DWLBC REPORT

Mallee PWA and Murrayville WSPA - Groundwater Monitoring Status Report 2006

2006/28

Government of South Australia
Department of Water, Land and Biodiversity Conservation

Mallee PWA and Murrayville WSPA Groundwater Monitoring Status Report 2006

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Department of Water, Land and Biodiversity Conservation

December 2006

Report DWLBC 2006/28

Government of South Australia
Department of Water, Land and Biodiversity Conservation

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FOREWORD

South Australia's unique and precious natural resources are fundamental to the economic and social wellbeing of the State. It is critical that these resources are managed in a sustainable manner to safeguard them both for current users and for future generations.

The Department of Water, Land and Biodiversity Conservation (DWLBC) strives to ensure that our natural resources are managed so that they are available for all users, including the environment.

In order for us to best manage these natural resources it is imperative that we have a sound knowledge of their condition and how they are likely to respond to management changes. DWLBC scientific and technical staff continues to improve this knowledge through undertaking investigations, technical reviews and resource modelling.

Rob Freeman
CHIEF EXECUTIVE
DEPARTMENT OF WATER, LAND AND BIODIVERSITY CONSERVATION

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EXECUTIVE SUMMARY

This second review of monitoring trends (both water level and salinity) in the Mallee PWA and the Murrayville WSPA has found no major adverse impacts due to irrigation extractions from the Murray Group Limestone aquifer, and has continued to confirm the robustness of the groundwater resource.

Generally, in areas where irrigation has been established for some time and extractions are relatively stable, eg Parilla, drawdowns have reached an equilibrium and the extent of the cone of drawdown remains unchanged. Decreases in extraction in the Murrayville WSPA and Zone 11A have reduced drawdown in these areas by several metres. New irrigation to the north of Lameroo has extended the drawdown cone west from Parilla, but because the aquifer is virtually unconfined in this area, the magnitude of the regional drawdown is not expected to exceed two metres.

Salinity trends are stable, or decreasing in some areas where drawdown is accelerating the inflow of lower salinity groundwater from the south.

The area of groundwater flow reversal north of Peebinga has reduced in size over the last two seasons as a result of reduced extractions, however changes in ownership of some enterprises will probably result in increased pumping to previous levels and a small increase in flow reversal. Predictions by the Mallee groundwater model have shown the salinity impacts of this increase in flow reversal to be insignificant.

The onset of drought during 2006 is expected to have a similar impact as in 2002, with incomplete recovery during spring due to the early commencement of irrigation.

Recommendations are still in place to improve the coverage of the monitoring network in the Berrook area in Zone 11B. A significant increase in monitoring activity will occur in the Mindarie area when heavy mineral sand mining commences next year.

1. INTRODUCTION

The Department of Water, Land and Biodiversity Conservation (DWLBC) is responsible for the management of the State's underground water resources. As part of its role, the DWLBC monitors and maintains an extensive statewide groundwater monitoring network. It has been monitoring in the Mallee area (Fig. 1) for over 20 years. The two main parameters measured to assess the condition of the underground resources are water levels and salinity from various observation wells located throughout the Mallee Prescribed Wells Area (PWA). Over time, a history of the condition of the underlying aquifers has been established. This has provided important baseline information so that long-term trends and short-term changes in the status of the resource can be readily identified.

In this region, the aquifer developed for irrigation extends across the State border into Victoria and consequently, observation bore data from the Murrayville Water Supply Protection Area (WSPA) is also included in this report.

The purpose of this report is to provide the SA Murray Darling Basin Natural Resource Management Board, Grampians Wimmera Mallee Water, the Border Groundwater Agreement Review Committee and interested stakeholders with vital information on the historical and current trends for both water level and salinity, the current condition of the groundwater resources; and to summarise water usage information.

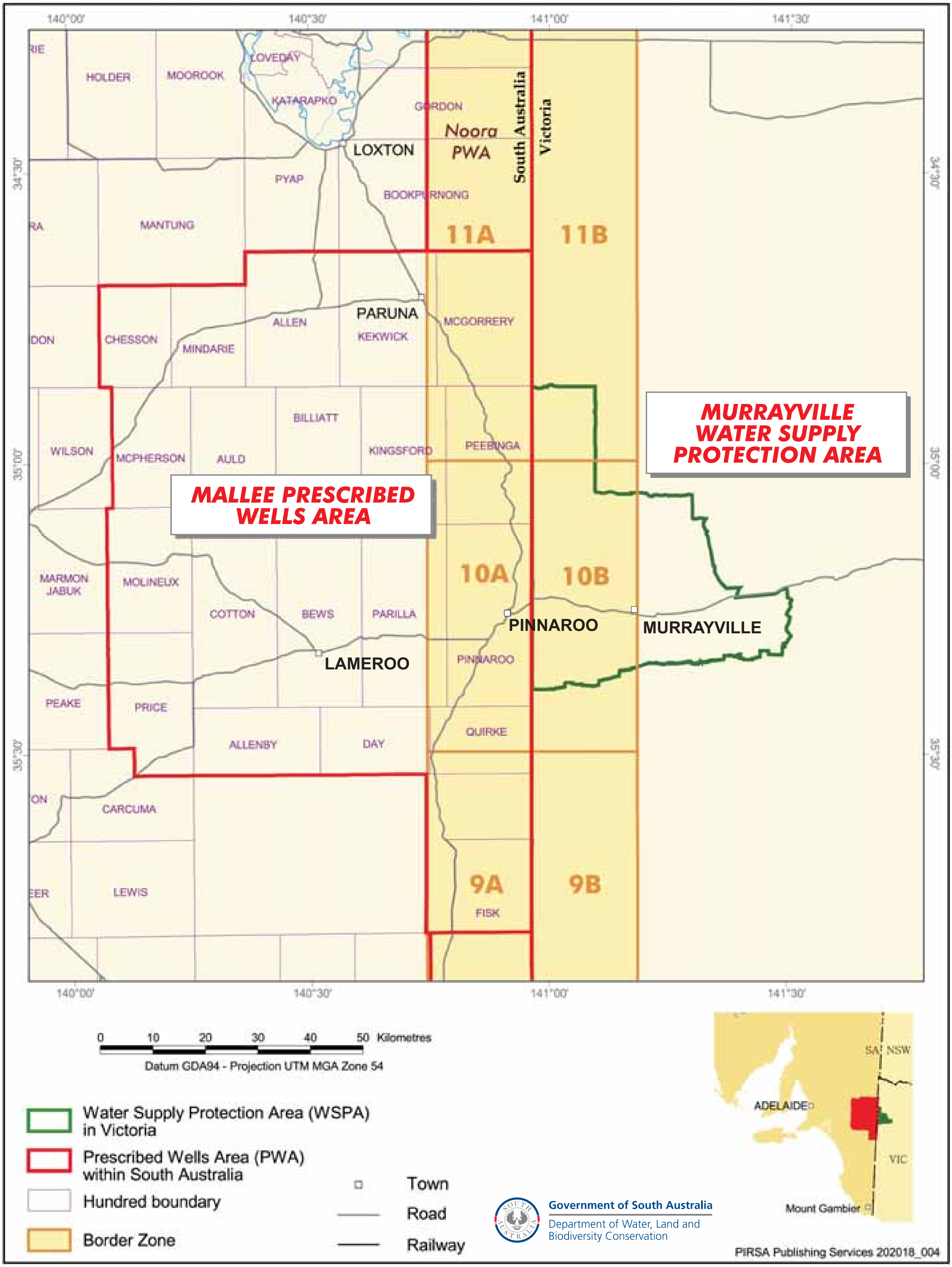


Figure 1. Location of Mallee PWA and Murrayville WSPA

2. SUMMARY OF AQUIFERS

The Murray Basin contains marine and non-marine sequences which have been deposited over the last 65 million years to form three main aquifer systems as shown in Figure 2; the unconfined Pliocene Sands (shallowest), the Murray Group Limestone and the Renmark Group (deepest). These aquifers are separated by clay and marl confining layers. Table 1 summarises the hydrogeological units within the Mallee region.

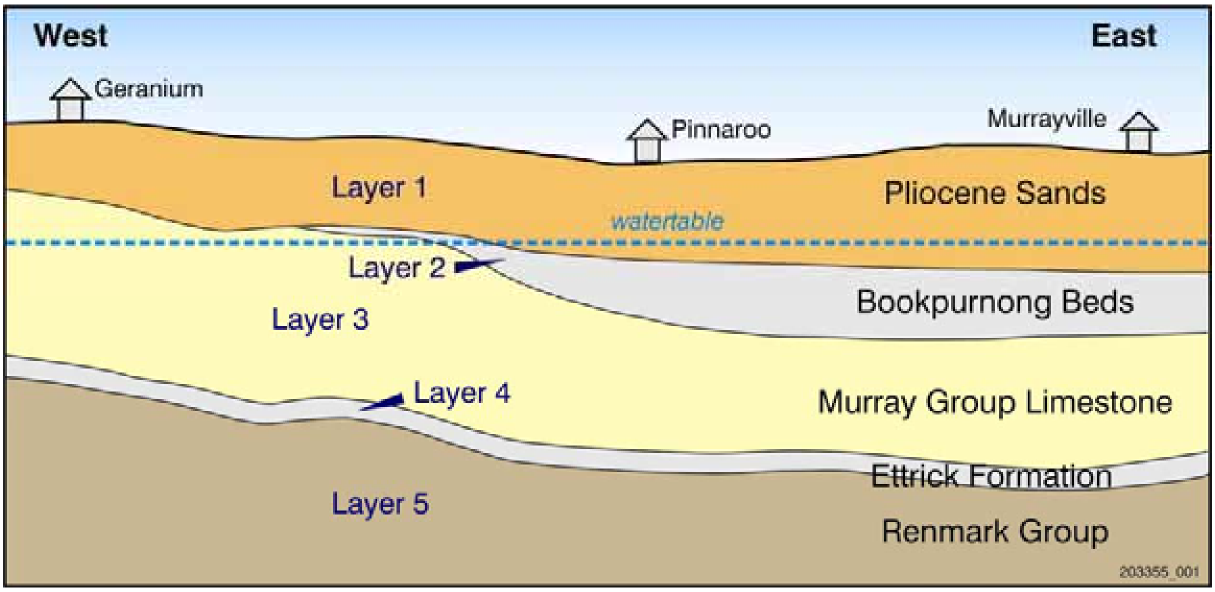


Figure 2. Hydrogeological cross section

Table 1. Hydrogeological units within the Mallee region

Aquifer	Lithology	Thickness (m)	Comments
Pliocene Sands	Fine to coarse sands, clayey in part. Orange-grey	0–15	Unconfined aquifer. Absent in west of Mallee PWA
Bookpurnong Beds	Grey–green fossiliferous silts and clay	0–30	Confining layer. Absent in west of Mallee PWA
Murray Group Limestone	Grey to off-white fossiliferous limestone	80–140	Aquifer developed for irrigation
Ettrick Formation	Grey–green stiff marl	15–20	Confining layer
Renmark Group	Interbedded sands and clays	100–200	Confined aquifer. Not developed

The Murray Group Limestone aquifer is by far the most widely developed aquifer in the region for irrigation, stock, domestic, town water supply and in the near future, mineral sands production.

The Renmark Group confined aquifer underlies all of the Mallee region, and although it contains good quality groundwater below 3000 mg/L in most areas, there are no wells developing this aquifer because of its depth and unreliable yield for irrigation supplies. Because it is a sand aquifer, sandscreen completions are required which are much more expensive than the open hole construction used in the overlying limestone aquifer.

The Pliocene Sands aquifer only contains groundwater in the eastern part of the region. Salinities increase to the north and east, from 1500 mg/L near Pinnaroo to over 20 000 mg/L at the northern margin of the Mallee PWA and to the east of Murrayville. There are only a few stock bores using this aquifer to the north of Pinnaroo where the salinities are low.

3. CLIMATE

Five rainfall stations located in the Mallee region were selected as representative of the rainfall pattern throughout the area. The rainfall records are available for a period of up to 115 years. Rainfall is winter dominant, with the monthly averages for these five stations shown in Table 2.

Table 2. Average monthly rainfall within the Mallee region (mm)

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Geranium	18	21	19	29	44	44	46	39	44	39	26	25
Pinnaroo	17	22	18	24	35	36	36	39	36	34	25	20
Mindarie	17	19	14	20	30	30	32	34	33	33	20	19
Paruna	15	19	14	19	29	29	31	30	29	30	20	19
Murrayville	19	24	13	21	35	33	35	35	33	34	24	22

The annual average rainfall decreases to the northeast, from 404 mm at Geranium, 343 mm at Pinnaroo and 331 mm at Murrayville in the south, to 300 mm at Mindarie and 283 mm at Paruna further north.

Figure 3 shows the monthly rainfall recorded at Pinnaroo for the period 1907–2003. The cumulative deviation is also plotted and measures the difference between the actual measured rainfall and the long term average rainfall on a monthly basis. An upward trend in this line indicates above average rainfall, and conversely, a downward trend indicates below average rainfall. Although the records span over a 110-year period, the period shown is selected for comparison against groundwater level monitoring data.

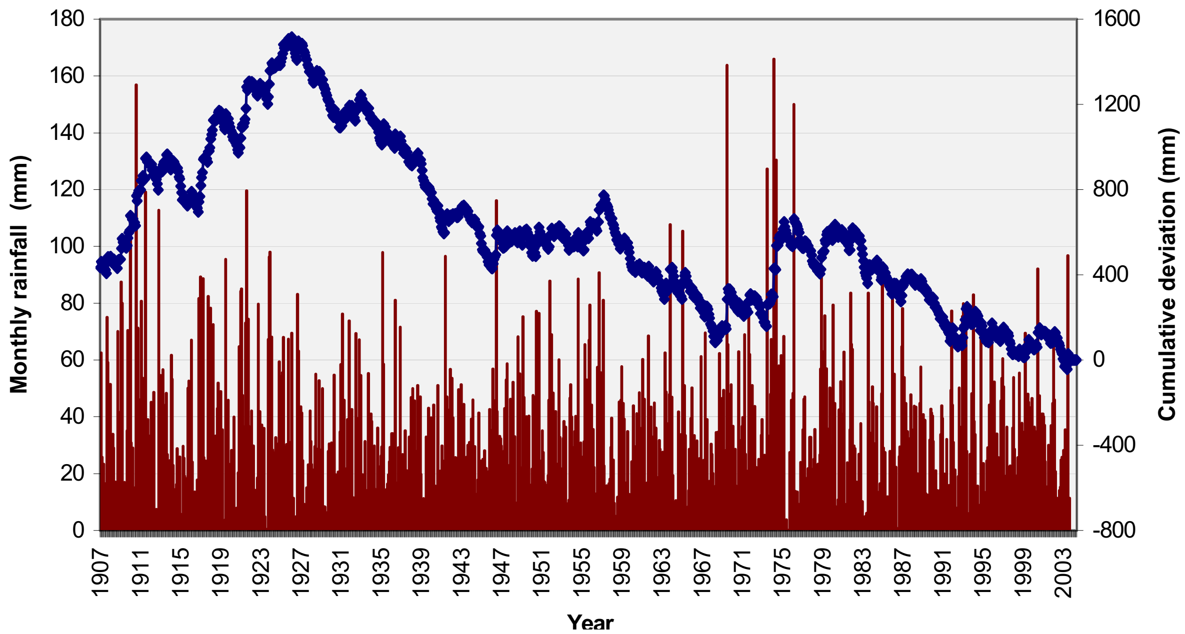


Figure 3. Monthly rainfall for Pinnaroo

The rainfall records show an above average trend from 1907 until around 1925, with a long period of below average rainfall until 1945. The next ten years were generally near average, ending with a high rainfall period in 1956. Another period of below average rainfall occurred until 1968. Some wetter years then occurred over the next ten years until 1979. Since then, the graph shows a continuous declining trend, suggesting that the rainfall has been consistently below average, with the exception of wet years in 1987, 1992 and 2000.

Because of the large depth to the watertable of 40–60 m, there is little direct correlation between groundwater levels and variations in rainfall. However, there may be an indirect correlation in that dry years (such as 2002), will result in increased groundwater pumping that may lead to a lowering of groundwater levels.

4. OBSERVATION NETWORKS

4.1 MALLEE PWA

4.1.1 GROUNDWATER LEVEL

Water level and salinity monitoring began in the Mallee PWA in 1982 with a regional network of some 90 bores. This network has been rationalised over the years, with additions from drilling programs and deletions due to duplication and access difficulties. Recent additions include the conversion of disused Murray Group Limestone stock bores to observation bores in the overlying Pliocene Sands watertable aquifer, and the drilling of a new Renmark Group observation bore near the SA/Victoria border in the area of maximum drawdown in groundwater levels in the Murray Group Limestone aquifer.

There are two types of monitoring carried out in the Mallee PWA. As part of the requirements of the Groundwater (Border Agreement) Act 1985, monitoring at three monthly intervals is carried out in the Border Zones. Selected bores in the remainder of the Mallee PWA are also monitored at six monthly intervals.

Additional monitoring is carried out to determine seasonal drawdown impacts due to irrigation. Modifications to this network will be made as irrigation development extends into new areas (either as new development, or a redistribution of existing irrigation).

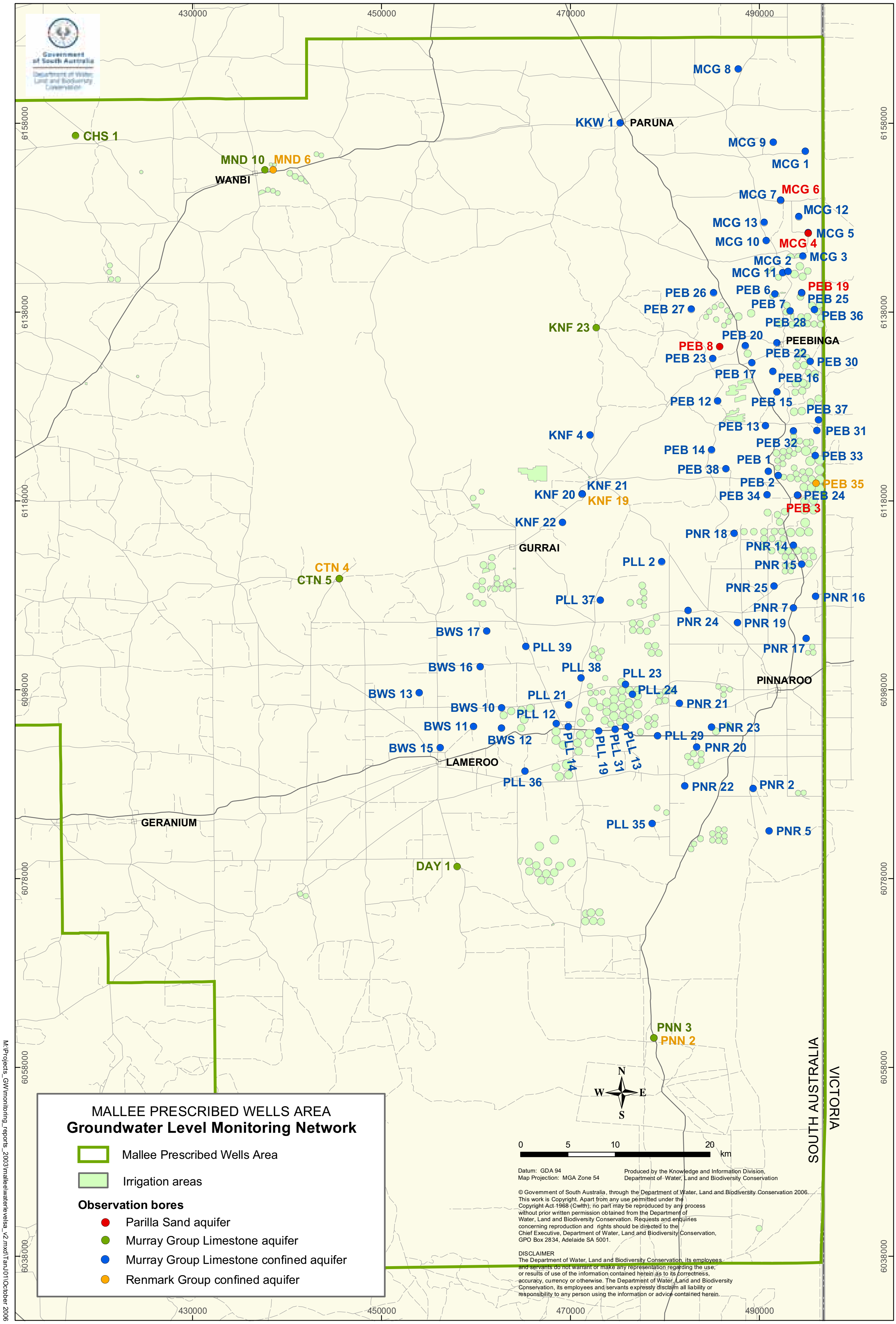
Table 3 shows the current status of the Mallee PWA monitoring network, and Figure 4 displays the locations of the bores.

Table 3. Network summary for groundwater levels in the Mallee PWA

Aquifer	Total number of observation bores	Data loggers	Comments
Pliocene Sands	7	0	5 bores 3 monthly 2 bores seasonal
Murray Group Limestone	84	2	34 bores 3 monthly 3 bores 6 monthly 45 bores seasonal
Renmark Group	5	1	2 bores 3 monthly 2 bores 6 monthly

4.1.2 GROUNDWATER SALINITY

Again, as part of the requirements of the Groundwater (Border Agreement) Act 1985, 11 bores are monitored at three monthly intervals by DWLBC personnel, both in the Border Zones and the Parilla area (Fig. 5). Mandatory submission of annual samples by all irrigators for salinity testing will be introduced in the WAP review.


MALLEE PRESCRIBED WELLS AREA
Groundwater Level Monitoring Network
Mallee Prescribed Wells Area
Irrigation areas
Observation bores
Parilla Sand aquifer
Murray Group Limestone aquifer
Murray Group Limestone confined aquifer
Renmark Group confined aquifer
Government of South Australia
Department of Water, Land and Biodiversity Conservation
430000
450000
470000
490000
6158000
6138000
6118000
6098000
6078000
6058000
6038000
PARUNA
WANBI
PEEBINGA
GURRAI
PINNAROO
LAMEROO
GERANIUM
SOUTH AUSTRALIA
VICTORIA
CHS 1
MND 10
MND 6
KKW 1
MCG 8
MCG 9
MCG 1
MCG 7
MCG 6
MCG 12
MCG 13
MCG 5
MCG 10
MCG 4
MCG 2
MCG 3
MCG 11
PEB 26
PEB 6
PEB 19
PEB 25
PEB 27
PEB 7
PEB 36
PEB 28
KNF 23
PEB 20
PEB 8
PEB 22
PEB 23
PEB 30
PEB 17
PEB 16
PEB 12
PEB 15
PEB 37
PEB 13
PEB 31
KNF 4
PEB 32
PEB 14
PEB 33
PEB 1
PEB 38
PEB 2
PEB 35
KNF 21
PEB 34
PEB 24
KNF 20
KNF 19
PEB 3
KNF 22
PNR 18
PNR 14
CTN 4
CTN 5
PLL 2
PNR 15
PNR 25
PNR 16
PLL 37
PNR 7
PNR 24
PNR 19
BWS 17
PLL 39
PNR 17
BWS 16
PLL 38
PLL 23
PLL 24
BWS 13
PLL 21
PNR 21
BWS 10
PLL 12
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Map Projection: MGA Zone 54
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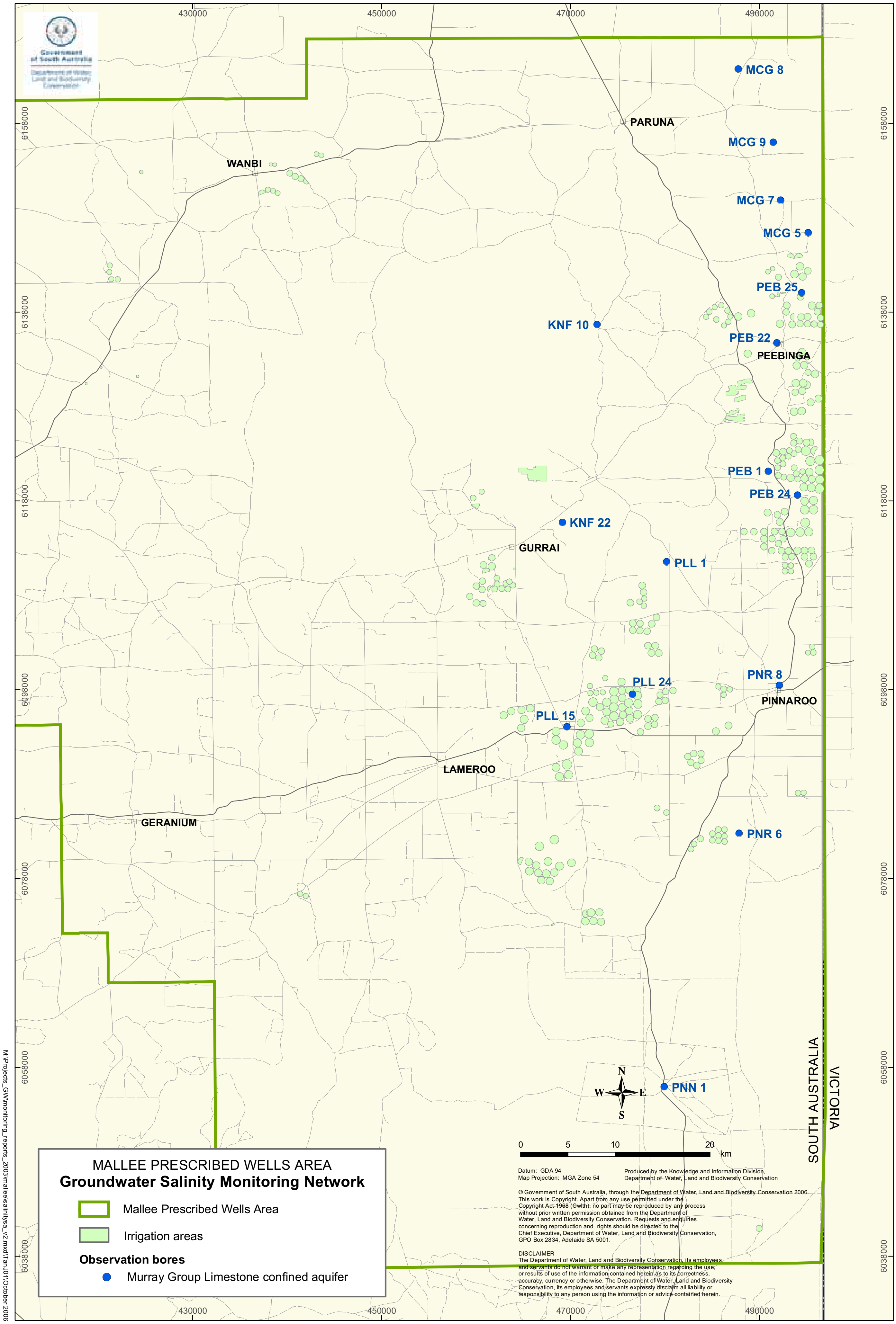
Figure 4



MALLEE PRESCRIBED WELLS AREA
Groundwater Salinity Monitoring Network
Mallee Prescribed Wells Area
Irrigation areas
Observation bores
Murray Group Limestone confined aquifer
MCG 8
PARUNA
MCG 9
WANBI
MCG 7
MCG 5
PEB 25
KNF 10
PEB 22
PEEBINGA
PEB 1
PEB 24
KNF 22
GURRAI
PLL 1
PNR 8
PLL 24
PINNAROO
PLL 15
LAMEROO
GERANIUM
PNR 6
PNN 1
SOUTH AUSTRALIA
VICTORIA
430000
450000
470000
490000
6158000
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Datum: GDA 94
Map Projection: MGA Zone 54
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Figure 5

4.2 MURRAYVILLE WSPA

4.2.1 GROUNDWATER LEVEL

The groundwater monitoring network in the Murrayville Water Supply Protection Area has increased substantially since observations of water levels of some bores commenced during the 1960s. There are two monitoring programs being undertaken in the area, three monthly and monthly, with locations of observation wells shown in Figure 6.

A contractor for the Victorian Department of Sustainability and Environment (DSE) undertakes quarterly monitoring of most bores as part of the Groundwater (Border Agreement) Act 1985 requirement. For those bores designated as requiring monthly monitoring in the Murrayville Area Groundwater Management Plan 2001, monitoring has been undertaken since 1998 by a private contractor on behalf of GWMWater.

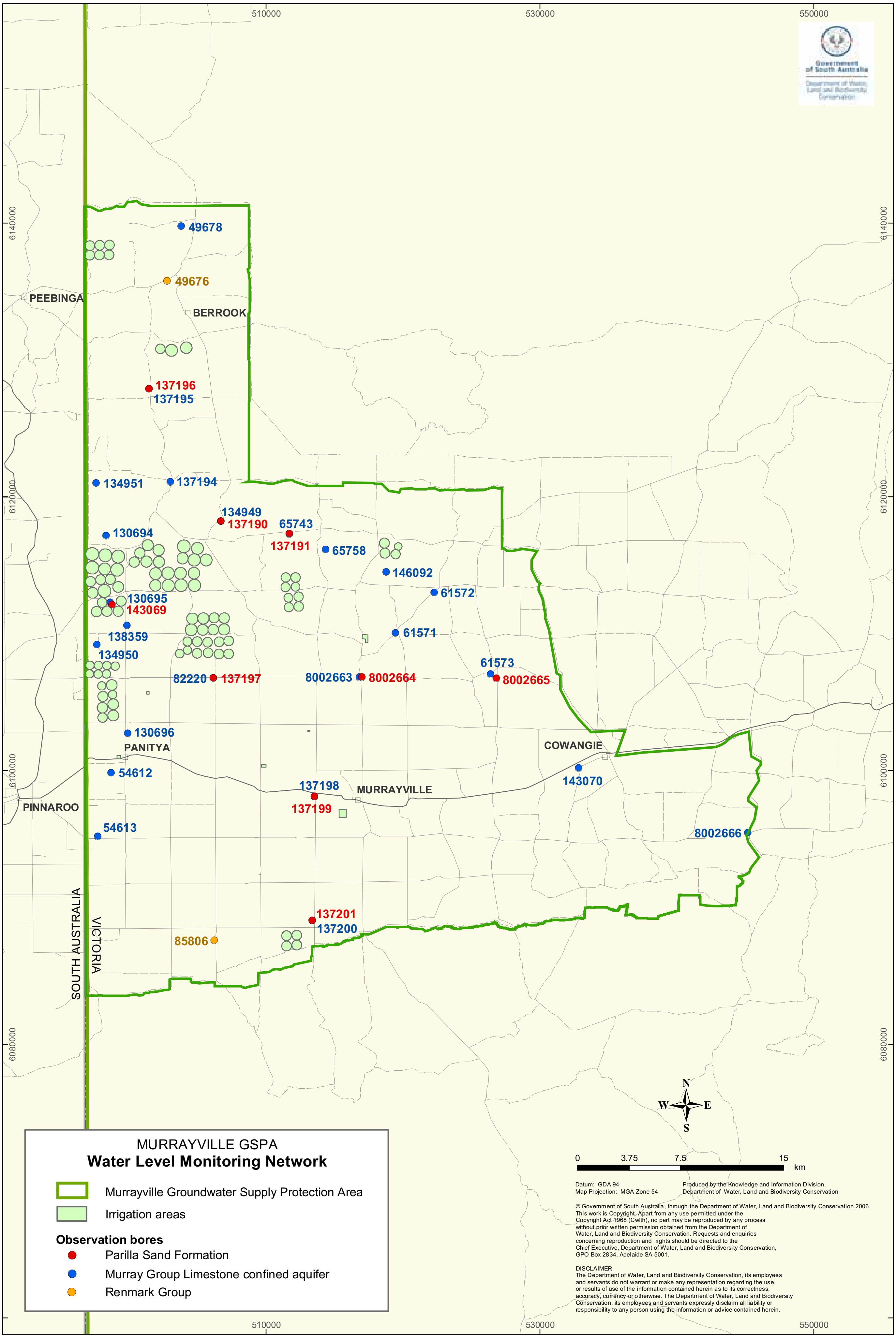
Table 4. Network summary for groundwater levels in the Murrayville WSPA

Aquifer	Total number of observation bores	Data loggers	Comments
Pliocene Sands	9	0	9 bores monthly
Murray Group Limestone	26	4	19 bores monthly 7 bores 3 monthly
Renmark Group	2	0	1 bore monthly 1 bore 3 monthly

4.2.2 GROUNDWATER SALINITY

Prior to the implementation of the Murrayville Area Groundwater Management Plan in 2001, salinity monitoring was undertaken either on a three or six monthly basis by DSE as part of the requirements of the Groundwater (Border Agreement) Act 1985. Since 2001, the salinity monitoring network has increased to incorporate an additional eight bores, four of which have been monitored by GWMW since 1982. The salinity monitoring network now consists of 14 bores, six of which are monitored three monthly, with the remaining eight bores monitored on a six monthly basis (Fig. 7).

An annual sampling of over 50 irrigation, urban, domestic and stock and observation bores is carried out by GWMWater with full chemical analyses by Water ECOscience.


MURRAYVILLE GSPA
Water Level Monitoring Network
Murrayville Groundwater Supply Protection Area
Irrigation areas
Observation bores
Parilla Sand Formation
Murray Group Limestone confined aquifer
Renmark Group
510000
530000
550000
6140000
6120000
6100000
6080000
PEEBINGA
BERROOK
PANITYA
PINNAROO
MURRAYVILLE
COWANGIE
SOUTH AUSTRALIA
VICTORIA
49678
49676
137196
137195
134951
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146092
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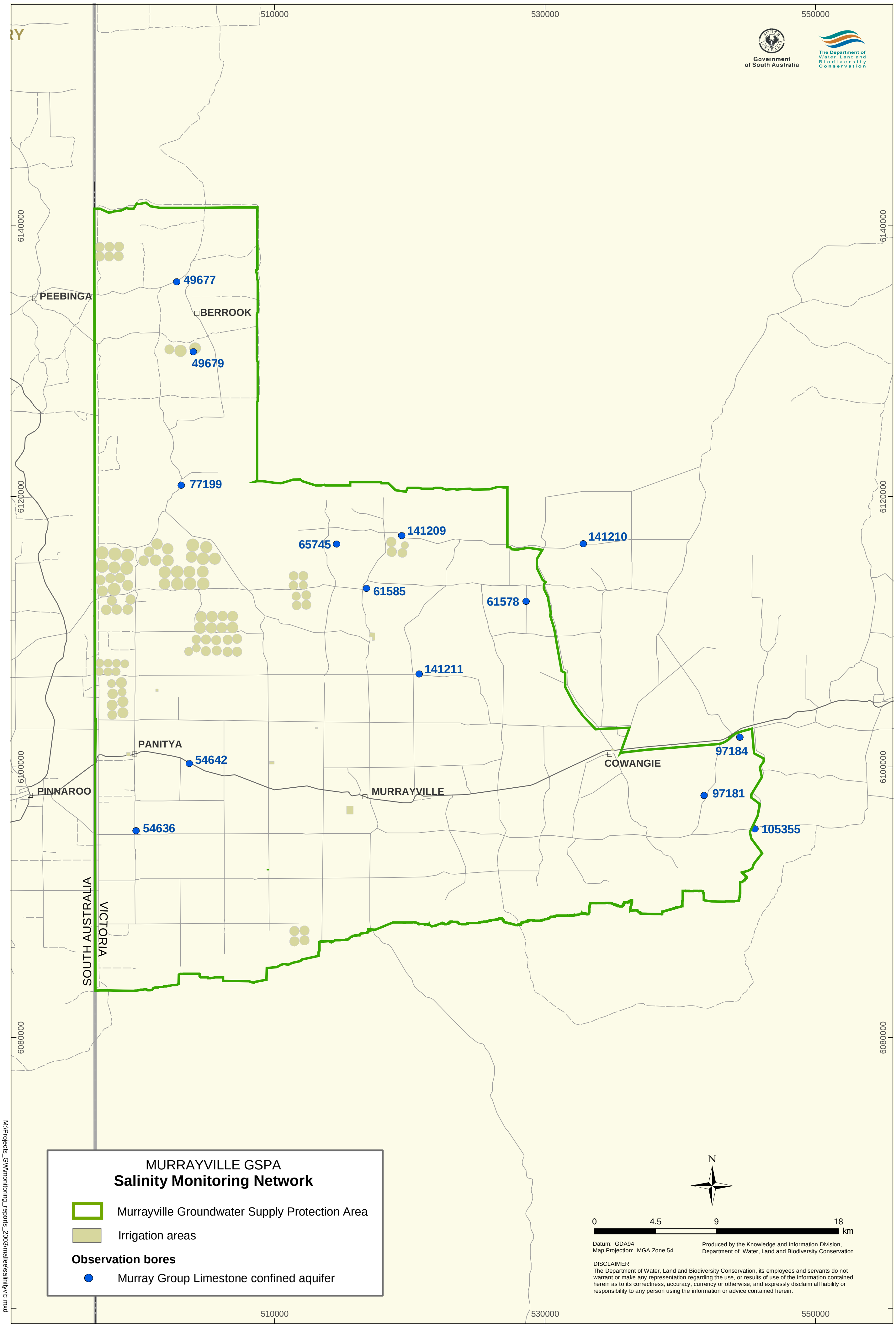
Figure 6


MURRAYVILLE GSPA
Salinity Monitoring Network
Murrayville Groundwater Supply Protection Area
Irrigation areas
Observation bores
Murray Group Limestone confined aquifer
Government of South Australia
The Department of Water, Land and Biodiversity Conservation
510000
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PEEBINGA
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SOUTH AUSTRALIA
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Datum: GDA94
Map Projection: MGA Zone 54
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Figure 7

5. GROUNDWATER EXTRACTIONS

Before examining trends from the observation networks, it is important to study the history of groundwater extraction that is driving the changes in groundwater levels. In the Mallee PWA, estimates of historical extraction were achieved by interviewing each irrigator where possible at the end of each irrigation season to obtain the number of hours of pumping and the pumping rate of each bore. This method was considered accurate to within 10–15% with a tendency to overestimate extractions (pumping rates are usually overestimated).

Meters have been progressively installed on all active irrigation bores in the Mallee PWA, which will result in more accurate estimates in the future. In the Murrayville WSPA, meters have been installed on all irrigation bores at the time of drilling.

Figure 8 shows the irrigation extractions for both the Mallee PWA and the Murrayville WSPA. A gradual rise in the Mallee PWA was observed until 1994–95 when a sharp increase took place. A steady rise has continued in the Mallee PWA until 2004–05 with extractions for 2005–06 showing a reduction to 28 200 ML. Extractions in Murrayville decreased to 4100 ML. The rising trend in the Mallee is not expected to increase indefinitely because there are few unused allocations in the areas of good quality groundwater. In areas where the salinity is over 1500 mg/L (2700 EC), usage is likely to remain low.

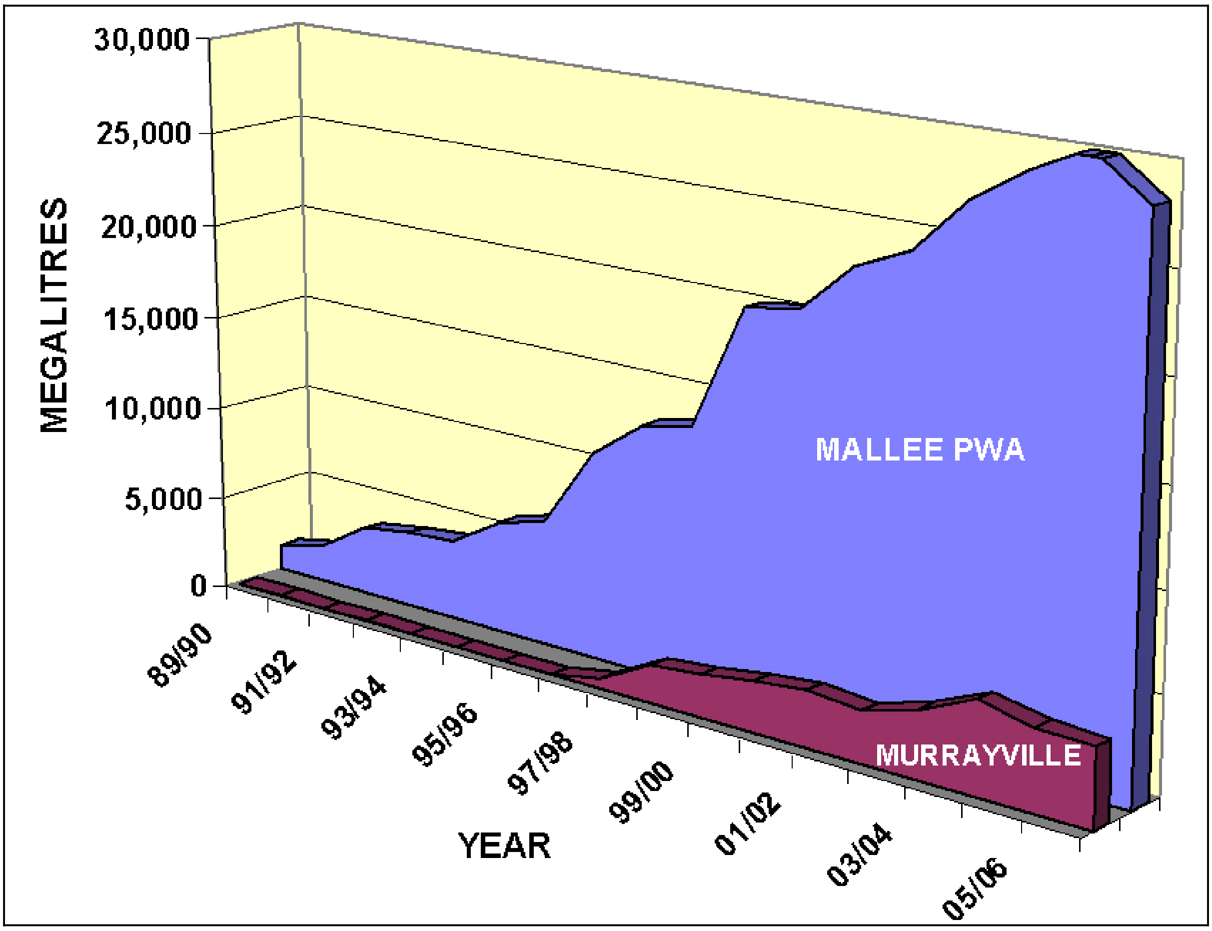


Figure 8. Groundwater extractions for Mallee PWA and Murrayville WSPA

6. WATER LEVEL TRENDS

Long term monitoring has detected drawdowns as a result of irrigation withdrawals from the Murray Group Limestone aquifer. The magnitude of the drawdowns depends on several factors – whether the aquifer is confined or not, and how concentrated the irrigation bores are located.

Drawdowns in the confined portion of the aquifer occur more quickly and are greater than drawdowns in the unconfined portion because they are an instant pressure response to pumping. In an unconfined aquifer, drawdowns only occur when water physically drains out of the sediments as a result of pumping, which is a much slower process. Drawdowns are a natural response to pumping, and should be monitored to ensure there are no adverse impacts that affect the sustainability of the resource.

Drawdowns are greater in areas of concentrated pumping, and this tends to occur in areas of low groundwater salinity and suitable soils. In areas where there is no irrigation, there is no regional drawdown and water levels are relatively constant. Monitoring results will be discussed for distinct management areas and the various aquifers.

6.1 PLIOCENE SANDS AND RENMARK GROUP AQUIFERS

As mentioned previously, there are no extractions from the Renmark Group confined aquifer, and only isolated stock use from the Pliocene Sands watertable aquifer. It can also be seen in Figure 9 that the watertable aquifer hydrographs (labelled as PS) show no observable response to either irrigation or the increased recharge following clearing in both management areas.

Similarly, the Renmark Group hydrographs (labelled as RG) show no response to irrigation from the overlying aquifer. This includes the new bore (PEB 35) which was drilled on the SA/Vic Border close to the area of maximum drawdown.

The lack of response in these aquifers suggests that volumes of induced leakage into the limestone aquifer are relatively low.

6.2 MURRAY GROUP LIMESTONE AQUIFER

6.2.1 NON-IRRIGATED AREAS

In areas located at some distance from irrigation where salinities are generally over 1500 mg/L, there is very little change in water levels in the MGL aquifer. This is certainly the case in the Mallee PWA as seen in Figure 10, although KKW 1 seems to be showing a very slight rising trend. Generally, the effects of clearing have not yet percolated down far enough to have an impact.

The Murrayville WSPA also contains areas where there is little change in water levels. Importantly, these areas include to the east of Murrayville where if a significant drop in water level occurred, a movement of saline groundwater from the east could result. The likelihood

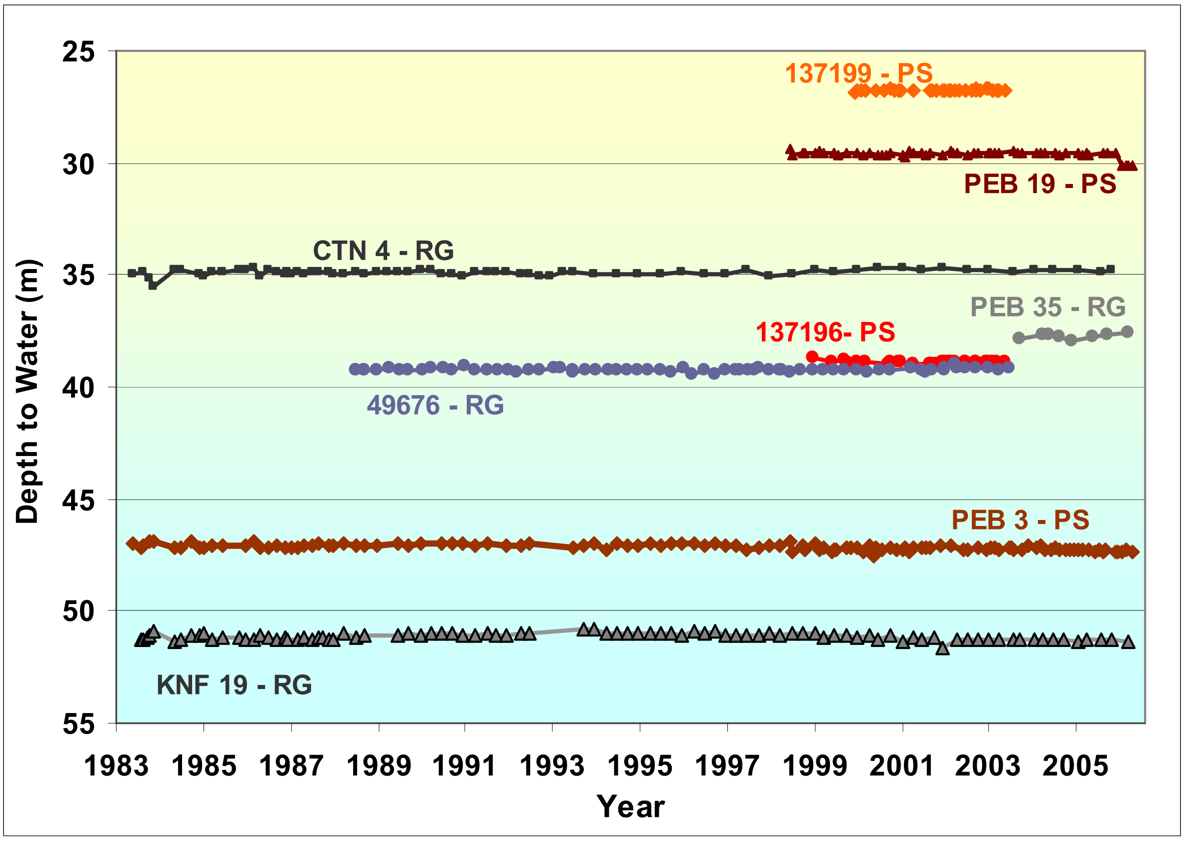


Figure 9. Hydrographs from Pliocene Sands and Renmark Group aquifers

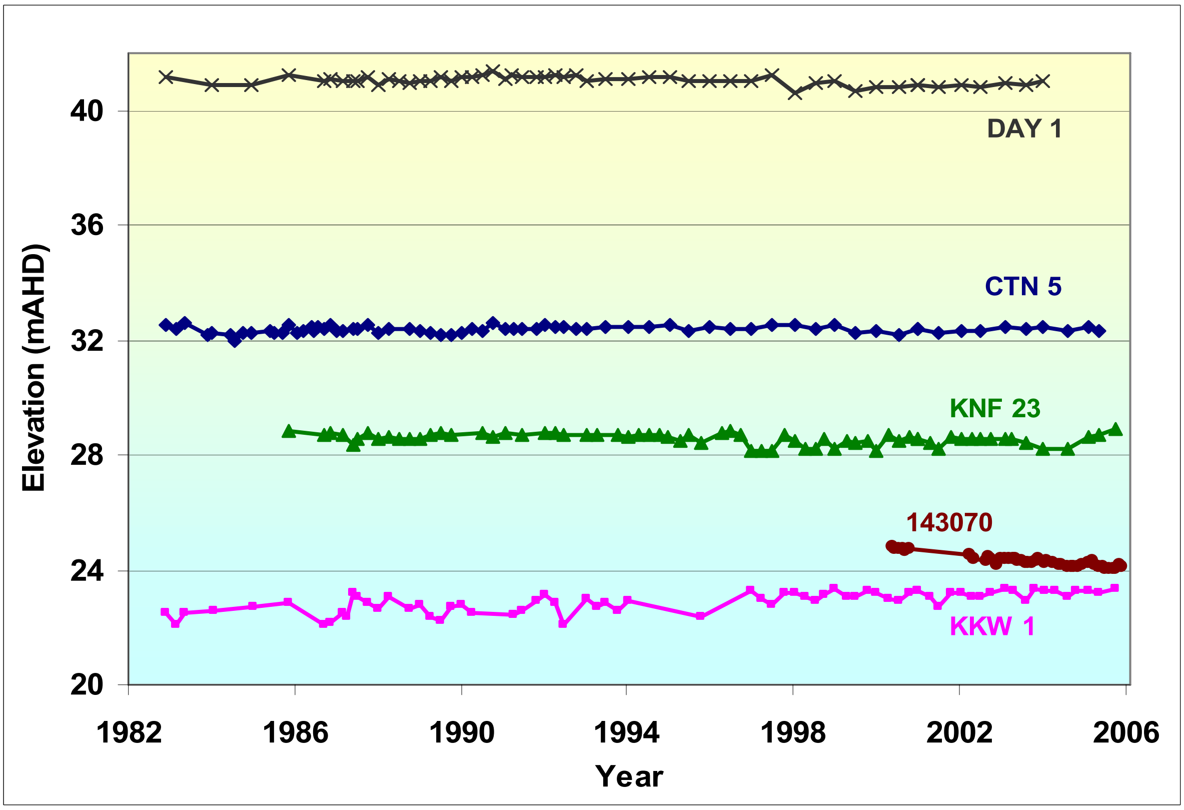


Figure 10. Hydrographs from non-irrigated areas in the Mallee PWA

of such inflows has been investigated using the Mallee groundwater model (Barnett and Osei-bonsu, 2006). The slight decline in bore 143 070 is most likely due to decreased hydrostatic loading by the overlying watertable which is falling in response to dry years.

6.2.2 ZONE 10A

Hydrographs from representative observation wells showing water level and salinity trends are displayed in Figure 11. Extraction volumes since 1994 are also presented. It can be seen that seasonal drawdowns have been mostly stable since 2000, despite the fact that extractions have increased every year since 2002. This trend indicates an equilibrium has been reached in areas of concentrated pumping, and underlines the robust nature of the resource. In particular, the drawdowns have not increased markedly, if at all, since licenced extractions rose to over 14 000 ML in 2004–05. There was a decrease in pumping in 2005–06 to 13 280 ML.

Salinity levels show no change, except for several wells that show a decreasing trend due to the increased irrigation-induced inflow of lower salinity groundwater from the south.

6.2.3 ZONE 11A

The water level, salinity and extraction trends for Zone 11A are presented in Figure 12. After falling in response to increasing pumping since irrigation began in the early 1990s, water level trends have been stable since 2002. In areas where pumping has decreased recently, water levels are rising. Salinity trends are stable.

6.2.4 ZONE 10B

Figure 13 shows that drawdowns have increased in parallel with extractions from 1997 until 2004, when a reduction in pumping lead to a widespread recovery in water levels. This has occurred despite increasing extractions in the adjacent Zone 10A.

Salinity levels are stable, with some showing a slight reducing trend due to low salinity inflows. Some wells have shown a sudden rise in salinity (eg 54642) due to corrosion of steel casing, which has allowed contamination by the overlying saline Pliocene Sands aquifer.

6.2.5 HD OF PARILLA

Monitoring has shown water level trends in this intensive area of irrigation have been mostly stable since 2000 in response to reasonably constant extractions in the range 6000–7000 ML/yr (Fig. 14). There has been some movement of irrigation away from the area of concentration to the east of Parilla township.

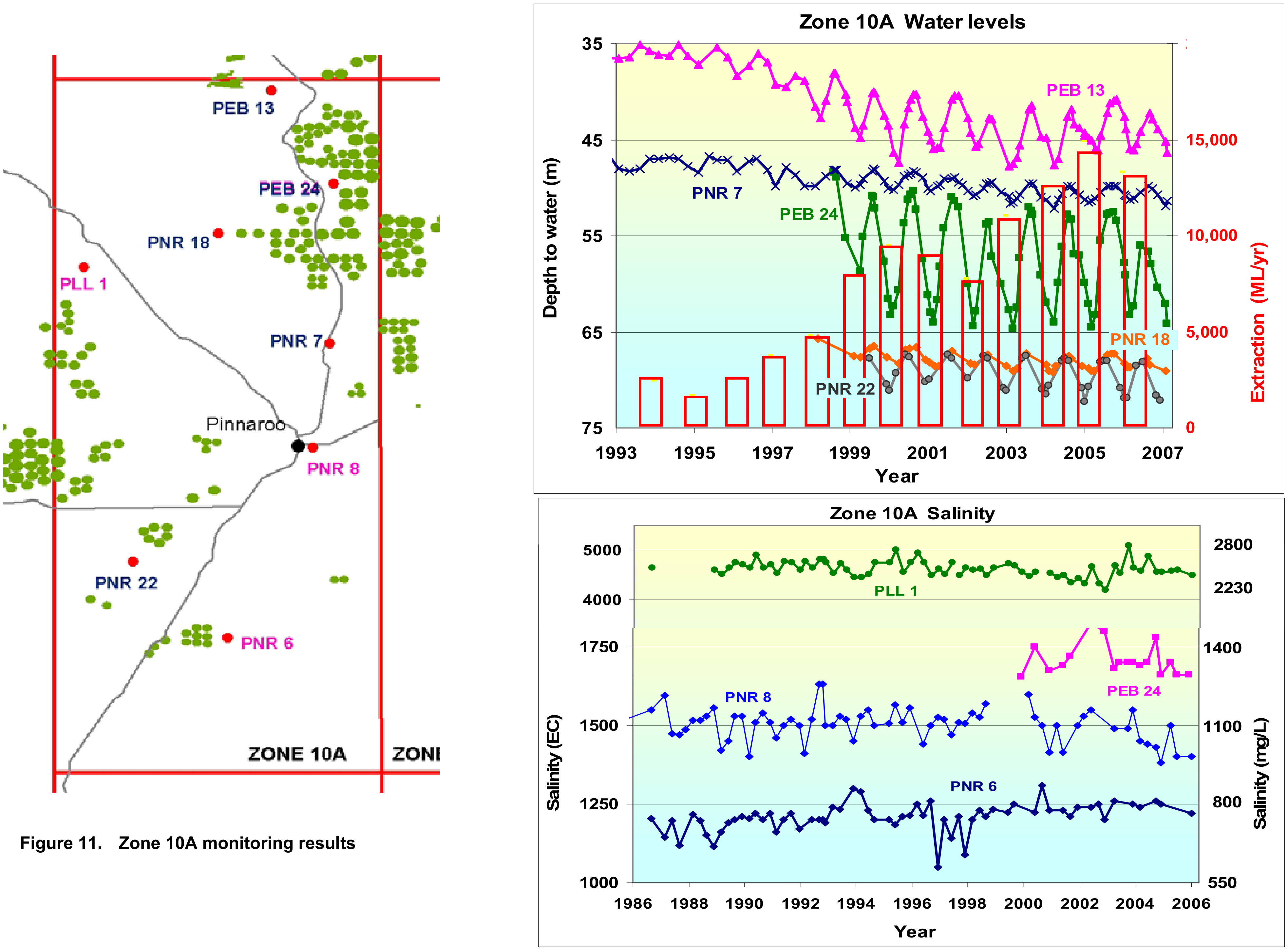
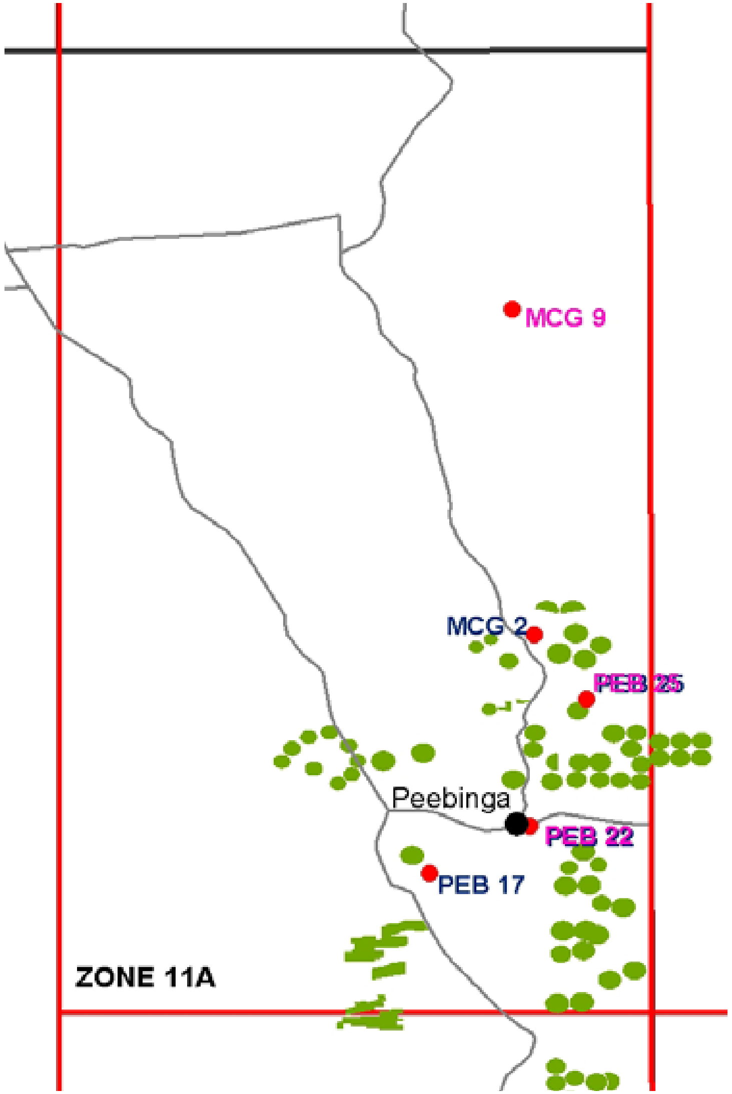
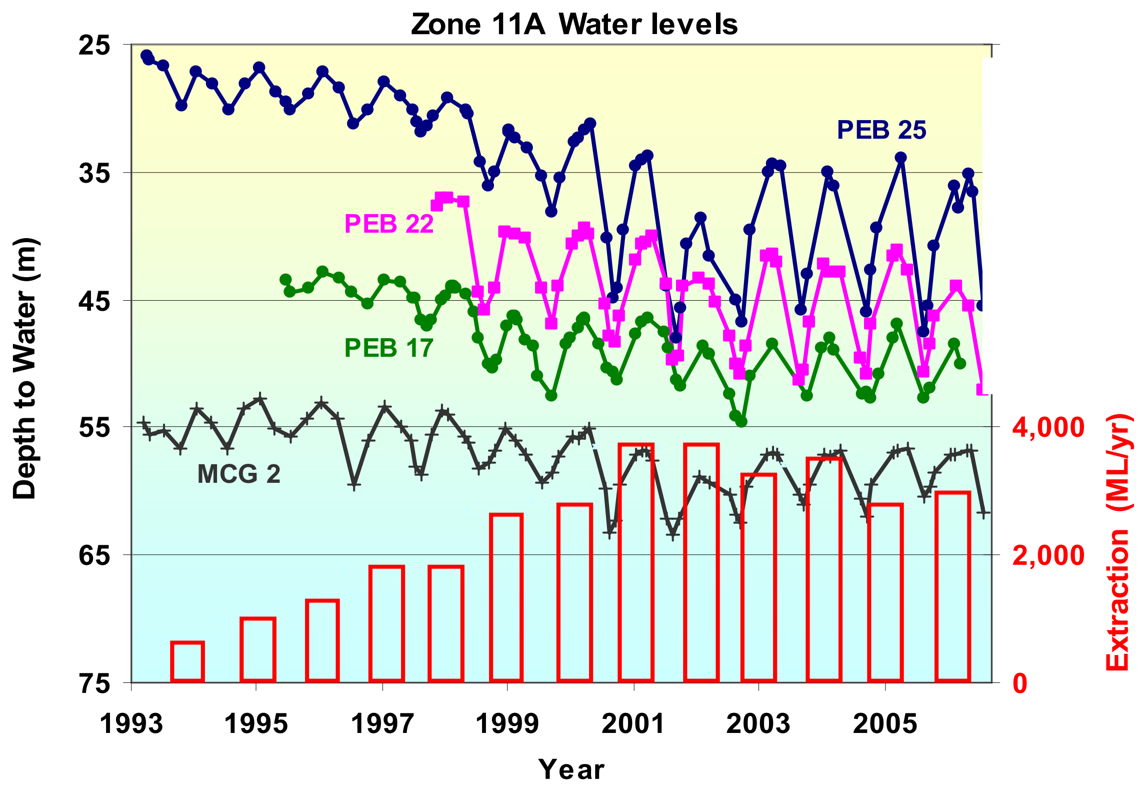


Figure 11. Zone 10A monitoring results





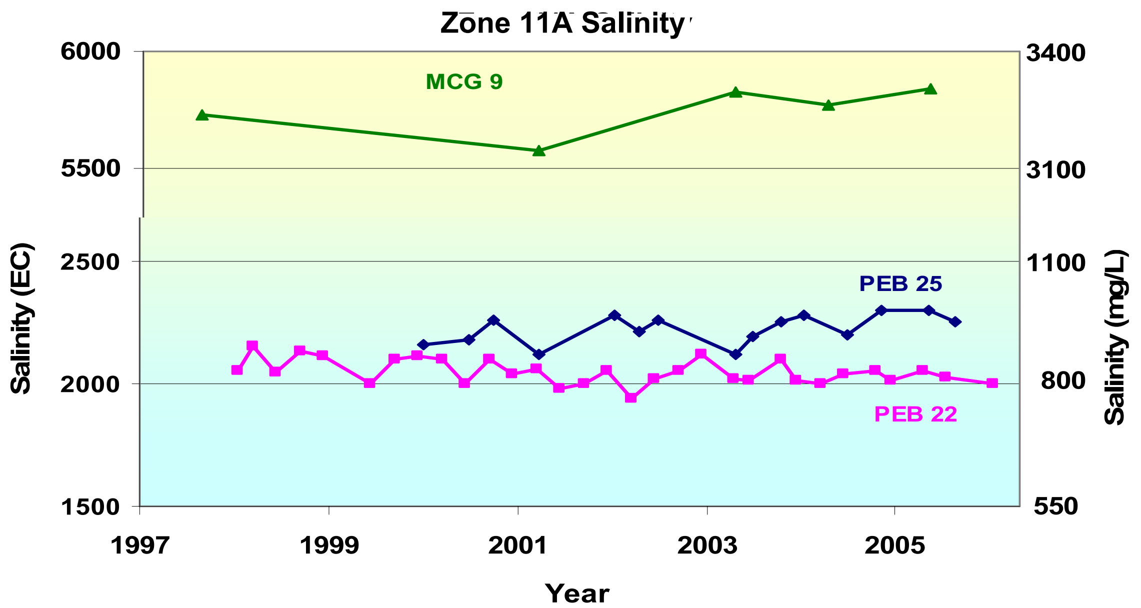


Figure 12. Zone 11A monitoring results

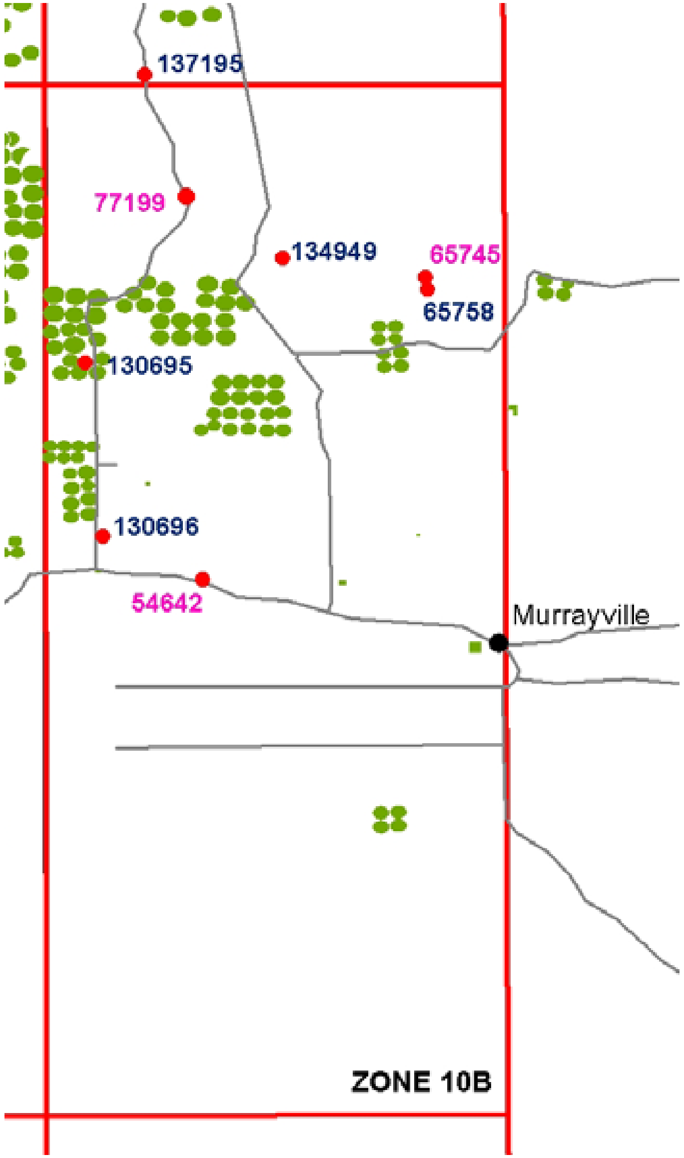
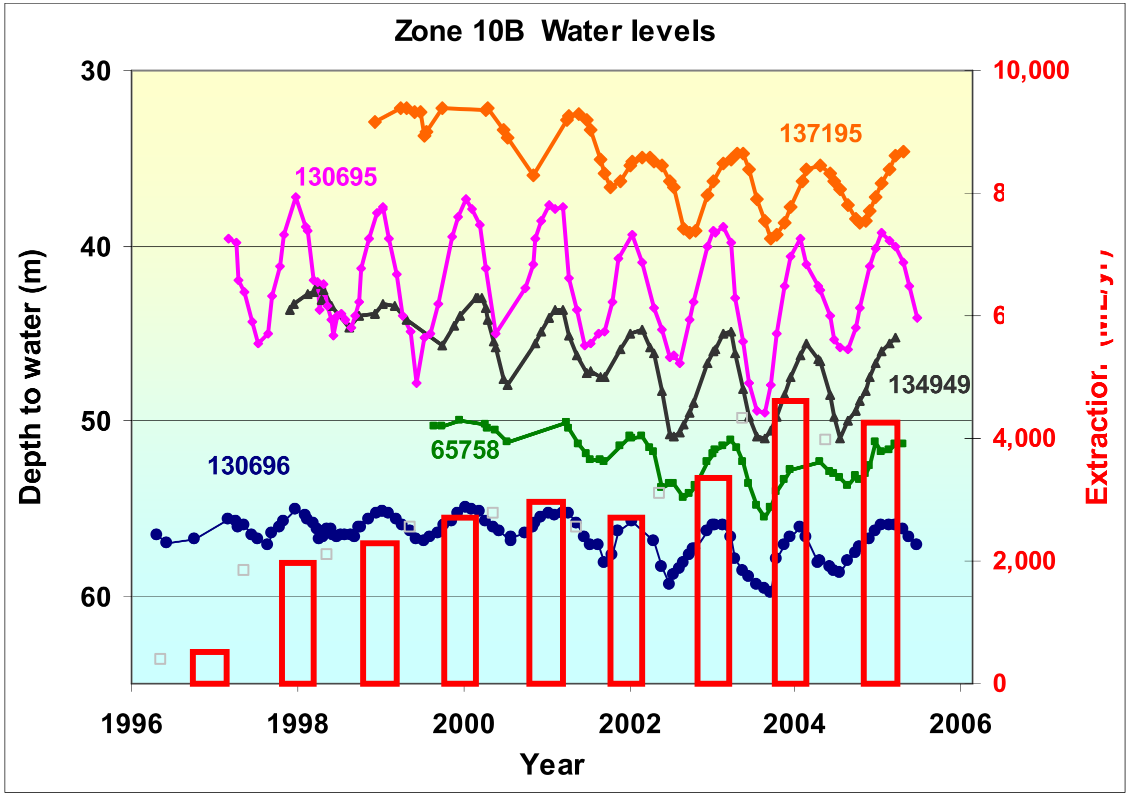
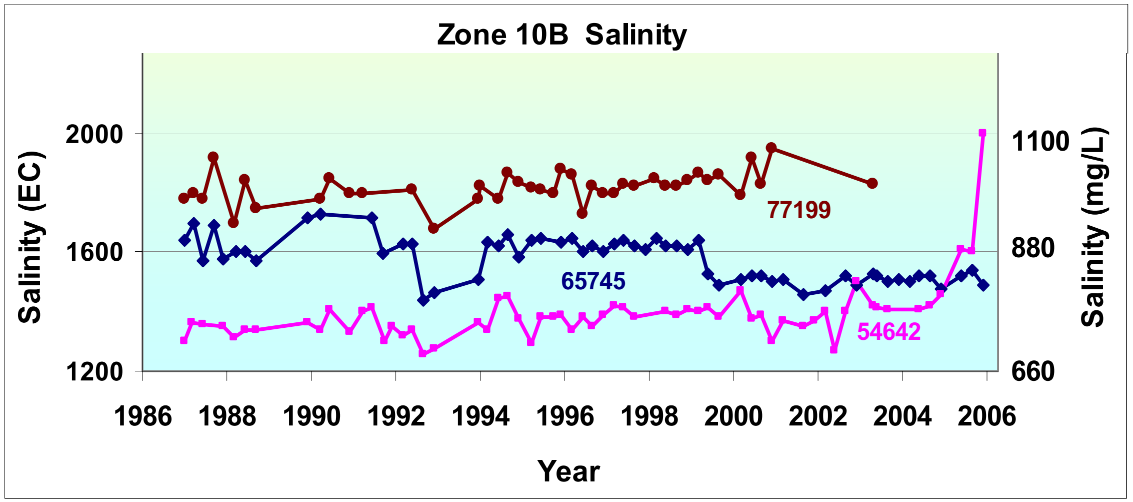
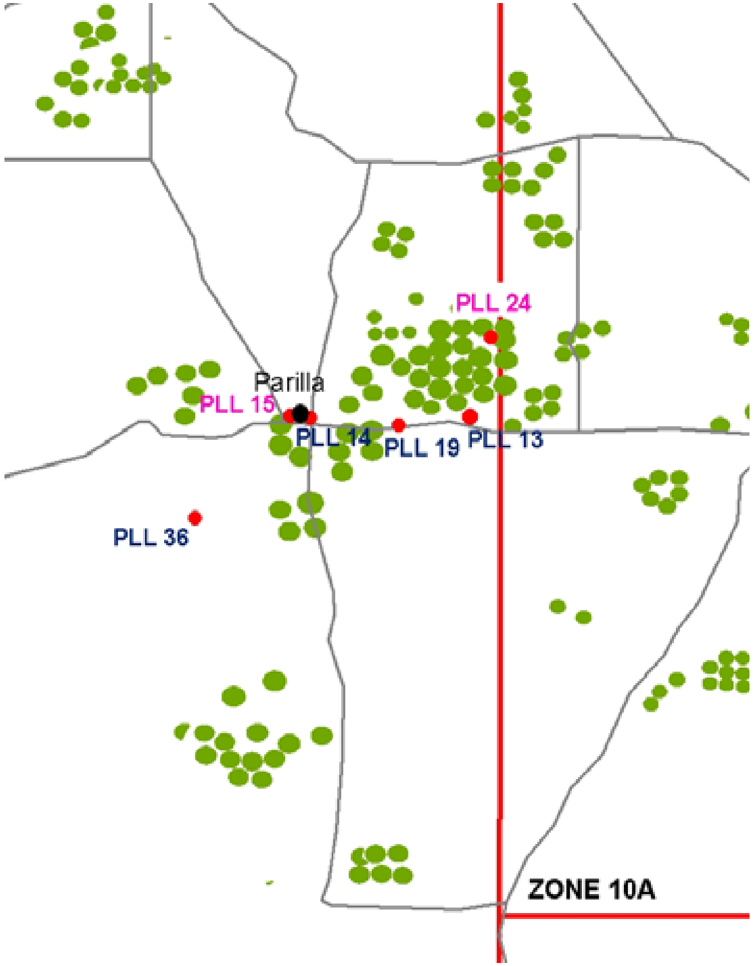
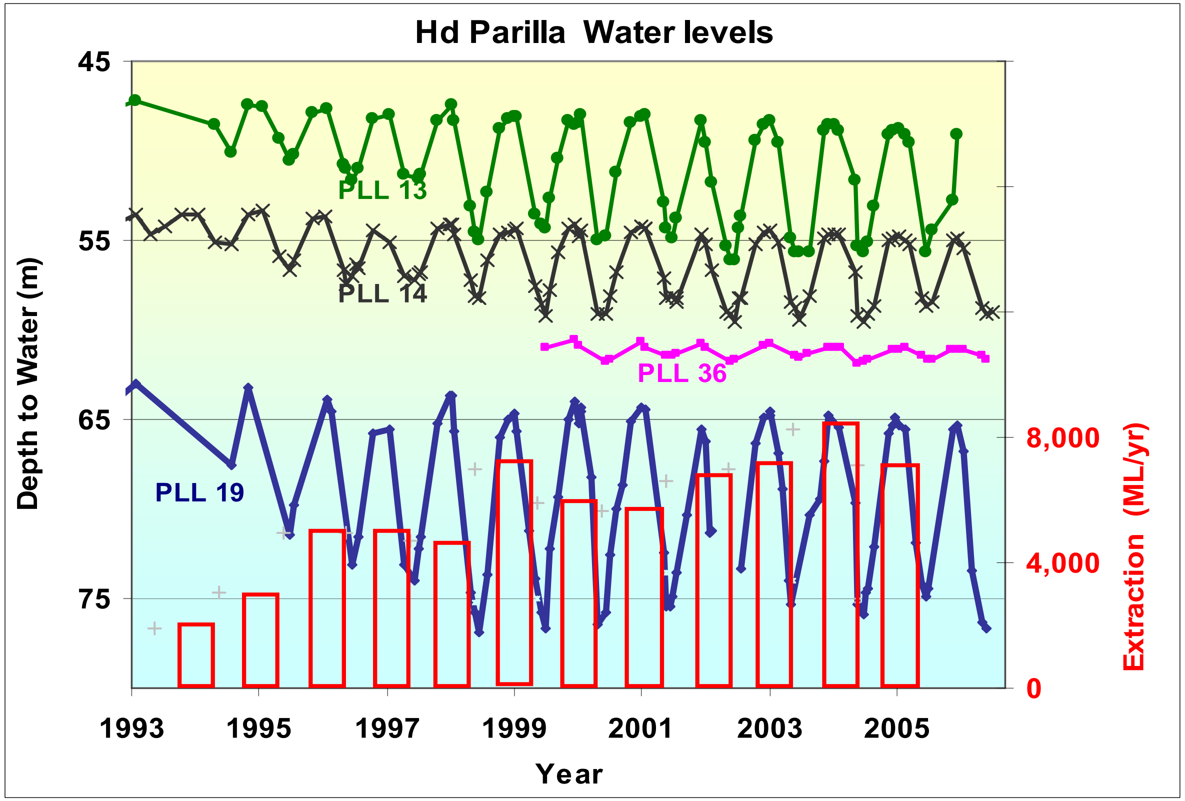


Figure 13. Zone 10B monitoring results









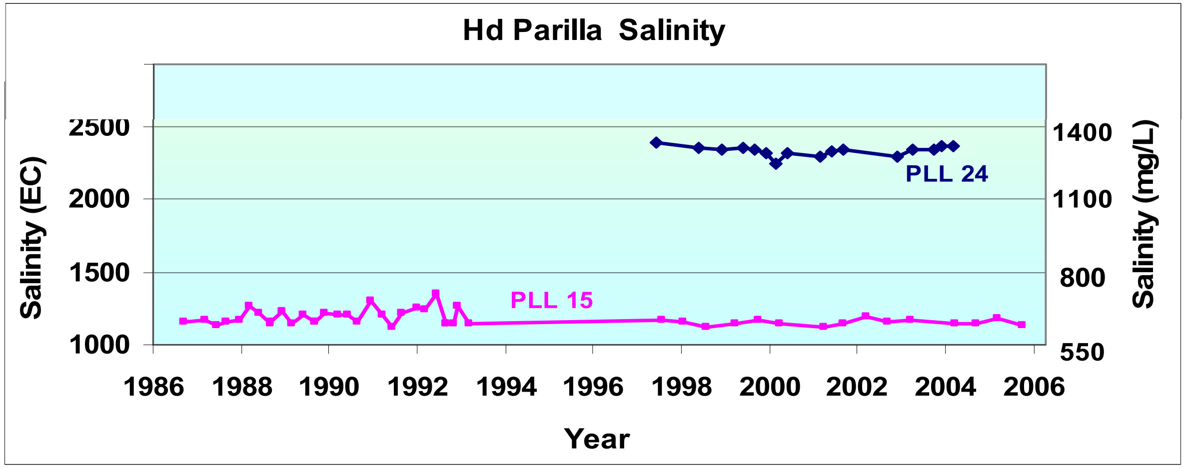


Figure 14. Hd Parilla monitoring results

7. REGIONAL FLOW PATTERNS

The previous discussions have examined trends at individual sampling points. To help obtain a regional perspective, contour plans have been prepared of the seasonal drawdown during the last two irrigation seasons. In addition, contours of the pressure surface of the limestone aquifer were created at the time of peak recovery to determine regional groundwater flow patterns at this time. Contours of residual drawdown since 1990 were also constructed to depict the long term impacts of irrigation. These terms are explained in Figure 15.

It should be stressed that the areas of irrigation shown in green in Figures 4–7 and these drawdown plans in this report represent the total extent, and not the area irrigated in any one season. The actual irrigated area at any time is about 30% of the green areas shown due to the rotational requirements of vegetable irrigation.

Contours are shown for the 2003–04 and 2004–05 irrigation seasons. Contours for the 2000–01 to 2002–03 seasons are presented in Barnett (2003). Figure 16A shows the pressure surface contours for 2003 indicating groundwater flow to the north with some concentration of flow toward Peebinga due to irrigation drawdowns. There is a small area where reversal of groundwater flow from the north is observed, driven by very small gradients. The seasonal drawdowns for 2003–04 (Fig. 16B) show similar patterns to previous years with some exceptions. In the Parilla area, pumping has been more dispersed leading to a decrease in the depth of the cone of depression, but a lateral spread to the west and northeast. To the southwest of Peebinga, reduced pumping has decreased drawdown in this area. Pumping has also spread to the southwest of Pinnaroo.

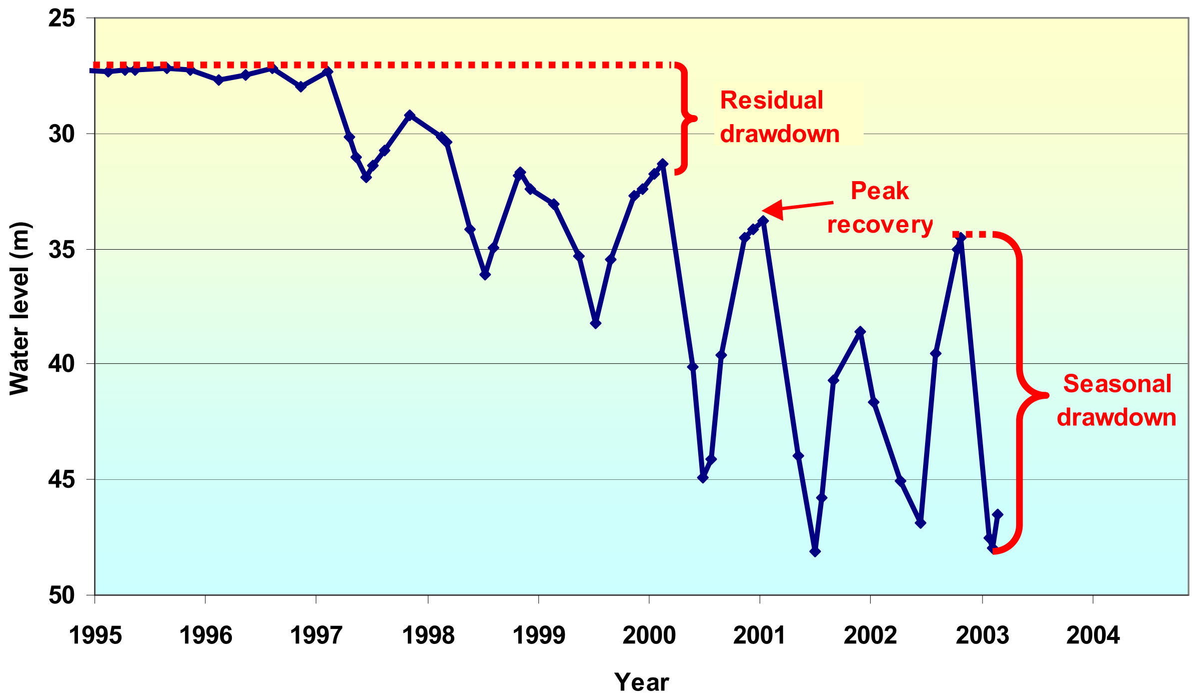


Figure 15. Explanation of contour plans

Figure 17A shows a very similar pattern of groundwater flow in 2004 to previous years, but with a reduced area of flow reversal in the north as a result of reduced pumping in Zone 11A. The seasonal 2004–05 drawdowns (Fig. 17B) show noticeable decreases in the Murrayville WSPA and Zone 11A, as well as a small decline in the vicinity of the maximum drawdown in Zone 10A. New extractions to the north of Lameroo have widened the drawdown cone around Parilla, although the depth of the cone has stabilised.

Groundwater flow in 2005 (Fig. 18A) shows a further reduction in the area of flow reversal in response to reduced pumping in Zone 11A. Figure 18B displays the long term residual drawdown from 1990–2005 due to irrigation pumping (see explanation in Fig. 15). The largest residual drawdowns of up to 9 m occur at centres of concentrated pumping where seasonal drawdowns are greatest.

7.1 DISCUSSION

The ramifications of reversals in groundwater flow toward centres of concentrated pumping were discussed in Barnett (2003). Although the area in Zone 11A has reduced in size over the last two seasons as a result of reduced extractions, changes in ownership of some enterprises will probably result in increased pumping to previous levels and an increase in flow reversal. Predictions by the Mallee groundwater model (Barnett and Osei-bonsu, 2006), have shown the salinity impacts of this increase in flow reversal to be insignificant.

There is no evidence of any flow reversal during the non-pumping season in the Murrayville WSPA, with northerly flow paths maintained until the Boltons – Berrook area. It is only in this area that there is a permanent westerly gradient. Also shown in Figure 18A are the salinity contours for the limestone aquifer, which show that in this area of westward movement, salinities are less than 3000 mg/L (5400 EC). Again, the Mallee groundwater model predicts minimal salinity impacts.

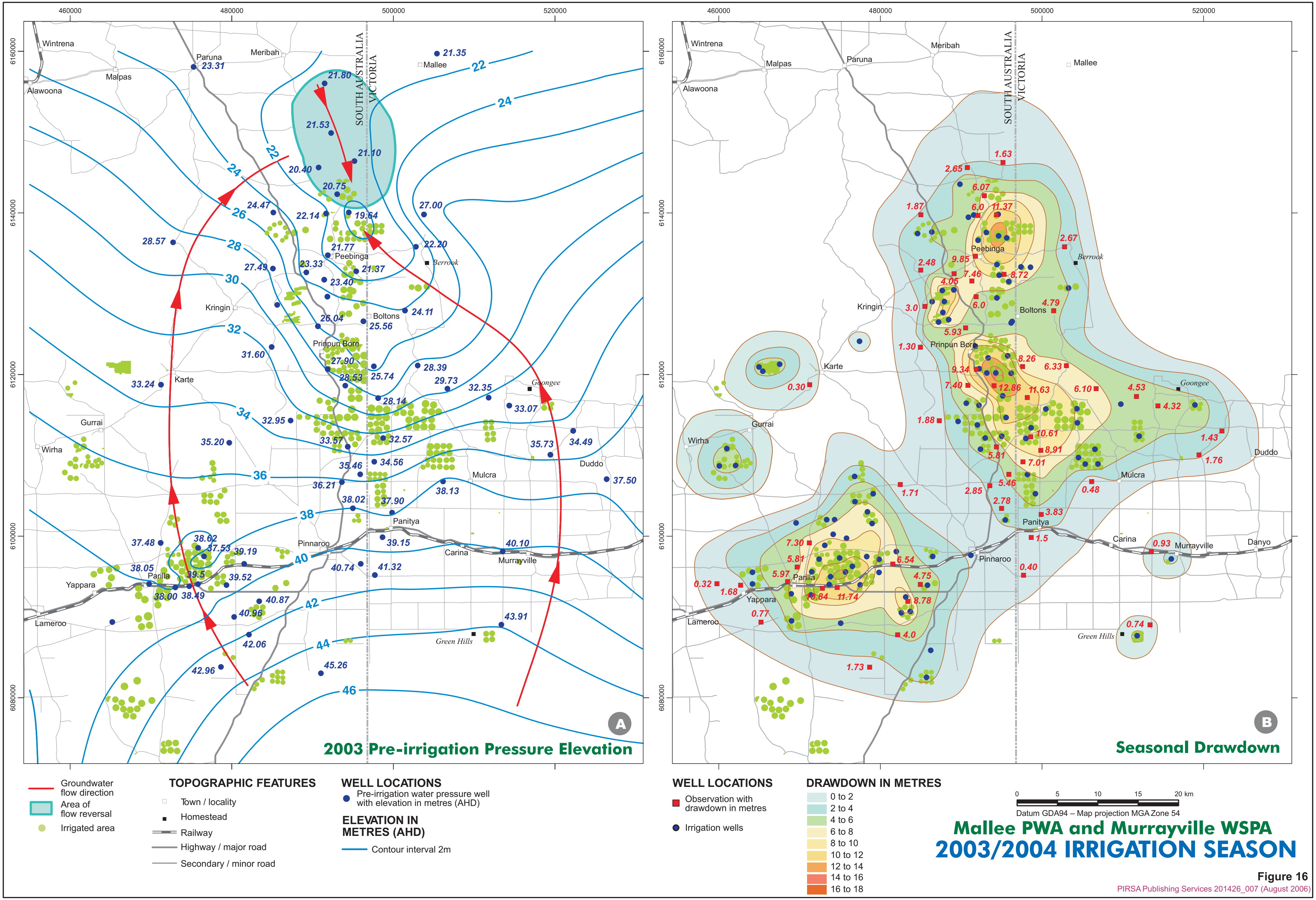


Figure 16

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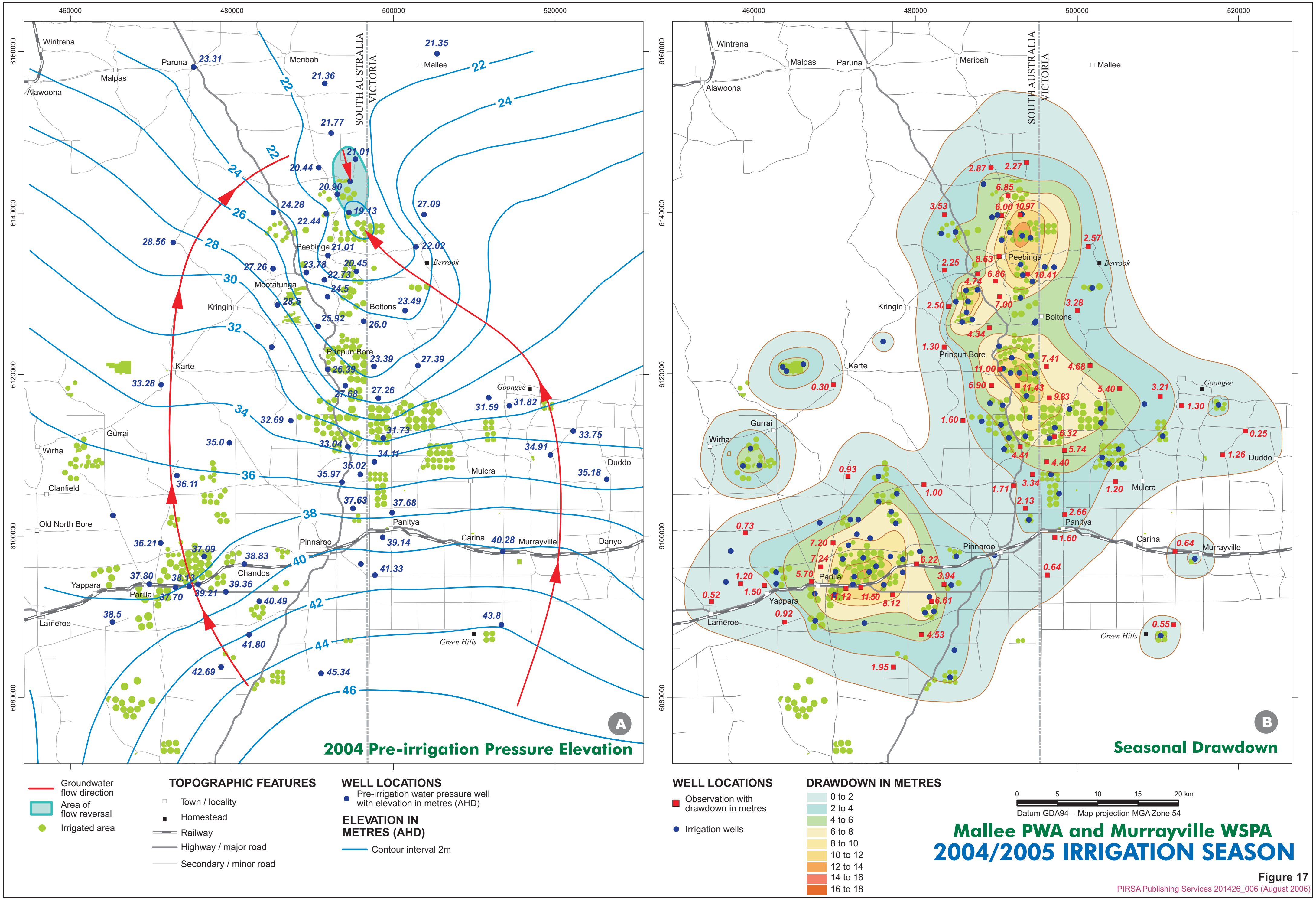
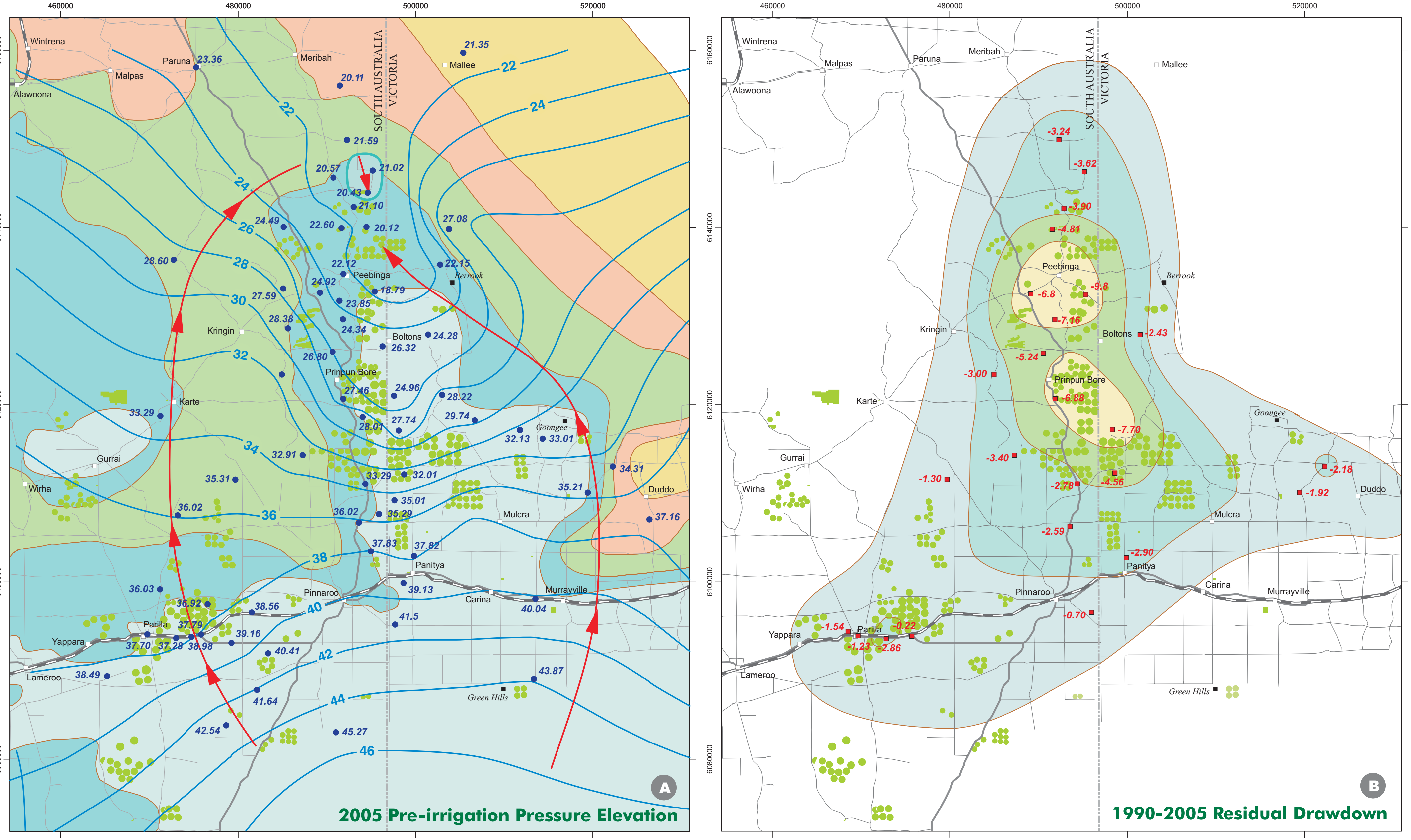

2004 Pre-irrigation Pressure Elevation
A
Seasonal Drawdown
B
SOUTH AUSTRALIA
VICTORIA
Wintrena
Paruna
Meribah
Mallee
Malpas
Alawoona
Peebinga
Berrook
Mootatunga
Kringin
Boltons
Pinpun Bore
Karte
Goongee
Gurrai
Wirha
Clanfield
Mulcra
Duddo
Old North Bore
Panitya
Pinnaroo
Carina
Murrayville
Danyo
Chandos
Yappara
Parilla
Lameroo
Green Hills
Groundwater flow direction
Area of flow reversal
Irrigated area
TOPOGRAPHIC FEATURES
Town / locality
Homestead
Railway
Highway / major road
Secondary / minor road
WELL LOCATIONS
Pre-irrigation water pressure well with elevation in metres (AHD)
ELEVATION IN METRES (AHD)
Contour interval 2m
WELL LOCATIONS
Observation with drawdown in metres
Irrigation wells
DRAWDOWN IN METRES
0 to 2
2 to 4
4 to 6
6 to 8
8 to 10
10 to 12
12 to 14
14 to 16
16 to 18
0 5 10 15 20 km
Datum GDA94 – Map projection MGA Zone 54
Mallee PWA and Murrayville WSPA
2004/2005 IRRIGATION SEASON
Figure 17
PIRSA Publishing Services 201426_006 (August 2006)



Groundwater flow direction

Area of flow reversal

Irrigated area

TOPOGRAPHIC FEATURES

Town / locality

Homestead

Railway

Highway / major road

Secondary / minor road

WELL LOCATIONS

Pre-irrigation water pressure well with elevation in metres (AHD)

ELEVATION IN METRES (AHD)

Contour interval 2m

LIMESTONE SALINITY (mg/L)

500 - 1000

1000 - 1500

1500 - 3000

3000 - 7000

7000 - 14000

WELL LOCATIONS

Observation with drawdown in metres

DRAWDOWN IN METRES

0 to 2

2 to 4

4 to 6

6 to 8

8 to 10

10 to 12

12 to 14

14 to 16

16 to 18

0 5 10 15 20 km

Datum GDA94 – Map projection MGA Zone 54

Mallee PWA and Murrayville WSPA
2005 IRRIGATION SEASON

Figure 18

PIRSA Publishing Services 201426_005 (August 2006)

8. NETWORK UPGRADE

8.1 MALLEE PWA

Recommendations for expansion of the network and bore rehabilitation outlined in Barnett (2003) have largely been followed. Fourteen additional bores are being monitored, and five bores have been deepened. The only gap remaining is in the Gurrai – Karte area.

A network in the Wanbi area has been established to monitor the impacts of pumping for the impending mineral sand mining operation. This monitoring will be carried out by the mining company.

8.2 MURRAYVILLE WSPA

The areal coverage of both the limestone and overlying Pliocene Sands aquifers networks has been improved by the drilling of four new observation wells in gaps identified in Barnett (2003). The only significant gap remains in the Berrook area to the north where groundwater movement turns westerly. Several more bores are required in the area to confirm this movement, including a replacement for bore 49678.

The accuracy of the drawdown and elevation contours would be improved if the frequency of monitoring bores 54612, 54613, 61571, 61572 and 49677 were increased to monthly.

As mentioned previously, an improved salinity testing method is required for the monitoring bores in the Cowangie area.

9. CONCLUSIONS AND RECOMMENDATIONS

This second review of monitoring trends (both water level and salinity) in the Mallee PWA and the Murrayville WSPA has found no major adverse impacts due to irrigation extractions from the Murray Group Limestone aquifer, and has continued to confirm the robustness of the groundwater resource.

Generally, in areas where irrigation has been established for some time and extractions are relatively stable, eg Parilla, drawdowns have reached an equilibrium and the extent of the cone of drawdown remains unchanged. Decreases in extraction in the Murrayville WSPA and Zone 11A have reduced drawdown in these areas by several metres. New irrigation to the north of Lameroo has extended the drawdown cone west from Parilla, but because the aquifer is virtually unconfined in this area, the magnitude of the regional drawdown is not expected to exceed two metres.

Salinity trends are stable, or decreasing in some areas where drawdown is accelerating the inflow of lower salinity groundwater from the south.

The area of groundwater flow reversal north of Peebinga has reduced in size over the last two seasons as a result of reduced extractions, however changes in ownership of some enterprises will probably result in increased pumping to previous levels and a small increase in flow reversal. Predictions by the Mallee groundwater model have shown the salinity impacts of this increase in flow reversal to be insignificant.

The onset of drought during 2006 is expected to have a similar impact as in 2002, with incomplete recovery during spring due to the early commencement of irrigation.

Recommendations are still in place to improve the coverage of the monitoring network in the Berrook area in Zone 11B. A significant increase in monitoring activity will occur in the Mindarie area when heavy mineral sand mining commences next year.

GLOSSARY

Act (the). In this document, refers to The *Natural Resources Management Act* (South Australia) 2004.

Adaptive management. A management approach, often used in natural resource management, where there is little information and/or a lot of complexity and there is a need to implement some management changes sooner rather than later. The approach is to use the best available information for the first actions, implement the changes, monitor the outcomes, investigate the assumptions and regularly evaluate and review the actions required. Consideration must be given to the temporal and spatial scale of monitoring and the evaluation processes appropriate to the ecosystem being managed.

Aquifer. An underground layer of rock or sediment which holds water and allows water to percolate through.

Aquifer, confined. Aquifer in which the upper surface is impervious and the water is held at greater than atmospheric pressure. Water in a penetrating well will rise above the surface of the aquifer.

Aquifer, unconfined. Aquifer in which the upper surface has free connection to the ground surface and the water surface is at atmospheric pressure.

Aquitard. A layer in the geological profile that separates two aquifers and restricts the flow between them.

Cone of depression. An inverted cone-shaped space within an aquifer caused by a rate of groundwater extraction which exceeds the rate of recharge. Continuing extraction of water can extend the area and may affect the viability of adjacent wells, due to declining water levels or water quality.

DWLBC. Department of Water, Land and Biodiversity Conservation. Government of South Australia.

EC. Abbreviation for electrical conductivity. 1 EC unit = 1 micro-Siemen per centimetre (µS/cm) measured at 25 degrees Celsius. Commonly used to indicate the salinity of water.

Hydrogeology. The study of groundwater, which includes its occurrence, recharge and discharge processes and the properties of aquifers. *(See hydrology.)*

Irrigation. Watering land by any means for the purpose of growing plants.

Irrigation season. The period in which major irrigation diversions occur, usually starting in August–September and ending in April–May.

Megalitre (ML). One million litres (1 000 000).

Model. A conceptual or mathematical means of understanding elements of the real world which allows for predictions of outcomes given certain conditions. Examples include estimating storm runoff, assessing the impacts of dams or predicting ecological response to environmental change.

Potentiometric head. The potentiometric head or surface is the level to which water rises in a well due to water pressure in the aquifer.

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Barnett, SR, 2003. Mallee PWA and Murrayville WSPA - Groundwater Monitoring Status Report 2003. *South Australia. Department of Water, Land and Biodiversity Conservation. DWLBC Report* 2003/29.

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