Angas Bremer Irrigation Management Zone 2013 – 2014 Annual Report

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Angas Bremer Water Management Committee Inc

Supported by

Government of South Australia
South Australian Murray-Darling Basin Natural Resources Management Board

2013-14 Annual Irrigation Report

Contents

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Report of the Activities of the Committee 2013-2014

1. Salt Trends

A report currently under review for the journal *Acta Hort*.

Negotiating the Problems of Irrigation through Social Learning based around an Irrigator Code of Practice

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Abstract
The irrigators of the Angas Bremer region of South Australia have successfully negotiated most of the problems that can afflict irrigated agriculture. Their first challenge was the over-exploitation of groundwater. The community of about 160 irrigators set up the legal framework to reduce groundwater consumption and invested in pipelines that brought in water from nearby Lake Alexandrina. The import of water into the region brought with it the threat of waterlogging in some regions and increases in root-zone salinity as water quality of the lake deteriorated during a prolonged drought. The irrigators set up their own code of practice in 2001 in an attempt to manage waterlogging and salinity. This involved a system of reporting irrigated areas and water use, planting two hectares of native vegetation for every 100 ML of water entitlement, installing two 6 m wells on each property to monitor the

shallow aquifer and installing wetting front detectors to monitor salt in the root zone. The process was managed and paid for by the irrigators themselves and became a legal requirement as part of their water licence. Although the reporting requirements were onerous, compliance was very high and underpinned a decade long process of social learning, which allowed irrigators to face each challenge and prepared them for the next one.

INTRODUCTION

The Angas Bremer region of South Australia is situated 80 km southeast of Adelaide, beside Lake Alexandrina, about 30 km from the mouth of the Murray river. The region has about 7100 ha of irrigated crops, primarily wine grapes, and a winter dominated rainfall of 392 mm. Irrigation of pasture began during the 1950's when electrification of the region allowed farmers to pump groundwater from a reasonable quality confined aquifer. By the end of the decade, 5 GL of groundwater was being pumped each year. Groundwater extraction had doubled by 1975 and doubled again by 1987. During the 1980s it became clear that this expansion of groundwater use was not sustainable. Each year wells were dug deeper and the salinity of the groundwater increased.

In response, the community of about 160 irrigators organised themselves to start the process of reducing groundwater extraction. Fortunately, the wine grape industry was taking off in the region, and in a period of high grape prices farmers were able to invest in pipelines that brought in water from Lake Alexandrina on their southern boundary. This new source of surface water allowed them to cut back drastically on groundwater use, but it introduced a new problem. The irrigated area was increasing rapidly and more and more water was being brought into the region via the new pipelines. Farmers were concerned that the increased volumes of drainage water would cause waterlogging and salinity, as had already occurred in nearby irrigation areas along the River Murray.

The general problems of water scarcity and salinity in South Australia were receiving increasing attention by governing authorities, and steps were being taken to ensure farmers became more efficient. One strategy being put forward was that all farmers had to comply with an 85% irrigation efficiency target, even though it was not clear how this number could be calculated or how compliance would be enforced. The irrigators of the Angas Bremer region, who already had a strong history of working together in dealing with their groundwater problems, decided they would rather develop their own local response to what they considered to be a set of local problems (Muller 2002).

The Angas Bremer Water Management Committee (ABWMC) was an extremely proactive group representing the irrigators of the region, and had engaged in wide community consultation. Their view was that the Water Allocation Plan produced by the authorities failed to involve the irrigators or capture their full range of their concerns. They wanted to set up a system of accreditation for irrigators which they called an Irrigator Code of Practice which they claimed, from the irrigators' perspective, would 'have some meaning and serve a real purpose' (ABWMC, 2001; Thomson 2004).

The Angas Bremer Irrigator Code of Practice was implemented in the following year and continues to this day. This paper evaluates whether this code has "served the real purpose" as envisaged by the ABWMC. The particular focus is on managing salt in the root zone over a period of eight years.

IRRIGATOR CODE OF PRACTICE

The Code of Practice had to provide the ABWMC with information that pertained to the sustainability of irrigation in the region. They wanted every farmer to monitor irrigation amounts, salt and groundwater on their own farms, so the code had to be simple enough that all irrigators could participate. The irrigators also had to finance the costs of monitoring equipment themselves, and collect and report their own data, so this also put constraints on how much information could be collected. The Angas Bremer Code of Practice ended up having four parts as follows:

i) Reporting total water use

At the end of the season, every irrigation licence holder had to report on the area of each irrigated crop on the farm and the total amount of water applied to each crop.

ii) Groundwater monitoring

Each irrigation licence holder had to install a 6 m deep test well and measure the depth to groundwater four times a year

iii) Vegetation planting and management

Each irrigation licence holder had to plant two hectares of native vegetation for every 100 ML of water entitlement. This could be planted on their own property or in communal areas identified by the ABWMC.

iv) Irrigation efficiency

Irrigation efficiency has various definitions and is notoriously hard to measure. The ABWMC needed a simple procedure that could engage every irrigator in monitoring and indicate whether too much or too little water was being applied. The committee decided to use the FullStop Wetting Front Detector (WFD, www.fullstop.com.au), which is a funnel shaped device buried in the ground that captures and stores a water sample during or after irrigation (Stirzaker, 2003).

During the 01-02 irrigation season, the ABWMC engaged a member of the local community to install two WFDs on each property which had a licence to irrigate. The aim was to have one detector located near the middle of the root zone and one below the root-zone, and since the active root zone was assumed to be 70 cm deep, detectors were installed at 50 and 100 cm below the surface. Irrigators were supplied with a recording sheet which required them to enter their irrigation details, so that the irrigation amount could be calculated from the run-time. They then recorded the date and duration of each irrigation event and whether the WFDs detected a wetting front at 50 and 100 cm depths. Growers were encouraged to measure the salinity of samples collected from the 100 cm depth. If they did not have their own salinity meter, a water sample could be left at the Post Office, where a community member measured the salinity.

RESULTS AND DISCUSSION

The four aspects of the Code of Practice were directed towards the expectation that the groundwater level in the shallow aquifer would rise. This was a reasonable expectation because i) the area of irrigated grapes, hence irrigation, had expanded rapidly ii) aquifer pressures would rise after the reduction in groundwater extraction and iii) salinity and waterlogging were common features in other irrigation area of the Murray Darling Basin.

A Code of Practice can only be successful if the irrigators are monitoring the right indicators and if there is good compliance. Compliance was excellent in the first three parts of the code, namely reporting annual water use, reporting groundwater depth in 6 m wells and revegetation. The fourth part of the code, which involved monitoring each irrigation event, recording whether a WFD captured a soil water sample and measuring the salinity, was the most demanding aspect. Many farmers provided feedback that their WFDs were not working, or not working as they expected.

The main difficulty was that almost 60% of irrigators never obtained a water sample from WFDs at 100 cm depth. Given the expectation that irrigators were over-irrigating, water ought to be passing the WFDs at 100 cm. This was the first large scale deployment of WFDs, which at this time was a brand new instrument, so there was little field experience. It is now known that a placement depth of 100 cm is too deep for this equipment, as wetting fronts weaken with depth, and the Fullstop only collects a water sample when the soil is wetter than 3 kPa suction (Stirzaker, 2008).

Nevertheless, two further pieces of information suggested that leaching might be much lower than expected. First, the average annual irrigation for all grape irrigators was just over 2 ML/ha (200 mm), whereas vines could transpire substantially more water. Second, when salt samples were recorded from 100 cm, the values tended to be high, again suggesting that leaching fractions were low. Assuming steady state conditions, the amount of salt entering the root zone via the irrigation water is equal to the amount of salt draining past the WFD at 100 cm depth which can be approximated as follows:

$$Vi * ECi = Vd * ECd \qquad \text{(equation 1)}$$

where
Vi is the volume of irrigation water applied
ECi is the Electrical Conductivity of water in irrigation water
Vd is the drainage past 100 cm
ECd is the Electrical Conductivity of water captured in the WFD at 100 cm

The monitoring data for one irrigator over the first three seasons is shown in Figure 1. The salinity of irrigation water from Lake Alexandrina was around 1 to 1.5 dS/m. At the start of the 02-03 season, EC measured from the WFD at 100 cm depth was between 1 and 2 dS/m. By the end of the season, when 211 mm of irrigation had been applied, the EC had risen to 7.4 dS/m. During the subsequent winter the EC fell back to between 1-2 dS/m but rose to 11.8 dS/m after 141 mm of irrigation was applied in the second season. In the third season only 99 mm of irrigation was applied and the final salinity was 15.6 dS/m. As the total amount of irrigation decreases there are fewer occasions when the WFD collects a water sample and when it does the salinity is higher. The rainfall over the 3 seasons, which is strongly winter dominant, was 320, 345 and 452 mm respectively. Irrigation has a proportionally greater effect on the WFD response than rainfall, as the irrigation water is applied over just a fraction of the field areas, localised around the drip emitters. Salinities in the range of 7-16 dS/m were commonly reported during the latter part of the season across the whole region and these are well above the published salt thresholds for grapes. The aspirational 85% irrigation efficiency target, with 15% of applied water going to leaching, would according to equation 1 lead to salinity at the bottom of the root zone being seven times higher than the irrigation water, because leaching would be one seventh of the irrigation volume. Average root zone salinities in the range of 5-13 dS/m could be expected to cut yield to 50% of that in non-saline conditions, with the range influenced by cultivar and rootstock (Zhang and Walker, 2002). In the case of Angas Bremer, the wine grape quality was more important than yield, which is largely why low volumes of water were applied. However it appeared that these low volumes added more salt to the root-zone than could be leached by irrigation plus rainfall, and the high salt levels in the root zone was in the range that would be detrimental to vines.

The 06-07 season marked the start of a major change for the Angas Bremer irrigators. The long drought in south-eastern Australia had reduced inflows into the Murray Darling river system until the Murray virtually stopped flowing into Lake Alexandrina. The three seasons from 2007 to 2010 are illustrated for one irrigator in Figure 2. At the start of the irrigation season, the lake water was 2 dS/m, double its usual spring value. The lake level was falling and by midway through the irrigation season the EC reached 4 dS/m and many pump intakes were dry. Those irrigators who had retained some groundwater allocation switched to bore water, while others had to stop irrigating altogether.

The irrigator whose record is shown in Figure 2 had installed a new WFD at 30 cm to measure salt levels in the zone that he considered the most active part of the root zone. As the salinity of the irrigation water increased from 2 to 4 dS/m, the soil water at 30 cm depth peaked at 10 dS/m. The following season he had to rely on groundwater, which ranged from 3.5-4 dS/m and the salinity at 30 cm depth reached 20 dS/m. This was clearly unsustainable and many irrigators faced financial ruin. In response the ABWMC were able to mobilise irrigators quickly, largely due to their history of concerted action, and they managed to develop the business case and persuade government to invest in a 110 km pipeline to bring water from the Murray River upstream of the Lake. Water started arriving from the pipeline early in the following season and the effect was dramatic. Irrigation water fell below 1 dS/m and the soil water salinity at 30 cm depth quickly fell below 5 dS/m.

The number of salinity readings reported by irrigators can be seen as a surrogate for compliance of this aspect of the code. In the first year (02-03) irrigators were only asked to report on salinity at 100 cm depth and about 150 readings were submitted. This fell to just 50 readings over the next four seasons. Over the same period, irrigators who did not activate WFDs at the 100 cm depth, started to record salt readings from 50 cm. Many of these readings returned very high salinities, until a general observation emerged: the less often the WFD responded, the higher the salinity was likely to be. There were a minority of irrigators who claimed not to even record wetting fronts at 50 cm depth, so many of these installed WFDs at 30 cm depth before the 06-07 season. As expected many of these returned very high salt readings. These irrigators typically applied water little and often, so the wetted zone around a drip emitter was relatively small and all the salt applied had to be contained in a smaller volume of soil and hence water, leading to high concentrations.

The total number of salt readings submitted to the ABWMC was 164 in 02-03 and had risen to 495 by 06-07 as the quality of the lake water started to deteriorate (Figure 3). During the season that the lake water became unusable, 808 salinity samples were reported, falling to 565 two years later when the pipeline was bringing in relatively fresh water from the Murray River. The change of interest shown by the irrigators reflects their evolving understanding of the nature of the problem they were confronting. Their focus had been around applying excess water that would cause groundwater to rise. Their monitoring shifted the focus from too much water to too much salt in the root zone. The second part of the code of practice, monitoring the 6 m wells confirmed this. About half the wells contained some water in the 02-03 season and there was little change in the groundwater in the shallow aquifer over subsequent seasons, except for land adjacent to the lake where groundwater was returning to natural levels after the reduction in pumping from the deeper aquifer.

The new pipeline still does not guarantee sustainability of irrigation in the region. Although the new water quality is better than lake water, substantial amounts of salt are still imported via irrigation water. The pipeline cannot supply all the region’s requirements for the growing season, so many farmers are involved in aquifer storage and recovery by pumping river water down into the saltier aquifer and re-pumping during the irrigation season. Thus an understanding of the sustainable groundwater yield and salinity remain fundamental to the region's future.

Table 1 summarises what is being learned from the experience of implementing an Irrigator Code of Practice at the scale of the individual grower, at the scale of the Angas Bremer region, and emerging lessons for NRM agencies based on the typology of Rodela (2011). Individual irrigators had been encouraged to measure soil water status, but none had been measuring salt, as required by the Code of Practice. It turned out that monitoring salt was more important than monitoring soil water because most of the total water stress experienced by the vines derived from the osmotic component. In particular, those irrigators who were applying water 'little and often' and not activating deeper WFDs found out that much of the salt was trapped in a small region around the drippers and accumulating to very high levels. Perhaps the most significant finding was that attempts at leaching during the summer or at the end of the irrigation season were ineffective. Soil profiles were getting dry by the end of the season and attempts at leaching by drip irrigation just added more salt. The optimum time for leaching was after winter rains had replenished the soil water when the vines were no longer transpiring. By monitoring WFDs at this time, extra irrigation water could be applied before bud burst if salt levels were deemed to be too high. Irrigators had worked out that they could not stop salt levels rising through the summer and exceeding the thresholds promoted by scientists; but they could ensure the season started at low salt by augmenting leaching following the winter rains by additional irrigation in spring.

The Angas Bremer Water Management committee were at the centre of learning at the regional scale. They were responsible for the Code of Practice which had been developed around the expectation that the level of water in the shallow aquifer would rise due to over-irrigation. It turned out that applying insufficient water was a bigger problem and hence the salt accumulation in the root zone. Yet their original desire to fully involve irrigators in the process of carrying out a Water Allocation Plan proved to be extremely far sighted. Although they had not foreseen that the salinity of their irrigation water would skyrocket through the drought, they were able to manage the problem when it hit because irrigators had learned how to adapt irrigation and leaching practices.

Another unexpected benefit from the district wide monitoring was that the irrigators developed confidence to engage with outside experts, particular about groundwater. It is the behaviour of the deep aquifer that holds the key to the sustainability of the region, particularly with respect to aquifer storage and recovery. Even though irrigation water is more secure than before with the new river pipeline, the deep aquifer will be needed routinely for some irrigators and as an emergency supply for others. Although irrigators were not involved in monitoring the deep aquifer, and interpretation of the data requires expert knowledge, irrigators understand how the advice they are given is constructed and are willing to contest the experts on contentious issues such as the rules governing aquifer storage.

Lessons for NRM policy are still emerging. The NRM board has now introduced the first stage of the code to other irrigation areas, i.e. reporting total water application, but it has not been as successful as the Angas Bremer experience. The ABWMC were unique as they both enforced the code and also fed data back to individual irrigators in a timely manner. What was envisaged as an exercise in compliance to a code grew into a rich experience of social learning. The Angas Bremer had both highly motivated individuals and received substantial financial support from the NRM board. In an era when water quality has largely fallen off the national agenda, it is no longer clear how this level of social learning could be replicated in other areas.

CONCLUSIONS

Managing the sustainability of irrigation is a complex problem. There is uncertainty about the amount and quality of surface water, how much water can be extracted from aquifers, and the dynamics of salt and pressures in the deep and shallow aquifers. Obviously the relevant experts must deploy their knowledge to make the best predictions possible and set limits on water use in the water allocation planning process. However plans are not enough. By involving local irrigators in the processes of monitoring, the whole region was able to learn from the unfolding reality of pumping too much groundwater or importing salty surface water. The understanding gained by the irrigators challenged the formal knowledge of experts, contributed to deeper insights into the sustainability of the region and allowed them to adapt to current and unforeseen problems.

ACKNOWLEDGEMENTS

We acknowledge the visionary and courageous actions of the Angas Bremer Water Management Committee in setting up this environment for social learning and for inviting scientists and catchment managers to be part of the process. We particularly recognise the role of Tony Thomson who initiated and guided the process through its formative stages.

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Tables

Table 1: Social learning at individual scale, at the scale of the Angas Bremer region and emerging lessons for the NRM agencies

	Individual-centric	**Network-centric**	**Systems-centric**
Unit of observation	Grape Grower	AB Water Management Committee	Natural Resources Management Board
Learning outcome	Salt dynamics in the root zone	Salt and groundwater dynamics in the region	Requirement to improve sustainability of irrigation in the state
Operational measures	Change in irrigation durations and time of leaching	Planning ASR and securing new water resources	What elements of the Angas Bremer experience can be replicated?
Learning process	Experiential: growers learn by doing	Transformative: The region has changed in the face of dwindling water supply	Emergent: How best to link compliance with social learning

Figures

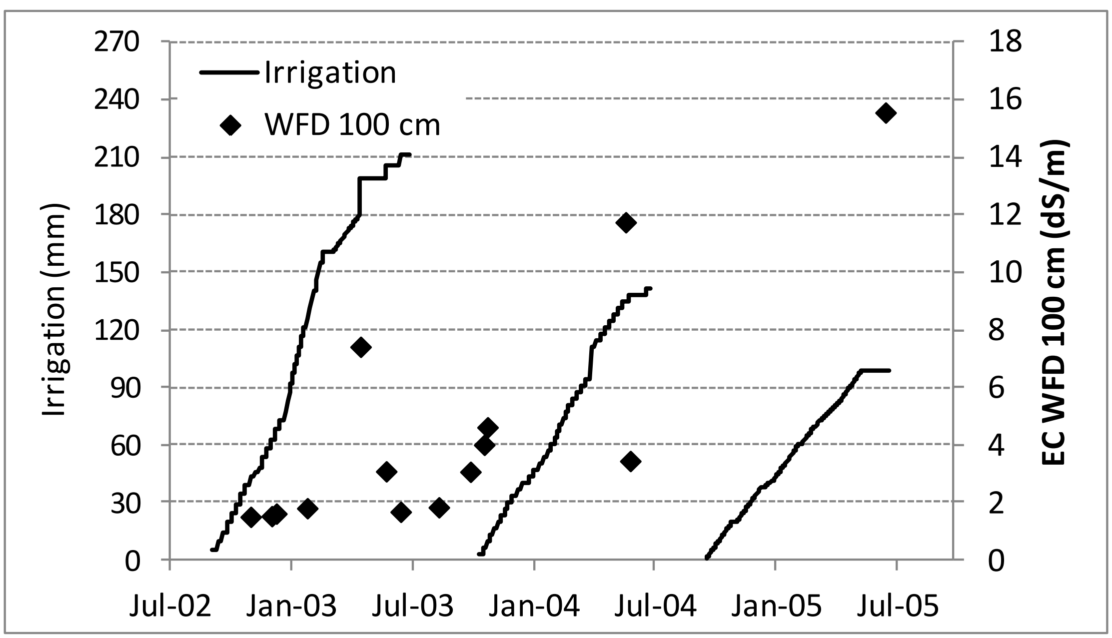


Figure 1. Irrigation and electrical conductivity (EC) measured from FullStop wetting front detector at 100cm depth from 2002 to 2005.

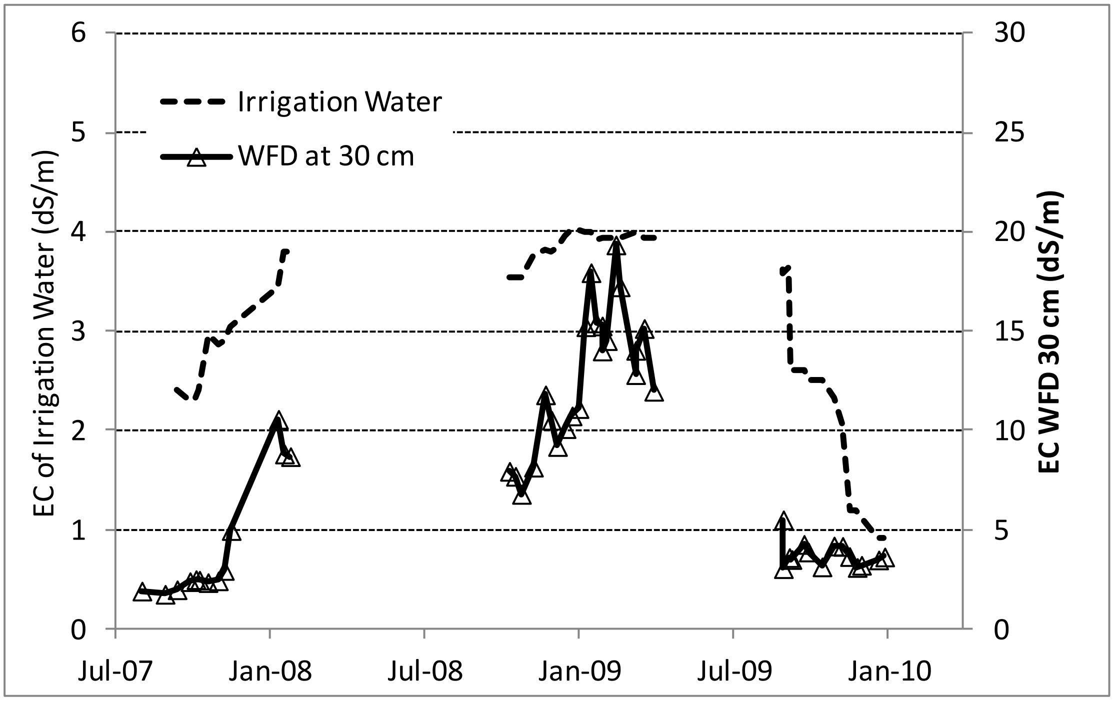


Figure 2. Electrical conductivity (EC) of irrigation water (dotted line, left axis) and of the soil solution (solid line, right axis) measured from FullStop wetting front detector at 30 cm depths from 2007 to 2010.

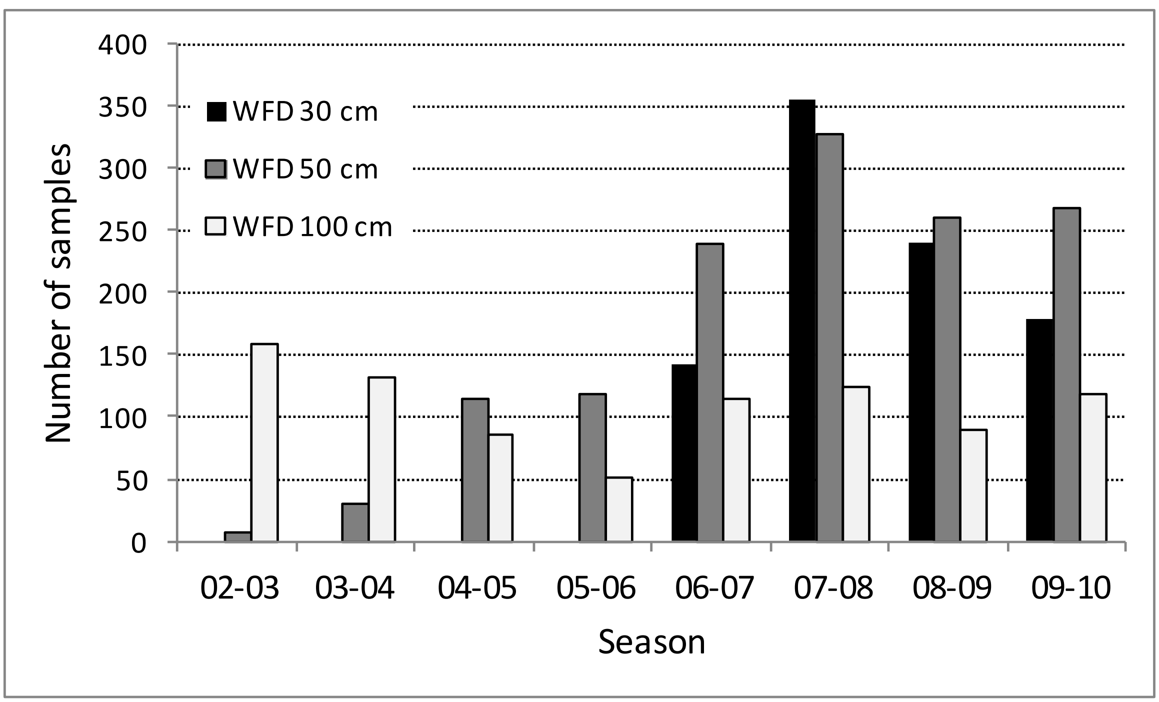


Figure 3. The number of salinity samples reported by irrigators from FullStop wetting front detectors at 30, 50 and 100 cm.

2. Biodiversity Project

The Angas Bremer Water Management Committee has been undertaking a project since June 2012 with funding from the Australian Government. The aim of this project is to restore vegetation to improve and link biodiversity corridors, along the Angas and Bremer Rivers and the shore of Lake Alexandrina as well as associated swamps and wetlands within the Langhorne Creek area.

The project has involved 15 sites; 6 on the Bremer River, 2 swamps or wetlands associated with the Bremer River, one site neighbouring Gollan's waterhole, and 6 on the Angas River (Figure 3). Work has taking place on a total of 42 hectares. Sites were chosen based on criteria such as landholder interest, continuity with other sites, and their importance as refuges.

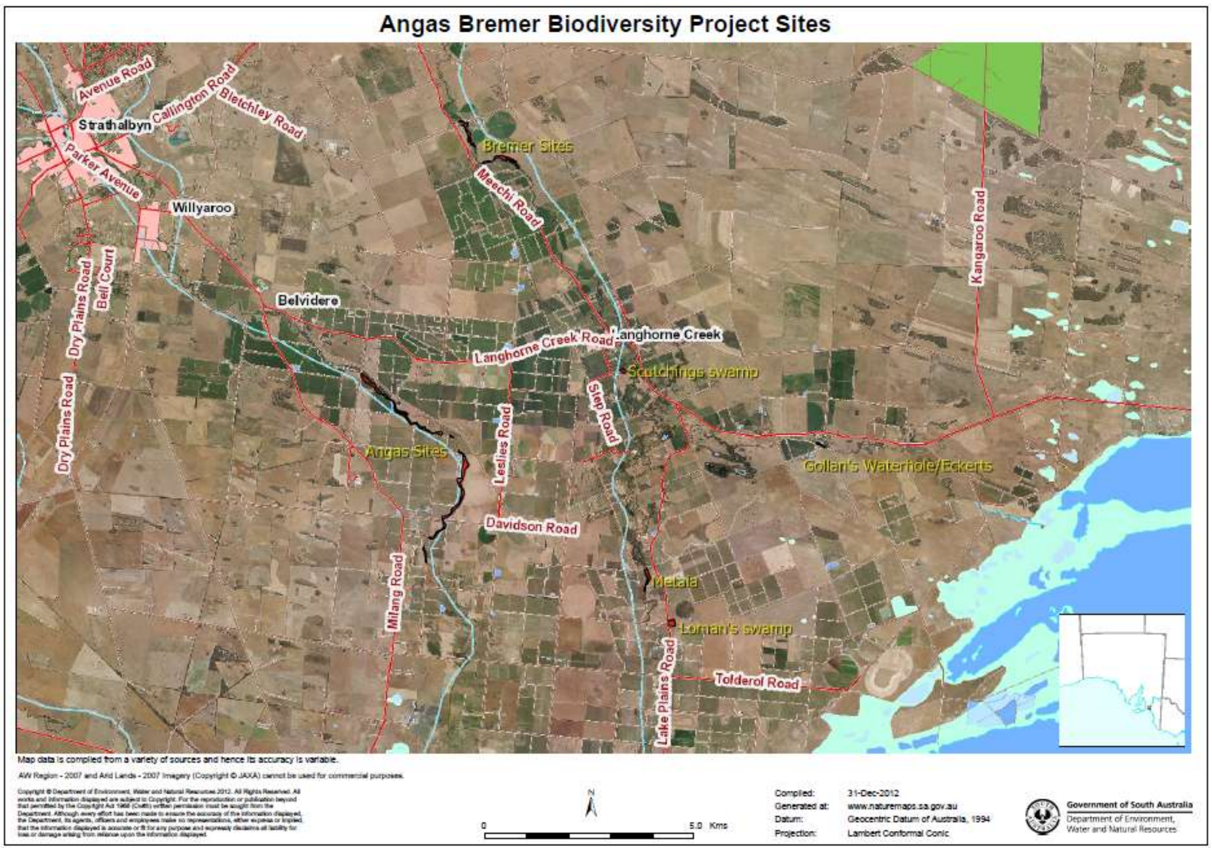


Figure 4. Biodiversity Project sites, coloured red, with yellow labels.

The work for this project has been undertaken by the landholders themselves, the ABWMC project officer, and various local contractors including and coordinated by Jeff Whitaker. Site preparation included; fencing along watercourses on a number of sites, weed control at all sites prior to planting or direct seeding, and an extensive rabbit baiting program in winter 2013 that included most sites.

Initial direct seeding and some tubestock planting took place in the second half of 2013. Unfortunately, the heatwave in January 2014 significantly reduced the survivorship of the emerging seedlings from the direct seeding efforts, which was very disheartening. Hopefully there is some viable seed left in the soil profile from the direct seeding which will germinate in the future. The dry start to 2014 also meant that weed control planned for that year was pushed back until the very end of the project when the winter rains finally allowed some growth of the weeds and provided better opportunities for effective control. The rest of the tubestock planting (over 5000 plants of 47 different understorey, midstorey and overstorey species) and some further direct seeding work took place towards the end of the project in June, July and August when conditions were more favourable. The seedlings were grown at the Milang Community Nursery and State Flora at Murray Bridge from locally collected seed.

Monitoring of water quality, aquatic invertebrates and frogs occurred at each site every Spring, and vegetation in Autumn. Photos of the sites have been taken every 6 months at designated photopoints to monitor the progress of the project (see Figure 5 for an example). Photos should continue to be taken at the sites to keep a record of the establishment of the revegetation over time, and the flora and fauna monitoring can be done again in future years to see whether it has provided the biodiverse habitat envisaged by the project.

Frogs, which are thought to be an indicator of wetland health, were recorded at every site in 2013 and 2014. Gollan's waterhole on Mosquito Creek stood out with a greater number of frog species than the other sites and the only place where Peron's tree frogs (*Litoria peronii*) were recorded. Other frog species noted so far in the monitoring sessions were the Common Froglet (*Crinia signifera*), Eastern Banjo Frog (*Limnodynastes dumerilii*), the Spotted Marsh Frog (*Limnodynastes tasmaniensis*) and the Southern Brown Tree Frog (*Litoria ewingii*). The Southern Bell Frog, a threatened species, has not yet been recorded at any of the sites, but is known to occur around Lake Alexandrina.

Perons Tree Frog
Photo: Darcy Whittaker

Spotted Marsh Frog
Photo: Darcy Whittaker

Bird surveys have been carried out by the Strathalbyn Naturalists Club in Spring and Autumn in 2013 and 2014, with a diverse range of birds being identified including water birds, birds of prey and tree dwelling species. Sixty seven species were recorded, of which 5 were introduced species.

Blue Wren
Photo: Darcy Whittaker

A section of Jeff Whitaker's report is provided here - *It is expected that as these sites develop more species diverse mid storey and understorey vegetation structure, changes in the bird populations utilizing the sites will be observed. The linking of previous individual revegetation efforts into more substantial areas will provide opportunities for greater diversity. Already species such as White Browed Babblers (which are colony nesters needing reasonable areas of dense bush to thrive) are re-establishing themselves in the revegetation work carried out some years ago at Rosemount... The areas that the babblers have already settled may well be developing to a stage where other more sensitive species can get a toe hold on some new territory.*
The purpose of these surveys is purely to provide a base-line understanding of what species currently use the sites so that future change can be recognised.'

Landholders are now responsible for the management of the sites on their properties over the next 10 years (and hopefully beyond), with technical support being provided by the Angas Bremer Water Management Committee if needed. The committee will also apply for grants when any become available that may be able to assist the landholders further. A Landcare Grant application has recently been submitted for funds to run a seed collection and native plant propagation workshop, as well as to further increase the number of plants on the Biodiversity Fund properties. If the grant application is successful, the workshop will also be open to any other interested landholders, particularly those with river frontage or swamps on their property.

a) November 2013

b) May 2014

Figure 5 a and b). A site on the Bremer River that has undergone weed control, direct seeding and tubestock planting

Figure 6 a and b) Direct seeding and tubestock planting sites, May 2014

3. Cover Crops Trial

In April 2014 the Angas Bremer Water Management Committee was awarded an Alexandrina Council Rural Initiatives grant, which has enabled 4 landholders in the district to become part of a project run by Chris Penfold from the University of Adelaide. The grant covered the cost of the seed for the landholders and contributed to the successful Viticulture Innovation Day held at Pecadore Vineyard in Langhorne Creek on the 24th of October 2014.

The seeds were sown on the 4 properties in mid June 2014, using 3 different seed mixes – Native Wallaby Grass (*Austrodanthonia geniculata*), Uplands cocksfoot and a ryegrass/clover mix. Early winter rains helped with some germination, however, the season has been trying ever since with frosts and then very dry conditions.

The results are currently patchy within and between the sites, presumably due to the late sowing time, seasonal conditions, and soil and other conditions within the vineyards. Wallaby grass particularly can be very slow to start and it will be interesting to see what happens at the sites over the summer, particularly if summer rain occurs.

Next year, if sufficient funds are available, the sites will be re-sown where needed, this time earlier in the season and possibly with different seed.

The Viticulture Innovation Day will be held again in October 2015 and this will be an opportunity to showcase the results of the trial to other vineyard managers in the region.

Figure 7 a) Chris Penfold's seeder in a vineyard, **b)** Emerging cover crop plants (Uplands cocksfoot) in October 2014, **c)** Chris Penfold demonstrating the results of the Undervine Crop Trial at CMV Vineyard, October 2014.

4. Use of ABWMC Data

The collection of the water use and irrigation data by the Angas Bremer Water Management Committee is certainly of use to the irrigators locally and the SA Murray Darling Basin NRM Board, but is also often requested by the Department for Environment, Water and Natural Resources and CSIRO staff. This year it was also used in 2 external research projects. One from the University of New South Wales for a project looking at innovative approaches to water management (see Appendix F), and another through Griffith University for a project investigating the influence of drought on irrigators' decisions to trade temporary or permanent water access entitlements (see Appendix G). The results of the two projects are very interesting and of direct relevance to the region.

Water management is currently a popular topic for research, and there is likely to be an increasing demand for data. The ABWMC looks forward to being able to assist with other research projects in the future. As the ABWMC is a community group with only a small amount of funding, a small administration fee is now being charged to cover the project officer's time to extract and administer the data.

Irrigation Annual Report Forms Data Summary and Comment

Irrigation Annual Report forms (IAR's) were mailed to 134 irrigators. 126 irrigators who returned their completed forms on time have achieved "Accredited Irrigator" status and have been awarded accreditation certificates. The option to submit reports on-line through the website was even more popular this year than previous years with 106 irrigators using this option. Three IAR's that were received by the committee after the due date did not achieve accreditation and a further 4 irrigators have not (at the date of this report) returned their IAR forms. The data from 129 irrigators has been collated and that data is presented in the following graphs and tables. Comments are included with each chart or table.

Flooding:- Flooding by diversion or pumping was reported by a number of irrigators. The flooding events occurred during July and August 2013. 554 hectares was recorded as being flooded this year, slightly less than the 596 hectares flooded the year before and a further increase over the 150 ha flooded in 2011-12. These figures include some properties that were flooded twice or more over the year.

Revegetation: - The total area of re-vegetation reported in the Irrigation Annual Reports as around 1,890 ha. This includes a 40 hectare increase in the area revegetated after the completion of the Biodiversity Project.

Red Gum Health:- 79 Irrigators reported on the health of the red gums on their properties. Health, or otherwise, was rated from 0 to 5, 5 being healthy and 0 being dead. Red gums were generally noted to be once again in relatively good health. Three irrigators reported all the trees on their property as long dead but of those whose trees largely remain, 24 irrigators reported that their red gums were all 100% healthy, while the remainder listed the majority of their trees to be in relatively good health. The good health of the trees was attributed to the continuation of reasonable winter rains and high flows in the rivers that allowed flood water to reach many swamps. One mention was also made that the exclusion of all grazing had helped to improve the health of the red gums on that property.

Water Leasing:- Table 1 below shows the amount of water leased in 2013-14 compared with water leased in 2012-13. Overall, there was more water leased by irrigators this year than last. The amount of River Murray water leased to Outside Irrigators increased by over 1200ML and the amount leased in from Outside similarly increased by 1000ML. Total volumes leased in and out of the Zone were similar in 2013-14. The volume of River Murray water leased to other irrigators within the Angas Bremer Irrigation Management Zone also increased but only by around 200ML. The amount of groundwater leased between irrigators within the zone has been lowering over the last few years, and for the last two years no reports of leased Groundwater within the zone were received. Irrigators still seem to be preferentially irrigating with and leasing, the available River Murray water.

Table 1

Type of Lease	Megalitres 2012-2013	Megalitres 2013-2014
RM water leased from ABIMZ to outside ABIMZ	1070.00	2329.00
RM water leased from outside ABIMZ to inside ABIMZ	1563.20	2510.00
RM water leased from inside ABIMZ to inside ABIMZ	431.47	651.87
Groundwater leased from AB licence to AB licence	0	0

Figure 8: Angas and Bremer Rivers Water Extractions 2009-2014:- Not all of the water taken from these rivers, such as the water diverted through weirs and sluices, is accounted for in this chart. The volumes on this graph are metered volumes, as well as the amount recharged into the aquifer from these rivers, as reported on the Irrigation Annual Reports. The amount of water that was recorded as having been extracted from these rivers has increased over the last couple of years but is still low compared with the extraction levels recorded in 2010. More meters are likely to be installed and monitored, after completion of the roll out of licences through the Eastern Mt Lofty Ranges Water Allocation Plan.

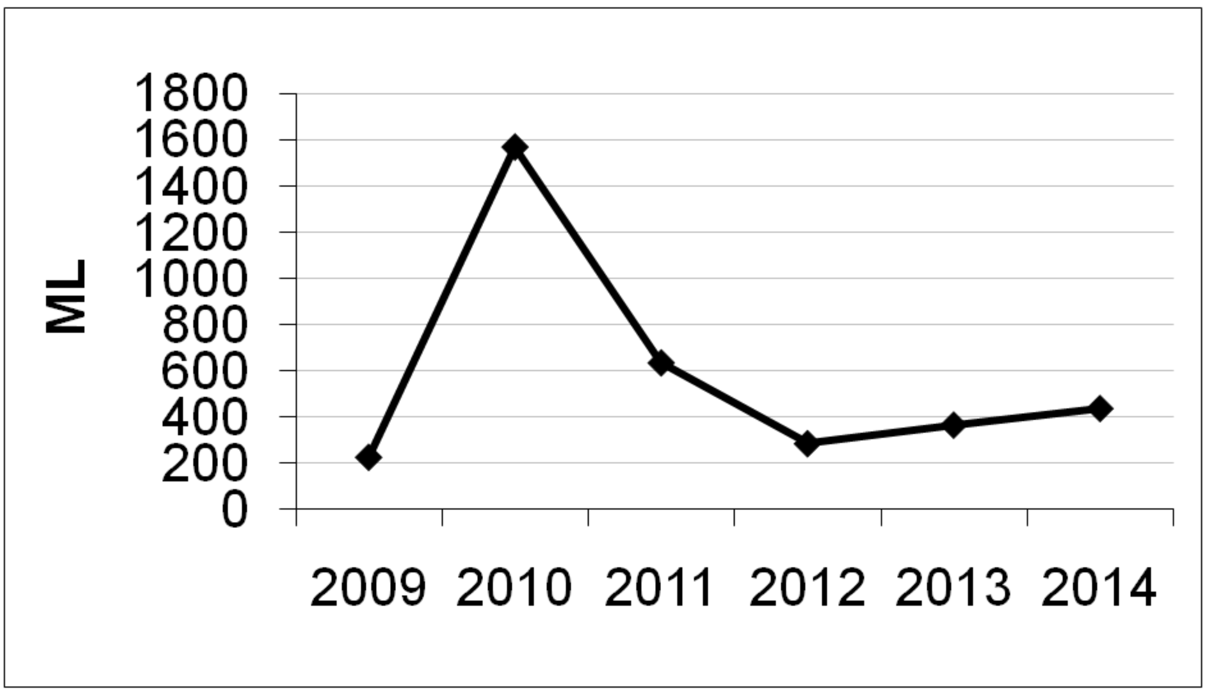


Figure 9: River Murray Water Entitlement, Site Use Approval and Extraction 2009-2014:- Entitlement (RivM Ent) is the volume of water endorsed on licenses and does not include any credits for rollover, recharge etc. The River Murray Site Use Approval (RivM SUA) is the maximum quantity of River Murray water that can be used for irrigation on land identified as being in the Angas Bremer Irrigation Management Zone in 2013-2014. Extraction (RivM Ext) is the volume of water that was used during the irrigation year. As Site Use Approval volumes give a more accurate description of the amount of water that could potentially be used in the region, it is now being recorded on the charts instead of the Entitlement volume. The total Site Use Approval volume for 2013-14 remained at 28,382 ML, and the recorded use was 17598.14 ML, very similar to the 17,379 ML used last year.

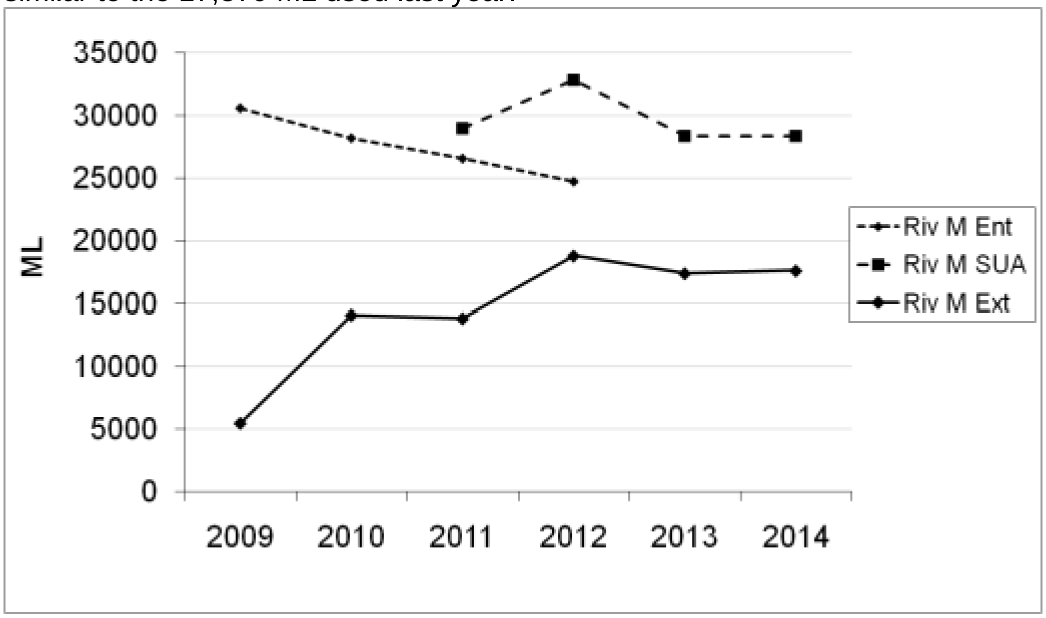


Figure 10: Groundwater Entitlement and Extraction 2009-2014:- The maximum entitlement for 2013-14 was 6,500ML and the recorded use was 2684.88 ML, double the volume of 1287.62ML used in the previous year. This is still much lower than the 7,700 ML used during the "Millenium Drought".

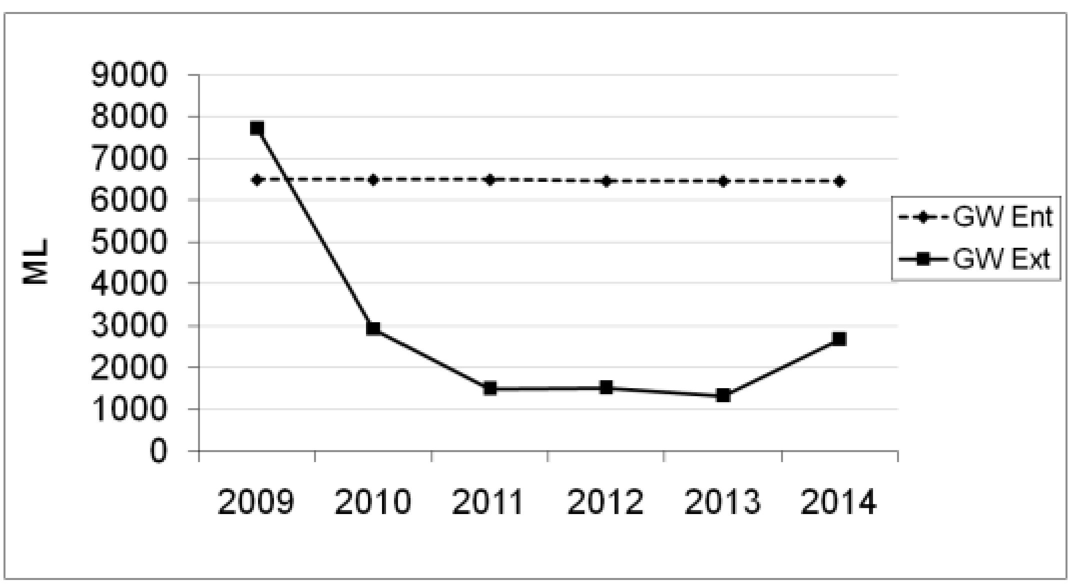


Figure 11: Managed Aquifer Recharge (formally termed Aquifer Storage and Recovery (ASR)) :- This chart shows the total volume of water artificially recharged to the aquifer from 1985 to 2014. The **1,308 ML** recharged from the rivers in 2013-2014 was very similar to last year's volume, and still substantially lower than the record levels achieved in 2010. Whereas last year the volumes extracted from the aquifer and recharged were almost equal, this year the amount of water recharged was only half the volume extracted. No information on the salinity of recharge water was received from irrigators this year through the Annual Reports. From the March irrigation water samples provide to Natural Resources SA MDB, groundwater salinities varied between 800 EC and 4600 EC. See Charts 26 and 27 for a display of confined aquifer salinities. It is likely that the samples with lower salinities came from bores which had been used for recharging as well as extracting water. Hopefully more irrigators will provide irrigation water samples next year to enable better monitoring of the impact of managed aquifer recharge on the quality of the water in the confined aquifer.

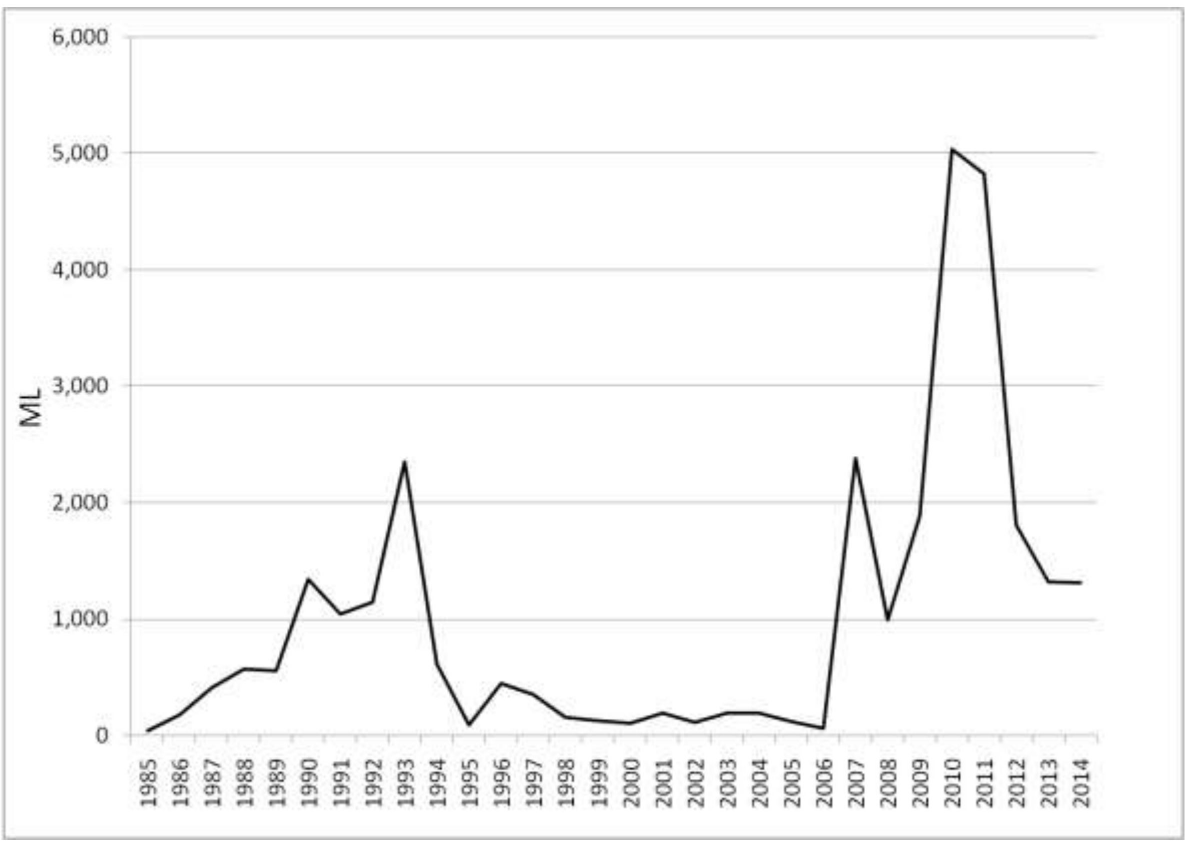


Figure 12: Total volume of water used 2013-2014: - The total volume of water extracted from all sources within the region over the 2013-14 year was **20,723 ML**, which is higher than the previous year (19,035 ML) but lower than two years ago (22,108 ML). The increase from the 2012-13 year appears to be due to the increase in groundwater used for irrigation in the last year. There was also slightly less River Murray water reported as used for recharge and more directly for irrigation in 2013-14 compared with the previous year. When looking over the last 5 years of water use, there was a distinct increase in River Murray use in 2012 which has been sustained over the last 3 years. There has also been a corresponding decrease in the volume of water used for recharge over the same time period.

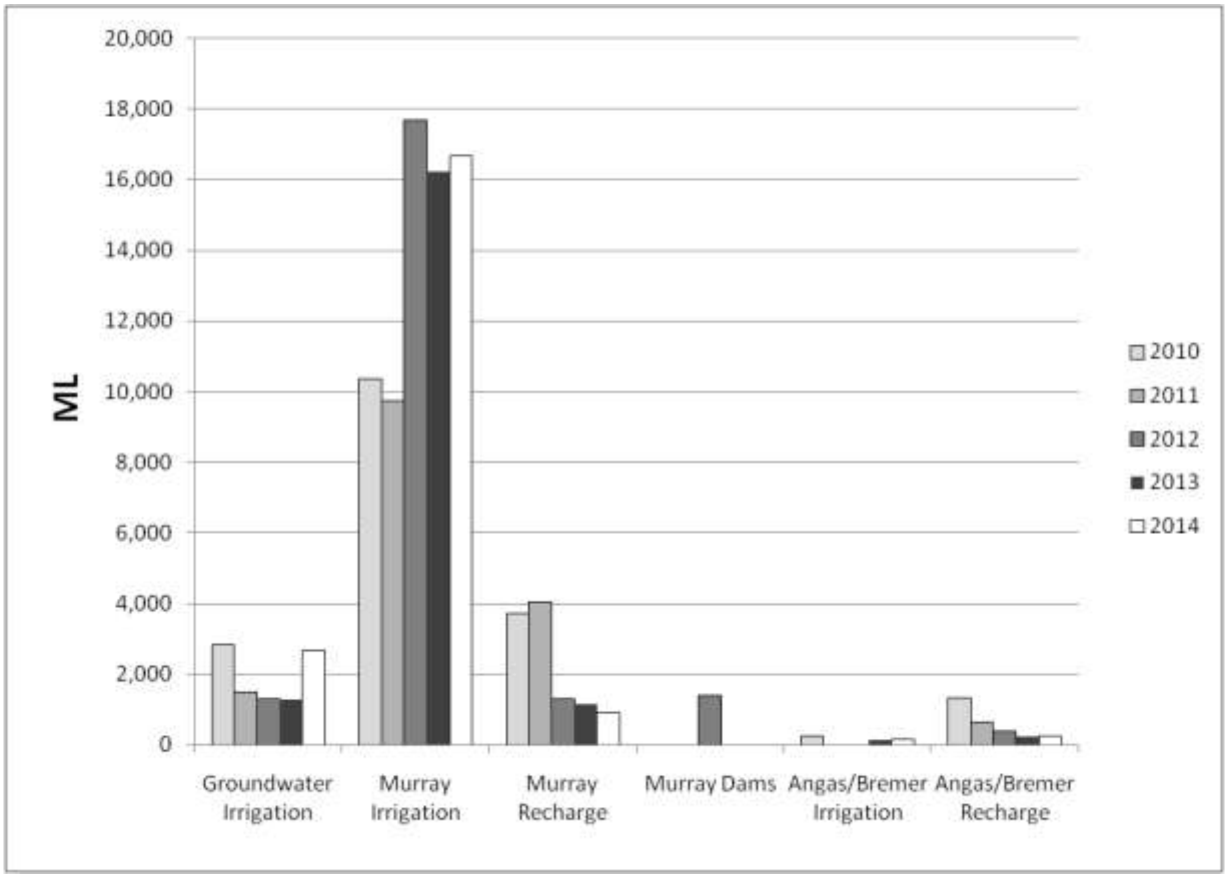


Figure 13: Total volume of water used for each crop type: - This volume is the total used from all sources; groundwater, watercourse water and River Murray water that was applied to each crop type (grapes excluded). **The total volume of water applied to grapes was 13,230 MLin 2013-14 compared with 13,128 ML in 2012-13, and 11,990 ML in 2011-12.** The volume of water used on some other crops including lucerne, potatoes and vegetable crops has decreased in 2013-14 compared with the previous year, even though the annual rainfall had also decreased.

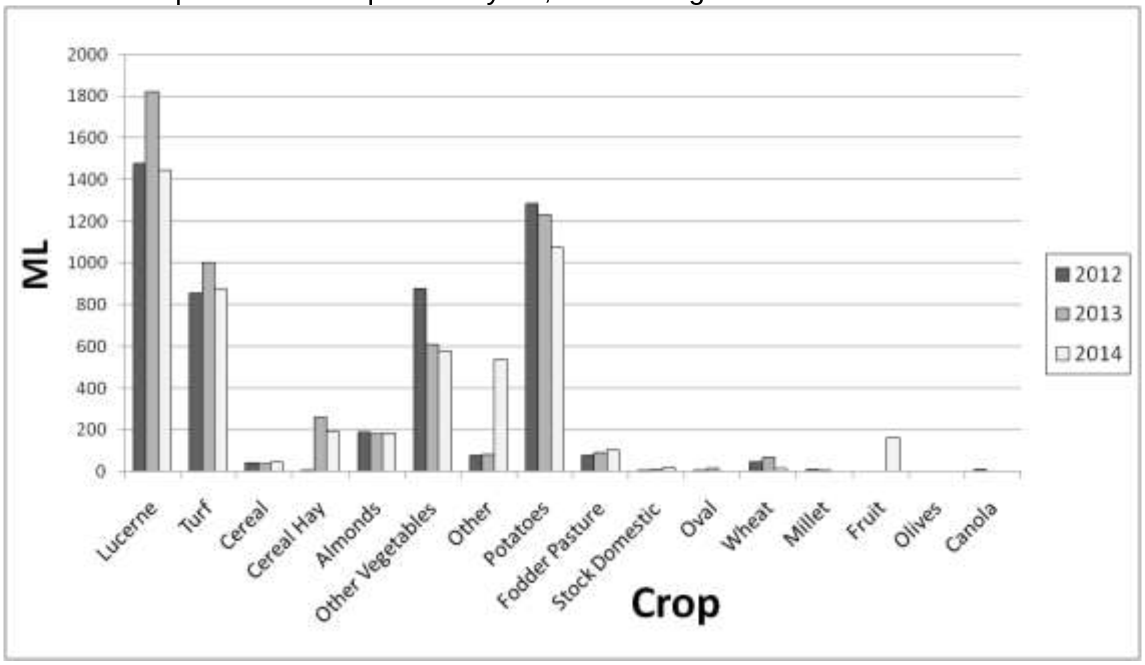


Figure 14: Number of Irrigators for Each Crop Type: - The number of irrigators growing each crop type in the region appears to have remained relatively stable over the last 3 years, with grapes and lucerne remaining as the most widely grown crop types.

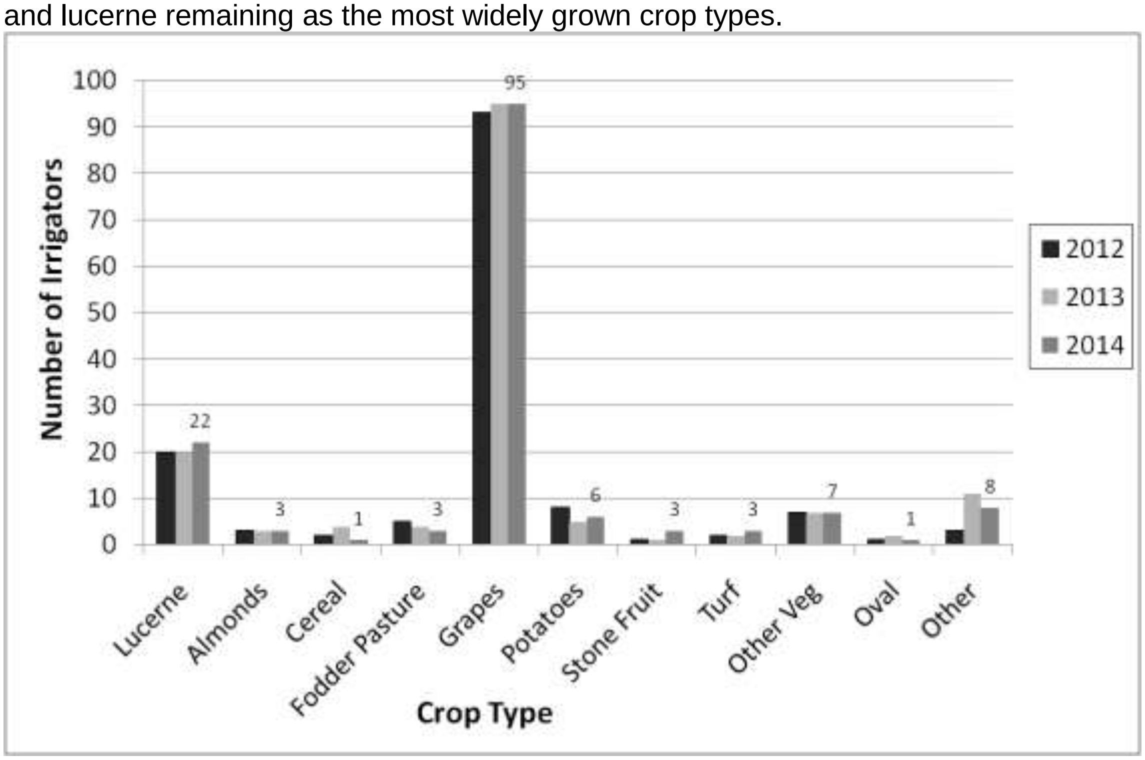


Figure 15: Area Irrigated by Crop Type: - The area of each crop irrigated is shown in hectares. **The area of grapes irrigated in 2013-14 was 5850 ha, a slight increase compared with the 5,641 ha recorded in 2012-13.** The total area under irrigation in 2103-14 was 7262 ha, which was very similar to last year's total of 7,203 ha. There was a decrease in the area of cereal, lucerne and potatoes irrigated in 2013-14, but increases in other vegetables and fruit. Eight irrigators selected the 'other' option for their crop type, with 157 hectares irrigated, suggesting it would be worthwhile finding out if another crop type needs to be added to the list on the Annual Report form.

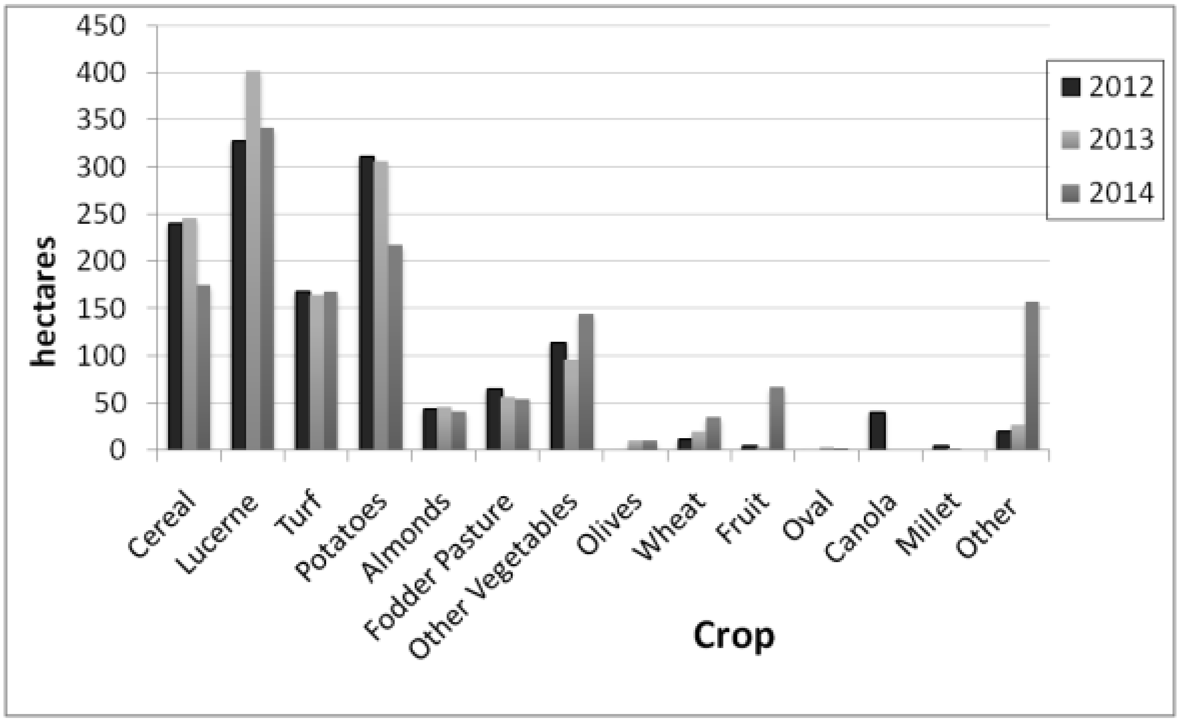


Figure 16: Average total irrigation for the year by crop type:- Irrigation is shown in mm for 2011-12, 2012-13 and 2013-14.

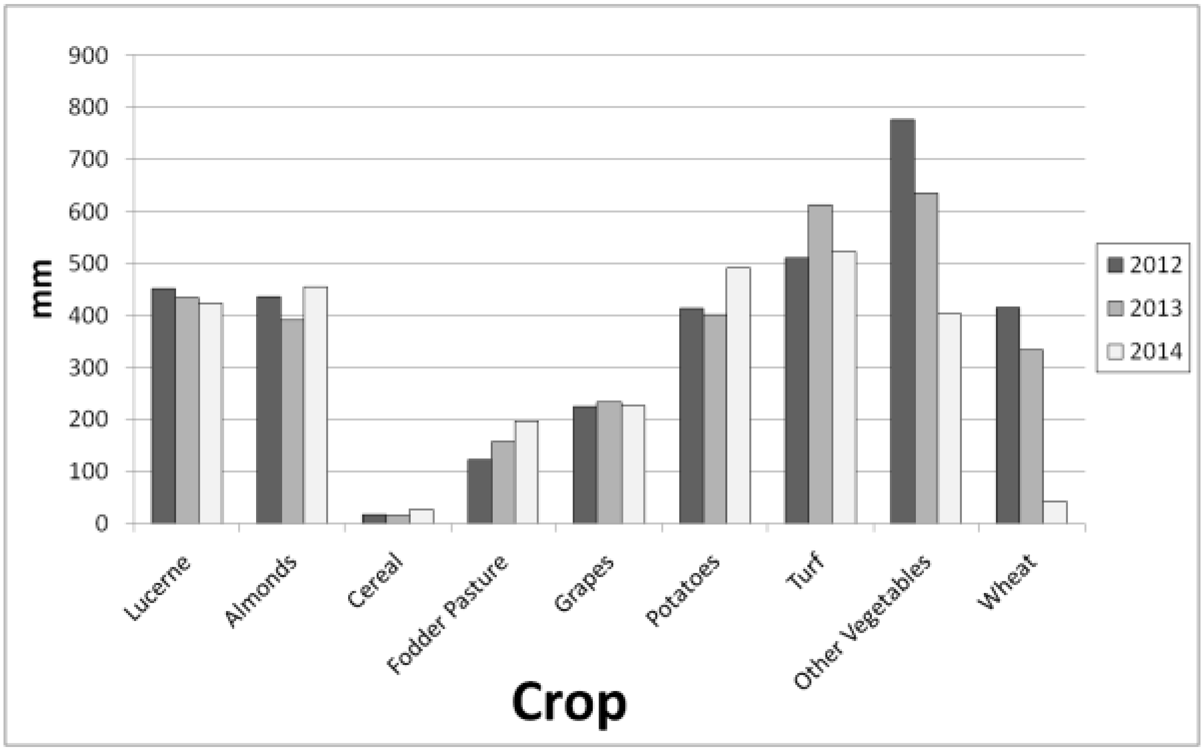
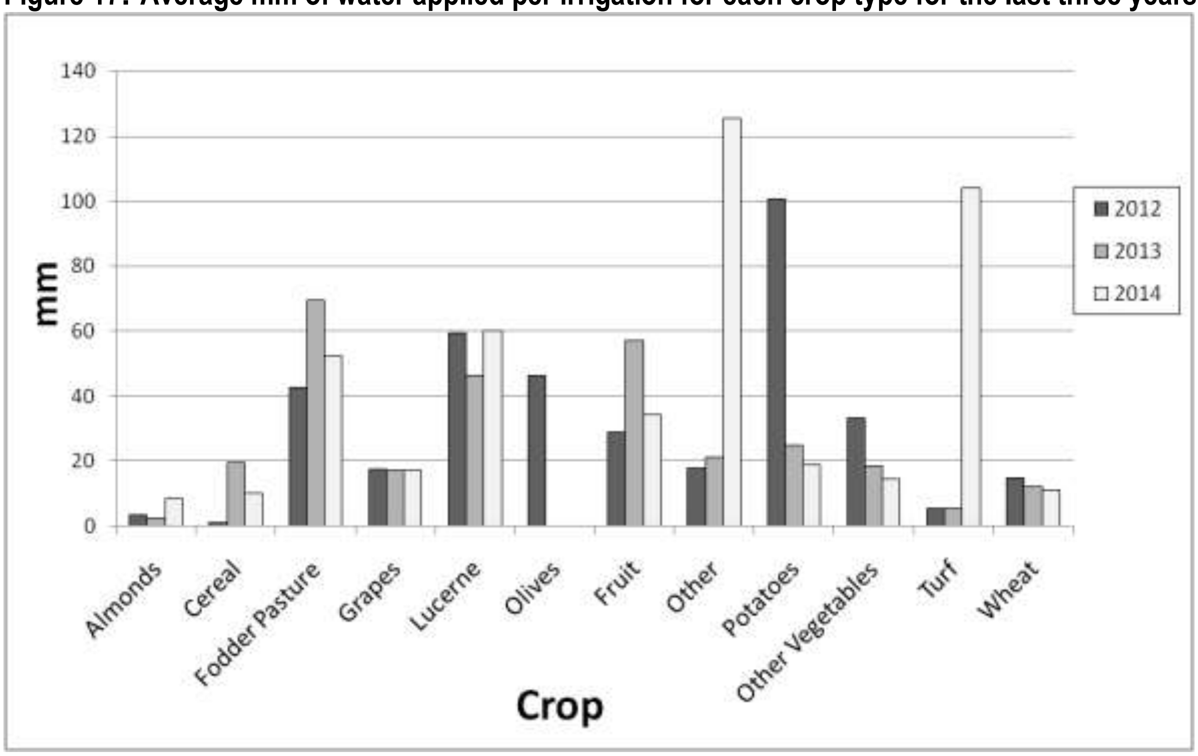
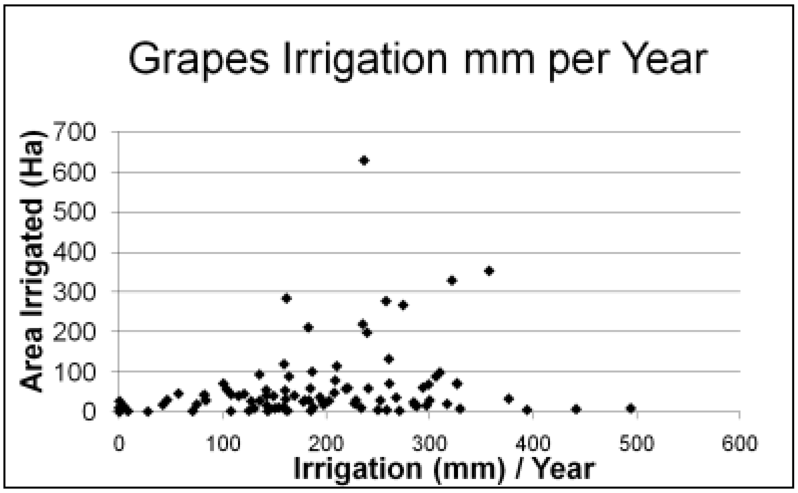


Figure 17: Average mm of water applied per irrigation for each crop type for the last three years.

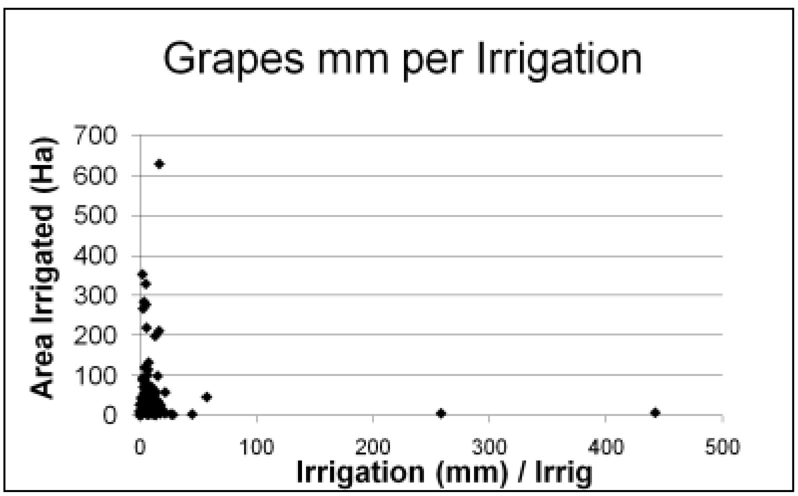


Figures 18-22: These charts are for the larger crops. **For each crop one chart shows (a) the mm per year and (b) the mm per irrigation**. For grapes an additional chart (16c) has been included. It excludes those irrigators who applied a large volume of water in a single irrigation or flood event.

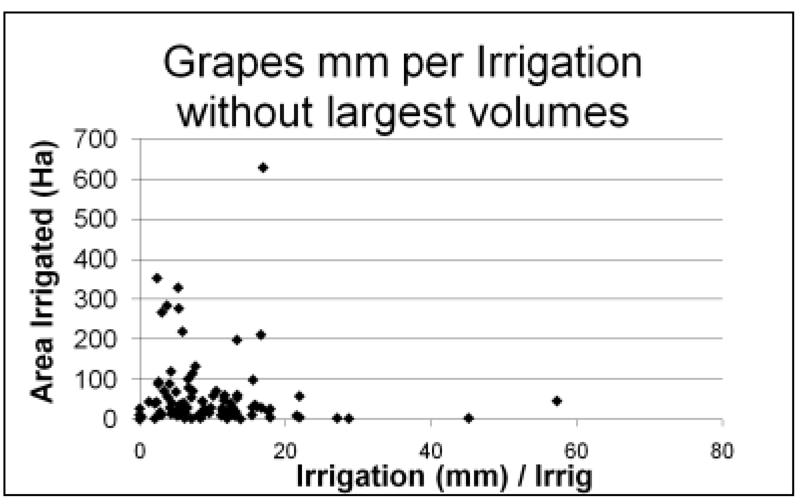
18a)



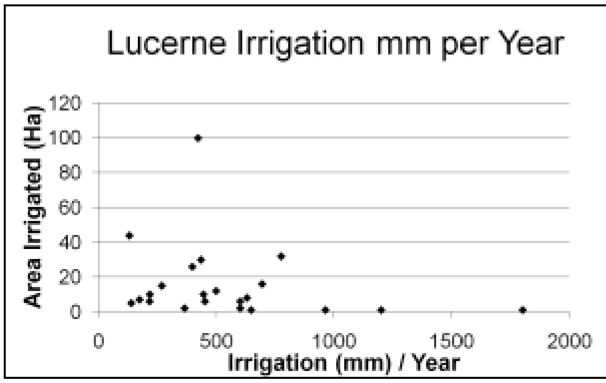
18b)



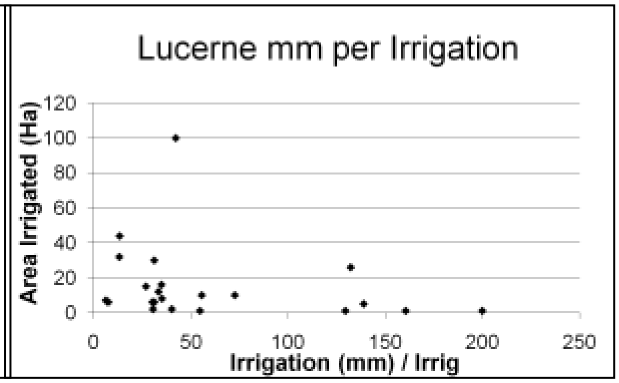
18c)



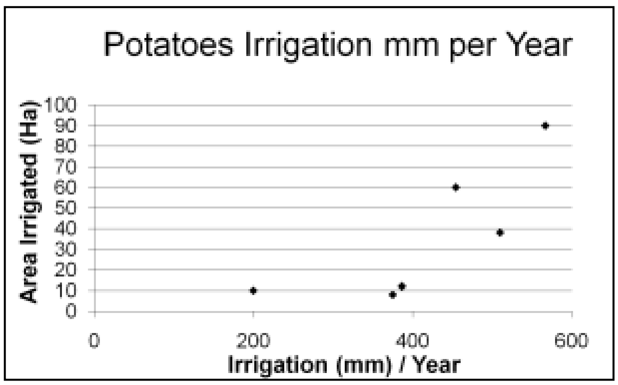
19 (a)



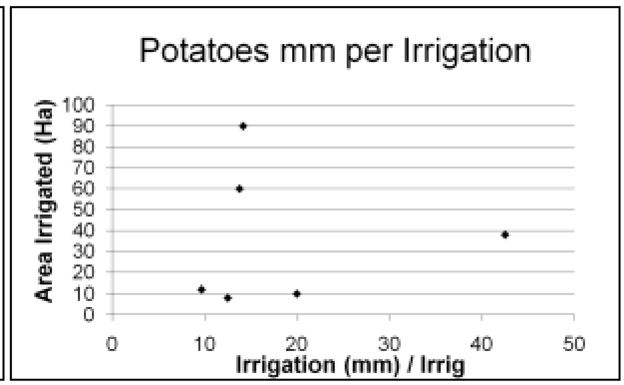
19 (b)



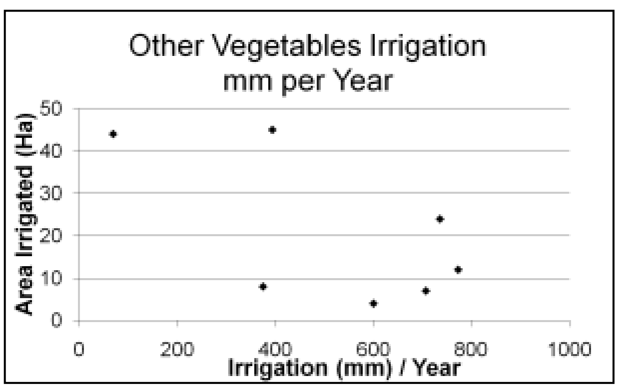
20(a)



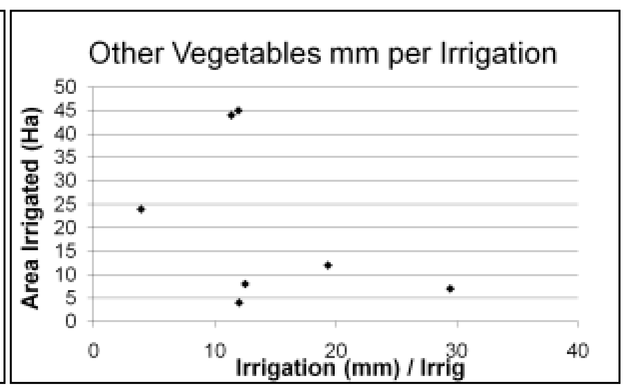
20 (b)



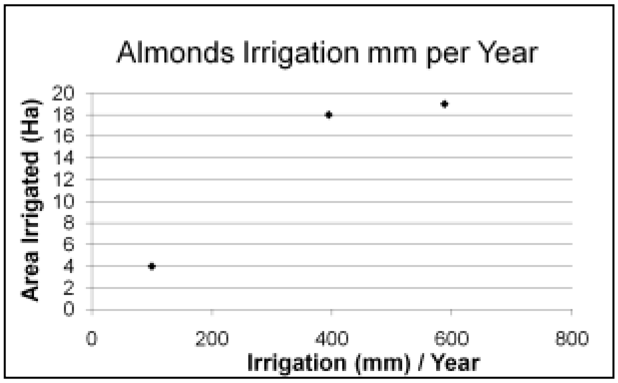
21 (a)



21(b)



22(a) **20 (b)**



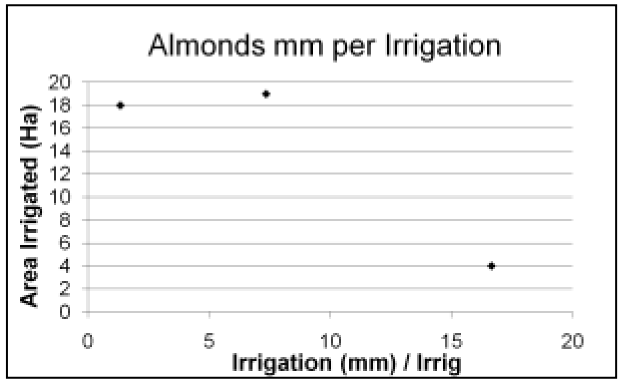
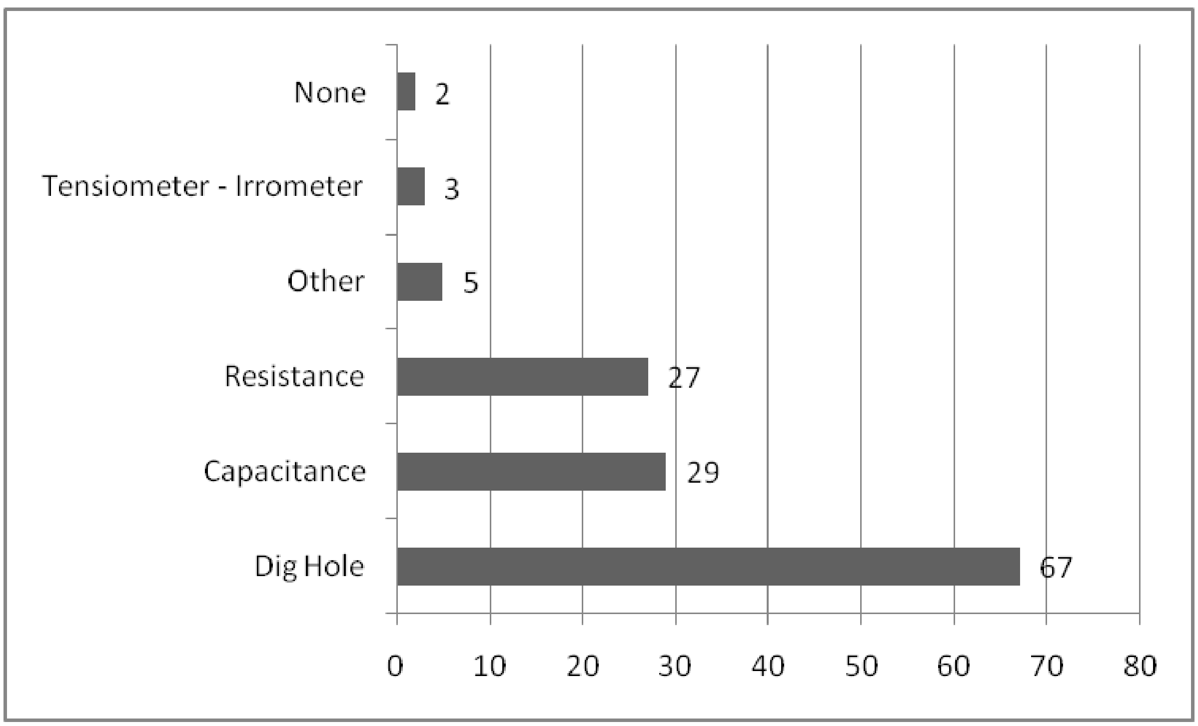


Figure 23: Number of growers using Soil Moisture Monitoring devices in 2013-14:- "Resistance" includes Gypsum Blocks. "Capacitace" includes Agwise soil moisture probes, Agrilink C probe, Dataflow Gopher, Sentek Diviner and Sentek EnviroSCAN. "Dig hole" includes Dig stick, spade, auger and post hole digger.



<u>Table 3: Average ML/ha per crop per year</u>:- This table shows the average ML/ha of irrigation water applied to different crop types and compares 2014 with previous years. This information is also displayed in the following Figure 24.

Year	Grape	Lucerne	Vegetable	Potato	Fodder	Almond	All Crops
2013-2014	2.26	4.24	4.02	4.92	1.98	4.56	2.51
2012-2013	2.62	4.53	6.35	4.01	1.58	3.91	2.62
2011-2012	2.25	4.52	7.76	4.13	1.22	4.37	2.55
2010-2011	1.9	2.2	2.4	3.1	0.5	3.4	2
2009-2010	2.3	4.32	3.6	3.72	1.2	5.11	2.47
2008-2009	1.73	2.99	4.38	1.74	1.24	1.04	1.78
2007-2008	1.97	4.36	7.8	2.51	2.36	5.24	2.07
2006-2007	2.04	5.13	6.43	4.12	1.7	5.23	3.67
2005-2006	1.8	4.23	5.04	2.99	1	4.06	2.95
2004-2005	1.99	5.22	5.18	3.67	2.74	4.79	2.25
2003-2004	1.97	4.5	8.8	3.5	2.7	4.2	2.28
2002-2003	2.2	6.8	6	3.8	4.3	4	2.61
2001-2002	2.1	4.4	5.1	4	3.3	4.5	2.5
2000-2001	2.1	4.8	5.7	3.6	4.7	3.1	2.6
1999-2000	2.1	6	6.3	3.7	3.7	2.8	2.6
1998-1999	2.2	5.1	4.5		3.8	2	2.7

Figure 24

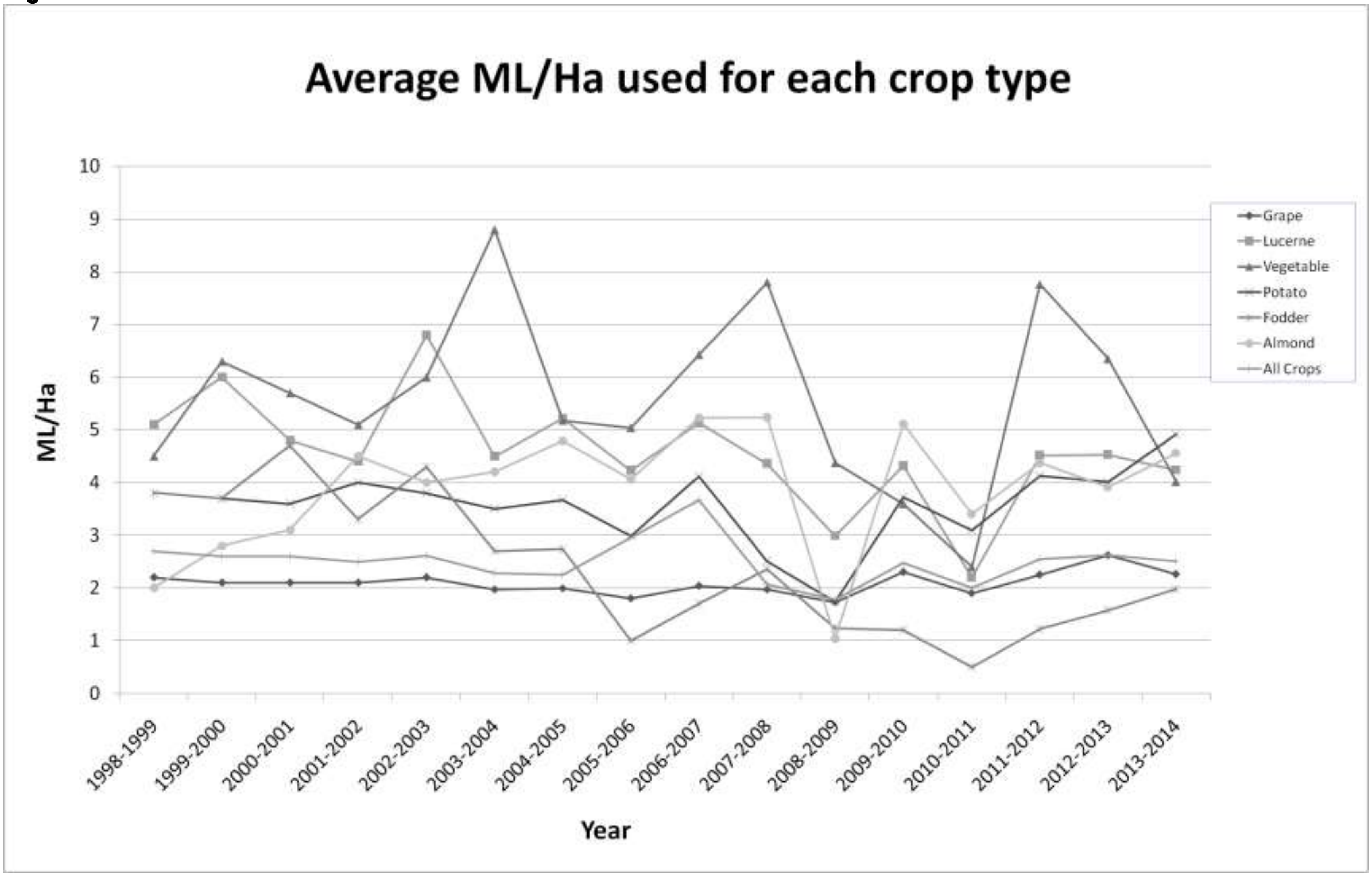

Average ML/Ha used for each crop type
10
9
8
7
6
5
4
3
2
1
0
ML/Ha
1998-1999
1999-2000
2000-2001
2001-2002
2002-2003
2003-2004
2004-2005
2005-2006
2006-2007
2007-2008
2008-2009
2009-2010
2010-2011
2011-2012
2012-2013
2013-2014
Year
Grape
Lucerne
Vegetable
Potato
Fodder
Almond
All Crops

Table 4: ML used and ha irrigated comparison chart:-

	2013-2014	2012-2013	2011-2012	2010-2011	2009-2010	2008-2009	2007-2008	2006-07	2005-06	2004-05	2003-04	2002-03	2001-02	2000-01	1999-2000
Total ML	**18,605**	**18,617**	**17,056**	**13,346**	**16,241**	**12,001**	**14,743**	**20,911**	**15,811**	**17,719**	**17,154**	**20,715**	**17,428**	**17,467**	**16,961**
Total ha	**7,406**	**7,107**	**6,687**	**6,687**	**6,578**	**6,748**	**7,049**	**8,370**	**7,739**	**7,869**	**7,509**	**7,934**	**7,089**	**6,788**	**6,625**
Grape ML	13,230	13,129	11,990	11,275	13,718	10,738	12,330	12,827	11,293	11,688	11,927	13,165	11,159	10,626	10,021
Grape ha	5,850	5,641	5,323	5,965	5,971	6,199	6,245	6,271	6,170	5,876	6,059	6,059	5,357	4,991	4,665
Lucerne ML	1,446	1,820	1,477	376	657	326	675	1,437	1,378	1,791	1,608	2,560	2,051	2,040	2,491
Lucerne ha	341	402	327	170	152	109	155	280	325	343	354	376	471	429	418
Veg ML	580	610	877	193	36	57	179	373	363	638	605	647	651	769	761
Veg ha	144	96	113	81	10	13	23	58	72	123	69	108	103	134	121
Potato ML	1,073	1,232	1,283	555	320	131	136	1,200	1,171	1,278	1,280	1,504	1,719	1,773	1,812
Potato ha	218	307	311	179	86	75	54	291	392	348	360	394	425	490	485
Fodder ML	107	90	78	22	47	32	53	222	144	505	399	752	316	742	358
Fodder ha	54	57	64	43	39	26	23	130	144	184	146	173	97	157	96
Almond ML	187	180	188	148	225	193	231	251	195	230	203	188	246	172	164
Almond ha	41	46	43	43	44	44	44	48	48	48	48	47	55	55	58
Other crops ML	1,935	1,556	1,094	777	1,238	524	795	2,004	900	1,589	1,132	1,899	1,286	1,259	1,354
Other crops ha	573	558.5	501	206	276	282	505	906	588	936	443	777	583	533	777

Charts of Standing Water Level and Salinity in Unconfined and Confined Aquifers

Figures (s) 25 a + b (Pg 32-33): These and the following charts were produced by the Department of Environment, Water and Natural Resources. These first two charts are contour maps of the Quaternary (Q) unconfined aquifer. The first **a)** is from the 2013-14 water use year (June 2014), the second **b)** from 2012-2013 (June 2013). The data for each map came from the State Government's Angas Bremer groundwater observation network. This data is available to the public on the Groundwater Data application of the WaterConnect website (www.waterconnect.sa.gov.au). The numbers on the maps are metres below ground level of the standing water table. Winter was selected as it is the time of greatest risk of shallow watertables. When compared with last year the picture was fairly similar across the region.

Figure 26a + b + c (Pg 34-36): The next 3 charts show the potentiometric surface and salinity contours of the Tertiary (T) confined aquifer in **a)** March 2014 and **b)** March 2013, using data from the State Government's Angas Bremer groundwater observation network only, and **c)** March 2014, using data from the groundwater observation network as well as water samples provided to the NRM Board by irrigators at the end of the 2013-14 irrigation season. The salinity is displayed in mg/litre (equivalent to ppm). The March data (post irrigation season) was selected as it shows the greatest level of impact due to extraction from the aquifer.
The water level was around 1m higher over most of the region in 2014 compared with the previous year. The salinity levels in 2014 are very similar to those from 2013 when the DEWNR Obs. Well data only is compared. The only differences seen in the 2014 chart (24a)) are an artefact of no water sample being collected at BRM 34 on the Angas River this year and a sample collected at FRL 52 near the Bremer River this year that was not included the previous year.
The inclusion of the irrigator's samples in 24c) shows much lower salinities across many parts of the region.

Figure 27 a + b (Pg 37): These charts display the salinity of the confined aquifer using **a)** data collected in September/October from the State Government's Angas Bremer groundwater observation network as well as the samples supplied by the irrigators to the NRM Board in September/October 2014, and **b)** groundwater observation network and irrigator's samples from Winter 2013 (mostly from September/October). When compared with 2013, the salinities appear to be generally higher in 2014; however, this is most likely due to fact that there were far fewer irrigators' samples provided in 2014.

Figures 26 c) and 27 a + b) are once again demonstrating the positive impact of recharging the confined aquifer with better quality water from the Murray, Angas and Bremer Rivers. Many of the irrigators who supplied water samples recharged into the same extraction bore or one close by. It should be noted however, that on the charts where the data from the irrigator's water samples are included, the extent of the fresher water may be more localised that it appears. The difference seen between 27a + b also highlights the importance of the provision of the water samples by the irrigators, and how differences in the number of samples provided can influence the observed results.

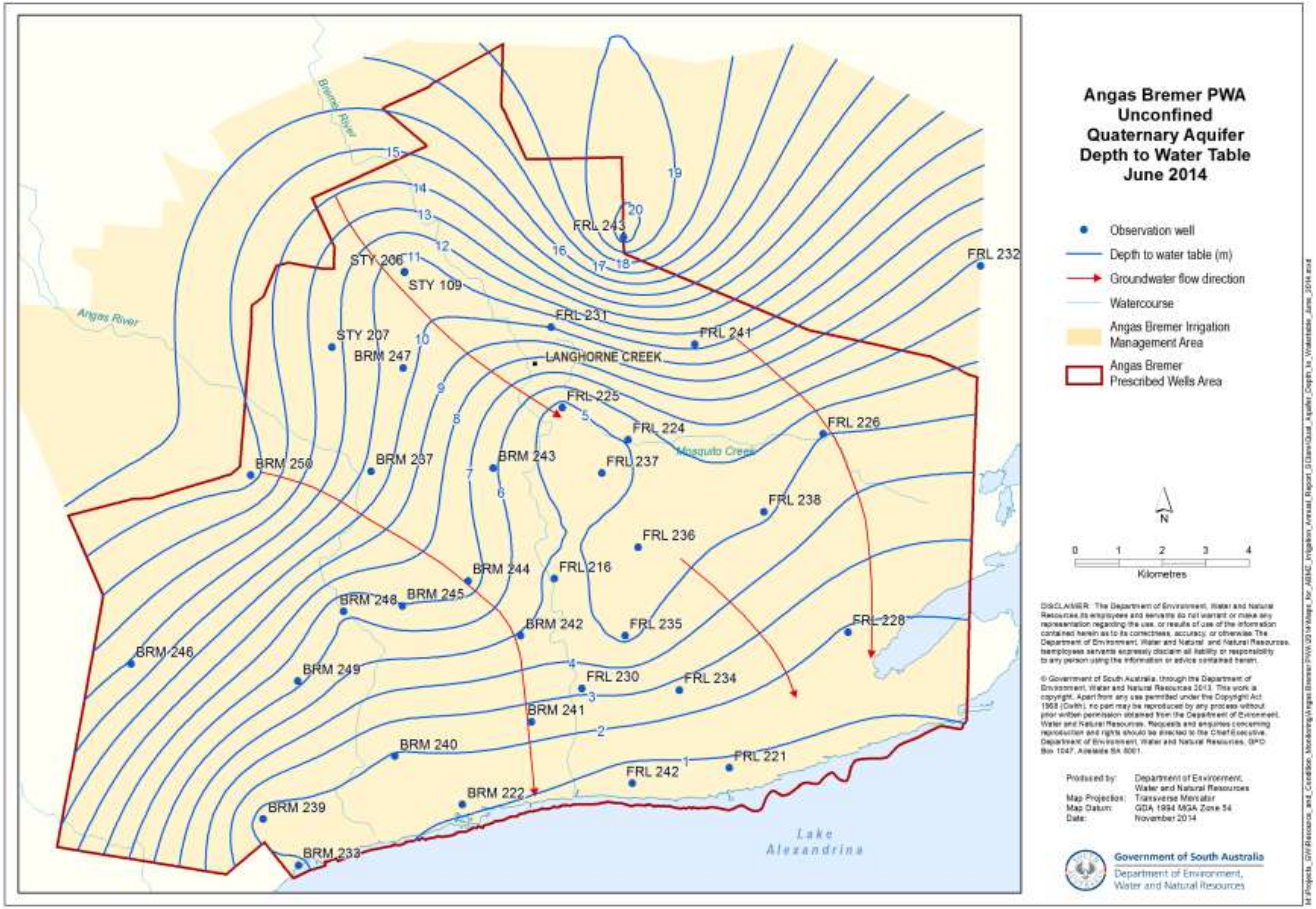


Figure 25a Standing Water Level in Quaternary Unconfined Aquifer June 2014

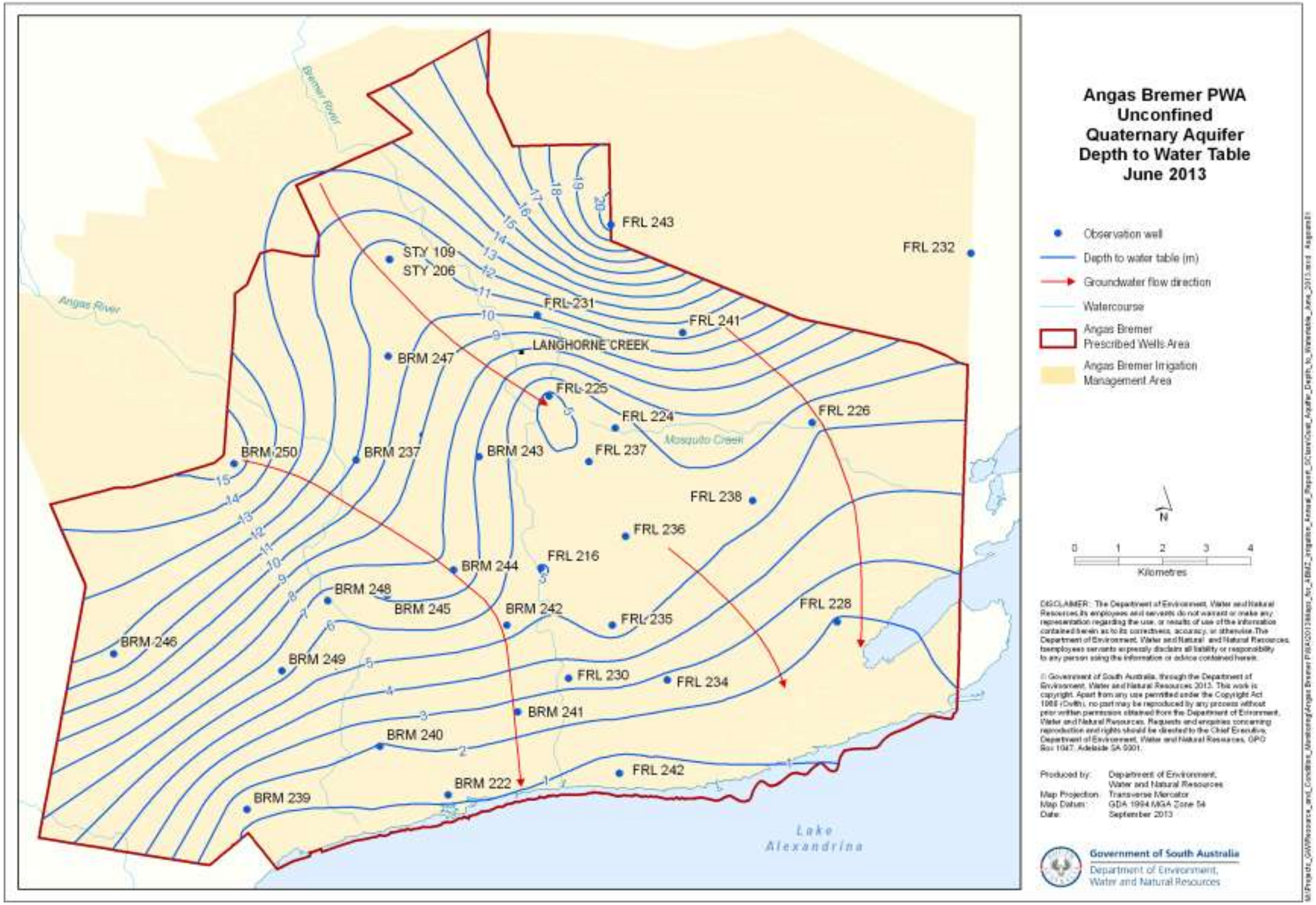


Figure 25b Standing Water Level in Quaternary Unconfined Aquifer June 2013

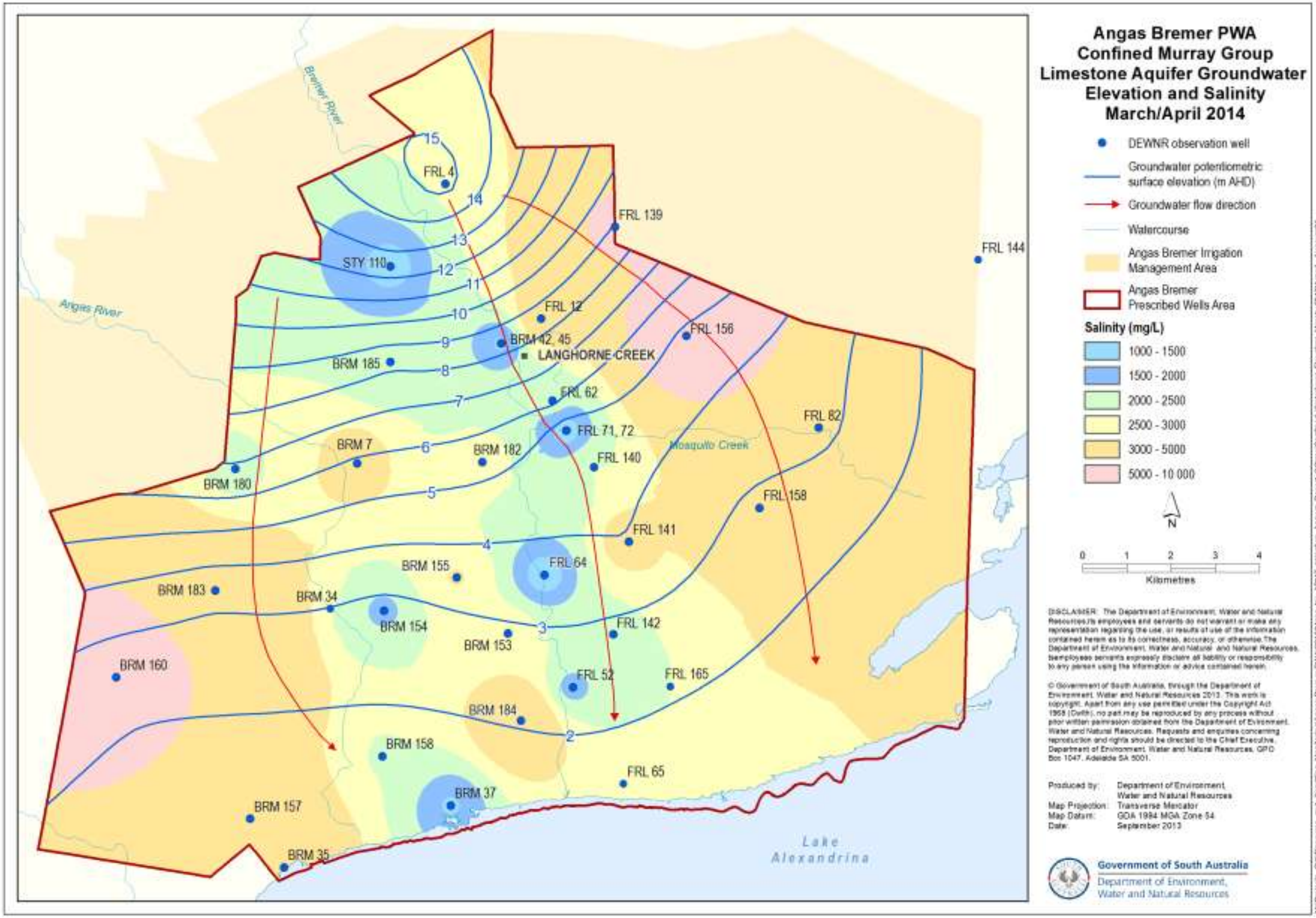


Figure 26a Water Level Elevation (m AHD) and salinity in Tertiary Confined Aquifer March 2014, Post Irrigation, (Obs. Well data)

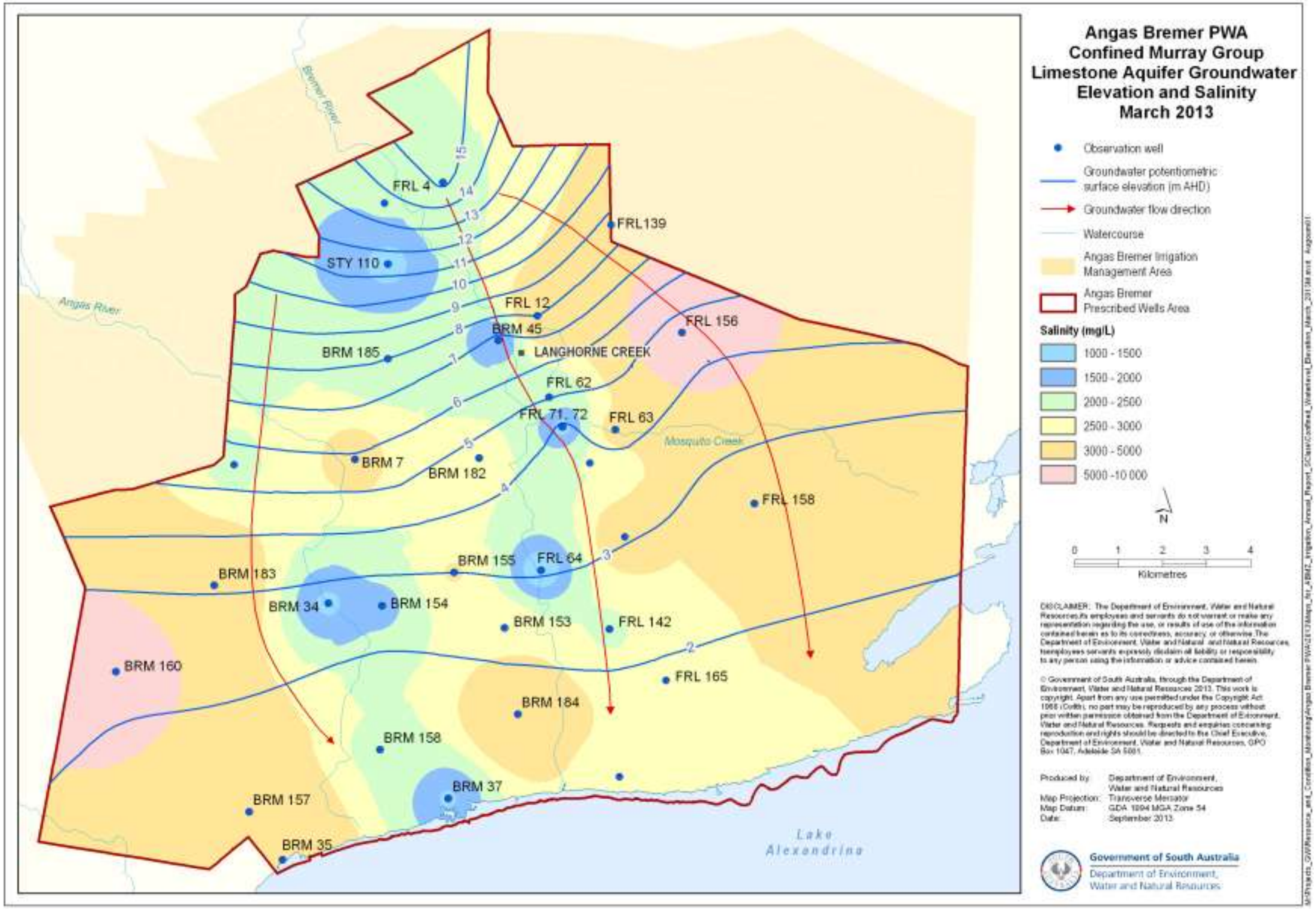


Figure 26b Water Level Elevation (m AHD) and salinity in Tertiary Confined Aquifer March 2013, Post Irrigation, (Obs. Well data)

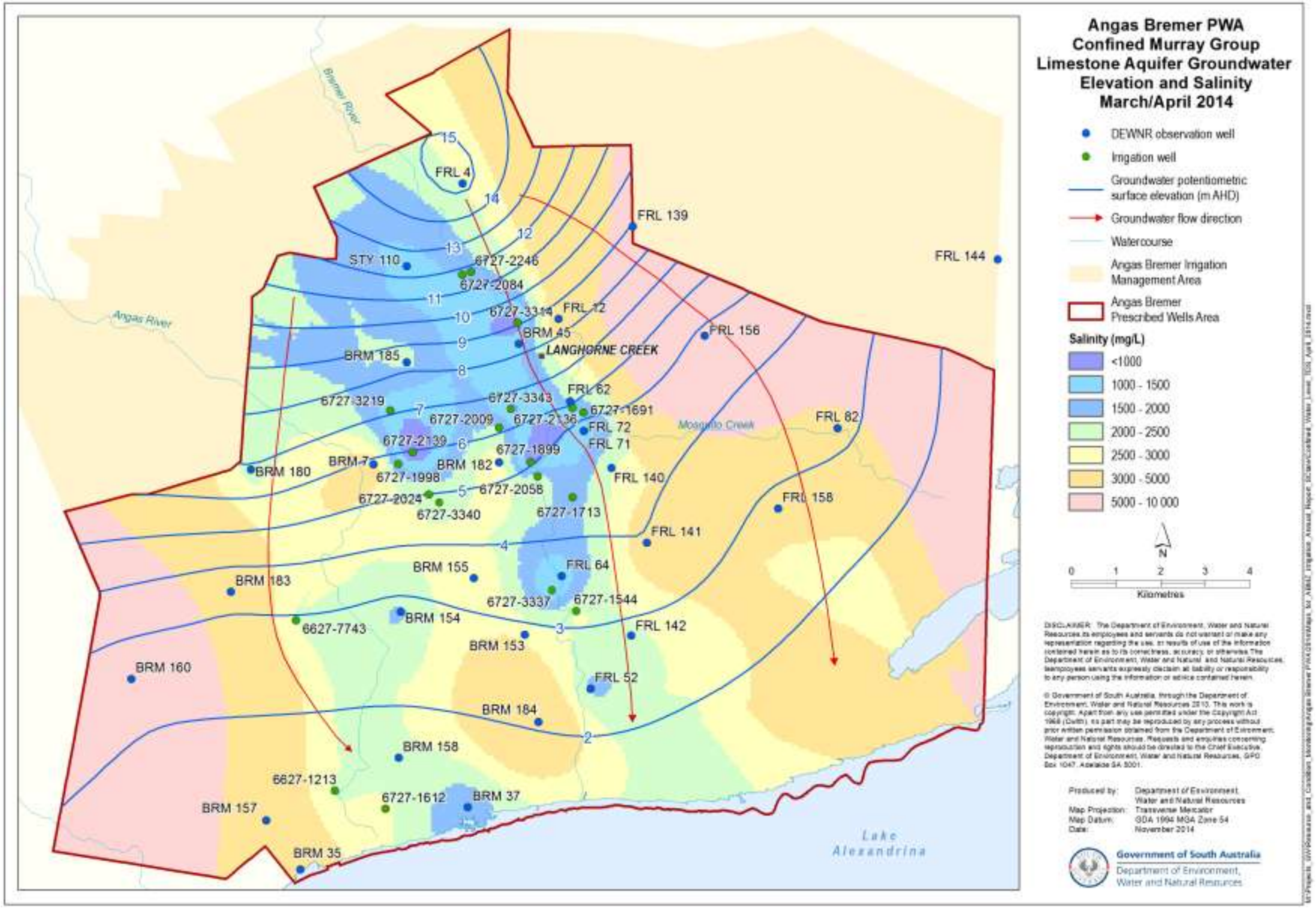


Figure 26c Water Level Elevation (m AHD) and salinity in Tertiary Confined Aquifer March 2014 Post Irrigation (data from Obs. Well and Irrigation Wells)

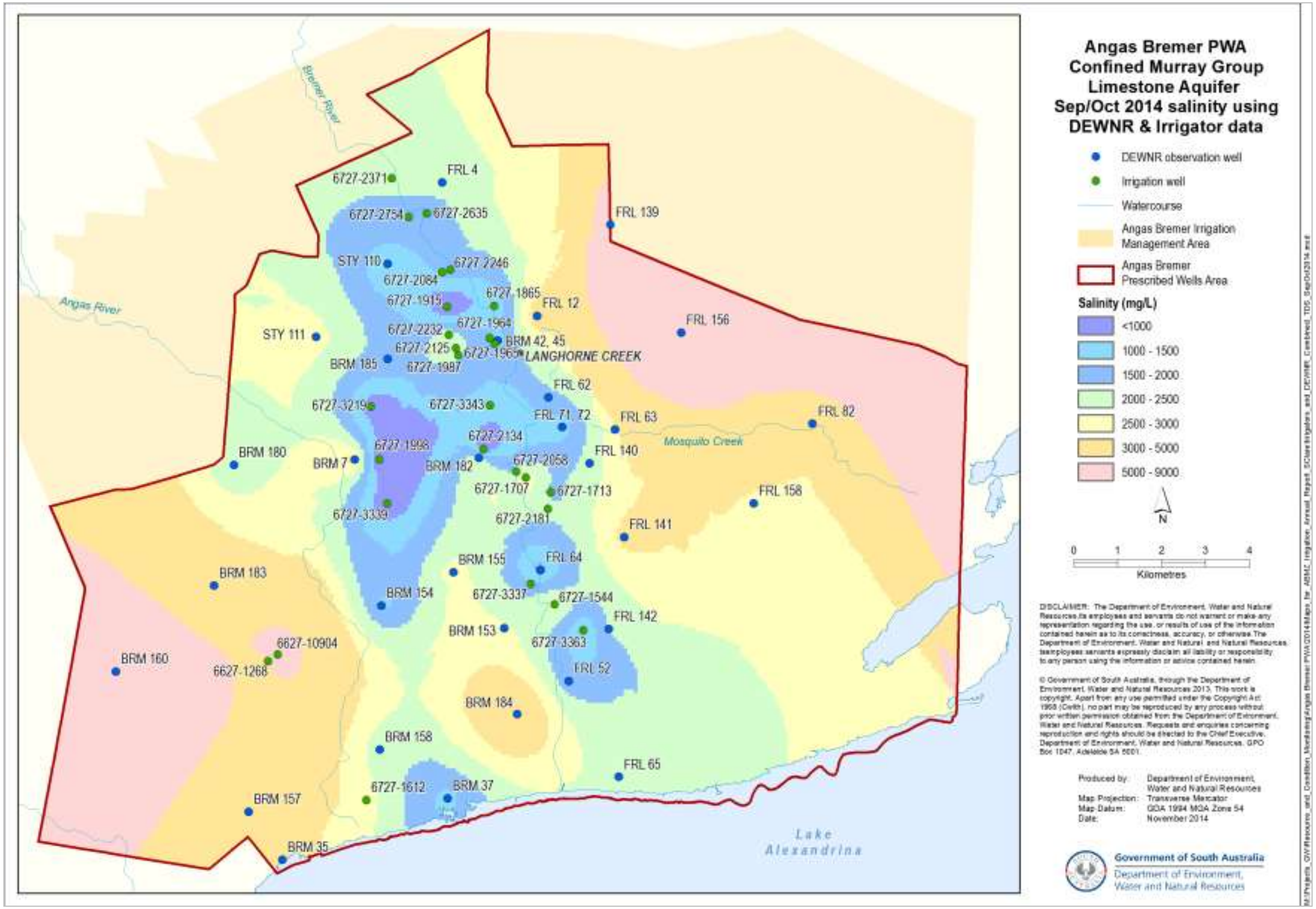


Figure 27a Salinity in Confined Aquifer samples from Govt Observation Wells and Irrigator's Water Samples Sept/Oct 2014

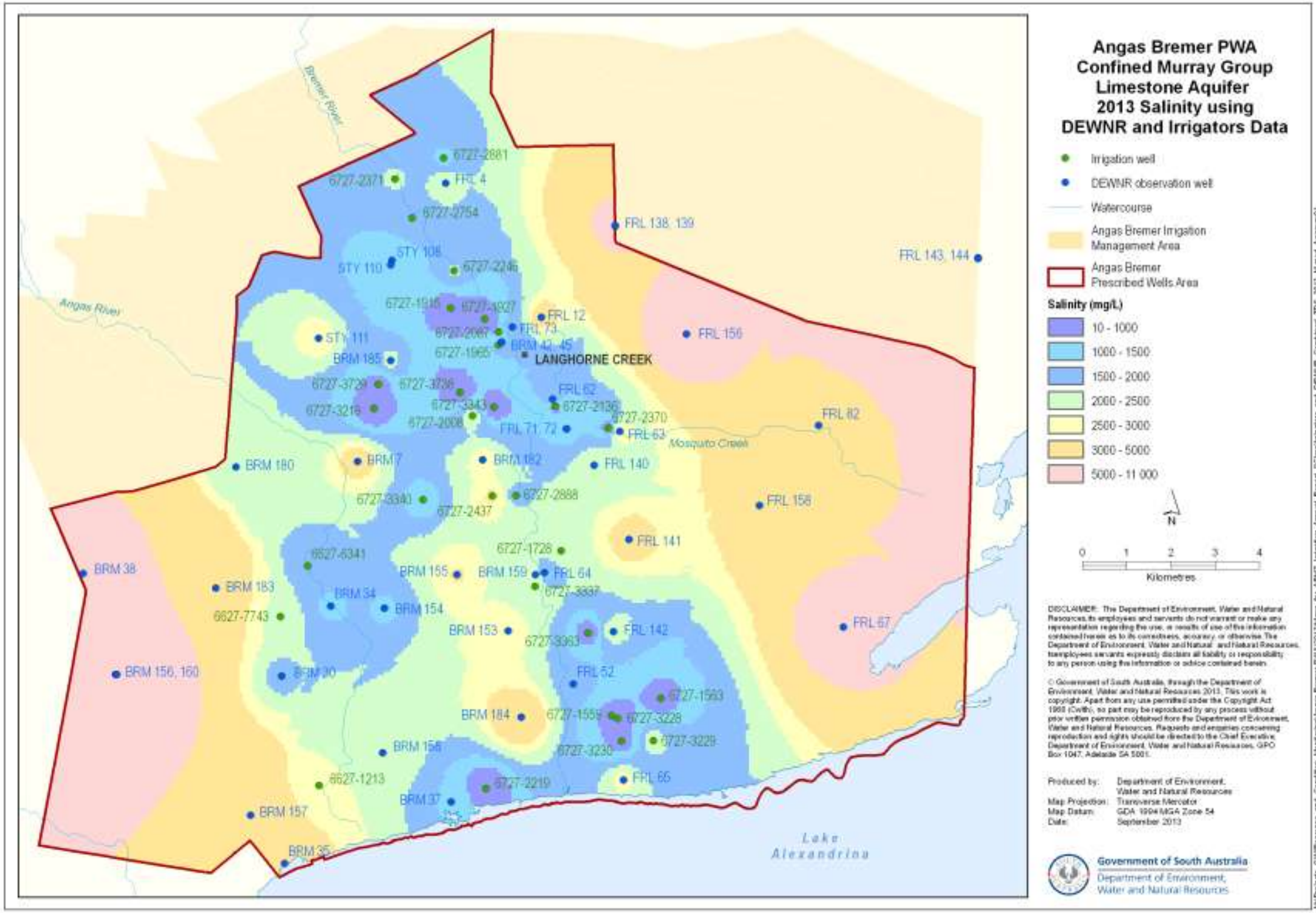


Figure 27b Salinity in Confined Aquifer samples from Govt Observation Wells and Irrigator's Water Samples Winter 2013

Langhorne Creek Weather Station Statistics

Michael Cutting, Natural Resources SA Murray Darling Basin

Background

An automatic weather station owned and operated by the SA Murray-Darling Basin NRM Board was installed at Lake Breeze vineyard in November 2006 and has been collecting local weather information since this time.
The Langhorne Creek station is part of an extensive automatic weather monitoring network operated by the SA MDB NRM Board consisting of 31 automatic weather stations and 7 rainfall only monitoring sites. All sites report data to a dedicated website on an hourly basis which is available for viewing at: www.aws-samdbnrm.sa.gov.au.

2013/14 Seasonal Summary

As illustrated in **Figure 28** 396.8mm of rainfall was recorded during 2013/14 (July – June) which was less than the 490.0 mm recorded in 2012/13
The 2013/14 evapotranspiration (ET) figure of 1,132.5mm was approximately 10% less than the level observed in 2012/13 but slightly above the five year average of 1,098.4mm.
The 2013/14 evaporative deficit (ET - rainfall) was 755.5mm which compared to a figure of 735.7mm in 2012/13.

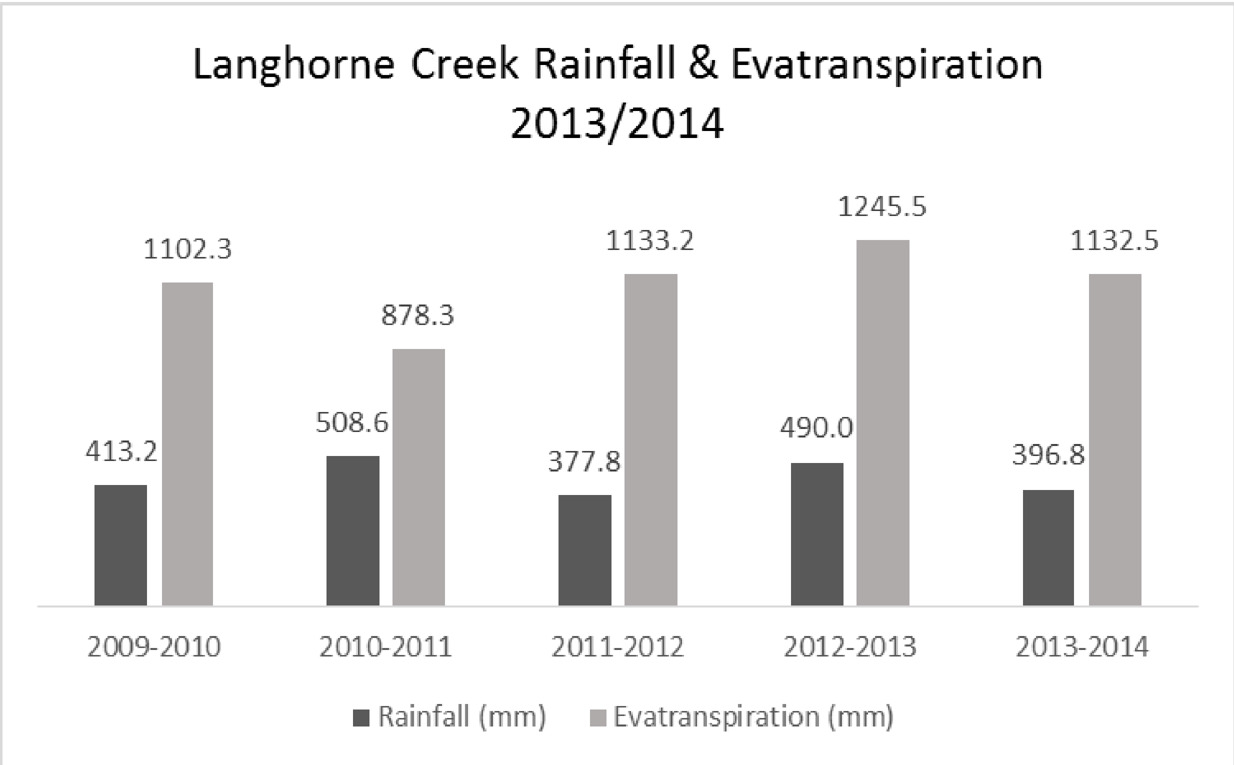
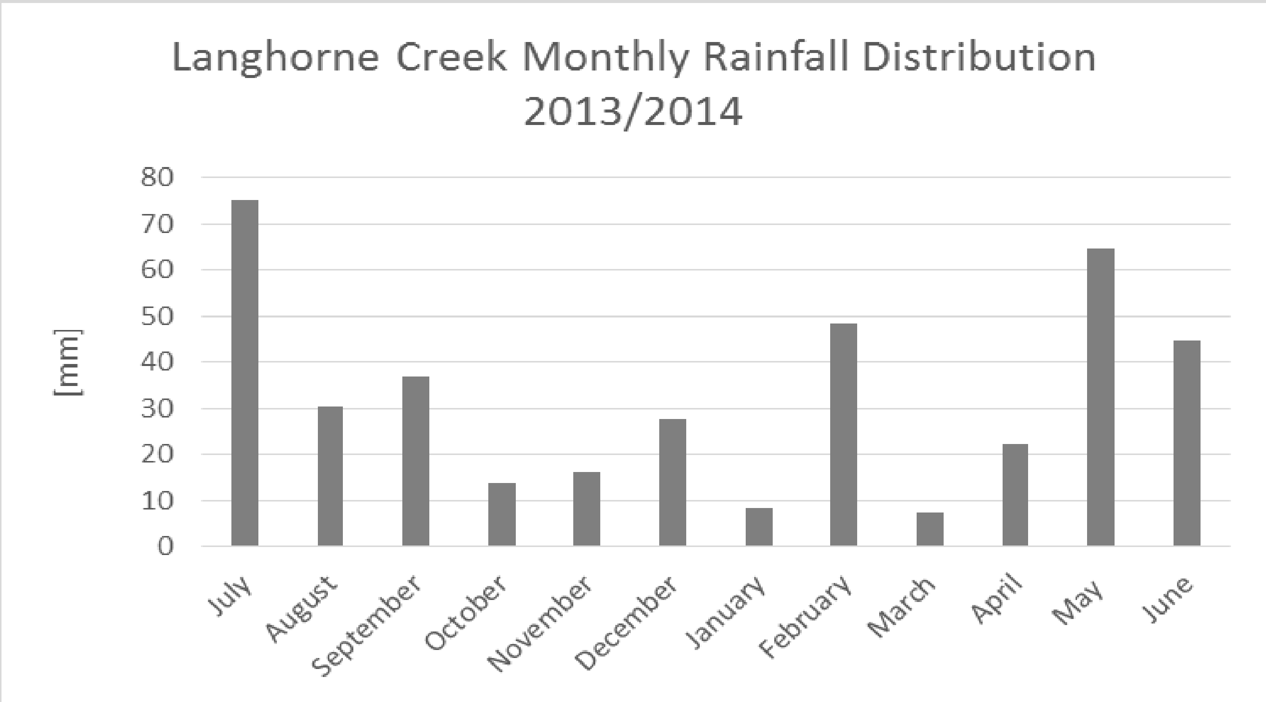


Figure 29 shows the distribution of rainfall during the 2013/14 irrigation season at Langhorne Creek. As was the case in 2012/13 the monthly rainfall distribution was generally more typical across the season although 36.4mm was recorded over the 13/14th February period which contributed to an above average February rainfall total of 48.4mm.



In terms of temperature extremes the hottest daily maximum recorded at the Lake Breeze site was 44.4°C on the 14th January 2014 and the coldest -1°C which was recorded on the 8th May 2014.

During 2013/14 there were 12 days of above 40°C recorded at the Lake Breeze weather station site with the average maximum summer temperature being 31.2°C.

The maximum daily evapotranspiration figure of 10.1mm was recorded on the 28th January 2014.

Angas Bremer Water Management Committee Inc Annual Public Meeting Minutes

25th August 2014
Langhorne Creek Hall Supper Room

Attendees: Sylvia Clarke, Enys Watt (DEWNR), Ken Scott (DEWNR), James Peters (Natural Resources SA Murray Darling Basin/DEWNR), Brett Ibbotson (Natural Resources SA Murray Darling Basin/DEWNR), James Stacey, Mac Cleggett, Rob Giles, George Borrett, Dale Wenzel, Barry Potts, Loene Furler, Geoff Warren, Brett Phillips, Terry McAnaney, Brett Cleggett, Nick McDonald, Darren Aworth.

Apologies: Jarrod Eaton (DEWNR), Lyz Risby (Natural Resources SA Murray Darling Basin/DEWNR), Jeff Whitaker, Michael Cutting (Natural Resources SA Murray Darling Basin/DEWNR), Michael Clements.

Meeting open: 7:10pm

Opening address by Chairman James Stacey:
The Chairman acknowledged the contributions made by Cameron Welsh and John Follett to the Angas Bremer Water Management Committee and water management in the region. He expressed his sympathies of behalf of the ABWMC at the sad passing of these two men.
The Rootzone Salinity project is continuing with a few dedicated sites but with more advanced technology being used. Richard Stirzaker will provide the ABWMC with a report shortly.
The committee has been liaising with the NRM Board and State Government regarding the River Murray and Eastern Mt Lofty Ranges Water Allocation Plans. A new Cover Crops Trial project has started and the Revegetation Project funded through the Commonwealth Government Biodiversity Fund is now complete.
The chairman thanked the ABWMC members and staff for their work over the year and announced that the SA MDB NRM Board has agreed to fund the committee for the next 2 years.

Brett Ibbotson (SA MDB NRM Board): Presented an update of the Eastern Mt Lofty Ranges Water Allocation Plan.
See attached slides (Appendix A).
There are 960 water users in the EMLR who will be licensed. The NRM Board is currently looking at ways of dealing with getting low flows to the rivers and are wanting ideas from the community on how to tackle this issue. The government is moving to self-reading of meters. Water users have 6 months to install meters and will need to submit their meter readings on-line (or via telephone). Currently those in low-demand zones and the flood diverters don't yet need a meter.
Mr. Stacey asked when the tricky ones will know about their license and whether levies have been collected yet? Mr Ibbotson responded that the issuing of the tricky licenses is imminent, and levies have already been collected from those who have a license.
Mr. Mac Cleggett asked Mr. Ibbotson who was to pay for a second meter if the first breaks down. The response was that it was a user pays systems and the water user will have to pay for it.

Ken Scott, (DEWNR): Presented an update on the Angas Bremer Licensing Project
See attached slides (Appendix B).
The DEWNR water licensing team is currently trying to get licenses to the 'tricky people'. The legislation requires that a volume is needed for each license. A rigorous method is

needed to work out these volumes and DEWNR need to liaise with the community to work out how best to do it. A meeting was held in Langhorne Creek at the end of July with the flood irrigators and flood diverters. It became obvious that there is a complicate system of moving the water around in this area. A second meeting is proposed for the 15th of September to work out how to calculate the volumes. From there, volumes will be determined and licenses will be issued by the end of the year.
Mr. Mac Cleggett asked who attended the meeting. Mr. Scott responded that about 30 people attended including pumpers and diverters. Invitations were sent out to about 70 people on their database.
Mr. Geoff Warren asked why the meeting wasn't advertised publically, as there were some people who receive flood water who didn't know about it.
The DEWNR licensing staff said that would like to know about any people who were missed and they would update their database. It was pointed out that those who receive water via natural flood events only, do not need to be licensed if they are not actively taking the water. But if they are interested they are welcome to come along to the next meeting.
Mr. Warren explained that these people have been told that they cannot get the water off their land and they cannot use the water for irrigation. Both these landholders had purchased the land since the initial surveys. Mr. Warren was then asked to pass on Ken Scott's details so that licensing could be discussed with them.
Ms. Loene Furler asked if those interested in redgum swamps could attend the next meeting and this was confirmed.
Mr. Nick McDonald queried how difficult it was to change the legislation instead of having to work out volumes for flooding. The response was that the Minister doesn't see it as a priority.
Mr. Mac Clegget asked whether there will be metering for flood diverters. Mr. Scott said the Board will discuss this at their October meeting and decide then. The Board meetings are public and the next one will be in Berri.

James Peters (SA MDB NRM Board): Presented an update on the River Murray WAP
See attached slides (Appendix C).
James Peters outlined the current amendment process and the key policy areas under review. A 3 month community consultation process will begin shortly and carry over to the New Year. There are 14 draft policy papers available on the website. The River Murray WAP is a transitional WAP and needs to be compliant with the Basin Plan by 2019. It is likely that there will be another review before 2019. The River Murray Advisory Committee and the NRM Board have chosen their preferred option for each policy area. The Board is seeking comments now and will run a series of public meetings.

Enys Watt (DEWNR): Presented the 2013 Groundwater Status Report.
See attached slides and report (Appendix D).
1996 ML was extracted from groundwater bores in 2013. The Groundwater levels in the observation wells were variable, with some going up and some down, when compared with last year. The status reports can be accessed through the Waterconnect website. The Angas Bremer district received 'Green Status' for 2013 indicating there is a negligible risk to the resource. There was a minor increase in groundwater level overall and a minor decrease in salinity.
Mr. Mac Cleggett queried why the aquifer was measured each year when it changes every year as water from the River Murray or Angas or Bremer is put in.
Ms. Enys Watt responded that this was to look for long-term trends. Aquifer recharge should improve the salinity over time and increase the water levels of the aquifer. Steve Barnett says the MAR is having a positive result.
Mr. James Stacey stated that it is good to see where the data is going and that it can now be used and seen.

Sylvia Clarke: Presented the 2013-14 Interim District Irrigation Annual Report.

Mr. Mac Cleggett pointed out that the theoretical crop requirement that Angas and Bremer users are being allocated is 2.1ML/ha but some are using over 3. He queried whether 2.1ML was the maximum allowed.
Ms. Kelly Gill (DEWNR) replied that irrigators will need to make up the rest from other sources. 2.1ML/Ha is the maximum from the Angas and Bremer based on use of sprinklers.

James Stacey: Presented the ABWMC Financial Report on behalf of the Treasurer
See attached audit report.

Official Business:
5 members were due to retire by rotation – Michael Clements, Nick McDonald, Darren Aworth, Loene Furler and Dale Wenzel.
All agreed to stand for renomination.
No formal nominations for other committee members had been received prior to the meeting.
Nominations were called from the floor. None were received.
The Chair moved that the renominating members be accepted for positions on the committee.
Seconded – Mac Cleggett. Carried by the meeting.

Other Business:
The ABWMC logo is currently being reviewed and will be discussed at the next committee meeting.
Mr. Rob Giles voiced concerns that even though we know that the long-term future of the aquifer depends on recharge, the amount going back into the aquifer has dropped off in the last couple of years. Incentives have worked well in the past and he would like the committee and the government to work on that again to encourage more aquifer recharge. He noted that it is dropping off at the moment because irrigators have access to good water but they will wish it was underground if a drought comes again. He suggested working on a plan for the next drought by banking it now.
The chairman agreed to put this on the agenda for the next meeting and to work with government to achieve this.
The chair noted the good attendances at meetings this year and thanked everyone for attending the APM. The ABWMC staff and committee members were also thanked for their efforts.

Meeting closed at 8:35pm

Audited Accounts 2013-14

ANGAS BREMER WATER MANAGEMENT COMMITTEE INC.

AUDITOR'S REPORT

Scope

I have audited the accounts of the Angas Bremer Water Management Committee Incorporated for the period ended 30th June, 2014 as set out on pages 1 to 3.

The accounts are a special purpose report and have been prepared on the basis explained in the Notes to the accounts. The Committee is responsible for the preparation and presentation of the accounts and the information they contain. I have conducted an independent audit of the 2013/2014 figures as shown in the accounts in order to express an opinion on them to the Committee members.

My audit has been conducted in accordance with the Australian auditing standards to provide reasonable assurance as to whether the accounts are free of material misstatement. My procedures included examination, on a test basis, of evidence supporting the amounts and other disclosures in the accounts, and the evaluation of accounting policies and significant accounting estimates. These procedures have been undertaken by me to form an opinion as to whether, in all respects, the accounts are presented fairly in accordance with the accounting policies as described in the Notes to the accounts.

The audit opinion expressed in this report has been formed on the above basis.

Audit Opinion

In my opinion, the accounts of the Angas Bremer Water Management Committee Incorporated are properly drawn up: (i) So as to give a true and fair view of the state of affairs of the Association as at 30th June, 2014 and the operations of the Association for the period ended on that date; and (ii) are in accordance with accounting standards that are applicable to the Association as a non-reporting entity.

....

Michael W. J. Perrey
Certified Practising Accountant

127 Swanport Road,
Murray Bridge
SA 5253

Signed at Murray Bridge this 5th day of August , 2014

ANGAS BREMER WATER MANAGEMENT COMMITTEE INC.

INCOME & EXPENDITURE STATEMENT

FOR THE YEAR ENDED 30TH JUNE 2014

		2014		2013
INCOME				
AB Business Plan	20,000.00		10,000.00	
AB Business Plan - Other	-		10,030.00	
SEWPAC	81,500.00		12,450.00	
Building on Water Quality Proj 118.2013	-		1,000.00	
Interest	27.06		76.92	
Newsletter	545.45		-	
Rural Incentives Grant Cover Crops	6,636.36		-	
Web Upgrade	1,000.00	109,708.87	-	33,556.92
EXPENDITURE				
2012 Salinity Man Promo		750.00		7,500.00
2012 Salinity Man Promo - Other		8,145.44		
AB Business Plan exp				
Advertising & Promotion	221.67		170.62	
Audit	548.00		295.45	
Insurance	2,574.92		2,504.42	
Meeting Costs	4,737.93		3,090.51	
Postage & Stationery	1,379.92		735.46	
Printing	1,378.64		923.64	
Project Coordinator	17,880.42		14,827.23	
Travelling	388.50		287.92	
Windows 7 Upgrade	200.00		-	
Other	-	29,310.00	23.18	22,858.43
Retained Funds expense		306.30		1.20
ASR Water Quality - Risk Ass		-		754.22
Biodiversity Project				
Contractor	57,972.75		10,092.50	
Equipment	9,794.41		630.48	
Postage	16.36		21.82	
Project Coordinator	18,449.60		13,973.99	
Seeds	12,952.86			
Stationery	123.81		183.41	
Travelling	1,132.88	100,442.67	1,216.36	26,118.56
Building on Water Quality		1,050.00		-
Cover Crops		3,111.82		
LC Rootzone Salinity		88.50		3,993.23
TOTAL EXPENDITURE		143,204.73		61,225.64
NET INCOME/(DEFICIT)		$(33,495.86)		$(27,668.72)

ANGAS BREMER WATER MANAGEMENT COMMITTEE INC.

BALANCE SHEET

AS AT 30TH JUNE 2014

	2014	2013
ASSOCIATION FUNDS		
Balance 1/07/13	59,242.82	86,911.54
plus Net Income/(Deficit)	(33,495.86)	(27,668.72)
Balance 30/06/14	$ 25,746.96	$ 59,242.82
Represented by:		
ASSETS		
Current Assets		
Cash & Bank Accounts	19,679.48	59,545.58
Tax Control	6,067.48	
TOTAL ASSETS	25,746.96	59,545.58
less LIABILITIES		
Current Liabilities		
ABN Withholding	-	7.34
Tax Control	-	295.42
Total Current Liabilities	-	302.76
TOTAL LIABILITIES	-	302.76
NET ASSETS	$ 25,746.96	$ 59,242.82

Angas Bremer Irrigators Revegetation Association Inc. 2013-14

ABIRA met on Wednesday 8th October 2014 at Rosemount Estate, Langhorne Creek.

Present : John Cranwell, David Kohl, Nicole Clark, Mick Burns, Wayne Sutton, and Sylvia Clarke

Treasurers Report: Balance 29/8/14 $20421.88 less insurance $1910.15 = $18511.73

Office Bearers: Chairman: Mick Burns
Vice Chairman: Mark Gilbert
Secretary: John Cranwell
Treasurer: Nicole Clark

Licence Agreements / NRM Management Agreements:
The Legal agreements between landowner & government, landowner & ABIRA, Irrigator & ABIRA, were never signed due to the River Murray WAP and the Eastern Mount Lofty WAP requiring ABIRA to have a legal interest in the land. This 'legal' requirement has now been removed from the wording in the WAPS so that ABIRA now only needs 'written consent from the landowner' allowing use of the land.

The Eastern Mt Lofty WAP was adopted by the government at the end of 2013 and the River Murray WAP is being revised and should be signed off by the government in early 2015. So the agreements should now be fine to go ahead.

Sylvia Clarke advised that NRM are holding $8000 in their account for ABIRA and this could be used for legal costs if new contracts / agreements need to be rechecked by lawyers.

The agreements have been sent to Crown Solicitors to be rechecked. Mick Burns / John Cranwell will notify Irrigators & Land holders in writing of new developments.

Other Business:
Jeff Whittaker will be approached to see if any up-keep is required on any of the sites.

As there is over $18,000 in our bank account that is receiving minimal interest, it was decided that $15,000 should be invested (best rate 12 months or less).

Next Meeting: Wednesday 29th July 2015 at Rosemount Office, Langhorne Creek

Appendix A – Eastern Mt Lofty Ranges Water Allocation Plan Update – Brett Ibbotson, SA MDB

Eastern Mount Lofty Ranges Water Allocation Plan Update

ABWMC Annual Public Meeting
Langhorne Creek Town Hall
25 August 2014

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EMLR WAP

Quick history

- **October 2003** Notice of Prohibition and Notice of Intent to prescribe water resources in the EMLR came into effect
- **September 2005** Regulation to prescribe water resources of the EMLR came into effect
- **May 2011** Draft Plan released for public consultation
- **December 2013** Adoption of the EMLR WAP by the Minister

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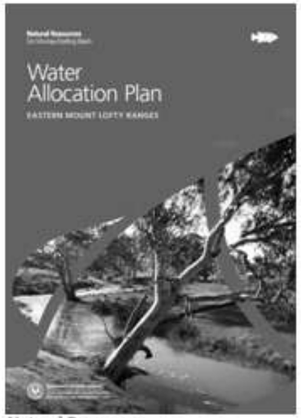
Where are we up to?



The focus is now on the implementation of the EMLR WAP.

This includes a number of individual projects including:

- *Existing user licensing*
- *Securing low flows*
- *Strategy to manage high demand*
- *Metering*

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Existing user licensing

- 960 existing users identified in the EMLR

As of the 14th August 2014

- 840 Proposed license packages have been issued
- 612 Actual license packages have been issued

However

- Remaining licenses to be issued are the most complicated

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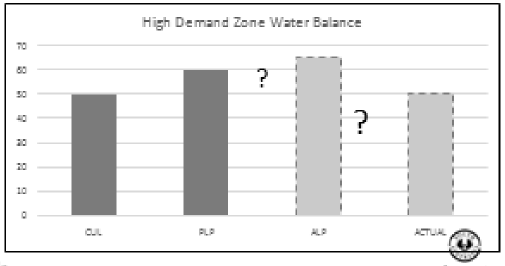
Securing low flows

- Development of trials
- Ideas from the community
- Not limited to low flow bypasses – could be a non-engineered or behavioural solution
- Intend to run competition

Strategy to manage high demand

- Project development
- Dependency - issue of ALP's to confirm allocation volumes and determination of actual use



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Metering

- Self-reads initiated – 400 of 600 licenses have responded – some licensee's yet to install meters
- Deferred position on metering – green zones (low demand) and Angas Bremer flood diverters

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Summary

- Implementation of EMLR WAP is happening
- Some issues still to be resolved
- Coordination of community engagement important
- We will be seeking further input and collaboration

Effective water planning in the Eastern Mount Lofty Ranges will be demonstrated if, in 10 years time, the community of water users:

- *Actively participate in and support effective management of their water resources*
- *Willingly meet or exceed minimum standards*
- *Understand and use the tools available to them*

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Questions or concerns?

Brett Ibbotson

Senior Project Officer

(Water Allocation Planning and MERI)

08 8391 7507

0428 205 298

Brett.Ibbotson@sa.gov.au

Mount Barker Natural Resources Centre, Upper Level, Corner Mann & Walker St

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Appendix B –Angas Bremer Licensing Project Update- Ken Scott, DEWNR

Licensing flood water use in the lower Angas and Bremer Rivers

ABWMC Annual Public Meeting
Langhorne Creek Town Hall
25 August 2014

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Water licensing process

Licensing process in the Eastern Mount Lofty Ranges (simplified):

1. Prescription of resource.
2. Issue of area-based authorisations.
3. Issue of licenses with a volumetric allocation.

Most water users in the Eastern Mount Lofty Ranges have been issued water licenses – exceptions include Lower Angas-Bremer flood diverters.

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Water licensing process

Licensing process in the Eastern Mount Lofty Ranges (simplified):

1. Prescription of resource.
2. Issue of area-based authorisations.
3. Issue of licenses with a volumetric allocation.

Angas Bremer Flood Irrigators are here

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The issue

- Licenses need to give volumetric allocations (as per the Act).
- Intent is to recognise historical practices (flood diversion).
- Information required from the flood irrigation community to determine the volume of water allocated for flood diversion.

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What's been done to date

- Background research.
- Targeted stakeholder meeting in Langhorne Creek (28 July 2014).

Objectives:

a) Inform stakeholders about the water licensing process; and

b) Seek information from the flood irrigation community to assist in calculating a flood diversion allocation volume.

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Summary of meeting

- Participants indicated that the goal of flood irrigation is to fill the soil profile, water red gum swamps, flush salt and provide water for neighbours.
- Levee banks have been constructed to achieve desired inundation patterns.
- Goals depend on the specific flood event.
- Observed during a field visit the next day.

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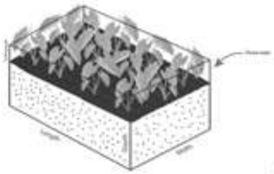
Summary of meeting (cont.)

Stakeholders provided us with suggestions and information which may assist in determining an allocation volume:

- Target soil wetting depth (area x depth calculation);
- Available water divided by the flooded area; and
- Actual estimates (local knowledge).



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Where to from here?

- Investigating methods for calculating flood allocation volumes.
- Summary of first meeting to be sent out to stakeholders.
- **Second stakeholder meeting scheduled for 15 September 2014.**
- Determine actual allocation volumes.
- Issue of licenses by end of year.

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SA Murray-Darling Basin
Ken Scott
Phone: 8463 6846
Email: kenneth.scott@sa.gov.au
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Appendix C –River Murray Water Allocation Plan - James Peters, SA MDB NRM

River Murray Water Allocation Plan

Update on the amendment process & key policy areas

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Amending the River Murray WAP

- The initial River Murray WAP was adopted in 2002 and there have been minor amendments since this time.
- The River Murray WAP is now being amended to update the science and policy content – mainly to include policies which were developed after 2002, and which operate outside the WAP.
- A draft WAP is expected to be released for formal public consultation in the coming months.

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Amendment Process

There are six stages in the amendment process of the River Murray WAP:

- A concept statement is developed that outlines the proposed content of the WAP.
- The community is given opportunities to help make decisions about the content of the concept statement.
- Based on the decisions made about the concept statement, a draft WAP is prepared.
- The community is again part of the decision making regarding the draft WAP.
- Based on the decisions made about the draft WAP, a final WAP is developed that is submitted to the Minister for Sustainability, Environment and Conservation for consideration.
- The adopted WAP is reviewed within five years to ensure it is still meeting the needs of the environment and the community.

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Amendment Process - Consultation

- Policies have been reviewed to ensure they are fit for purpose – with input from the River Murray Advisory Committee (RMAC) – a community based committee assisting with the WAP amendment process.
- Draft policy papers have been prepared with assistance from RMAC – these provide background into issues and a recommended policy position.
- Key stakeholder sessions held December 2013 to seek industry feedback on policy options.
- Draft policy papers are available online for broader community review – seeking feedback now .
- Draft WAP will be released in coming months for formal public consultation – a minimum 2 month consultation period.
- Comments on policies will be sought until the close of formal consultation.

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Basin Plan Requirements

- The Commonwealth Murray-Darling Basin Plan provides an overarching plan for water management in the Murray-Darling Basin.
- The amended River Murray WAP is considered a transitional water allocation plan. It will not be fully Basin Plan compliant, but needs to be 'no less consistent' with the Basin Plan than the current River Murray WAP.
- The Water Resource Plan for the SA River Murray will include the River Murray WAP and Basin Plan compliance is required by 2019. A further review of the River Murray WAP will occur to work towards Basin Plan compliance.

Key Policy Areas

- Salinity Management
- Dry Allocations Principles
- Private Carryover
- Environmental and Wetland Water

Salinity Management

- Salinity zoning policy has been in place since 2003 to manage the impact of irrigation on water quality while maximising development.
- Under the Murray-Darling Basin Agreement, South Australia needs to account for salinity impacts.
- Proposed to leave salinity boundaries for low and high salinity zones as they are for 2014 WAP, then review data and potentially update boundaries for the 2019 WAP.
- Salinity impact is managed through site use approvals. Conjunctive changes can be made in high impact zones while further development is allowed in low impact zones.
- Proposed to cease prior commitment (documented commitment to development prior to 2003).

Dry Allocations Principles

- Provisions for the allocation of water resources during periods of low water resource availability (dry periods) is a recognised gap in the current River Murray WAP.
- A new allocation framework is required to provide greater transparency, consistency and predictability in allocation decisions during dry periods, and to ensure consistency with the requirements of the *NRM Act 2004*, *Water Act 2007* (Cth) and the Basin Plan.
- A set of high level proposed dry allocation principles have been developed which will guide the allocation of water during periods of low water availability.
- Moving forward a detailed administrative policy will be developed.

Private Carryover

- A Private Carryover policy was introduced during the drought – allowing unused allocations to be taken and used during the following water use year
- This provided a mechanism to supplement heavily restricted allocations
- Proposed to be incorporate the policy into the River Murray WAP with minor changes
- South Australia has the right to store water for private carryover in upstream storages – providing carryover water from year to year will be dependent on storage factors, risk of spill, water availability for following year etc
- When stored water is available for carryover – the policy is applied and allocations issued to eligible account holders, based on unused water
- A volume up to a maximum of 20% of the SA Water Access Entitlement held, can be 'carried over'
- Changes to policy include – interstate allocations eligible; minister must make carryover announcements public; carryover allocations subject to restrictions on trade (as would apply to all allocations)

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Environmental and Wetland Water

- Development of the Basin Plan has involved extensive investigation and consideration of Environmental Water Requirements (EWR's), building on existing knowledge
- Basin Plan requires development of 1) annual environmental watering priorities and 2) long term environmental watering priorities to meet environmental water requirements identified for the SA River Murray
- The River Murray WAP includes policy provisions to protect water dependent ecosystems through ensuring the security of environmental water
- 200GL is allocated to water for wetland watering purposes
- Proposed to amend the current list of wetlands to a generalised geographical area to ensure all wetlands are captured
- Also proposed to include principles that support the flexible use of unregulated flows for ecological outcomes

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How Can You Be Involved?

- Your feedback on the proposed policies for the draft WAP is welcome now. Draft policy papers are available online for review (www.naturalresources.sa.gov.au/samurraydarlingbasin).
- The SA Murray-Darling Basin NRM Board will be actively seeking further comments through a formal consultation phase in the coming months. All comments provided now and during the formal consultation phase will be considered prior to finalising the WAP.
- If there are any policies or other issues you would like to discuss, please let us know. We are available to provide information and we want your feedback!

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Thank you for your participation.

Further information and feedback:

Peta Brettig
Senior Project Officer, River Murray Water Allocation Plan

Natural Resources, SA Murray-Darling Basin
GPO Box 2834
Adelaide SA 5001

Phone: (08) 8463 6877
Mobile: 0439 824 477
Email: rmwap.feedback@sa.gov.au

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Appendix D– AB Groundwater Status Report - Enys Watt, DEWNR

Angas Bremer Prescribed Wells Area

Murray Group Limestone Aquifer

Groundwater Level and Salinity Status Report 2013

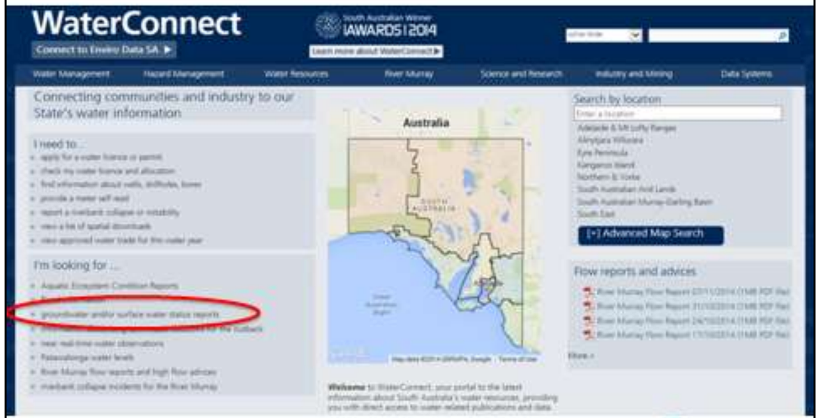
Government of South Australia
Department of Environment, Water and Natural Resources

Groundwater Level and Salinity Status Reports

- Prepared for all prescribed areas in SA
- Snapshot of groundwater levels and salinity for that particular year
- Can be accessed from the WaterConnect website at

  www.waterconnect.sa.gov.au

Government of South Australia
Department of Environment, Water and Natural Resources



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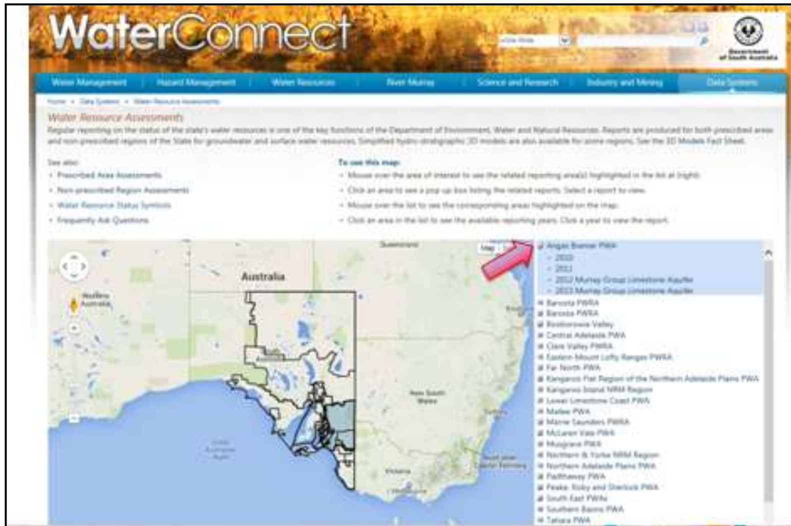
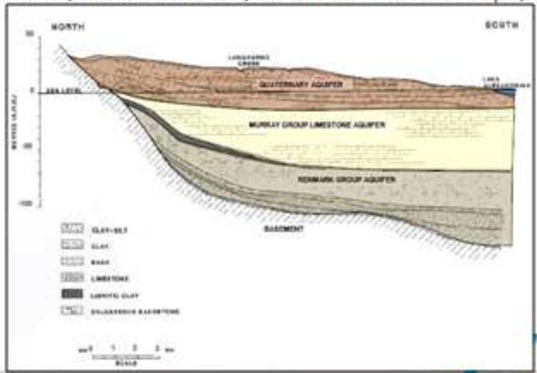
Department of Environment, Water and Natural Resources



Government of South Australia
Department of Environment, Water and Natural Resources

Angas Bremer PWA

- Three aquifers: Quaternary (unconfined), Murray Group Limestone (MGL; confined) and Renmark Group (confined)



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Murray Group Limestone Aquifer

- Almost all licensed groundwater extractions
- Up to 100 m thick
- Varies from soft clayey limestone to hard sandy limestone and soft fossiliferous limestone layers
- Irrigation supplies generally obtained from the fossiliferous layers
- Lower salinities (<3000 mg/L) limited to narrow zones parallel to Angas and Bremer Rivers

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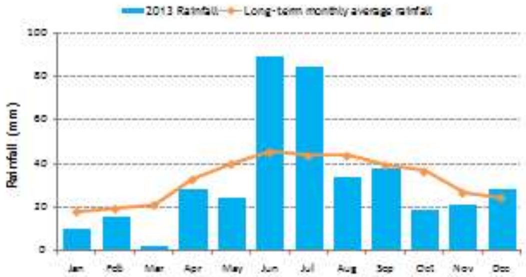
Rainfall

- Langhorne Creek station recorded 396 mm in 2013
- long-term average of 390 mm
- 445 mm in 2012



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Groundwater Use

- Licensed groundwater extractions (including MAR water) totalled 1996 ML for the 2012-13 water-use year
- 13 ML more than 2011-12
- MAR was 1511 ML, a 3% decrease

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Groundwater level trends

- Highly influenced by extractions and MAR
- Long-term trends:
  - decreasing or stable levels from 1970 to early 1990s
  - increasing or stable levels from early 1990s to 2005
    - significant reduction in extractions in response to increased availability of River Murray water sourced from Lake Alexandrina
  - decreasing levels from 2006 to 2009
    - extractions increased in response to decreased availability of River Murray water due to access and salinity problems caused by the 2006 drought
  - increasing levels from 2010 to 2012
    - flood water flowing into the lake and two new pipelines from the River Murray reduced demand on groundwater
    - significant volumes of MAR water injected into the aquifer (2010 & 2011)

Groundwater level trends

- In 2013:
  - Levels were variable
  - 58% of observation wells recorded an increase in the maximum recovered groundwater level when compared to 2011 groundwater level data
  - 42% recorded a decline in the maximum recovered groundwater level
    - Extractions and MAR similar to previous water-use year; likely return to average conditions after increase the previous year from the decrease in extractions

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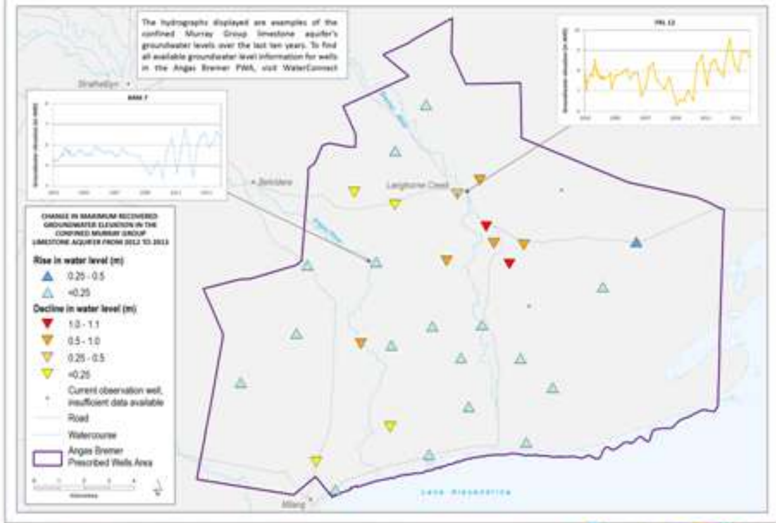

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Groundwater salinity

- Increases in salinity identified as the main threat to long-term sustainability of irrigation
- Downward leakage from Quaternary aquifer primary cause
- Lateral groundwater flow also a contributor
- Downward leakage and lateral flow are greater during periods of high extraction on both a regional and local scale
- Long-term trends
  - decrease since mid-1990s
  - increase after 2006
  - decrease in 2010 and 2011

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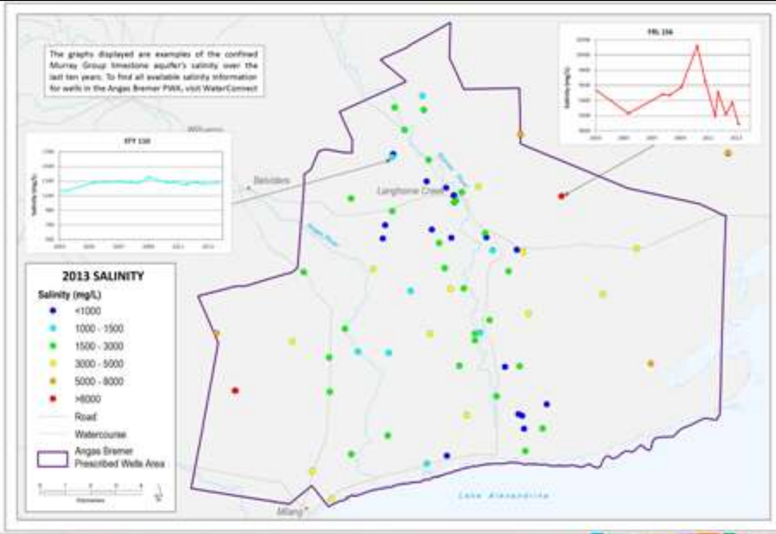
Groundwater salinity

- In 2013:
  - 49% of observation wells recorded a decrease in groundwater salinity when compared to 2012 salinity data
  - ~86% of observation wells recorded a salinity of greater than 1500 mg/L



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2013 Status

"No adverse trends, indicating negligible risk to the resource"

- This means that the groundwater status was observed to be stable (i.e. no significant change) or improving over the reporting period. Continuation of these trends favours a very low likelihood of negative impacts on beneficial use.
- The 2013 status for the MGL aquifer is supported by:
  - A minor overall increase in the maximum recovered groundwater level when compared to 2012 water level data
  - A minor overall decrease in groundwater salinity when compared to 2012 salinity data
- The use of the MGL aquifer for the storage of water that is of adequate water quality, which can later be extracted during irrigation season, enables the continued beneficial use of this aquifer.

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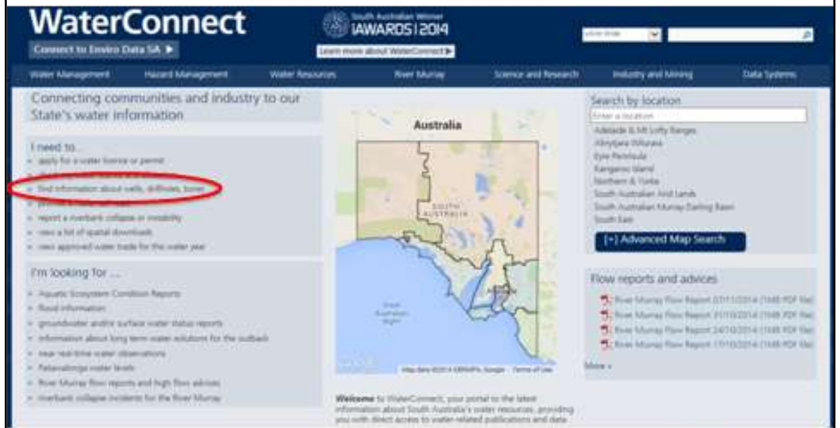

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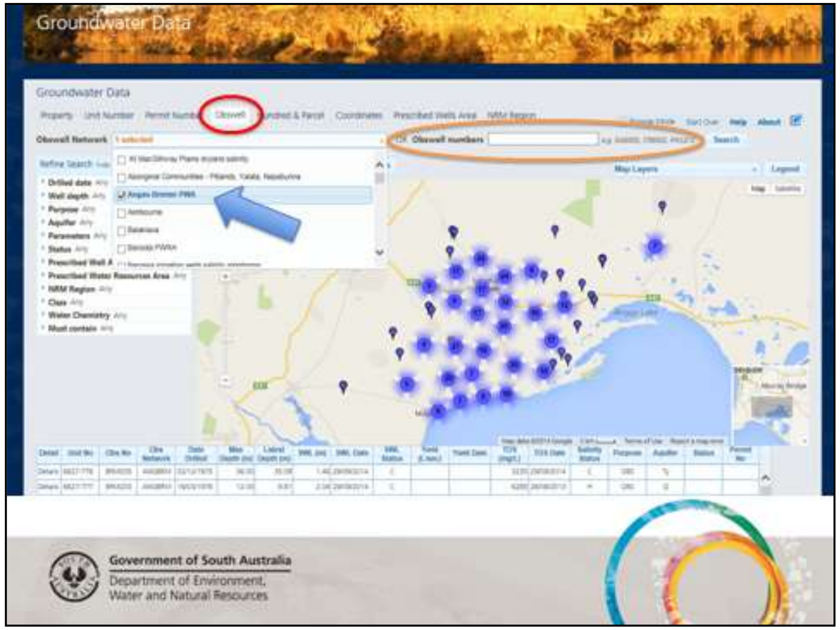
Groundwater Data
Government of South Australia
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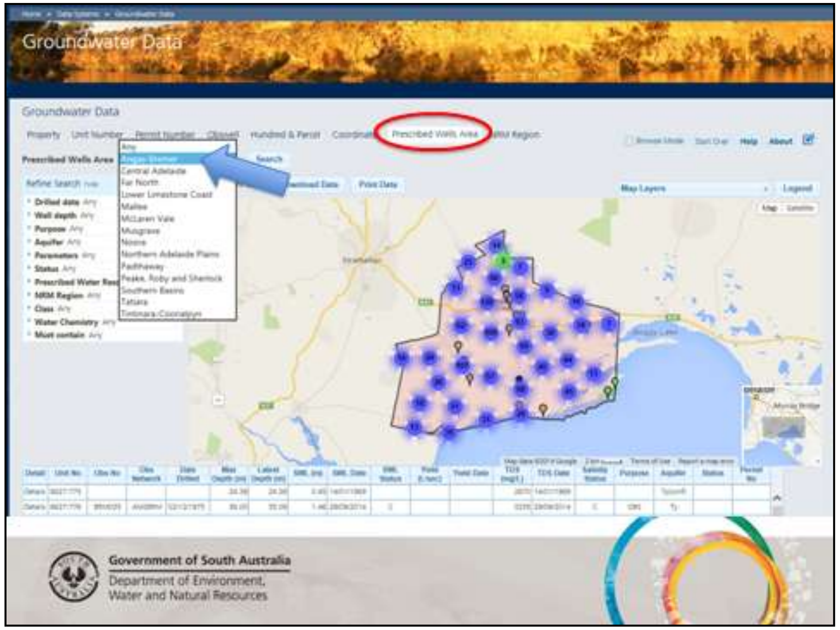
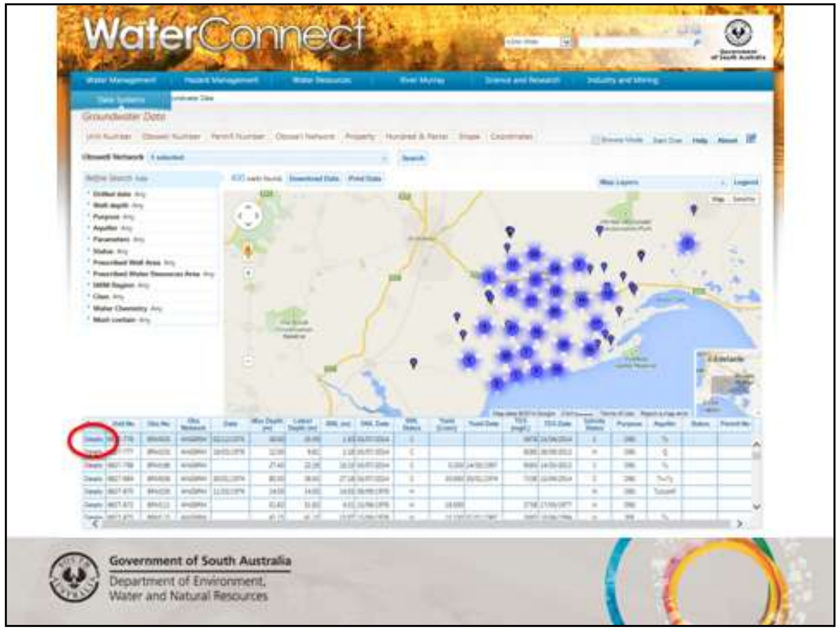
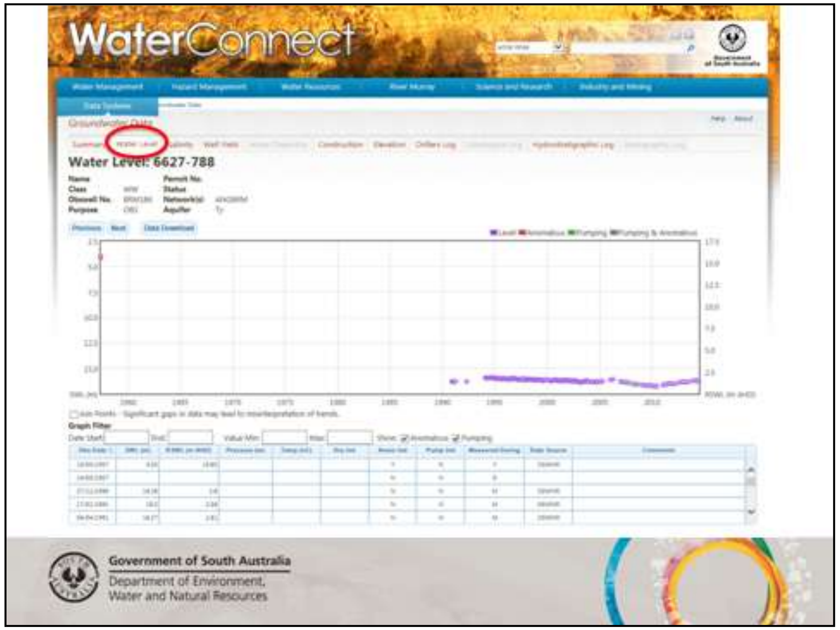

Groundwater Data
Government of South Australia
Department of Environment, Water and Natural Resources


WaterConnect
Government of South Australia
Department of Environment, Water and Natural Resources


WaterConnect
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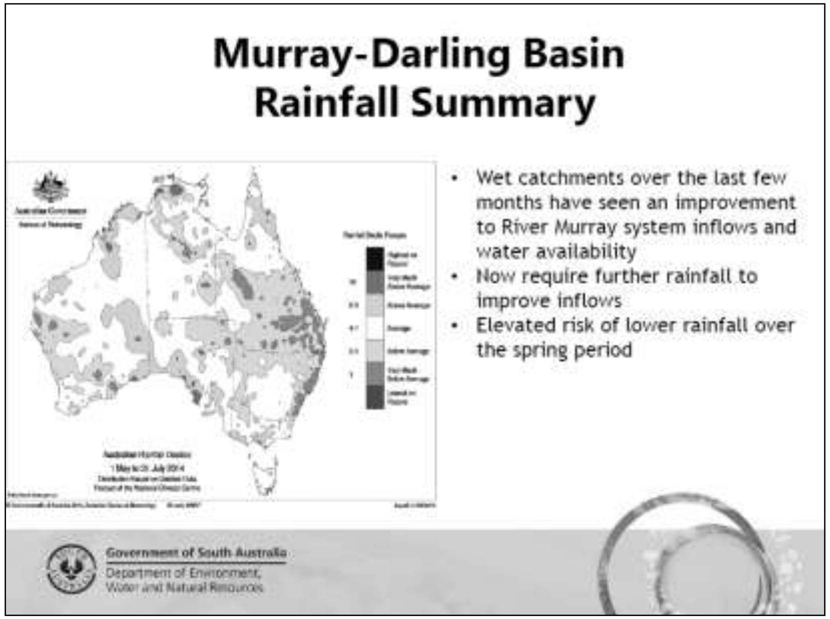
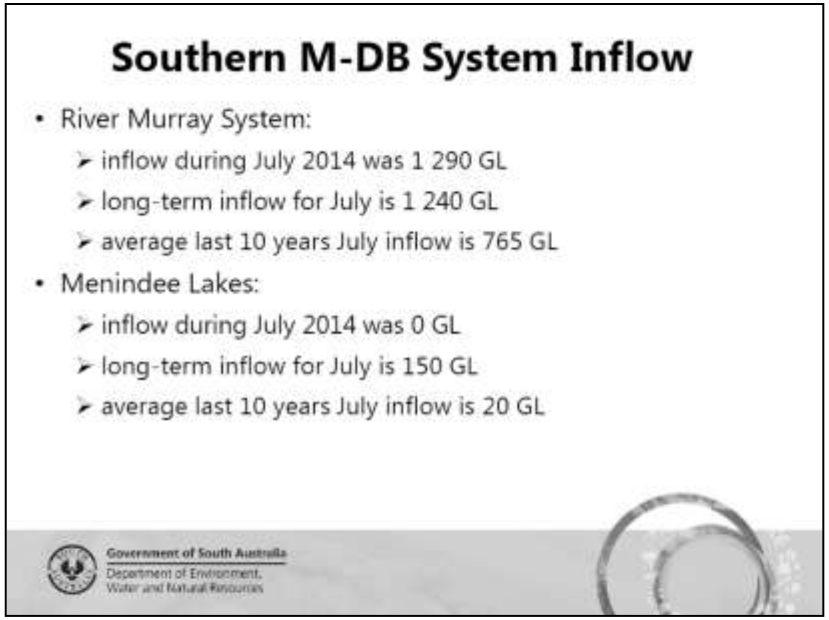
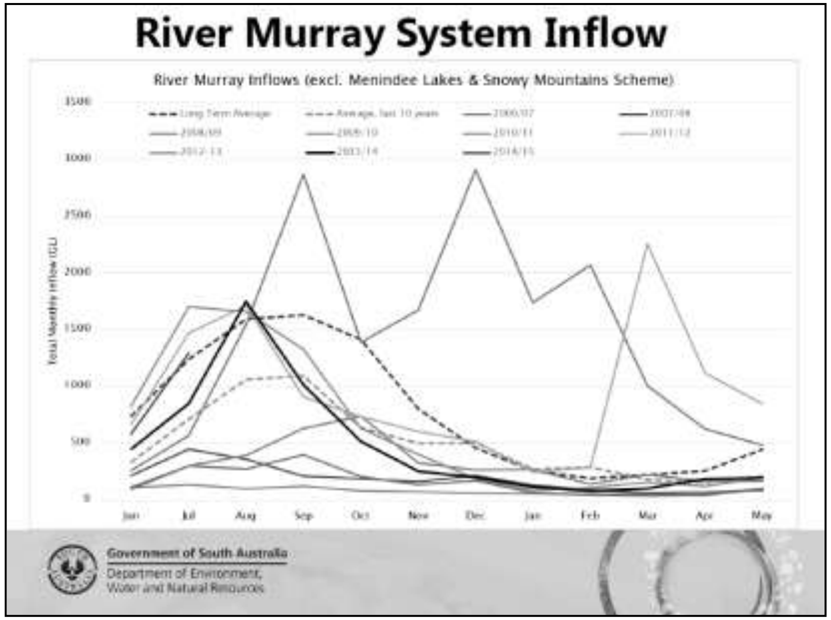
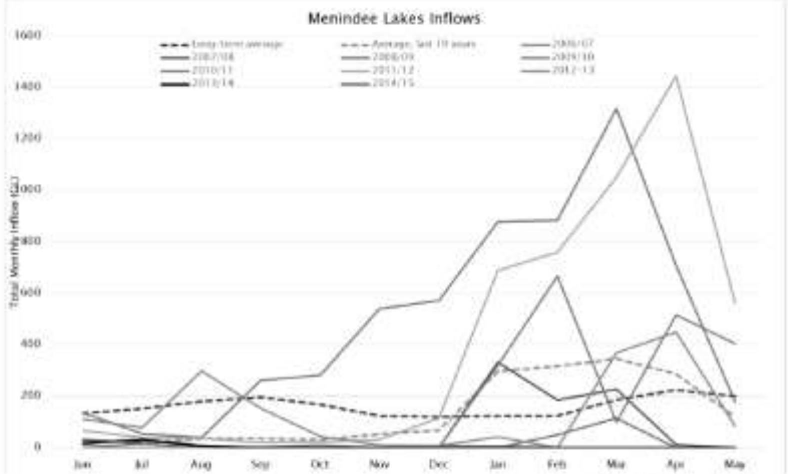
Appendix E – Murray-Darling Basin Summary- Jarrod Eaton, DEWNR







Menindee Lakes Inflow



River Murray System Tributary Storages

On 12 August 2014

Goulburn River

Lake Eildon = 2 870 GL (86% capacity)

Murrumbidgee River

Burrinjuck Dam = 765 GL (74% capacity)

Blowering Dam = 1 157 GL (70% capacity)

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MDBA Controlled/Operated Storages

Storage	Full Supply Volume (GL)	Mid August 2014 (GL)	Mid August 2013 (GL)	10 year average (end Aug) (GL)	Long-term Average (end Aug) (GL)
MDBA Storages (Hume, Dartmouth, Lake Victoria and Menindee Lakes*	9 269	6 790 (73%)	8 280 (89%)	4 940 (53%)	7 127 (77%)

- Current storage volumes less than at the same time last year due to lower inflows and high water demand over summer and autumn 2014
- The volume of water currently held in storage includes carryover and some small reserve volumes for 2014-15

* Menindee Lakes have reverted back to NSW control

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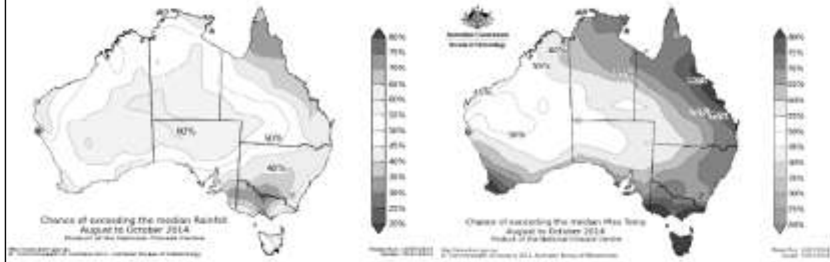
BoM 3 Month Weather Outlook



The national outlook for August to October 2014 indicates:

- A drier than normal season is more likely for south eastern Australia
- Warmer days are more likely for much of eastern Australia.
- Climate influences include a brief negative Indian Ocean Dipole, and near-average Pacific waters

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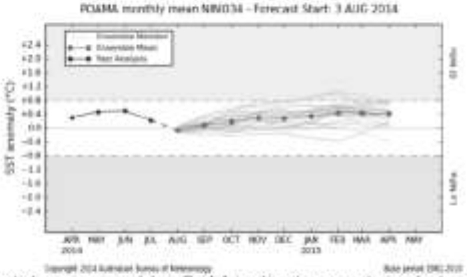
ENSO Outlook



- Climate models surveyed by BoM indicate a reduced chance of El Nino occurring in 2014, approximately 50%.
- Some cooling has occurred in the central and eastern Tropical Pacific Ocean with the key NINO regions returning to neutral values
- The Indian Ocean Dipole (IOD) is currently negative, but is likely to return to a neutral state by spring.
- Positive IOD events often coincide with El Niño.

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SA Deferred Water Storage

- DEWNR deferred and stored 49.6 GL of Entitlement Flow for Critical Human Water Needs and private carryover in 2013-14
- The majority of stored is held in Dartmouth Reservoir (currently 42.9 GL – assigned as 29.6 GL of Entitlement Flow in storage in Dartmouth for CHWN and 13.3 GL for Private Carryover
- 6.6 GL previously stored in Lake Victoria (but not transferred upstream) has spilt from Lake Victoria (noting no water was allocated by the Minister for private carryover in 2014-15)
- Lake Victoria is currently being filled to FSL in line with the Lake Victoria Operating Strategy in response to unregulated flow event SA is not planning to defer Entitlement Flow for any purpose in August 2014 due to unregulated flow and the high risk of spill from storage
- The risk of spill from Dartmouth Reservoir has increased in recent weeks in response to good inflows
- DEWNR will pursue opportunities to increase the stored volume in 2014-15 when conditions permit

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State Water Allocations 2014-15

- State water allocations for 2014-15
- NSW have increased allocations for general security entitlements on the River Murray to 17% (and 97% for high security). The general allocations for NSW tributaries include:
  - Murrumbidgee 26%
  - Lower Darling 100%
- Victoria have increased allocations for High Reliability Water Shares (HRWS) on the River Murray to 84% and for the following Victorian Tributaries:
  - Broken 46%
  - Bullarook Creek 30%
  - Campaspe 100%
  - Goulburn 100%
  - Loddon 100%
- The Minister for Water and the River Murray has announced SA Water Access Entitlement Holders will receive 100% allocation

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Flow to South Australia

- Flow to SA in July was 215 GL compared to 105 GL last July (long-term average 630 GL)
- Flow to SA is currently around 14 GL/day and will recede fairly rapidly over the next two weeks back to Entitlement Flows in September of 4.5 GL/d
- Flow to SA currently consists of:
  - August Entitlement Flow of 124 GL plus
  - Unregulated flow
- Undertaking a weir pool water level raising at Locks 1 and 2 – this raising is within the normal operating range of full supply level (FSL) to 300mm above FSL.
- Further raisings may occur – being undertaken under the Riverine Recovery Project weir pool manipulation project

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Lakes Alexandrina and Albert

On 22 August 2014

Lake Alexandrina

Average water level is +0.74 m AHD

Average salinity is 800 EC

Releases currently ~12 000 ML/d

Lake Albert

Average water level is +0.76 m AHD

Average salinity is 2 200 EC

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Lower Lakes and Barrage Management

- A short-term water level cycling event has been undertaken at the Lower Lakes to assist with improving water quality within Lake Albert
- Water levels have been maintained at around 0.85 m AHD for a week to improve water exchange between Lake Alexandrina and Lake Albert
- Water levels are currently being lowered to target 0.70 m AHD, with the potential for further lowering depending on the duration of unregulated flow
- Following the water level raising event, operations will continue to target a minimum releases rate of 2 GL/day (including fishways), prioritising releases through the Goolwa and Tauwitchere barrages
- Recent bathymetric surveys suggest there has been some sediment deposition on the Goolwa Channel arm of the Murray Mouth
- DEWNR, MDBA and SA Water are currently discussing Murray Mouth management issues and a paper is being prepared for the Basin Officials Committee

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Lower Lakes and Barrage Management

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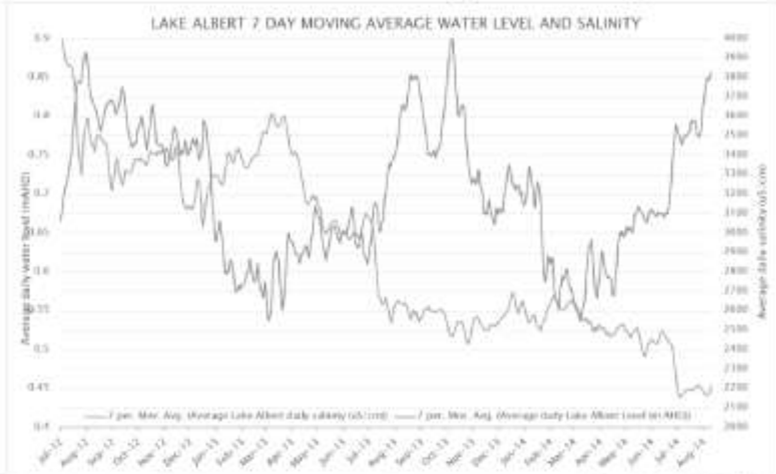
Lower Lakes and Barrage Management



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Summary

- Climate forecasts are trending towards drier conditions in the coming months, however the probability of EL Nino conditions developing have decreased
- There is still a risk that without major improvements in water resource availability (inflows into the storages) in 2014-15 that water availability will be low at the start of 2015-16
- DEWNR is actively looking at opportunities to defer and store more Entitlement Flow for future carryover allocations during dry periods
- The 6.6 GL of deferred water held in Lake Victoria has spilt from storage
- SA is currently receiving unregulated flow in addition to Entitlement Flow
- Current operations at the Lower Lakes and barrages aim to improve water quality in Lake Albert through a small raising event. Unregulated flow is being used to determine the extent and duration of the draw-down phase

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Appendix F- Sustainable Water Governance- UNSW

Gabriela Cuadrado-Quesada and Cameron Holley, University of New South Wales

Gabriela Cuadrado-Quesada and Cameron Holley from UNSW Australia visited the Angas Bremer region as a part of their research on sustainable groundwater governance and water planning. Gabriela Cuadrado-Quesada is PhD Candidate and Cameron Holley is a Senior Research Fellow (DECRA) at the Faculty of Law, UNSW Australia. They are part of and received funding from the National Centre for Groundwater Research and Training (NCGRT) and the Connected Water Initiative Research Centre, UNSW Australia. Their research is also funded by the UNSW Law and the Australian Research Council.

Their research aims include (i) to identify innovative approaches to water management in Australia, New Zealand, United States and Costa Rica, with a particular focus on groundwater; (ii) to assess the operation of these innovative approaches and their ability to achieve sustainable and participatory outcomes; (iii) to develop legal and governance principles to guide policymakers and law makers to deliver improved groundwater and surface water outcomes in an effective, efficient and politically acceptable manner; and (iv) to investigate the challenges and implications that lessons from practice pose for theories of water governance.

The Angas Bremer region was chosen as part of their study because it is an area where the groundwater resource had been used beyond its sustainable limit but with recognised innovation by the community in collaborative water governance. Sixteen interviews were conducted with a sample of government and non-government stakeholders from the Angas Bremer region.

The report below summaries the findings on four key conditions that appear to contribute to the achievement of sustainable and participatory outcomes in the Angas Bremer region.

Crisis: facing a water crisis in the form of drought and rising salinity appeared to be fundamental to motivate water users and the community to cooperatively develop and implement a water management solution. As one interviewee put it: “The community was passionate and active and prepared to fight for their rights and their existence… the crisis forced us not to just sit back but I think the concept of the community was we’ll be part of the fix and part of how to fix it”.

Leadership: community leadership was fundamental to bringing people together, sustaining community engagement and ensuring local water users’ views were heard in water management decision-making. As expressed by an interviewee: “The community was very strong, we had some strong leaders and if the government said no, we didn’t accept that basically… We had a proactive community leaders and representatives of the community, so it was really good”.

It is also worth noting that leadership was linked to crisis, with the latter driving the former. As noted by another participant: “I think leaders arise when there’s a crisis, you know, somebody rises up and does the job, don’t they?, and if they‘re encouraged by the community and they can see they can get a result in if it’s a good hard fight they’ll keep going, but nobody rises up to be a leader if there is no crisis”.

Government funding/in-kind support: the involvement and the support that the committee received from governmental agencies was vital to ensuring the committee had sufficient information and staff. Both staff and information were central to assist with coordinating the community, identifying funding opportunities and implementing projects. As explained by an interviewee: “I always think, when we first started out the government support was really good, because departments provided people to do research. You know, like they provided the information to us, because local people are not qualified to provide the information apart from their general feelings about what they see on their own property".

Small and homogenous community: the small and tight-knit population of the Angas Bremer community reduced conflict and made it easier for everyone to reach agreement on common goals and work together in implementing solutions. As noted by one participant: "the success of it is partly this community… it's small, it's lots of generational people, who intend to be here for more generations and it gives them much more ownership…which I think can influence how successful things happened… so if it was a different region… history may have been different".

These four conditions appeared central to facilitating successful water management by the Angas Bremer Water Management Committee, leading to numerous positive actions including the implementation of aquifer storage and recovery, decreasing groundwater irrigation, and new conditions on water licences such as annual reports, monitoring wells, FullStop devices, revegetation areas and a code of practice.

The experience in the Angas Bremer district has been extraordinarily successful and it has proven that with community leadership and adequate involvement of governmental agencies it is possible to address water crises and achieve efficient and sustainable solutions.

Despite the aforementioned achievements, there are also signs that the Angas Bremer Water Management Committee is beginning to confront a number of challenges that threaten its ongoing success. First, there is a decline in community engagement in water management. This appears to be because as the issues that had sparked community involvement were resolved, many participants understandably saw very little reason to continue to invest time and energy in the process. As one respondent explained: "It is hard to get people on the committee. I think because things are back to smooth sailing again, through the drought we were busy, not busy but there was more pressure on us".

Second, the Committee is facing the common challenge of volunteerism i.e. lack of money and time of those who volunteer. In an added difficulty, the committee has been confronted by a third challenge: declining funding and support from government. As noted by a participant "I think you could summarise the committee's activities now as fighting for their existence to keep the door open...They spend most of the time applying for grants to keep the door open, paper shuffling".

Overcoming these three threats will require greater funding and support, which is vital to reducing cost to volunteers and ensuring a more effective organisation and implementation process. Fostering networks and sharing experience with other organisations may also assist the Committee in finding new alliances, new resourcing opportunities and sustaining community interest in water management.

Appendix G - Is the decision to trade temporary or permanent water titles drought induced? Evidence from the Murray-Darling Basin in South Australia- Griffith University

Excerpts from a report by Constantin Seidl, Griffith University.

Introduction

Under the climate change pretext, water security and agricultural production is one of the most pressing issues of the coming decades. This is also true for the Murray-Darling Basin, Australia's largest irrigated agricultural area. Water markets have traditionally been used to ensure efficient water allocation in this area, however, climate change puts these markets under stress. In order to keep the markets efficient, it is paramount to understand their fundamental drivers and trends, especially the connection between water entitlement and water allocation markets. This paper tries to establish links between water entitlement and water allocation trade based on data from the South Australian Murray-Darling region as a whole and the Angas Bremer irrigation district, which supplies irrigation water for grape and broad acre farmers close to Lake Alexandrina around the Angas and the Bremer Rivers. It uses transaction data from relevant water markets, combined with meteorological and dam storage data.

Water Trade in the Murray-Darling Basin - an Overview

Water markets have been in operation in Australia and specifically in the Murray-Darling Basin since the 1980s. The unbundling of property rights, especially the separation of land and water ownership are prerequisites to functioning water markets and preceded the introduction of Australian water markets. The rationale is that well-defined water property rights lead to allocation of water towards the highest economic use and that this will rid the system of allocation inefficiency and overallocation. This can be seen as the main reason why water markets were introduced in Australia, together with providing water users with opportunities to manage their water risk. However, as the Australian constitution firmly vests water management decision within the States' authority, there was historically a multitude of water markets and products in the MDB. Despite the variety in terms and specific legal definitions of water titles, there are two general forms of a tradeable water title: the "water allocation" and the "water entitlement".

According to the *Water Act 2007*, a water entitlement is the right to receive annual volume of water with a certain degree of security; e.g. 90% security entitlements will provide their full water volume in 90 of 100 years. A water allocation is a one-off water volume, administered on the basis of an underlying entitlement. Water allocations and entitlements can both be traded and are traded separately.

In accordance with the water users entitlement and its security, the responsible authority, mainly the state governments, decide on the basis of climatic and other factors, like rainfall, temperature, evaporation and available capacity in the water storages, what volume of water allocations will be administered. These volumes are tracked in the water accounts against the water extraction rates of the individual user. Users are required to balance their water accounts if they are in deficit. This is the entry point for allocation trades, as they are used to satisfy short term consumption or balance accounts. The availability of a carry-over policy from one water year to the next is also important.

The efficiency improvements delivered by the MDB water market are widely accepted and the benefits from water trade are estimated to be around $550 million annually for the whole basin. Yet, there are some overarching patterns of trade. Entitlement trade has historically always been, and still is, less than allocation trade. This can be attributed to the fact that entitlement trade is mostly used as an exit strategy from the irrigation market and also to the consistently higher prices for entitlements. For example, where high security entitlement prices were around $ 2000 per ML in 2010, allocation prices ranged between $ 60-120 per ML. Additionally, allocation trade is less complex than entitlement trade.

Another dynamic is that South Australia is always a net importer of water, mainly from the Murrumbidgee, NSW Murray and lower Darling region. This is mainly due to the perennial nature of most of South Australia's crops and the lack of state-owned storage facilities. During the "Millennium Drought" between 2002 and 2010, the prices in both entitlement and allocation markets sky-rocketed, reflecting the overall reduced availability of water resources. Although the drought is now over, the total volume of water traded in markets has contracted surprisingly little. The allocation market has actually expanded by 44% from 2012 to 2013 up to 6184 GL, giving strong indication that the market is becoming more mature and trading occurs also for different reasons than just securing water availability for agriculture. For example, at the height of the millennium drought in 2006/07, the sale of allocations often provided higher income than actual farm production, so many farmers shut down production and sold water instead. This was especially true for annual plantings like rice or cotton.

Although, as already mentioned, the MDB water markets function quite well, there are still considerable issues to be addressed which impede market efficiency including Climate Change, Environmental Buy-backs and Carryover, Water Account balancing and Trading Caps.

Conclusion

This paper investigated drivers and impediments to allocation and entitlement trade in the South Australian Murray-Darling Basin. For this purpose it used data for the whole of SA Murray and for the Angas Bremer Irrigation Management Zone. It was shown that the decision to purchase temporary water is a multilayered and complex process. For SA-Murray, there is strong evidence for a lagged climate component in entitlement trade, whereas current climatic parameters have little to no influence. In contrast, for the Angas Bremer region, entitlement trade is totally disentangled from direct climatic considerations. Allocation trade displays little direct climate dependency for Angas Bremer and for SA-Murray as a whole. However, both markets for both regions are heavily driven by structural market framework parameters like the allocation factor or the need to balance water accounts.

Especially the allocation factor can be seen as a proxy parameter for drought, as it is defined under considerations of historic water use, climate parameters, stored water volume and environmental conditions by the South Australian government. Therefore, this paper argues, that both entitlement and allocation markets are influenced by climatic conditions, not directly via temperature or rainfall benchmarks but indirectly by government regulations, available storage and overall market availability of relevant water titles.

However, the influence of structural market parameters far supersede the climatic influences. Especially the government environmental buy-backs under the Restoring the Balance policy totally skewed traded volume in the entitlement markets for the SA Murray region and likely had huge price implications for other stakeholders. The most important drivers for the allocation market in this paper are the need to balance, the allocation factor and a strong autoregressive component. Whereas the autoregressive component can be confidently attributed to market maturity, both allocation factor and the need to balance represent strong state intervention in the water markets. State regulators have to be aware of the immense distortion powers of these interventions, especially in terms of balancing requirements.

Allocation trades are totally driven by the December and June obligation to balance, and this creates strong possibilities for arbitraging in the market. From a market efficiency point of view, more frequent balancing requirements would be advisable, as they reduce the possibility for arbitrage and the very predictable peaks in allocation trade and prices in December and June. However, more frequent balancing has adverse effects for irrigators in the basin. It removes water trade and water use flexibility from stakeholders as their water account must be balanced more often during the water year. This can create enormous pressure for farmers as it increases the opportunity costs and time efforts for water trading and might drive stakeholders out of the market. Another problem is the periodic structure of farm income: Farm revenue typically only occurs after harvest with the sale of crops, whereas cost of production and of capital have to be paid all year round. More frequent water balancing will introduce another cost factor during the year prior harvest and could create serious cash-flow problems for some farmers. Consequently, stakeholders and water authorities have to engage in meaningful discussions to enable a water balancing structure, which can both improve market efficiency without creating strong adverse effects for farmers.

Although carryover mechanisms are not quantifiable in this studies' data, due to limited data availability and resolution, carryover policies have the potential to dramatically increase watermarket efficiency and stakeholder market participation, as sensible water use in one year is rewarded by higher water availability in the following water year. Carryover also creates strong incentives for integrated water-use management, spanning over the administrative boundaries of one water year. However, water carryover can again be an entry point for arbitrage as water rollover for financial and not water use considerations is possible. Meant as a tool to provide farmers with flexible risk management strategies, the current regulations regarding carryover actually seem to create more insecurity and inefficiency than providing the intended benefits for water market efficiency. Especially the federal nature and limited time frame of water carryover agreements between the basin states limits their effectiveness as a risk management strategy. With carryover policies only negotiated and announced on a year to year basis, they provide little benefit for strategic long and medium-term risk management. A holistic basin wide carryover regulation would be ideal to provide both planning security and water market efficiency and flexibility. This requires basin-wide multi-year carryover agreements as strong signals to irrigators, notwithstanding possible cut-off policies relating to physically available storage in the Basin's water reservoirs.

Although this paper provided some meaningful insights in water market drivers, further research is needed to fully investigate the link between climate, entitlement markets and allocation markets. In particular, high resolution water price data and water trade data from different regions of the SA-Murray, as well as from other important irrigation areas in the Murray-Darling Basin could contribute greatly to the understanding of the subject. More sophisticated statistical methods, especially for quantifying the influence of market maturity will help to identify demand and supply side effects of traded water titles, isolated from a time-related general expansion of water markets. Notwithstanding the limited scope of this study, it is clear that South Australian water markets are substantially affected by government intervention and regulations, potentially impeding water market efficiency. Governing bodies have to be aware and careful with the application of water market regulations in order to ensure continued water market efficiency and limited market bias and distortions. A further deregulation of the market, especially in regards of carryover limitations and environmental buy-backs, for example in form of allocation trade instead of high security entitlements, has great potential to meaningfully contribute to water market participation and efficiency.

If you would like a copy of C. Seidl's entire report, please contact the Angas Bremer Water Management Committee's project officer.