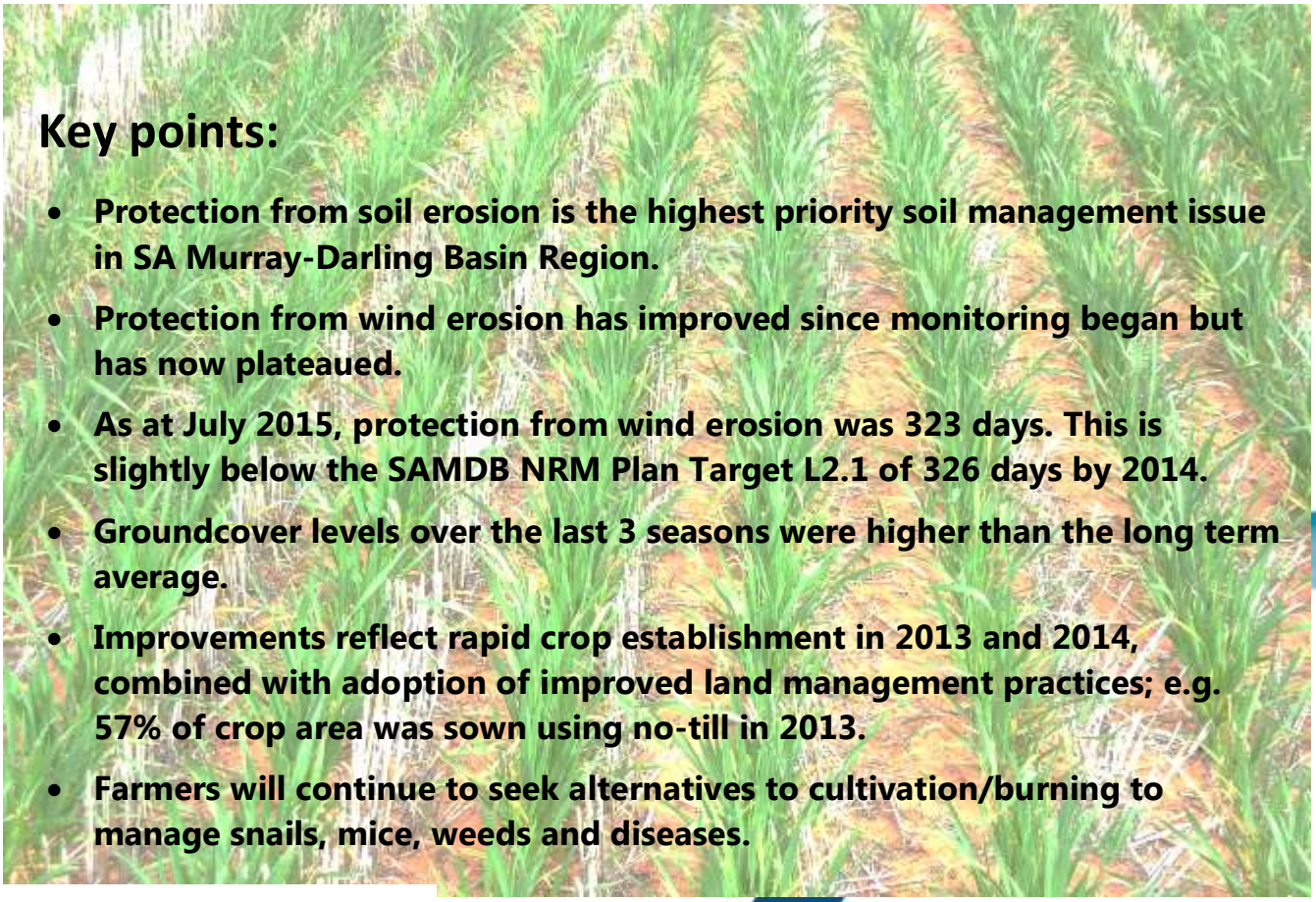
Progress report on achievement of the SA Murray-Darling Basin Region's soil erosion protection target

Prepared for the South Australian Murray-Darling Basin Region Natural Resources Management Board - July 2015



Key points:

- **Protection from soil erosion is the highest priority soil management issue in SA Murray-Darling Basin Region.**
- **Protection from wind erosion has improved since monitoring began but has now plateaued.**
- **As at July 2015, protection from wind erosion was 323 days. This is slightly below the SAMDB NRM Plan Target L2.1 of 326 days by 2014.**
- **Groundcover levels over the last 3 seasons were higher than the long term average.**
- **Improvements reflect rapid crop establishment in 2013 and 2014, combined with adoption of improved land management practices; e.g. 57% of crop area was sown using no-till in 2013.**
- **Farmers will continue to seek alternatives to cultivation/burning to manage snails, mice, weeds and diseases.**

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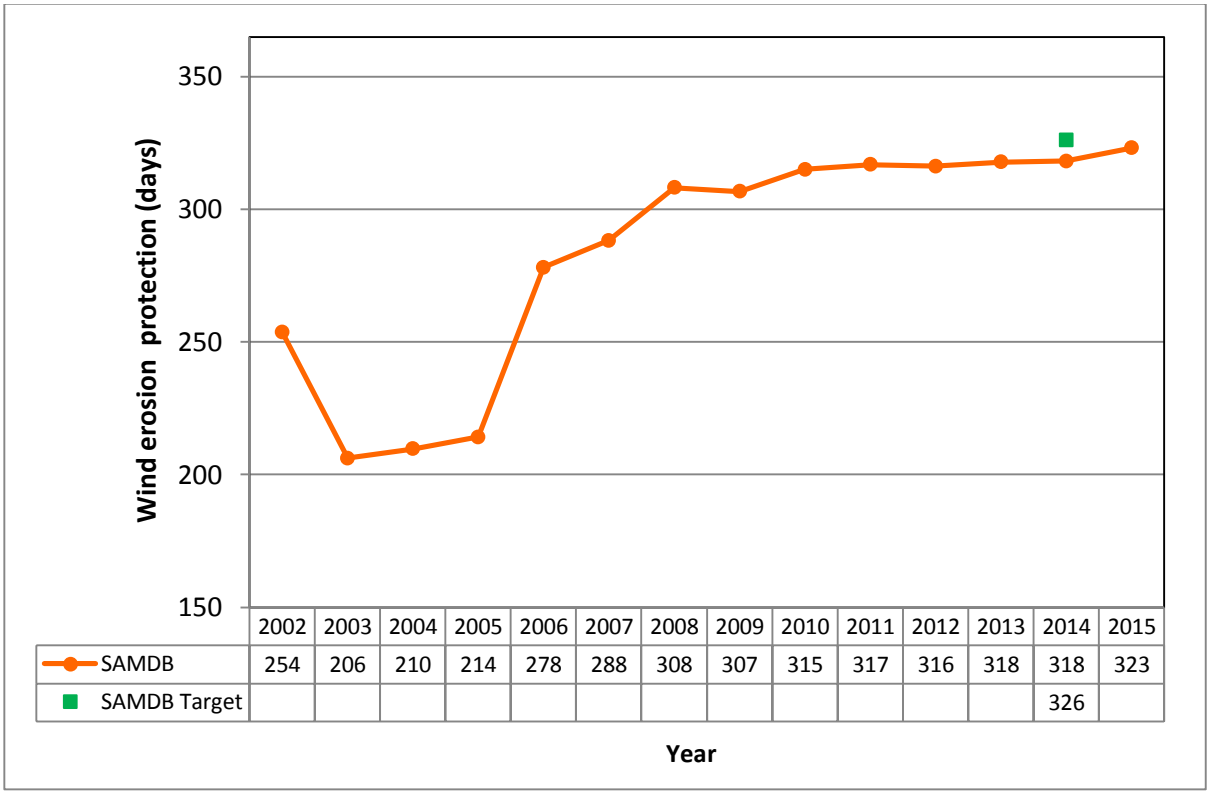
Summary

Progress towards the SAMDB Region's NRM Plan Target L2.1: Wind erosion protection

L2.1 By 2014 achieve a 6% improvement in wind erosion protection for agricultural cropping land



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
SAMDB	254	206	210	214	278	288	308	307	315	317	316	318	318	323
SAMDB Target													326	

Figure 1. Wind erosion protection index (days, 3 year rolling mean) for the SAMDB Region from 2002 to 2015, compared to the Target L2.1

- Protection of soil from erosion is the highest priority soil management issue in the SAMDB Region.
- Agricultural cropping land in the SAMDB Region was protected from wind erosion for 323 days in 2015 (Figure 1). This is slightly higher than 2014 and is the highest recorded since monitoring began. A further improvement of only 3 days wind erosion protection is needed to equal the Target of 326 days at 2014 (baseline 2008).
- From the 2002 drought up to 2010, there was a strong upward trend in wind erosion protection, which correlates with adoption of improved land management practices, particularly no-till cropping methods. Since 2010, the rate of improvement has tapered off, probably in line with the uptake of no-till reaching a plateau.
- The 3 year rolling mean cover levels as at 2014-15 were generally slightly higher than the long term average, and in particular the June cover levels were considerably higher. This is likely to reflect the uptake of no-till and stubble retention methods as well as relatively favourable early season rains in the last few seasons.
- Erosion protection is compromised where land managers use stubble burning or cultivation, most commonly to control snails, summer weeds, and weed herbicide

resistance. Herbicide resistance is increasing, and water repellence appears to be increasing where no-till has been used for over a decade.

- To achieve the SAMDB wind erosion protection target, efforts will be needed to investigate, develop and implement new or modified practices and systems to achieve greater soil erosion protection.

Background

In the SA Murray-Darling Basin (SAMDB) NRM Region, there is approximately 770,000 ha or 31% of cleared land that is inherently susceptible to wind erosion due to soil type, rainfall and topographic features (Class III_a, IV_a and V_a). This is mainly found on the sandier soil types of the Murraylands.

Soil erosion on agricultural land still occurs at times, and this is a major threat to the sustainability of the soil resource and agricultural production. Protection of soil from erosion is the highest priority soil management issue in the SAMDB Region.

The key factors in reducing the risk of erosion are keeping the soil surface covered and protected from wind and water; maintaining soil in a cohesive or undisturbed condition so that soil particles are not easily loosened, detached and transported; and keeping it in this protected state for as long as possible.

The Department of Environment, Water and Natural Resources (DEWNR) conducts observational field surveys to monitor trends in the protection of soil from erosion in the SAMDB Region and other agricultural cropping regions in SA. The surveys are undertaken in October, March, May and June each year. Soil surface cover levels and soil disturbance are visually rated during these surveys at nearly 1400 sites in the SAMDB Region. *It should be noted however that since October 2014, due to budget constraints, the field surveys have been scaled down and data has been collected from a reduced number of sites in the region. This has slightly reduced the accuracy of results.*

The surface cover rating system used is based on a scale of 1-8 where 1 = full cover and 8 = bare ground.

The measures for the SAMDB Region's Target L2.1 is the wind erosion protection index that is calculated from DEWNR's erosion protection field surveys. This index estimate the number of days that susceptible cropping land is adequately protected from wind erosion, expressed as a 3 year rolling mean to smooth out seasonal effects.

Soil surface cover levels

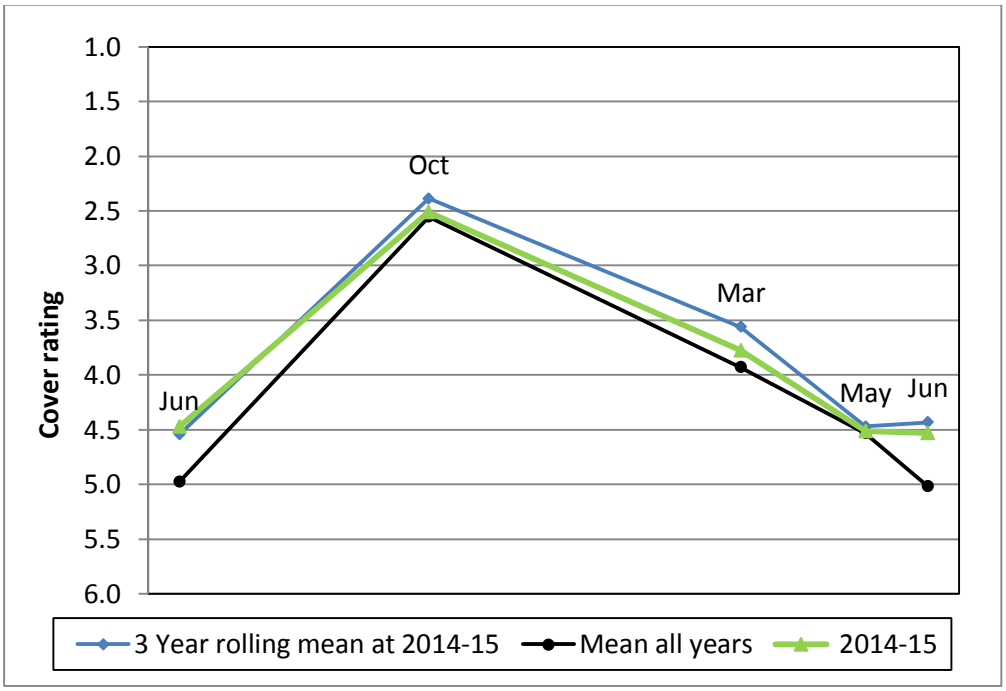
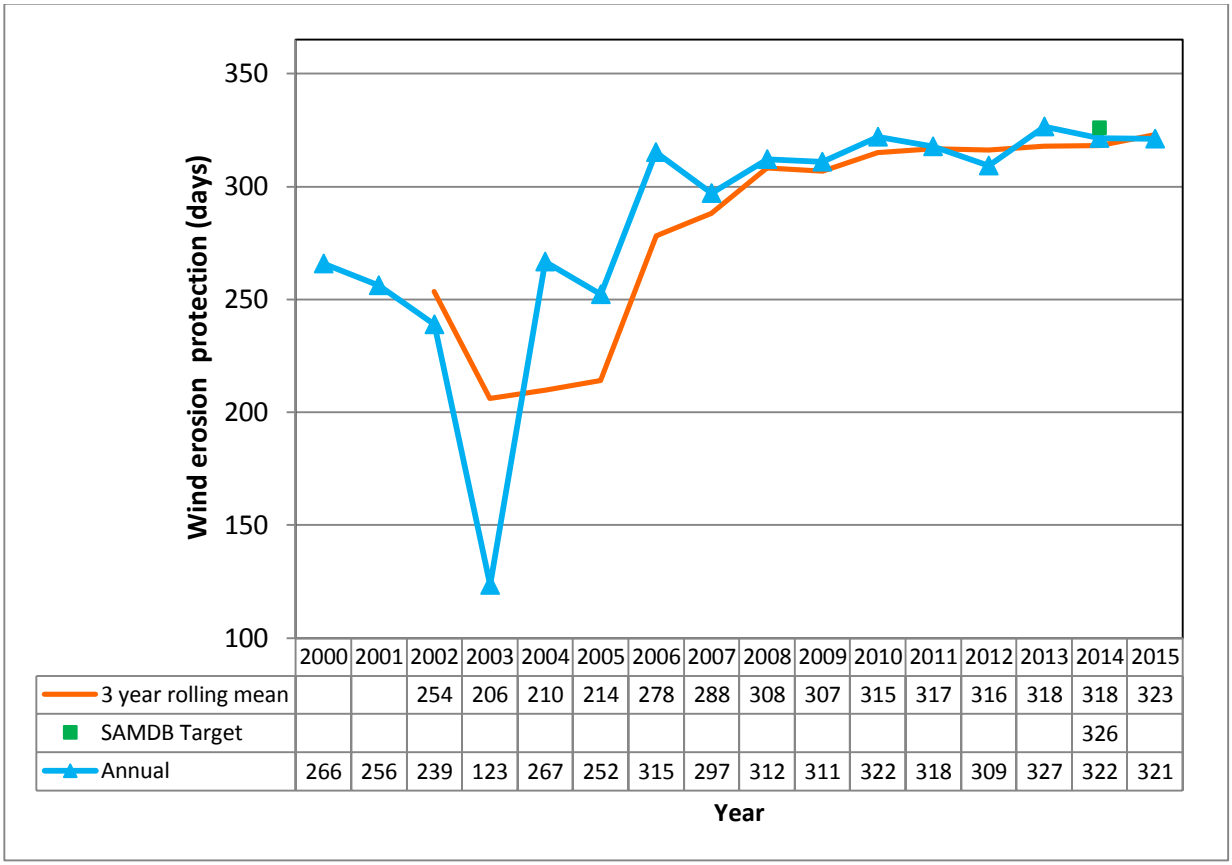


Figure 2. Mean surface cover rating on agricultural land in the SAMDB Region from field surveys from June 2014 to June 2015 compared to the three year rolling mean at 2014-15 and the average for the monitoring period since 1999-2000.

Note: Cover rating 1 = full cover, 8 = bare soil

Figure 2 shows that mean groundcover levels in the SAMDB Region from October 2014 to May 2015 were about the same as the long term average. This probably reflects the dry conditions in the Region through spring-summer 2014-15. The 3 year rolling mean cover levels as at 2014-15 were generally slightly higher than the long term average, probably due to favourable seasons for crop and pasture production as well as improved land management practices that retain more groundcover. The larger difference in mean cover levels in June 2015 and 3 year rolling mean compared to the long term mean is likely to reflect the uptake of no-till and stubble retention methods as well as relatively favourable early season rains in the last few seasons.

Soil erosion protection



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
3 year rolling mean			254	206	210	214	278	288	308	307	315	317	316	318	318	323
SAMDB Target															326	
Annual	266	256	239	123	267	252	315	297	312	311	322	318	309	327	322	321

Figure 3. Protection of susceptible cropping land from wind erosion (days), annually and as a 3 year rolling mean, in the SAMDB Region from 2000 to 2015, and the SAMDB Target L2.1 number of days' protection.

Although the SAMDB Region's soil protection target uses the wind erosion protection index, that is a 3 year rolling mean, the annual days of wind erosion protection show variations due to seasonal conditions. Note that the 2015 data is from a reduced number of field survey sites so the accuracy may be slightly lower.

Figure 3 shows that the annual wind erosion protection in 2015 was 321 days, virtually the same as 2014.

Wind erosion protection has increased substantially since monitoring began. The impact of the extremely dry year in 2002 (decile 1 growing season rainfall in Murraylands) is clearly evident in Figure 3, where very low crop and pasture production resulted in low surface cover levels going into 2003, and a corresponding low level of wind erosion protection. The 2006 season was also very dry, but erosion protection was only minimally affected in 2007 when there was substantially more no-till being used together with more careful management of groundcover levels by land managers.

Notably, however, over the more recent years of monitoring, the level of wind erosion protection has reached a plateau. This probably reflects the plateauing of the uptake of no-till practices in the region. Drier than average conditions in coming seasons could result in a fall in wind erosion protection.

Seasonal conditions, land management practices and their impacts on soil protection

The following is a summary of conditions and practices in agricultural areas of the SAMDB NRM Region over the past three years, which relate to the three year rolling mean erosion protection indices.

2012-13

The 2012 growing season had above average growing season rainfall but dry hot conditions in late spring, resulting in reasonably good crop biomass but poorer pasture cover going into summer. The dry summer-autumn also contributed to many producers moving stock in to containment feeding areas. Favourable conditions at the start of the 2013 growing season aided rapid establishment of crops and pastures hence groundcover.

2013-14

Generally good rainfall in the 2013 growing season produced good crop and pasture biomass and groundcover going into summer-autumn. Fires in the Ngarkat and Billiatt Conservation Parks burnt some adjacent agricultural land, exposing it to erosion. A rain event in February boosted groundcover. Variable rainfall at the start of the 2014 growing season resulted in poorer coverage of water repellent sands and localized wind erosion.

2014-15

The start to the 2014 cropping season was timely and one of the wettest in recent years, providing above average growth of crops and pastures. From early August through to summer, however, rainfall was well below average across the SAMDB (decile 1). This hastened senescence of crops and pastures, and substantially reduced yield potential. There was increased hay cutting of crops with lower yield potential due to the dry spring, crops severely affected by frost, and canola crops that were severely infected by Beet Westerns Mosaic Virus.

By the end of spring, however, crop and pasture biomass in most paddocks was good, providing good groundcover levels going into summer/autumn.

Heavy rainfall across the region in January germinated summer weeds and volunteer cereals, although hot dry weather followed and much growth died off. Some paddocks were cultivated in part of the Murray Plains. By the end of March, dry conditions led to depletion of cover in some grazed paddocks with some wind erosion observed in the Northern Mallee.

Good rains in April enabled sowing to get underway and stimulated pasture germination. May rainfall was patchy across the region, and plant establishment on water repellent sands was poor in many areas. Many grazed paddocks had low cover levels. June rain was below average to well below average. Many water repellent soils and paddocks that were cultivated and sown late were poorly covered or bare at the end of June, with some wind erosion occurring.

Trends in land management practices

DEWNR has commissioned a series of telephone surveys of agricultural land managers in SA between the years 2000 and 2014 to obtain data on their use of land management practices, as well as their awareness and understanding of soil and land management issues. These surveys have shown increasing adoption of land management practices that improve the protection of soil from erosion over the survey period.

Figure 4 shows that the proportion of the crop area reportedly sown using no-till methods in the SAMDB Region has increased from 9% in 1999 to 60% in 2010 and a similar level in 2013.

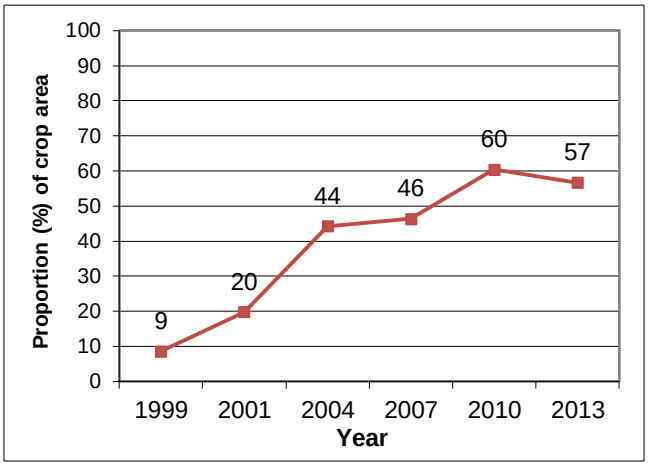


Figure 4. Proportion (%) of crop area in the SAMDB Region sown using no-till methods (including zero till) according to survey respondents

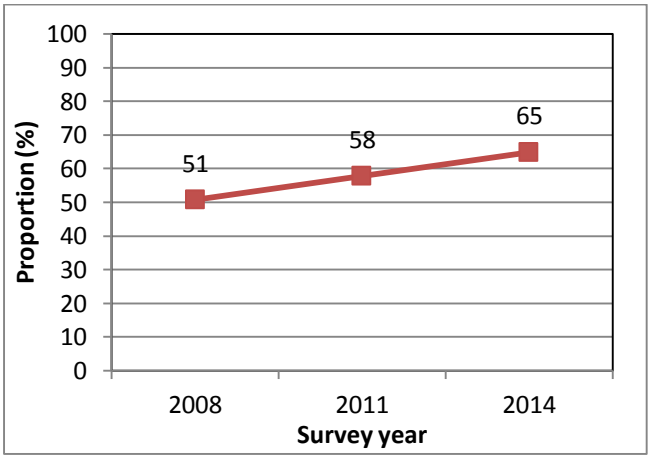


Figure 5. Proportion of cropping land managers in the SAMDB Region who aim to leave on average at least 50% surface cover of stubble/residues immediately prior to sowing.

The proportion of farmers who considered stubble retention as important has remained at around 90% over the period of the surveys. Figure 5 shows that since the 2008 survey (when question first asked), there has been an increase in the proportion of croppers who aim to leave on average at least 50% surface cover prior to sowing.

The proportion of land managers who reported usually or occasionally burning stubbles or residues fell to 28% over the survey period up to 2008 but has increased slightly to 33% since then (Figure 6).

The increase in number of farmers reporting burning of residues is probably due to their expectations of machinery blockages or pest problems caused by heavier stubbles in some recent seasons (eg. 2009, 2010) and anticipation of mice plagues. This suggests that many farmers think that keeping stubbles is important but not at the expense of the following season's crop.

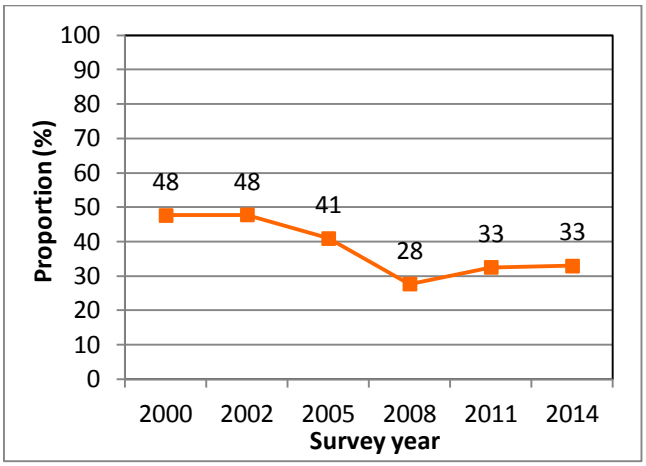


Figure 6. Proportion of cropping land managers in the SAMDB Region who usually or occasionally burn residues when preparing for cropping.

Geoscience Australia's Sentinel Hotspots remote sensing data (Figure 7) shows the number of fires detected on agricultural land (mainly 'hot' burns), which gives an approximate indication of deliberate paddock burning each year in the SAMDB NRM Region.

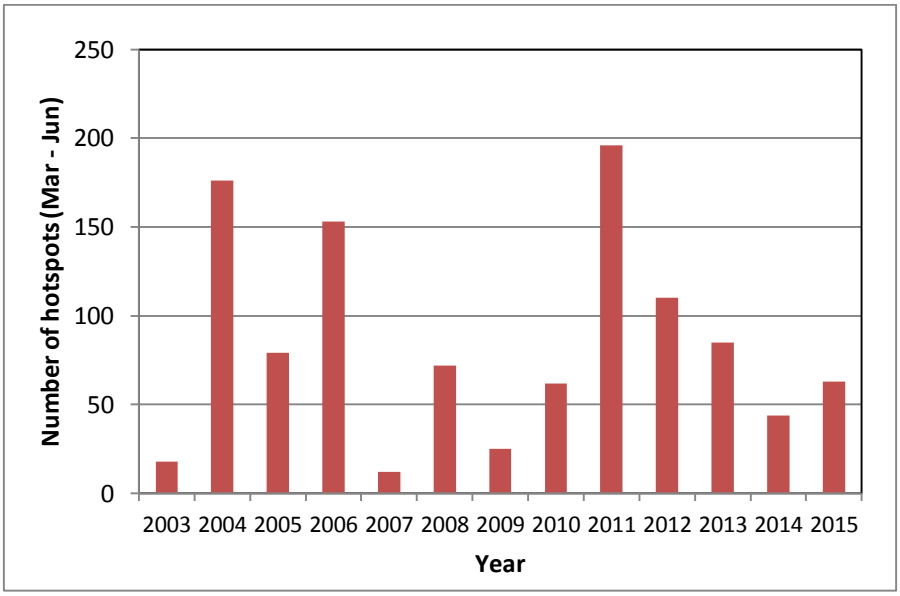


Figure 7. Number of hotspots recorded (infra-red remote sensing) on cleared agricultural land in the SAMDB NRM Region from March to June each year from 2003 to 2015; data from Geoscience Australia Sentinel Hotspots

This shows some seasonal variation in the use of burning, in response to the volume of stubble remaining from the previous year, and the perceived threat to crops from high numbers of mice and/or snails. The incidence of burning was highest in autumn 2011 following the high producing season in 2010 (including high summer-autumn vegetative growth in 2011). Burning of windrows or stubble dumps to reduce weed seed numbers is

now a common practice in the region, and leaves the rest of the stubble intact to provide protection from erosion.

The use of long fallow, where soil is in a cultivated or disturbed condition with little or no surface cover for several months prior to sowing, has decreased from 36% to 10% over the period of the surveys to 2011 (Figure 8). There is anecdotal evidence that the 2002 drought was a major event that led many Murraylands farmers to change from traditional cultivation systems to no-till.

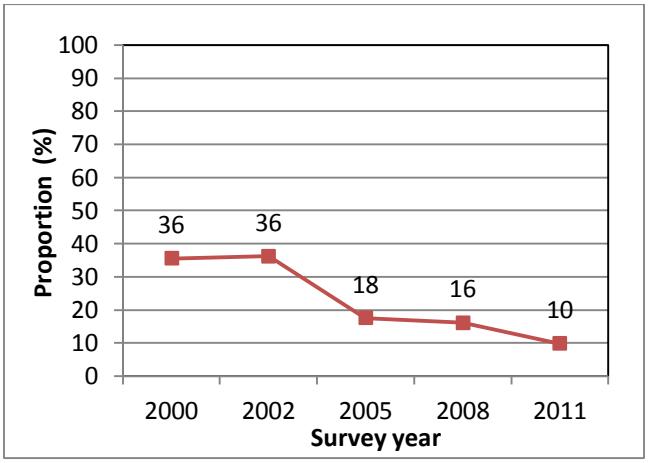


Figure 8. Proportion of cropping land managers in the SAMDB Region who usually or occasionally use long cultivated fallows

Removing stock from paddocks and feeding them in containment areas stops paddocks from becoming devoid of surface cover. The proportion of farmers in the region who reported using this practice has increased from around 30% to 55% over the period of the surveys to 2014 (Figure 9). Supplementary feeding of stock in paddocks is also commonly used through summer-autumn particularly where pasture feed availability is lower, and this was done widely through the dry summer in 2012-13. However, this may not necessarily protect surface cover.

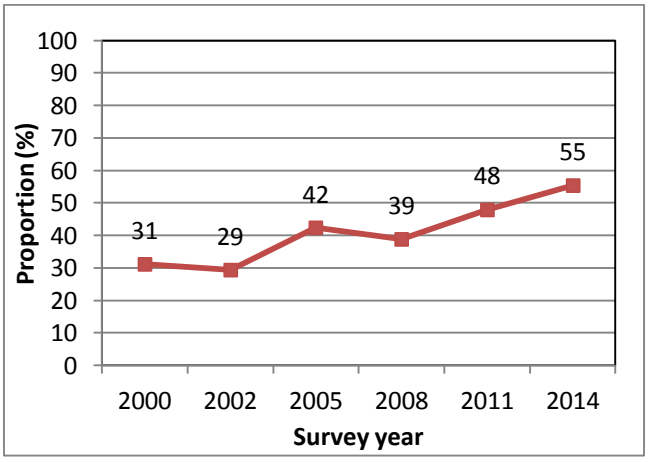


Figure 9. Proportion of land managers in the SAMDB Region who use confinement feeding areas for stock when necessary to manage erosion risk in paddocks.

These survey results indicate that farmers generally are increasingly using practices that protect the soil from erosion. The exception to this is burning stubble residues that are perceived to be likely to cause problems for the next season's crops.

The uptake of improved land management practices, particularly no-till, in the SAMDB Region over the survey period, correlates with the increased protection of agricultural cropping land from wind erosion. This data shows that the uptake of no-till in the SAMDB has levelled off, similarly to the other main cropping regions of SA. This reflects that the use of no-till methods is reaching an optimum level (that is, some tillage needed to manage pests, disease, weeds and herbicide resistance), so the achievement of further improvements in soil erosion protection will become more challenging. Investigation, development and implementation of modified or new practices or systems to manage these issues while maintaining or improving erosion protection, is needed.

Current and emerging issues

While land managers have no control over seasonal climatic variability, there are opportunities to better manage and improve soil protection through their management of land, including strategies to adapt and respond to climate variability.

There are a number of current and emerging issues that could impede achievement of the erosion protection target in the SAMDB Region.

A significant amount of stubble burning is undertaken in the region, mainly to control snails in paddocks for canola, and also for managing herbicide-resistant weeds. Sowing canola into burnt stubbles in the past has resulted in erosion damage / smothering of seedlings. More canola has been sown into cereal stubbles but this increases snail numbers. Stubble "bashing " can have a significant effect but relies on a period of hot weather occurring when farmers have time available to spend on the tractor and achieves about 60% control.

Wild radish is becoming a significant problem in parts of the region and has developed resistance to herbicides. Herbicides to control radish cost an estimated extra $20/ha. Cropping systems on some properties are now being based on controlling radish rather than disease, nutrition or crop profitability reasons.

Brome grass remains a problem for direct drill / no till systems and is a major cost for farmers so could lead to more burning and cultivation as control measures. After about 20 years of no-till, problems are starting to build up, such as herbicide resistant weeds. Rhizoctonia is reappearing. There is increasing hay production in the area because being it is being used as tool for managing herbicide resistance.

Cultivation is practised more in the northern mallee / lower rainfall areas due to the higher relative cost of using herbicides for summer weed control rather than cultivation. There are some indications that the area of land cultivated for weed control is increasing. There is an incentive in controlling weeds early, particularly ones such as caltrop, melons, and potato weed, as it costs less to control small plants.

Water repellence appears to be increasing in no-till soils. In particular, greyer sands are suffering poor crop establishment where no-till plus stubble retention is practised. There are also problems with weed control as non-wetting properties of the soil delays the germination of weeds resulting in staggered germination. Shallow stonier soils and sandier non-wetting grey sands produce less growth and surface cover as they dry out for long periods of time.

There is an increasing demand for straw for feedlots in the region. Paddocks cut low for straw have less protective cover against wind erosion.

More dry-sowing is occurring with better soils tending to be sown by a set date while non-wetting soils are sown more according to rainfall. In dry finishes to the season, early sown crops have tended to yield better than later sown ones. There are fewer farmers operating larger machinery who want to finish at a reasonable time therefore tend to sow early or dry-sow crops.

Most agricultural systems in the SAMDB Region are based on annual plant species which germinate with autumn or winter seasonal rainfall and senesce in spring. These residues deteriorate over summer with no more biomass produced until the next autumn or winter rainfall. Generally there are not many perennial plants or summer growing plants in these systems. Annual based systems provide more flexibility for growers, whereby paddocks are

not locked into a particular crop for more than one year. Crops that leave the soil more at risk of erosion such as grain legumes can be sown into standing stubbles from the previous crop (usually cereal), to improve soil erosion protection.

The length of the period between the senescence of annual plants in spring to the growth of new plants in autumn-winter, combined with natural breakdown of residues (particularly grain legumes), means that soil cover levels can drop below those regarded as adequate for erosion protection, irrespective of the management applied to residues. This is a particular concern in drier seasons when less biomass is produced.

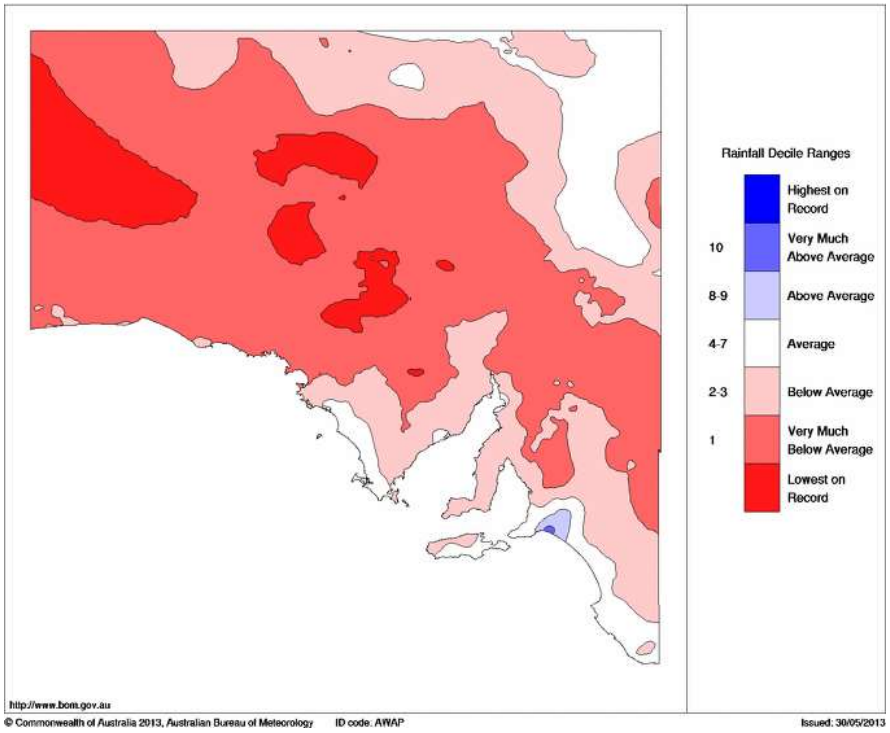
To achieve the SAMDB NRM Plan wind erosion protection target, efforts will be needed to investigate, develop and implement new or modified practices and systems to achieve greater soil erosion protection.

Appendix

SA Rainfall Deciles April – November 2012, 2013, 2014

South Australian Rainfall Deciles 1 April to 30 November 2012

Distribution Based on Gridded Data
Product of the National Climate Centre



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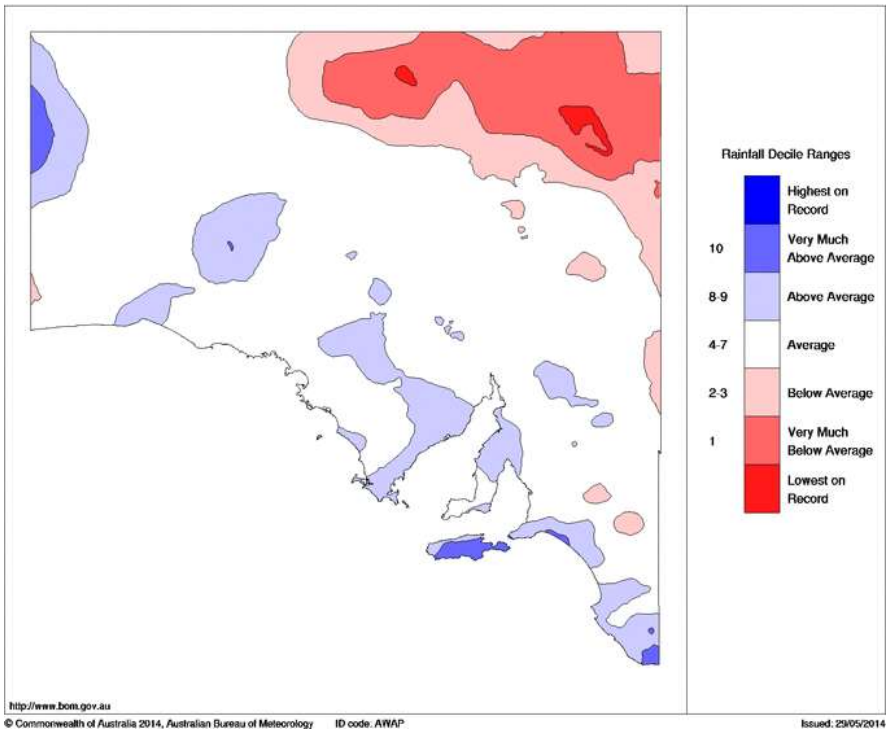
South Australian Rainfall Deciles 1 April to 30 November 2013

Distribution Based on Gridded Data
Product of the National Climate Centre



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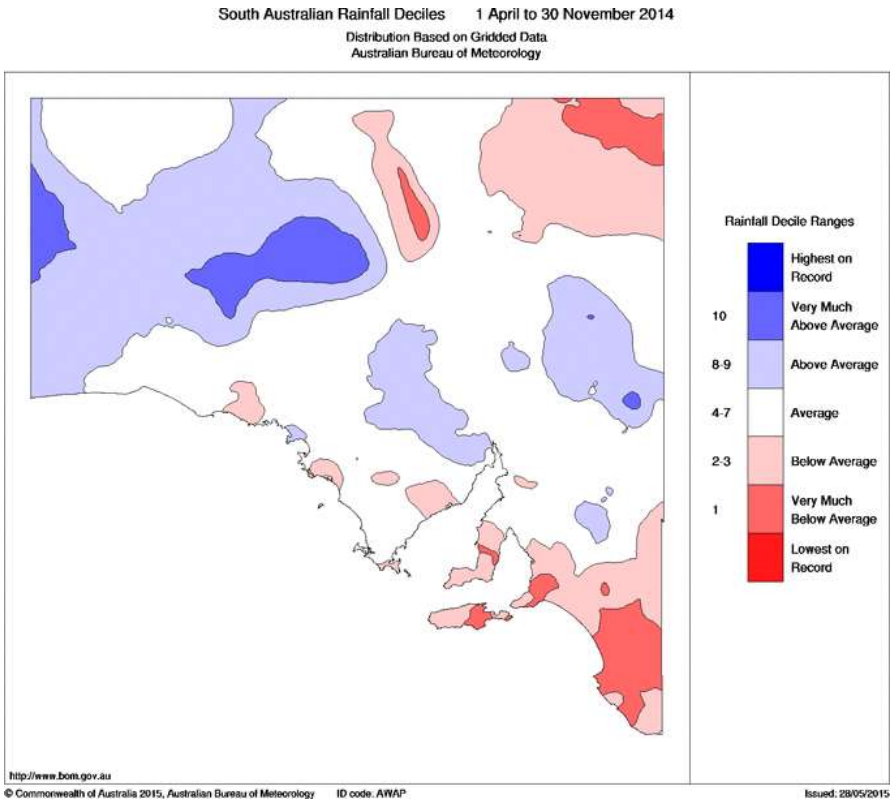
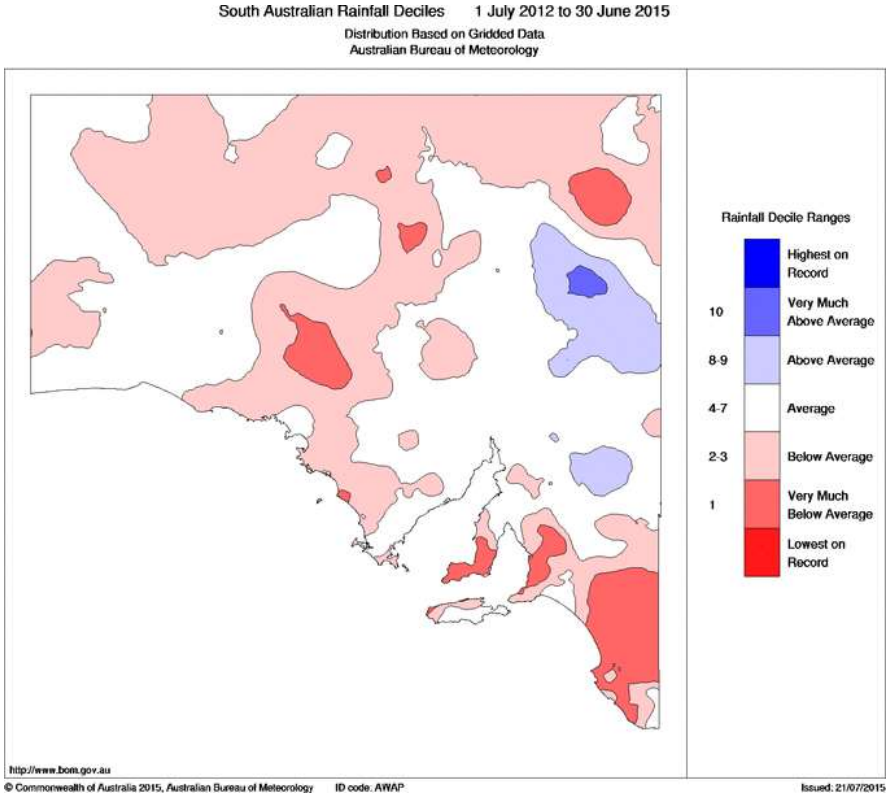


SA 3 Year Rainfall Deciles to June 2015



About this report

The information presented in this report outlines effects of recent seasonal conditions and land management practices on protection of agricultural land from soil erosion, and indicates what strategies or actions might be needed to ensure adequate erosion protection going into the next season.

The Department of Environment, Water and Natural Resources (DEWNR) conducts surveys to monitor trends in the protection of soil from the risk of erosion across the SAMDB and other NRM regions. Data from other sources is also compiled to assist with interpretation of data from these surveys.

DEWNR produces regular reports on soil erosion protection for the SAMDB NRM Region, including:

- An annual progress report for the Region's NRM Plan Soil Protection target in July each year, including a summary of trends in soil erosion protection since monitoring began
- On request, seasonal erosion protection reports.

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