Barossa Prescribed Water Resources Area 2018-19 water resources assessment

Department for Environment and Water
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DEW Technical report 2020/23

Government of South Australia
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Contents

1 Summary

Rainfall

- Rainfall at Tanunda measured 360 mm in 2018–19, which was lower than the average of 532 mm. Long-term data trends indicate a decline in rainfall.
- Rainfall is typically higher over Tanunda and Jacobs Creek sub-catchments, decreasing to the north-east and south-west; this was the case in 2018–19.
- Reduced winter (June to September) rainfall was observed, consistent with observations across other areas in South Australia.

Surface water

- Four principal streamflow gauging stations are operational, three of which recorded the lowest streamflow on record in 2018–19.
- Annual streamflow at Mount McKenzie, Penrice, Yaldara and Bethany streamflow gauging stations were all below average in 2018–19. Minimal or no flow was experienced between January and May 2019 at all four stations. Long-term data trends show a decline in streamflow.
- The highest salinity at Yaldara in 2018–19 was 4394 mg/L and 1507 mg/L at Bethany (Tanunda Creek). These values remain within the historical ranges experienced at each site.

Groundwater

- Water levels in all three aquifer systems (Upper Aquifer, Lower Aquifer and fractured rock aquifers) are at their lowest levels on record.
- 93% of groundwater wells with suitable long-term records recorded lower-than-average water levels.
- Most wells with long-term records reached their lowest recovered water level on record in 2019: 61% of wells in the Upper Aquifer, 63% in the Lower Aquifer and 52% of wells in fractured rock aquifers.
- Five-year trends in water level show that the majority of wells have declining water levels.

Water use

- Water use for irrigation, commercial, stock and domestic purposes comes from a variety of sources. These include pumping and diversions from watercourses and aquifers, interception and storage by farm dams, imported water from the SA Water mains network and water supply from Barossa Infrastructure Ltd (BIL) via SA Water infrastructure. Approximately 67% of water use was from imported sources.
- Water consumption in 2018–19 was the highest in the last 15 years, with 19 523 ML extracted, including licensed surface water sources: 989 ML, non-licensed surface water demand: 1100 ML, Imported water: 13 027 ML (11 419 ML from the BIL scheme and 1608 ML from SA Water) and groundwater: 4407 ML.

1.1 Purpose

The Department for Environment and Water (DEW) has a key responsibility to monitor and report annually on the status of prescribed and other groundwater and surface water resources. To fulfil this, data on water resources are collected regularly, analysed and reported in a series of annual reports. Three reports are provided to suit a range of audiences and their needs for differing levels of information:

- **Technical Notes**: (this document) build on the fact sheets to provide more comprehensive information for each resource area, helping to identify the resource condition in further detail;
- **Fact sheets**: provide summary information for each resource area with an Annual Resource Status Overview;
- **State-wide summary**: this summarises information for all resources across all regions in a quick-reference format.

This document is the Technical Note for the Barossa Prescribed Water Resources Area (PWRA) for 2018-19 and addresses rainfall, surface water and water use data collected between July 2018 and September 2019 and groundwater data collected up until December 2019.

1.2 Regional context

The Barossa PWRA includes both the highland areas of the Mount Lofty Ranges and the Barossa Valley (Figure 1.1). It is located approximately 60 km north-east of Adelaide and lies within the Northern and Yorke Landscape Region and includes both groundwater and surface water resources. These are prescribed resources under South Australia's Landscape SA Act 2019. A water allocation plan adopted in 2009 provides rules for their management.

Groundwater occurs in three major aquifer systems: two sedimentary aquifers (Upper and Lower) and the fractured rock aquifers. The sedimentary aquifers are largely restricted to the central Barossa Valley between Nuriootpa and Lyndoch (Figure 1.1). The largest volume of groundwater extraction occurs from the fractured rock aquifers that extend across the entire PWRA.

The North Para River is the main watercourse in the PWRA. All streams are ephemeral and feature seasonally disconnected, permanent pools sustained predominantly by groundwater.

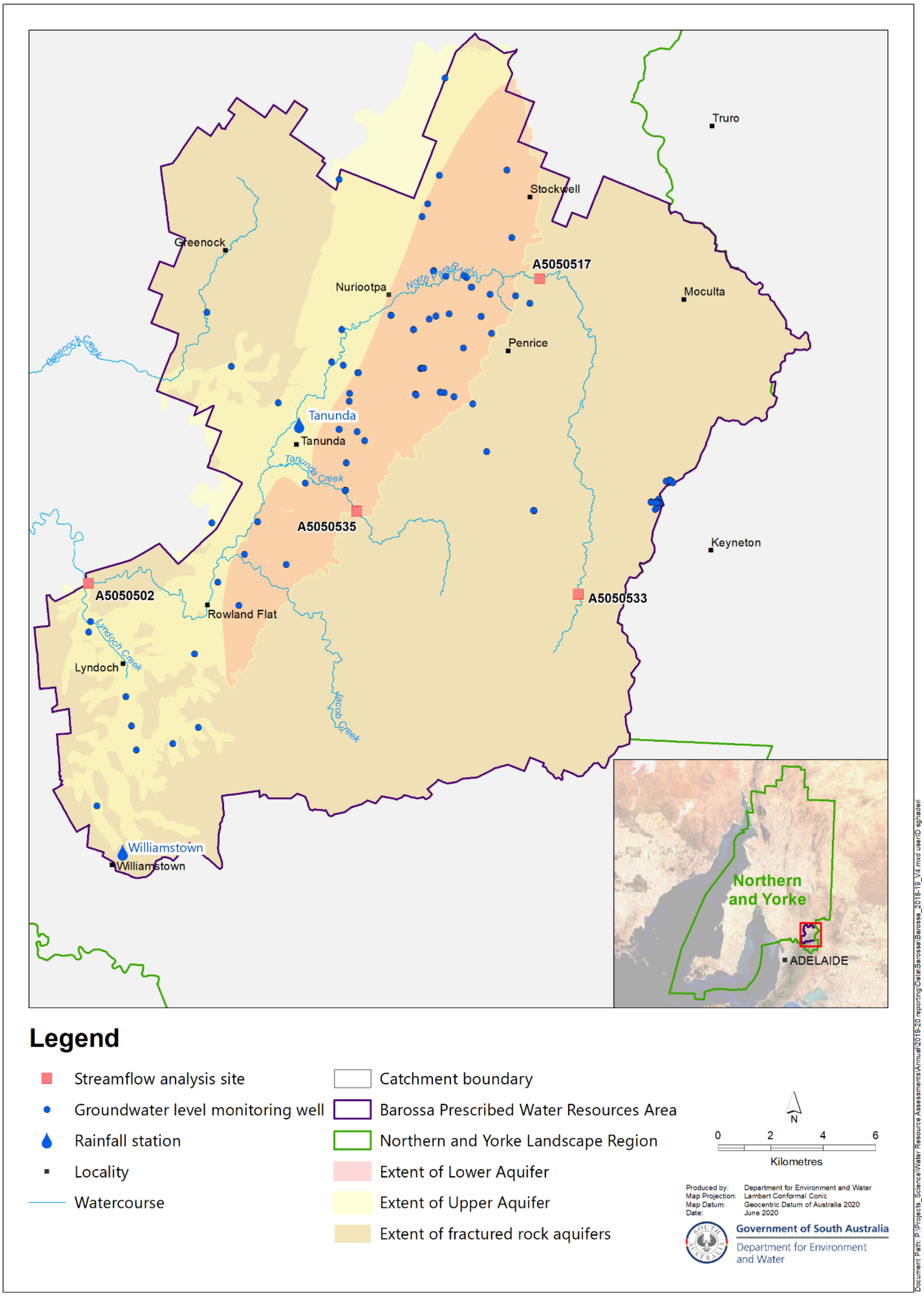


Figure 1.1 Location of Barossa PWRA

2 Methods and data

This section describes the source of rainfall, surface water, groundwater and water use data presented in this report and the methods used to analyse and present this data.

2.1 Rainfall

Daily rainfall observations were used from selected Bureau of Meteorology (BoM) stations in order to calculate monthly and annual totals. The data were obtained from the SILO Patched Point Dataset service provided by the Queensland Government, which provides interpolated values to fill gaps in observations (Figure 3.1 and Figure 3.2).

Rainfall maps were compiled using gridded datasets obtained from the BoM (Figure 3.5). The long-term average annual rainfall map (1986–2015) was obtained from Climate Data Online. The map of total rainfall in 2018–19 was compiled from monthly rainfall grids obtained for the months between July 2018 and June 2019 from the Australian Landscape Water Balance website.

2.2 Surface water

2.2.1 Annual streamflow

The status of each of the streamflow gauging stations is determined by expressing the annual streamflow for the applicable year as a percentile[1] of the total period of data availability. The period of data availability for the Yaldara streamflow gauging station is 1977–78 to 2018–19. Streamflow data were then given a description based on their percentile and decile[1] (Table 2.1).

Table 2.1. Percentile/decile descriptions*

Decile	Percentile	Description	Colour
N/A	100	Highest on record	
10	90 to 100	Very much above average	
8 and 9	70 to 90	Above average	
4, 5, 6, and 7	30 to 70	Average	
2 and 3	10 to 30	Below average	
1	0 to 10	Very much below average	
N/A	0	Lowest on record	

* Deciles and descriptions as defined by the BoM[2]

Annual streamflow data (Figure 4.2) is presented as the deviation of each year's streamflow from the long-term average with the bars shaded using the BoM classification shown in Table 2.1.

[1] The nth percentile of a set of data is the value at which n% of the data is below it. For example, if the 75th percentile annual flow is 100 ML, 75% of the years on record had annual flow of less than 100 ML. Median streamflow: 50% of the records were above this value and 50% below. Decile: a division of a ranked set of data into ten groups with an equal number of values. In this case e.g. the first decile contains those values below the 10^{th} percentile.

[2] Bureau of Meteorology Annual climate statement 2019

2.2.2 Monthly streamflow

Monthly streamflow for the applicable year is assessed alongside the long-term average monthly streamflow for the period 1977–78 to 2018–19 (Figure 4.3A) and long-term monthly statistics including (a) high flows (25th percentile), (b) median flows (50th percentile) and low flows (75th percentile).

2.2.3 Daily streamflow

Daily streamflow is presented to show the detailed variability throughout the applicable year (Figure 4.3B).

2.2.4 Salinity

Box plots on a monthly basis are used to assess surface water salinity (Figure 2.1 and Figure 4.4). This enables the salinity (TDS; total dissolved solids in mg/L) for the applicable year to be presented against long-term salinity statistics (maximum, 75th percentile, median or 50th percentile, 25th percentile and minimum).

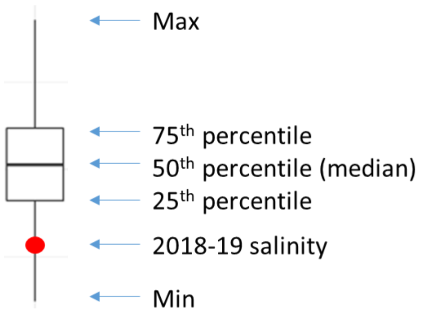


Figure 2.1. Box and whisker plot

2.3 Groundwater

2.3.1 Water level

Water level[3] data were obtained from wells in the monitoring network by both manual and continuous logger observations. All available water level data are verified and reduced to an annual maximum water level for each well for further analysis. The annual maximum level is used as this represents the unstressed or recovered water level following pumping each year for irrigation and other uses. The amount of pumping can vary from year to year, and the proximity of pumping wells to observation wells may affect the reliability of trends and historical comparisons. Therefore, the recovered level is used as it is a more reliable indicator of the status of the groundwater resource. The period of recovery each year was reviewed for each well; in general the aquifers in the Barossa PWRA return to a recovered maximum level between June and January of the following year.

For those wells with suitable long-term records, the annual recovered water levels were then ranked from lowest to highest and given a description in the same way as annual streamflow, according to their decile range (see above, Table 2.1). The definition of a suitable long-term record varies depending on the history of monitoring activities in different areas; for the Barossa PWRA, any well with 10 years or more of recovered water level data is included. The number of wells in each description class for the most recent year is then summarised for each aquifer (for example

[3] "Water level" in this report refers to both the watertable elevation, as measured in wells completed in unconfined aquifers, and the potentiometric water level elevation, as measured in wells completed in confined aquifers where the water level or pressure in the monitoring well rises above the top of the aquifer. These are collectively referred to as the "reduced standing water level" (RSWL).

see Figure 5.1). Hydrographs are shown for a selection of wells to illustrate common or important trends (for example see Figure 5.3).

Five-year trends were calculated using annual recovered water levels for those wells that have at least five measurements (i.e. at least one measurement a year). The trend line was calculated by linear regression and the well is given a status of ‘declining’, ‘rising’, or ‘stable’, depending on whether the slope of this trend line is below, above or within a given tolerance threshold. This threshold allows for the demarcation of wells where water levels are changing at very low rates and the water level can therefore be considered stable. The threshold also accommodates for very small measurement errors. The number of rising, declining and stable wells are then summarized for each aquifer (for example see Figure 5.2).

Moderately sized, sedimentary, confined and unconfined aquifers such as the Upper and Lower Aquifers are given tolerance thresholds of 2 cm/y, while fractured rock aquifers with lower storages are given a tolerance threshold of 1 cm/y.

Twenty-year changes in water level were calculated as the difference between the average water level in a three-year period twenty years ago (i.e. 1998–2000) and the average water level in 2019.

2.3.2 Salinity

Since 2018, irrigators in the Barossa PWRA have submitted groundwater samples that DEW has tested for salinity (total dissolved solids measured in mg/L, abbreviated as TDS). Where multiple samples were submitted from a well in a calendar year, the mean salinity is used for analysis. The results are shown for each aquifer (for example see Figure 5.4).

There are insufficient data to undertake an analysis of groundwater salinity trends at this point in time.

2.4 Water use

Meter readings are used to estimate licensed extraction volumes for both surface water and groundwater sources. Where meter readings are not available, licensed or allocated volumes are used for surface water sources (Figure 6.1 and Figure 6.2).

Non-licensed water use (stock and domestic) from farm dams is not metered and is estimated at 30% of dam capacity (AMLR NRM Board, 2019). Futher information on the number, type and distribution of farm dams in the PWRA is provided in Section 6.3. Dam capacity estimates are undertaken using different methods with data derived from aerial surveys one of the primary sources.

2.5 Further information

Both surface water and groundwater data can be viewed and downloaded using the *Surface Water Data* and *Groundwater Data* pages under the Data Systems tab on WaterConnect. For additional information related to groundwater monitoring well nomenclature, please refer to the Well Details page on WaterConnect.

Other important sources of information on water resources in the Barossa PWRA are:

- Summary reports on the surface water (DEWNR, 2011) and groundwater resources of the Barossa PWRA (DEWNR, 2014) and annual surface water status reports such as DEW (2019a) and groundwater level and salinity status reports such as DEW (2019b, c, d).
- The Water Allocation Plan for the Barossa Prescribed Water Resources Area (AMLR NRM Board, 2009).
- Jones-Gill and Savadamuthu (2014) describe the development of a hydrological model of the PWRA to (i) assess the impacts of current water use and potential future water management scenarios on the flow regime and (ii) provide model outputs for ecological water requirement analysis within the PWRA.
- Montazeri and Savadamuthu (2018) provide an update to the surface water modelling undertaken by Jones-Gill and Savadamuthu (2014) to aid in assessing the impacts of current water use, urban development and future climate projections on the Barossa PWRA flow regime.
- Cranswick et al. (2015) provide a detailed background and conceptual model of the hydrogeology of the Barossa PWRA. Hancock et al. (2014) studied interactions between groundwater and surface water systems in the Barossa PWRA. These studies were completed to support water planning in the Barossa PWRA.

3 Rainfall

The Barossa PWRA has mild, wet winters and hot, dry summers which are typical of a Mediterranean climate. Annual rainfall varies from more than 750 mm at high points in the Barossa Ranges to about 300 mm north of Angaston.

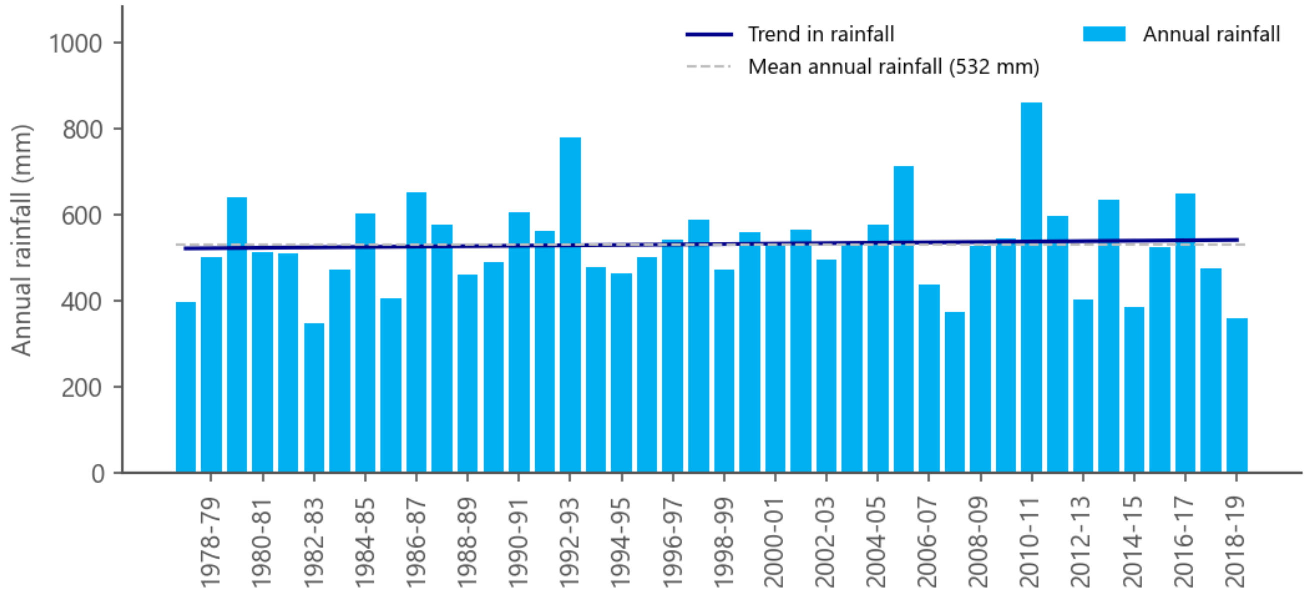


Figure 3.1. Annual rainfall for 1977–78 to 2018–19 at the Tanunda rainfall station (23318)

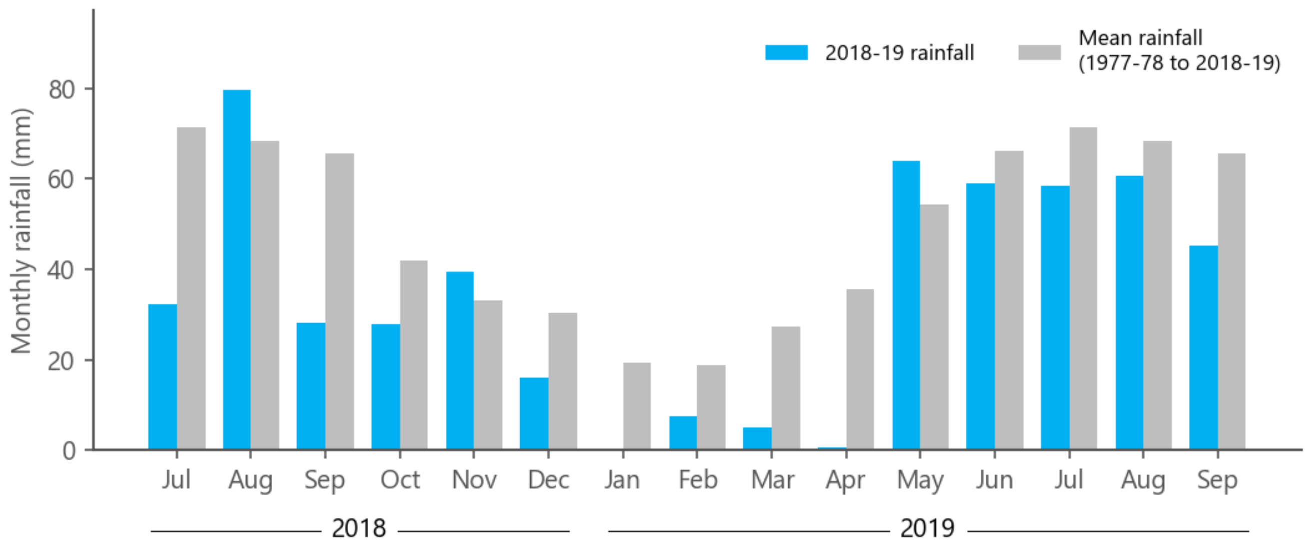


Figure 3.2. Monthly rainfall between July 2018 and September 2019 at the Tanunda rainfall station (23318)

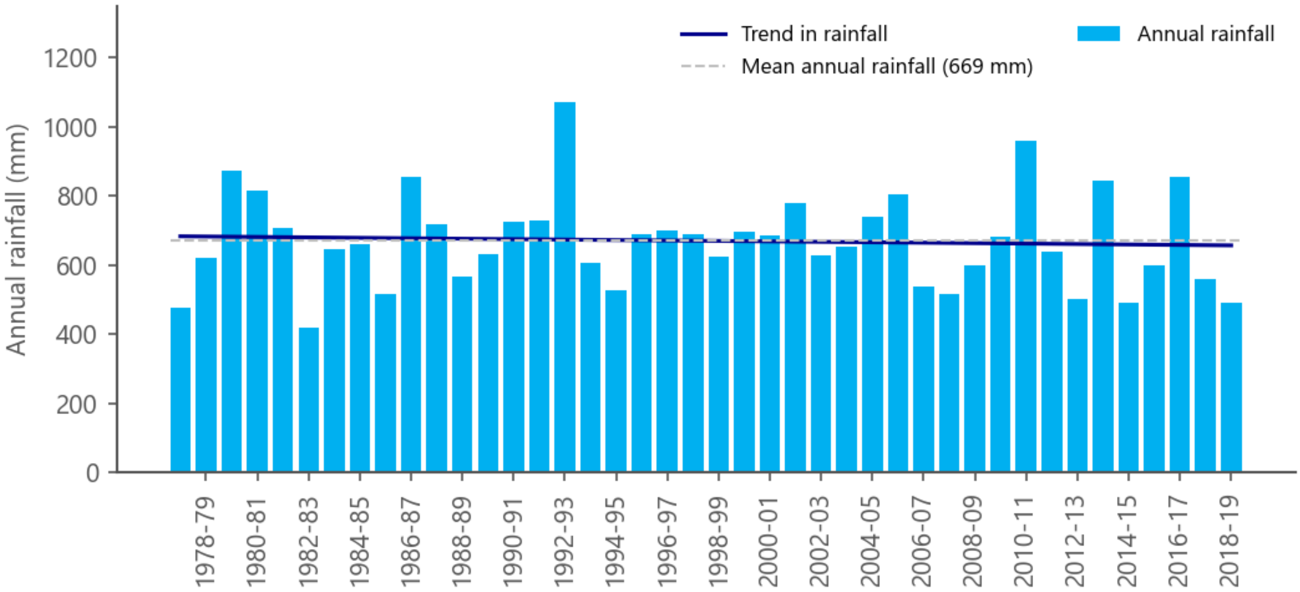


Figure 3.3. Annual rainfall for 1977–78 to 2018–19 at the Williamstown rainfall station (23752)

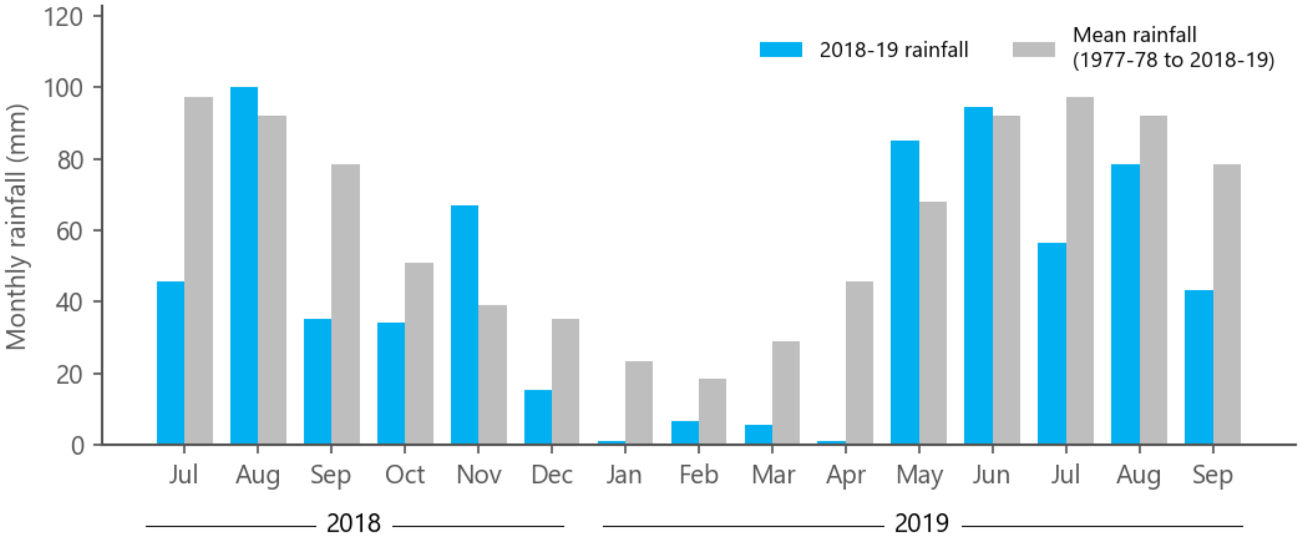


Figure 3.4. Monthly rainfall between July 2018 and September 2019 at the Williamstown rainfall station (23752)

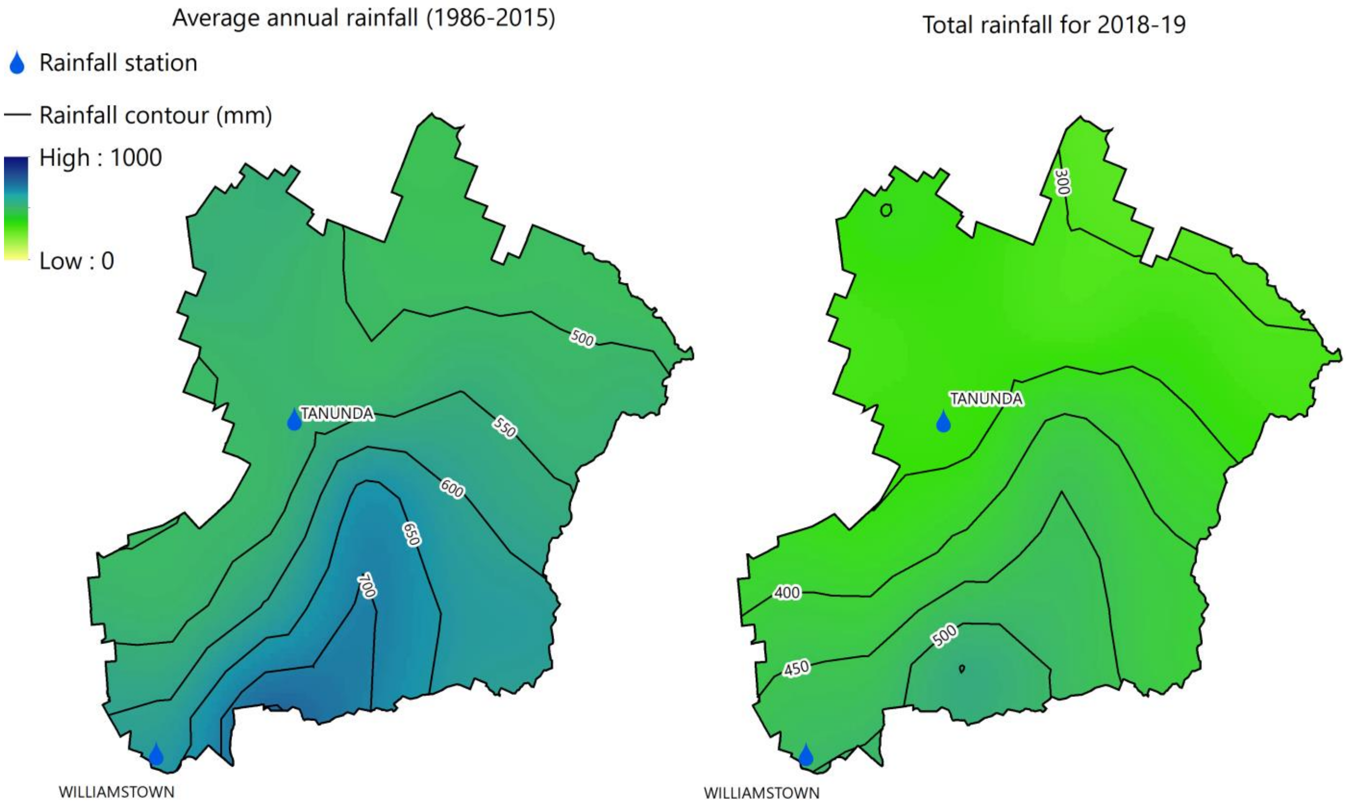


Figure 3.5. Rainfall in the Barossa PWRA for 2018–19 compared to the long-term average annual rainfall (1986–2015)

- The Tanunda rainfall station (BoM station 23318) is used as a representative rainfall station for the central and northern parts of the Barossa PWRA. The annual total recorded for 2018–19 was 360 mm. This was 172 mm lower than the average annual rainfall of 532 mm (1977–78 to 2018–19). The long-term trend is increasing over this period (Figure 3.1).
- The Williamstown rainfall station (BoM station 23725) is used as a representative rainfall station for the southern part of the Barossa PWRA which generally experiences higher rainfall. The annual total recorded for 2018–19 was 492 mm. This was 172 mm lower than the average annual rainfall of 664 mm (1977–78 to 2018–19). The long-term trend is decreasing over this period (Figure 3.3).
- Lower-than-average rainfall was also observed at other rainfall stations in the PWRA.
- Drier-than-average conditions were observed throughout the period with the 2018 winter being drier than the 2019 winter. The spring and summer months were also extremely dry in comparison to the long-term average (Figure 3.2).
- Rainfall in 2018–19 was significantly lower in all parts of the PWRA compared to average annual rainfall patterns. The long-term average annual rainfall shows the higher rainfall band (600–700 mm) extending north to the Tanunda Creek catchment whereas this higher band was not present in the PWRA in 2018–19 (Figure 3.5)[4].

[4] Some differences may be noticeable between the spatial rainfall maps and the annual rainfall from individual stations. This is due to the use of different data sources and time periods and further detail is provided in Section 2.1.

4 Surface water

4.1 Streamflow

The North Para River is the main watercourse in the Barossa PWRA and flows south to north in the eastern-side of the PWRA between Mount McKenzie and Penrice streamflow gauging stations (Figure 1.1). The river then heads in a south-westerly direction between Penrice and Yaldara streamflow gauging stations. Major tributaries include Tanunda Creek and Jacobs Creeks. All streams are ephemeral and feature seasonally disconnected permanent pools, sustained predominantly by groundwater. Trends in streamflow and salinity are primarily rainfall driven, i.e. lower than average winter rainfall will result in reduced annual streamflow volumes. Conversely, higher rainfall will result in increased surface water availability. Prolonged drier-than-average rainfall years combined with hotter and drier conditions associated with changing climate is expected to have direct implications for the management of water resources in the Barossa PWRA.

Four streamflow gauging stations (Figure 1.1) are used as representative stations when assessing streamflow in the Barossa PWRA (Figure 4.1):

- Three stations on the North Para River: Mount McKenzie (A5050533), Penrice (A5050517) and Yaldara (A5050502).
- One station on the Tanunda Creek: Bethany (A5050535).

In 2018–19, lower-than-average streamflow was recorded in all four representative gauging stations (Figure 4.1), with three of them recording 'lowest on record' streamflow. Further detail on methodologies used for analysis can be found in Section 2.

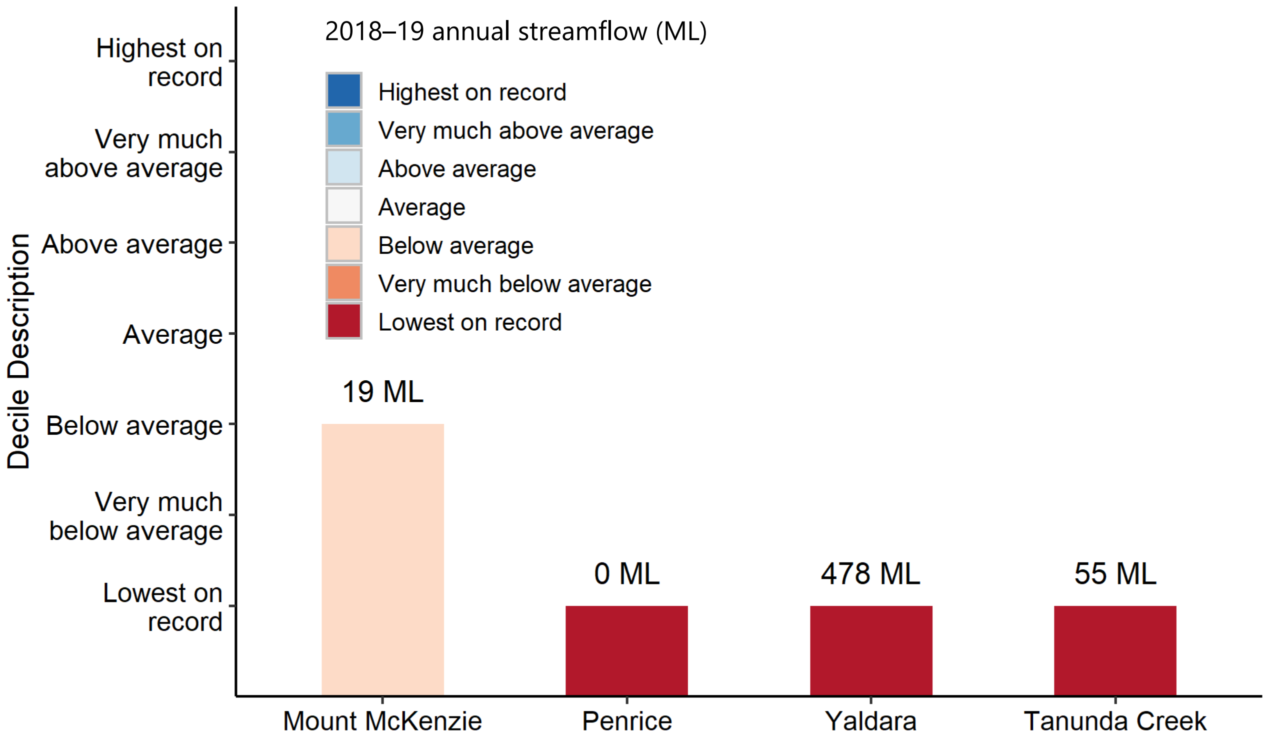


Figure 4.1. Barossa PWRA annual streamflow summary 2018–19

4.1.1 North Para River: Yaldara (A505050)

The principal long-term streamflow gauging station for the PWRA is located at Yaldara, at the outlet of the North Para catchment, and covers a catchment area of 376 km^2.

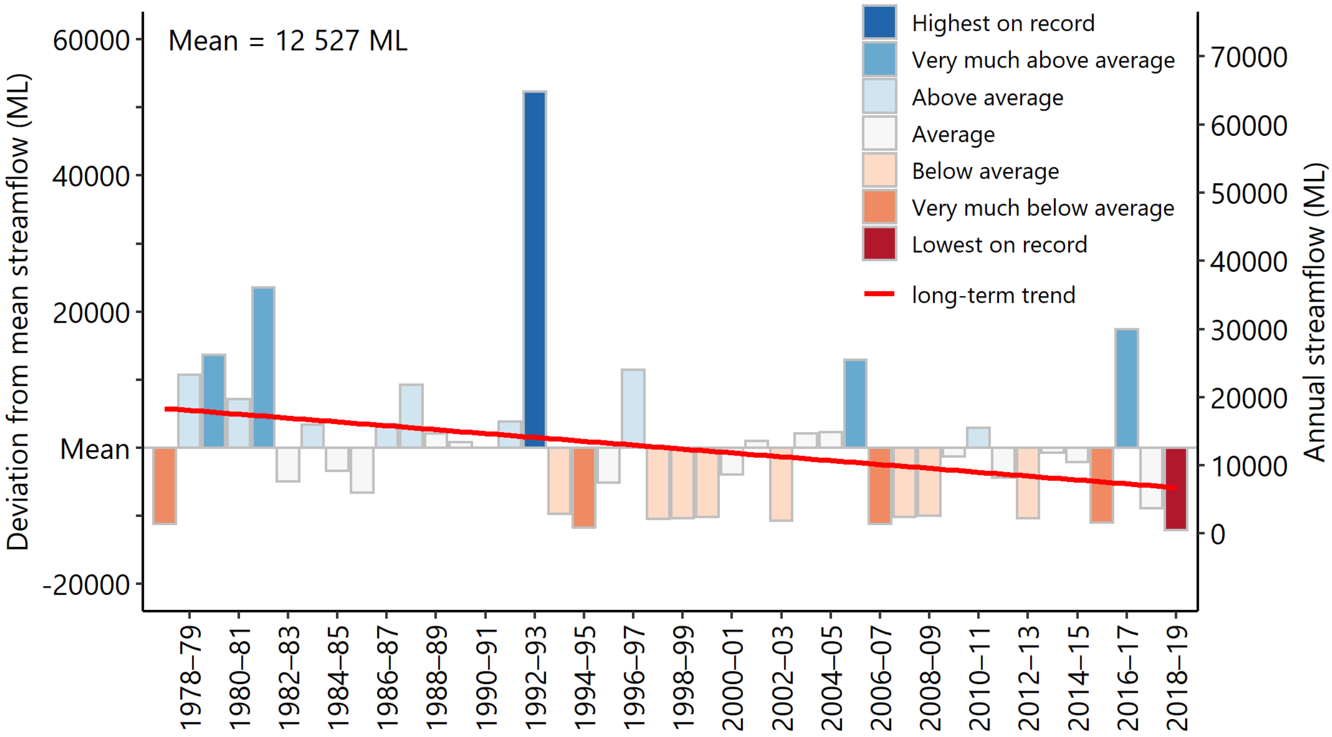


Figure 4.2. Annual deviation from mean streamflow at Yaldara (1977–78 to 2018–19)

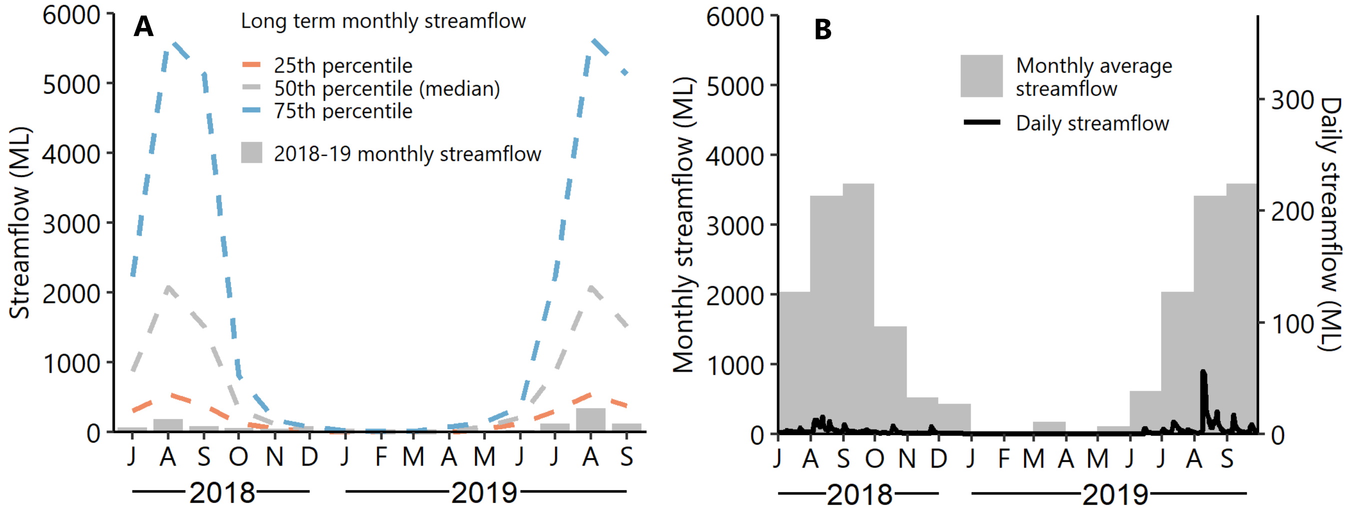


Figure 4.3. (A) Long-term monthly statistics and 2018–19 monthly streamflow at Yaldara; (B) Long-term average monthly streamflow and 2018–19 daily streamflow at Yaldara

The deviation of each individual year's streamflow from the long-term average streamflow is shown in Figure 4.2. Yaldara recorded an annual streamflow of 478 ML in 2018–19, which is 12049 ML (96%) below the average annual streamflow of 12 527 ML (1977–78 to 2018–19).

The annual total is ranked as 'lowest on record' assessed for the period 1977–78 to 2018–2019. Annual streamflow at Yaldara indicates a long-term declining trend with 11 out of the last 15 years below the average annual streamflow (Figure 4.2).

Figure 4.3A shows the monthly streamflow for 2018–19 (grey bars) relative to the long-term monthly streamflow (1977–78 to 2018–19) for (a) low flows (25th percentile), (b) median flows (50th percentile) and high flows (75th percentile). All months in 2018–19 were below the 25th percentile streamflow at the Yaldara streamflow gauging station with no flow recorded between January and early June 2019 (Figure 4.3A).

Figure 4.3B presents the long-term average monthly streamflow (1977–78 to 2018–19) and the daily flows for 2018–19. Maximum daily flows were recorded in August 2018 and there were 134 zero flow days experienced in 2018–19. Flow was persistent during the months of July to December 2018 and ceased between January and early June 2019. In the period from July to September 2019, flows remained below the long-term average monthly streamflow. Monthly streamflow recorded at Yaldara was 116 ML in July 2019, 336 ML in August 2019 and 122 ML in September 2019.

4.2 Salinity

Below-average summer rainfall can result in increased irrigation extractions. These two elements can cause salinities to increase by reducing the amount of streamflow available to dilute salts. Conversely, higher rainfall will result in increased surface water availability and decreased irrigation extractions, resulting in a reduction or stabilisation of salinity.

Salinity is recorded at the Yaldara, Penrice and Tanunda Creek streamflow gauging stations, with salinity typically increasing further downstream due to the accumulation of salts. Figure 4.4 shows the long-term monthly salinity statistics for the period 1992–2018 and median monthly values for 2018–19 (red dots) at the Yaldara streamflow gauging station.

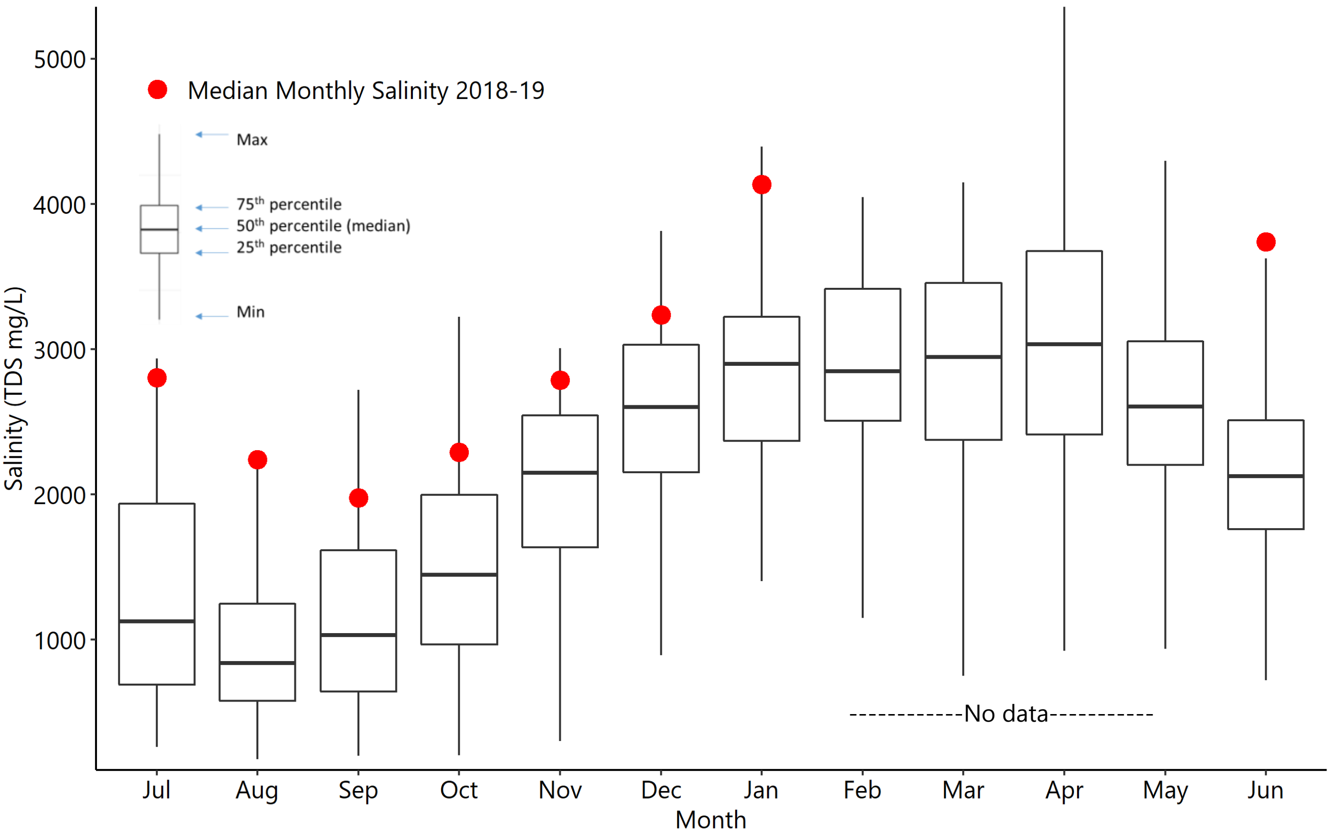


Figure 4.4. Long-term and 2018–19 monthly salinity at Yaldara streamflow gauging station (A5050502)

Salinity in the North Para River is generally greater than 1000 mg/L, increasing further down the catchment, and the highest salinity recorded at Yaldara in 2018–19 was 4394 mg/L. The long-term monthly data at this site indicates a high variability in monthly salinity, which is indicated by the greater range between the minimum and maximum values. All recorded salinity values were greater than the 75th percentile in 2018–19. This higher salinity is likely to be a result of the lower than average rainfall, and therefore streamflow experienced. There were no salinity levels recorded between February and May due to insufficient streamflow recorded at the site.

In comparison, salinity levels at Tanunda Creek were lower than 1000 mg/L for 80% of the available data period. The highest salinity recorded at Tanunda Creek in 2018–19 was 1507 mg/L.

5 Groundwater

5.1 Hydrogeology

The Barossa PWRA consists of three main groundwater systems: two sedimentary aquifer systems (Upper Aquifer and Lower Aquifer) that are located within the region’s largest valley and fractured rock aquifers of the Mount Lofty Ranges that form the eastern and western margins of the valley.

5.1.1 Upper Aquifer

The Upper Aquifer system consists of sediments that are often referred to as the middle, upper gravel and water table aquifers. They overlie a carbonaceous clay, confining layer. The Upper Aquifer system includes Tertiary non-carbonaceous sands, lenticular sands and gravels within Quaternary clays and Holocene gravels and sands associated with drainage channels incised into the Quaternary clay. The aquifer system is generally unconfined, however some of the sub-aquifers can be confined. In addition to the main valley, aquifers belonging to this system also occur in a broad valley to the south of Lyndoch.

5.1.2 Lower Aquifer

The Lower Aquifer system is generally confined and consists of Tertiary carbonaceous clays, gravels, sands and silts that were deposited in the deepest part of the basin and form a complex system of interconnected sub-aquifers. It is separated from the overlying Upper Aquifer by a carbonaceous clay confining layer. Pressure levels in the Lower Aquifer are subject to large seasonal fluctuations in response to pumping. In general, groundwater in the Lower Aquifer flows towards the south and south-west.

5.1.3 Fractured rock aquifers

Pre-Cambrian and Palaeozoic sandstones, siltstones and schists form fractured rock aquifers where groundwater is stored and flows through fractures and fissures in the rock. Wells completed in this aquifer generally have low yields, although there are some exceptions. Beneath the valley sediments, the upper part of the fractured rock aquifers is generally a highly weathered clay-rich layer, which can act as a confining layer between the fractured rock aquifers and the overlying sedimentary aquifers. Groundwater in the fractured rock aquifers beneath the valley floor generally flows to the south and south-west; in some areas steep hydraulic gradients can occur. The fractured rock aquifers are the most widely used in the PWRA.

5.2 Upper Aquifer - water level

Following the 2018–19 irrigation season, the majority (61%) of Upper Aquifer monitoring wells with long-term records recovered to their lowest water level on record. These wells are spread across the aquifer with the majority located north of Nuriootpa and south of Lyndoch. Wells in the central part of the valley, near Tanunda, recovered to levels which were generally below average (Figure 5.1).

The change in water level over the last 20 years in wells with suitable long-term records ranged from a decline of 6.70 m to a rise of 0.99 m (the median change is a decline of 0.79 m). The majority of wells (80%) recorded a decline in water level over this time period.

Five-year trends in water levels are declining in all wells with rates of decline ranging from 0.60 m/y to 0.04 m/y (the median rate of decline is 0.15 m/y) (Figure 5.2).

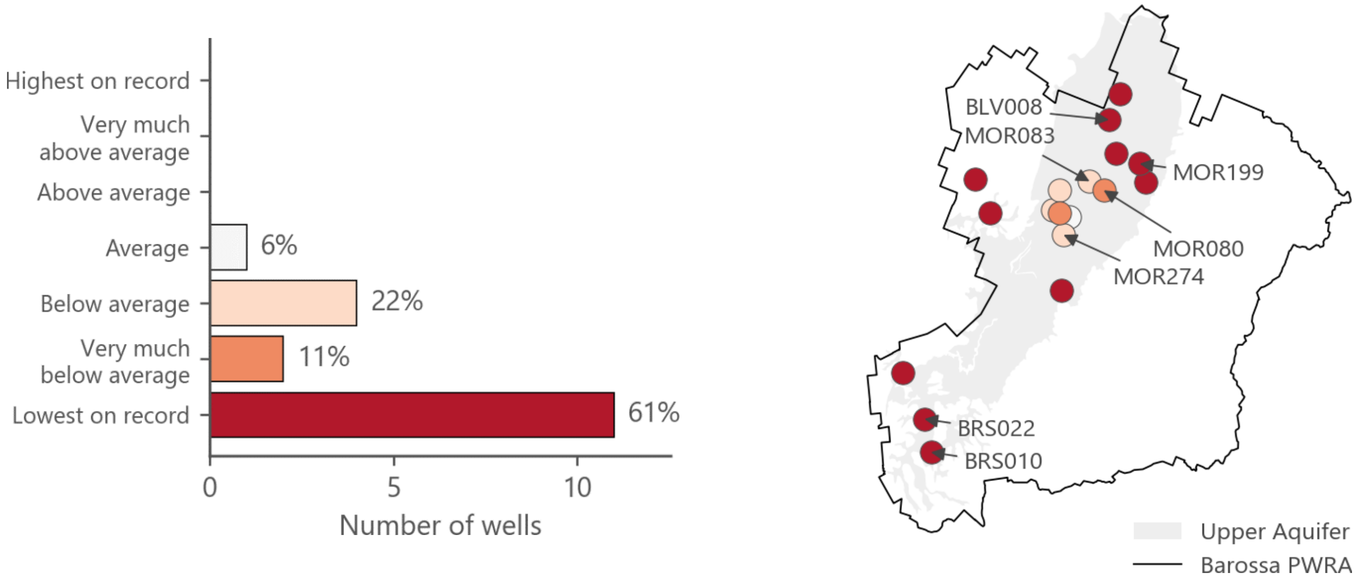


Figure 5.1. 2019 recovered water levels for wells in the Upper Aquifer

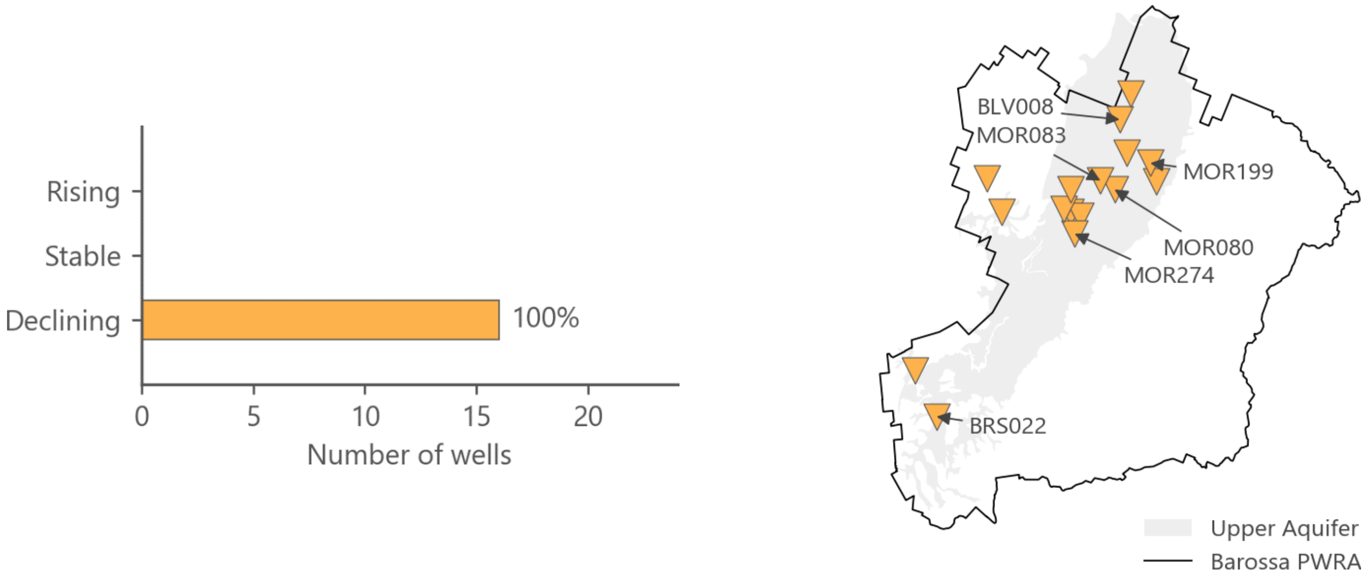


Figure 5.2. 2015–2019 trend in recovered water levels for wells in the Upper Aquifer

Figure 5.3 shows hydrographs from a selection of Upper Aquifer monitoring wells to illustrate common or important trends. The majority of groundwater use from the Upper Aquifer occurs to the east and south of Nuriootpa where the Upper Aquifer is thickest and is recharged from the North Para River. Despite monitoring wells in the area showing below-average levels (e.g. MOR080 and MOR199), the total decline of water levels since 1990 is 1.73 m on average.

Further south, near Tanunda and Lyndoch (e.g. MOR064 and BRS010), water levels have been declining gradually since the 1990s and were at their lowest levels on record in 2019. It is likely that the presence of clay-rich layers near the surface prevents rainfall recharge in these areas and groundwater pumping may be a contributor to declining levels.

In the north of the PWRA, shallow groundwater is more saline and is not suitable for irrigation. Gradual declines in level (e.g. BLV008) may be a caused by a decline in rainfall over the last 15 years and the decline of water level in the underlying fractured rock aquifers.

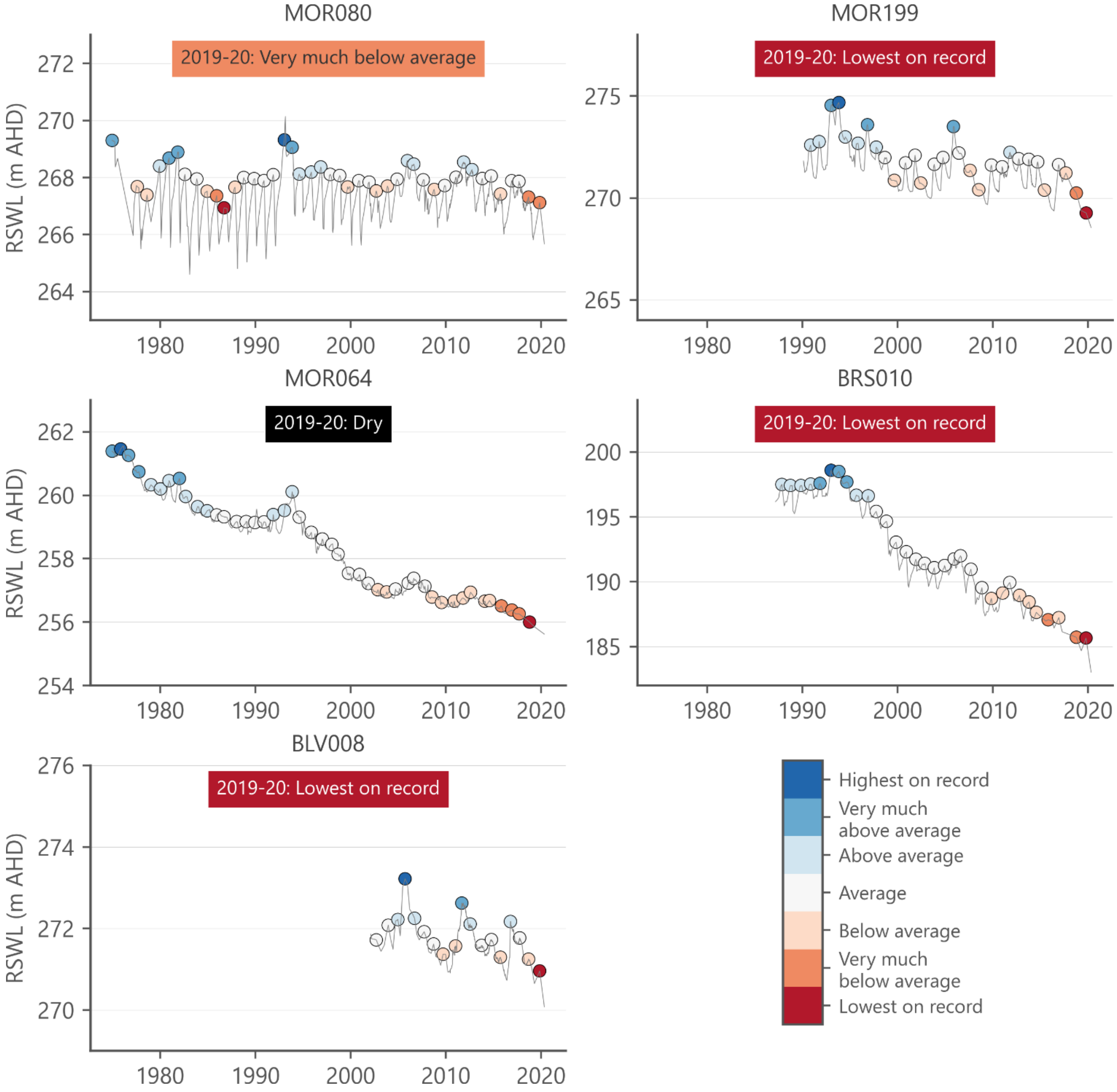
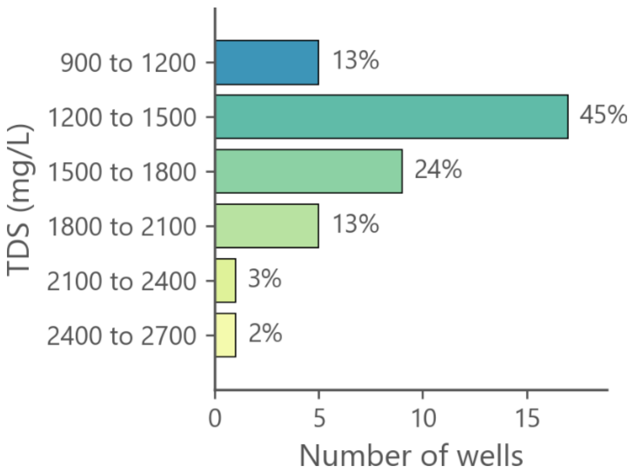


Figure 5.3. Selected Upper Aquifer hydrographs. MOR064 is not included in summary results as the well is currently dry.

5.3 Upper Aquifer - salinity

Groundwater salinity is highly variable in the Upper Aquifer, ranging from 960 to 12000 mg/L. The lowest salinities are found in the vicinity of the North Para River as it flows into the Barossa Valley, near Angaston Creek and in the Lyndoch Valley. Generally, higher salinity groundwater is found to the north and west of the North Para River and to the east of Tanunda.

Since 2018, irrigators in the Barossa PWRA have submitted groundwater samples that DEW has tested for salinity. In 2019, results from 38 irrigation wells in the Upper Aquifer ranged between 960 mg/L and 2693 mg/L with a median of 1472 mg/L (Figure 5.4).



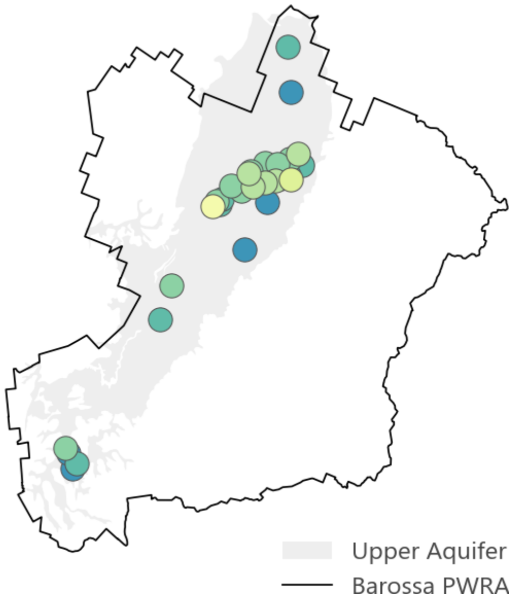


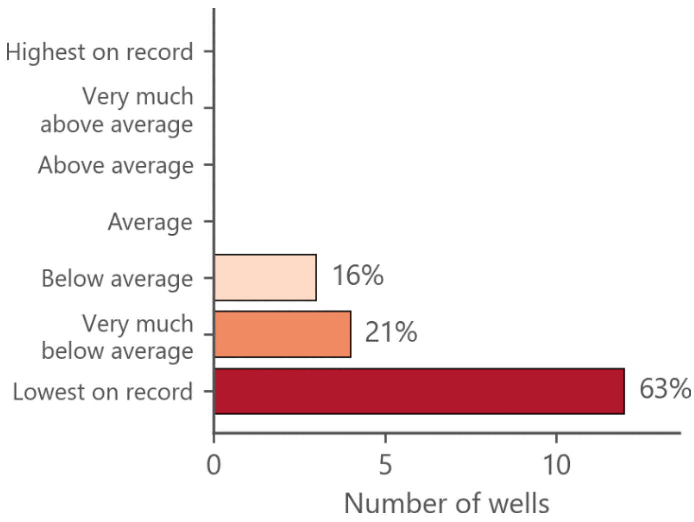
Figure 5.4. 2019 salinity observations from wells in the Upper Aquifer

5.4 Lower Aquifer - water level

Following the 2018–19 irrigation season, the majority (63%) of Lower Aquifer monitoring wells recovered to their lowest water level on record. These wells are spread throughout the extent of the Lower Aquifer. Almost all wells with suitable long-term records show a decline in water level over the past 20 years, ranging from a drop of 7.45 m in MOR205 to 0.45 m in MOR206 (Figure 5.5).

The change in water level over the last 20 years in wells with suitable long-term records ranged from a decline of 8.77 m to a rise of 0.29 m (the median change is a decline of 1.62 m). The majority of wells (94%) recorded a decline in water level over this time period.

Five-year trends in water levels are declining in all wells with rates of decline ranging from 2.22 m/y to 0.02 m/y (the median rate of decline is 0.28 m/y) (Figure 5.6).



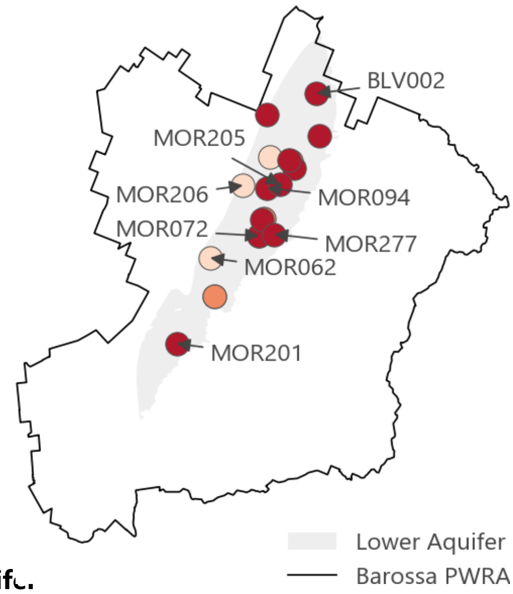
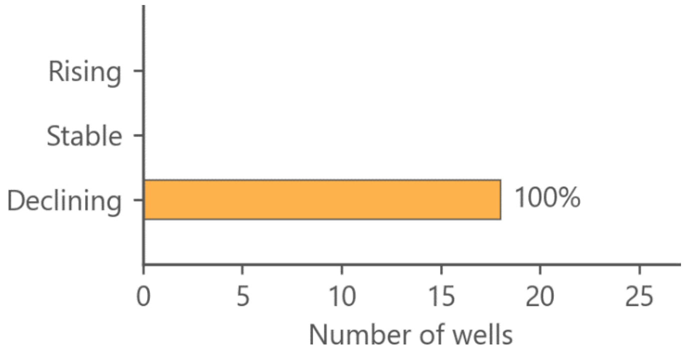


Figure 5.5. 2019 recovered water levels for wells in the Lower Aquif



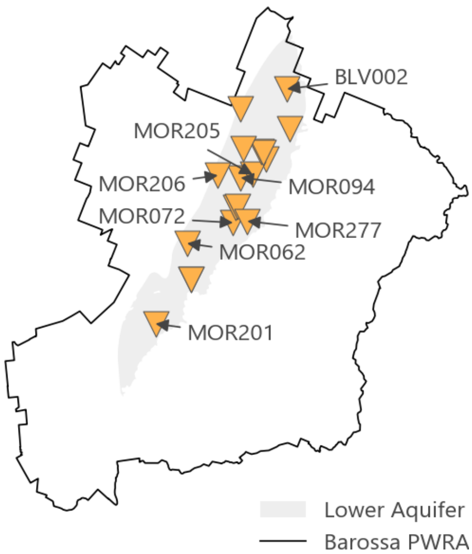


Figure 5.6. 2015–2019 trend in recovered water levels for wells in the Lower Aquifer

Figure 5.7 shows hydrographs from a selection of Lower Aquifer monitoring wells to illustrate common or important trends. The majority of groundwater extraction from the Lower Aquifer occurs in the floor of the Barossa Valley from Light Pass to Rowland Flat. Where the aquifer is confined, monitoring wells show large seasonal drawdowns in response to groundwater pumping, followed by rapid recoveries after the irrigation season (e.g. MOR094, MOR062 and MOR201). In 2019, most of these wells recovered to their lowest level on record with total water level declines of up to 3 m since 1990.

MOR072 is completed in the shallower part of the Lower Aquifer where the aquifer can be semi-confined and not as responsive to pumping and recovery patterns. Nonetheless, the total decline of water levels since 1990 is also up to 3 m.

In the northern part of the PWRA, a smaller volume of groundwater is extracted from the Lower Aquifer and water levels are declining gradually (e.g. BLV002).

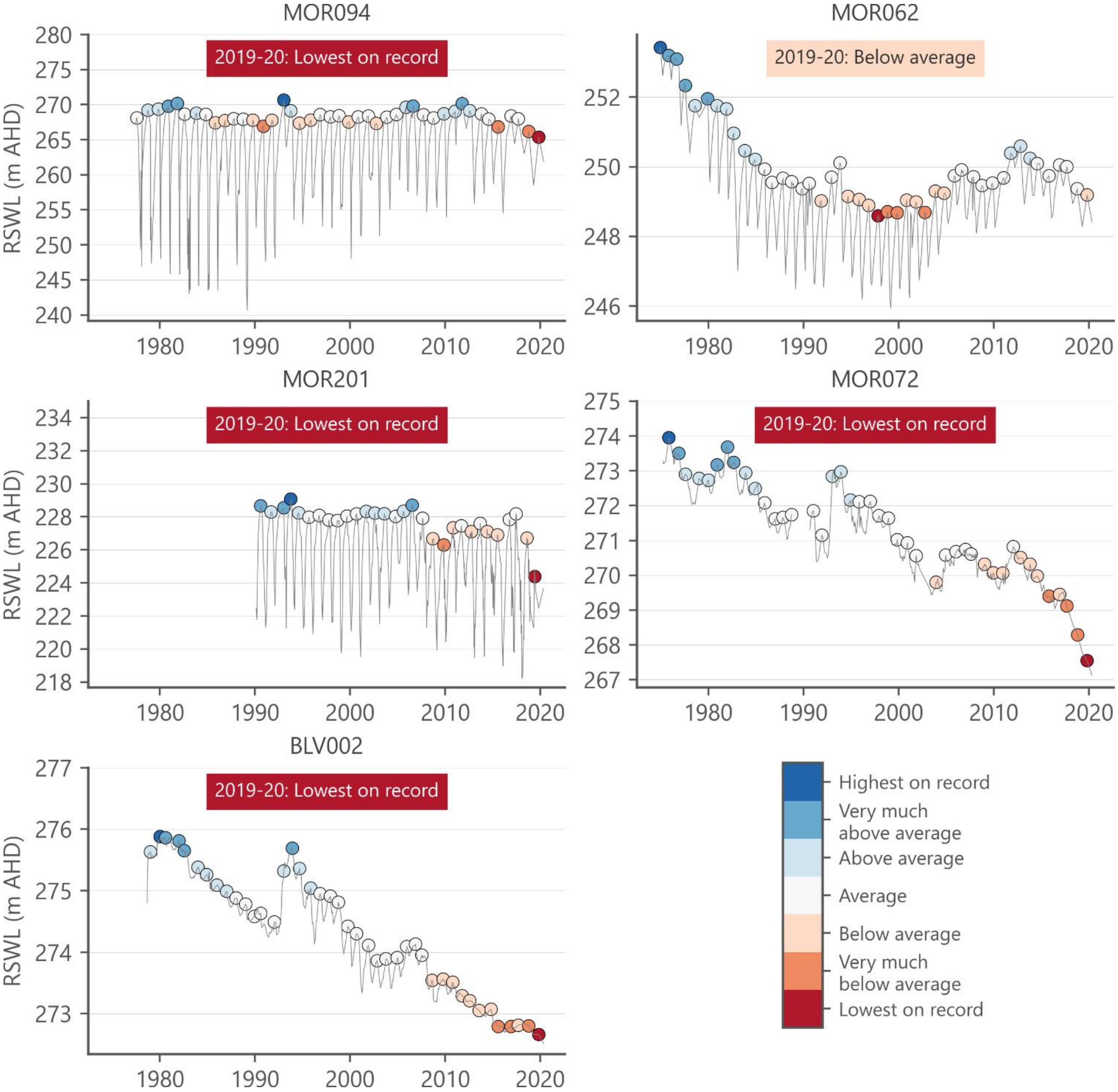
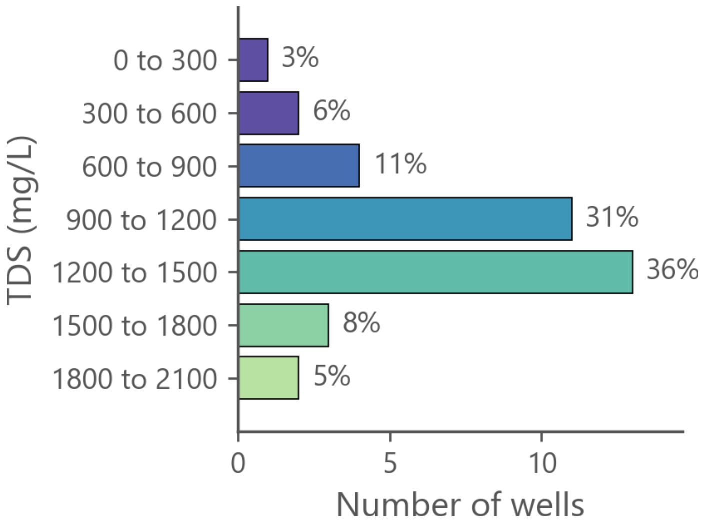


Figure 5.7. Selected Lower Aquifer hydrographs

5.5 Lower Aquifer - salinity

The salinity of the Lower Aquifer is generally below 3000 mg/L.

Since 2018, irrigators in the Barossa PWRA have submitted groundwater samples that DEW has tested for salinity. In 2019, salinity results from 34 irrigation wells in Lower Aquifer ranged between 278 mg/L and 1915 mg/L with a median of 1205 mg/L (Figure 5.8).



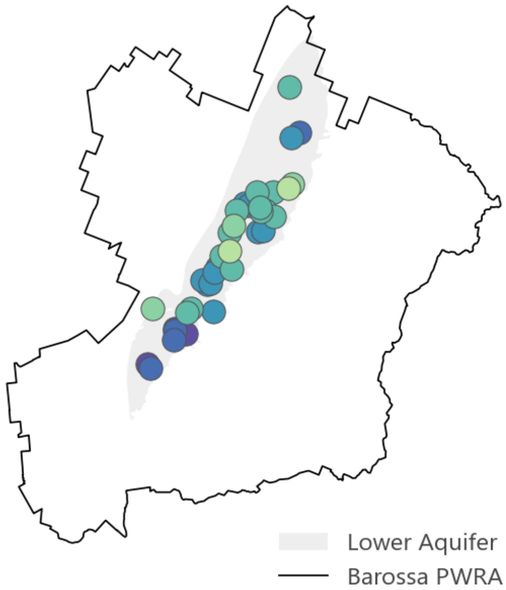


Figure 5.8. 2019 salinity observations in the Lower Aquifer

5.6 Fractured rock aquifers - water level

Following the 2018–19 irrigation season, the water level in 52% of monitoring wells recovered to their lowest recovered level on record. Fewer than 15% of monitoring wells had levels which were average or above (Figure 5.9).

The change in water level over the last 20 years in wells with suitable long-term records ranged from a decline of 10.03 m to a rise of 3.48 m (the median change is a decline of 3.21 m). The majority of wells (85%) recorded a decline in water level over this time period.

Five-year trends in water levels are declining in 87% of wells with rates ranging from a decline of 1.43 m/y to a rise of 0.54 m/y (the median change is declining at 0.57 m/y) (Figure 5.10).

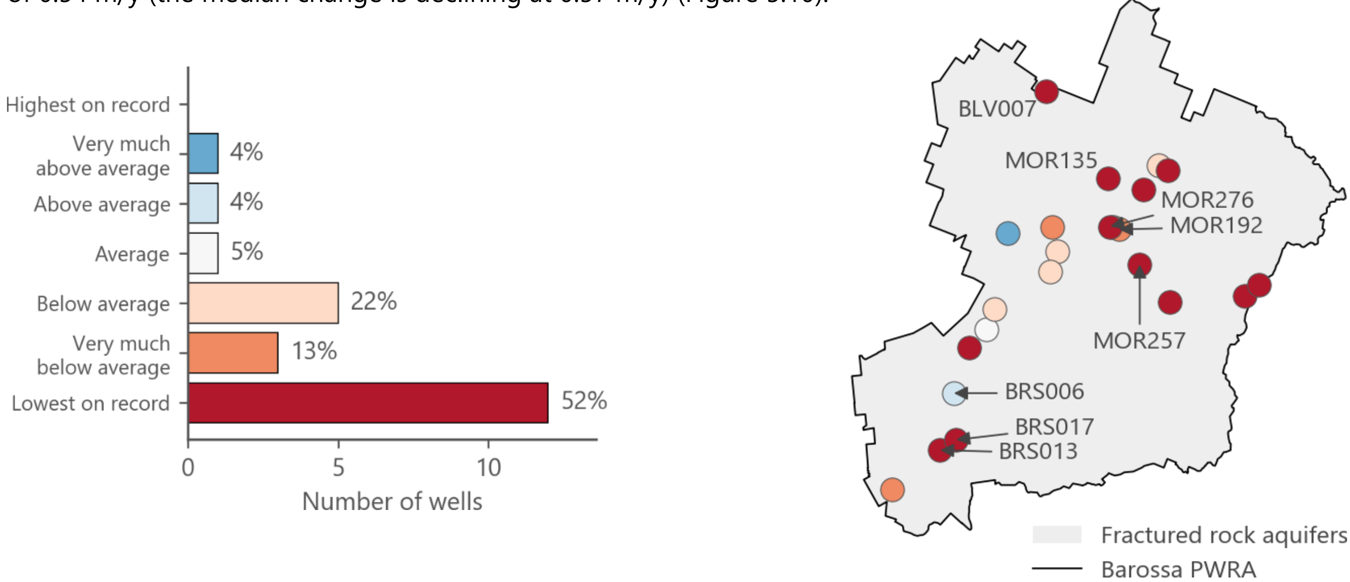


Figure 5.9. 2019 recovered water levels for fractured rock aquifers

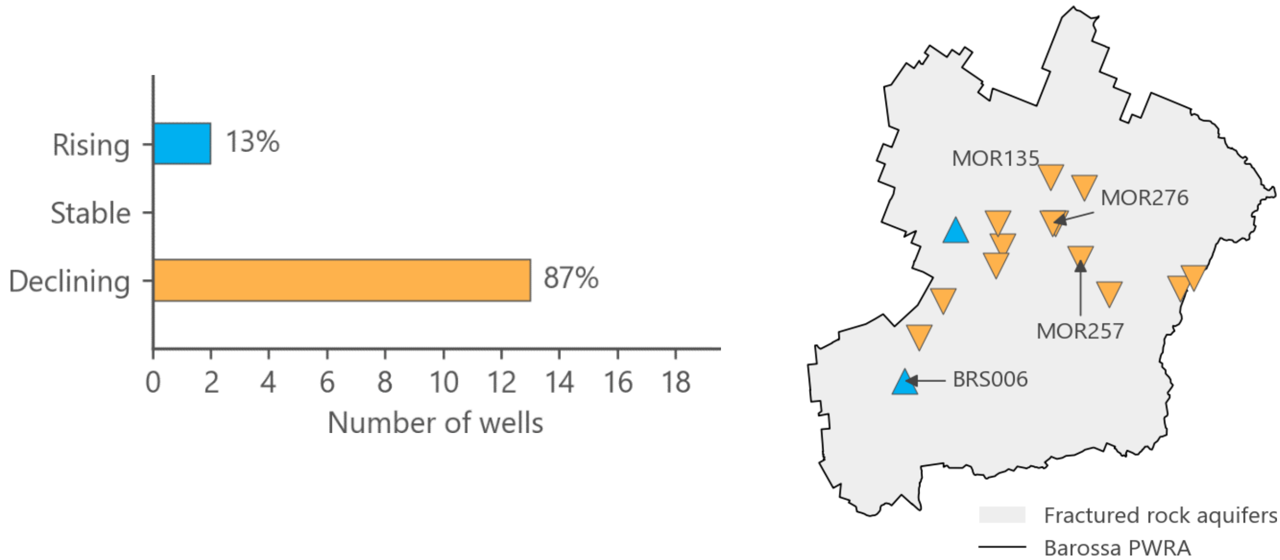


Figure 5.10. 2015–2019 trend in recovered water levels for wells in fractured rock aquifers

Figure 5.11 shows hydrographs from a selection of monitoring wells completed in fractured rock aquifers to illustrate common or important trends. Groundwater is extracted from these aquifers across the PWRA with numerous users in the vicinity of Angaston and Lyndoch where sedimentary aquifers are absent. South of Angaston, water levels have declined between 6 m and 7 m in the past 20 years (e.g. MOR257). This may be due to a combination of increased groundwater pumping and below average rainfall in the area (e.g. at BoM rainfall station 23300 at Angaston, which is no longer operational). Sustained decline of groundwater levels could cause movement of higher salinity groundwater to the area. To the west of Angaston, groundwater levels are generally stable, possibly due to increased use of imported water since 2002 via the Barossa Infrastructure Limited (BIL) scheme (e.g. MOR192). Near Lyndoch, most observation wells have declining water level trends, likely due to decreasing rainfall trends (Figure 3.3) and continued groundwater pumping (e.g. BRS013).

The fractured rock aquifers are less frequently used where there are Tertiary sediments and observation wells are generally showing stable trends with gradual declines in a few areas. A decline of about 4 m since 2000 recorded in MOR135, east of Nuriootpa, could be due to pumping from the overlying Lower Aquifer (e.g. MOR094 in Figure 5.7). Further north, the fractured rock aquifers are more saline and groundwater extraction is marginal. Water level declines are potentially due to a combination of decreases in rainfall (Figure 3.3) and increases in native vegetation, which reduces rainfall recharge (e.g. BLV007).

Figure 5.11. Selected hydrographs for wells in fractured rock aquifers

5.7 Fractured rock aquifers - salinity

Groundwater salinity in fractured rock aquifers can be highly variable due to the complex system of preferential flow paths affecting recharge and movement through the aquifer. Groundwater salinity in the fractured rock aquifers of the Barossa PWRA is typically less than 3000 mg/L but can be greater than 6000 mg/L.

Since 2018, irrigators in the Barossa PWRA have submitted groundwater samples that DEW has tested for salinity. In 2019, salinity results from 75 irrigation wells in fractured rock aquifers ranged between 402 mg/L and 3200 mg/L with a median of 1393 mg/L (Figure 5.12).

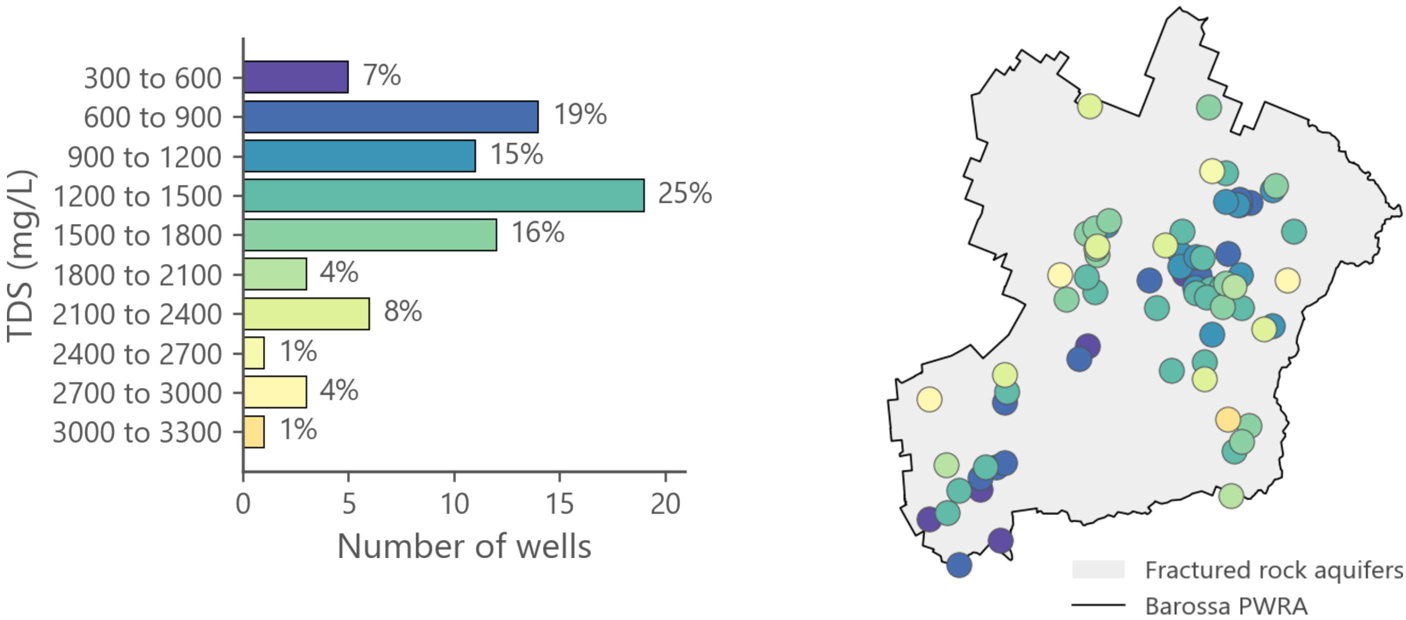


Figure 5.12. 2019 salinity observations in fractured rock aquifers

6 Water use

In the Barossa PWRA, water sources include watercourses, farm dams, imported water from the SA Water mains network and water supply from Barossa Infrastructure Ltd (BIL) via SA Water infrastructure. Imported water is transferred from the River Murray to the PWRA.

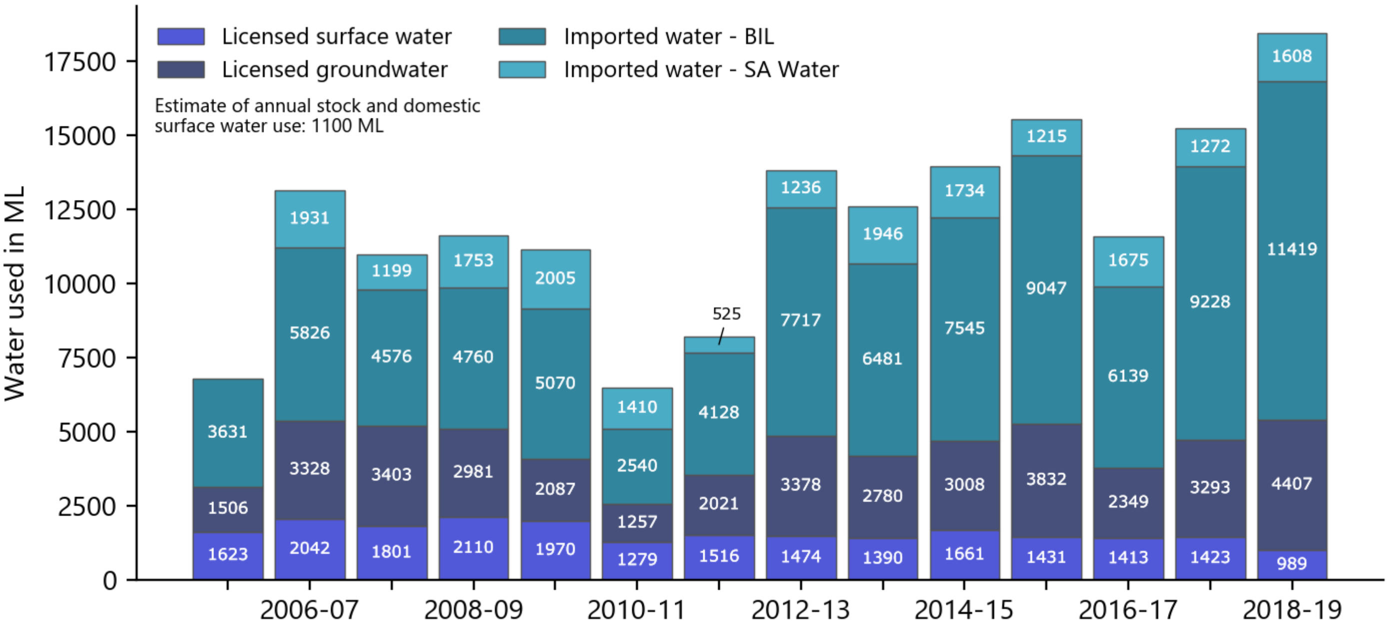


Figure 6.1 Water used from 2005–06 to 2018–19 for the Barossa PWRA

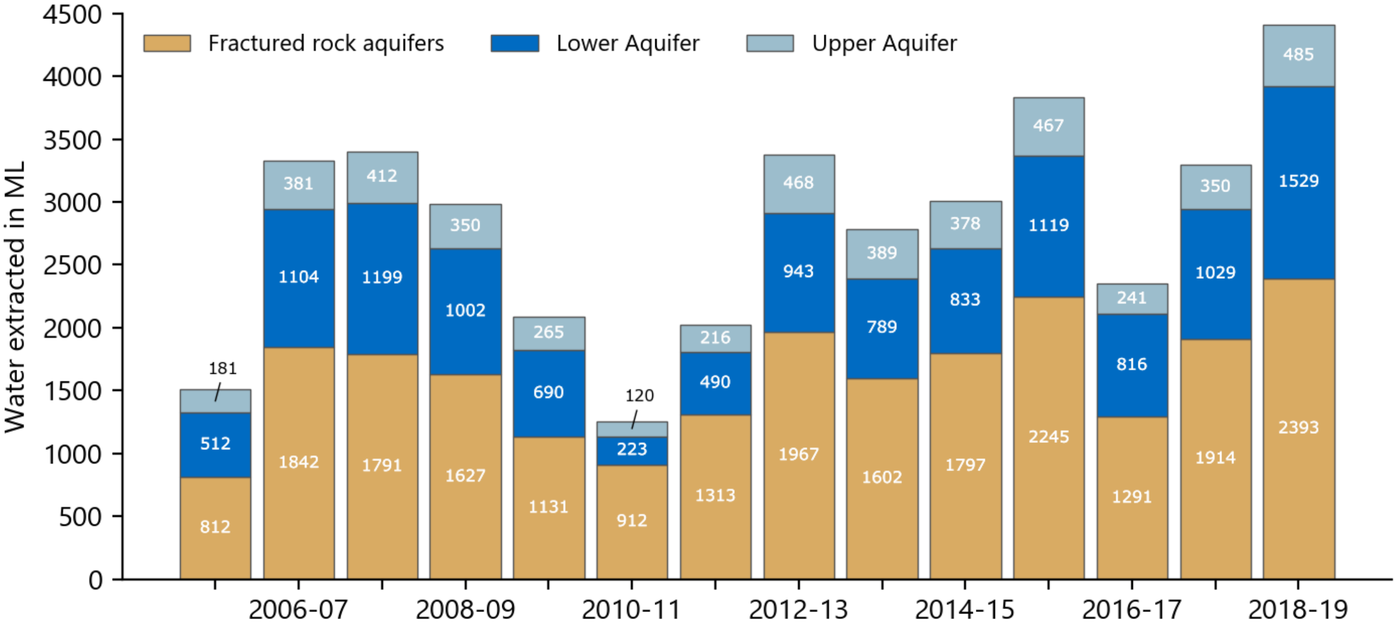


Figure 6.2 Metered groundwater extraction in aquifers of the Barossa PWRA from 2005–06 to 2018–19

The total volume of water used in 2018–19 was 19 523 ML (Figure 6.1). This includes:

- Metered groundwater extraction across the Barossa PWRA (Figure 6.2);
- Surface water volumes discussed below in Section 6.1; and
- Water imported into the PWRA via the BIL scheme and SA Water.

6.1 Surface water use

In 2018–19, use from licensed surface water sources (dams and watercourses) was 989 ML compared to 1423 ML in 2017–18. This data is based on meter readings from licensed water users. Non-licensed water demand (stock and domestic) was estimated at 1100 ML. These are non-metered and are estimated at 30% of dam capacity. The non-licensed data is estimated based on analysis in the water allocation plan (AMLR NRM, 2019). The volume of imported water into the Barossa PWRA was 13 027 ML. This comprised 11 419 ML from the Barossa Infrastructure Limited (BIL) Scheme and 1608 ML from SA Water. These values are shown in Figure 6.1.

6.2 Groundwater use

In 2018–19, licensed groundwater extractions (from fractured rock aquifers, the Lower Aquifer, and Upper Aquifer) were 4407 ML compared to 3293 ML in 2017–18 (Figure 6.1 and Figure 6.2). The largest extracted volume is from the fractured rock aquifers.

The Lower Aquifer also provides a significant volume even though it has a limited spatial extent. The smallest volumes are extracted from the Upper Aquifer due to its smaller spatial extent, the limited thickness of the aquifer in some areas and the unsuitability for irrigation due to salinity in the north of the PWRA. There have been no significant changes in the relative distribution of the total extracted volumes between the various aquifer systems.

6.3 Farm dams

There are a total of 1780 farm dams in the Barossa PWRA, 14% of which are licensed. Licensed dams represent 68% of the total estimated storage capacity of 8692 ML (Jones-Gill and Savadamuthu, 2014; Montazeri and Savadamuthu, 2018).

Across the PWRA, smaller dams (capacity less than 5 ML) account for the majority of the number of dams (84%), but represent only a small proportion (18%) of the total storage capacity of dams. Larger dams (5 ML or greater capacity) make up only 16% of the total dam count but contribute to 82% of the total storage capacity (Figure 6.3). The average farm dam density of the PWRA is 17 ML/km^2, with the higher rainfall headwaters having a higher density in comparison to the lower rainfall areas (Figure 6.3).

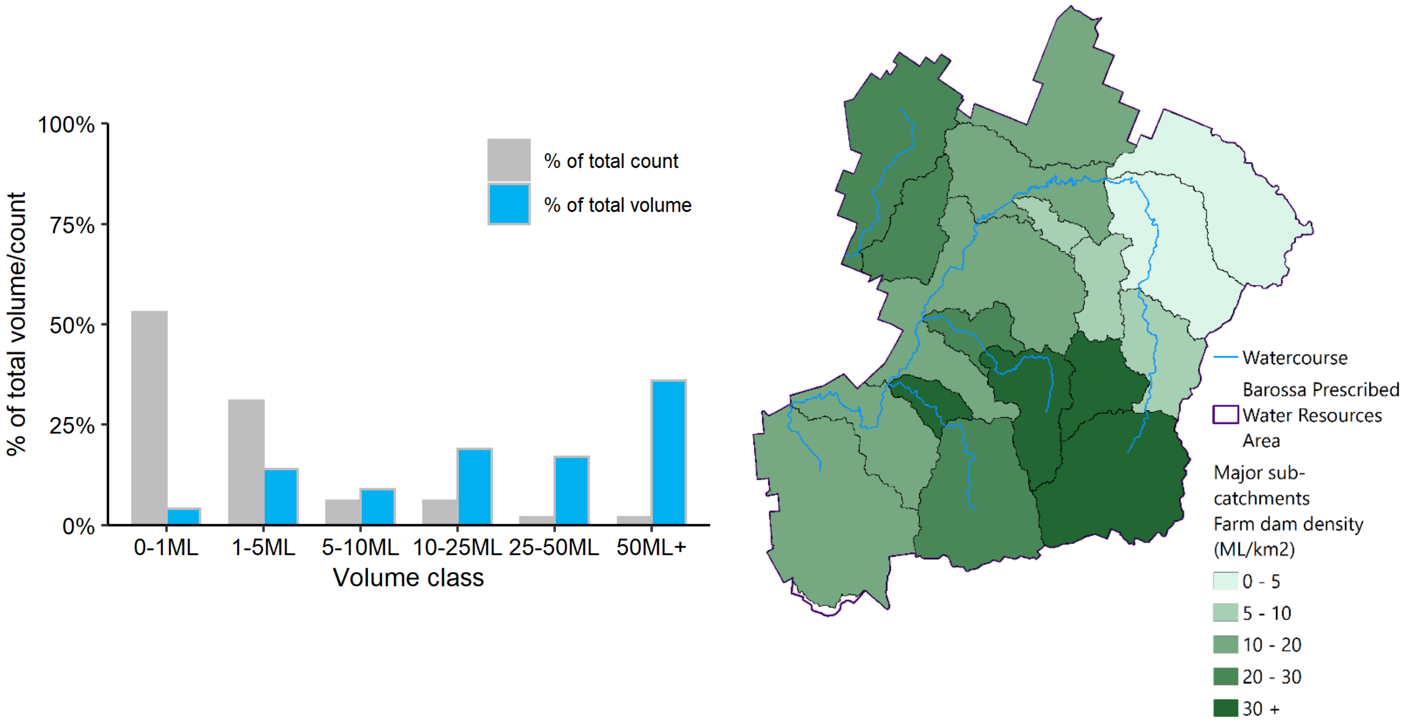


Figure 6.3 Farm dam volume, count analysis, and density in the Barossa PWRA

7 References

AMLR NRM Board (2009). Water Allocation Plan Barossa Prescribed Water Resources Area, Government of South Australia, Department of Environment, Water and Natural Resources, Adelaide and Mount Lofty Ranges Natural Resources Management Board, Adelaide.

Cranswick RH, Pierce D, Wright S and Videka H (2015). Barossa PWRA Groundwater Resource Capacity: Report 1 – Hydrogeological Assessment and Conceptual Model Development, DEWNR Technical report 2015/17, Government of South Australia, through Department of Environment, Water and Natural Resources, Adelaide.

DEW (2019a). Barossa Prescribed Water Resources Area 2018 Surface water status report, Government of South Australia, through Department for Environment and Water, Adelaide.

DEW (2019b). Barossa Prescribed Water Resources Area Fractured rock aquifers 2018 Groundwater level and salinity status report, Government of South Australia, through Department for Environment and Water, Adelaide.

DEW (2019c). Barossa Prescribed Water Resources Area Lower Aquifer 2018 Groundwater level and salinity status report, Government of South Australia, through Department for Environment and Water, Adelaide.

DEW (2019d). Barossa Prescribed Water Resources Area Upper Aquifer 2018 Groundwater level and salinity status report, Government of South Australia, through Department for Environment and Water, Adelaide.

DEWNR (2011). Barossa PWRA Groundwater Level and Salinity Status Report 2009–10, Government of South Australia, through Department for Water, Adelaide.

DEWNR (2014). Barossa PWRA Surface Water Status Report 2010–11, Government of South Australia, through Department of Environment, Water and Natural Resources, Adelaide.

Jones-Gill A and Savadamuthu K (2014). Hydro-ecological investigations to inform the Barossa PWRA WAP review – Hydrology Report, DEWNR Technical Report 2014/14, Government of South Australia, through Department of Environment, Water and Natural Resources, Adelaide.

Hancock M, Stewart S and Green G (2014). Interactions between groundwater and surface water systems, Barossa Prescribed Water Resources Area, DEWNR Technical Report 2014/09, Government of South Australia, through Department of Environment, Water and Natural Resources, Adelaide.

Montazeri M and Savadamuthu K (2018). Hydrological investigations to inform Barossa PWRA WAP – Part 2. DEWNR Technical note 2018/42, Government of South Australia, Department of Environment, Water and Natural Resources, Adelaide.

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