CENTRAL ADELAIDE PWA

GROUNDWATER LEVEL AND SALINITY STATUS REPORT

2009–10

DEPARTMENT FOR WATER

Government of South Australia
Department for Water

SUMMARY 2009–10

The Central Adelaide Prescribed Wells Area (PWA) encompasses the Adelaide metropolitan region; it extends from Outer Harbour in the north to Noarlunga in the south and is bound to the east by the Mount Lofty Ranges. It is a regional-scale resource for which groundwater has been prescribed under South Australia's *Natural Resources Management Act 2004*. A Water Allocation Plan is in the process of being produced to provide for the sustainable management of the groundwater resources.

Although the Central Adelaide PWA is prescribed, licences have not been issued and there is currently no comprehensive metering of extractions. The most recent estimate of use in the Metropolitan Area is about 10 000–12 000 ML/yr, with most extractions coming from the T1 aquifer. Domestic bores completed in the shallow Quaternary aquifers are thought to extract about 500 ML/yr. Groundwater use for all purposes in the surrounding fractured rock aquifers and the Noarlunga Embayment is estimated to be just under 1000 ML/yr.

Groundwater monitoring is mainly concentrated in areas of high groundwater use which are the sedimentary aquifers beneath the Metropolitan Area and the fractured rock aquifer in the One Tree Hill area. Very little monitoring has been carried out elsewhere due to the low demand for groundwater.

Groundwater levels in the shallow Quaternary aquifers have declined by up to a metre due to below-average rainfall since the 2006 dry winter, however the high rainfall in 2010 has led to a strong recovery in water levels in some areas.

Most extractions occur from the confined T1 aquifer with concentrations of pumping in the Thebarton area (industrial purposes) and the West Lakes–Grange area (golf course irrigation). Long-standing depressions in the pressure level surface have formed in these areas, but groundwater water level trends appear to have stabilised which suggests a new equilibrium has been established. No adverse groundwater salinity trends have been observed in the T1 aquifer.

Industrial extractions from the confined T2 aquifer occur at Regency Park and also at Osborne where a significant increase in pumping commenced in 2006, causing a reduction in the pressure level of up to seven metres. Recent monitoring has indicated the groundwater level decline is stabilising with a new equilibrium being established. Limited groundwater salinity monitoring suggests a long-term increase of 10 mg/L/yr, but because of large data gaps, continued monitoring is required to confirm the trend.

Both groundwater levels and salinities in the fractured rock aquifers in the Adelaide Hills are showing little change, but where these aquifers underlie the Tertiary sediments in the north-eastern suburbs and do not directly receive recharge from rainfall, some small rising salinity trends have been detected.

ASSESSMENT OF STATUS

The Central Adelaide PWA has been assigned a status of yellow "Adverse trends indicating low risk to the resource in the medium term" based on current trends. This status is supported by:

- a significant reduction in pressure levels in the T2 aquifer since 2006 due to an increase in industrial extraction. However, the rate of decline decreased in 2009–10.
- limited salinity monitoring that suggests a long-term increase of 10 mg/L/yr in the T2 aquifer. However, this apparent increasing trend, if continued, will not lead to a change in the current beneficial uses of the resource in the short to medium term.
- both groundwater and salinity levels in the T1 aquifer and the fractured rock aquifers in the Adelaide Hills are showing little change.

Continued monitoring is required to establish reliable salinity trends in both the T1 and T2 aquifers.

STATUS (2009–10)

No adverse trends, indicating a stable or improving situation

Trends are either stable (no significant change) or improving (i.e. decreasing salinity or rising water levels).

Adverse trends indicating low risk to the resource in the medium term

Observed adverse trends are gradual and if continued, will not lead to a change in the current beneficial uses of the groundwater resource for at least 15 years. Beneficial uses may be drinking water, irrigation or stock watering.

Adverse trends indicating high risk to the resource eventuating in the short to medium term

Observed adverse trends are significant and if continued, will lead to a change in the current beneficial uses of the groundwater resource in about 10 years.

Degradation of the resource compromising present use within the short term

Trends indicate degradation of the resource is occurring, or will occur within 5 years. Degradation will result in a change in the beneficial use (i.e. no longer suitable for drinking or irrigation purposes) and may take the form of increasing groundwater salinities, or a fall in the groundwater levels such that extractions from the aquifer may not be possible.

BACKGROUND

The Central Adelaide Prescribed Wells Area (CAPWA) encompasses the Adelaide metropolitan region; it extends from Outer Harbour in the north to Noarlunga in the south and is bound to the east by the Mount Lofty Ranges (Fig. 1). It is a regional-scale resource for which groundwater has been prescribed under South Australia's *Natural Resources Management Act 2004*. A Water Allocation Plan is in the process of being produced to provide for the sustainable management of the groundwater resources.

HYDROGEOLOGY

The CAPWA includes several different hydrogeological regimes encompassing both sedimentary and fractured rock aquifers (Fig. 1). They include:

- the Adelaide Plains Sub-basin
- the Golden Grove Embayment
- the Noarlunga Embayment
- the fractured rock aquifers of the Adelaide Hills.

Adelaide Plains Sub-basin and Golden Grove Embayment

These two areas comprise the sedimentary aquifers that underlie the Adelaide Plains. There are two main aquifers, each with differing yield characteristics and as a result, different types of users. These are the shallow Quaternary aquifers and the deep confined Tertiary aquifers.

Quaternary Aquifers

The main lithology of the Quaternary sediments beneath Adelaide is mottled clay and silt known as the Hindmarsh Clay, which contains up to six thin interbedded sand and gravel layers. These layers form thin aquifers which are designated Q1 to Q6 in order of increasing depth. The shallowest Q1 aquifer lies at depths between 3–10 m below ground level with an average thickness of 2 m. The deepest occurs up to 50 m below ground. Householders taking groundwater from domestic bores to water gardens tap into these aquifers which provide relatively low yields of up to 3 L/sec.

Since 1990, about 2600 domestic bores have been drilled in the metropolitan area, and of these, an estimated 2000 are thought to be operational.

Confined Tertiary Aquifers

These deep aquifers are the largest and most important groundwater resource in the Adelaide metropolitan area. They comprise layers of sand and limestone separated by thin but effective clay confining layers. The area can be divided into two main provinces; the Golden Grove Embayment and the Adelaide Plains Sub-basin with the Para Fault forming the boundary (Fig. 2). A geological cross section shows significant differences in the thickness and extent of the various Tertiary aquifers in these provinces (Fig. 2). As with the Quaternary aquifers, the Tertiary aquifers are numbered with increasing depth below the ground surface, with the shallowest designated the T1 aquifer.

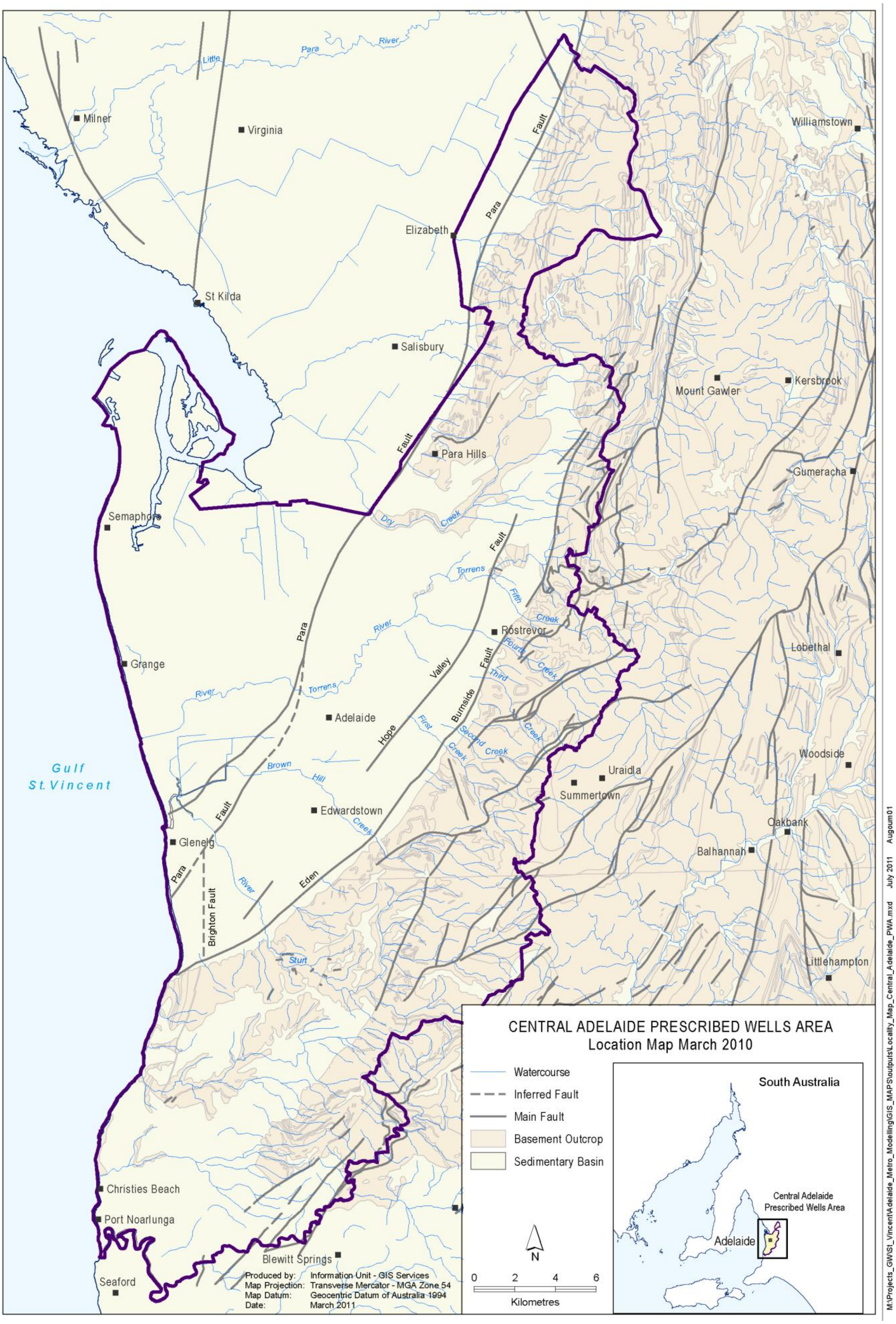

Figure 1. Location of the Central Adelaide PWA

1) Tertiary aquifers of the Golden Grove Embayment

The Tertiary sediments within the Golden Grove Embayment form a complex sedimentary sequence which thickens from about 20 m in the Tea Tree Gully area to over 300 m in the south-west near the coast at Brighton (Fig. 1). Most extractions come from the T1 and T2 aquifers which consist mainly of sand units which receive natural recharge laterally across the Eden–Burnside Fault from the fractured rock aquifers of the Mt Lofty Ranges (Fig. 2). Close to the coast, the deeper T3 and T4 aquifers are intersected below a depth of 150 m and contain brackish groundwater with salinities in excess of 5000 mg/L.

2) Tertiary aquifers of the Adelaide Plains Sub-Basin

The sedimentary units in this province are much thicker and more consistent than in the Golden Grove Embayment (Fig. 2). The Tertiary aquifers are up to 400 m thick, with most extractions coming from the T1 and T2 aquifers which consist of interbedded limestones, sandstones and fossiliferous sands. The deeper T3 and T4 aquifers are less productive and contain highly saline groundwater.

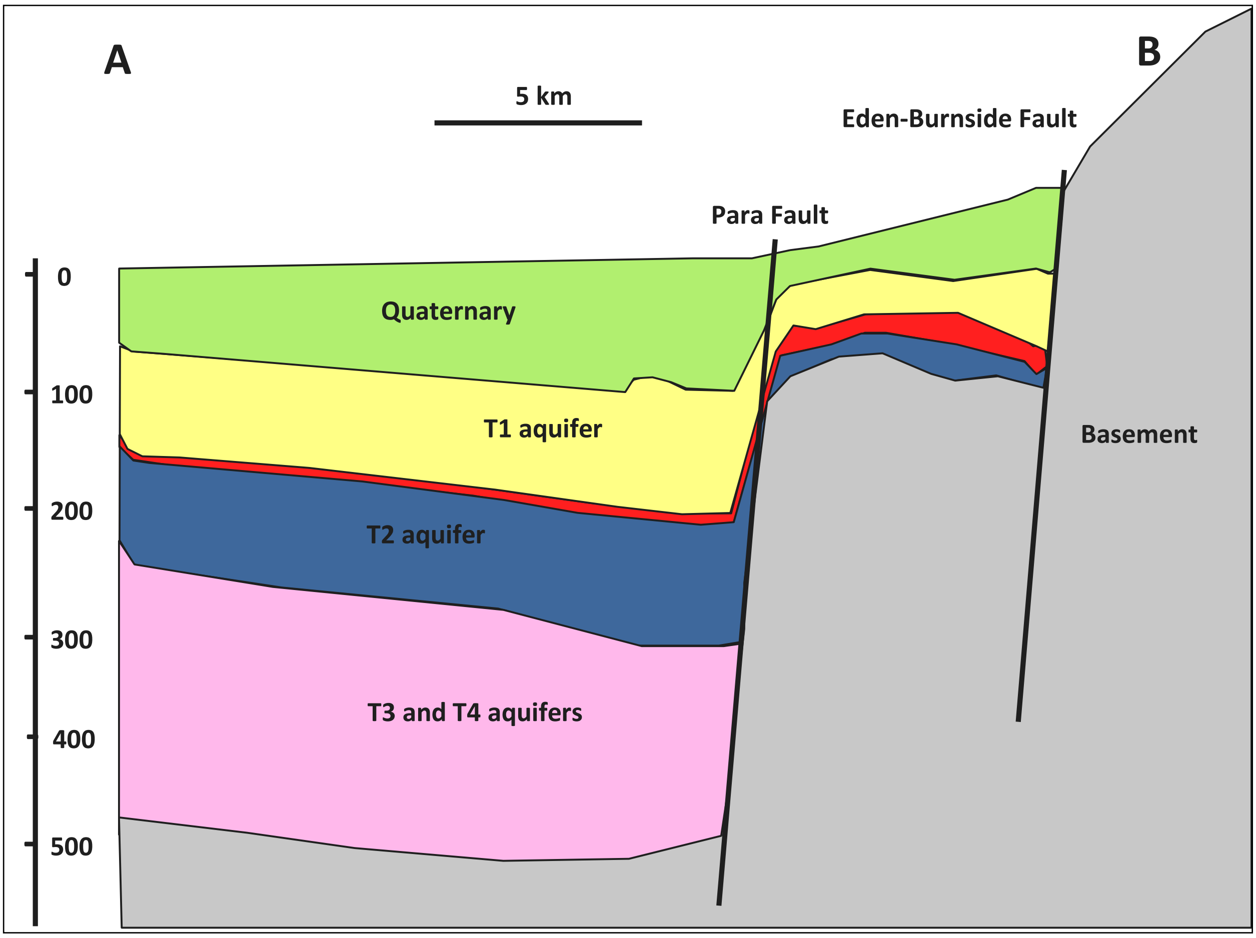

Figure 2. Geological cross section across the Central Adelaide PWA

Noarlunga Embayment

The Noarlunga Embayment is bounded to the southeast by the Clarendon Fault and to the north and northwest by basement outcrop (Fig. 2). As a groundwater resource, the Noarlunga Embayment is dominated by sandy aquifers containing brackish or saline groundwater. Sediments reach a maximum thickness of about 170 m in the southwest area of the embayment.

Shallow Quaternary sands and gravels form thin unconfined and confined aquifers with characteristically low well yields (less than 0.5 L/sec). Tertiary sands are largely undifferentiated and form mainly confined aquifers beneath the Quaternary sediments at depths ranging between 20 and 40 m below ground.

The Tertiary aquifers have the lowest salinity (less than 2000 mg/L) in a narrow strip about 1 km wide adjacent to the Clarendon Fault. Elsewhere, the salinities within the aquifers are typically in excess of 3000 mg/L, possibly higher in the southwest of the embayment where there is little or no data.

Fractured Rock Aquifer

The fractured rock aquifers within the Central Adelaide PWA comprise Precambrian Adelaidean metasediments which form the scarp face of the Adelaide Hills and also underlie the sediments of the Adelaide Plains. These aquifers are highly variable and occur as multiple local aquifer systems. Well yields average about 5 L/s, which is not sufficient for extensive irrigation development. Salinities range from less than 1000 mg/L in higher rainfall areas, to over 3000 mg/L close to the coast.

These aquifers are significant, not only as a stock and domestic water supply, but also as a source of recharge to the sedimentary aquifers beneath the Adelaide Plains.

GROUNDWATER FLOW AND SALINITY

Due to the lack of monitoring data outside the Adelaide Plains, groundwater flow and salinity contours have only been prepared for the two major Tertiary aquifers (T1 and T2 aquifers). Before development, these aquifers were artesian, with groundwater flowing from the hills in a westerly direction to the sea. Discharge from these aquifers is thought to occur under St Vincent Gulf.

T1 Aquifer

The major long-standing cone of depression within the T1 Aquifer corresponds to the location of pumping centres at Penrice, Thebarton and golf courses in the Grange–West Lakes area (Fig. 3). The pressure levels never fully recover due to the continuous industrial pumping during winter. This cone has formed major new flow directions from the north and west.

The extent of groundwater salinity below 1000 mg/L in the T1 aquifer reflects the flowpaths from the recharge areas.

T2 Aquifer

Since 2006, extensive and continuous pumping from the T2 Aquifer in two major pumping areas at Osborne and Regency Park has generated a long-standing regional cone of depression in the aquifer, which has formed major new flow directions from the north and west (Fig. 4).

The salinity distribution pattern is similar to the overlying T1 aquifer. The low salinity zone below 1000 mg/L is restricted to the south-western suburbs at the Para Fault. This salinity distribution suggests that most of the recharge to the aquifer occurs as lateral flow. Drilling has indicated that some salinity stratification is evident within the T2 aquifer.

For a more detailed description of the hydrogeology of the Adelaide Metropolitan Area, please see :

http://www.waterconnect.sa.gov.au/BusinessUnits/InformationUnit/Technical%20Publications/dwlbc_report_2006_10.pdf

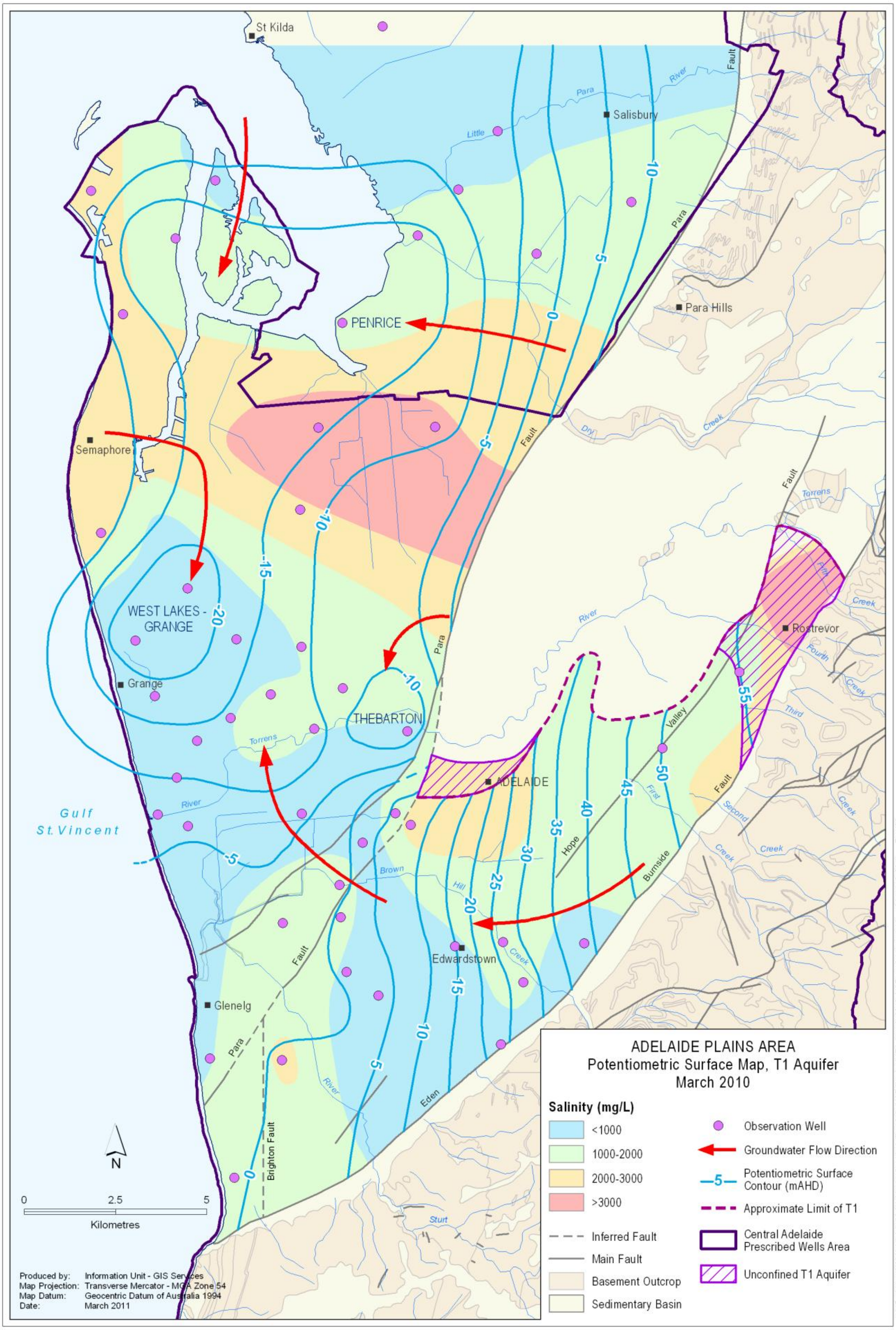

Figure 3. Groundwater-flow direction and salinity distribution in the T1 aquifer in the Central Adelaide PWA (March 2010)

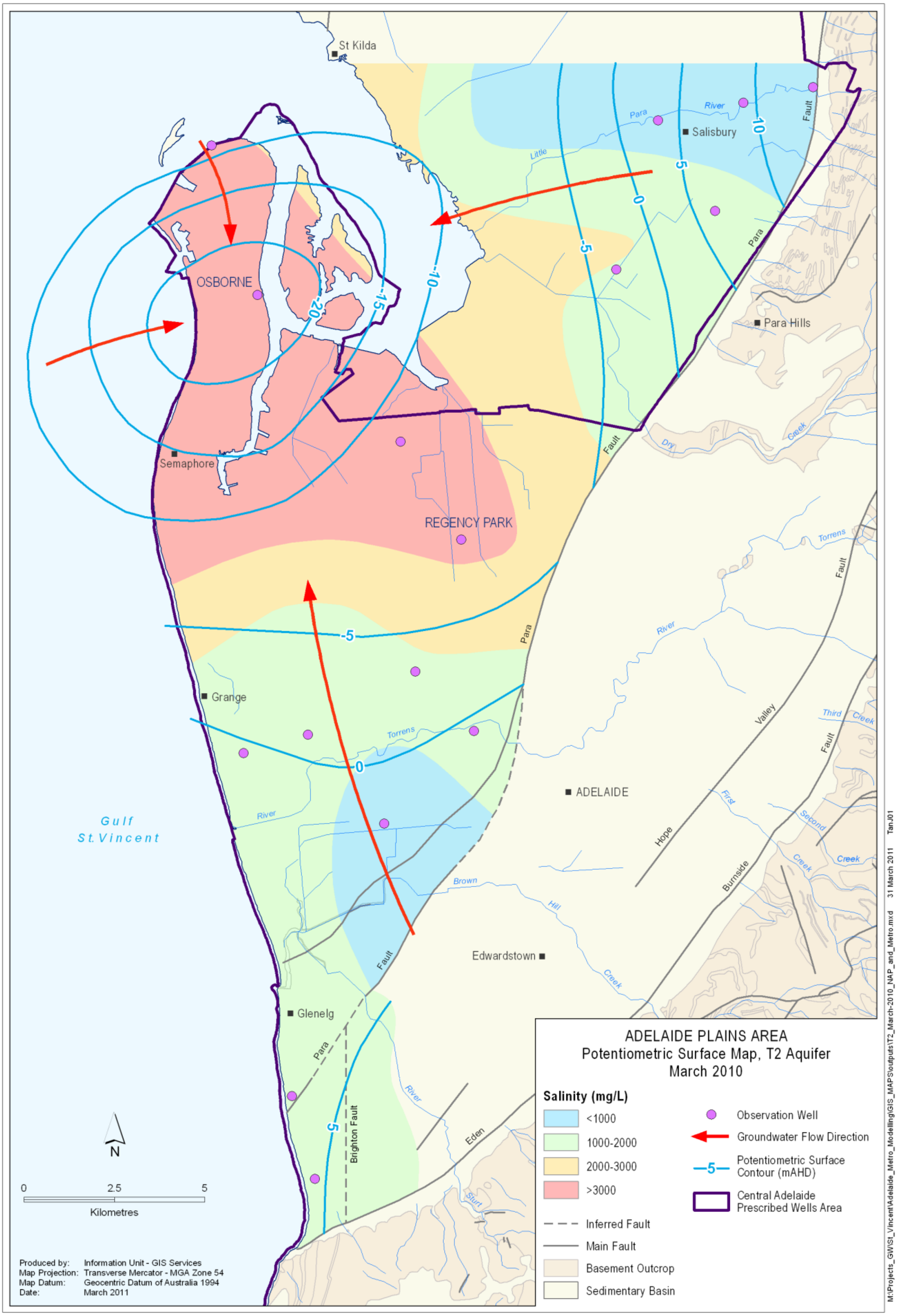

Figure 4. Groundwater flow direction and salinity distribution in the T2 aquifer in the Central Adelaide PWA (March 2010)

GROUNDWATER DEPENDENT ECOSYSTEMS

Whilst groundwater dependent ecosystems (GDEs) have not been used in the assessment of the status of the resource, it is important to note the presence and ecological characteristics of the GDEs found in the Central Adelaide PWA. Water Allocation Plans must include an assessment of the water required by ecosystems; this includes water from both surface water and groundwater resources. Groundwater dependent ecosystems can be defined as ecosystems where groundwater provides all or part of the water quantity, chemistry or temperature, either permanently, seasonally or intermittently. It is generally considered that shallow water tables, i.e. those less than ten metres below the surface, are more likely to support GDEs than deeper water tables. The exception to this is stygofauna (animals that inhabit water filled cracks and pools below the ground) which can be found at greater depths.

The majority of GDEs in the Central Adelaide PWA have been heavily modified through urbanisation of the surrounding landscape. However, the remaining ecosystems still support a number of remnant ecological assets.

There are numerous streams that flow through the Central Adelaide PWA, most of which have groundwater contributions that maintain aquatic habitat such as wetlands, persistent pools and baseflow. The groundwater contribution to these watercourses is driven from the fractured rock aquifers around the hills face and localised inputs from Tertiary aquifers on the break of slope from the hills and Quaternary aquifers on the plains. These groundwater dependent ecosystems are known to support a diversity of fish, aquatic macroinvertebrates, frogs and plants.

Plants with a dependence on groundwater extend along significant lengths of watercourses, around groundwater dependent wetlands and over the perched coastal aquifers in the region. These plants include river redgum (*Eucalyptus camaldulensis*), SA bluegum (*E. leucoxylon*), bulrush (*Typha sp.*), common reed (*Phragmites australis*) and sedges (*Cyperus sp.*).

Direct groundwater discharge to the offshore marine environment occurs from aquifers in the Central Adelaide PWA and may support particular aquatic animals and plants. Other possible GDEs in the Central Adelaide PWA include stygofauna.

Rainfall is a very important part of the groundwater balance because it is a source of replenishment or recharge to aquifers by infiltration through the soil or by percolation from streamflow in drainage lines.

The Adelaide area has a typical Mediterranean-type climate; hot, dry summers and cool, wet winters. There is a strong gradient in average annual precipitation across the Central Adelaide PWA from west to east, ranging from 440 mm at Seaton near the coast, to 531 mm in Adelaide and 913 mm at Cherry Gardens in the Adelaide Hills.

Rainfall data from two Bureau of Meteorology stations; Seaton (23024) (Fig. 5) and Cherry Gardens (23709) (Fig. 6) were selected to examine rainfall trends. The cumulative deviation from mean monthly rainfall identified periods where rainfall trends are above or below average. An upward slope indicates a period where the rainfall is greater than the average, while a downward slope indicates a period where the rainfall is below the average.

Long periods of above and below average rainfall were recorded at Seaton. Of interest is the period of below average rainfall since 2002 (Fig. 5).

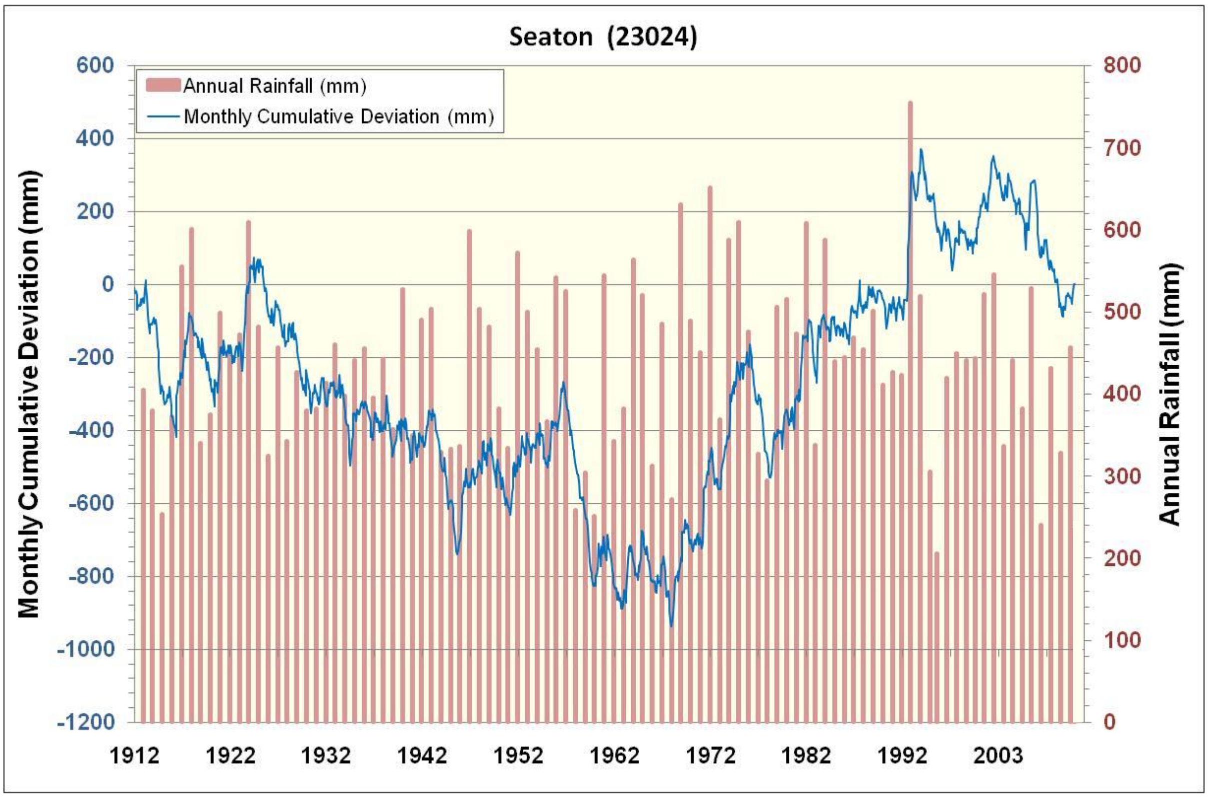

Figure 5. Annual rainfall and cumulative deviation from mean monthly rainfall at Seaton in the CAPWA

In contrast, the record for Cherry Gardens shows a pattern of more consistent and higher rainfall, with below-average rainfall only experienced after the 2006 drought (Fig. 6).

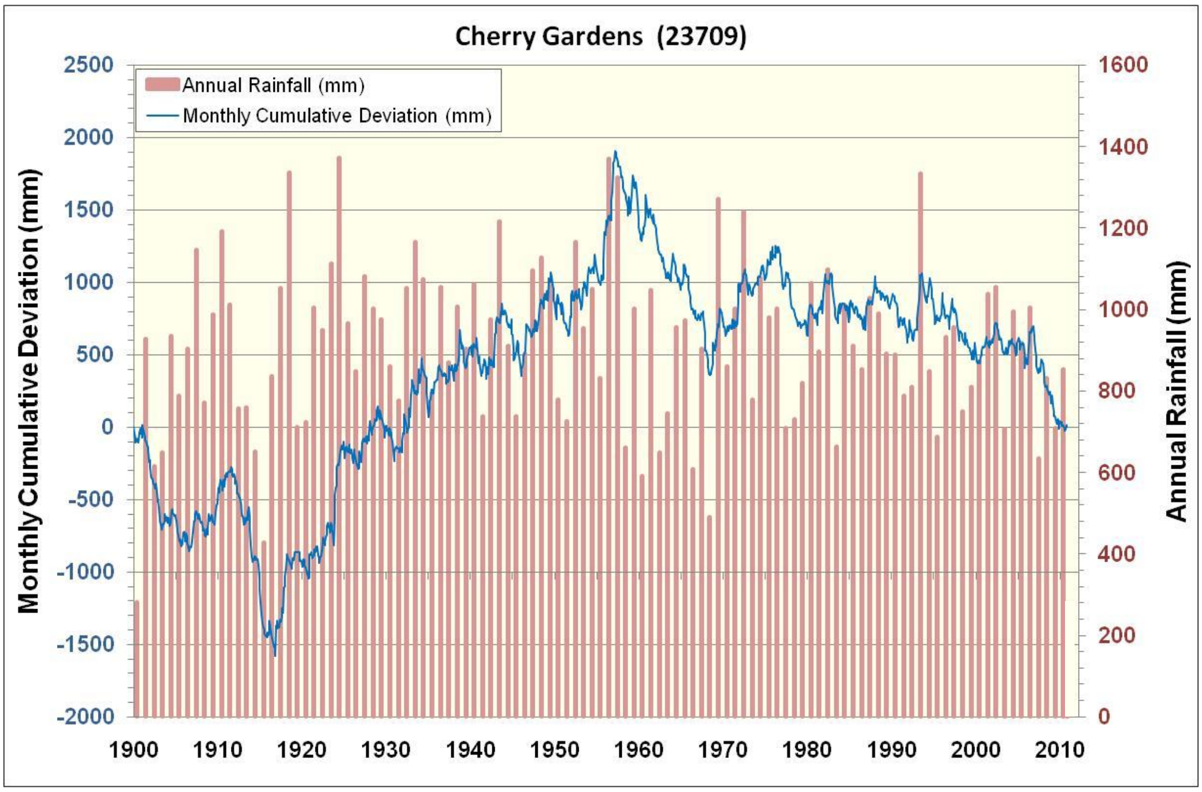

Figure 6. **Annual rainfall and cumulative deviation from mean monthly rainfall at Cherry Gardens in the CAPWA**

GROUNDWATER USE

Although the Central Adelaide PWA is prescribed under the *Natural Resources Management Act 2004*, licences for groundwater extractions have not been issued and there is currently no comprehensive metering of extraction volumes.

Historically, groundwater has been extracted for the irrigation of market gardens in the eastern and western suburbs from the T1 aquifer. On several occasions up until the 1970s, SA Water extracted up to 10 000 ML/yr from a number of bores in the western suburbs of Adelaide to supplement the Mount Lofty Ranges reservoir water supply during drought years.

Figure 7 displays historic estimates of groundwater use in the Central Adelaide PWA. A lack of data in any given year does not imply that no extraction occurred.

A survey of groundwater use was carried out in 1987 and found that major users were industry, irrigation of parks and school ovals and watering of golf courses (Fig. 8). The most recent estimate of groundwater extraction in the Metropolitan Area is about 10 000–12 000 ML/yr, with most extractions coming from the T1 aquifer.

The recent status report by SKM (2009)[1] estimated the use from domestic bores completed in the shallow Quaternary aquifers beneath the Metropolitan Area to be about 500 ML/yr.

For the surrounding fractured rock aquifer and the Noarlunga Embayment, SKM estimated groundwater use for all purposes to be just under 1000 ML/yr.

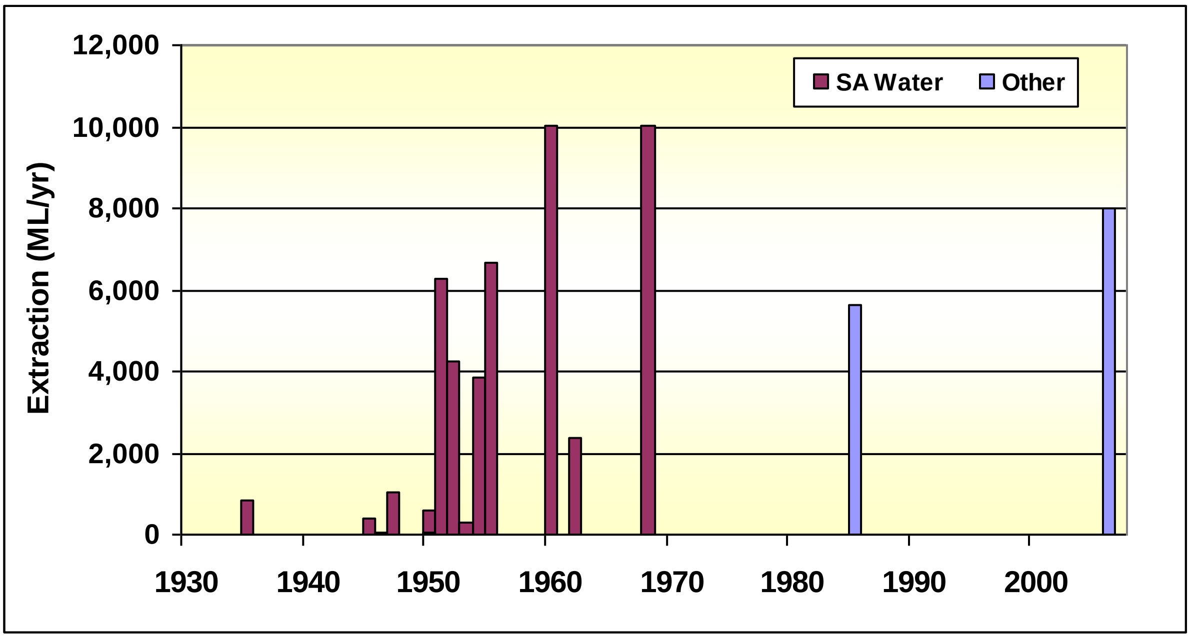

Figure 7. Historic estimates of groundwater use in the CAPWA

[1] SKM 2009, *State and Condition of the Underground Water Resources of the Central Adelaide Prescribed Wells Area*, Draft Report Version 1–5, Sinclair Knights Merz, Adelaide

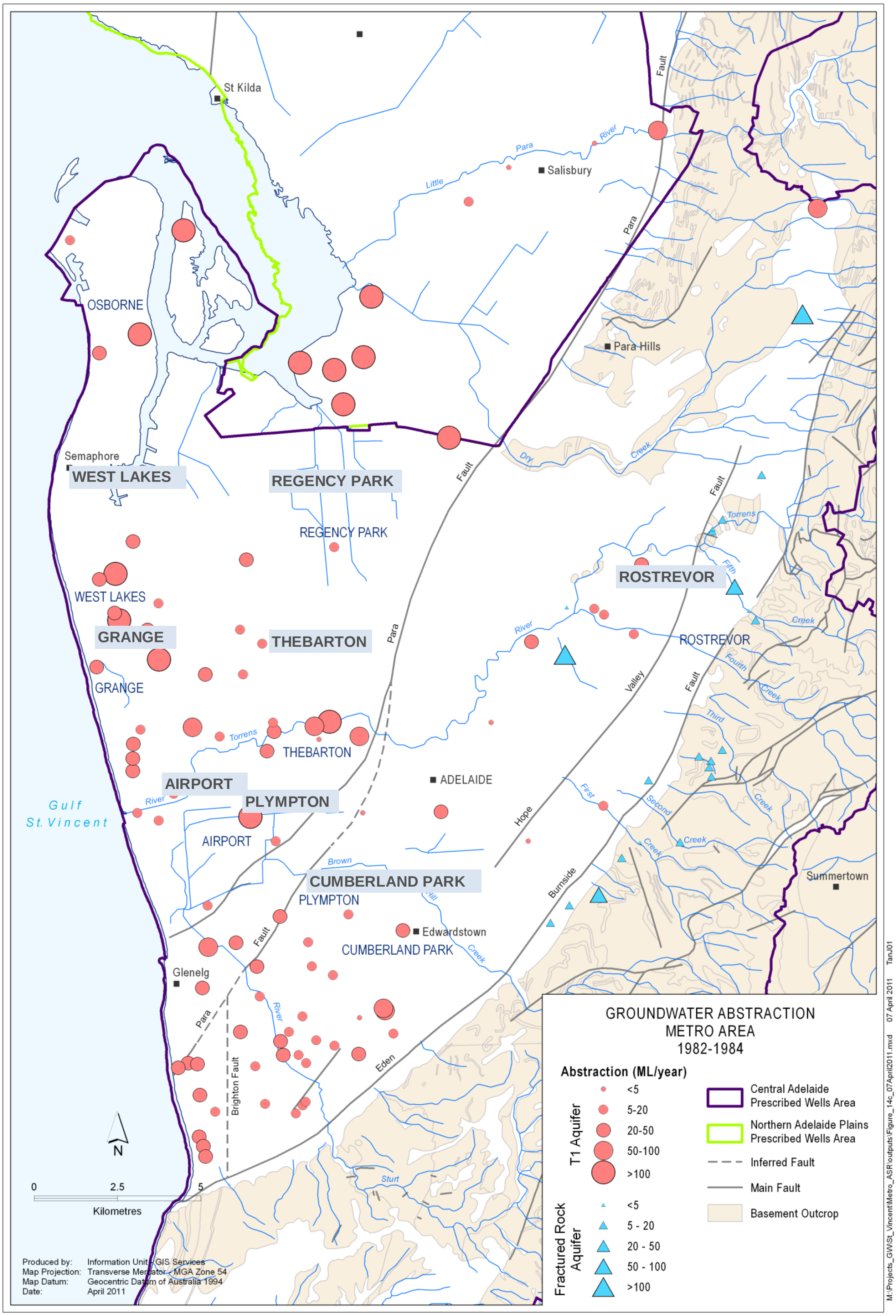

Figure 8. **Locations of major groundwater users in the CAPWA**

GROUNDWATER OBSERVATION NETWORKS

Groundwater monitoring is mainly concentrated in areas of high groundwater use which are the sedimentary aquifers beneath the Metropolitan Area (Adelaide Plains Sub-basin and Golden Grove Embayment) and the fractured rock aquifer in the One Tree Hill area. Very little monitoring has been carried out elsewhere due to the low groundwater demand.

WATER LEVEL NETWORK

The groundwater level observation network for the Central Adelaide PWA contains a total of 129 observation wells are monitored at six monthly intervals (Figs. 9 & 10). Table 1 details the number of wells monitoring each aquifer.

Table 1. Groundwater level observation network

Aquifer	Number of wells
Quaternary	28
Tertiary T1 aquifer	46
T2 aquifer	11
T3 aquifer	4
T4 aquifer	1
Fractured rock aquifers	39

SALINITY NETWORK

The groundwater salinity observation network for the Central Adelaide PWA contains a total of 40 observation wells (Table 2) monitored on an approximately annual basis (Fig. 11).

Table 2. Groundwater salinity observation network

Aquifer	Number of wells
Quaternary	0
Tertiary T1 aquifer	14
T2 aquifer	7
T3 aquifer	4
T4 aquifer	1
Fractured rock aquifers	14

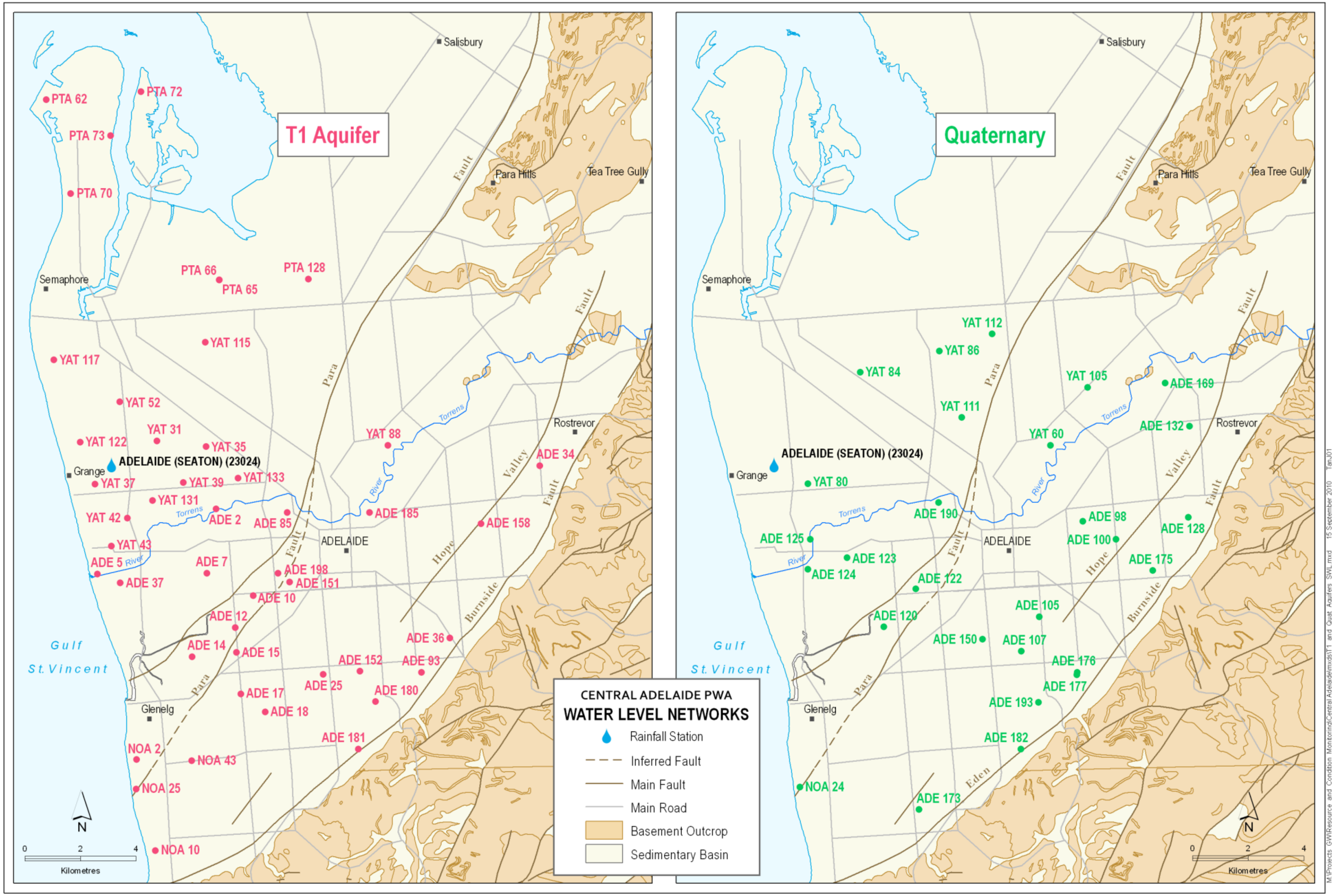

Figure 9. Location of groundwater level observation wells for the T1 and Quaternary aquifers in the CAPWA

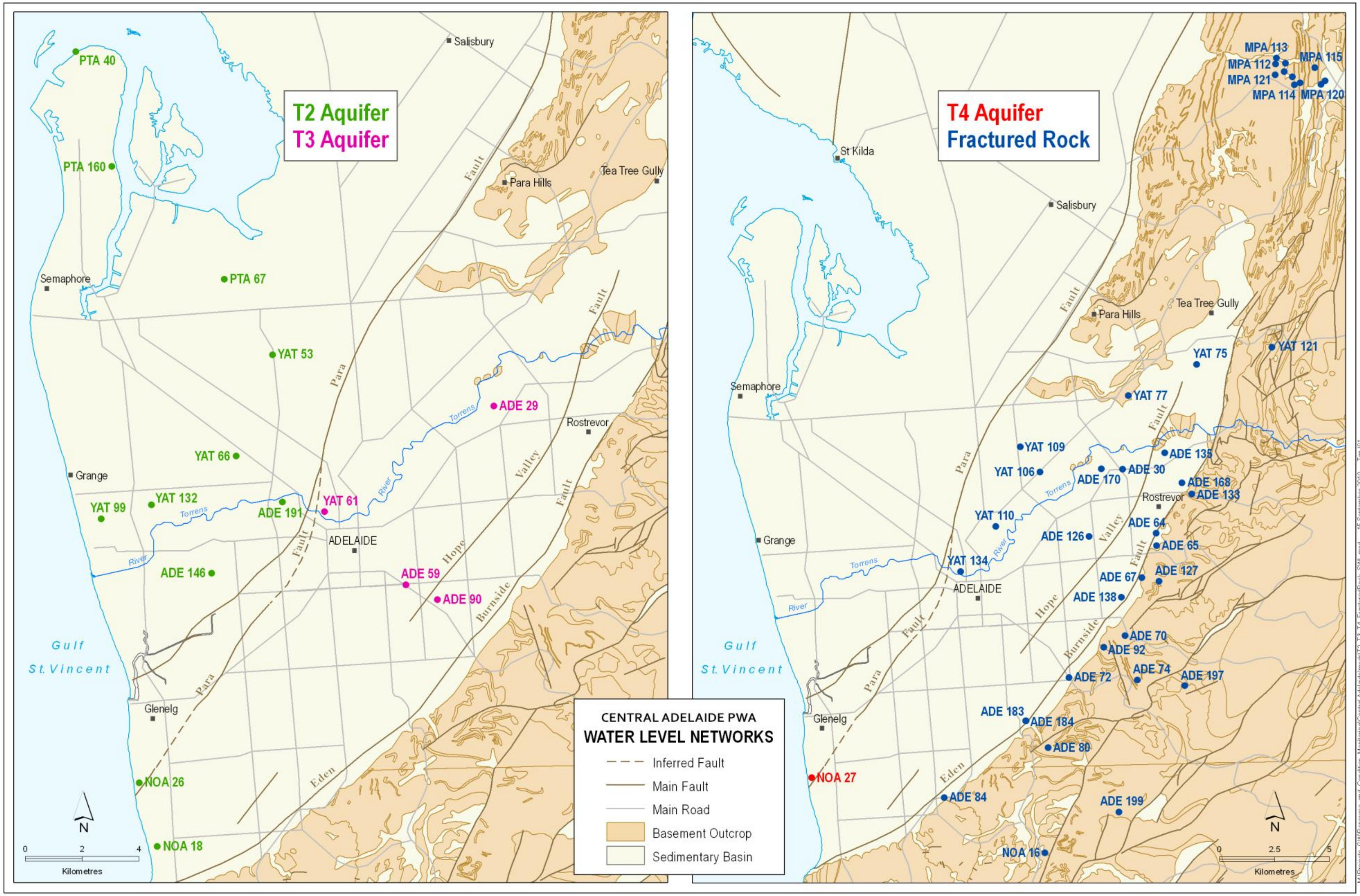

Figure 10. Location of groundwater level observation wells in the T2, T3, T4 and Fractured rock aquifers in the CAPWA

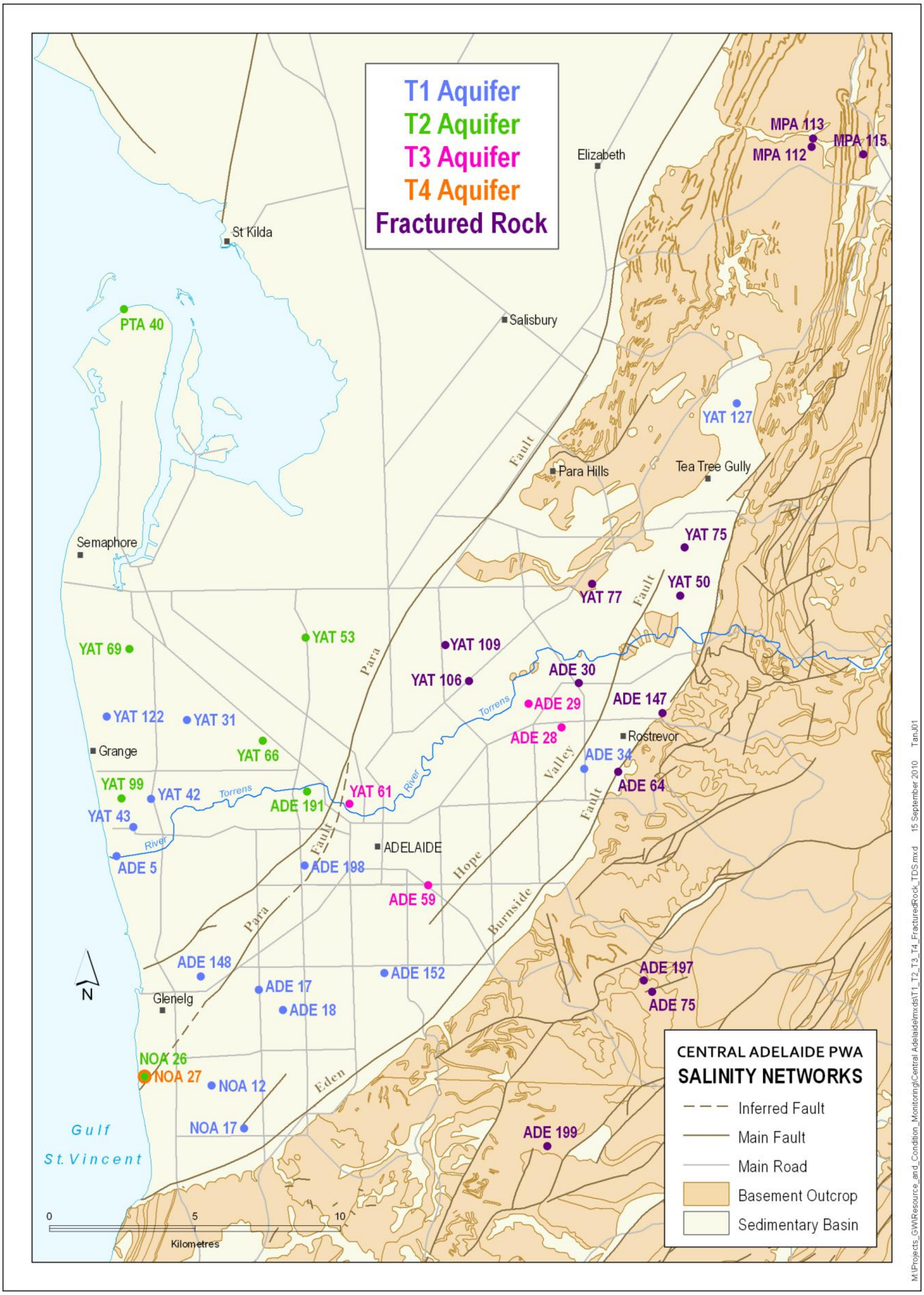

Figure 11. Location of groundwater salinity monitoring wells in the CAPWA

QUATERNARY AQUIFERS

The groundwater levels from a broad coverage of suburbs generally show little change, with some showing a reasonably close relationship to rainfall patterns with the cumulative deviation from mean monthly rainfall graphed in light blue referring to the secondary axis (Fig. 12). All wells indicate a decline in level due to the 2006 dry winter, with below average rainfall since then resulting in declines of up to one metre. These dry years would have increased extractions for garden watering, but because of the low yields from domestic bores, the impacts would be localised. The high rainfall in 2010 has led to a strong recovery in water levels in some areas.

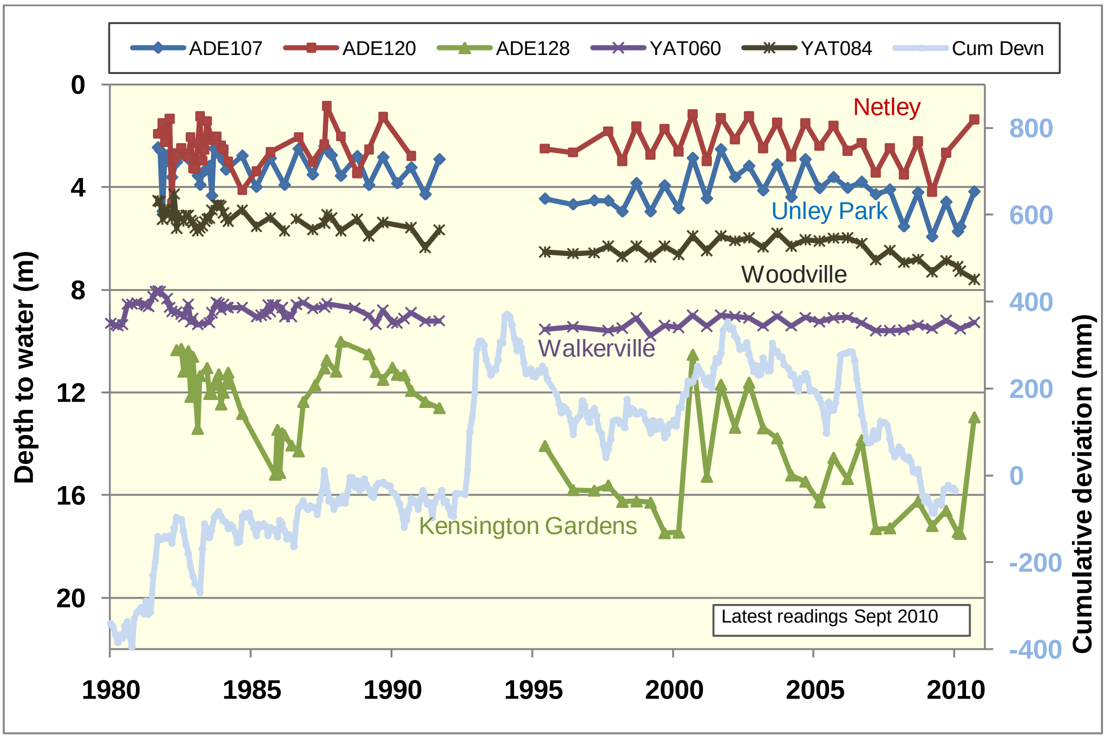

Figure 12. Groundwater level trends for the Quaternary aquifer in the CAPWA

T1 AQUIFER

All observation wells in the Adelaide Plains Sub-basin to the west of the city with long term records show the impacts of drought extractions for public water supply before 1970 (Fig. 13). Quite large drawdowns of up to 20 m were recorded at that time. More recently, the groundwater level fluctuations in the T1 aquifer can be divided into two groups, depending on the purpose of the groundwater extractions.

Summer irrigation extractions

Summer irrigation pumping causes major seasonal fluctuations, with declines in groundwater level during summer and recovery in winter. The West Lakes–Grange area (Fig. 8) experiences seasonal changes of up to 15 m (Fig. 13), with the drawdown trend approaching equilibrium. Significant increases in drawdown are not expected because there is limited potential for an expansion of the irrigated areas (golf courses and school ovals).

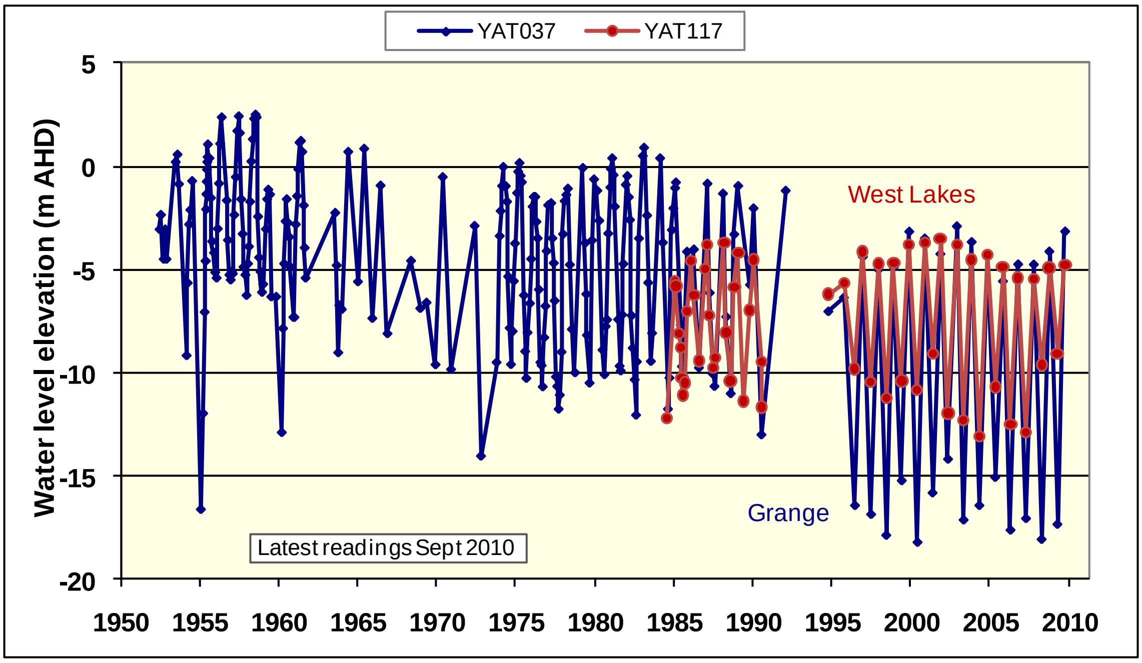

Figure 13. Groundwater level trends for the T1 aquifer in the West Lakes – Grange area of the CAPWA

To the southwest of the city in the suburbs of Cumberland Park and Plympton (Fig. 8), seasonal drawdowns range up to 5 m (Fig. 14). In the Rostrevor area to the northeast of the city, only small groundwater level changes have been observed, suggesting little or no pumping (ADE034 in Figure 14, scale on right hand axis in green).

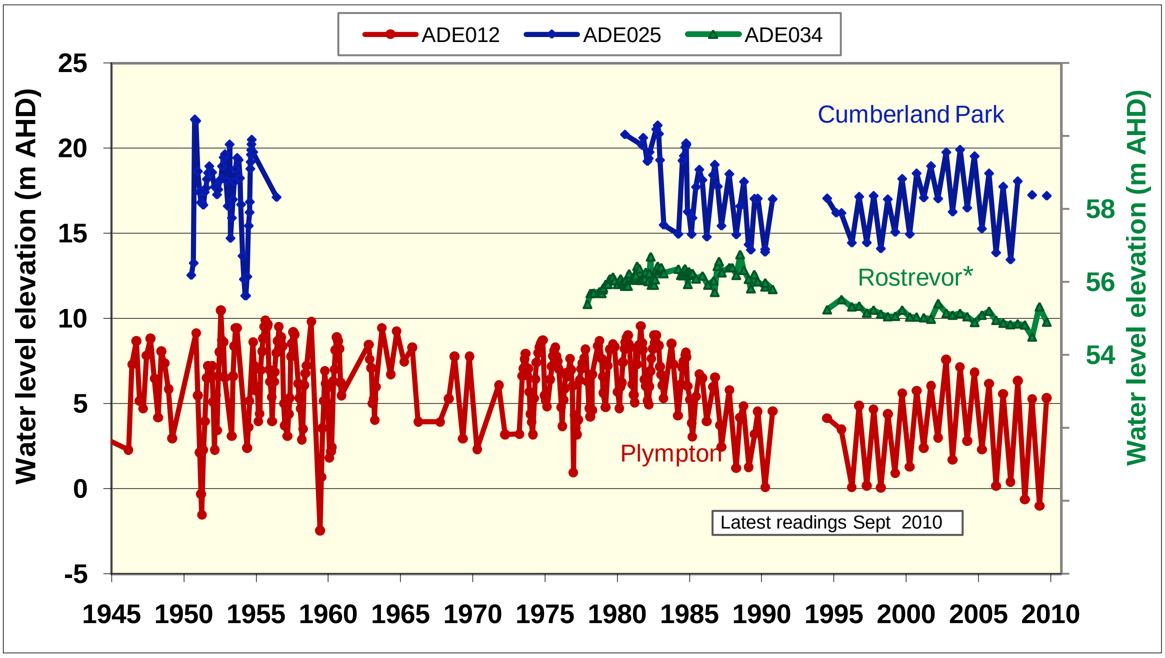

Figure 14. Groundwater level trends for the T1 aquifer in the southwestern and northeastern suburbs of the CAPWA

*Water level elevation (m AHD) refers to secondary axis on the right hand side of the graph

Industrial extractions

Industrial extractions occur all year round and although seasonal fluctuations are smaller than those resulting from summer irrigation, there is no opportunity for water levels to fully recover and consequently, a long-standing cone of drawdown results. Figures 15 and 16 show groundwater levels in the Osborne and Thebarton areas respectively where such extractions occur (Fig. 8). After initial declines in the 1980s, the levels appear to have stabilised.

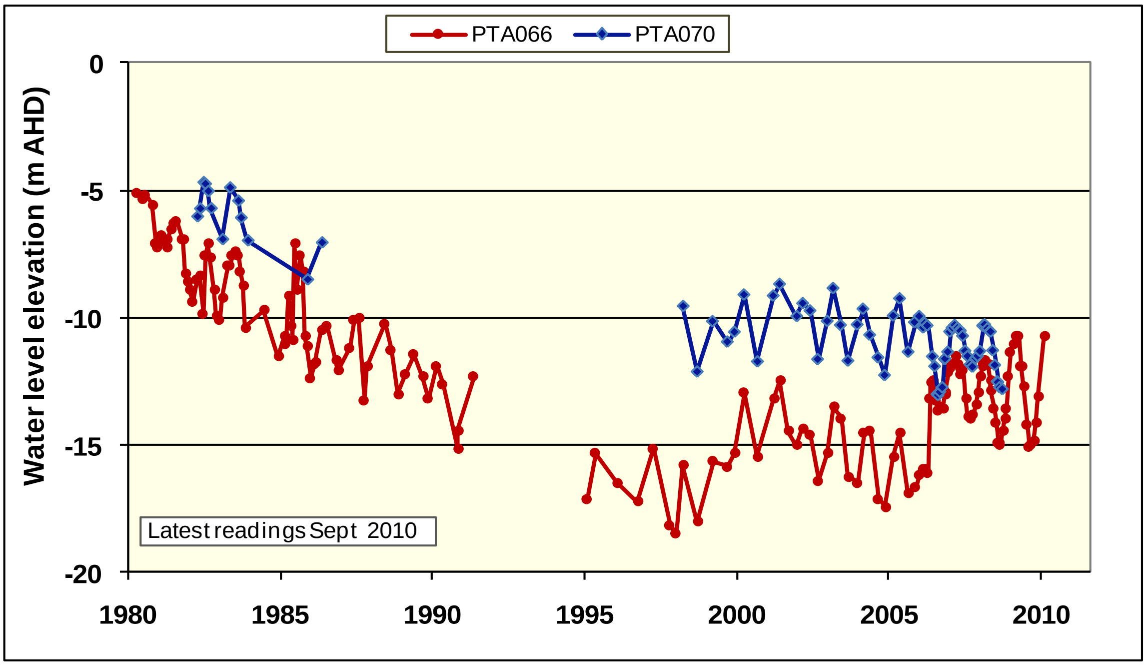

Figure 15. Groundwater level trends for the T1 aquifer in the Osborne area of the CAPWA

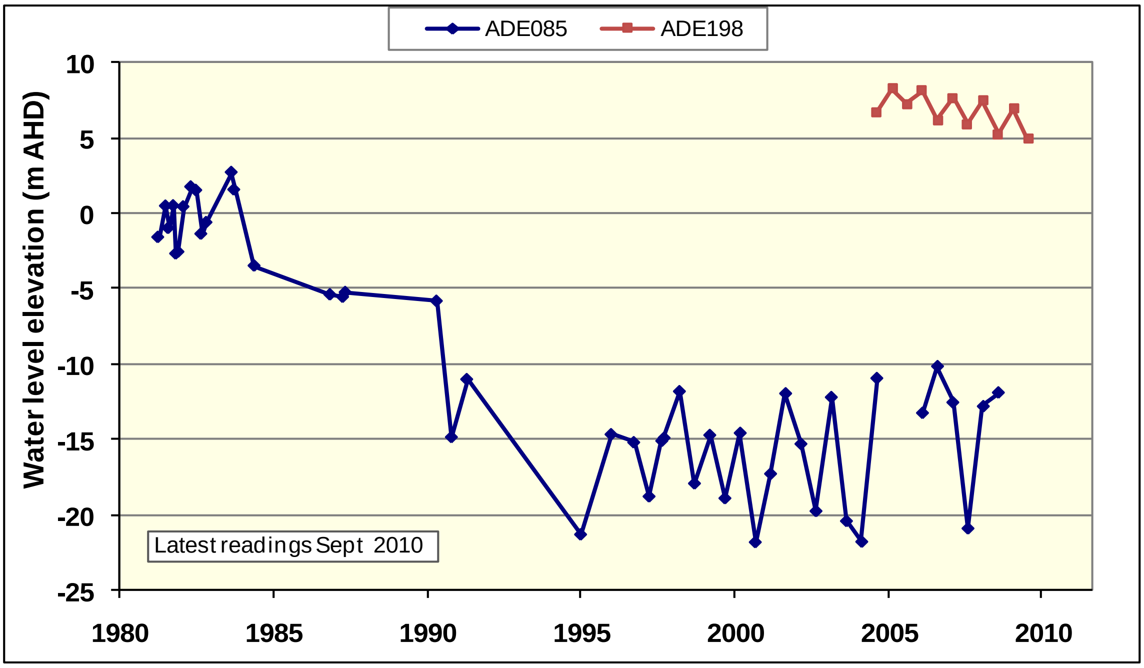

Figure 16. Groundwater level trends for the T1 aquifer in the Thebarton area of the CAPWA

T2 AQUIFER

Long-term records show seasonal fluctuations as well as an overall decline in pressure levels. In the western suburbs such as Thebarton and Adelaide Airport (Fig. 8), the decline has been averaging 0.5 m/yr since 1980, apart from the period between 1997 and 2004 when levels recovered in response to a probable decrease in extractions. The rate of decline appears to have decreased in recent years.

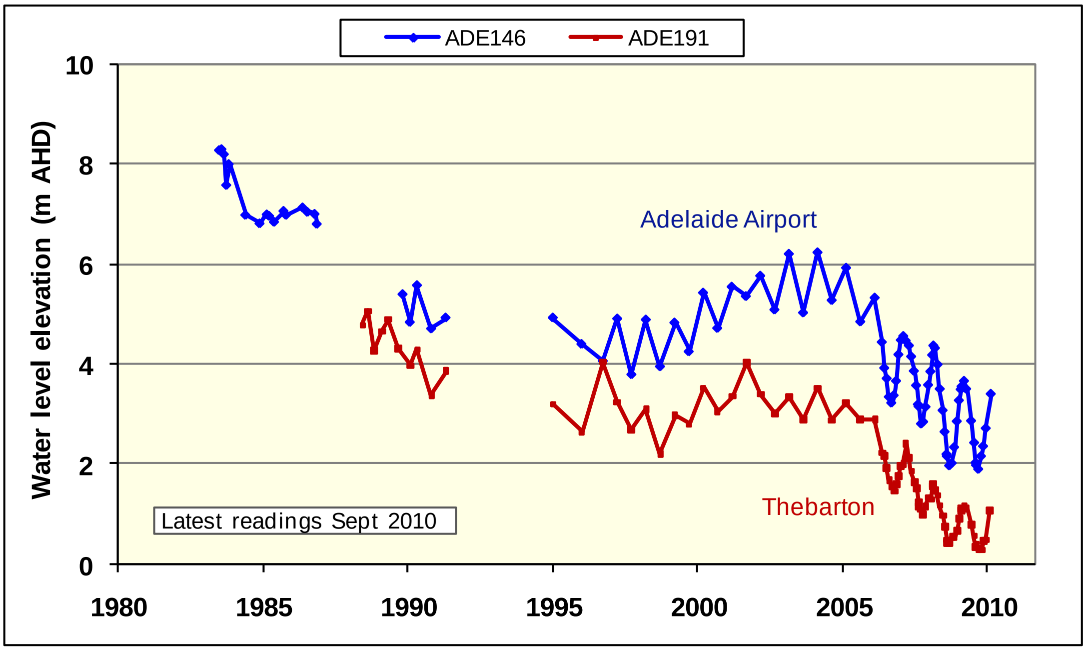

Figure 17. Groundwater level trends for the T2 aquifer in the western suburbs of the CAPWA

Similar declines have been observed in the northwestern suburbs, which averaged about 0.3m/yr up until 1997. Extraction by industry in Regency Park caused the gradual decline in observation well YAT053 commencing in 2001, with additional industrial extractions at Osborne causing the steeper decline commencing in 2006. The rate of decline appears to be stabilising in recent years.

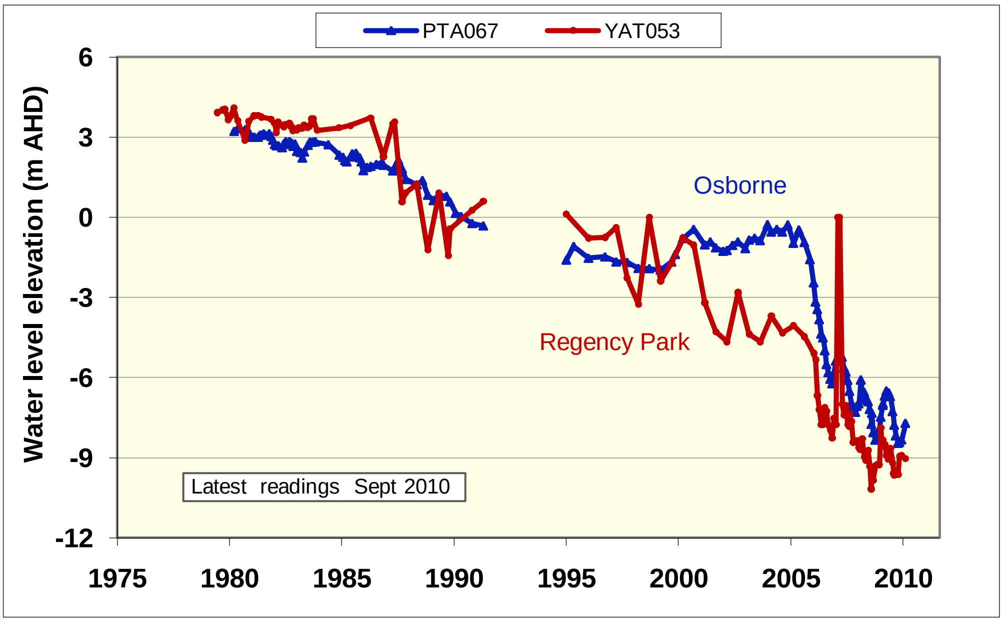

Figure 18. Groundwater level trends for the T2 aquifer in the northwestern suburbs of the CAPWA

T3 AQUIFER

There is currently very little if any extraction from the T3 aquifer and consequently groundwater levels are relatively stable (Fig. 19). The seasonal variations in observation well ADE029 and the small decline in pressure levels in the other observation wells could be due to hydrostatic loading effects or leakage into the overlying T2 aquifer that is being pumped.

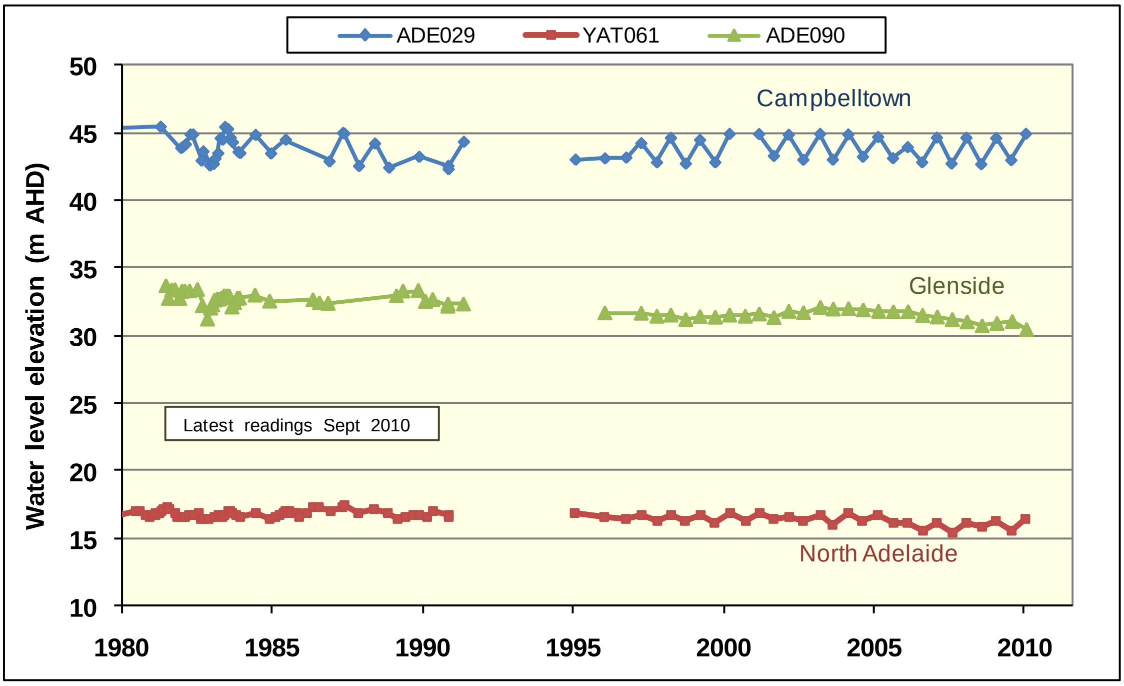

Figure 19. Groundwater level trends for the T3 aquifer in the CAPWA

T4 AQUIFER

There is currently no extraction from the T4 aquifer because of its depth (about 400 m) and likelihood of intersecting saline groundwater. Observation well NOA027 is the only well currently monitoring the T4 aquifer and is located within 500 m of the coast at Brighton. It is artesian and the water level is derived from pressure readings which could explain irregular readings. The hydrograph (Fig. 20) shows an overall decrease of approximately one metre over the last few years which is probably the result of hydrostatic unloading associated with pumping in the overlying T2 aquifer.

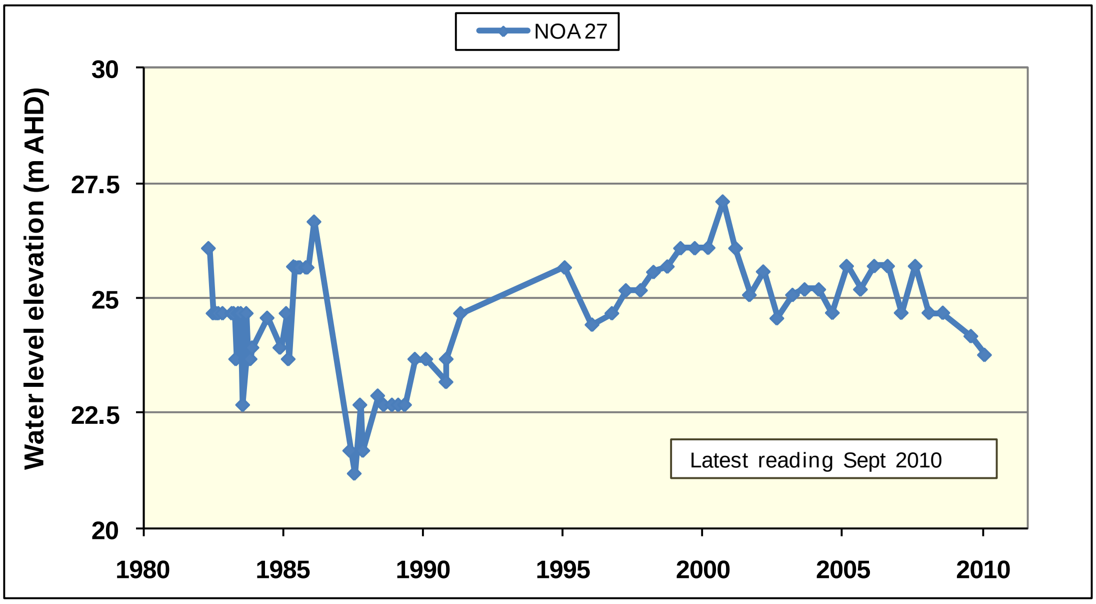

Figure 20. Groundwater level trends for the T4 aquifer in the CAPWA

FRACTURED ROCK AQUIFER

Groundwater levels in this aquifer show a variety of responses depending on the topographic position of the observation well in the landscape, and proximity to points of extraction. Long-term trends are reasonably stable or show a slight decline where the fractured rock aquifer is overlain by Tertiary sediments in the eastern suburbs (Fig. 21). Observation well MPA125 in the Adelaide Hills shows little change, or a relationship with rainfall (Fig. 22).

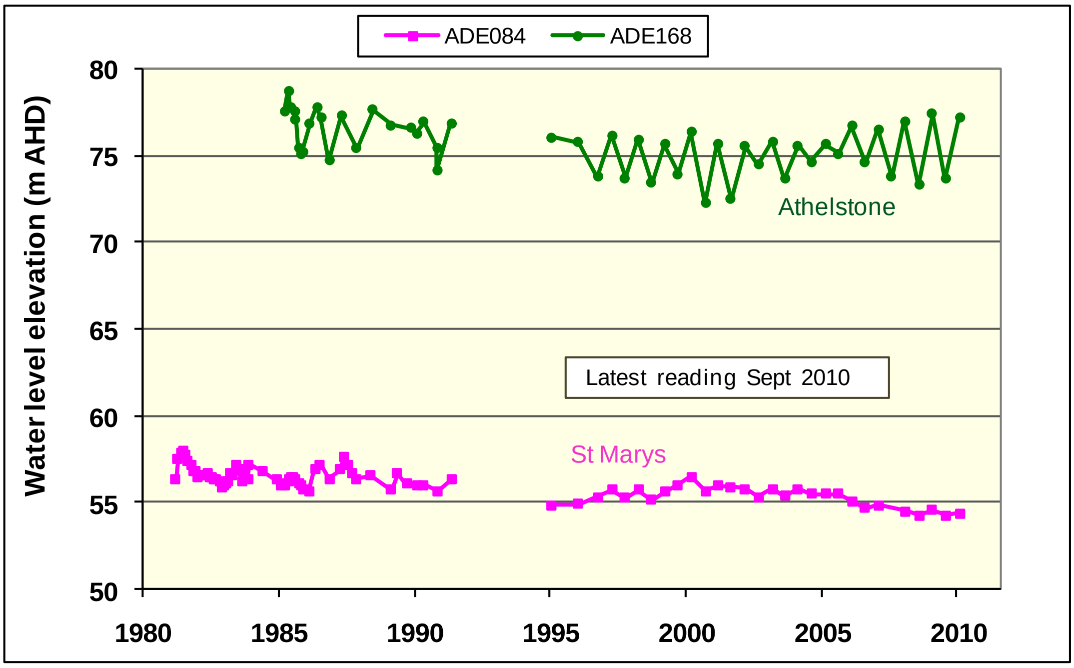

Figure 21. Groundwater level trends for the fractured rock aquifer in the eastern suburbs of the CAPWA

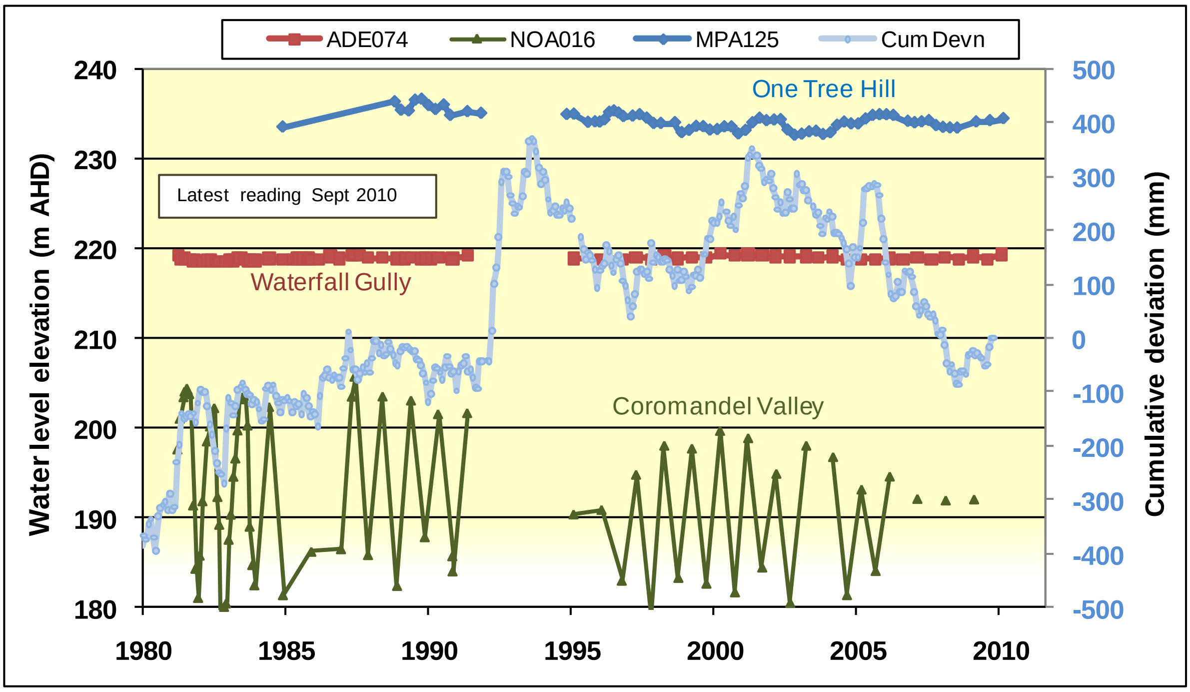

Figure 22. Groundwater level trends for the fractured rock aquifer in the Adelaide Hills region of the CAPWA

GROUNDWATER SALINITY TRENDS

Within the Central Adelaide PWA, there are large data gaps in the salinity monitoring record which may have prevented the full range of natural variations from being observed. It should be noted that recorded salinities may have been affected by contamination through corroded well casings. It is also difficult to determine if observed trends are real or the result of changes in sampling and testing methods over the years. A consistent monitoring regime is required to determine if the trends are real.

T1 AQUIFER

The groundwater salinity data for the T1 aquifer shows a variety of long term trends (Fig. 23). In the southern suburbs, there appears to be a general long term increase in groundwater salinity levels averaging only 1 mg/L/yr (Fig. 23). This rate of rise is relatively insignificant for the purpose of the aquifer, mainly irrigation and industrial use. Similarly, trends in the western suburbs are varied (Fig. 24), with some obvious small decreasing trends.

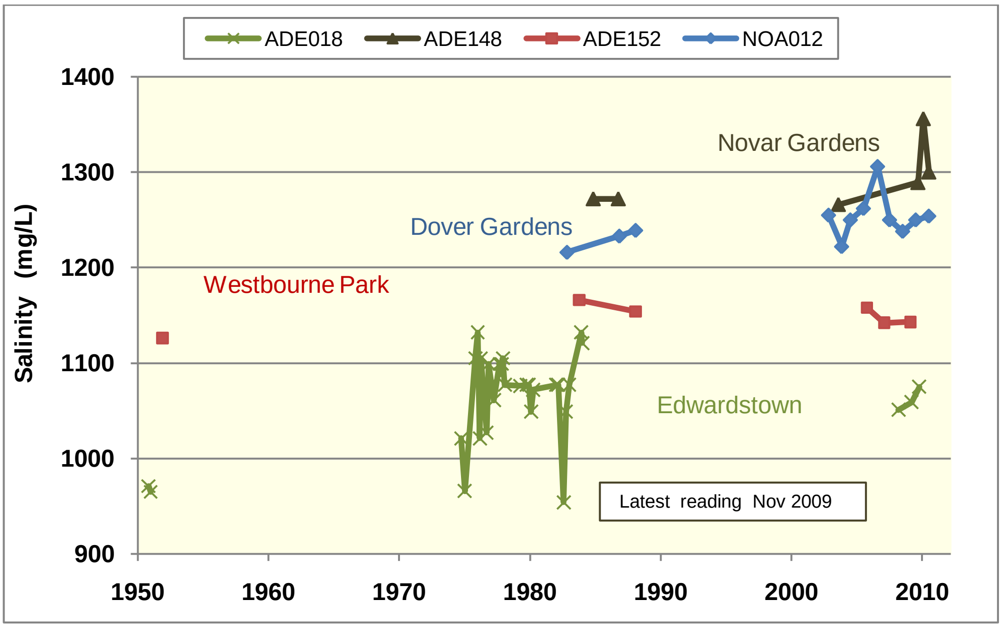

Figure 23. Groundwater salinity trends for the T1 aquifer in the southern suburbs of the CAPWA

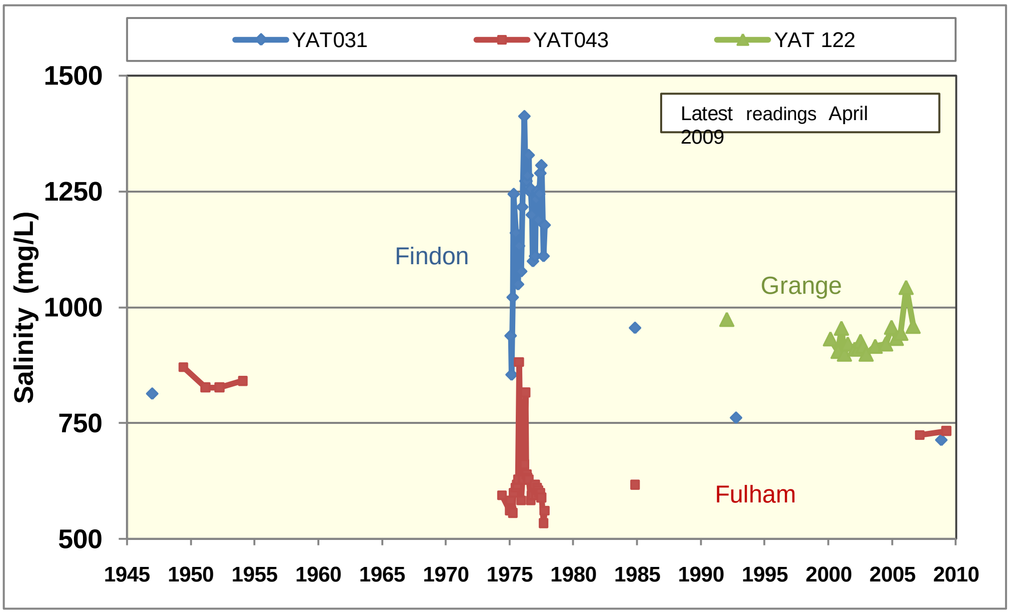

Figure 24. Groundwater salinity trends for the T1 aquifer in the western suburbs of the CAPWA

T2 AQUIFER

Long-term groundwater salinity trends in the T2 aquifer indicate a gradual rise averaging about 10 mg/L/yr (Fig. 25), although this rate of rise may not be significant given the relatively high salinity level. Given the long data gap, further monitoring is required to verify the rising groundwater salinity trend.

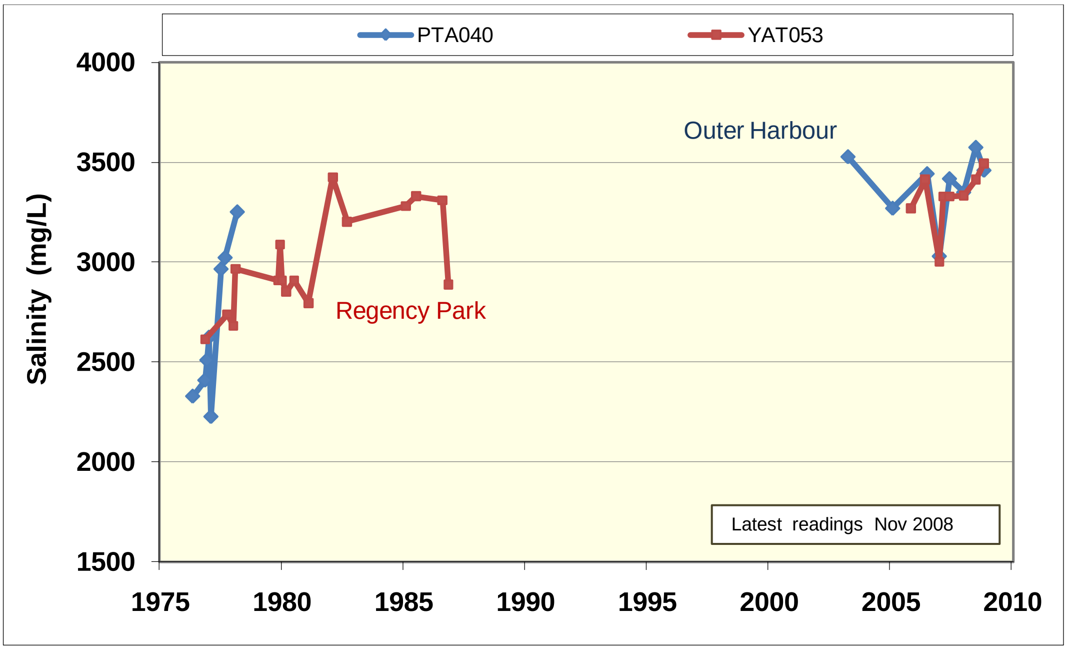

Figure 25. Groundwater salinity trends for the T2 aquifer in the CAPWA

T3 AQUIFER

Observation well ADE029 is the only well with a suitable record to examine historic salinity trends in the T3 aquifer (Fig. 26). Despite considerable variations during the 1970s when groundwater was used in the area for the irrigation of market gardens, there appears to be no permanent degradation of the resource. There is insufficient data availability to determine current trends.

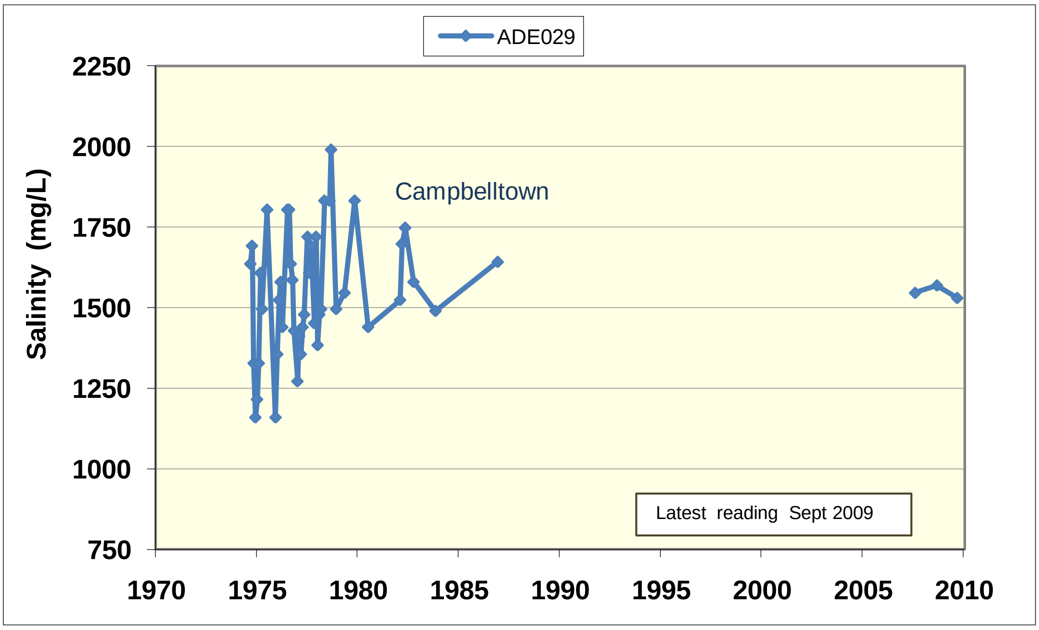

Figure 26. Groundwater salinity trends for the T3 aquifer in the CAPWA

T4 AQUIFER

Observed groundwater salinities in well NOA027 at Brighton, the only observation well within the T4 Aquifer, are quite high (Fig. 27).

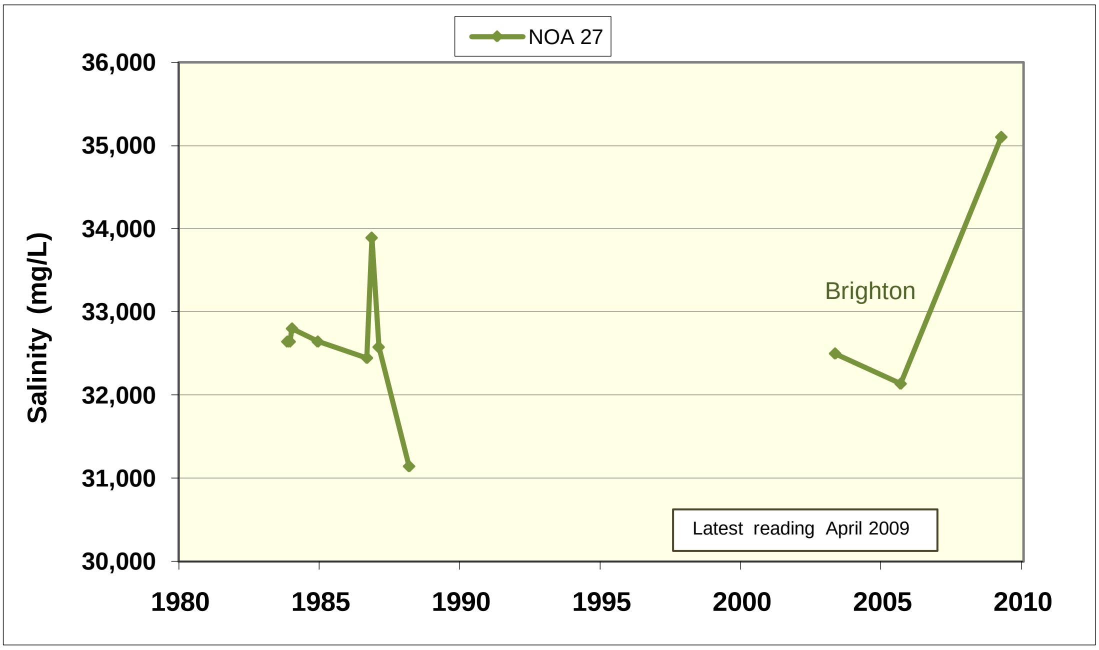

Figure 27. Groundwater salinity trends for the T4 aquifer in the CAPWA

FRACTURED ROCK AQUIFERS

Observation wells located in the outcropping, unconfined FRAs (ADE075, ADE147 and MPA113) receive direct rainfall recharge and are showing relatively stable trends (Fig. 28). However, those observation wells located where the FRAs are overlain and confined by Tertiary sediments (ADE030, YAT050) are showing small rising trends (Fig. 28).

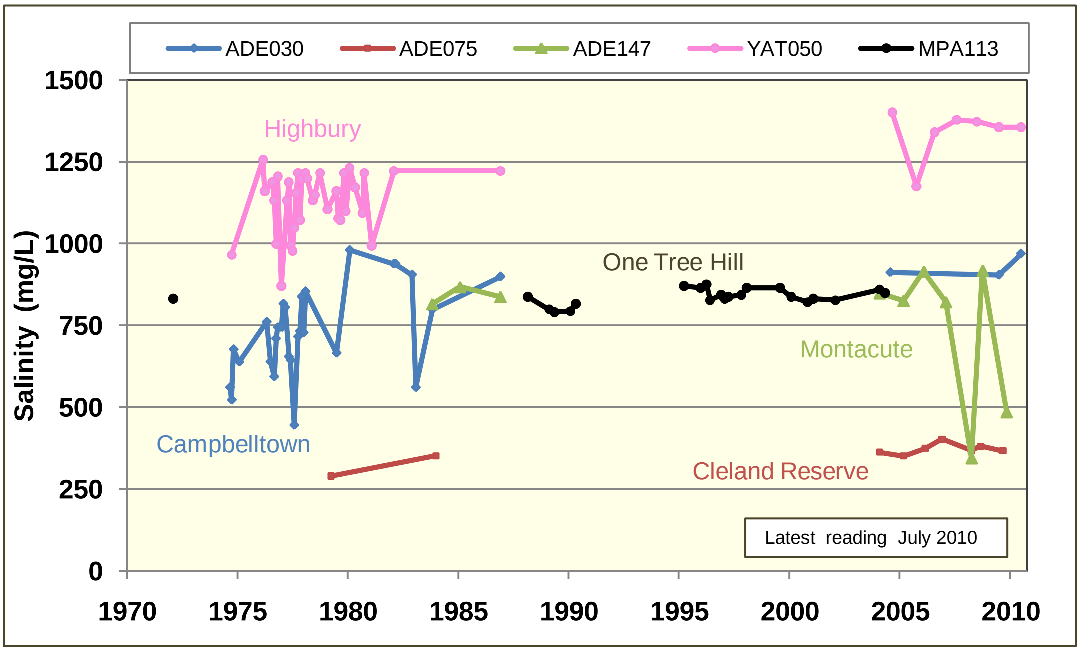

Figure 28. Groundwater salinity trends for the fractured rock aquifer in the CAPWA