TECHNICAL NOTE 2007/10

Department of Water, Land and Biodiversity Conservation

CURRENCY LIMESTONE GROUNDWATER MANAGEMENT AREA - STATUS REPORT 2007

Steve Barnett

August 2007

ISBN 978-1-921528-01-9

Preferred way to cite this publication

Barnett S, 2008, *Currency limestone groundwater management area – status report 2007,* DWLBC Technical Note 2007/10, Government of South Australia, through Department of Water, Land and Biodiversity Conservation, Adelaide.

Knowledge and Information Division

25 Grenfell Street, Adelaide

GPO Box 2834, Adelaide SA 5001

Telephone	National	(08) 8463 6946
	International	+61 8 8463 6946
Fax	National	(08) 8463 6999
	International	+61 8 8463 6999
Website	www.dwlbc.sa.gov.au	

Download this document at:

http://www.dwlbc.sa.gov.au/publications/technical_note/html

Government of South Australia

Department of Water, Land and Biodiversity Conservation

CONTENTS

List of Figures

List of Tables

INTRODUCTION

The Currency Limestone Groundwater Management Area (CL GMA) is located 6 km north of Goolwa and is bounded by the Mount Lofty Ranges (MLR) to the west, the Finniss River to the north and Currency Creek to the south (Fig. 1). It occupies an area of ~250 km^2 and is part of the Eastern Mt Lofty Ranges Prescribed Water Resource Area.

Groundwater resources were first used for the irrigation of lucerne in the 1960s from the same confined limestone aquifer that is developed in the Angas–Bremer area. Extractions declined markedly in the 1980s, but have steadily increased since 1990 with the expanding plantings of vines, olives and pasture.

In order to inform the development of management options for the new Water Allocation Plan (WAP) for the EMLR PWRA, groundwater level and salinity trends in the CL GMA have been examined by the Department of Water, Land and Biodiversity Conservation (DWLBC).

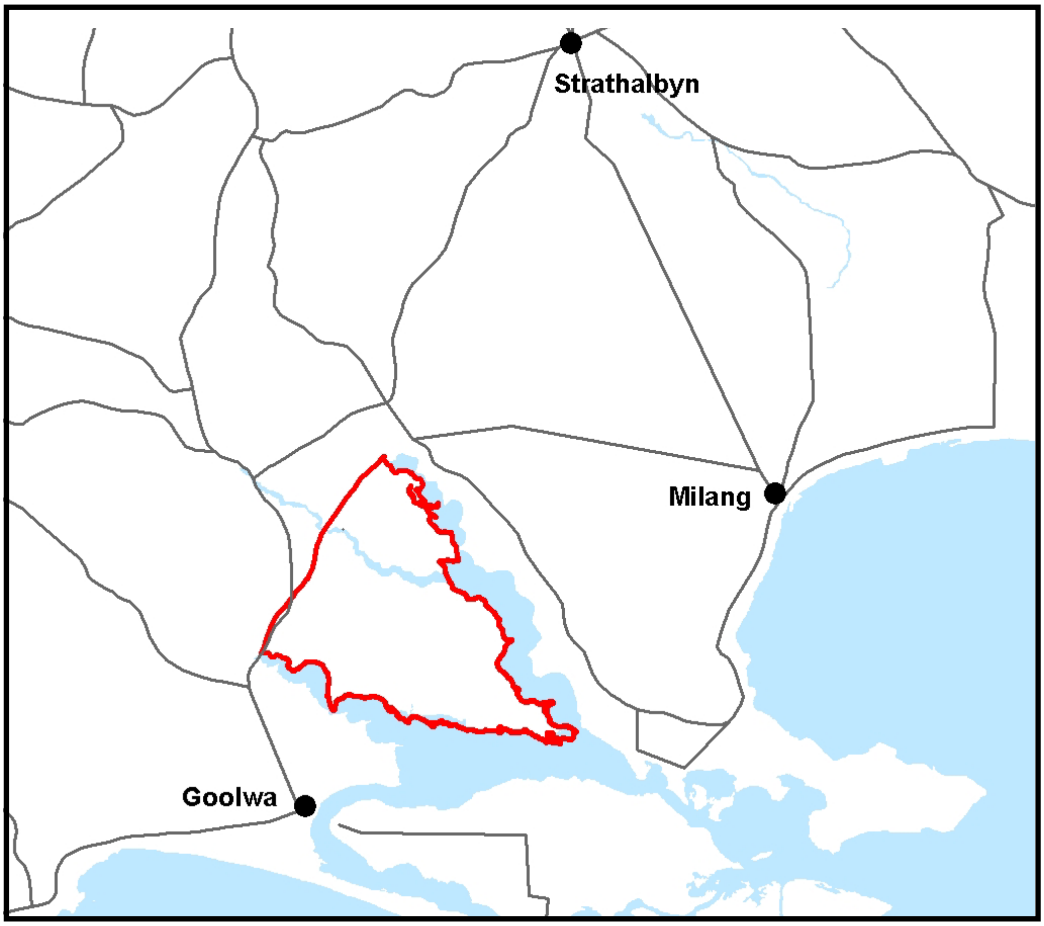


Figure 1. Location of the Currency Limestone GMA

HYDROGEOLOGY

The CL GMA lies on the western margin of the Murray Basin, where Quaternary and Tertiary sediments are deposited over Permian sediments and Cambrian basement rocks (Fig. 2).

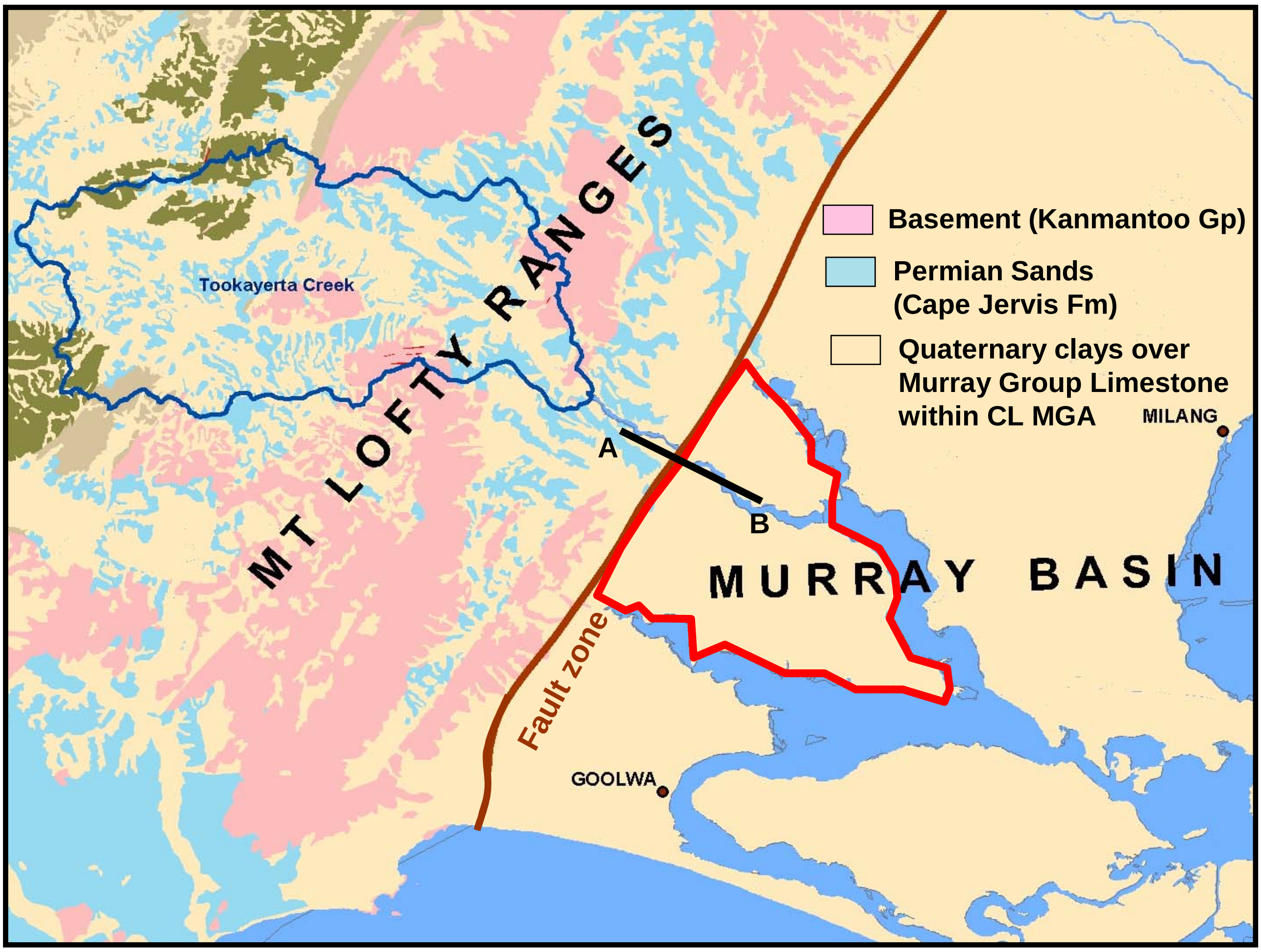


Figure 2. Surface geology around the Currency Limestone GMA

Four aquifers are recognised within the area (Table 1). In order of decreasing depth, they are:

1. Kanmantoo Group fractured rock aquifer (KG)
2. Permian Sands aquifer (PS)
3. Confined Tertiary Murray Group Limestone aquifer (MGL)
4. Unconfined Quaternary aquifer (QC)

Clayey members of the Quaternary sediments act as the confining layer to the MGL aquifer.

KANMANTOO GROUP AQUIFER

The Kanmantoo Group basement rocks have been metamorphosed by heat and pressure and consist of greywacke, schist and gneiss. They form the eastern half of the Mt Lofty Ranges. A NE-SW trending fault zone (running along the Strathalbyn–Goolwa Road) forms the boundary between the Ranges and the Murray Basin. Due to down faulting to the east of the fault, the Kanmantoo Group underlies the sediments of the Murray Basin and the CL GMA.

These fractured rocks are in general, poor aquifers being tight and impermeable with few open systems of fractures and joints in which groundwater is stored and transmitted. Yields are mostly below 3 L/s, with salinities generally above 1500 mg/L. There are no irrigation wells developing this aquifer within the CL GMA.

PERMIAN SANDS AQUIFER

About 280 million years ago in the Permian era, large continental ice sheets moving from the southeast to the northwest, carved out several large U-shaped valleys from the older Kanmantoo Group basement rocks, which were later filled by glacial deposits (Fig. 2). These sediments consist of unconsolidated sands, silts and clays with occasional gravel beds, and are known as the Permian Sands aquifer. When uplift occurred to the west of the NE-SW trending fault zone to form the Ranges, the Permian Sands were also uplifted and form part of the eastern slopes of the Ranges. To the east of the fault, they underlie the Murray Basin sediments.

The Permian Sands are generally quite permeable, allowing high recharge rates from rainfall resulting in very low salinities in some areas (below 500 mg/L), and also high yields over 10 L/s. Consequently, this aquifer is widely developed for irrigation and town water supply use in the Tookayerta catchment, and for irrigation in the Finniss River catchment to the south of Ashbourne. However, the Permian Sand aquifer can vary in productivity due to changes in the sedimentary deposition, with higher clay contents in some areas leading to low yields and higher salinity.

MURRAY GROUP LIMESTONE AQUIFER

The MGL aquifer consists predominately of a shallow marine fossiliferous limestone that was deposited about 50 million years ago in the Murray Basin. The MGL aquifer is up to 100 m thick and overlies the Kanmantoo Group basement rocks, and in some areas, the Permian Sands.

This aquifer is the only groundwater source of irrigation supplies in the CL GMA, with salinity ranging from 600 mg/L in the vicinity of Black Swamp, to over 4000 mg/L toward Lake Alexandrina.

Currently, the main source of recharge to the MGL aquifer is believed to be lateral recharge from the Permian Sands aquifer at the western boundary with the GMA. Figure 3 presents the geological cross section A-B along Black Swamp (location in Fig. 2), which shows the likely recharge mechanism for the MGL aquifer. Some recharge may occur through downward leakage from the overlying Quaternary aquifer if the pressure level in the MGL aquifer is below the watertable elevation. The potentiometric surface contours show that general groundwater flow is from the northwest to southeast (Fig. 4).

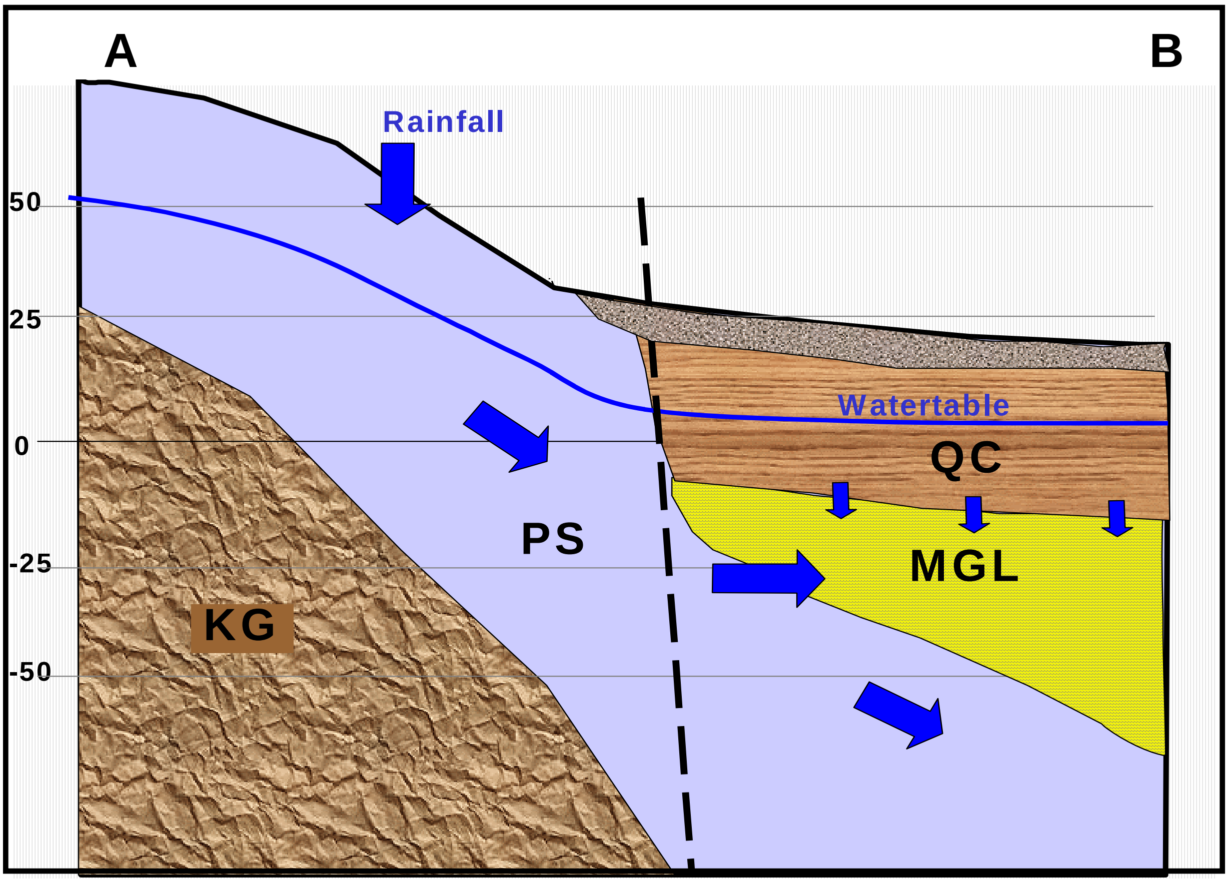


Figure 3. Geological cross sectio A-B showing recharge mechanisms for the MGL aquifer

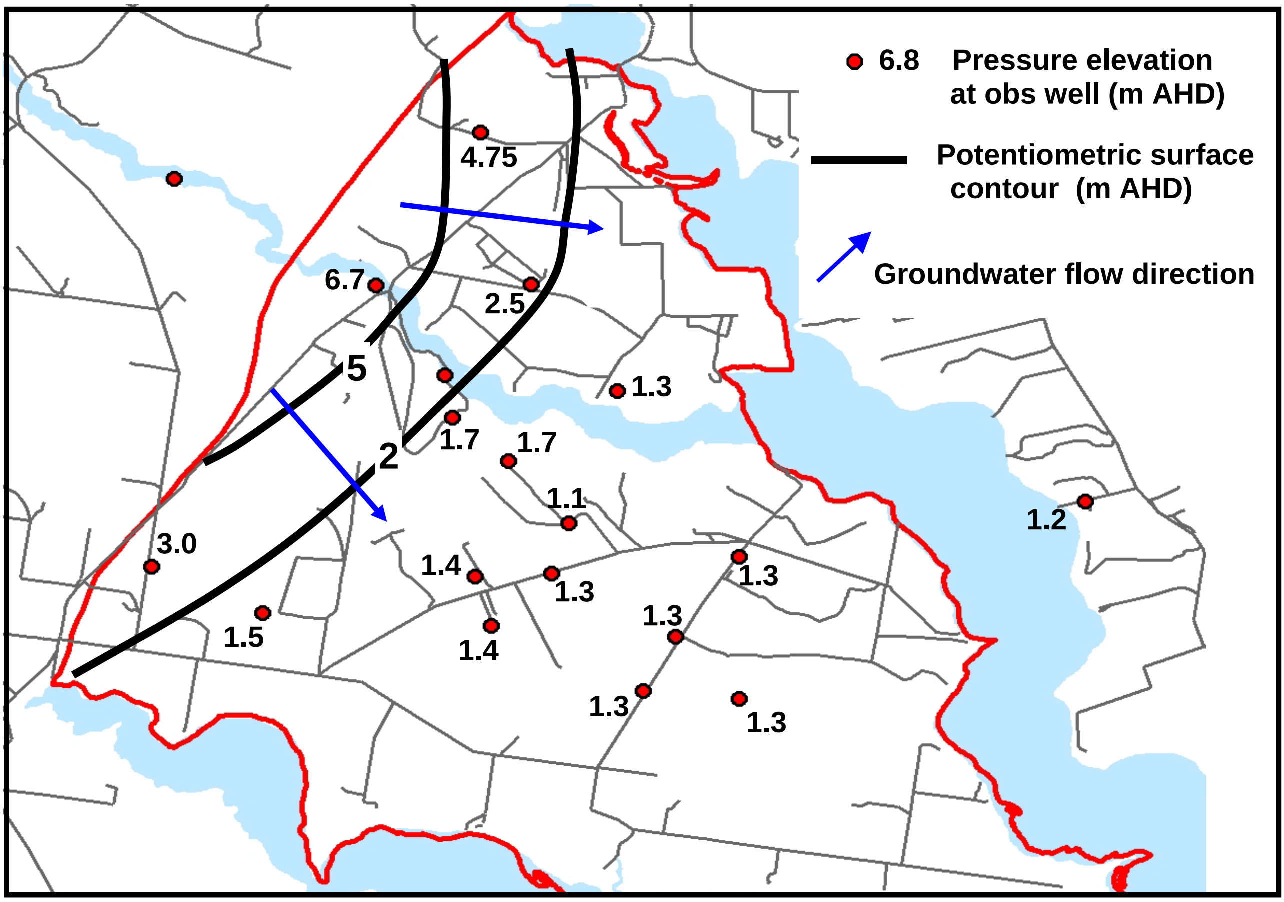


Figure 4. Potentiometric surface contours for the MGL aquifer

QUATERNARY AQUIFER

An aquifer system has developed within a 10–20 m thick sequence of Quaternary sediments, which consist mainly of clays, silt, sands and occasional gravels. A recent drilling program constructed five additional observation wells, which indicate groundwater flow away Black Swamp in Figure 5. The generally low salinity below 2000 mg/L found within the 5 m contour confirms recharge from the swamp in this reach. Elsewhere, salinities are in the range of 7–10 000 mg/L.

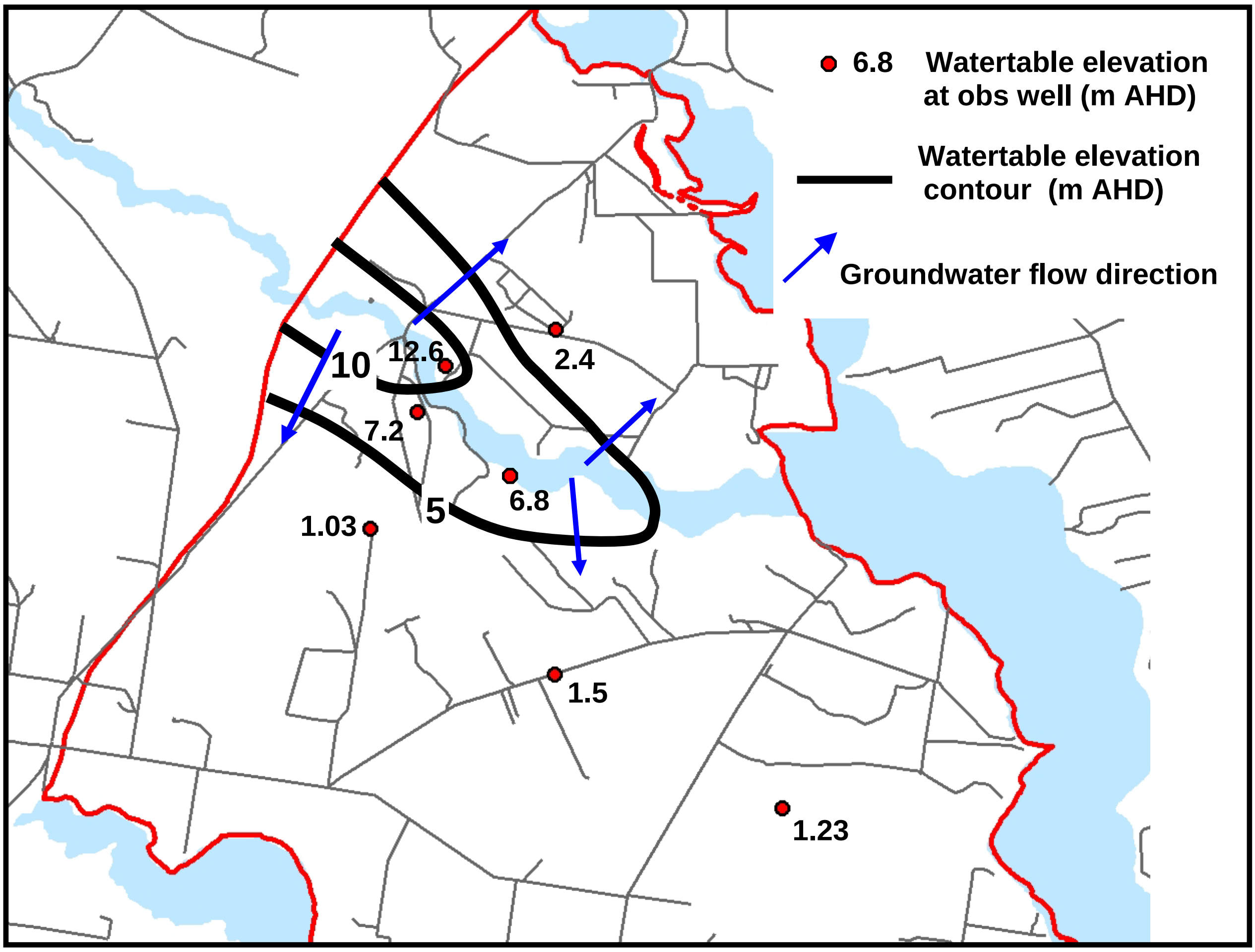


Figure 5. Quaternary watertable contours

MONITORING NETWORK

A groundwater monitoring network in the CL GMA was established in 1990 in response to increasing groundwater extractions. Currently there are 24 observation wells monitoring two aquifers as detailed in Table 1, with locations shown in Figure 6.

Table 1. Current observation wells in the Currency Limestone GMA

Aquifer monitored	Symbol in OBSWELL database	Number of monitoring wells
Quaternary Aquifer	Qpap	6
Murray Group Limestone Aquifer	Ty	18

Water levels were monitored irregularly (but at least six monthly) until 2006, but since then have been monitored on a three monthly basis. Salinities are monitored at least annually.

All water level and salinity results are available from the DWLBC 'OBSWELL' web site under the network name of CURR_CRK at the following address:

https://info.pir.sa.gov.au/obswell/new/obsWell/MainMenu/menu

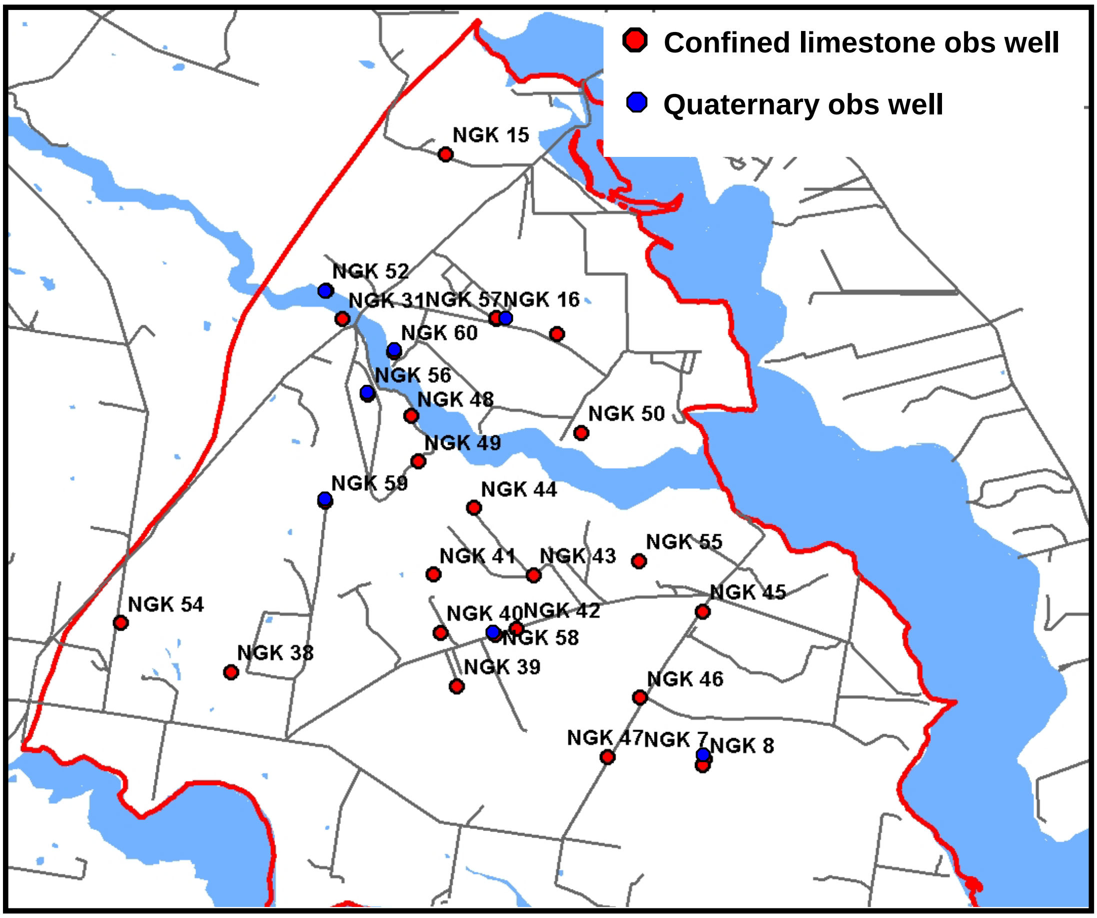


Figure 6. Currency Limestone GMA observation network

MONITORING TRENDS IN THE MGL AQUIFER

Although regular monitoring has been carried out only over the last few years, significant trends have been observed. Seasonal drawdowns in pressure levels during the irrigation season gradually increased since 1999 (in response to increasing extractions), to a maximum of about 3 m in 2005–06. Figure 7 shows a typical hydrograph for the MGL aquifer, with Figure 8 displaying the regional seasonal drawdown contours.

The hydrographs also a reasonably strong recovery during the non-pumping season, indicating the limestone aquifer is highly transmissive.

The 2006 drought year had a significant impact on drawdown, due to increased extractions. This is the consequence of not only the dry winter which would have resulted in an earlier commencement of irrigation, but also an increasing dependence on groundwater due to the deteriorating surface water quality in Lake Alexandrina. Figures 7 and 8 both show a widespread increase in the seasonal drawdown for the 2006–07 irrigation season. This trend of increasing drawdowns is likely to continue while lake water is unusable.

The water level monitoring to date indicates that volume alone may not be the major limiting factor in determining the sustainability of the groundwater resource.

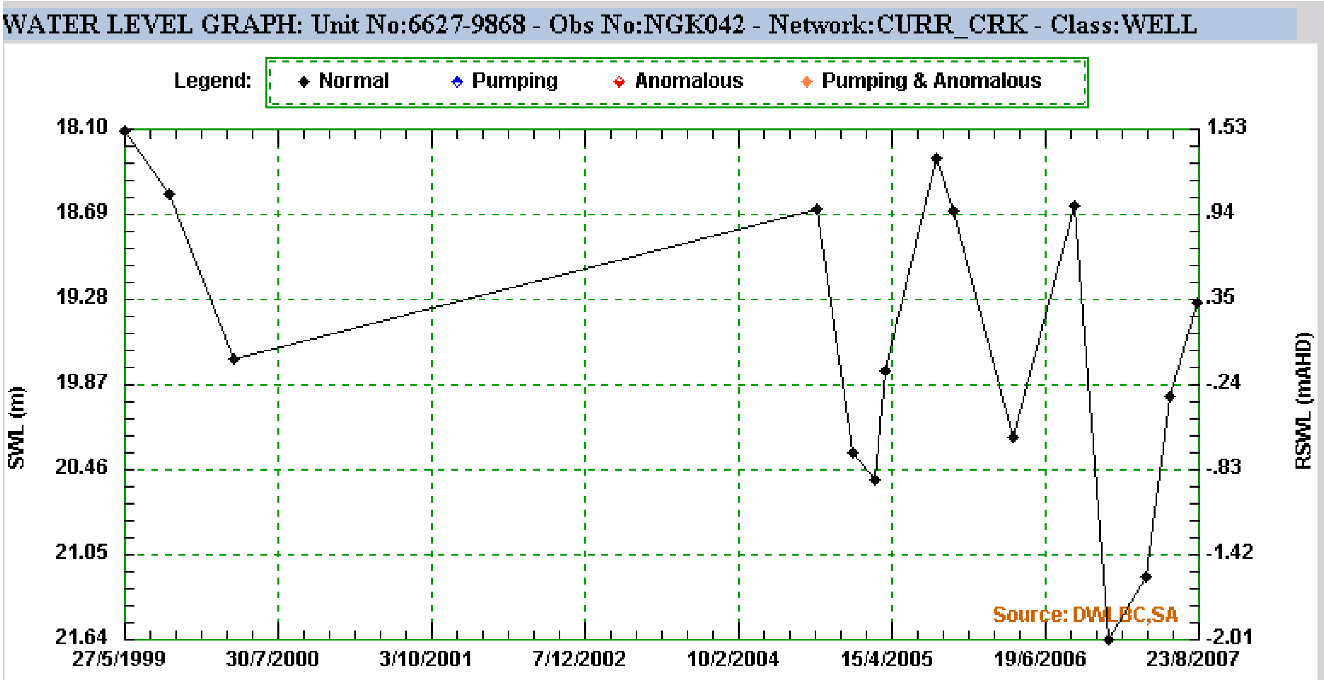
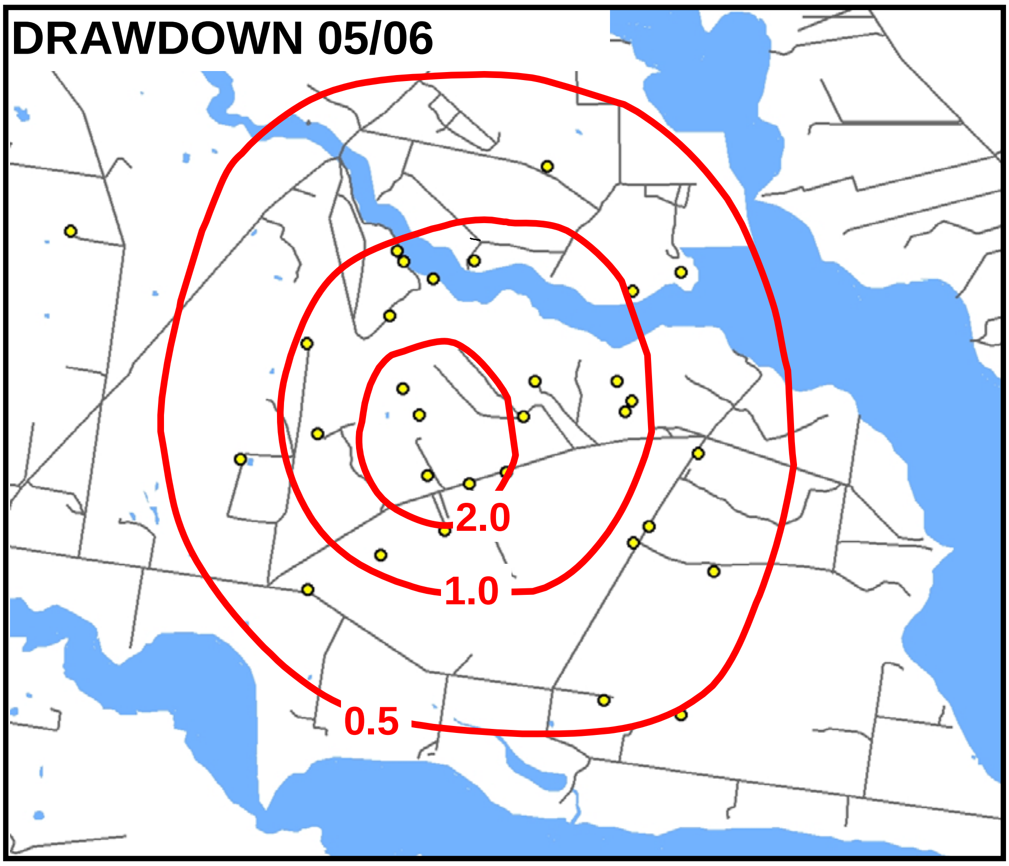


Figure 7. Typical MGL hydrograph



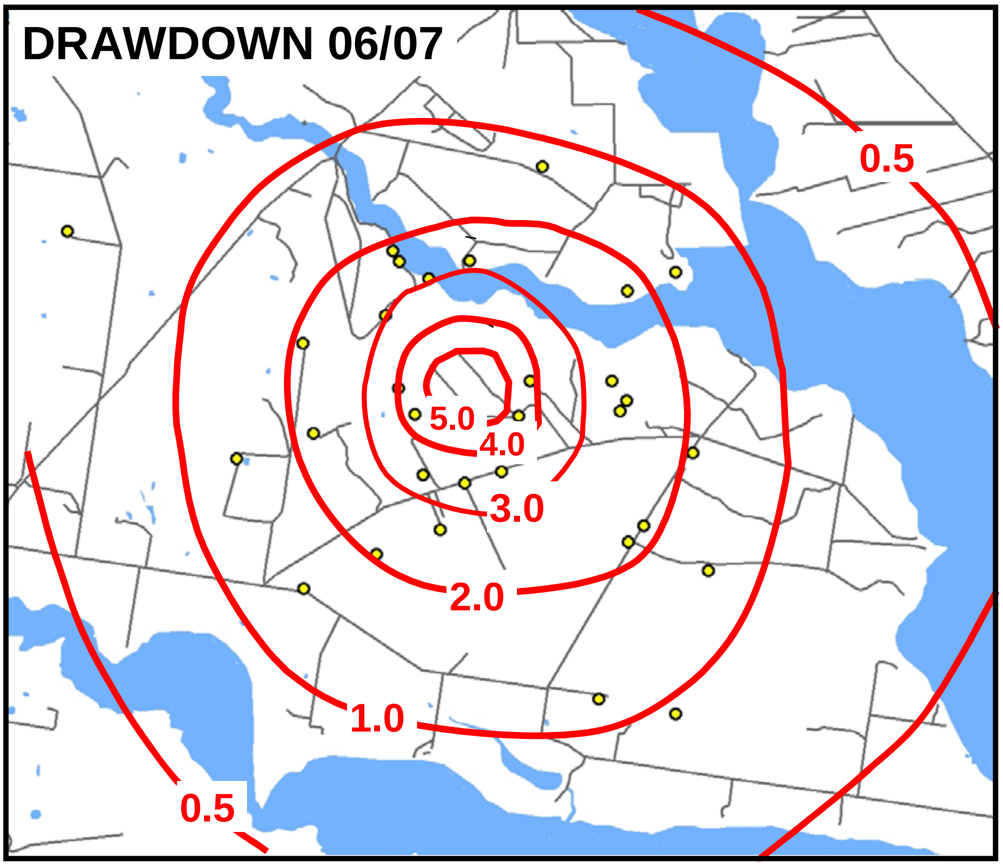


Figure 8. Contours of seasonal drawdown in the Currency Limestone GMA

The salinity monitoring however, displays some threatening trends. Limestone salinities have been rising in an almost linear trend since 1999 in 14 irrigation wells (Fig. 9). The rate of rise varies throughout the area, from no change to over 50 mg/L/y. Figure 10 displays the rate of rise for each well superimposed on the 2006–07 seasonal drawdown. Whilst it may be expected that the highest rates of rise are in the area of maximum drawdown, there are other seemingly anomalous trends. These results suggest that downward leakage is the dominant cause of salinity increase, with the rate of rise seemingly dependent on the drawdown (and hence pumping rate) in each well.

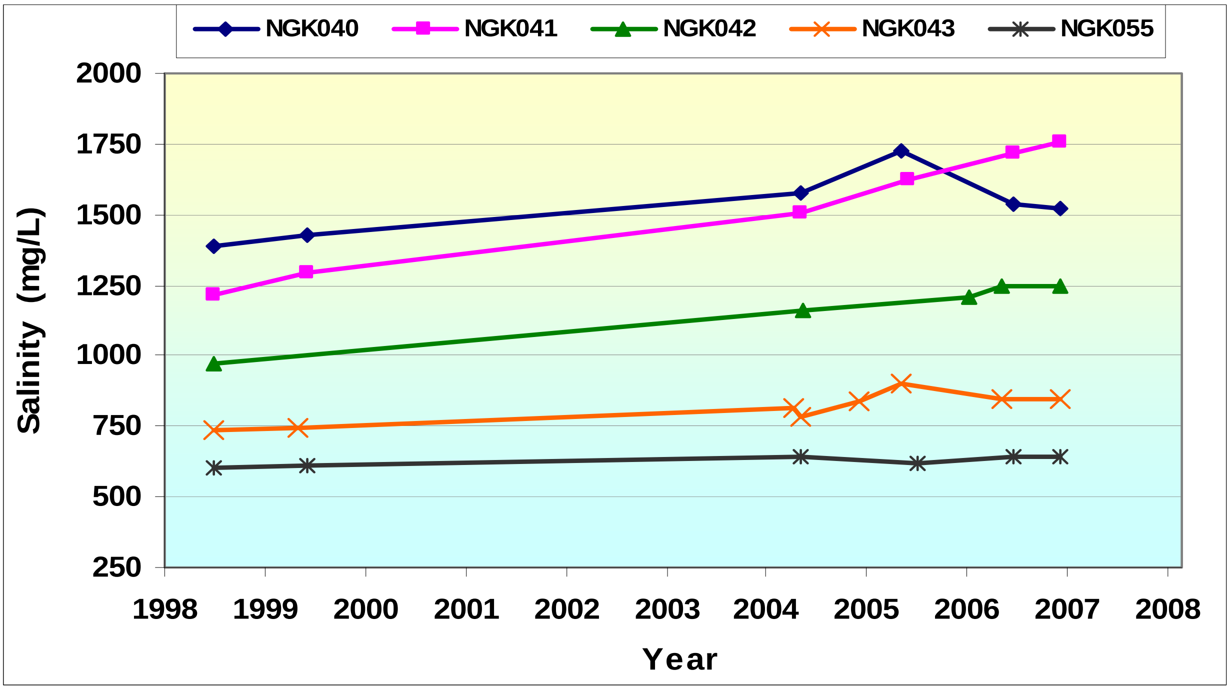


Figure 9. **Salinity trends in the Currency Limestone GMA**

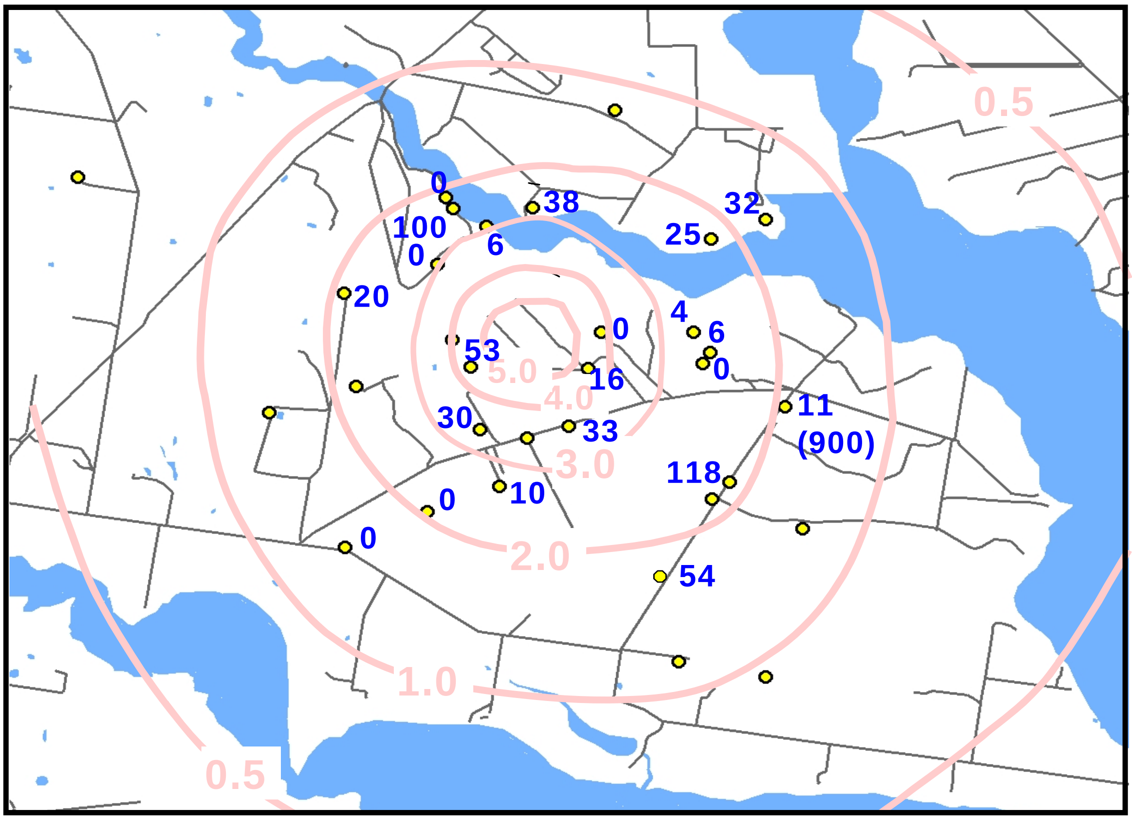


Figure 10. **Rate of rise in salinity in the Currency Limestone GMA**

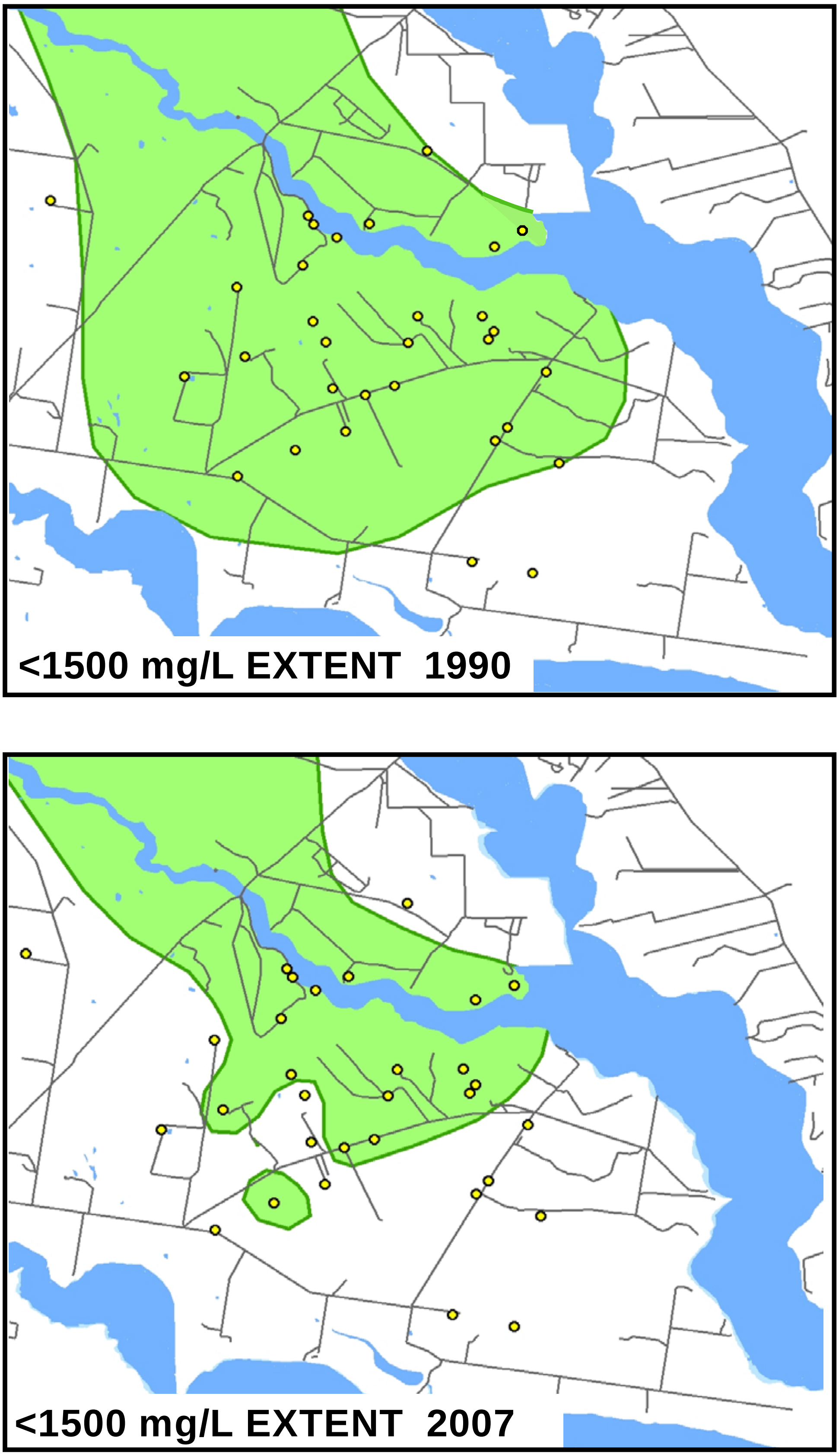


Figure 11. Changes in the extent of fresh groundwater in the Currency Limestone GMA

The dramatic reduction in area of groundwater with a salinity below 1500 mg/L since 1990 (Fig. 11), highlights the impact of the salinity increases, and raises doubts about the long term sustainability of the groundwater resource at the current extraction rate.

SUMMARY AND CONCLUSIONS

Salinity monitoring in the Currency Limestone GMA has shown consistent increases in salinity of up to 50 mg/L/y since 1999, which has lead to a dramatic reduction in the area of groundwater with salinities below 1500 mg/L. It is postulated that downward leakage from the overlying high salinity Quaternary aquifer appears to be the dominant cause of salinity increase. The rate of rise seems to be dependent on the drawdown (and hence pumping rate) in each well. Similar rising salinity trends are being observed in the Angas-Bremer PWA to the northeast (Zulfic and Barnett, 2007).

The volume of extractions causing the drawdown in pressure levels in the Murray Group limestone aquifer is not known with accuracy due to the lack of metering in the area.

It appears that the lens of fresh groundwater currently being developed may have been recharged between 5000 and 8000 years ago, when South Australia and much of the rest of the world, experienced a much wetter climate than has existed over the last hundred years or so (Bowler, 1971). Current recharge rates of low salinity water are much lower and consequently, it is highly likely that the salinity increases are irreversible, and that the current extraction regime is not sustainable in the long term. This issue also has important ramifications for the sustainability of the groundwater resources of the Angas–Bremer PWA (Zulfic and Barnett, 2007).

Artificially recharging lake water into the aquifer when salinities are appropriate may prolong the availability of the resource with salinities below 1500 mg/L.

REFERENCES

Bowler, J.M., 1971. Pleistocene salinities and climate change; Evidence from lakes and lunettes in southeastern Australia. *In;* Mulvaney, D.J. and Golson, J. (Eds). Aboriginal man and environment in Australia. Australian National University Press, Canberra, p 47-65.

Zulfic, D. and Barnett, S.R., 2007. Angas Bremer PWA - Groundwater Status Report 2007*. South Australia. Department of Water, Land and Biodiversity Conservation. DWLBC Report* 2007/27.