BOOBOROWIE VALLEY

GROUNDWATER STATUS REPORT

2009-10

DEPARTMENT FOR WATER

Government of South Australia
Department for Water

SUMMARY 2009 - 10

The Booborowie Valley is situated in the northern Mount Lofty Ranges in the Mid-North of South Australia, approximately 150 km north of Adelaide. It is a local scale groundwater resource which has no management regime in place as it has not been prescribed under South Australia's *Natural Resources Management Act 2004*.

Groundwater extractions in the Booborowie Valley occur from sedimentary aquifers and the surrounding fractured rock aquifer. Stock and domestic supplies are obtained from a shallow Quaternary aquifer, while irrigation supplies are provided by a basal gravel aquifer about 30 m below ground.

Because the Booborowie Valley is not prescribed, there is no metering of extraction volumes. Estimated extractions have shown a significant decline from about 1,200 ML/yr in 1990 to about 300 ML/yr in 2010.

Groundwater levels respond to recharge in very wet years (such as 1992-93), but a prolonged period of below average rainfall has caused gradual water level declines in all aquifers. Groundwater salinity trends are variable, and may reflect long term changes in land use rather than impacts of groundwater extraction.

ASSESSMENT OF STATUS

The Booborowie Valley 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;

- Gradual decline in water levels over the last 15 years appears to be climate driven, and is not expected to affect access to the resource by groundwater users over the next 10 – 20 years.
- Apparently stable salinity levels.

At the current low level of extraction, it is considered that the observed groundwater level and salinity trends are unlikely to lead to a change in capacity to serve the current consumptive uses of the groundwater resource in the medium term.

STATUS

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 Booborowie Valley is situated in the northern Mount Lofty Ranges in the Mid-North of South Australia, approximately 150 km north of Adelaide. It is a local scale groundwater resource which has no management regime in place as it has not been prescribed under *South Australia's Natural Resources Management Act 2004*.

HYDROGEOLOGY

The Booborowie Valley consists of an inter-montane valley about 2 km wide and 20 km long, orientated in a north-south direction and flanked by Adelaidean fractured rocks. The valley is filled with low permeability Quaternary alluvial sediments which attain a maximum thickness of about 50 m. The basal gravel aquifer is up to 10 m thick and provides limited but important supplies of groundwater to landowners in the region.

Yields of up to 50 L/sec have been obtained, with salinities mostly below 3,000 mg/L. Recharge to the sedimentary aquifers occurs from rainfall and intermittent flow in the Booborowie Creek only in very wet years, with lateral inflow from the fractured rock aquifer occurring continuously, but at relatively low levels.

For further information, see the 2005 monitoring status report:
http://www.waterforgood.sa.gov.au/wp-content/uploads/2010/06/Technical%20Reports/ki_dwlbc_2005_31_screen.pdf

GROUNDWATER FLOW AND SALINITY

Groundwater level elevation contours have been produced for the alluvial aquifer and are presented in Figure 1. They show that within the alluvial aquifer, groundwater flows in a southerly direction where it discharges laterally to the west where the Booborowie Creek valley cuts through the Brown Hill Range.

The groundwater salinity distribution (Fig. 1) indicates that lower salinities occur in the north and west of the valley and may reflect the higher permeability of the surrounding fractured rock aquifers in these areas. There is little difference in salinity between the shallow alluvial and basal gravel aquifers. The salinity increases downgradient toward the area of discharge.

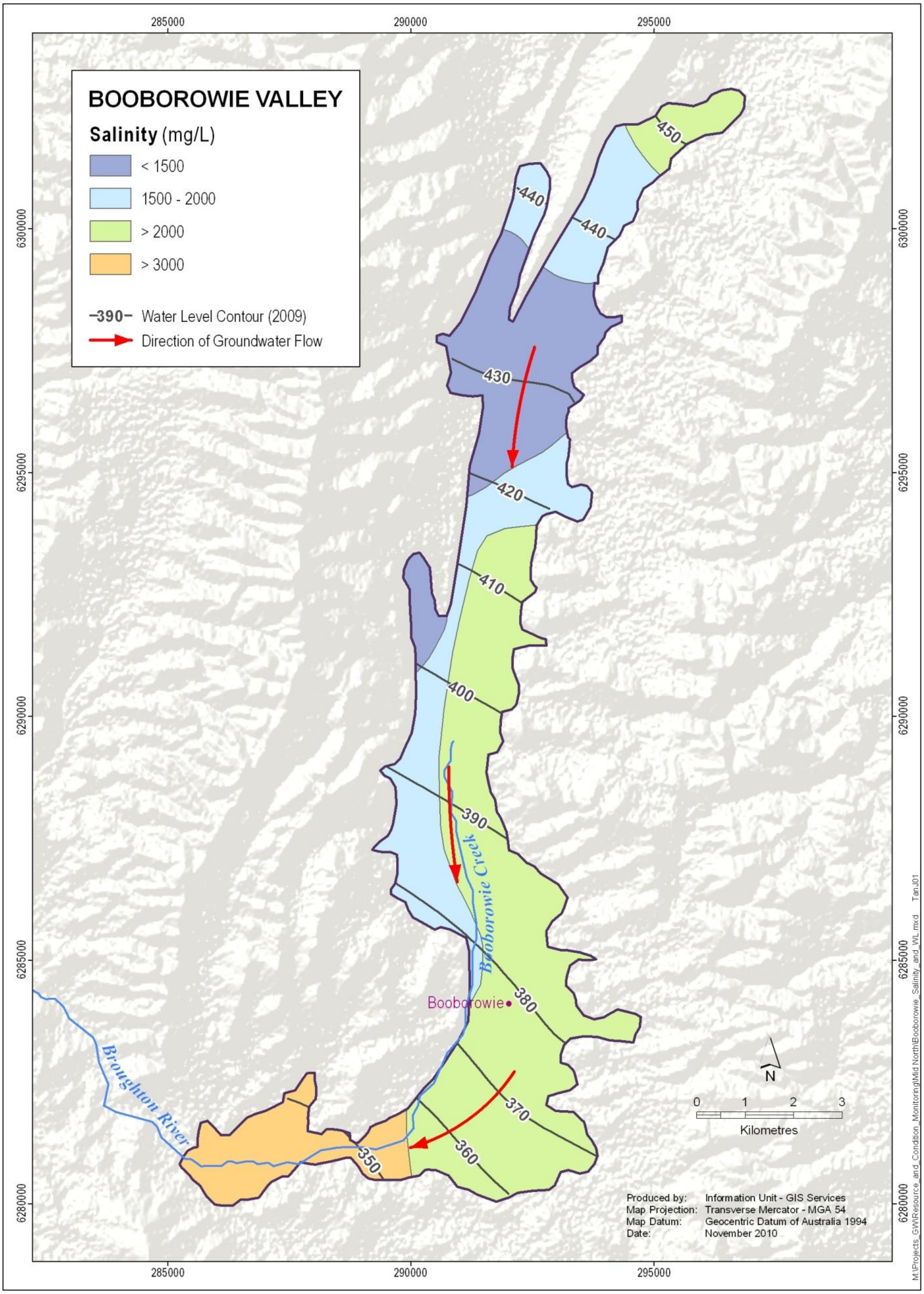

Figure 1. Groundwater flow and salinity distribution for Quaternary aquifers in the Booborowie Valley

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 Booborowie Valley. 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 watertables, i.e. those less than 10 m below the surface are more likely to support GDEs than deeper watertables. The exception to this is stygofauna (animals that inhabit water filled cracks and pools below the ground), which can be found at greater depths.

Evidence from the early 1900s showed that the Booborowie Valley once supported a swamp and marsh ecosystem due to a very shallow watertable. Changes in landuse from the 1920's onwards have lowered groundwater levels so that these historic GDEs are now disconnected from the watertable and no longer exist in the landscape.

The only remaining GDEs in the Booborowie Valley are found along the eastern tributaries of Booborowie Creek (Cartapo and Waltons Palace Creeks), largely in the surrounding hill zone where groundwater contributions to surface aquatic ecosystems are provided through the fractured rock aquifer. Mapped ecosystems in these tributaries include persistent pools and instream sedges and emergent macrophytes such as the common reed *Phragmites australis* and bulrush (*Typha sp.*).

There are no records of native fish species in the persistent pools of the eastern tributaries. Macroinvertebrate populations are likely to be dominated by still-water generalists and opportunistic species responding to rainfall events. Other possible GDEs in the Booborowie Valley include stygofauna.

RAINFALL

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.

Rainfall in the Booborowie Valley is winter dominant, with the annual rainfall at the Booborowie township averaging 440 mm/yr.

Figure 2 shows the annual rainfall recorded at the Bureau of Meteorology station at Booborowie for the period 1884–2009 in red columns. The cumulative deviation is also graphed in blue and measures the difference between the actual measured rainfall and the long term average rainfall on an annual basis. An upward trend in this line indicates above average rainfall, and conversely, a downward trend indicates below average rainfall.

Above average rainfall can be observed during the years 1973-74, 1978-80, and in 1992-1993. Significant periods of below average rainfall were recorded during the years 1982-85 and generally since 2002 to the present day.

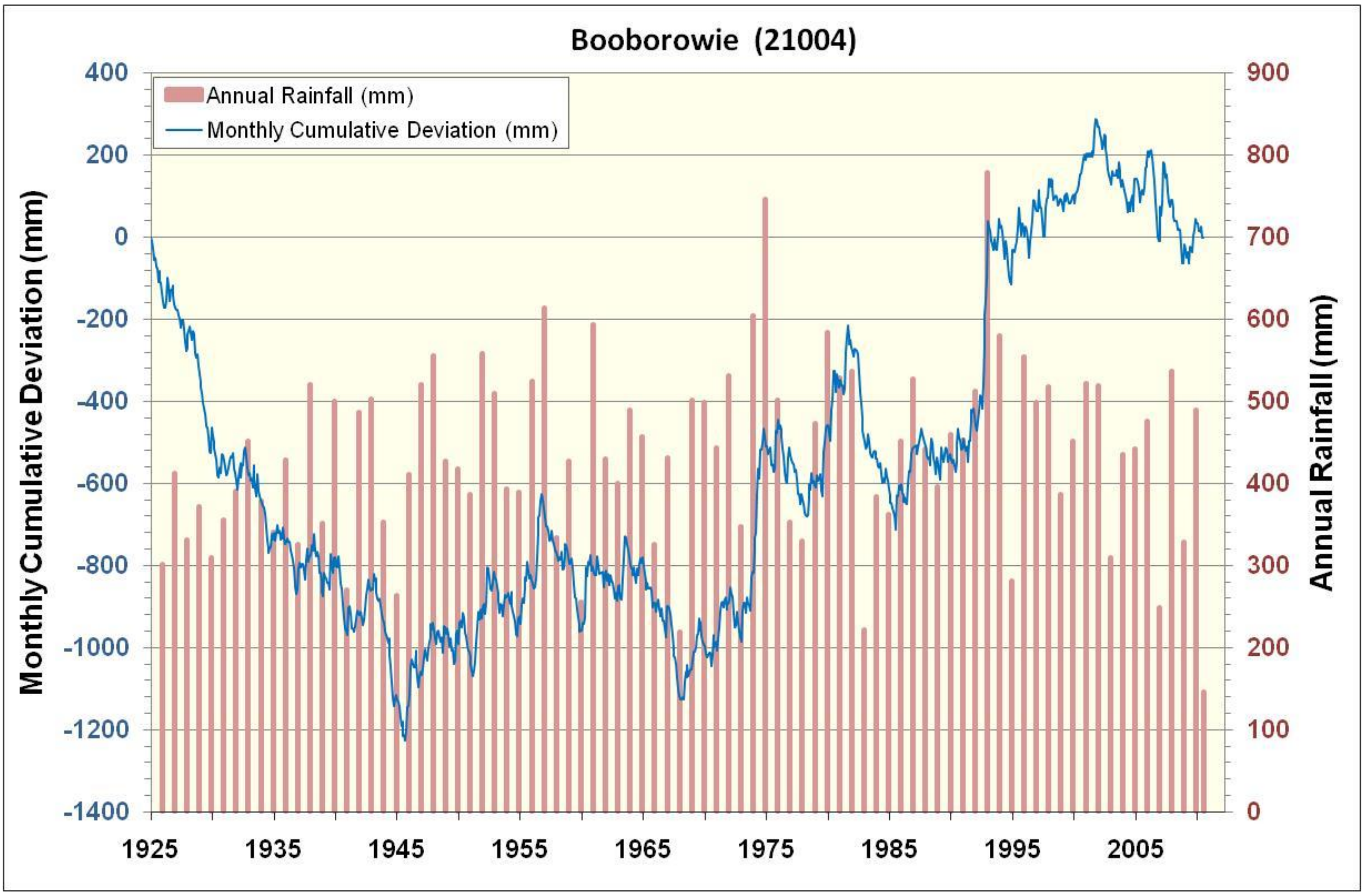

Figure 2. **Annual rainfall and cumulative deviation from mean monthly rainfall at Booborowie**

GROUNDWATER USE

The Booborowie Valley has been described as the "nursery of the South Australian lucerne seed industry," due to the fertile soils and abundance of water. The area cultivated reached a maximum of 20 250 ha in 1970, however only about 70 ha was irrigated. Aphid outbreaks decimated the crop in the early 1980s, but it has since recovered.

As there is no metering in the Booborowie Valley, estimates of groundwater extractions presented in Table 1 are based on the area under irrigation, application rates for lucerne, well yields, and pumping information provided by landholders. A steady decline in extractions since 1990 has accelerated sharply by 2010.

Table 1. Estimated historic groundwater use in the Booborowie Valley

Year	*Estimated use (ML)*
1972	1,100
1990	1,200
2005	950
2010	300

WATER LEVEL NETWORK

The groundwater level observation network for the Booborowie Valley is shown in Figure 3. Monitoring began in 1971, and there are currently 33 wells being monitored on a semi regular six monthly frequency.

Three aquifers are monitored;

1. Nine wells in the shallow alluvium which consists mainly of silts and clays (less than 20 m deep),
2. Eight wells in the basal gravel aquifer (more than 20 m deep), which provides all irrigation extractions,
3. Sixteen wells in the fractured rock aquifer.

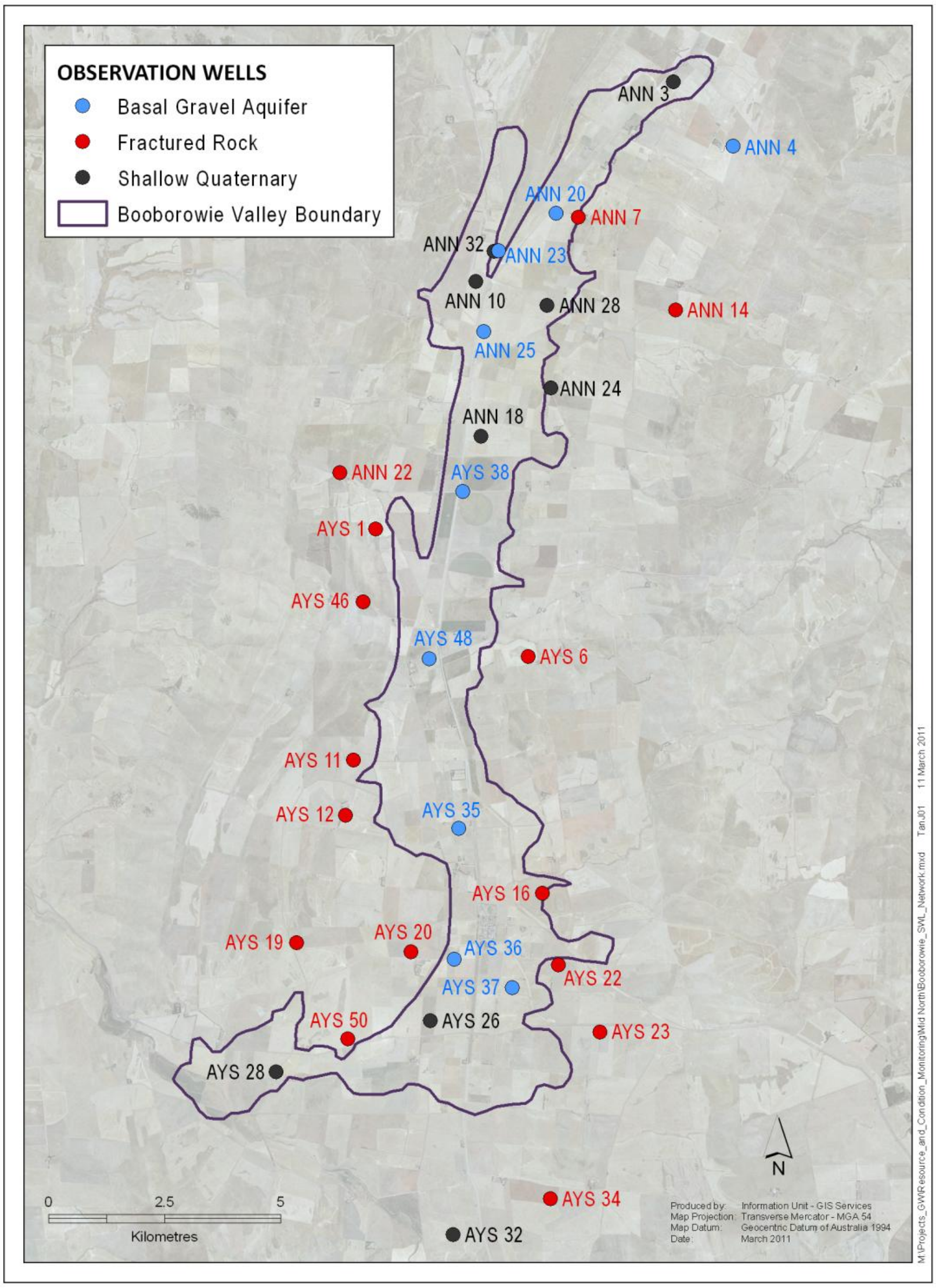

Figure 3. Location of groundwater level observation wells in the Booborowie Valley

SALINITY NETWORK

The groundwater salinity observation network for the Booborowie Valley is shown in Figure 4. Salinity monitoring began in 1972 and has been continued intermittently since then. There are currently 20 wells being monitored on an annual frequency.

Three aquifers are monitored;

1. Nine wells in the fractured rock aquifer which surrounds the valley,
2. Six wells in the shallow alluvium which consists mainly of silts and clays (less than 20 m deep),
3. Five wells in the main basal gravel aquifer (more than 20 m deep).

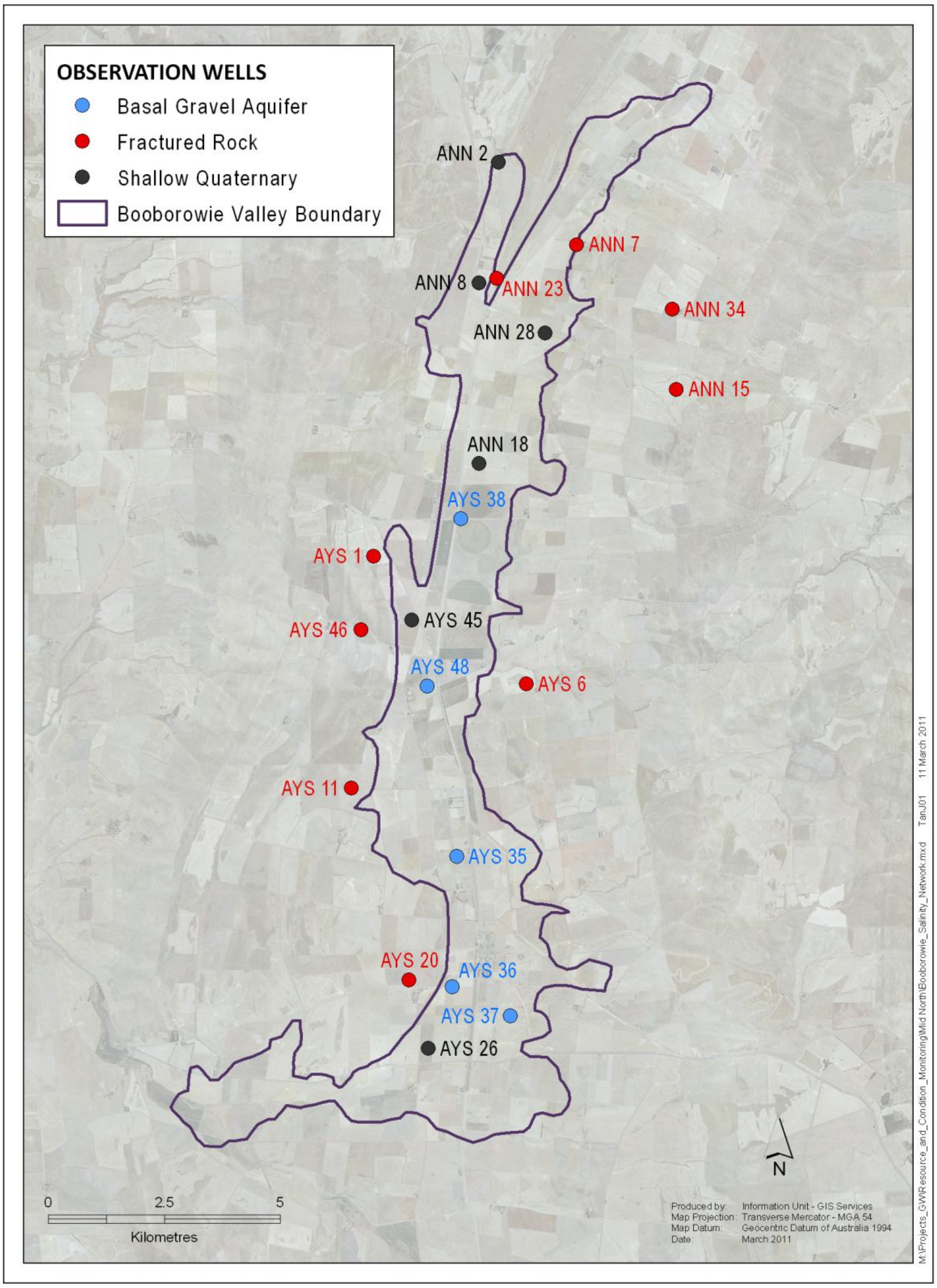

Figure 4. Location of groundwater salinity observation wells in the Booborowie Valley

GROUNDWATER LEVEL TRENDS

Hydrographs are presented following for observation wells located in the three different aquifers in the Booborowie Valley. The most complete record comes from observation wells constructed by the former Mines Department in 1973 which are completed in the deeper basal gravel aquifer.

SHALLOW ALLUVIAL AQUIFER

Only stock and domestic supplies are obtained from shallow wells in this aquifer. The hydrographs in Figure 5 also show a response to episodic recharge which occurs in very wet years such as 1992, with a steady decline in water levels since then. AYS028 is showing a small long term rise as it is located at the downgradient end of the valley where groundwater discharges laterally to the west where the Booborowie Creek valley cuts through the Brown Hill Range.

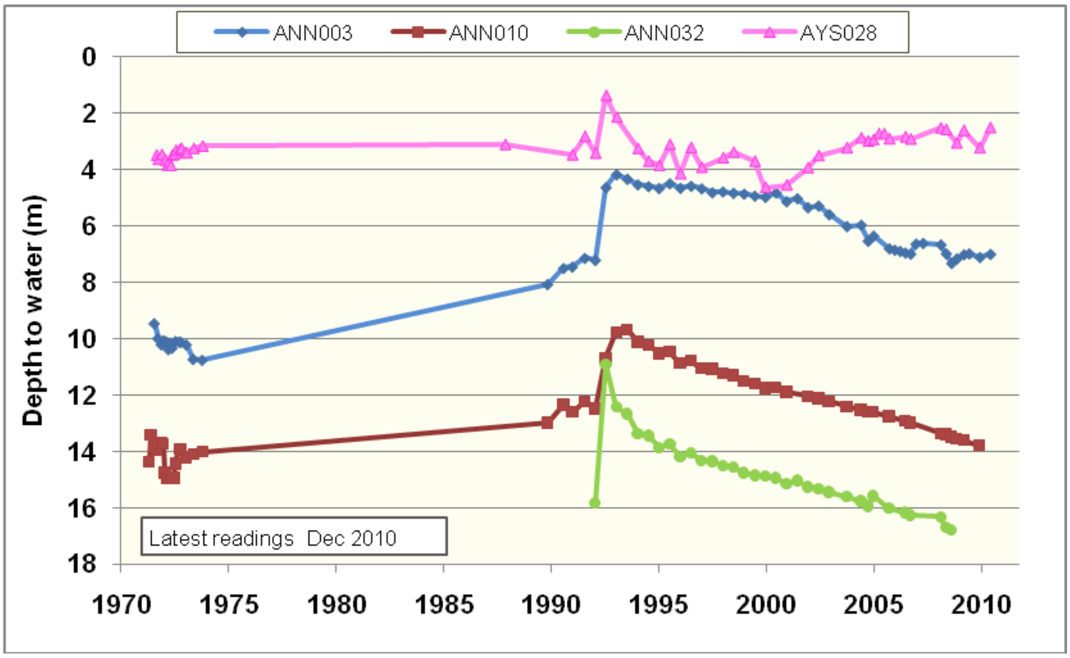

Figure 5. Groundwater level trends of the shallow alluvial aquifer in the Booborowie Valley

BASAL GRAVEL AQUIFER

The hydrographs in Figure 6 show a classic response to episodic recharge which only occurs in very wet years, such as 1974, 1981 and 1992. Outside these periods in average rainfall years, there is very little water level response to winter rainfall. Wells AYS035 and AYS038 show a seasonal drawdown response due to pumping which decreased significantly in recent years. The steady decline since 1992 is due to lack of recharge resulting from below average rainfall.

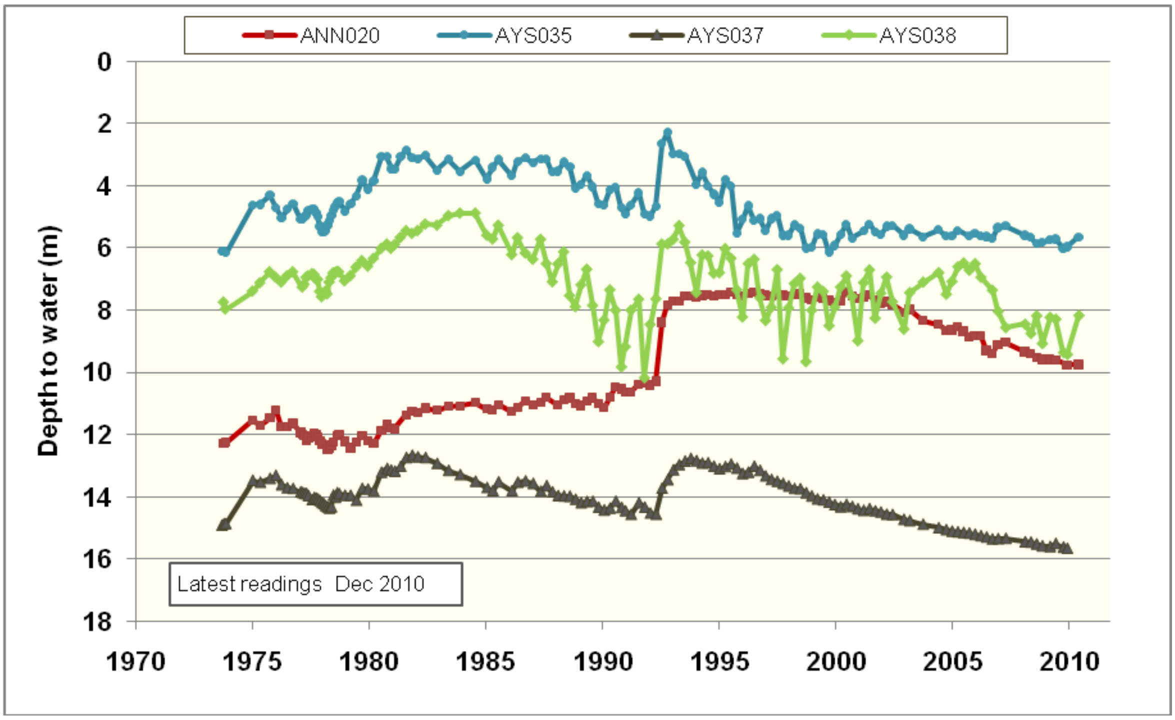

Figure 6. Groundwater level trends of the basal gravel aquifer in the Booborowie Valley

FRACTURED ROCK AQUIFER

The hydrographs in Figure 7 similarly show the response to episodic recharge, with the rate of decline depending on the permeability of the aquifer. The more rapid decline in well AYS034 in the south may be due to a more permeable aquifer allowing more rapid groundwater movement, than may be the case at ANN007 in the north where the decline is more gradual. Well AYS020 by contrast, is showing a recent rising trend.

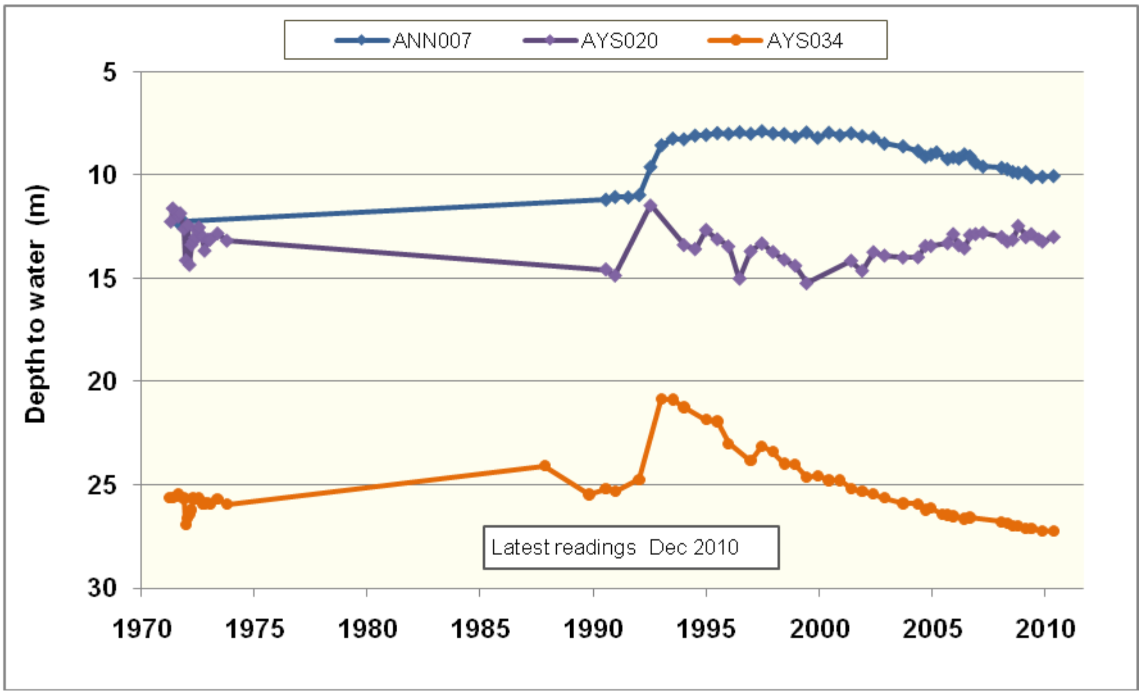

Figure 7. Groundwater level trends of the fractured rock aquifer in the Booborowie Valley

GROUNDWATER SALINITY TRENDS

SHALLOW ALLUVIAL AQUIFER

The trends in groundwater salinity shown in Figure 8 for wells completed in the shallow alluvium vary from relatively stable (wells ANN018 and AYS045) to long term rising trends ranging from 10 to 20 mg/L/yr (wells ANN002 and AYS026). Of interest is the significant rise in salinity observed in some wells that occurred after wet 1992-93 season, which was most likely caused by the flushing of unsaturated zone salt down to the watertable.

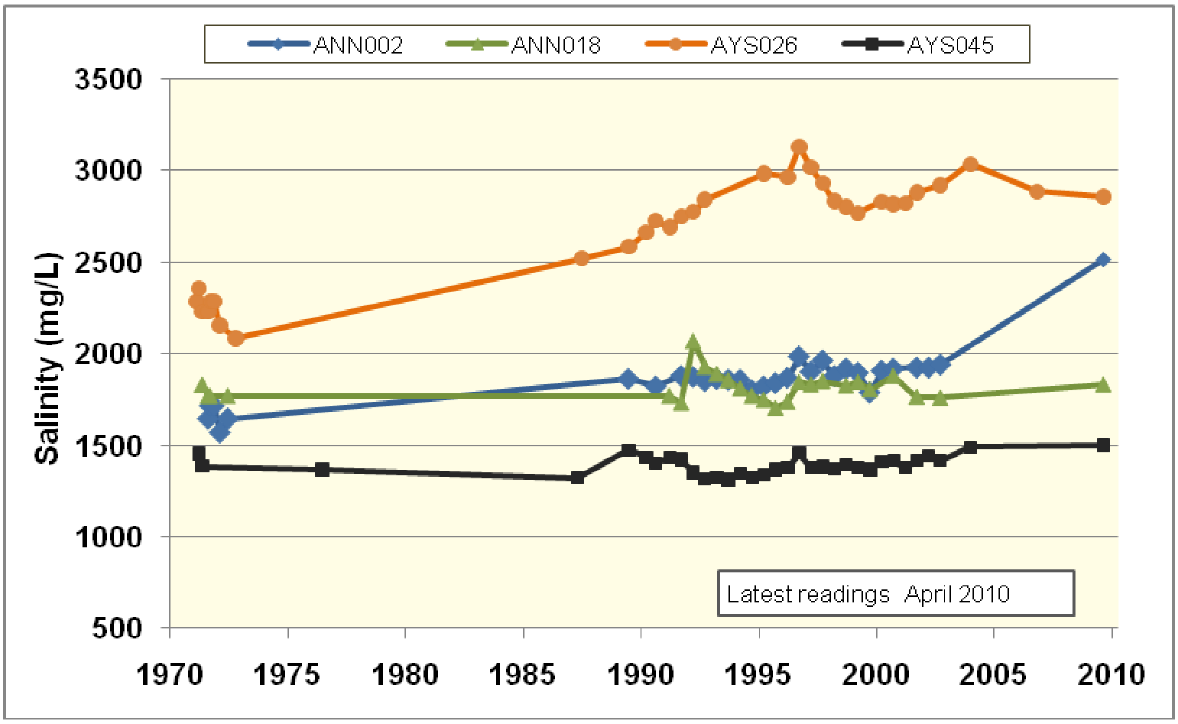

Figure 8. Groundwater salinity trends of the shallow alluvial aquifer in the Booborowie Valley

BASAL GRAVEL AQUIFER

There is insufficient data to comment on salinity trends in this aquifer.

FRACTURED ROCK AQUIFER

The fractured rock observation wells (Fig. 9) also show a variety of trends from decreasing salinity to a slow rising trend. These trends may reflect long term changes in response to changing land use. Some wells monitoring the fractured rock aquifer beneath a significant thickness of alluvium also show rise in salinity following the wet 1992-93 season.

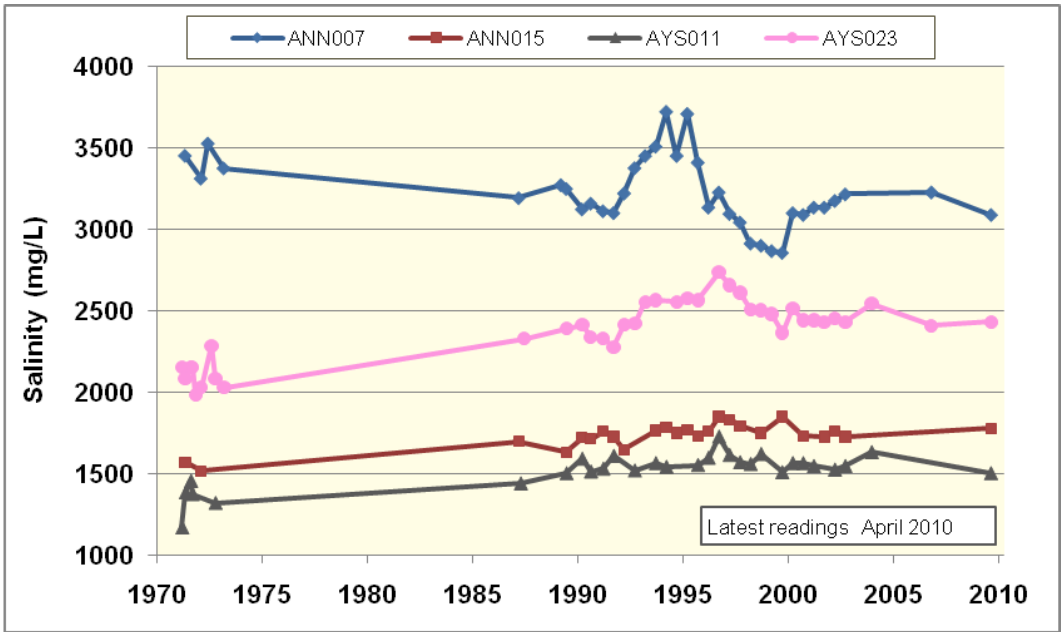

Figure 9. Groundwater salinity trends of the fractured rock aquifer in the Booborowie Valley