

Are you farming for the future?



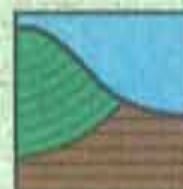
THE NORTHERN AGRICULTURAL DISTRICT



**WEST BROUGHTON SOIL
CONSERVATION BOARD**



**DEPARTMENT OF
PRIMARY INDUSTRIES (AGRICULTURE)**



**NATIONAL
SOIL
CONSERVATION
PROGRAM**

Are you farming for the future?

THE NORTHERN AGRICULTURAL DISTRICT

By Glenn Gale, senior soils officer

Bulletin 8/92

ISBN 0 7308 2099 8

Acknowledgment

This bulletin was initiated by the West Broughton Soil Conservation Board to promote good farming practices.

Produced by the South Australian Department of Primary Industries with support from the National Soil Conservation Program. The assistance of members of the West Broughton Soil Conservation Board and research and extension staff is gratefully acknowledged.

Are you farming for the future?

The increasing concern about the long-term condition of the land and the pressure to get more and more from it makes this one of the most important questions that farmers can ask. The answer lies in using the land within its capability. In other words, using the land without causing permanent damage or a reduction in its future productivity.

The problems

To ensure that land in the northern agricultural district is used within its capability farmers must overcome several problems:

- water erosion;
- decline of organic matter in the soil and breakdown of soil structure;
- wind erosion;
- decline in native vegetation;
- dryland salinity.

Proven solutions to these problems exist and many farmers have put them into practice. The purpose of this booklet is to summarise these solutions and to encourage their use by farmers throughout the Northern Agricultural District.

▼ *The long-term future of farming depends on using the land within its capability.*



PROVEN SOLUTIONS

Most often a combination of structures is required to control the flow of run-off across cultivated land so that:

- *erosion is minimised;*
- *flooding is prevented; and*
- *waterlogging is minimised.*

CONTROL RUN-OFF

Run-off from rainfall can be effectively controlled and erosion reduced by properly constructed and maintained contour banks, waterways and diversion banks. The value of structures to control run-off has been proved on farms in the northern agricultural district for over 50 years.

Systems for control of run-off

The design of systems to control run-off should be planned well because fences, tracks, access and natural drainage lines must all be taken into account. For best results design run-off control as part of a property plan.



Run-off control systems help to prevent water erosion and waterlogging.



▼ A catchment approach to run-off control is needed to overcome large-scale problems such as flooding.



Catchment approach

The most effective way of controlling run-off is through a coordinated catchment approach. The West Broughton Soil Conservation Board has sponsored four catchment projects to demonstrate this:

- the Pisant Creek Project;
- the Koolunga North Self-help Project;
- the Koolunga West Project;
- the Narridy Creek Project.

FACT

A survey conducted by the CSIRO in the Hundred of Belalie during the early 1940s showed that over 70 per cent of the arable land had lost more than one-quarter of its topsoil.

PROVEN SOLUTIONS

Contour banks

Contour banks provide simple, effective and long-lasting protection from water erosion.

Effective contour banks are:

- well planned and surveyed;
- properly constructed;
- carefully maintained;
- connected to a well grassed waterway.

Contour bank construction and maintenance costs are low, especially when the long life of the banks is considered.



Contour banks can be constructed from as little as \$4/ha. (Leetaloo)



▲ Renovate contour banks every four or five years.

Waterways

Well grassed waterways are an essential part of a run-off control system. Grassed waterways:

- safely conduct run-off water through cultivated areas
- contain run-off water, which helps to prevent flooding and water logging.

▼ Where natural drainage lines cannot be used, waterways can be constructed with patrol graders. Build waterways at least one year before the contour banks and sow them to pasture. (Bundaleer)



▼ Waterways must be well grassed. (Narriby)



FACT

About 40 per cent (40 000 ha) of the land with a moderate potential for water erosion in the West Broughton Soil Conservation District was protected with contour banks by the end of 1991.

PROVEN SOLUTIONS

RETAIN STUBBLE

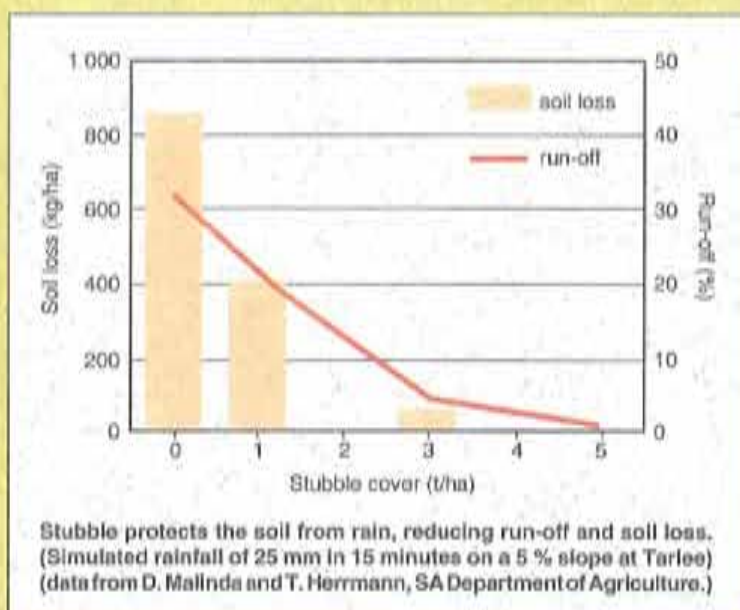
The retention of crop and pasture residues improves long-term productivity and reduces soil degradation.

Protection from erosion:

A 2 t/ha wheat crop produces about 3 t/ha of stubble and chaff. When evenly spread, this will provide about 75 per cent ground cover, and gives adequate protection from water erosion. Less stubble is required to protect soils from wind erosion. Generally, about 35 per cent ground cover is adequate.

Stubble retention:

- *protects the soil from wind and water erosion;*
- *adds organic matter to the soil, improving soil structure and fertility;*
- *increases water infiltration;*
- *protects the soil from raindrop action, reducing soil movement and surface sealing;*
- *recycles plant nutrients;*
- *can dramatically increase earthworm numbers.*



▼ About 35 per cent ground cover is adequate protection from wind erosion.



▲ About 75 per cent ground cover is adequate protection from water erosion.

FACT

Farmers in the district have successfully retained stubbles from 4 t/ha wheat crops.

PROVEN SOLUTIONS

Success with stubble retention

Most stubbles can be successfully retained provided there is adequate planning.

- Begin stubble treatment at, or immediately after, harvest. This will allow the most time for the stubble to break down before seeding or pasture regeneration.



▲ Stubble choppers chop stubble into manageable lengths and leaves it on the soil surface. (Yacka)

► Chop and spread straw and chaff when harvesting. (Appila)



- Keep as much stubble as possible on the soil surface. This provides the greatest soil protection and a better seedbed. Most of the problems experienced with stubble retention are caused by incorporating stubble into the seedbed.
- Break stubbles into manageable lengths (usually 15 cm or less). It is the length of the stubble, not the quantity, that causes blockages in machinery. Avoid repeated harrowing or working just to break up or bury stubble. The damage these extra cultivations do to the soil structure outweighs the benefits of keeping stubble.
- Grain legume stubbles need careful management as they are highly prone to erosion. Grazing aggravates the erosion risk.



▲ Match stubble length with the capacity of tillage and seeding equipment.

► Restrict grazing of legume stubbles to prevent erosion.



- Stubble is too valuable to burn. When stubbles are burnt, all of the nitrogen and sulphur are lost. Burn only as a last resort, and use a cold burn after the opening rains.

FACT

When the stubble from a 2 t/ha Spear wheat crop is burnt about 15 kg of nitrogen is lost per hectare. This is equivalent to the nitrogen contained in 34 kg of urea.

PROVEN SOLUTIONS

REDUCE TILLAGE

Of all farm practices, cultivation is the greatest destroyer of the soil. Reduced tillage systems limit cultivation and the consequent soil erosion and decline in soil structure.

Reduced tillage results in improved crop emergence, root growth, crop yield, and overall farm viability.

Reduced tillage

- *minimises the loss of soil structure and the decline in organic matter of the soil;*
- *reduces wind and water erosion;*
- *decreases surface sealing and hard-setting of the soil;*
- *leaves stubble on the soil surface;*
- *increases water infiltration;*
- *increases earthworm activity;*
- *enables more timely sowing.*

► Reduce cultivation to one or two passes, one of which is sowing. (Belalie East)



◄ Avoid working fast and working soil that is too dry or too wet.



▲ Reduce tillage by replacing some cultivations with herbicide spraying. (Appila)

Cultivations can be reduced

- Replace cultivations with herbicides.
- Use chemical topping, spray grazing or slashing of pastures to reduce weed populations before cropping.
- Cultivate only when weeds are present.
- Control crop diseases with appropriate rotations.

The degree to which cultivation can be reduced depends on getting other management factors right, particularly weed control throughout the rotation. In the light of increasing herbicide resistance, some cultivation for weed control will be necessary in the rotation. In the long term, it is the total number of cultivations over the rotation that is important.

FACT

The loss of 1 mm of topsoil represents 10 to 12 t/ha. Such losses occur frequently on bare or sloping soils and often go unnoticed.

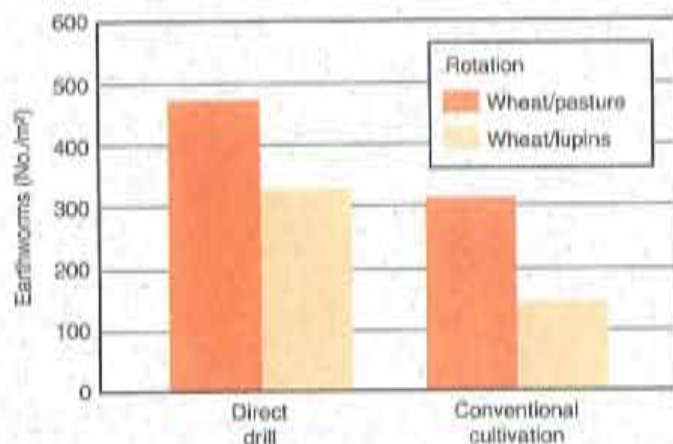
PROVEN SOLUTIONS

Direct drilling

Direct drilling, or the sowing of a crop into unworked soil, is the ultimate form of reduced tillage. Any weeds present before sowing are controlled with herbicides.

Direct drilling:

- *is markedly superior to other forms of reduced tillage in lifting soil organic matter and improving soil structure;*
- *increases rainfall infiltration and minimises erosion;*
- *enables higher yields through more timely sowing;*
- *reduces the use of machinery and fuel;*
- *encourages the proliferation of earthworms*



Earthworms thrive under direct drilling and in rotations that include a pasture phase. (Data from Kapunda, August 1990; J. Buckerfield, CSIRO)



▲ Direct drilling benefits soil structure and fertility and provides an opportunity for higher yields through timely sowing. (Appila)

▼ Direct drilling is well suited to situations with a high erosion risk such as sowing grain legume crops and sowing crops into grain legume stubble. (Crystal Brook).



FACT

Dust lost through wind erosion is the most fertile part of the soil. Concentrations of 60 ppm available phosphorous have been recorded in dust samples that came from a paddock with an average concentration of 24 ppm available phosphorous.

PROVEN SOLUTIONS

IMPROVE SOIL STRUCTURE AND ORGANIC MATTER

Soil structure and organic matter are closely related and play a vital role in preventing soil erosion and maintaining crop production and overall farm viability.

Well-structured soils:

- *are porous;*
- *are friable;*
- *have stable soil aggregates or crumbs;*
- *are resistant to erosion, compaction and formation of surface crust.*

Well-structured soils allow:

- *quick water infiltration;*
- *good germination, seedling emergence and root growth;*
- *good aeration;*
- *easy working.*

Soil structure

Soil structure refers to the way individual soil particles of sand, silt and clay are bound together.

The structure of a soil is influenced by its physical and chemical properties, its organic matter content and the activity of soil organisms.

Organic matter

Organic matter or humus is formed by the decomposition of plant and animal residues by micro-organisms.



◀ Soils with depleted organic matter are poorly structured, difficult to cultivate and unproductive.

Organic matter:

- *maintains good soil structure;*
- *improves the chemical and biological fertility of the soil;*
- *contains almost all the soil nitrogen reserves;*
- *is the main soil binding agent in sandy soils.*

▼ Well-structured soils are highly productive and resistant to erosion.



FACT

In most soils, about 95 per cent of the nitrogen is present in the organic matter. Only a small proportion of this is released each year for use by a crop.

Soil structure and organic matter can be improved

Improving soil structure is a long-term process and relies on increasing the organic matter content of the soil.

- Use a rotation that includes a vigorous legume pasture phase.
- Reduce tillage.
- Retain stubbles.
- Monitor organic matter through soil tests for organic carbon.
- Apply adequate fertiliser to crops.
- Apply gypsum to responsive soils.



▲ Improving soil structure and organic matter will increase farm productivity

The object is to maintain high organic matter levels. Restoring depleted organic matter is a difficult and long-term process.

▼ Red-brown earth



Soil type, soil structure and organic matter

Soil structure and organic matter vary considerably with soil type and management. Red-brown earth soils, particularly those with a sandy loam to loam surface texture, are highly susceptible to a decline in soil structure and organic matter. Sandy soils have a low potential for a decline in structure but are highly susceptible to a decline in organic matter. Calcareous loamy soils have a low potential for a decline in structure because of their high lime content. They are prone to a decline in organic matter but this is often a slow process because they have naturally high levels of organic matter.

Dark-brown cracking clay soils have a low potential for a decline in structure and organic matter. This is because of their clay content and naturally high levels of organic matter.



▲ Sandy soil



▲ Calcareous loamy soil

▼ Dark-brown cracking clay



PROVEN SOLUTIONS

GROW VIGOROUS LEGUME PASTURES

Planned rotations that include a vigorous legume pasture phase are essential for the long-term well-being of the land and for the production of high yielding crops and high quality grain.

Because of the variation in rainfall, soil types and rotations across the Northern Agricultural district a number of different pasture legumes, including medics, clovers and vetches, have a role.

Benefits of a vigorous legume pasture phase:

- *improved soil structure;*
- *increased organic matter;*
- *improved nitrogen fertility;*
- *increased earthworm and microbial populations;*
- *some reduction in crop diseases and weeds.*



The essential features of a well-managed pasture are legume dominance, high density and insect and weed control. (Gladstone)



▼ *Ley farming is practical, is proved and is the key to long-term farm productivity. (Appila)*



FACT

A good legume pasture can increase soil nitrogen by more than 80 kg/ha in one season. This is equivalent to at least 170 kg/ha of urea.

Most pastures in the Northern Agricultural districts consist of annual medics and clovers because of their ability to regenerate after crops and persist in pasture phases.

Annual medics:

- are generally adapted to neutral to alkaline soils;
- are suited to lower rainfall than are clovers and dominate where the rainfall is less than 375 mm;
- are well suited to regular cropping rotations because they have a high proportion of hard seeds,



Subterranean clovers:

- are generally suited to neutral to acid soils;
- require at least 400 mm annual rainfall;
- produce fewer hard seeds than do medics and are therefore less suited to regular cropping rotations;
- are well suited to permanent pastures.



How to get the best out of annual legume pastures

- When selecting varieties pay careful attention to farming system, rainfall and soil texture and pH.
- Sow at the recommended rate.
- Use mixtures in paddocks with several soil types.
- Defer grazing during seedling establishment.
- Restrict grazing from the onset of flowering and graze judiciously over summer and autumn to ensure there will be some seed reserves.
- Control pests such as red-legged earth mite, lucerne flea and aphids.



◀ Improve pasture composition by removing broad-leaf weeds with the spray-graze technique. (Yacka)

PROVEN SOLUTIONS

PLAN FERTILISER USE

Planning fertiliser use is essential to prevent the depletion of soil nutrients through removal in farm products and to improve or maintain soil fertility for optimum crop and pasture yields.

To develop a planned fertiliser program, determine the nutrient status of soils, crops and pastures by keeping accurate paddock records and using soil and plant tests. The main nutrient deficiencies that occur in the Northern Agricultural district are nitrogen, phosphorus and zinc.



▲ The intensification of cropping in the past 10 to 20 years has increased the removal of soil nutrients from farmland, especially where grain legumes are grown. The need for fertilisers to maintain and improve soil fertility has increased accordingly.

Nitrogen

Nitrogen deficiency is considered by many to be the greatest constraint to cereal yields. Nitrogen is also a critical factor for achieving adequate protein levels in wheat grain. To overcome a nitrogen deficiency:

- in the short term, apply nitrogen fertiliser;
- in the long term, increase the reserve of nitrogen-rich soil organic matter through vigorous legume pastures.

Phosphorus

All soils in the district were deficient in phosphorus in their natural state. Regular additions of phosphate fertiliser are required for maximum growth of crops and pastures.

Zinc

Zinc deficiency has occurred in the district, varying in degree with soil type and management. The most reliable method for identifying zinc deficiency is to tissue test crops and pastures.



► Productive crops and pastures result from well-planned rotations and a planned fertiliser program. (Caltowie)

FACT

Grain legumes remove considerably more nutrients than do cereals. For example, one tonne of peas contains about 39 kg of nitrogen, 3.8 kg of phosphorus and 2.4 kg of sulphur, while one tonne of wheat contains about 21 kg of nitrogen, 2.6 kg of phosphorus and 1.6 kg of sulphur.

REHABILITATE SALT LAND

The prevention and rehabilitation of dryland salinity requires a catchment approach to water use. The main issues are:

- prevention of ground water recharge on un-affected areas;
- increasing productivity on affected areas.

The aim is to minimise the amount of ground water recharge by maximising water use.

On un-affected land

- Use crop and pasture species that use a lot of water such as lucerne.



▲ Management of saltland requires a catchment approach to water use.

- Grow high-yielding crops and pastures to maximise water use.
- Establish perennial vegetation - either agricultural or native species - on land of low productivity such as rocky outcrops, paddock corners and laneways.

On land that is moderately saline

- Use salt-tolerant crops such as barley.
- Maintain surface cover at all times to prevent salt from concentrating at the soil surface.



▲ Lucerne uses a lot of water and can help lower the water-table. (Bundaleer)

On land that is highly saline

This land is too saline for broadacre crops.

- Fence the area.
- Where the ground water is too saline for lucerne, establish and maintain pasture using salt-tolerant species, such as tall wheat grass, puccinellia, strawberry clover and saltbush.
- Control grazing so that surface cover remains at all times to prevent salt from concentrating at the soil surface.
- Install structures to control water run-on from adjacent areas.
- Establish salt-tolerant native trees and shrubs to increase water use.

▼ Highly saline land fenced and sown to tall wheat grass. (Jamestown)



FACT

Dryland salinity is caused by changes in water use that have occurred since European settlement. Deep-rooted perennial vegetation has been replaced by shallow-rooted annual plants that use less water. Groundwater levels rise, mobilising salt stored in the landscape. Where this water gets within 1 to 2 m of the soil surface, saltland develops.

PROVEN SOLUTIONS

CONSERVE AND ESTABLISH NATIVE VEGETATION

Conserve remnant native vegetation

Most of the original native vegetation, including mallee scrub, shrublands and open grasslands, was removed for agricultural development. Grazing, burning, fragmentation and isolation, and invasion by introduced plants and animals has degraded much of what remains. Sound management of the remaining native vegetation is essential to ensure that regeneration occurs.

- Fence to control grazing.
- Control animal and plant pests.
- On grazed areas, control grazing pressure to enable regeneration.
- Enter into Heritage Agreements with the Department of Environment and Land Management.



▲ Blocks of native vegetation add variety to the landscape, provide shelter and habitat for birds and other wildlife and contribute to rural lifestyle. (Bundaleer)

Establish native vegetation

Native vegetation can improve agricultural production and should be established wherever possible, for example:

- for the protection of crops, pastures and livestock;
- to increase water use on areas of low productivity such as rocky reefs, shallow soils and paddock corners, and on and around saline areas and areas prone to waterlogging;
- to stabilise erosion gullies;
- for woodlots, honey and amenity purposes.

▼ Control grazing pressure to conserve the natural perennial vegetation. (Port Pirie)



▼ Native vegetation established on a rocky hilltop. (Gulnare)



FACT

Old native trees, even when dead, are especially important as more than one-quarter of native bird species use tree hollows for shelter and breeding.

STABILISE SANDHILLS AND SANDY SOILS

Sandhills and sandy soils that are associated with the dune-swale system on the coastal plains are highly prone to wind erosion.

Increasing the stability of these soils will reduce the risk of wind erosion.

- Maintain ground cover.
- Minimise soil disturbance.
- Improve soil fertility and organic matter.
- Match crop type to the capability of the land.
- Control root diseases.
- Plan the layout of property improvements.
- Eradicate rabbits.



▲ Cropping according to the capability of the land will maximise yields and reduce the risk of wind erosion. Here barley has been sown on the sandy rise and peas on the flat.

▼ Control of root diseases improves yields, ground cover and the build-up of organic matter.



Stabilising large sandhills

Large sandhills are best fenced off and used for permanent pasture but an occasional crop may be necessary to reclaim eroded areas, improve soil fertility, control weeds or renovate pastures.

- Sow with a cereal crop that will provide good ground cover, for example cereal rye, barley or triticale.
- Sow sandhills at the start of the cropping program.
- Use adequate amounts of nitrogen and phosphorous fertiliser.
- Resow as soon as possible if wind damage occurs.
- Use minimum tillage or direct drilling.
- Retain crop stubbles and pasture residues and control grazing to maintain at least 70 per cent ground cover.

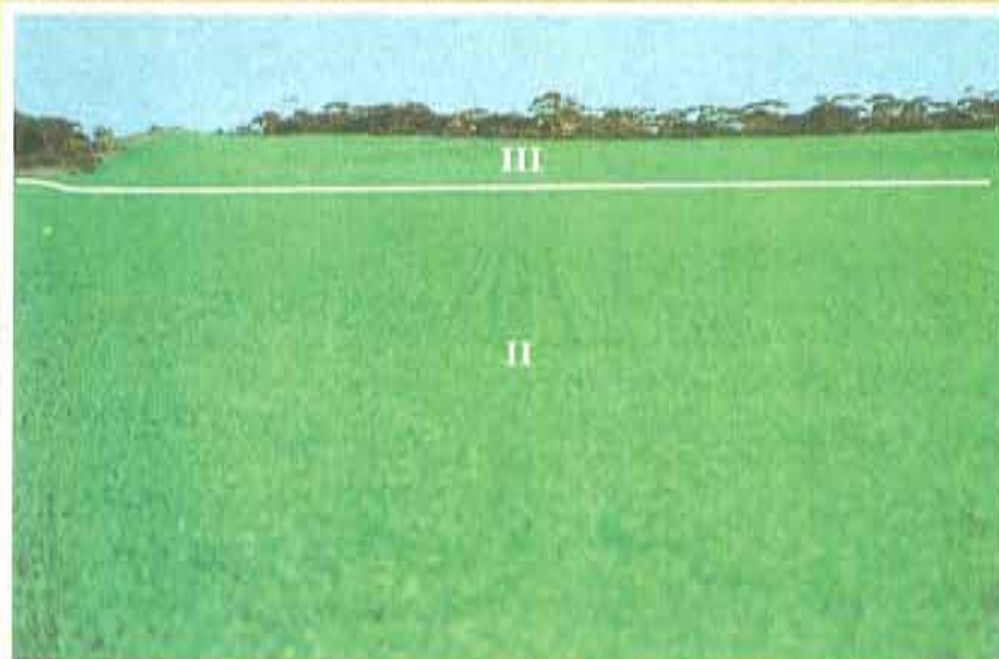
PLAN THE PROPERTY

All land should be used within its capability so that it is in as good as, or better, condition for future generations. The best way to achieve this is to develop and implement a property plan.

Property planning involves consideration of all the components of the property including climate, topography, soil, native vegetation, property improvements, crops and livestock, pastures, economics and personal goals, and their integration into a profitable, sustainable and efficient farming system.

- Assess the resources of the property and the capability of the land.
- Plan the best arrangement of property improvements.
- Identify the land use and management options to which the land is suited.
- Establish a financial plan, priorities and a work program to implement the plan.

Soil conservation boards encourage land-holders to prepare property plans, and are authorised to approve property plans provided they conform with their district plans.



Examples of land classes and their management

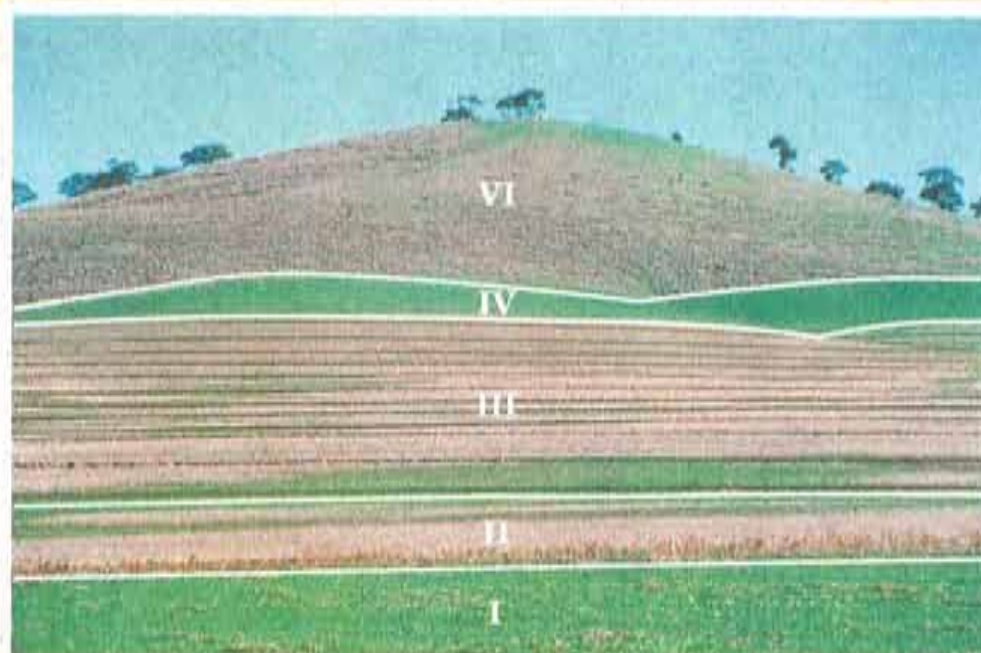
Land with a potential for wind erosion,

- II Standard management of minimum tillage, stubble retention and a rotation that includes a pasture phase
- III Standard management, with crops restricted to cereals and, on average, a rotation with no more than one crop in two years.

Land capability

Assessing the capability of the land is the first step in property planning. Eight land classes are used to rank agricultural land from highest to lowest capability. The capability of the land, and therefore the land class into which it is placed, depends on the nature and severity of the limitations present (for example water erosion potential, wind erosion potential, rockiness and salinity). The classes are summarised as follows.

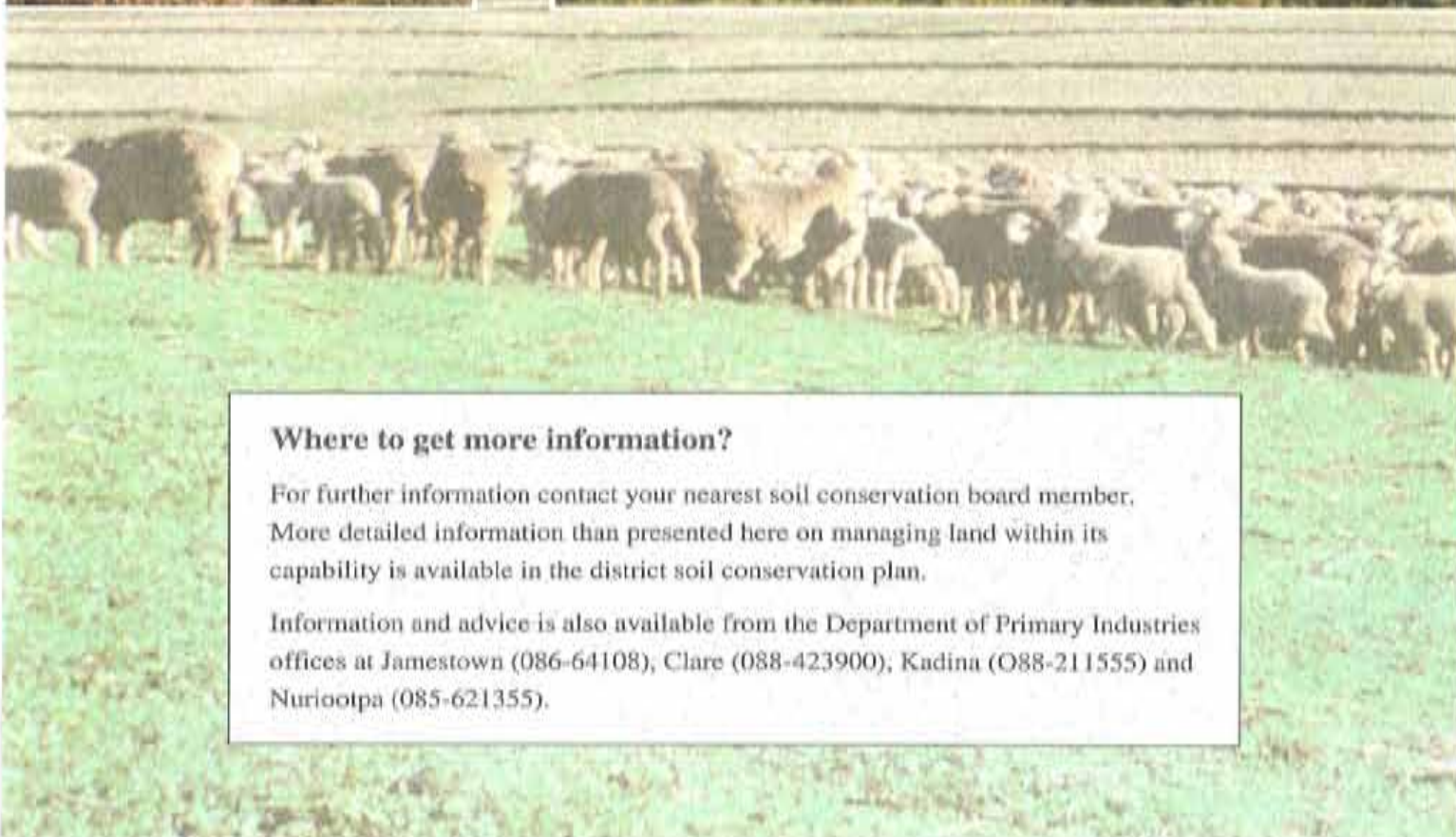
Class	Capability	Land use options	Broad land management categories
I	Very high ↓	Many ↓	Arable. No special requirements.
II			Arable. Simple practices required.
III			Arable. Intensive management practices required.
IV			Semi-arable. Occasional cropping.
V			Non-arable. Improved pastures.
VI			Non-arable. Rough grazing only.
VII			Non-arable. Permanent vegetation cover essential.
VIII	Very low	None	Non-arable. No agricultural use.



Examples of land classes and their management.

Land with a potential for water erosion.

- I Standard management of minimum tillage, stubble retention, and a rotation that includes a pasture phase.
- II Standard management plus contour cultivation.
- III Standard management plus contour banks, waterways and reduced use of grain legumes.
- IV Improved pasture and controlled grazing to maintain ground cover.
- VI Non-arable because of rockiness and steep slopes. Grazed carefully to maintain ground cover.



Where to get more information?

For further information contact your nearest soil conservation board member. More detailed information than presented here on managing land within its capability is available in the district soil conservation plan.

Information and advice is also available from the Department of Primary Industries offices at Jamestown (086-64108), Clare (088-423900), Kadina (088-211555) and Nuriootpa (085-621355).