dream of Paul's to own a farm. Currently, Saffron Downs cannot fully support his family, so Paul splits his time between a busy marketing job in Adelaide and being a woolgrower.

Saffron Downs currently runs a flock of 700 Merino ewes, mated to Merino and Wiltshire Horn sires. Paul hopes to increase the mob size to about 1500 ewes, but tough seasonal conditions have prevented this. The annual average rainfall is 300 millimetres but less than half the average rainfall has fallen during the past few years with only 50 millimetres being recorded for 2006.

Saffron Downs has a mix of native and annual grass species and some shrub cover including one of the few remaining areas of Lomandra grasslands. Numerous gullies and ephemeral creek systems dissect the property, flowing into the Stone Chimney Creek and Baldina Creek system. Paul estimates that the creeks run on Saffron Downs only about once every five years.

Since owning Saffron Downs, Paul has focused on the rehabilitation of a major creek which had been badly eroding. Through an Envirofund grant, about 5 kilometres of fencing has been completed along either side of the creek to exclude livestock and encourage the regeneration of the native vegetation.



"I hope that by rehabilitating the creek and restricting stock access I will be able to stop any further erosion which was starting to spread into the paddock and return some productivity to the area."

The four plain wire fence was established as far back from the creek as possible, in most places about 200 metres from the creek bank, following the contour of the land.

A range of revegetation methods has been trialled with limited success. Saltbush seedlings were planted along the edge of the creek but were eaten by rabbits.

Fencing off creeks to reduce erosion and encouraging the regeneration of riparian areas is important for South Australian woolgrower Paul Besanko, Saffron Downs, Burra.

Photo Kylie Nicholls.



Paul hopes that over time, fencing off one of the main watercourses on his Burra property, Saffron Downs, to exclude stock will reduce the risk of further erosion and improve the ground cover along the creek bank. Control of weeds such as artichokes is also a key part of creek management. Photo Kylie Nicholls.

At the head of the creek, deep rip lines were established to a depth of about 36 centimetres. The rip lines were then left for 12 months to allow any rainfall to infiltrate before being planted. A mix of native shrub seedlings was sourced from Trees For Life including *Melaleuca* species and *Acacia* species.

Although Paul said this method was more expensive and time consuming, plant survival rates have been better.

However, he admits it has been difficult to see the benefits so far due to the dry seasonal conditions and the disappointingly slow growth of the planted shrub species and regeneration.

Paul has also been involved with the Land, Water & Wool project at Burra with work on his property focusing on the control of weeds along the watercourses, including Artichokes and Boxthorn, and the establishment of long-term creek monitoring. He believes the project results will provide further information on the best way to manage the riparian areas on Saffron Downs.

For more information on creek erosion and how to manage it, visit www.landwaterwool.gov.au to download your free copy of the project's *Preventing creek erosion fact sheet* or telephone the Murray-Darling Basin NRM Board Senior Project Officer Sarah Kuchel on 08 8582 4477. Other useful contacts and publications are listed at the end of this report.

The continuing drought has meant there are few clear results yet from the three research and demonstration components of this project. However, all the sites have been fully established and baseline (before treatment) data collected.

Local woolgrowers will continue to manage these sites, and the South Australian Murray-Darling Basin Natural Resources Management Board has indicated its willingness to continue periodic monitoring of them once more normal seasons resume. This will ensure that the sites and the Land, Water & Wool project continue to provide useful information, and demonstration of best practice management, for local woolgrowers well into the future.

Working with woolgrowers

A strong focus of the project has been training and education. Activities in this part of the project have aimed at delivering practical information to help local woolgrowers improve riparian condition and contribute to overall on-farm productivity and profitability.

Through various training programs, workshops, fact sheets and regular newsletters, woolgrowers have been better equipped with the necessary capacity, knowledge and skills to take the research forward and continue to better manage their riparian areas and properties.

As part of the Land, Water & Wool project, a Tactical Grazing Management Workshop, presented by the NSW Department of Primary Industries, was run for low-rainfall woolgrowers, at Wonga Station near Morgan in March 2006. The owners of Wonga Station, John and David Lindner are participants in the project.

The aim of the practical workshop was to help pastoralists develop a grazing management and monitoring program for their own property which will improve pasture productivity and sustainability. Some of the topics covered in the workshop included the estimation of the amount of available forage, total grazing pressure and appropriate stocking rates and assessments of ground cover and shrub cover and utilisation of key pasture species. These were all carried out using on-ground assessments and activities. The workshop was attended by 11 participants including local woolgrowers and consultants from both government and non-government organisations.

In August 2006, a Sheep Nutrition Workshop was presented by Dr Lewis Kahn from Agricultural Information and Monitoring Services at Burra. The workshop was attended by 47 participants including local woolgrowers, school students and consultants from both government and non-government organisations.

This workshop focused on helping woolgrowers optimise the use of pastures and stubbles. Some of the topics covered included the digestion of feed by ruminants, energy and protein requirements of livestock, the principles of supplementation and feeding, feed intake, the management of pasture quality and herbage mass, different feed types and mineral supplements.

A final Native Plant Identification Workshop was run by Brendan Lay from the Pastoral Program in the Department of Water, Land and Biodiversity Conservation, at Pine Valley Station near Burra in October 2006. Graziers were provided with information on how to identify native plant species, general and specific characteristics of some plant species such as grazing tolerance and identification of plant species which could be indicators of landscape health.

The workshop was attended by 24 participants including local woolgrowers, representatives from Elders and consultants from government organisations.



A strong focus of the project has been training and education with a range of workshops held to help woolgrowers increase their knowledge and management skills. Photo above, courtesy of Stuart and Sarah Weres. Photo at left Kylie Nicholls.

The local woolgrowers directly involved with the Land, Water & Wool project have also received one-on-one advice and support to assist with changes to grazing management practices and an adaptive riparian management approach.

“I gained a better understanding of the pasture base required to stop a downward spiral or lead to degradation on my farm. It was also good to learn ways to record various types of land systems.”

“I found the workshop very useful for plant identification, I can now look at my own property, identify soil areas by what is growing and know more about their nutritional value for stock.”

“The presenter was excellent and I learnt a huge range of valuable information including the nutritional requirements of ewes at lambing.”

Some of the important skills that local woolgrowers have learnt include:

- native plant identification
- pasture assessment
- alternative grazing methods
- setting up a grazing plan
- estimating the amount of available feed
- assessing ground cover
- assessing shrub cover
- estimating total grazing pressure
- paddock monitoring
- how to optimise paddock feed
- ewe nutrition before lambing
- sheep mineral requirements
- appropriate stocking rates
- principles of sheep feeding
- creek management
- condition scoring sheep
- best practice weed control.

Resources

Project products

A range of communication products and information have been developed and circulated throughout the lifetime of the project to help raise awareness of the importance of riparian areas, and help woolgrowers to improve riparian management and wool productivity.

This included media articles for local newspapers and six issues of the newsletter *Grassland Matters* which is posted to the combined mailing list of the SA Land, Water & Wool Native Vegetation and Biodiversity Project and SA Land, Water & Wool Rivers Project which totals more than 600 farmers, technical and extension officers and other interested people.

Three fact sheets have been developed on planned grazing, managing weeds, and creek erosion, which provide woolgrowers with a diverse range of information on topics such as creek bank erosion processes and management to prevent erosion, perennial grasses and planned grazing management, stocking rates, pasture utilisation, ground cover, fencing and water issues, prevention of weed infestations and best practice weed control.



A simple pasture monitoring checklist for woolgrowers has also been developed by the research team from Agricultural Information and Monitoring Services which provides a range of trigger points for assessing pasture condition. The pasture monitoring checklist is included in the *Planned grazing fact sheet*.

In conjunction with the developer of the Rapid Appraisal of Riparian Condition method Amy Jansen, the Land, Water & Wool Project Team has developed a *Rapid Appraisal of Riparian Condition — Technical guideline for the mid north of South Australia*, tailored to the Burra region. This guideline provides woolgrowers, and natural resource management staff with a simple and practical method to assess riparian health and condition, and how they change over time in response to land management, in the mid north of South Australia.





More information

There are a number of organisations that produce useful information for woolgrowers. For creek and riparian management, including detailed information on revegetation of riparian areas, weed control and managing stock along creeks the most comprehensive range of fact sheets, technical guidelines and manuals can be accessed at www.rivers.gov.au.

Other useful contacts at the national, state and local level are listed below.

Land, Water & Wool SA Rivers Project

Kylie Nicholls
Project Officer
Full Bottle Media
Tel: 08 8842 3275
E-mail: fullbottlemedia@rbe.net.au

SA Murray-Darling Basin Natural Resources Management Board

Sarah Kuchel
Senior Project Officer,
Mallee & Burra Water Resources
Tel: 08 8582 4477 / 0427 394 719
Fax: 08 8582 4488
Web: www.rivermurray.sa.gov.au and
www.samdbnrm.sa.gov.au

Rural Solutions SA

Tel: 08 8842 6256
Fax: 08 8842 3775
E-mail: info@ruralsolutions.sa.gov.au
Web: www.ruralsolutions.sa.gov.au

Mid North Grasslands Working Group

Helen Weckert
Tel: 08 8846 6086
E-mail: eulunga@rbe.net.au
Web: www.nativegrass.org.au

Agricultural Information & Monitoring Services

Lewis Kahn
Tel: 02 6771 1273
E-mail: lewiskahn@bigpond.com

Judi Earl
Tel: 02 6779 2286
E-mail: judiearl@auzzie.net

Australian Water Environments

Tel: 08 8378 8000
Fax: 08 8357 8988
E-mail: emmamackenzie@austwaterenv.com.au
Web: www.austwaterenv.com.au

Principle Focus

Chris Scheid
Tel: 1800 190 012
E-mail: info@principlefocus.com.au
Web: www.principlefocus.com.au

Greening Australia

Anne Brown
Biodiversity Support Officer
Tel: 08 8668 4312 / 0409 684 312
Fax: 08 8668 4312
E-mail: brown@greeningsa.org.au

Mick Durant
Environmental Services Officer
South Australia Murray-Darling Basin
Tel: 08 8372 0193 / 0427 182 779
E-mail: durant@greeningsa.org.au

Todd Berkinshaw
Environmental Services Manager
Tel: 08 8372 0109 / 0407 407 520
Fax: 08 8372 0122

Northern & Yorke Natural Resources Management Board

Tel: 08 8636 2361
E-mail: nynrm@bigpond.com
Web: www.nynrm.sa.gov.au

Land, Water & Wool program

Tel: 02 6263 6000

E-mail: Land&WaterAustralia@lwa.gov.au

Web: www.landwaterwool.gov.au

Australian Wool Innovation

Tel: 1800 070 099

E-mail: info@woolinnovation.com.au

Web: www.wool.com.au

Meat & Livestock Australia

Tel: 1800 023 100

E-mail: info@mla.com.au

Web: www.mla.com.au

Weeds Australia

Tel: 03 6344 9657

Web: www.weeds.org.au

CRC for Australian Weed Management

Tel: 08 8303 6590

E-mail: crcweeds@adelaide.edu.au

Web: www.weeds.crc.org.au

Department of Water, Land and Biodiversity Conservation (DWLBC)

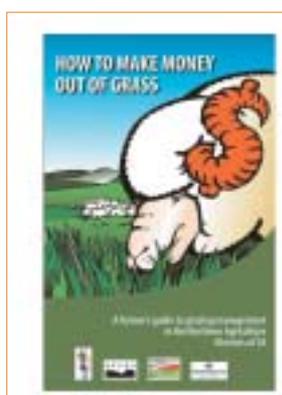
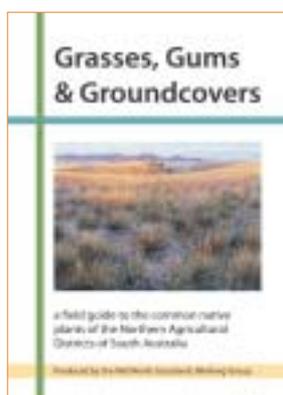
Tel: 08 8463 6800

Web: www.dwlbc.sa.gov.au

Department for Environment, Heritage and Aboriginal Affairs

Tel: 08 8204 9000

Web: www.dehaa.sa.gov.au



Useful publications

Bush Invaders of South-East Australia, 2001, Muyt, A.R.G. & Richardson, F.J., Victoria. ISBN 0 9587439 7 5.

Field Guide to the Plants of Outback South Australia, Frank Kutsche and Brendan Lay, Openbook Print. Further information: The Manager, Pastoral Program, Department of Water, Land and Biodiversity Conservation, GPO Box 2834, Adelaide SA 5000.

Grasses, Gums & Groundcovers, a field guide to the common native plants of the Northern Agricultural Districts of South Australia, Mid North Grasslands Working Group, Custom Press. Further information: Kylie Nicholls, PO Box 488, Clare SA 5453, Tel: 08 8842 3275, E-mail: fullbottlemedia@rbe.net.au

Holistic Management: A new framework for decision making, Allan Savory, Island Press.

How to make money out of grass — A farmer's guide to grazing management in the Northern Agricultural Districts of SA, Mid North Grasslands Working Group, Custom Press. Further information: Kylie Nicholls, PO Box 488, Clare SA 5453, Tel: 08 8842 3275, E-mail: fullbottlemedia@rbe.net.au

Managing Streamsides: Stock control, fencing and watering options, 2000, Wright, D. & Jacobson, T. Department of Primary Industries Water & Environment, Tasmania.

Native Grasses: An Identification Handbook for Temperate Australia, Meredith Mitchell, Landlink Press.

Native Vegetation of the Murray Region, 2006, Todd Berkinshaw, Greening Australia (South Australia) Inc., ISBN 0 9775143 0 7.

Noxious and environmental weed control handbook 2004–2005, Ensbey, R., NSW Agriculture, Orange, ISSN 1443 0622.

Noxious Weeds of Australia, 2001, Parson, W. & Cuthbertson, E., CSIRO Publishing, ISBN 0 643 06514 8.

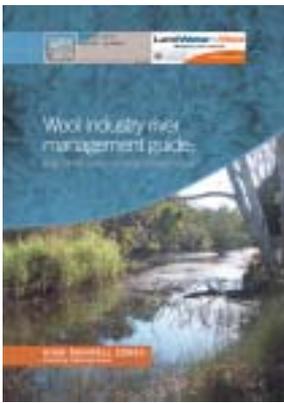


Publications for woolgrowers

The *Wool industry river management guides* bring together the latest science and recommended management practices for riparian areas within the context of a commercial woolgrowing property. The Guides are available for the high rainfall regions (above 600 mm) and sheep/wheat regions (300–600 mm) of Australia. Each book has over 200 full-colour pages. In addition www.rivers.gov.au/lww will offer an active contents list which will give you a snapshot of what is in each section.

High rainfall zone: product code PX050951

Sheep/wheat zone: product code PX050952

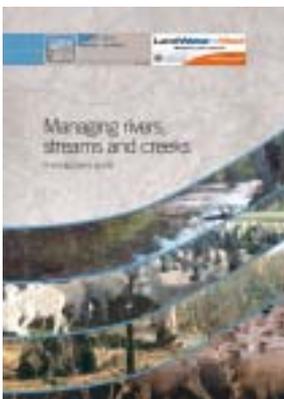


Managing rivers, streams and creeks: A woolgrowers guide — is a summary of the key recommendations from the ‘Wool industry river management guides’ and provides an introduction to river and riparian management issues on farm.

Product code PX051003

Are my waterways in good condition? — a checklist that provides colour coded pictures that you can use to assess the condition of your stream or creek. It is a quick and easy way to work out the health of the streams or creeks running through your property, and it suggests management actions to improve or maintain these vital parts of your farm.

Product code PB061114

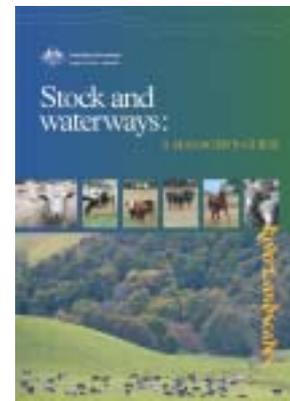


River Insights — this publication featuring the stories of ten woolgrowers and what has motivated them to manage their rivers, creeks and streams in ways that make both economic and environmental sense.

Product code PK050950

Stock and waterways: a manager’s guide — offers practical advice on how stock farmers can manage riparian land both productively and sustainably, and includes a number of case studies from farmers throughout Australia who have seen the benefits of changing their management practices.

Product code PR061132



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