PEAKE-ROBY-SHERLOCK PWA

GROUNDWATER LEVEL AND SALINITY STATUS REPORT

2011

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2011 SUMMARY

The Peake-Roby-Sherlock Prescribed Wells Area is located about 120 km southeast of Adelaide and is underlain by sedimentary aquifers of the Murray Basin. It is a local-scale groundwater resource with a small number of irrigators. Groundwater is prescribed under South Australia's *Natural Resources Management Act 2004* and a Water Allocation Plan provides for the sustainable management of the groundwater resources.

Extractions for the 2010–11 water use year totalled 1220 ML, which represents a decrease of 32% from the previous year. Nearly all of this extraction occurs from the confined Buccleuch Group aquifer, with only 0.5 ML taken from the unconfined Murray Group Limestone aquifer.

There have been considerable seasonal variations in pressure levels since large-scale irrigation commenced in 2004, with the seasonal drawdowns decreasing with distance from areas of irrigation. Drawdowns have increased every year until 2009–10 with drawdowns stabilising and beginning to decrease in magnitude in 2010–11 in response to decreased extractions.

Rising salinity in the western portion of the Prescribed Wells Area is the greatest risk resulting from irrigation extraction from the Buccleuch Group aquifer. Insufficient time has passed since large-scale irrigation commenced for the establishment of long-term trends. However, short term observed trends in the 13 observation wells show little variation in salinity from 2006 to 2011. When long term trends incorporating pre irrigation salinity values (mostly at the time of drilling) are examined, only minor variation in salinity is evident indicating salinity in the region at this stage appears relatively stable.

ASSESSMENT OF STATUS

2011 STATUS

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

This means that the Peake-Roby-Sherlock Prescribed Wells Area has been assigned a green status of "No adverse trends, indicating a stable or improving situation". The 2011 status is supported by:

- considerable seasonal variations in pressure levels since large-scale irrigation commenced in 2004, with seasonal drawdown during the irrigation season ranging up to 11 m
- Due to drawdown in the confined aquifer, salinity is anticipated to increase in the future. Salinity increases are not expected to affect the current beneficial use of the resource by groundwater users over the next 10–20 years

Although the observed groundwater level trends during 2011 are showing a recovery from previous years, the levels are still much lower than pre-irrigation levels.

 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.

To view the 2009–10 *Peake-Roby-Sherlock groundwater level and salinity status report*, visit WaterConnect.

For futher details and to access the Water Allocation Plan for the Peake-Roby-Sherlock Prescribed Wells Area, visit:

http://www.samdbnrm.sa.gov.au/Water/WaterAllocationPlanningProgram/PeakeRobyandSherlockPWA.aspx

BACKGROUND

The Peake-Roby-Sherlock Prescribed Wells Area (PWA) is located about 120 km southeast of Adelaide and is underlain by sedimentary aquifers of the Murray Basin (Fig. 1). It is a local-scale groundwater resource with a small number of irrigators. Groundwater is prescribed under South Australia's *Natural Resources Management Act 2004* and a Water Allocation Plan provides for the sustainable management of the groundwater resources.

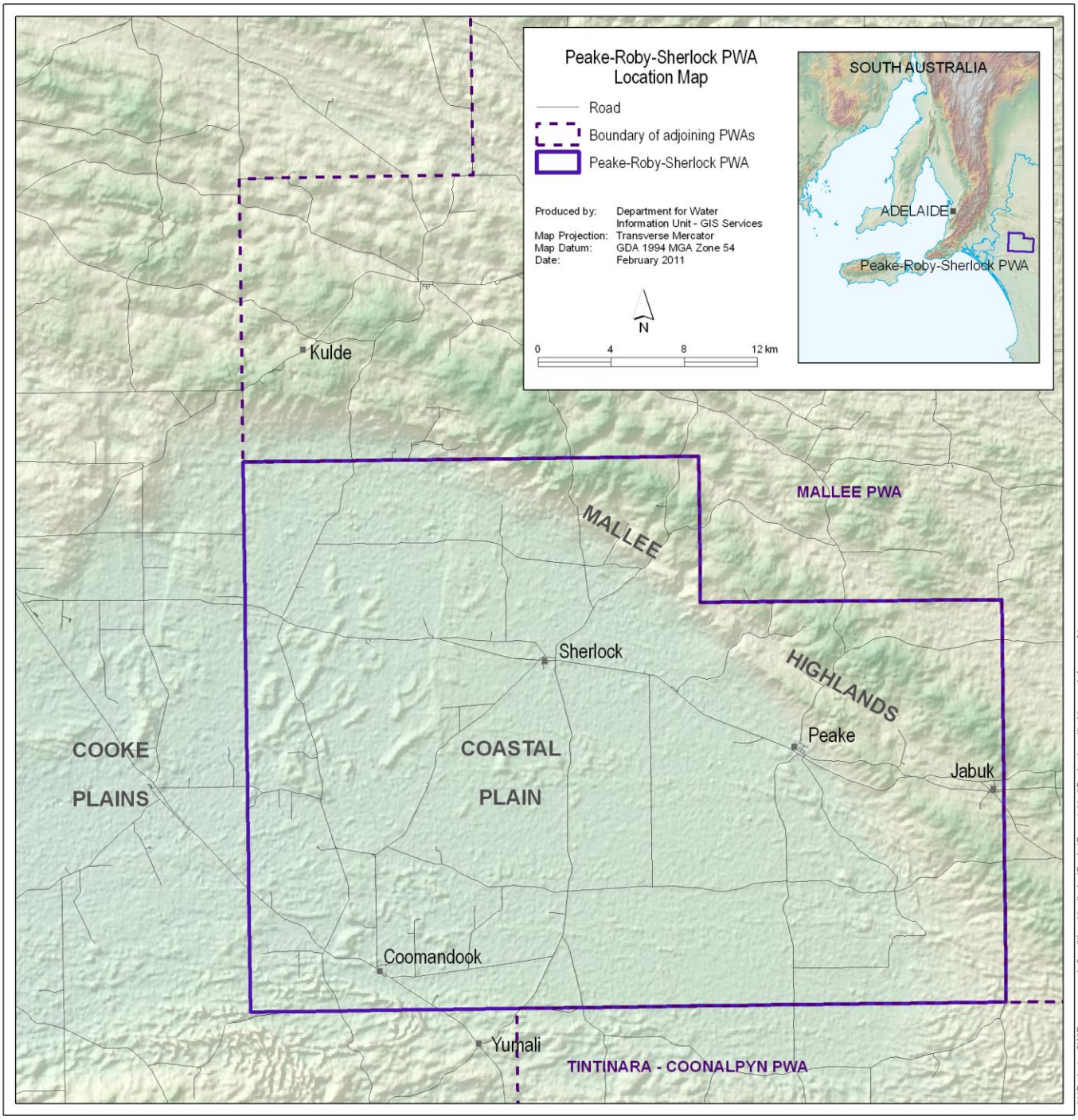

Figure 1. The Peake-Roby-Sherlock Prescribed Wells Area

HYDROGEOLOGY

The Peake-Roby-Sherlock PWA has two distinct aquifers – an unconfined aquifer and a confined aquifer (Fig. 2).

Unconfined Aquifer

The unconfined aquifer is continuous across the Peake-Roby-Sherlock PWA but can be divided into two main regions, the low lying coastal plain and the Mallee Highlands, each with different hydrogeological characteristics. Recharge to the unconfined aquifer primarily occurs locally via rainfall infiltrating directly into the aquifer through the soil profile.

Coastal Plain

On the low-lying coastal plain, groundwater occurs within a Quaternary limestone aquifer at shallow depths ranging between three and eight metres below ground level. Due to high salinities, there are currently no extractions from this resource.

Mallee Highlands

Beneath the Mallee Highlands groundwater is found in the Tertiary age Murray Group Limestone aquifer at a depth of about 40–50 m below the ground. Groundwater is mostly used for stock and domestic purposes with a small amount extracted for irrigation. Further to the east in the adjoining Mallee PWA, this aquifer is used extensively for irrigation.

Confined Aquifer

The confined aquifer comprises both the Buccleuch Group and the underlying Renmark Group. The most widely used aquifer is the Buccleuch Group, which consists of a consolidated bryozoal limestone or "coral" that lies at a depth of 90–100 m below the ground and varies in thickness from 5–25 m. The Ettrick Formation occurs between the confined aquifer and the overlying Murray Group Limestone aquifer and comprises a layer of black carbonaceous clay up to 20 m thick.

The coral layer lenses out towards the east, coincidentally where the terrain rises toward the Mallee Highland. Below this coral, sand layers within the Renmark Group lie at a depth of about 130 m and may be developed for supplies, with wells requiring sand screens.

As the Buccleuch and Renmark Group aquifers are confined, they are not recharged by local rainfall. The primary recharge source is the lateral inflow of groundwater into the Peake-Roby-Sherlock PWA from southwestern Victoria.

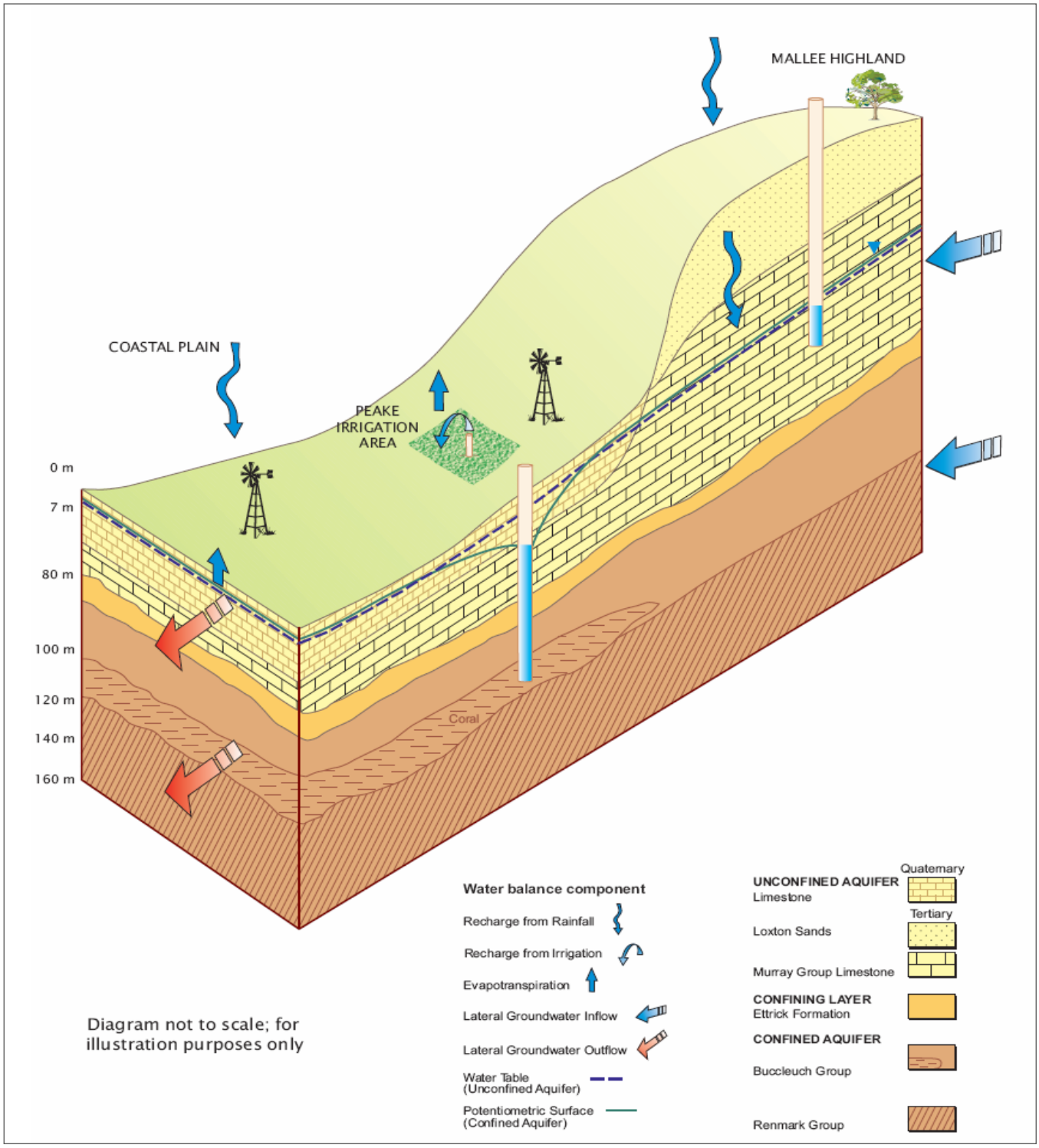

Figure 2. Schematic cross-section of the Peake-Roby-Sherlock PWA

GROUNDWATER FLOW AND SALINITY

Unconfined Aquifer

Groundwater level elevation contours indicate groundwater flow within the unconfined aquifer is from east to west (Fig. 3). The salinity distribution shows a marked increase from about 1500–3000 mg/L beneath the Mallee Highlands to very high groundwater salinities of over 35 000 mg/L beneath the coastal plain (Fig. 3). This increase in salinity reflects the extent of marine transgression which occurred about one million years ago.

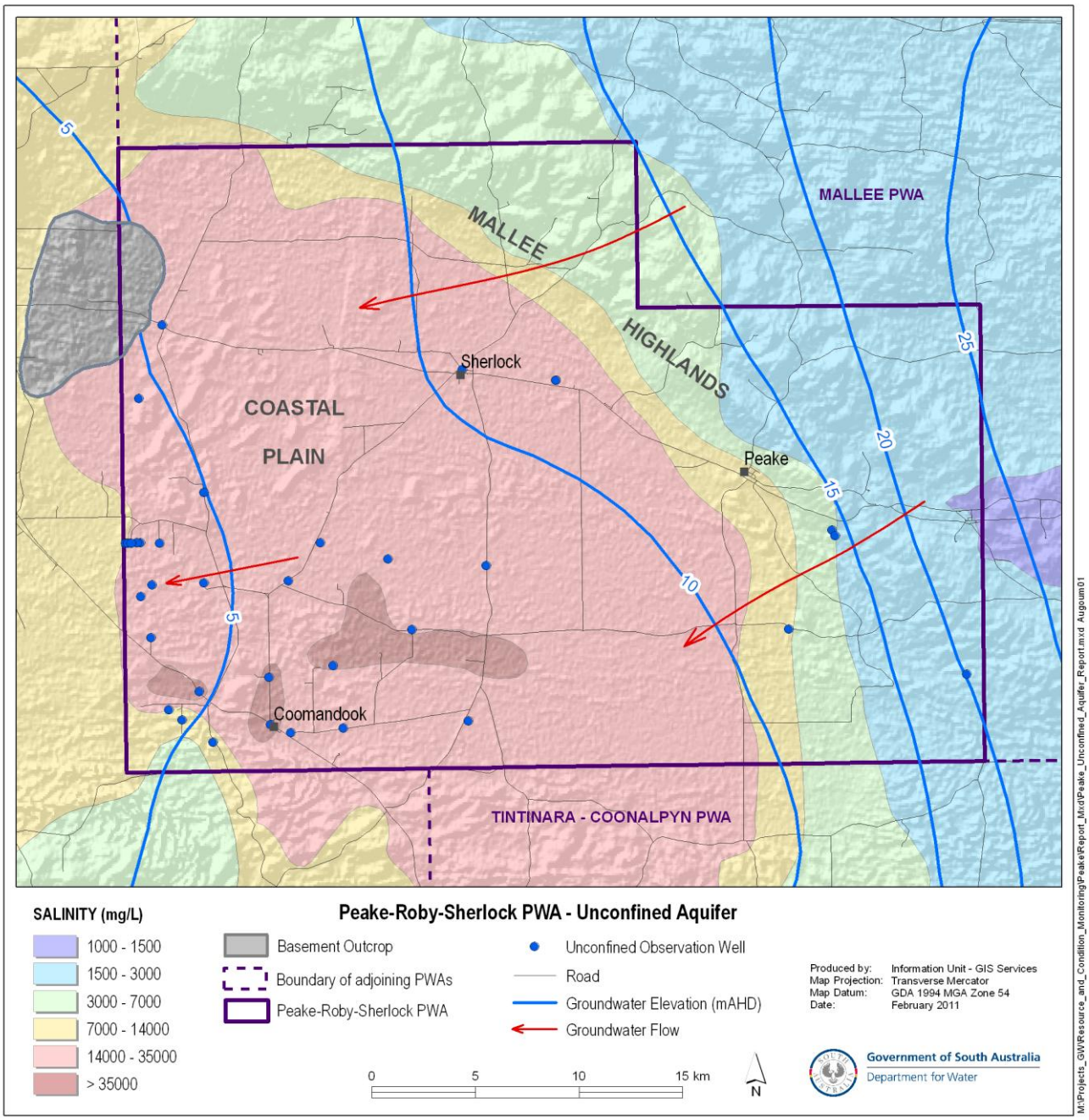

Figure 3. **Groundwater flow direction and salinity distribution of the unconfined aquifer in the Peake-Roby-Sherlock PWA for the 2010 season**[1]

[1] Upon review of 2011 data, there were very little discernable difference in the potentiometric surface and salinity as previously reported in 2010, as a consequence the figure has not been altered.

Confined Aquifer

Groundwater elevation contours indicate that irrigation extractions have produced a cone of depression in the pressure surface of the confined aquifer which has altered the groundwater flow direction. Before irrigation commenced in 2004, groundwater flow would have been generally in a west to south-westerly direction similar to the overlying unconfined aquifer. There is now a component of groundwater flow from the west at very slow rates (Fig. 4).

The salinity distribution shows a steady increase in salinity within the confined aquifer towards the west. To the south-west of Sherlock, groundwater salinities are usually too high for stock and reticulated water is used for stock and domestic supplies.

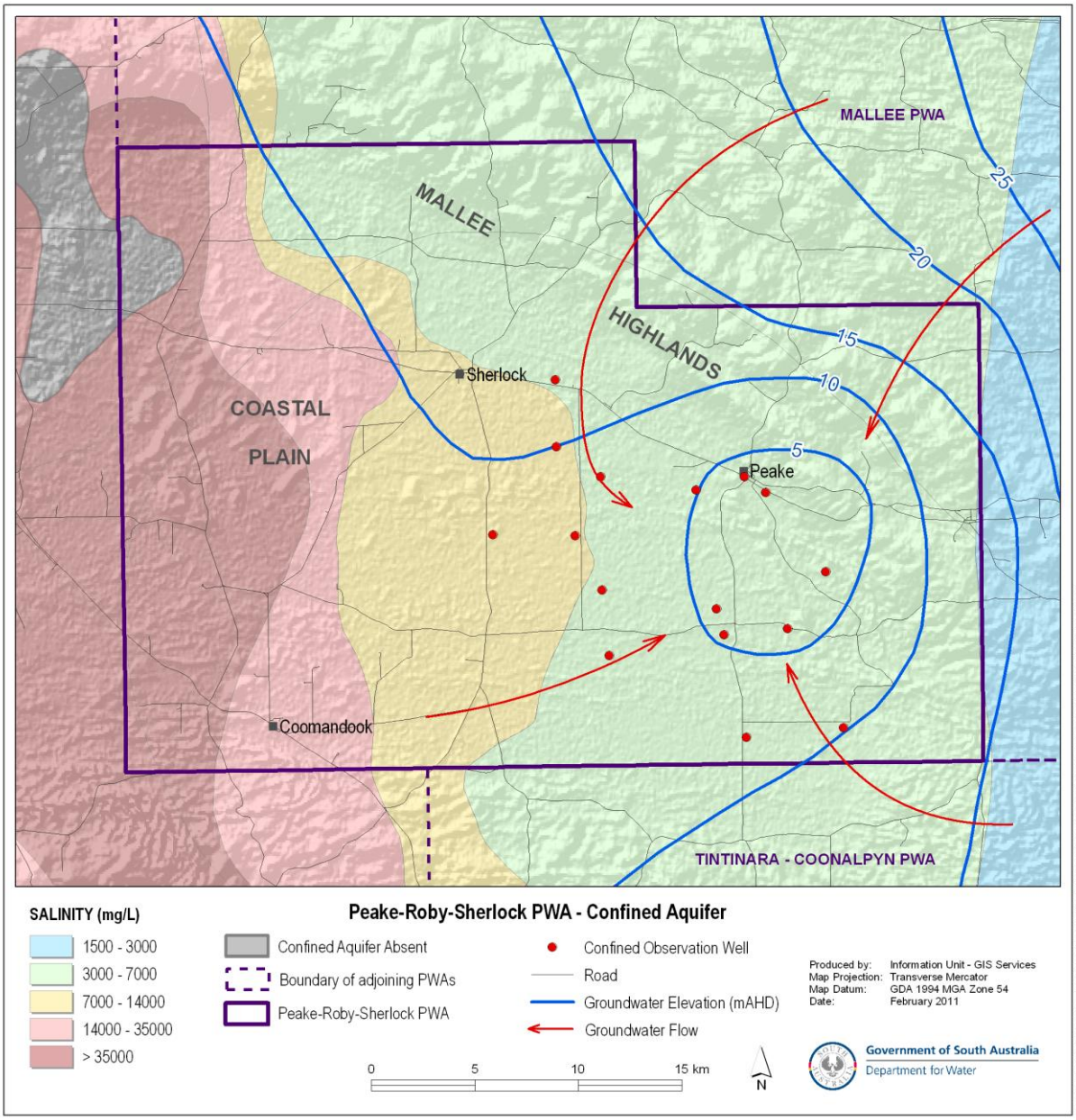

Figure 4. Groundwater flow direction and salinity distribution of the confined aquifer in the Peake-Roby-Sherlock PWA for September 2010[2]

[2] Upon review of 2011 data, there were very little discernable difference in the potentiometric surface and salinity as previously reported in 2010, as a consequence the figure has not been altered.

GROUNDWATER DEPENDENT ECOSYSTEMS

Whilst groundwater dependent ecosystems (GDEs) have not been considered in the assessment of the status of the groundwater resource, it is important to note the presence and ecological characteristics of the GDEs in the Peake-Roby-Sherlock 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 requirements, either permanently, seasonally or intermittently. It is generally considered that shallow watertables less than ten metres below the surface are more likely to support GDEs than deeper watertables. The exception to this is stygofauna (animals that inhabit water-filled spaces and pools below the ground) which can be found at greater depths.

A number of saline wetlands have been mapped in the southeastern section of the Peake-Roby-Sherlock PWA which are likely to be groundwater dependent. There is currently no information on the ecological functioning of the wetlands, their condition and their level of dependence on groundwater.

A study was undertaken in October 2003 in the adjacent Mallee PWA to identify the existence of stygofauna. The study found no evidence of stygofauna within the Murray Group Limestone aquifer. It was recognised that it was difficult to comprehensively sample such an aquifer, particularly where samples can only be taken from disturbed sites.

RAINFALL

The climate of the Peake-Roby-Sherlock PWA is characterised by hot, dry summers and cool to cold, wet winters. The long term annual average rainfall for the period 1889 to 2011 recorded at Peake rainfall station (25513) is 392 mm, with the overall long term rainfall trend slightly decreasing. The cumulative deviation from the average annual rainfall identifies periods where annual 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 (Fig. 5).

Rainfall records from the Peake station (Fig. 5) show alternating above and below average trends prior to 1992–93. Since then, the graph shows a continuous declining trend, suggesting rainfall has been generally below average. Above average rainfall was recorded in 2010 with 549 mm, whilst near average rainfall (409 mm) was recorded in 2011.

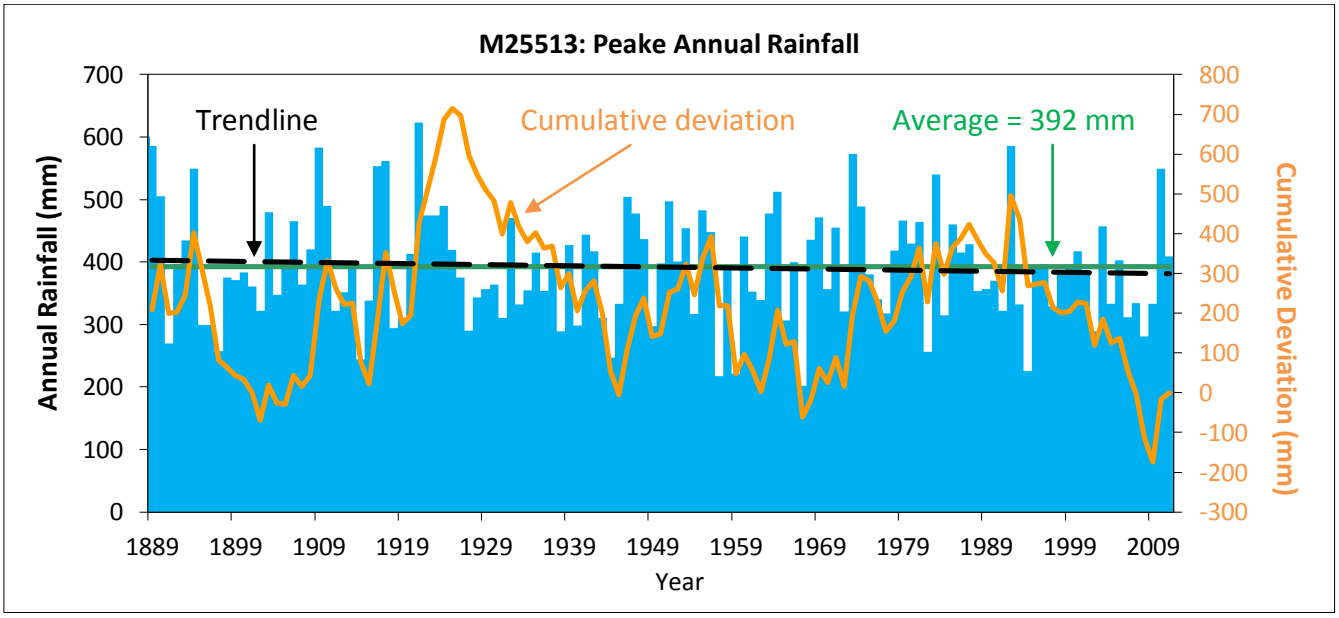

Figure 5. **Annual rainfall and cumulative deviation for average annual rainfall for the Peake station in the Peake-Roby-Sherlock PWA**

GROUNDWATER USE

Metered extractions within the Peake-Roby-Sherlock PWA commenced in 2004. For the 2010–11 water-use year, groundwater extractions totalled 1220 ML, a decrease of 32% from the previous year (Fig. 6). Nearly all of this extraction occurs from the confined aquifer, with only 0.5 ML taken from the unconfined aquifer. The marked increase in extraction in 2008–09 coincided with the revocation of a Notice of Prohibition.

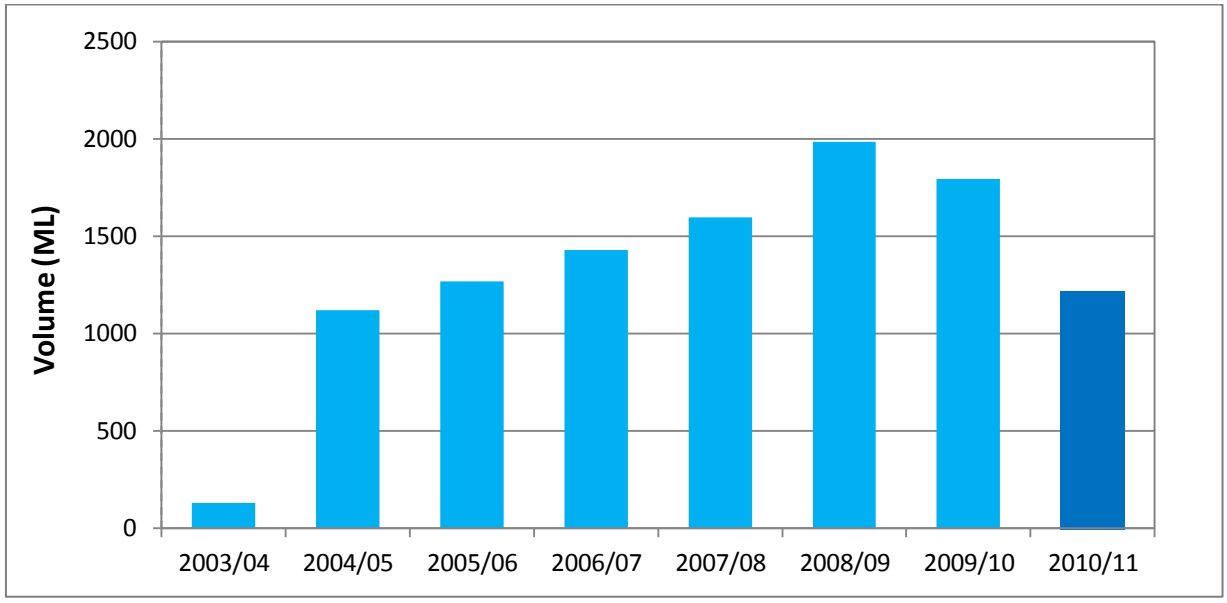

Figure 6. **Historical metered groundwater use in the Peake-Roby-Sherlock PWA**

Groundwater extracted within the Peak-Roby-Sherlock PWA is used predominantly for pasture crops (Fig. 7).

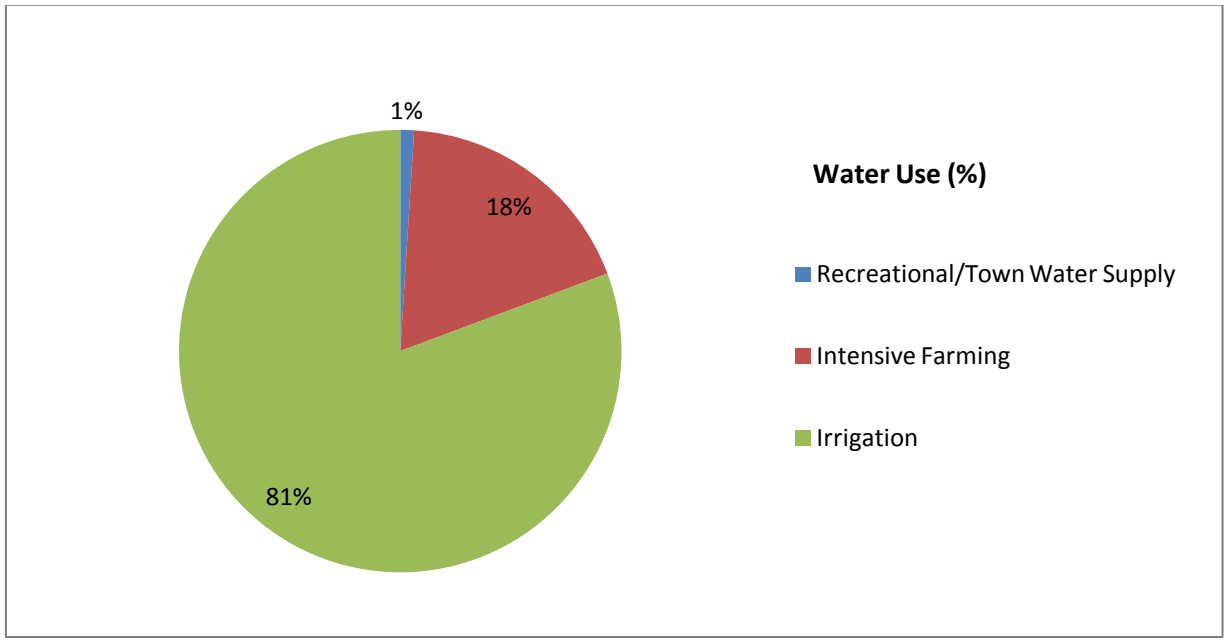

Figure 7. **Groundwater proportions extracted per type of use in the Peake-Roby-Sherlock PWA**

GROUNDWATER OBSERVATION NETWORKS

The monitoring of groundwater levels in the Peake-Roby-Sherlock PWA began in 1989 when concerns were expressed about rising watertables in the south-west of the area. Initially, the network was established on a local scale, but when interest in establishing irrigation in the Peake area first became apparent in 2000, the network was expanded. The large increase in development in 2004 prompted an intensification of the network and commencement of salinity monitoring.

WATER LEVEL NETWORK

There are currently 13 observation wells within the Peake-Roby-Sherlock PWA which monitor the unconfined aquifer (Fig 8). Most of these were established in 1987 to monitor rising watertables on the low-lying coastal plain due to the clearance of native vegetation. There are currently 16 observation wells monitoring pressure levels in the confined aquifer in the Peake-Roby-Sherlock PWA (Fig. 8).

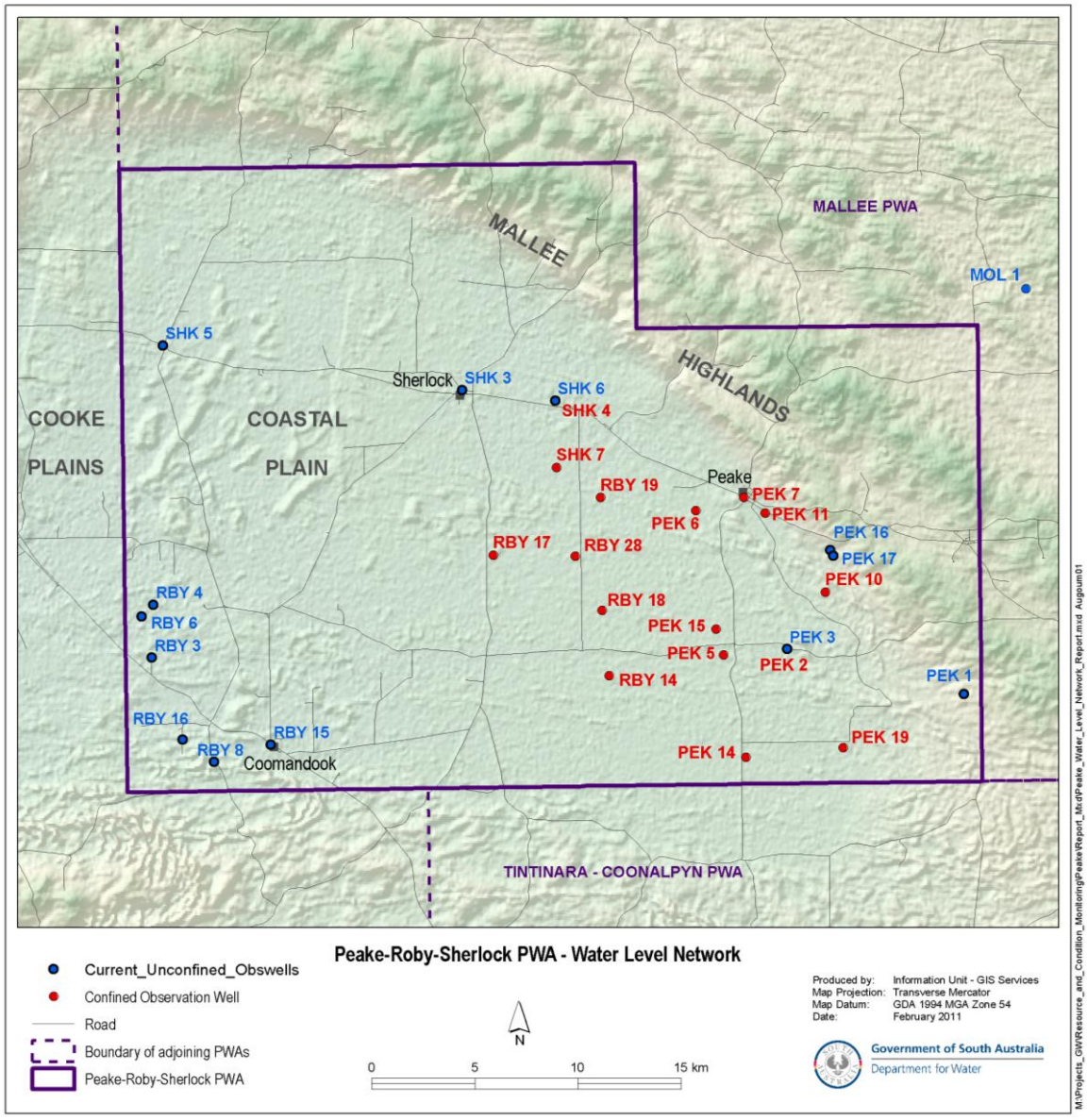

Figure 8. **Location of groundwater level observation wells in the Peake-Roby-Sherlock PWA**

SALINITY NETWORK

There are 13 wells within the confined aquifer salinity observation network (Fig. 9). These private stock and domestic wells are concentrated to the west of the main extraction area where the risk of salinity increases due to flow reversal is highest. They are sampled at six monthly intervals.

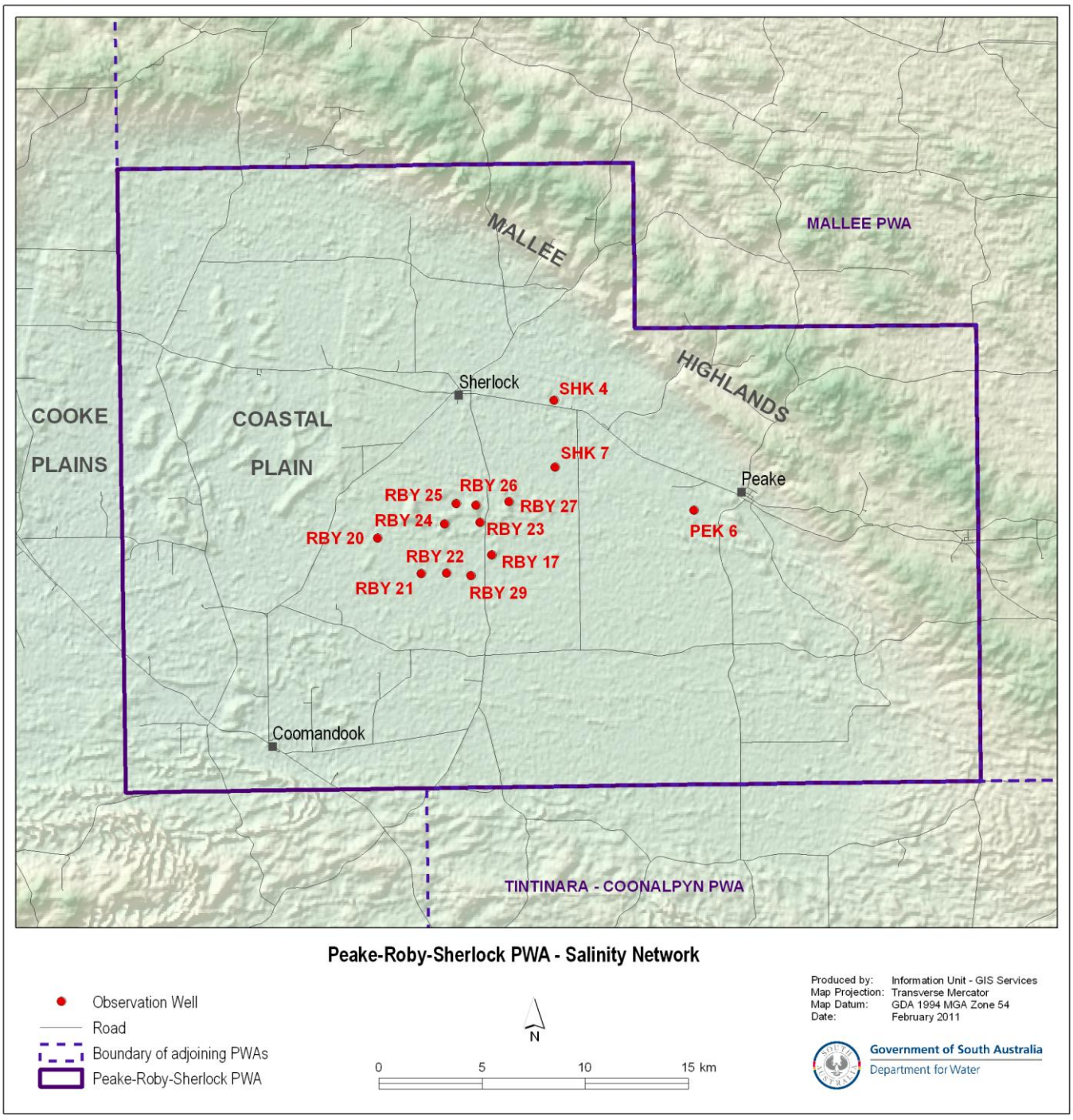

Figure 9. Location of groundwater salinity observation wells in the Peake-Roby-Sherlock PWA

GROUNDWATER LEVEL TRENDS

UNCONFINED AQUIFER

Coastal Plain

Prior to 1993, regional watertables recorded a rising long-term trend of 50–100 mm/y due to an increase in recharge following extensive clearing of native vegetation. This watertable rise had resulted in dryland salinity affecting hundreds of hectares in the Cooke Plains area (Fig. 1) found to the west of the Peake-Roby-Sherlock PWA.

Since 1993 there have been significant periods of below-average rainfall which has resulted in a slow decline in watertable levels. However, when compared to the cumulative deviation from average annual rainfall shown in orange, the shallow watertable can be seen rising in response to episodic wet years such as 1992, 1993, 1996 and 2010 (Fig. 10).

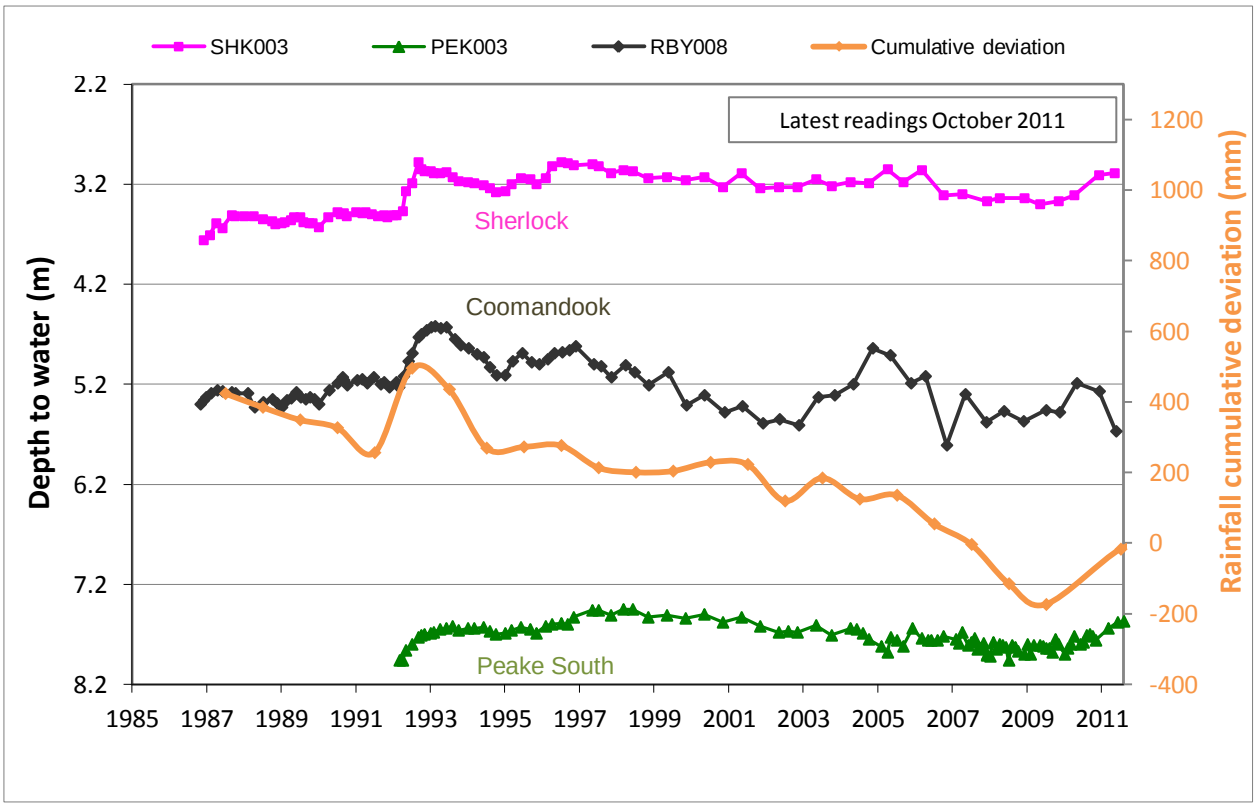

Figure 10. **Groundwater levels trends of the Coastal Plain unconfined aquifer in the Peake-Roby-Sherlock PWA**

Mallee Highlands

Hydrographs for observation wells in the Mallee Highlands (Fig. 11) show a very gradual rising trend of one to five centimetres per year due to vegetation clearance, despite the below-average rainfall prior to 2010 and the considerable depth to the watertable. Vegetation clearance will also cause a long term increase in groundwater salinity as salt previously stored in the root zone of the native vegetation is flushed down to the watertable by the increased recharge.

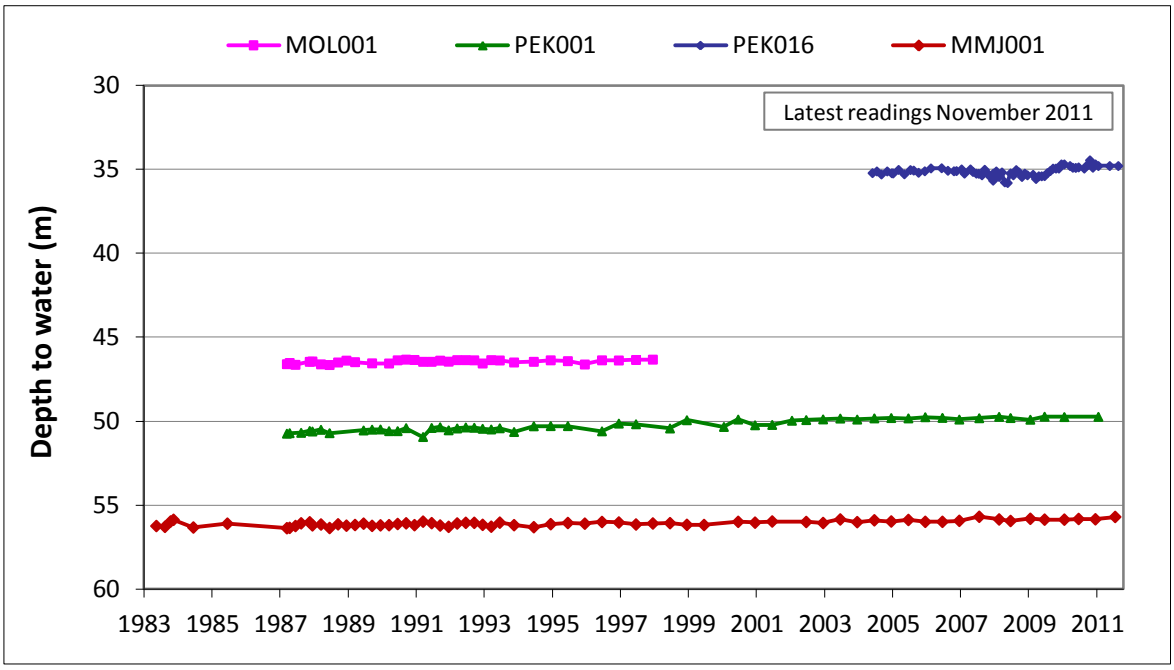

Figure 11. **Groundwater levels trends of the Mallee Highlands unconfined aquifer in the Peake-Roby-Sherlock PWA and the Mallee PWA**

CONFINED AQUIFER

As most of the groundwater extractions come from the confined aquifer, there is little direct correlation between groundwater levels and variations in rainfall. However, there could be an indirect correlation in that dry years (such as 2002 and 2006) will result in increased groundwater pumping that may lead to a lowering of groundwater levels. In particular, a dry winter could lead to an earlier start to pumping for the irrigation season which may prevent water levels from recovering to their normal levels in spring. Conversely, a wet spring might delay the start of irrigation, leading to a higher than normal recovery in groundwater levels.

Observation well PEK007 is the Peake town water supply well located at a distance of three kilometres from the area of concentrated pumping for irrigation; observation well PEK002 is located four kilometres away and SHK004 is at a distance of 15 km.

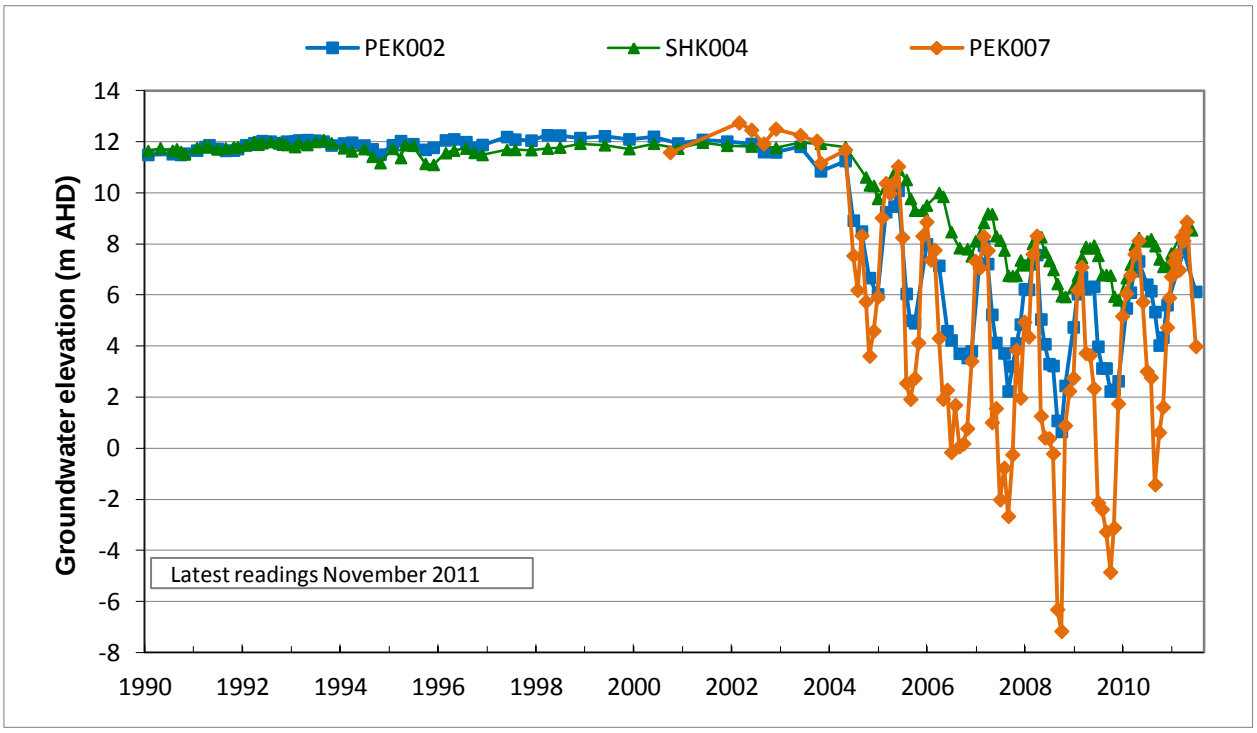

Figure 12. Groundwater levels trends of the confined aquifer in the Peake-Roby-Sherlock PWA

Large seasonal variations in pressure levels have developed since large-scale irrigation commenced in 2004, with the seasonal drawdowns decreasing with distance from the areas of irrigation (Fig. 12). Drawdowns have increased every year until 2009–10. Since then, drawdowns appear to have stabilised and are beginning to decrease in magnitude in response to decreased extractions.

GROUNDWATER SALINITY TRENDS

Rising salinity in the western portion of the PWA is the greatest risk resulting from irrigation extraction from the confined aquifer. Insufficient time has passed since large-scale irrigation commenced for the establishment of long-term trends. However, observed trends in the 12 observation wells for the period 2005 to 2011 show six wells with increasing salinity trends (ranging from 6.2 to 22.2 mg/L/y) and 6 wells with decreasing trends (typically between 12.4 to 40 mg/L/y). When long-term trends incorporating pre-irrigation salinity values (mostly at the time of drilling) were examined, half the wells showed a decreasing trend, with the remainder averaging an increase of 10 mg/L/y.

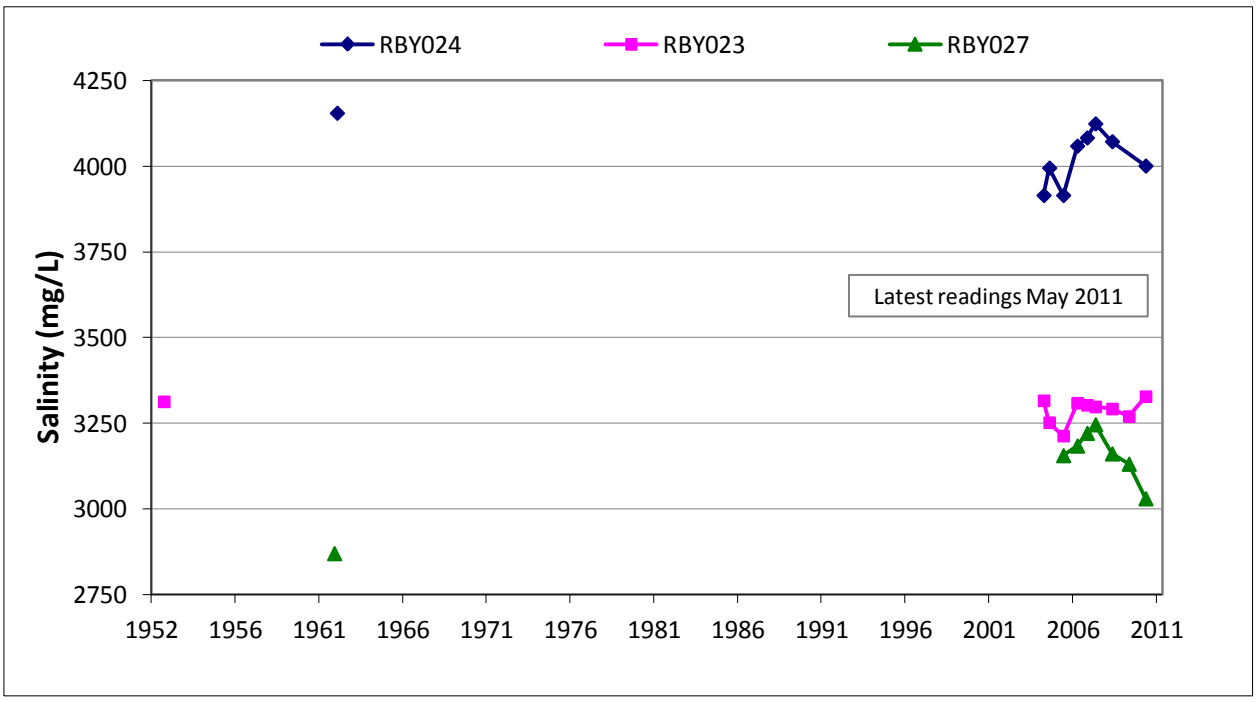

Figure 13. Groundwater salinity trends of the confined aquifer in the Peake-Roby-Sherlock PWA

RESOURCE CONDITION INDICATORS

The Peake-Roby-Sherlock PWA Water Allocation Plan has identified resource condition limits for the confined aquifer from which almost all irrigation extractions occur. These limits are designed to give early warning of unfavourable trends in water levels and salinity that may affect other users of the resource.

Groundwater Level

As stated in the Water Allocation Plan, the rolling three-year average of the annual maximum drawdown and recovery levels, measured in at least 50% of designated observation wells, should not fall below the maximum drawdown or recovery thresholds. The rolling three-year average maximum recovery levels (the highest level of recovery during the non-irrigation season, usually in August) are above the thresholds in all designated observation wells (Fig. 14). This indicates that the resource condition limits have not been reached or exceeded.

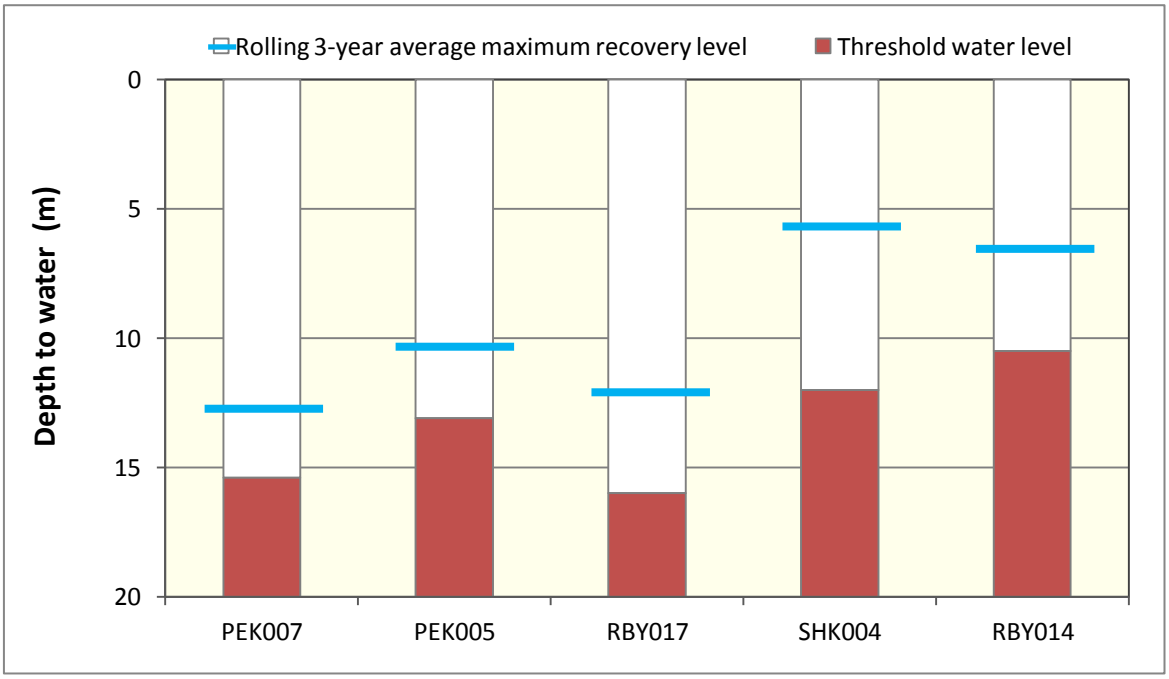

Figure 14. Maximum recovery level condition indicators

Similarly, the rolling three-year average maximum drawdown levels recorded during the irrigation season (usually Feb–March) are also above the thresholds in all designated wells (Fig. 15).

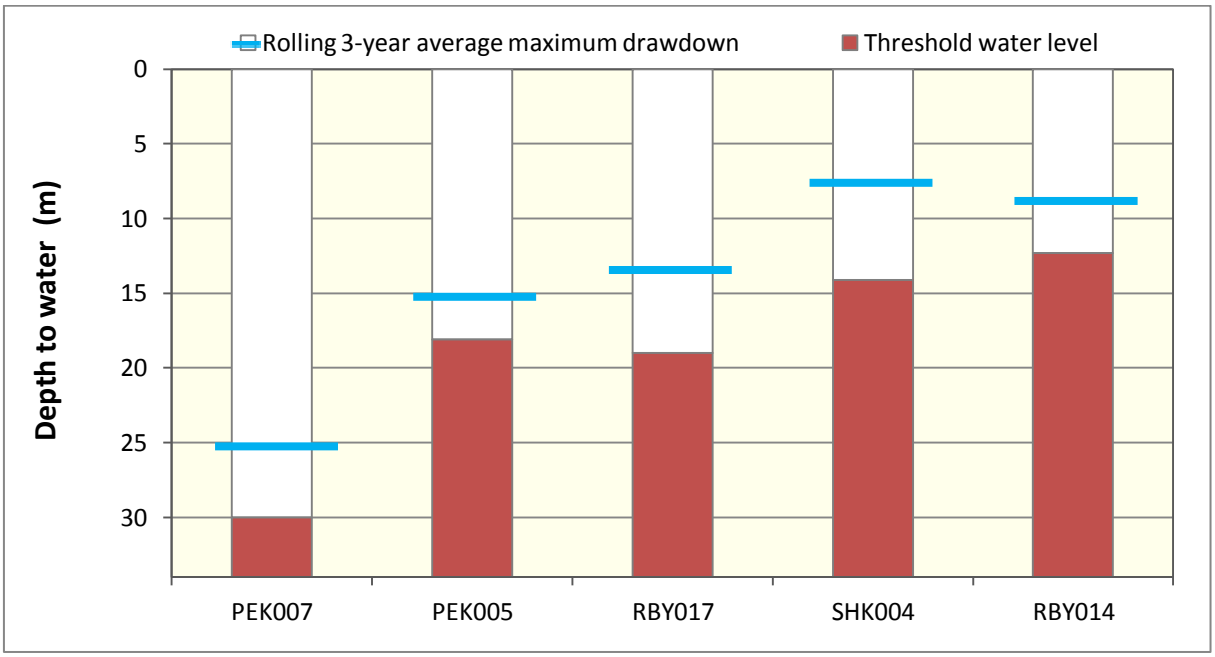

Figure 15. Maximum water level condition indicators

Groundwater Salinity

The rolling three-year average of the maximum groundwater salinity, measured in at least 50% of the designated observation wells, should not rise by more than 5% from the baseline salinity threshold. All designated wells have recorded an average change in salinity of less than 5% (Fig. 16). Observation well PEK006 has recently had its corroded casing rehabilitated and therefore does not have sufficient salinity data to allow the calculation to be made at this time.

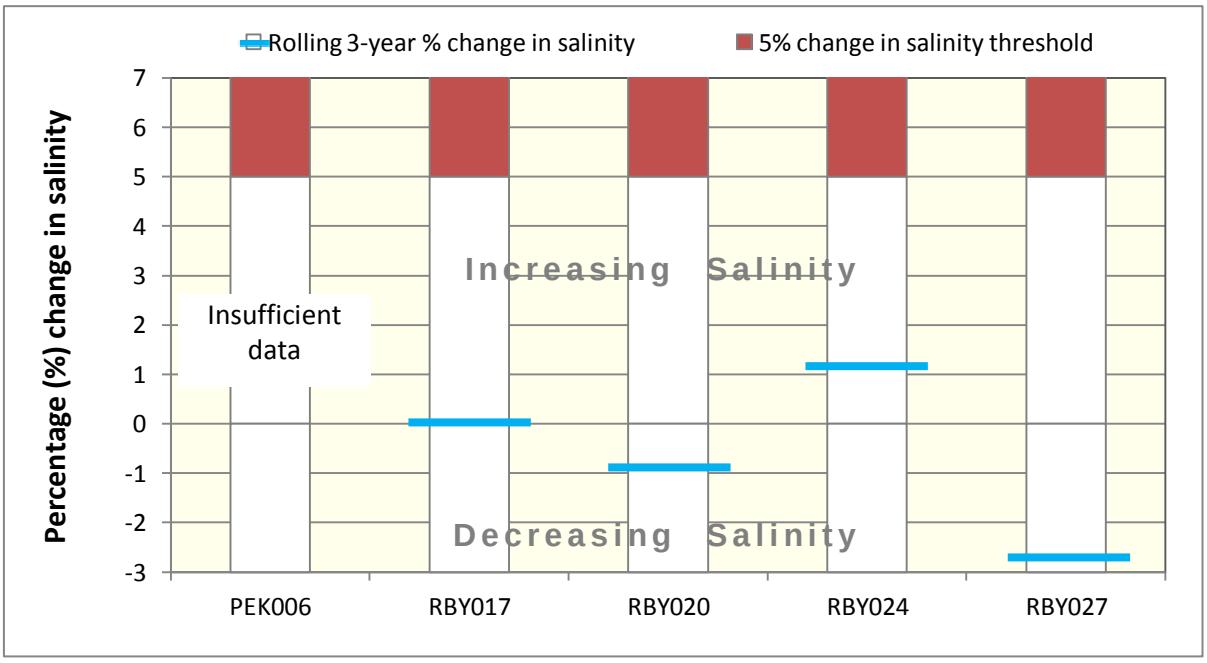

Figure 16. Salinity condition indicators