Western Mount Lofty Ranges Prescribed Water Resources Area 2018-19 water resources assessment

Department for Environment and Water
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Contents

1 Summary

Rainfall

- Rainfall across the region was lower than average in 2018–19. Rainfall at Hindmarsh in 2018–19 was 774 mm, 11% below average, while rainfall at Mount Bold was 614 mm, 23% below average.
- Annual rainfall typically varies between 400 mm at the lower elevations and over 1000 mm in parts of the Mount Lofty Ranges.

Surface water

- There are eight representative long-term streamflow gauging stations used for the analysis, seven of which recorded lower-than-average streamflow in 2018–19. Two stations recorded 'very much below average'.
- Long-term data trends at the representative gauging stations show a stable or increase in streamflow due to high rainfall experienced during 2016–17.
- The highest salinity in the Onkaparinga River was 922 mg/L in 2018–19 and 509 mg/L in the River Torrens (Sixth Creek). These values remain within the historical ranges experienced at each site.

Groundwater

- Water levels in the Permian Sand and Tertiary limestone aquifers were generally at average levels when compared to their historic levels.
- Water levels in more than 50% of monitoring wells in fractured rock aquifers recorded below-average to lowest-on-record levels compared to their historic levels, with the median well recording below-average levels.
- All monitoring wells with salinity data in the fractured rock aquifers show decreasing or stable salinities over the period 2015–2019. In 2019, no salinity data was available for Permian Sand and Tertiary limestone aquifers. However, historical data shows that salinity of less than 1000 mg/L typically occurs in these aquifers within the Myponga and Hindmarsh Tiers basins.

Water use

- Water used 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 and imported water from the SA Water reticulated network.
- Water consumption in 2018–19 totalled 99 895 ML, comprising licensed surface water sources: 20 151 ML, licensed watercourse extraction 9 660 ML, non-licensed surface water demand: 4 956 ML, forestry: 17 413 ML, SA Water: 31 781 ML and groundwater extraction: 15 934 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 Western Mount Lofty Ranges Prescribed Water Resources Area (PWRA) for 2018-19 and addresses 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 Western Mount Lofty Ranges Prescribed Water Resources Area (WMLR PWRA) is located 10 km east of Adelaide (Figure 1.1). It lies predominantly within the Hills and Fleurieu Landscape Region but has small areas also located within the Green Adelaide and Northern and Yorke Landscape Regions. The PWRA includes both groundwater and surface water resources and these are prescribed resources under South Australia's Landscape SA Act 2019. A water allocation plan, adopted in 2013, provides rules for their management.

Approximately 75% of the State's population depends on the water resources of the WMLR PWRA, which supplies 60% of metropolitan Adelaide's water requirements in an average year. The water resources are therefore vitally important socially, economically and ecologically.

The eastern regions of the PWRA include the highest hills in the area and form the upland eastern extent of the Mount Lofty Ranges watershed. Several important watercourses drain the northern and central parts of the PWRA, flowing west through metropolitan Adelaide and its surrounding suburbs, before entering Gulf St Vincent, including: the South Para River, Little Para River, Torrens River, Onkaparinga River and Myponga River. The south-western part of the PWRA includes the Fleurieu Peninsula, which is characterised by smaller coastal catchments, draining a central plateau. The Fleurieu Peninsula contains numerous wetlands including the Fleurieu Swamps, listed under the *Environment Protection and Biodiversity Conservation Act 1999*. The most south-easterly parts of the PWRA comprise the Hindmarsh River and Inman River catchments which drain the Fleurieu Peninsula towards the south-east (Figure 1.1).

There are two types of aquifers in the Western Mount Lofty Ranges PWRA: the fractured rock aquifers and sedimentary aquifers. The fractured rock aquifers occur where groundwater is stored and moves through joints and fractures in the basement rocks. There are three main sedimentary groundwater systems within the Western Mount Lofty Ranges PWRA: the Permian sand, Tertiary limestone and Quaternary aquifers (Figure 1.1). The McLaren Vale Prescribed Wells Area (PWA), located within the boundaries of the WMLR PWRA, is managed separately and a dedicated water resource assessment has been prepared for the aquifers in this PWA (AMLR NRM Board 2013).

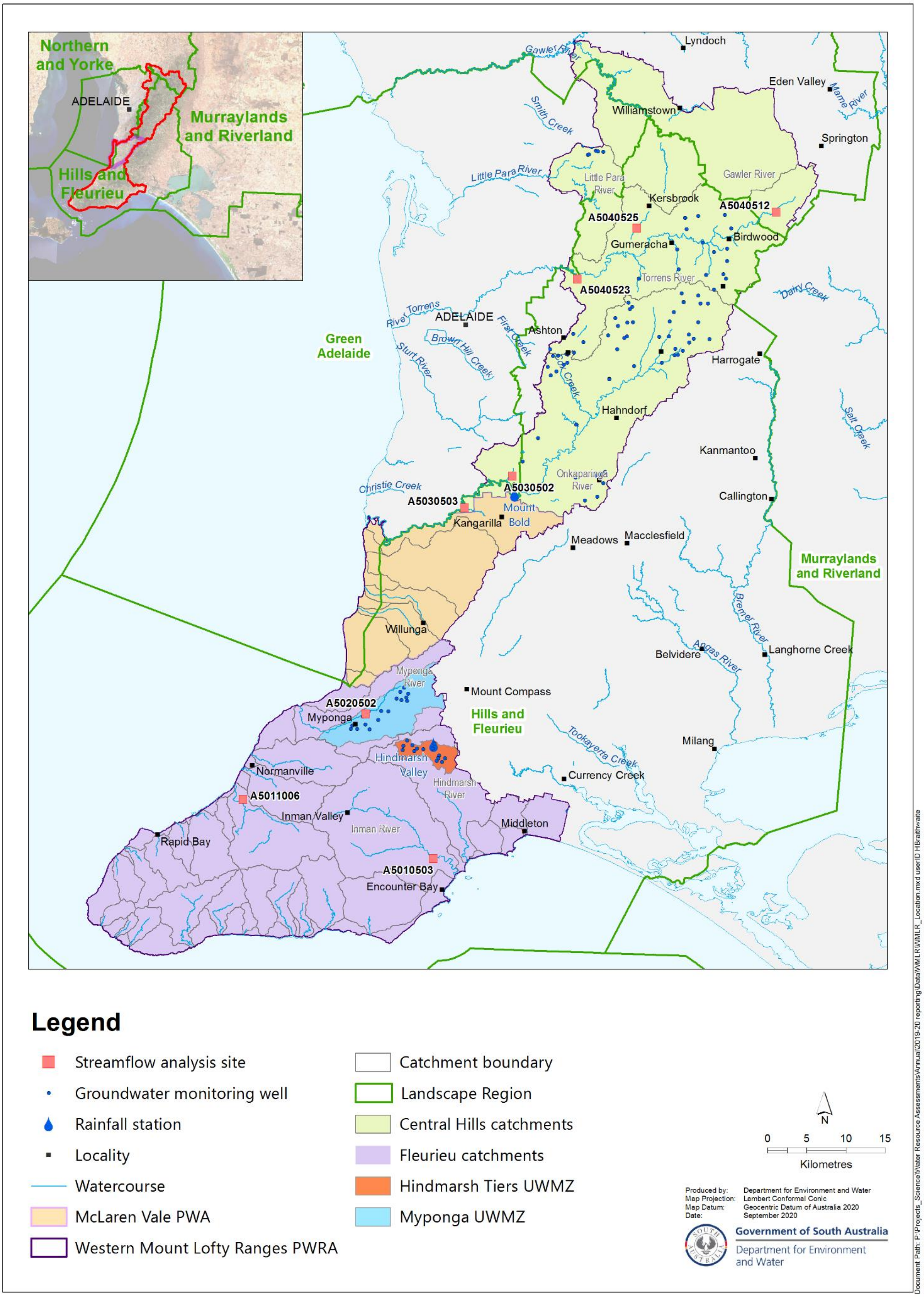

Figure 1.1. Location of prescribed areas of the WMLR

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 3.3). 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 common streamflow data availability period for the WMLR streamflow gauging stations is 1973–74 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 and Figure 4.4) 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 10th 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 monthly average streamflow (Figure 4.3A and Figure 4.5A), for the period 1973–74 to 2018–19 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 and Figure 4.5B).

2.2.4 Salinity

Box plots on a monthly basis are used to assess surface water salinity (Figure 2.1, Figure 4.6 and Figure 4.7). 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).

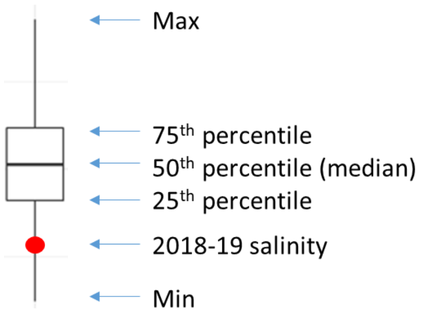

Figure 2.1 Box and whisker plot

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 monitoring 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 WMLR PWRA return to a recovered maximum level between June and December.

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 WMLR PWRA, in the Permian Sand and Tertiary limestone aquifers, any well with 10 years or more of recovered water level data is included, while in the fractured rock aquifers, any well with

[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).

at least 7 years of data is included. The number of wells in each description class for the most recent year is then summarised for each aquifer (for example 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 which 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 summarised for each aquifer (for example see Figure 5.2).

Moderately sized sedimentary confined and unconfined aquifers such as the Permian Sand aquifer and Tertiary limestone aquifer are given tolerance thresholds of 2 cm/y, while fractured rock aquifers with lower storages are given a tolerance threshold of 1 cm/y.

Thirty-year changes in water level were calculated as the difference between the average water level in a three-year period thirty years ago (i.e. 1988–1990) and the average water level in 2019.

2.3.2 Salinity

Water samples from monitoring wells and irrigation wells are collected in the WMLR PWRA. These samples are tested for electrical conductivity (EC) and the salinity (total dissolved solids measured in mg/L, abbreviated as TDS) is calculated. Where more than one water sample has been collected in the course of a year, the annual mean salinity is used for analysis. An example of the results is shown in Figure 5.4. Groundwater salinity in the sedimentary aquifers of WMLR are not currently monitored, but salinity is typically less than 1000 mg/L in these aquifers within Myponga and Hindmarsh Tiers basins.

Five-year salinity trends are calculated where there are at least five years of salinity data (i.e. at least one measurement per year). The trend line is calculated by linear regression and the percentage change in salinity is calculated through the following formula:

$$\text{Percentage change in salinity (\%)} = \frac{\text{Slope of linear trend line (mg/L/y)} * 5}{\text{Value of trend line at start of period (mg/L)}} * 100$$

If the percentage change is greater than 10% then the well is given a status of 'increasing' or 'decreasing' depending on how the salinity is changing, while if the absolute percentage change is less than 10% it is given a status of 'stable'. The latter is intended to reflect the fact that salinity measurements based on the measurement of the electrical conductivity of a water sample are often subject to small instrument errors. The number of increasing, decreasing and stable wells are then summarized in for each resource (e.g. Figure 5.5).

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 to estimate extraction from surface water sources (Figure 317816.1 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, 2013). 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 on the WMLR PWRA are:

- Summary reports on the surface water (DEWNR, 2014) and groundwater resources of the WMLR PWRA (DEWNR, 2011), and annual surface water status reports such as DEW (2019a) and groundwater level and salinity status reports such as DEW (2019b);
- The Water Allocation Plan for the WMLR Prescribed Water Resources Area (AMLR NRM Board, 2013);
- Penney et al. (2020 draft) provides details regarding the construction and calibration of hydrological models for six water supply catchments across the Western Mount Lofty Ranges);
- Green et al. (2007) provides information on groundwater recharge and flow processes in the fractured rock aquifers of WMLR PWRA;
- Background information can be found on WMLR groundwater at Piccadilly Valley (Barnett and Zulfic, 1999), Upper Onkaparinga catchment (Zulfic et al., 2002), Torrens rural catchment (Barnett and Zulfic, 2000), Southern Fleurieu (Barnett and Rix, 2006) and South Para River catchment (Zulfic, 2006); these studies were completed to support water planning in WMLR PWRA.

3 Rainfall

The WMLR PWRA is characterised by warm summers and cold wet winters, and annual rainfall typically varies between 400 mm at the lower elevations and over 1000 mm in the higher elevations of the Mount Lofty Ranges.

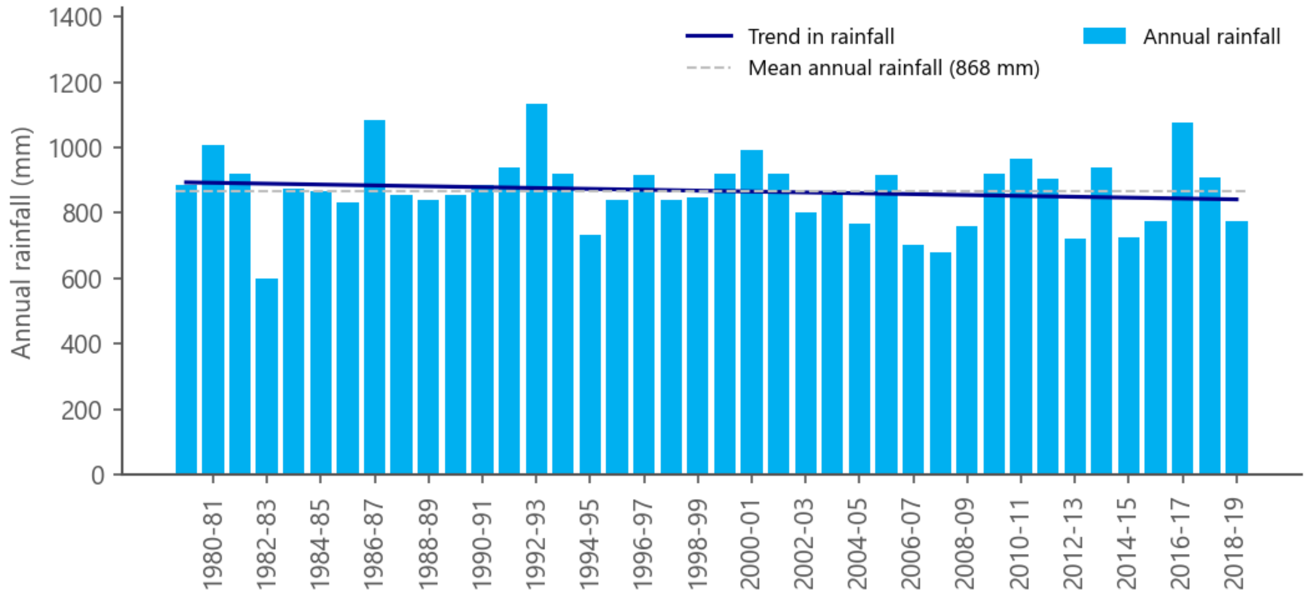

Figure 3.1 **Annual rainfall for 1979–80 to 2018–19 at the Hindmarsh Valley rainfall station (23823)**

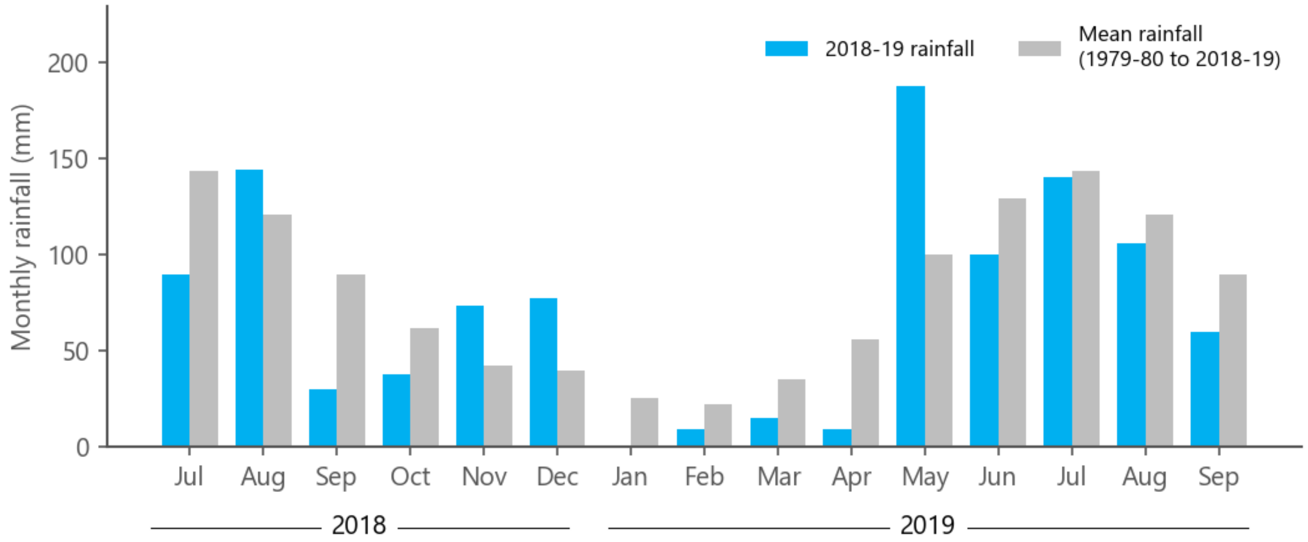

Figure 3.2 **Monthly rainfall between July 2018 and September 2019 at the Hindmarsh Valley rainfall station (23823)**

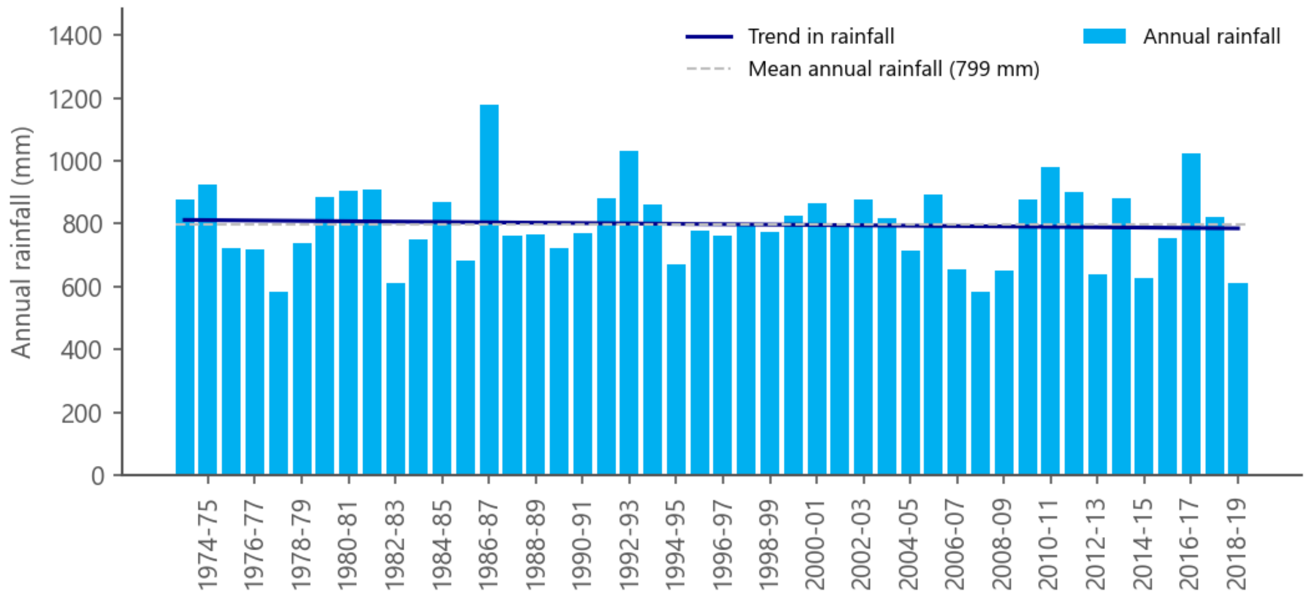

Figure 3.3 Annual rainfall for 1973–74 to 2018–19 at the Mount Bold rainfall station (23734)

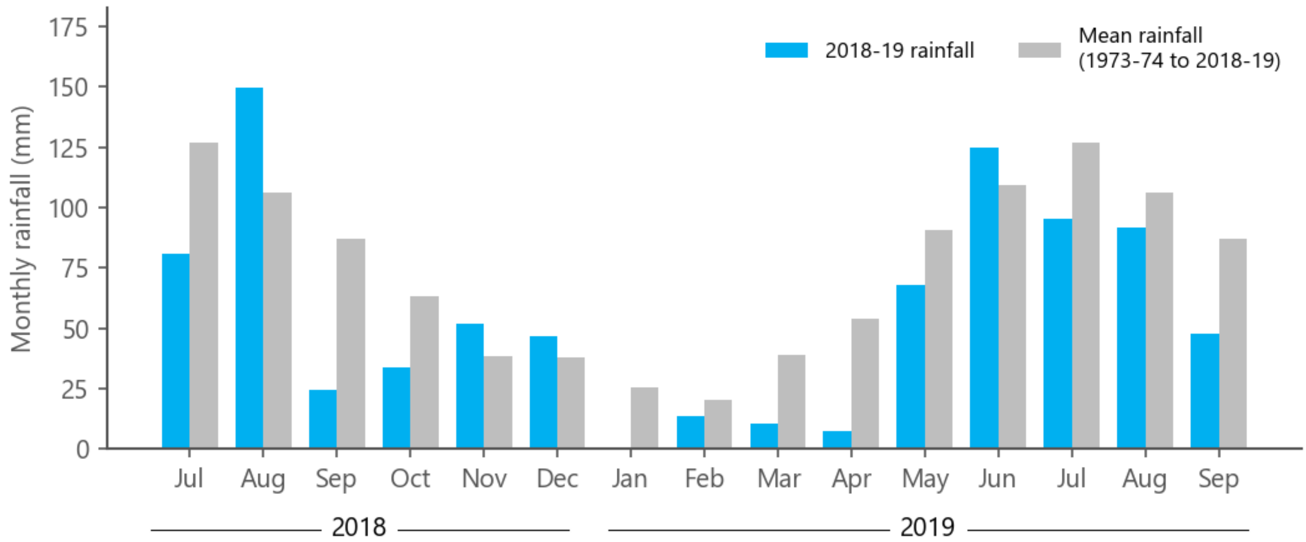

Figure 3.4 Monthly rainfall between July 2018 and September 2019 at the Mount Bold rainfall station (23734)

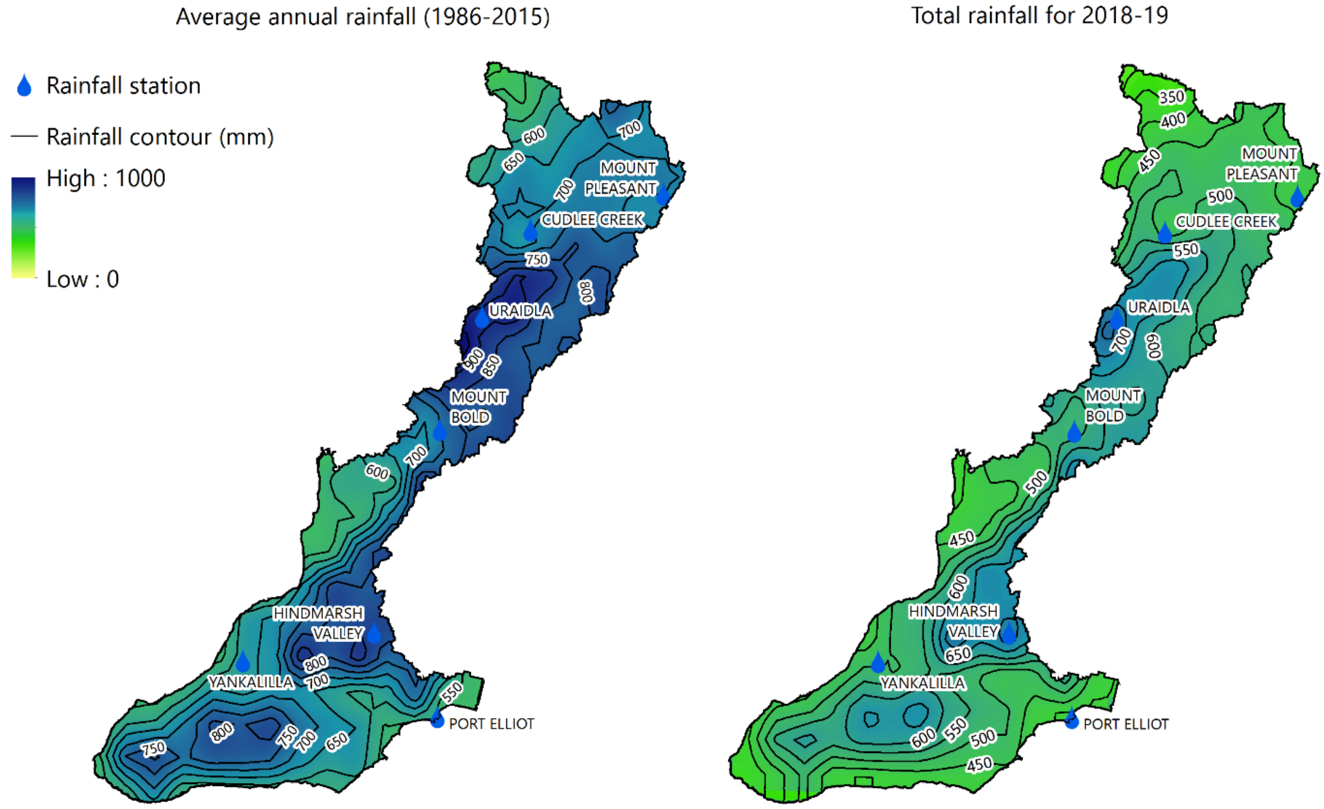

Figure 3.5 Rainfall in the prescribed areas of the WMLR for 2018–19 compared to the standard 30-year climatological average (1985–2015)

- The Hindmarsh Valley rainfall station (BoM station 23823) is used as a representative rainfall station for the Permian Sand and Tertiary limestone aquifers and the Fleurieu surface water catchments. The annual total recorded for 2018–19 was 774 mm. This was 94 mm lower than the average annual rainfall of 868 mm (1979–80 to 2018–19). The long-term trend is declining across this period (Figure 3.1).

- Predominantly drier-than-average conditions were observed at the Hindmarsh Valley rainfall station during the 2018–19 period with the exception of August, November and December (2018, and in particular May (2019) experiencing almost twice the monthly average. With the exception of these months, the spring-summer months were extremely dry in comparison to the long-term average (Figure 3.2).

- The Mount Bold rainfall station (BoM station 23734) is used as a representative rainfall station for the Fractured Rock Aquifers and the Onkaparinga catchment. The annual total recorded for 2018–19 was 613 mm. This was 186 mm lower than the average annual rainfall of 799 mm (1973–74 to 2018–19). The long-term trend is increasing across this period (Figure 3.3).

- Predominantly drier-than-average conditions were observed at the Mount Bold rainfall station during the 2018–19 period with the exception of August and November (2018) and May (2019). With the exception of these months, the spring-summer months were very dry in comparison to the long-term average (Figure 3.4).

- Rainfall in 2018–19 was significantly lower in all parts of the PWRA compared to the average annual rainfall patterns. The long-term-average annual rainfall shows higher rainfall bands (over 900 mm) near Uraidla, whereas these high rainfall bands were not present 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

Several significant watercourses drain the northern and central parts of the PWRA, flowing west through metropolitan Adelaide and its surrounding suburbs, before entering Gulf St Vincent, including: the South Para River, Little Para River, River Torrens, Onkaparinga River and Myponga River. The south-western part of the PWRA includes the Fleurieu Peninsula, which is characterised by smaller coastal catchments, draining a central plateau. The most south-easterly parts of the PWRA comprise the Hindmarsh River and Inman River which drain the Fleurieu Peninsula towards the south-east. 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 to management of water resources in the WMLR PWRA. The spatial variability in hydrological behaviour of the surface water catchments within the WMLR makes it challenging when assigning a single representative streamflow gauging station for the PWRA. Therefore eight streamflow gauging stations were chosen to be representative of the central, and southern portions of the WMLR PWRA. The River Torrens and Onkaparinga River catchments represent the central part, while the southern part of the region is represented by streamflow gauging stations located on the Fleurieu Peninsula. The common streamflow data availability period is 1973–74 to 2018–19.

The representative sites for the River Torrens are the Mount Pleasant (A5040512), Sixth Creek (A5040523) and Kersbrook Creek (A5040523) streamflow gauging stations. For the Onkaparinga River catchment, the Scott Creek (A5030502) and Bakers Gully (A5030503) streamflow gauging stations are used. The representative sites for the Fleurieu Peninsula are the Myponga River (A5020502), Inman River (A5010503) and the Yankalilla River (A5011006) streamflow gauging stations. In 2018–19, lower than average streamflow was recorded (Figure 4.1) at seven of the stations and the Sixth Creek station recorded average streamflow. Further detail on the methodology used for analysis can be found in Section 2.

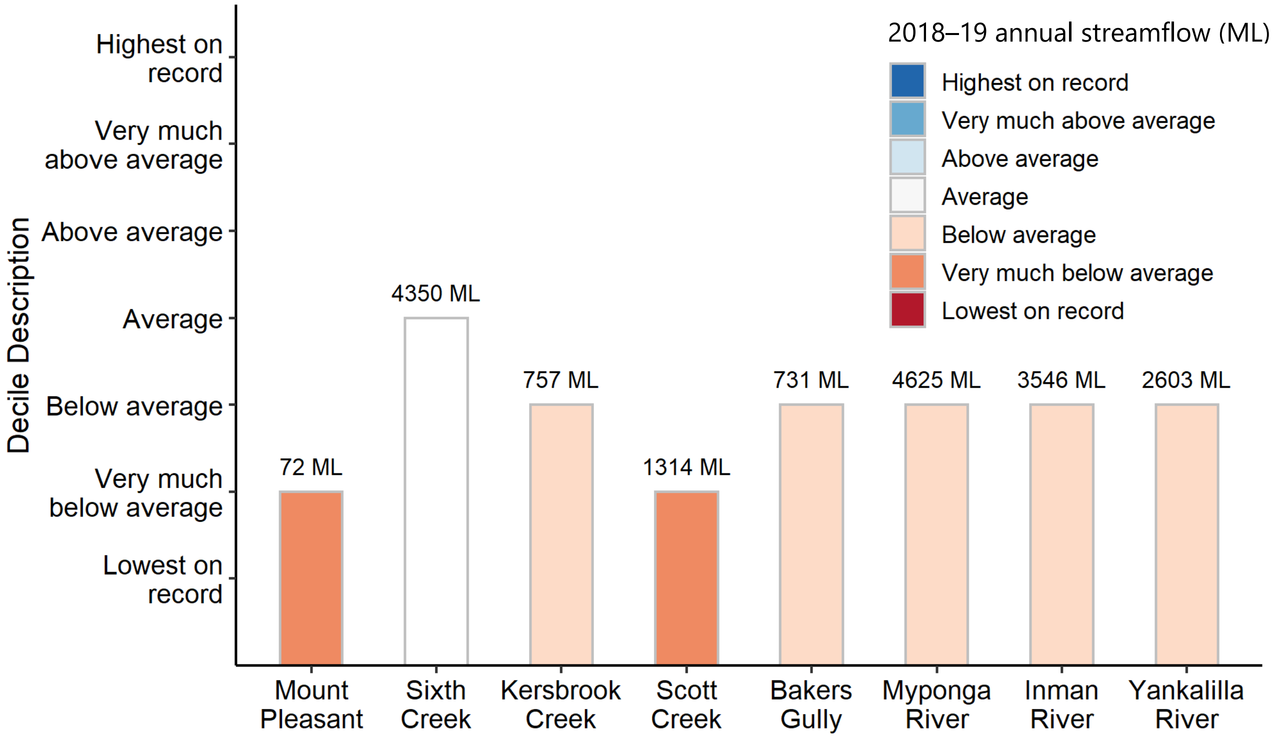

Figure 4.1. WMLR PWRA annual streamflow summary 2018–19

4.1.1 River Torrens: Mount Pleasant (A5040512)

One of the principal long-term streamflow gauging stations for the central part of the WMLR PWRA is at Mount Pleasant. This site is located in the headwaters of the River Torrens and captures a catchment area of 26 km². It is upstream of the Mount Pleasant dissipator where River Murray water is discharged to the River Torrens.

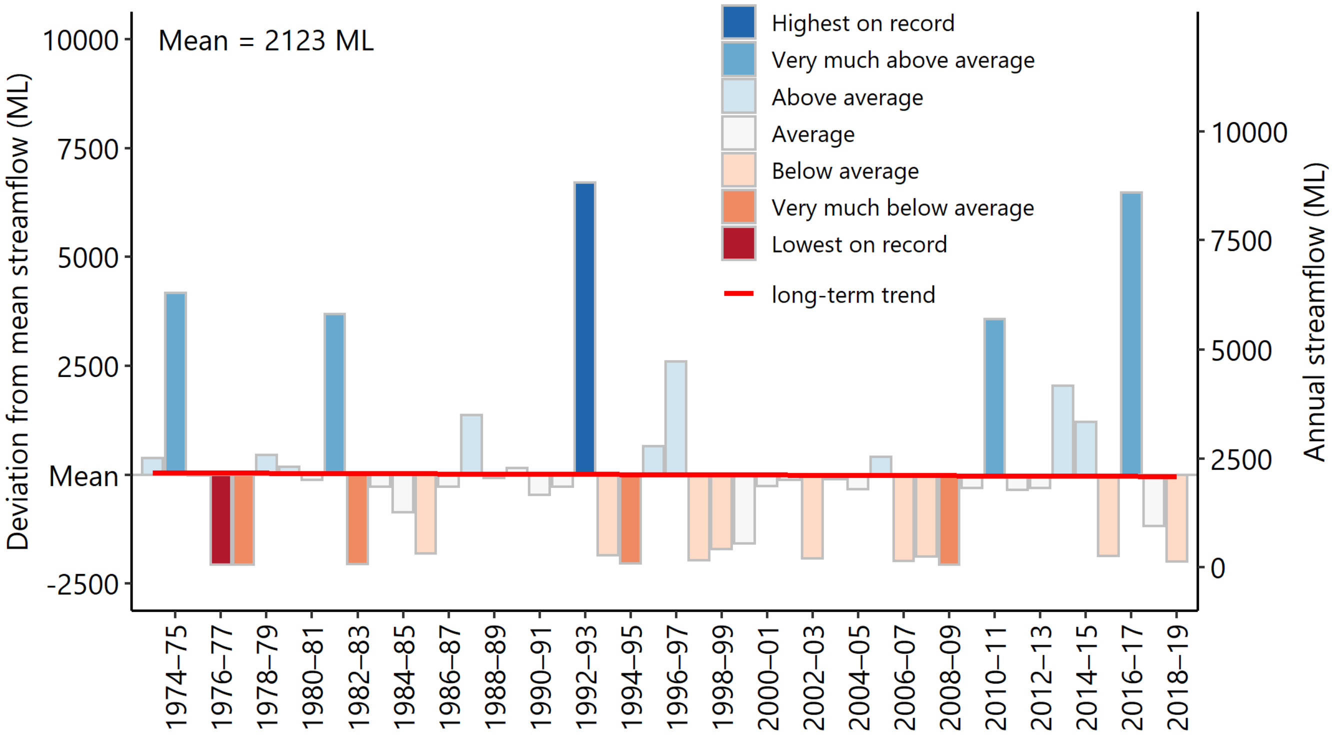

Figure 4.2. Annual deviation from mean streamflow at Mount Pleasant (1973-74 to 2018–19)

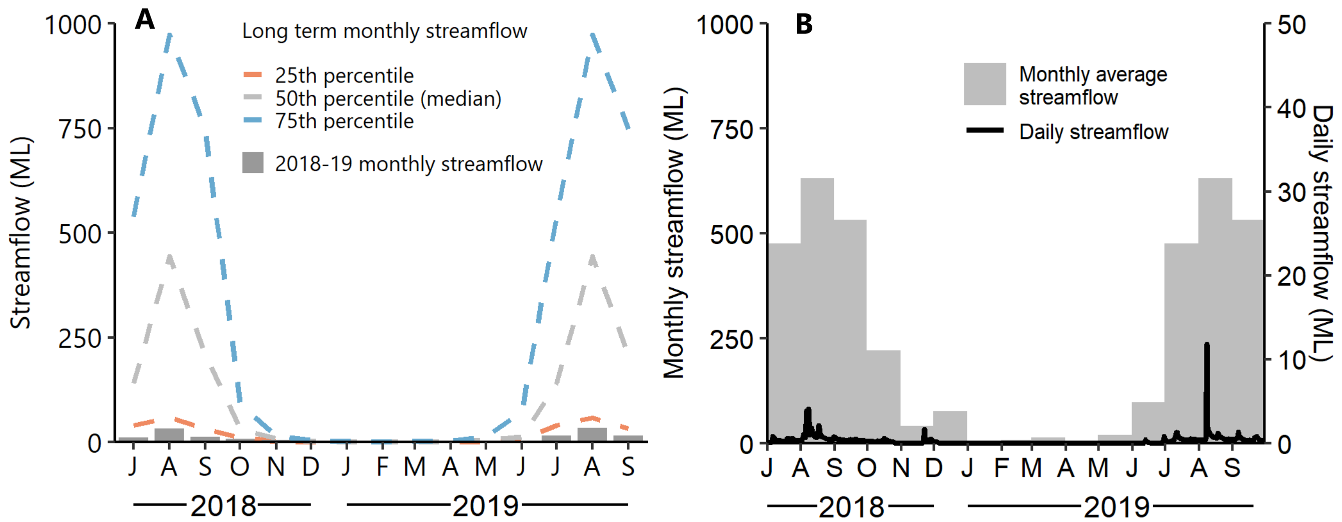

Figure 4.3. (A) Long-term monthly statistics and 2018–19 monthly streamflow at Mount Pleasant; (B) Long-term average monthly streamflow and 2018–19 daily streamflow at Mount Pleasant

The deviation of each individual year's streamflow from the long-term average is shown in Figure 4.2. The annual streamflow at Mount Pleasant in 2018–19 was 72 ML, which is 2050 ML below the average annual streamflow of 2123 ML (1973–74 to 2018–19).

The annual streamflow for 2018–19 is ranked as 'very much below average' assessed for the period 1973–74 to 2018–19. Annual streamflow in the River Torrens at Mount Pleasant indicates a long-term stable trend but 3 out of the last 5 years have been 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 (1973–74 to 2018–19) for (a) low flows (25^{th} percentile), (b) median flows (50^{th} percentile) and high flows (75^{th} percentile). All months in 2018–19 were drier than average in 2018–19.

The headwaters of the River Torrens at Mount Pleasant are ephemeral and zero or low flows are typically recorded between January and April. The majority of the flow occurs between July and October and normally accounts for almost 90% of the total annual flow in any given year. In 2018–19, streamflow occurred from July to December 2018 and again in June 2019.

Figure 4.3B presents the long-term average monthly streamflow (1973–74 to 2018–19) and the daily flows for 2018–19. Maximum daily flows were recorded in August 2018 and there were 219 zero flow days experienced in 2018–19 due to the ephemerality of the system. In the period from July to September 2019, flows remained below the long-term average monthly streamflow.

4.1.1 Inman River (A5010503)

One of the principal long-term streamflow gauging stations in the Fleurieu Peninsula is located at the outlet of the River Inman catchment, and covers a catchment area of 164 km^2. The station is upstream of the Victor Harbor sewage treatment works, north of Victor Harbor.

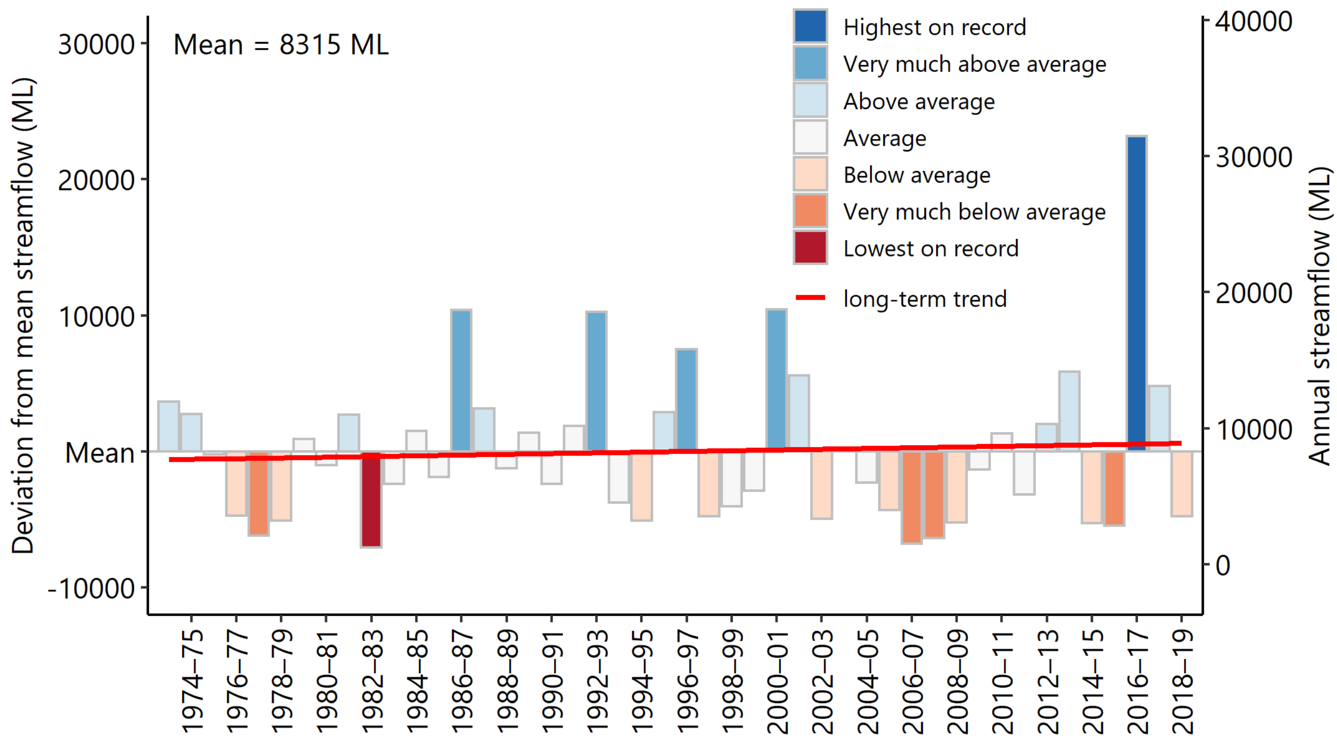

Figure 4.4. Annual deviation from mean streamflow on the River Inman (1973-74 to 2018–19)

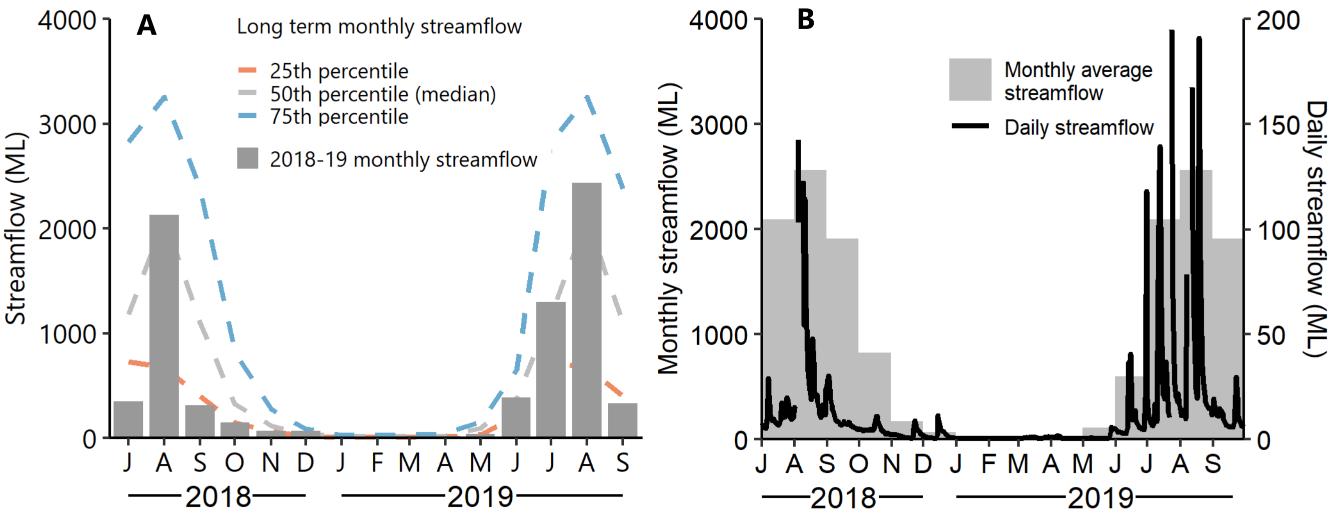

Figure 4.5 (A) Long-term monthly statistics and 2018–19 monthly streamflow on the River Inman; (B) Long-term average monthly streamflow and 2018–19 daily streamflow on the River Inman

The deviation of each individual year's streamflow from the long-term average streamflow is shown in Figure 4.4 for the period 1973–74 to 2018–19. The River Inman streamflow gauging station recorded an annual flow of 3546 ML in 2018–19, which is 4769 ML below the average annual streamflow of 8315 ML (1973–74 to 2018–19).

The annual total for 2018–19 is ranked as 'below average' for the assessment period 1973–74 to 2018–19. Annual streamflow in the Inman River indicates a long-term slight increasing trend which is influenced by the high rainfall recorded in 2016–17. However, 3 out of the last 5 years were below the average annual streamflow (Figure 4.4).

Figure 4.5A shows the monthly streamflow for 2018–19 (grey bars) relative to the long-term monthly streamflow (1973–74 to 2018–19) for (a) low flows (25th percentile), (b) median flows (50th percentile) and high flows (75th percentile). In 2018–19, streamflow occurred throughout the year and August 2018 and June 2019 were between the 50th and 75th percentile monthly flows. The remaining months were below the 50th (or median) monthly streamflow. The Inman River streamflow gauging station is at the outlet of the catchment and flows are typically recorded all year round but the lowest flows are experienced from January to April. The majority of the flows occur between June and October and normally account for 95% of the total annual flow in any given year.

Figure 4.5B presents the long-term average monthly streamflow (1973–74 to 2018–19) and the daily flows for 2018–19. Maximum daily flows were recorded in August 2018 and there were no zero flow days experienced in 2018–19. In the period from July to September 2019, flows remained below the long-term average monthly streamflow.

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 routinely at many locations across the WMLR PWRA and two of these stations are used as representative sites for this assessment, one in the Onkaparinga River catchment (upstream of the Hahndorf dissipator A5031001), and the other in the River Torrens catchment (Sixth Creek A5040523). The Sixth Creek station (A5040523) has been used as a representative site for the Torrens catchment as there are no imports of water into this sub-catchment that could affect the dilution of salts.

Figure 4.6 and Figure 4.7 show the long term monthly salinity statistics (from the early 2000's) and median monthly values for 2018–19 (red dots) at the Onkaparinga River and River Torrens (Sixth Creek) streamflow gauging stations.

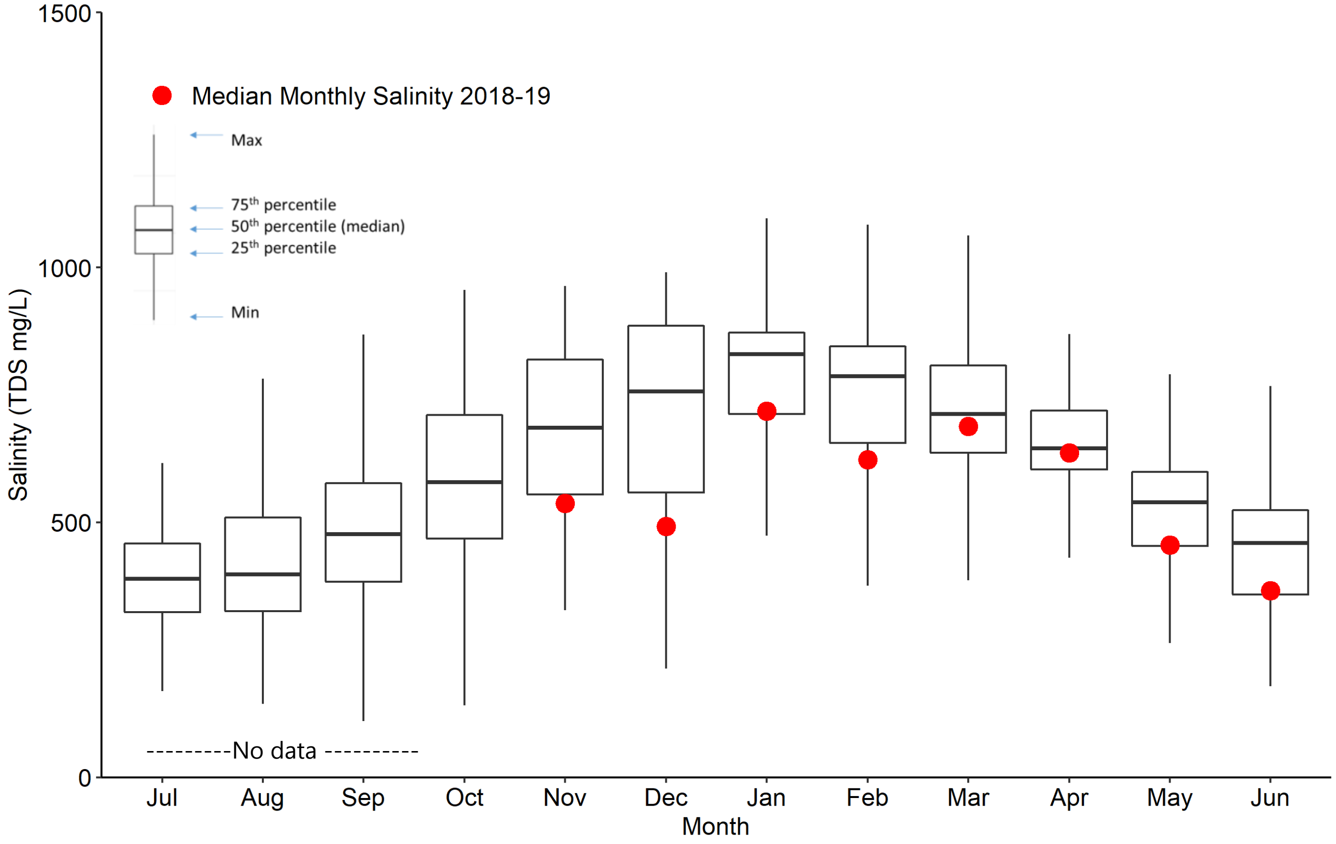

Figure 4.6. Long-term and 2018–19 monthly salinity at the Onkaparinga River streamflow gauging station (A5031001)

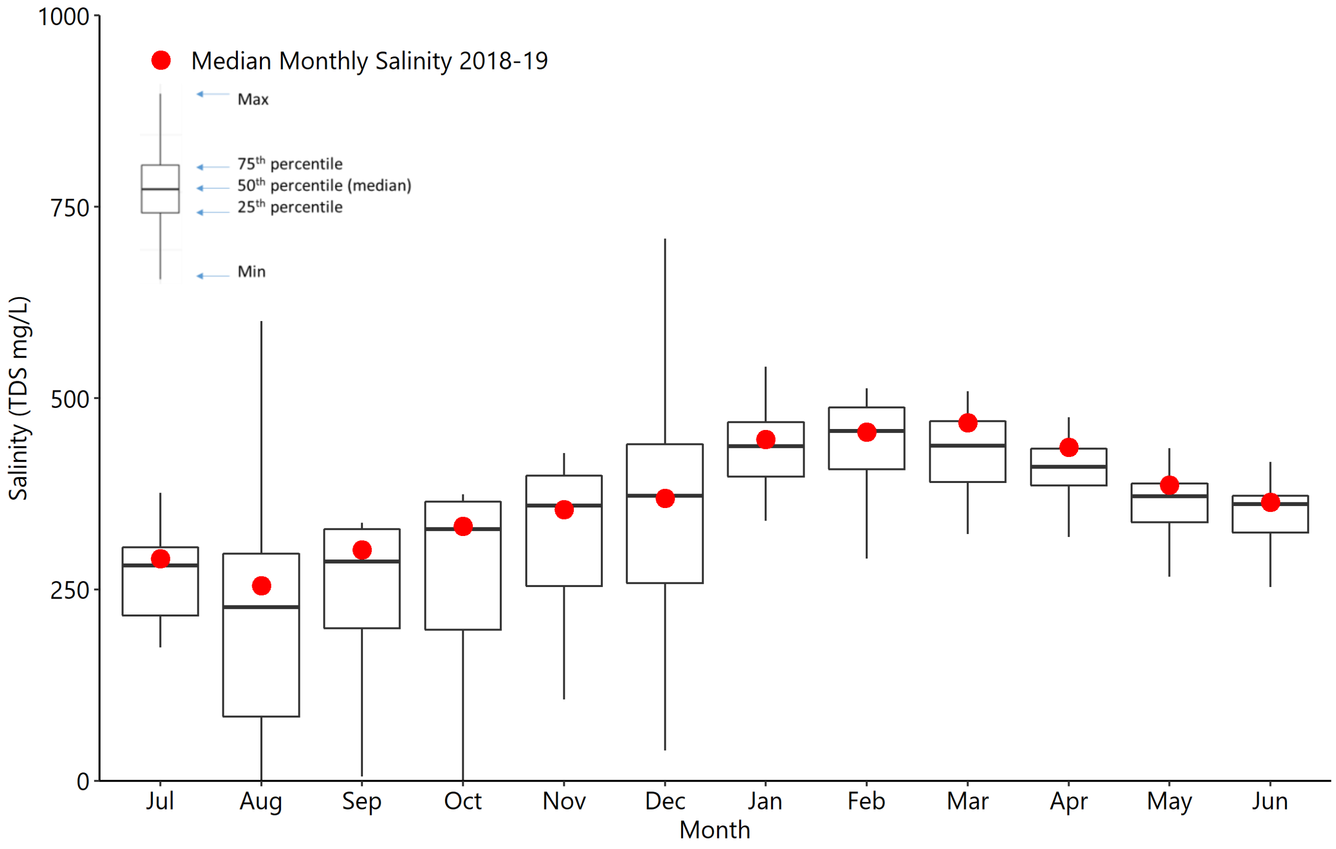

Figure 4.7. Long-term and 2018–19 monthly salinity at the River Torrens (Sixth Creek) streamflow gauging station (A5040523)

The majority of salinity levels are below 1000 mg/L at the stations presented above for the period of data availability (early 2000's to 2018–19).

The median salinity observed in the Onkaparinga River is 600 mg/L and the highest salinity recorded in 2018–19 was 922 mg/L. There is a period of missing data from June to October 2018 at this station due to instrumentation maintenance (Figure 4.6).

In comparison, Sixth Creek has slightly less saline conditions with a median salinity of approximately 400 mg/L. The highest salinity observed in 2018–19 was 509 mg/L.

The 2018–19 salinity levels remained within the historical ranges experienced each month for both stations. The long-term data indicates a lower variability in monthly salinity for the Sixth Creek site, as indicated by the smaller range between the minimum and maximum monthly values.

5 Groundwater

5.1 Hydrogeology

There are two different types of aquifers in the WMLR PWRA. The fractured rock aquifers occur where groundwater is stored and moves through joints and fractures in the basement rocks. Sedimentary aquifers occur in the valleys where groundwater flows through the pore spaces within the sediments. Recharge to both of these aquifers occurs directly from the portion of rainfall that percolates down to the water table through the soil profile or, in the case of the sedimentary aquifers, indirectly by throughflow from adjacent aquifers. The majority of groundwater extraction in the area occurs from the fractured rock aquifers in the Central Hills region and sedimentary aquifers (i.e. Permian Sand aquifer and Tertiary limestone aquifer) in the Myponga and Hindmarsh Tiers basins (Figure 1.1). As a result, the groundwater monitoring network and this report predominantly focus on these areas of higher groundwater demand.

5.1.1 Fractured rock aquifers

The fractured rock aquifers comprise three geological units: the Barossa Complex, the Adelaidean sediments and the Kanmantoo Group. Generally, the Adelaidean sedimentary rocks are more favourable in terms of recharge, salinity and yields, while the Barossa Complex and Kanmantoo Group rocks provide groundwater of poorer quality at low yields.

The Adelaidean sedimentary rocks are the main source of groundwater extractions in the area. As these rocks have not been subjected to the heat and pressure of metamorphism, they are considered reasonably good aquifers because the joints and fractures are open and permeable, resulting in relatively high yields. In addition, these sediments occur in the west of the region where the rainfall is higher, resulting in higher recharge and lower salinities. Groundwater extraction and monitoring from the fractured rock aquifers mainly occurs in the Central Hill region as defined in the WAP and as such is the main focus of this report.

5.1.2 Sedimentary aquifers

There are three types of sedimentary aquifers in the area: Permian sand, Tertiary limestone and Quaternary sediments. Tertiary limestone aquifers provide good quality water and high yields, while the Permian sand aquifers display a wide variation in characteristics. Quaternary sediments are found at the lowest points in the catchments adjacent to drainage lines and consist of dark grey silts and clays but these are not discussed in this report.

5.1.2.1 Permian Sand aquifer

The Permian sediments consist of unconsolidated sands, silts and clays with occasional gravel beds that are known as the Cape Jervis Formation. This aquifer is generally low-yielding, except in the northern Myponga Basin where the Tertiary limestone aquifer, which otherwise overlies the Permian Sand aquifer, is absent. Here, the aquifer shows generally good yields and low salinity; however, high clay content in some areas can lead to lower yields and higher salinities.

5.1.2.2 Tertiary limestone aquifer

The Tertiary limestone aquifer is restricted in extent to isolated basins, such as Myponga and Hindmarsh Tiers. The Tertiary limestone aquifer is an important source of water where it contains good quality groundwater and is confined by the overlying Quaternary clays, which may cause seasonal artesian conditions. This aquifer is widely developed for irrigation, primarily of dairy pasture in the Myponga and Hindmarsh Tiers Basins in the south of the PWRA on the Fleurieu Peninsula.

5.2 Fractured rock aquifers - water level

Following the 2018–19 irrigation season, the majority (59%) of fractured rock aquifer monitoring wells with long-term data recorded levels below average to lowest on record. These wells are spread across the aquifer with clusters near Lobethal, Woodside and Mount Bold Reservoir

Figure 5.1).

The change in water level over the last 30 years in wells with suitable long-term records ranged from a decline of 6.76 m to a rise of 5.78 m (the median change is a decline of 0.96 m).

Five-year trends in water levels (2015–2019) are declining in 51% of wells, with rates ranging from a decline of 1.55 m/y to a rise of 1.89 m/y (the median change is declining at 0.01 m/y) (Figure 5.2). However, 45% of wells showed an increasing five-year trend.

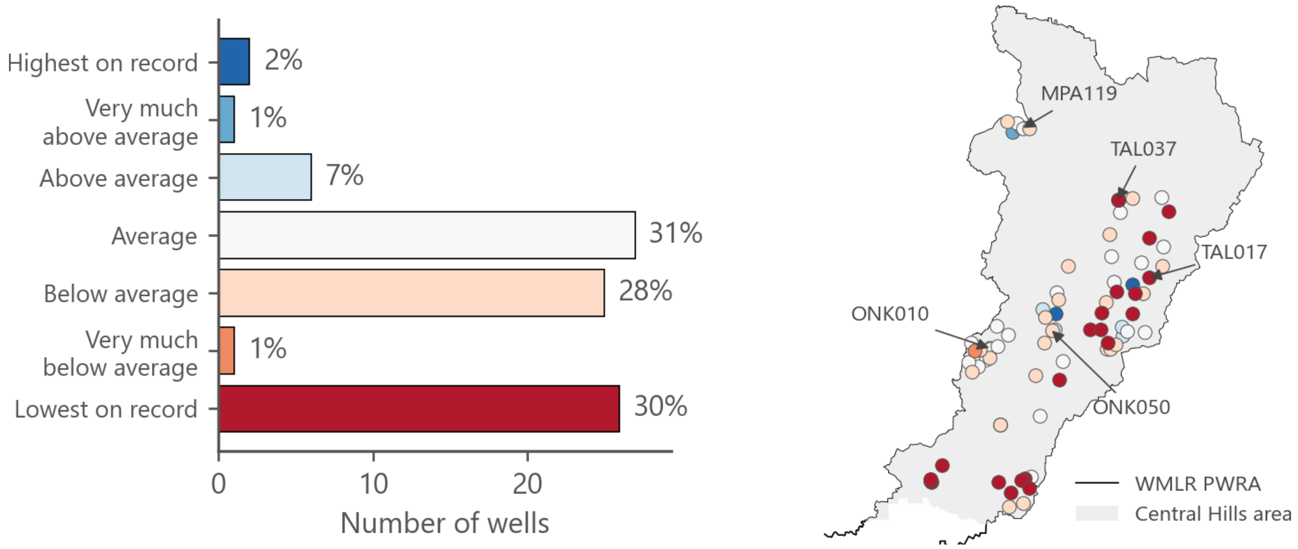

Figure 5.1. 2019 recovered water levels for wells in the fractured rock aquifers

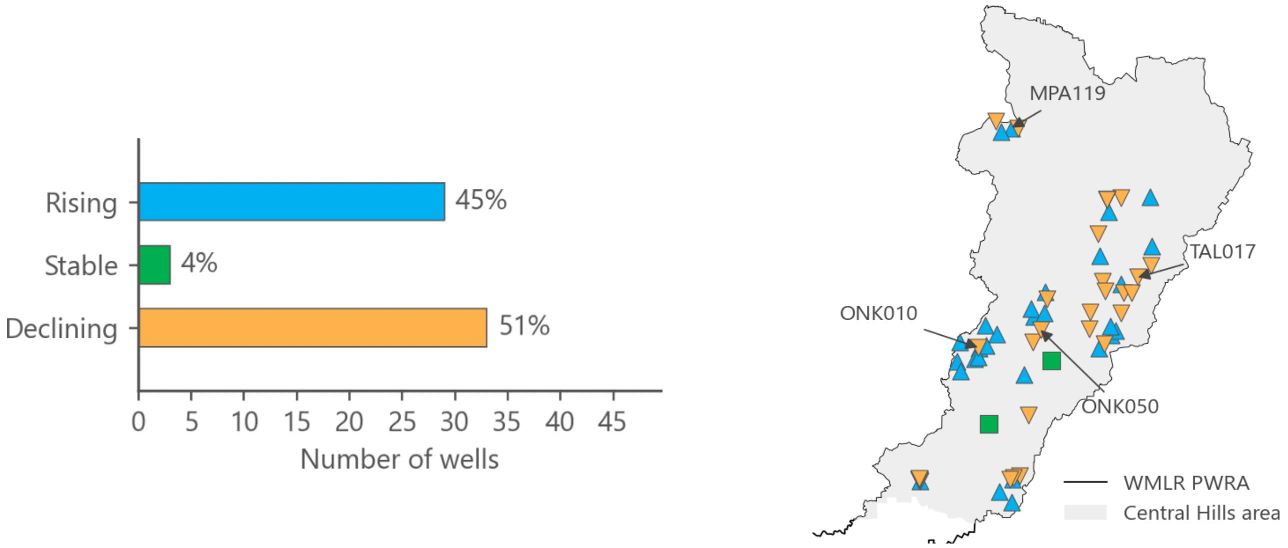

Figure 5.2. 2015-2019 trend in recovered water levels for wells in the fractured rock aquifers

Figure 5.3 shows representative hydrographs from a selection of fractured rock aquifer monitoring wells. Monitoring well ONK010 is located at Uraidla and displays large seasonal variations. Groundwater levels were generally stable from the start of monitoring until 2000 when levels gradually rose up to the highest levels on record in 2016, in response to extreme rainfall events. In 2019, an above-average level was recorded at this site. Monitoring well ONK050, located south of Lenswood, shows stable water levels since monitoring began in 2002.

TAL017 and TAL037 are located at Mount Torrens and north of Gumeracha and show a gradual decline since monitoring began. These wells recorded their lowest levels in 2019 but it should be noted that the length of record is relatively short at these wells.

MPA119, located at One Tree Hill, shows steady decline of levels from 1985 to 1999, followed by a rise of levels up until 2005. Groundwater levels declined from 2005 to 2009 due to below-average rainfall and stayed relatively stable since then.

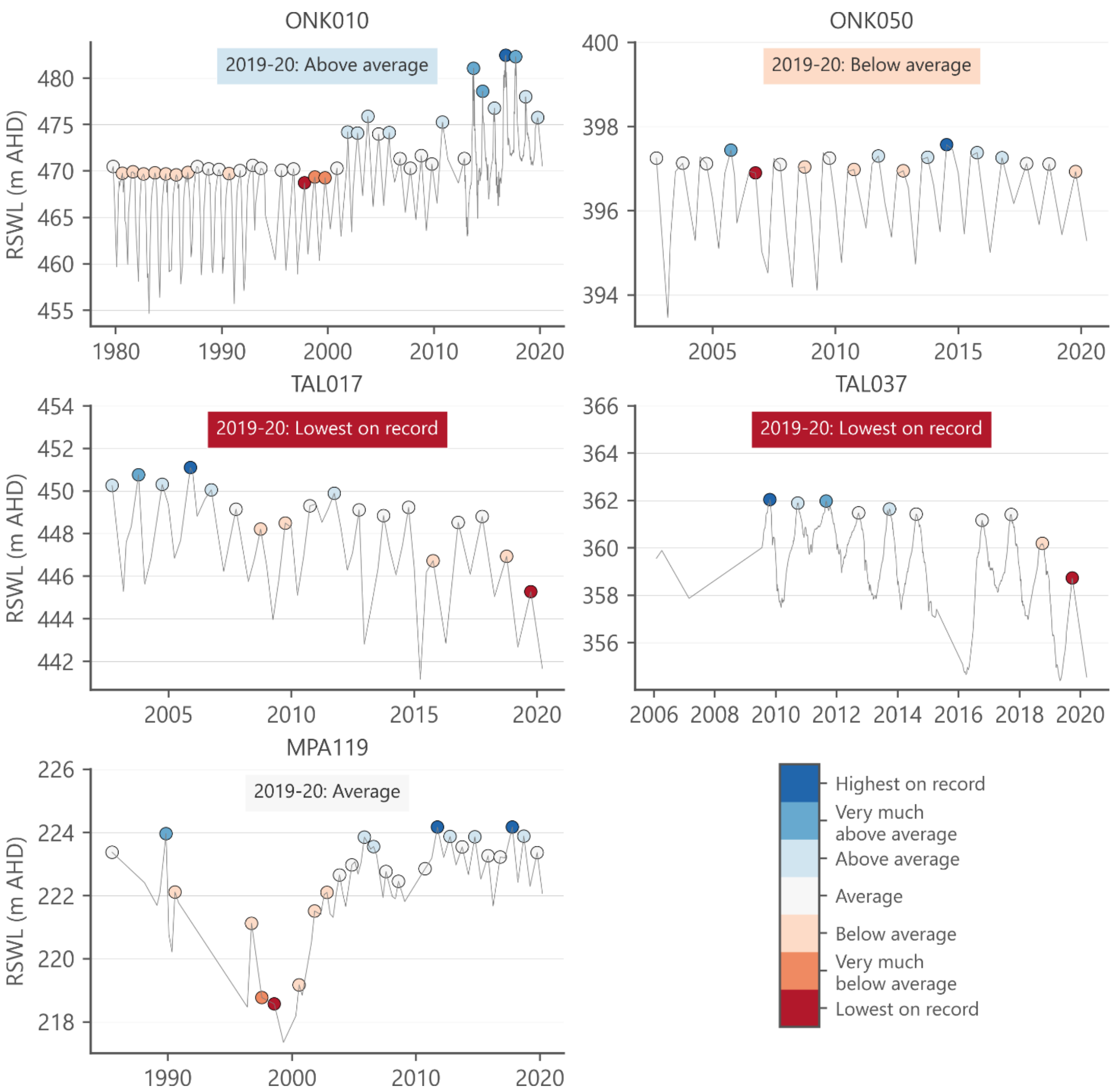

Figure 5.3. Selected fractured rock aquifer hydrographs

5.3 Fractured rock aquifers - salinity

Groundwater salinity is highly variable in the fractured rock aquifers and is influenced by the type of rock in which fractures occur. In 2019, results from 64 monitoring wells in the fractured rock aquifers ranged between 95 mg/L and 6532 mg/L with a median of 720 mg/L (Figure 5.4).

In the five years to 2019, all wells with available data showed stable (64%) or decreasing (36%) trends in salinity with rates of decrease ranging from 7 to 63 mg/L/y (Figure 5.5).

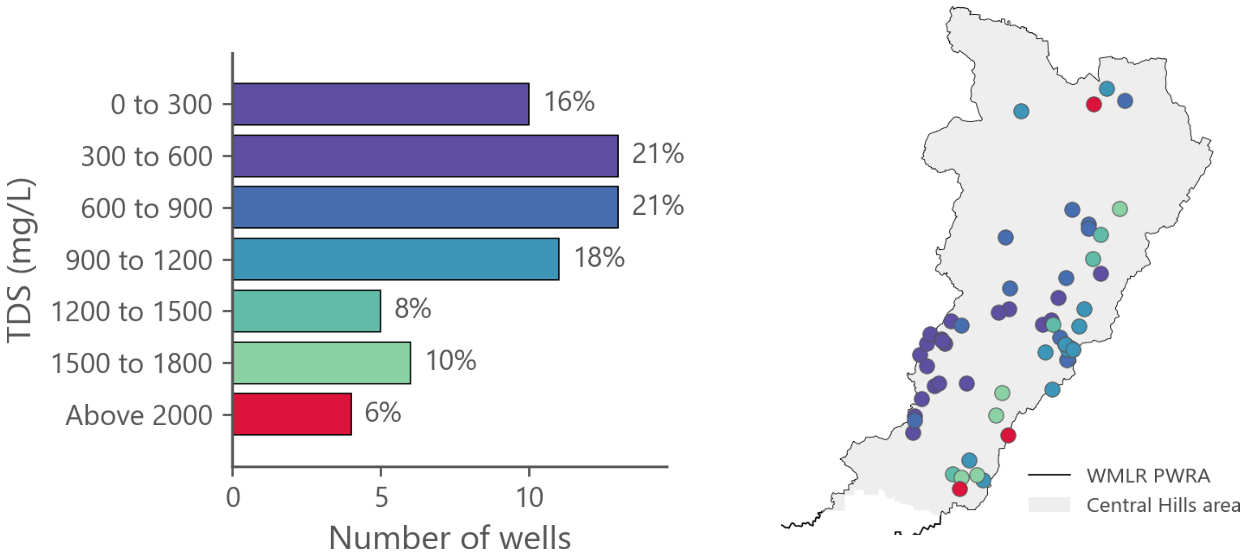

Figure 5.4. 2019 salinity observations from wells in the fractured rock aquifers

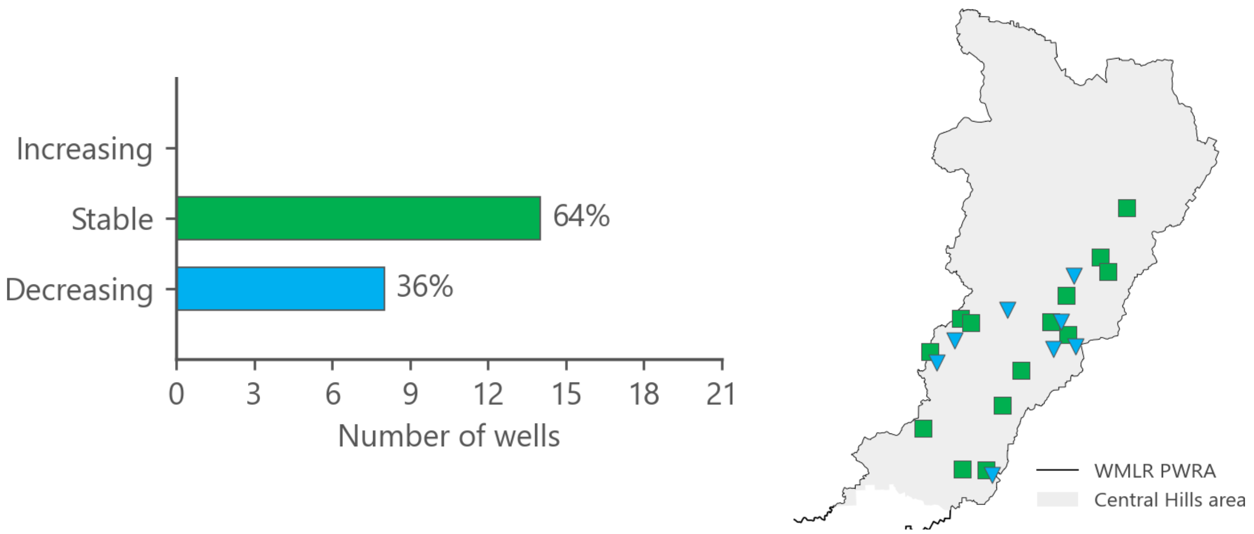

Figure 5.5. 2015-2019 trend in groundwater salinities for wells in the fractured rock aquifers

5.4 Permian Sand aquifer – water level

Following the 2018–19 irrigation season, water levels observed in the majority (55%) of Permian Sand monitoring wells were average and above average when compared to their historic records (Figure 5.6). Four monitoring wells (45%) showed below-average levels and are located in Myponga Basin.

The change in water level over the last 20 years in wells with suitable long-term records ranged from a decline of 1.45 m to a rise of 0.21 m (the median change is a decline of 0.40 m).

Five-year trends in water levels are rising (67%) or stable (11%) in the majority of wells, while a declining trend was observed in 22% of wells. Rates of change in water levels range from a decline of 0.13 m/y to a rise of 0.21 m/y (the median change is rising at 0.07 m/y (Figure 5.7).

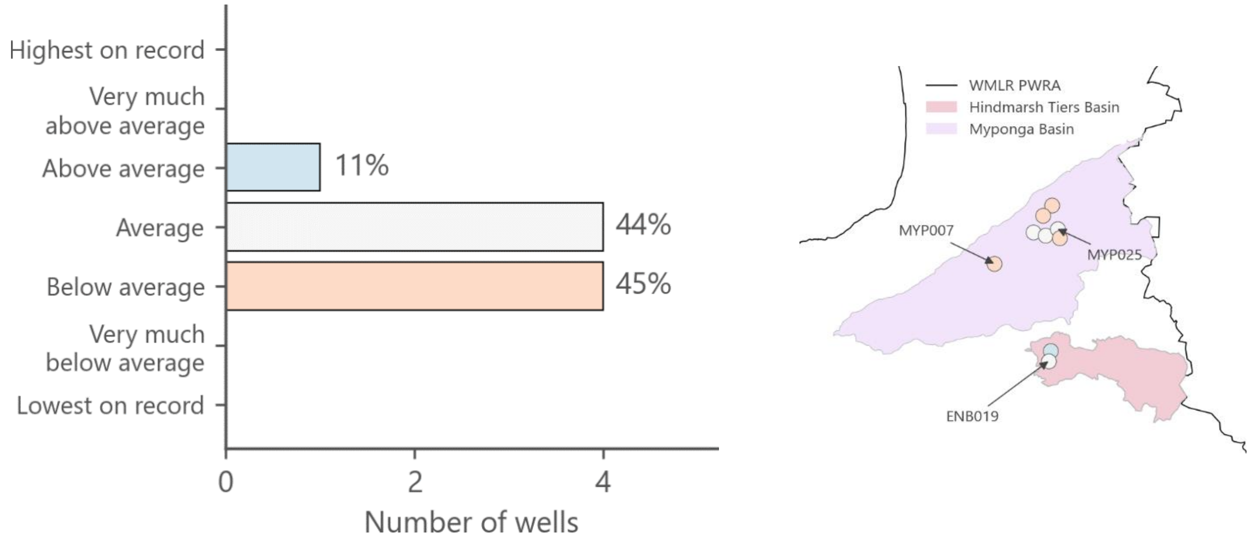

Figure 5.6. 2019 recovered water levels for wells in the Permian Sand aquifer

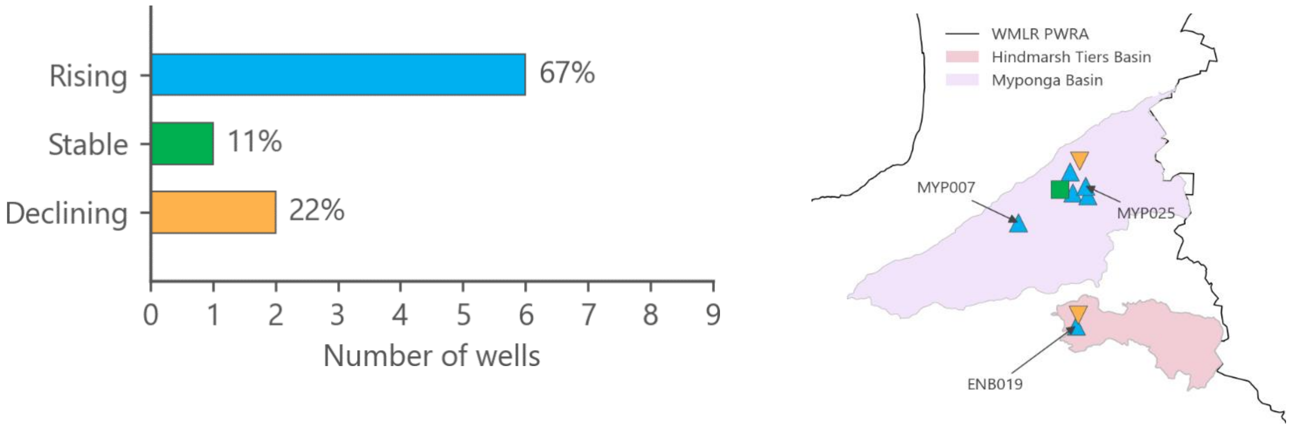

Figure 5.7. 2015-2019 trend in recovered water levels for wells in the Permian Sand aquifer

Figure 5.8 shows representative hydrographs from a selection of monitoring wells in the Permian Sand aquifer. The Permian sand aquifer displays large seasonal variations in groundwater levels in both the Myponga and Hindmarsh Tiers Basins. Groundwater levels in the Myponga Basin were relatively stable between 1975 and 1995 (MYP007). Since 2001, groundwater levels have declined by up to two metres (MYP007 and MYP025). This decline since 2001 correlates well with the dominant below-average rainfall trend recorded over this period. This is likely to have reduced recharge to the aquifer and increased demand from groundwater users because of the dry conditions. Groundwater levels have been relatively stable since 2010.

In the Hindmarsh Tiers Basin (ENB019), groundwater levels rose slightly between 1983 and 1993. Between 1993 and 1999, there is a gap in the data but levels declined by around two metres in this time. Levels were relatively stable between 1999 and 2004, after which they have declined slightly, with a gradual recovery from 2009 to 2016. In 2019, an average water level was experienced when compared to the long term record.

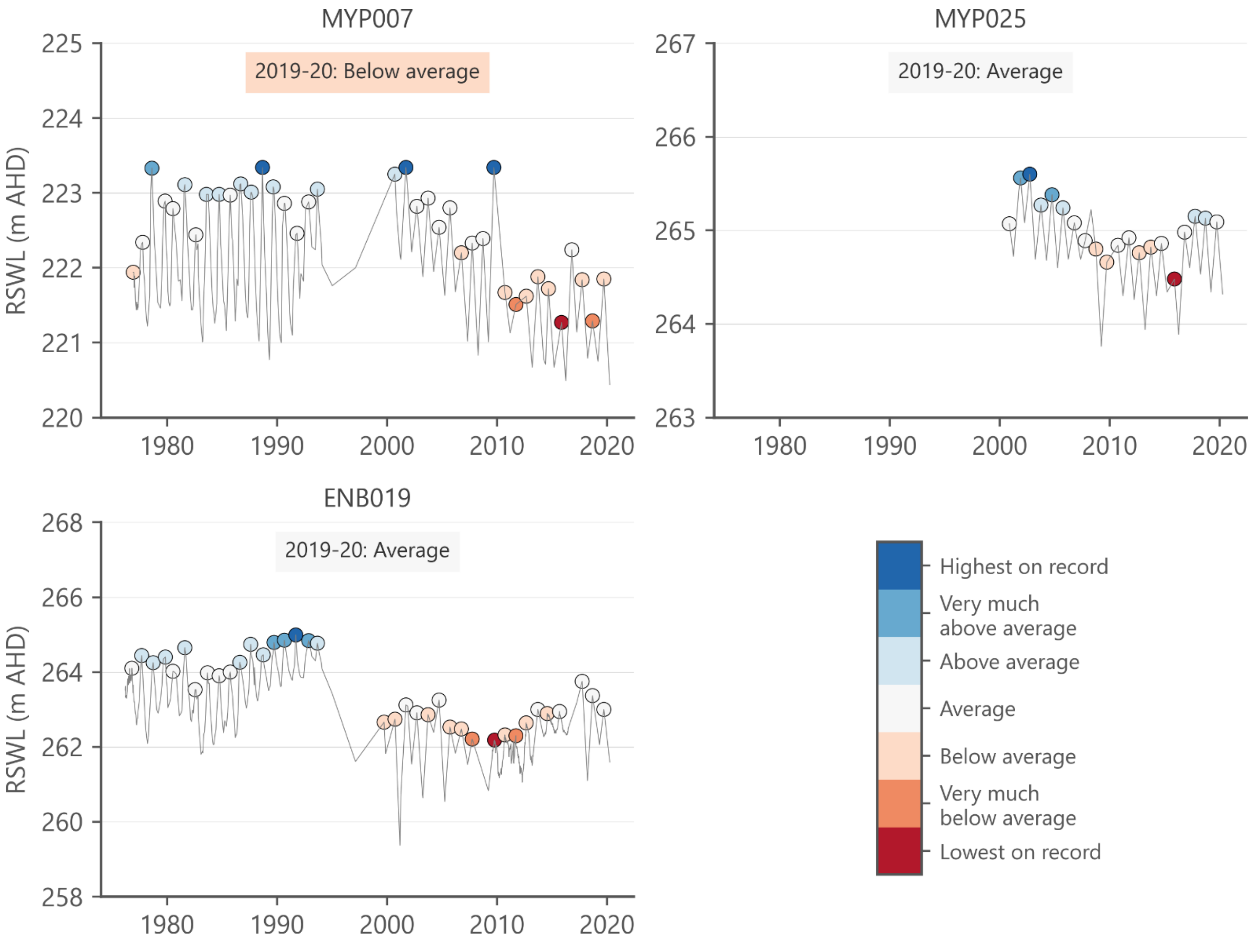

Figure 5.8. Selected hydrographs for the Permian Sand aquifer

5.5 Tertiary limestone aquifer – water level

Following the 2018–19 irrigation season, water levels observed in the majority (88%) of Tertiary limestone aquifer monitoring wells were average when compared to their historic records (Figure 5.9).

The change in water level over the last 30 years in wells with suitable long-term records ranged from a decline of 1.05 m to a rise of 0.48 m (the median change is a decline of 0.05 m).

Five-year trends (2015–2019) in water levels are declining in the majority of wells (62%), while an increasing trend was observed in 38% of the wells. The wells with rising five-year trends are all located in Myponga Basin. Rates of change in water levels range from a decline of 0.73 m/y to a rise of 0.36 m/y (the median change is declining at 0.09 m/y (Figure 5.10).

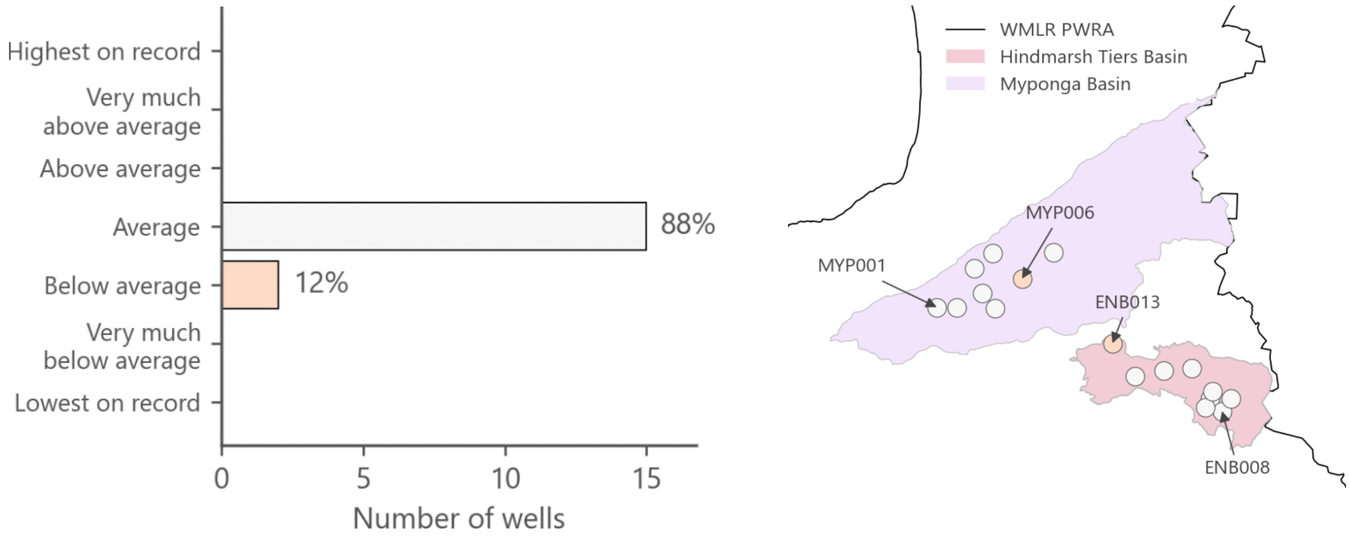

Figure 5.9. 2019 recovered water levels for wells in the Tertiary limestone aquifer

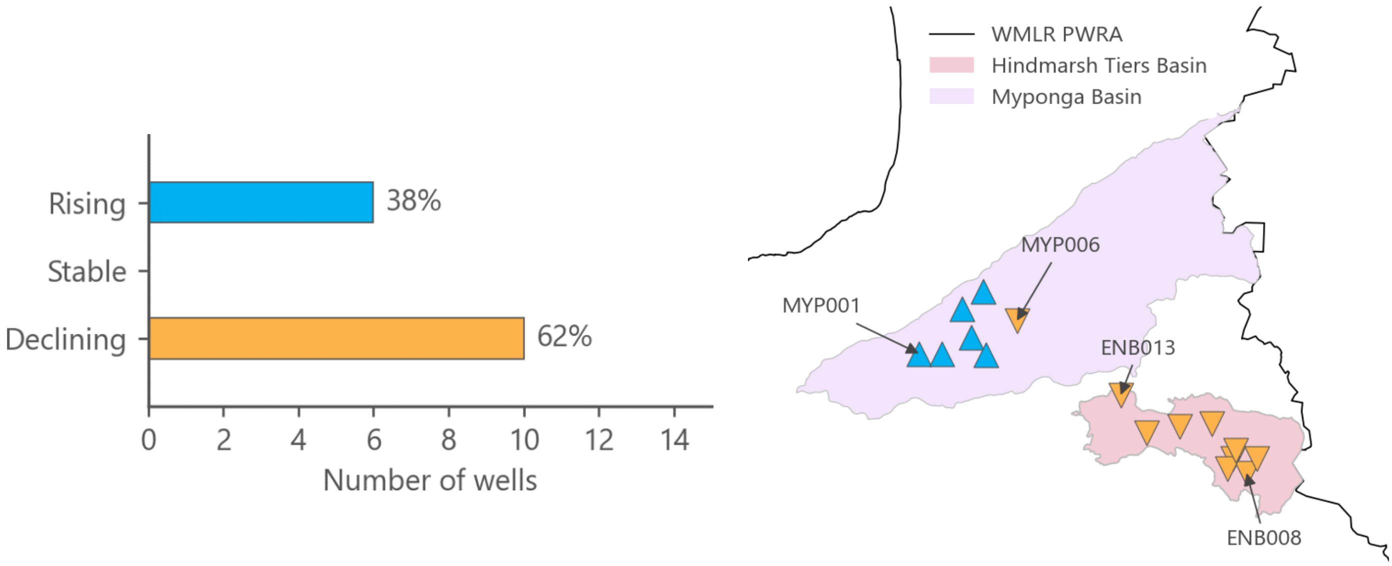

Figure 5.10. 2015-2019 trend in recovered water levels for wells in the Tertiary limestone aquifer

Figure 5.11 shows representative hydrographs from a selection of monitoring wells in the Tertiary limestone aquifer. Groundwater levels display large seasonal variations due to extractions from the aquifer because the Tertiary limestone is confined within the Myponga and Hindmarsh Tiers Basins. Groundwater levels in the Myponga Basin have remained stable since monitoring began in 1975, with a period of lower-than-average levels between 2005 and 2009 (MYP001 and MYP006).

In the Hindmarsh Tiers Basin, groundwater level has declined steadily since 1975 at ENB008 located at the eastern side of the basin followed by a rise until 2016. The increase in groundwater levels may be attributed to the wetter conditions in the 2009 to 2011 period, particularly the unusually wet summer of 2010–11. An average groundwater level was recorded in 2019. At the western side of the basin, ENB013 water levels have remained relatively stable since monitoring began in 1975.

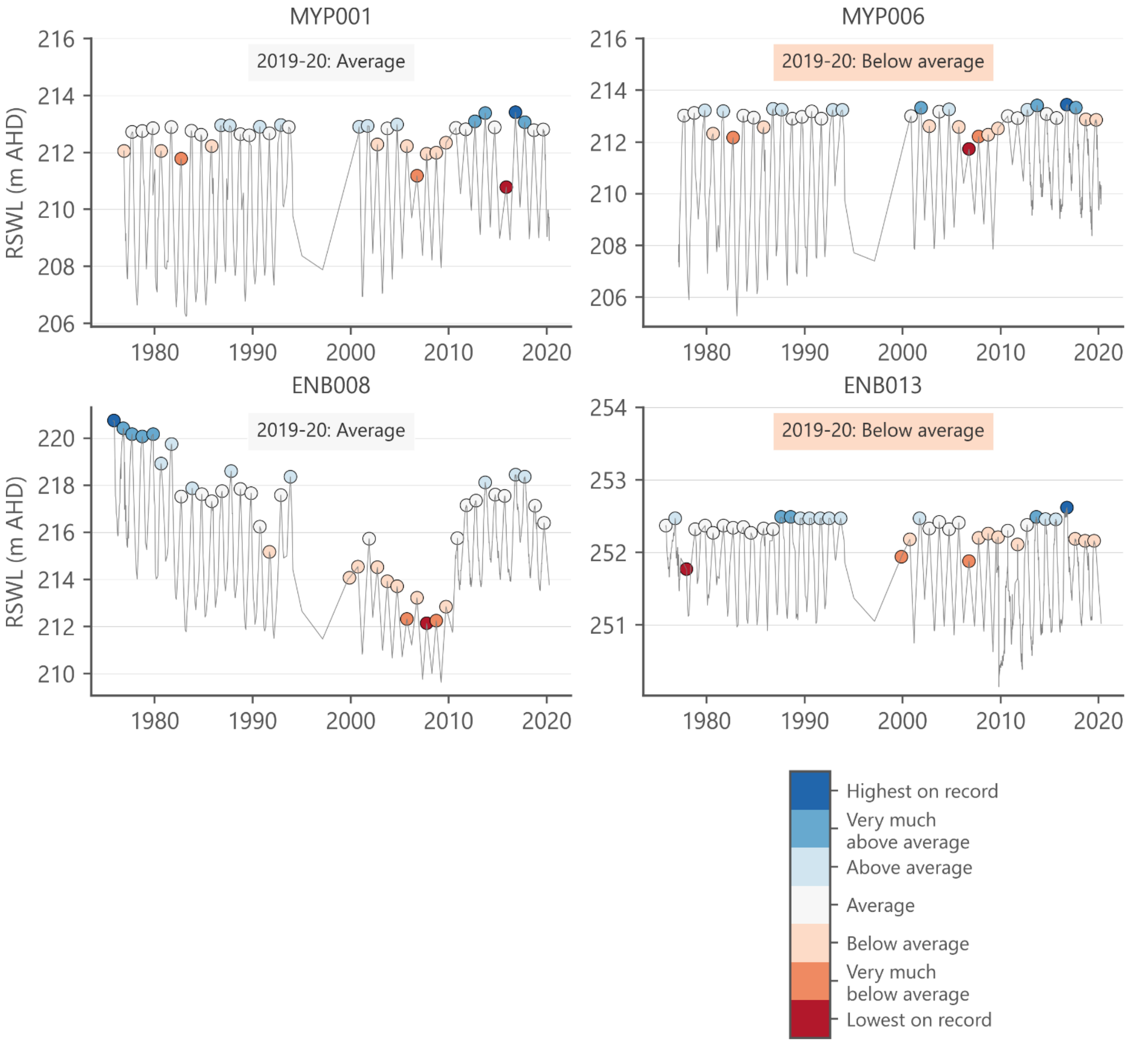

Figure 5.11. Selected hydrographs for wells in the Tertiary limestone aquifer

6 Water use

According to the WMLR WAP (AMLR NRM Board 2013), the prescribed area contains approximately 11 500 wells (2860 are recorded as stock and domestic wells), 13 000 dams and 250 watercourse extraction points. The PWRA contains eight water supply reservoirs distributed throughout the Little Para River, South Para River, River Torrens, Onkaparinga River and Myponga River catchments.

Demand for water includes crop irrigation (particularly viticulture), animal farming, mining, forestry, aboriginal water needs, commercial, industrial, town water supply and recreational uses. There is a high demand for consumptive use of the water resources in the PWRA, but the ecological importance has also been recognised. The watercourses, wetlands and swamps (including the Fleurieu Peninsula swamps) are of high conservation significance.

The total volume of water used in 2018–19 was 99 895 ML (Figure 317816.1). This includes only:

- Metered groundwater extraction across the WMLR PWRA (Figure 6.2); and
- Surface water volumes discussed below in Section 6.1.

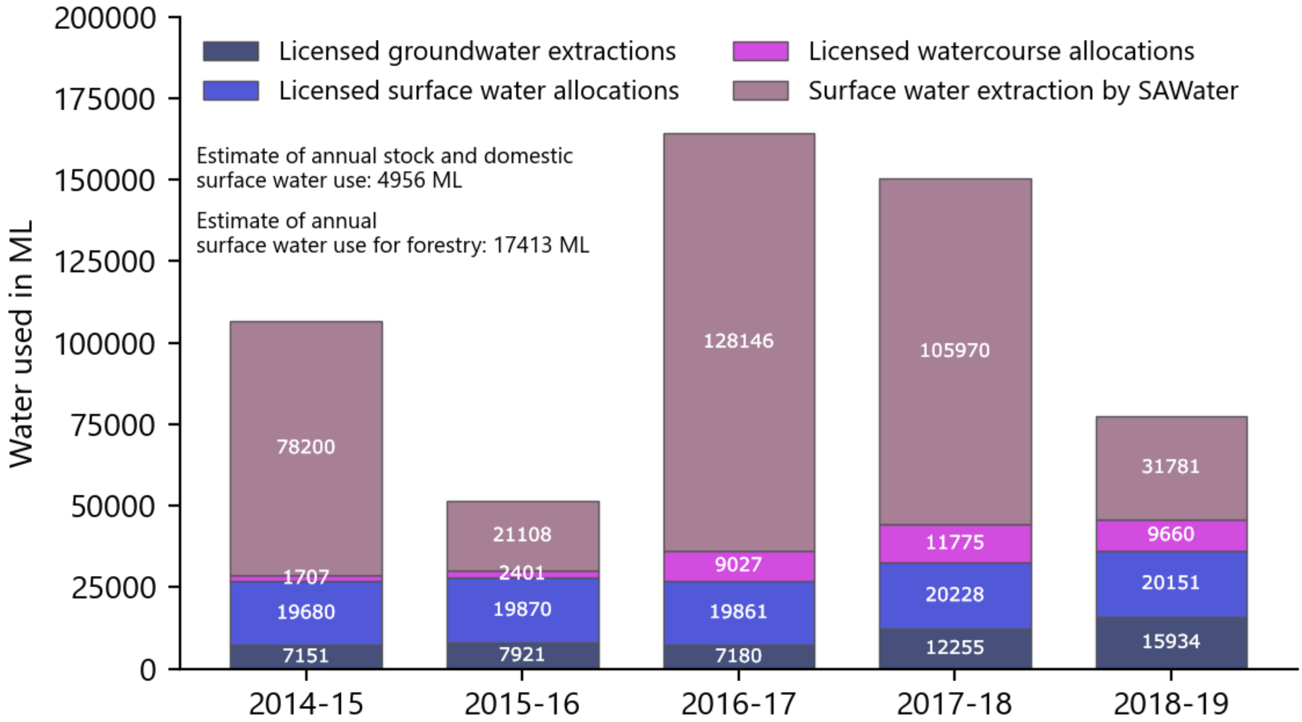

Figure 317816.1. Water used from 2004–05 to 2018–19 for the WMLR PWRA

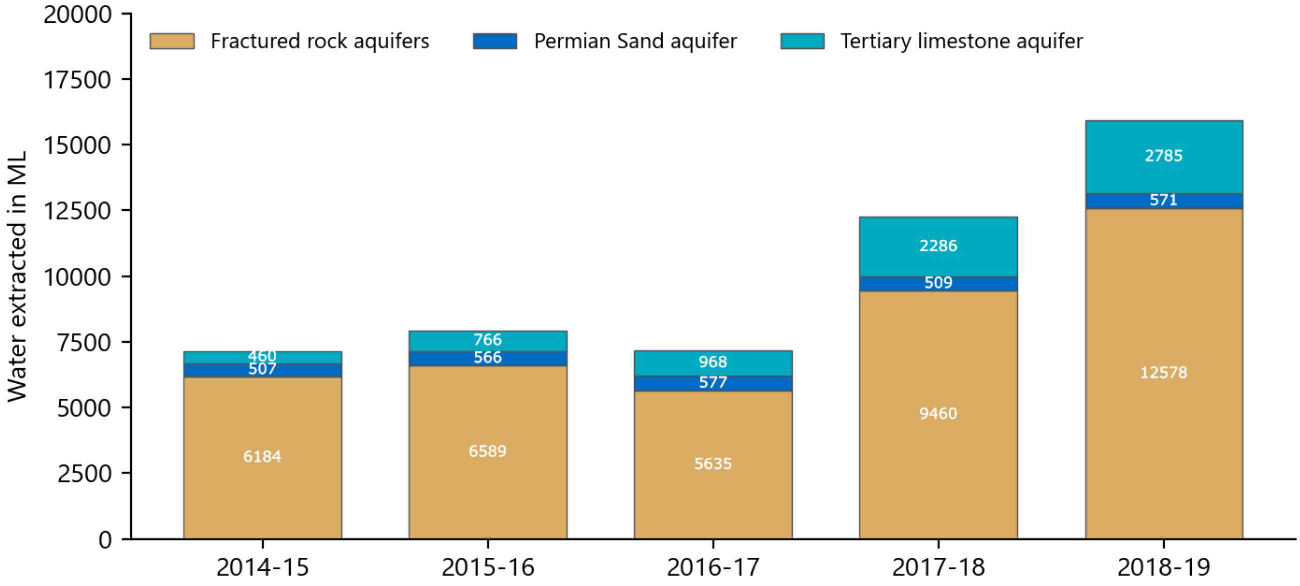

Figure 6.2. Metered groundwater extraction in aquifers of the prescribed areas of the WMLR

6.1 Surface water use

Surface water use in the WMLR PWRA is not comprehensively metered, therefore in this report licence allocations are used to provide an indication of the volumes of water being used where metered data is not available.

In 2018–19, the total surface water allocation for the WMLR PWRA was estimated to be 83 961 ML (compared to 160 342 ML in 2017–18). This consists of:

- 20 151 ML from licensed surface water sources (dams).
- 9660 ML from licensed watercourse sources.
- 4956 ML water demand for stock and domestic, which is not required to be licensed. This is approximated at 30% of dam capacity and is based on analysis in the water allocation plan (AMLR NRM Board, 2013).
- 17 413 ML from plantation forestry. This is based on analysis in the water allocation plan (AMLR NRM, 2013).
- 31 781 ML from SA Water extraction (compared to 105 970 ML in 2017–18). SA Water's extraction is related to rainfall. In high rainfall years, SA Water extracts the majority of its public water supply from the WMLR, while in dry years the River Murray provides a larger percentage of SA Water's total extraction. This data is based on metered values. These values are shown in Figure 317816.1.

6.2 Groundwater use

Groundwater is extracted for a range of purposes, such as irrigation of crops, town water supply and stock and domestic use. Water taken for irrigation and town water supply is metered and is managed through a water licensing system. Water taken for stock and domestic purposes is exempt from this requirement.

In 2018–19, a total volume of 15 934 was extracted from all groundwater resources across the area (Figure 6.2). Of this total:

- 79% was extracted from the fractured rock aquifer.
- 4% from the Permian Sand aquifer in the Myponga and Hindmarsh Tiers Basins.
- 17% was from the Tertiary limestone aquifer In the Myponga and Hindmarsh Tiers Basins.

6.3 Farm Dams

Based on the information contained in the WMLR WAP (AMLR NRM Board 2013), there are approximately 13 000 farm dams in the PWRA. 1700 of these are used for licensed purposes and the remainder are for stock and domestic or other non-licensed purposes. The total capacity of non-licensed dams is 16 516 ML, and the estimated total surface water demand for stock and domestic use is approximately 4956 ML.

The Onkaparinga River catchment is one of the main water supply catchments in the WMLR. Detailed analysis of the farm dams in the catchment (Figure 6.3) shows that there are 3476 farm dams (764 licensed) in the Onkaparinga with a total storage capacity of 14 605 ML. Approximately 84% of dams in the Onkaparinga have a storage capacity of less than 5 ML, while contributing to only 24% of the total storage capacity. Larger dams (5 ML or greater capacity) make up only 16% of the total dam count but account for 76% of total storage capacity.

Farm dam density in the WMLR PWRA is shown in Figure 6.3. Average farm dam density for the Onkaparinga upstream of Mount Bold is 35 ML/km^2. This is high compared to some of the other catchments across the WMLR: River Torrens upstream of the Gumeracha weir (26 ML/km^2), Little Para upstream of the gauging station A5040503 (13 ML/km^2) and South Para (10 ML/km^2). Dam density varies greatly across the catchment, with headwater zones and high rainfall areas such as Lenswood Creek and the Western Branch sub-catchment having much higher farm dam density (>58 ML/km^2) in comparison to some downstream receiving zones like Cox Creek (6 ML/km^2).

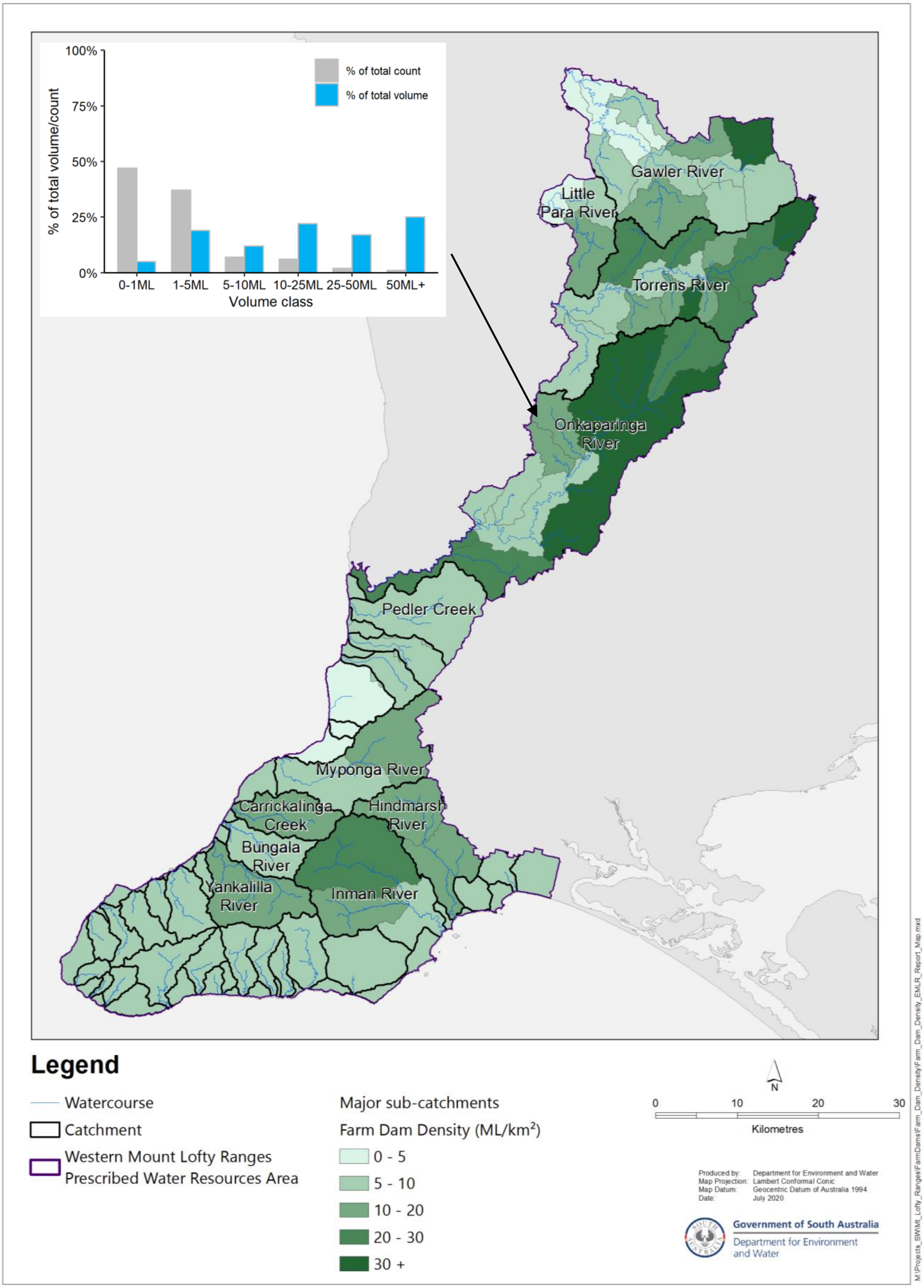

Figure 6.3. Farm dam density in the WMLR PWRA (Inset: farm dam volume and count in the Onkaparinga River catchment)

7 References

AMLR NRM Board (2013). Water Allocation Plan Western Mount Lofty Ranges Prescribed Water Resources Area, Government of South Australia, Department of Environment, Water and Natural Resources, Adelaide and Mount Lofty Ranges Natural Resources Management Board, South Australia.

Barnett SR and Zulfic D (1999). Mount Lofty Ranges groundwater assessment – Piccadilly Valley, Report Book 99/00001, Primary Industries and Resources South Australia, Adelaide.

Barnett SR and Zulfic D, 2000, Mount Lofty Ranges groundwater assessment - portions of Torrens Rural Catchment, Report Book 99/00019, Primary Industries and Resources South Australia, Adelaide.

Barnett SR and Rix R (2006). Southern Fleurieu Groundwater Assessment DWLBC Report 2006/24, Department of Water, Land and Biodiversity Conservation, Adelaide.

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

DEW (2019b). Western Mount Lofty Ranges Prescribed Water Resources Area 2018 Groundwater status report, Government of South Australia, through Department for Environment and Water, Adelaide.

DEWNR (2011). Western Mount Lofty Ranges PWRA Groundwater Level and Salinity Status Report 2011, Government of South Australia, through Department of Environment, Water and Natural Resources, Adelaide.

DEWNR (2014). Western Mount Lofty Ranges PWRA Surface Water Status Report 2012–13, Government of South Australia, through Department of Environment, Water and Natural Resources, Adelaide.

Green G, Banks E, Wilson T and Love A (2007). Groundwater recharge and flow investigations in the Western Mount Lofty Ranges, South Australia, DWLBC Report 2007/29, Department of Water, Land and Biodiversity Conservation, Adelaide.

Penney, D., Braithwaite, H., Alcorn, M. and Savadamuthu, K. (2020).Construction and calibration of hydrological models for six water supply catchments across the Western Mount Lofty Ranges. DEW Technical report 2020/XX, Government of South Australia, Department for Environment and Water, Adelaide (in prep).

Zulfic D, Barnett SR, and van den Akker J (2002). Mount Lofty Ranges Groundwater Assessment, Upper Onkaparinga Catchment. South Australia. Department of Water, Land and Biodiversity Conservation, Adelaide.

Zulfic D (2006). Mount Lofty Ranges groundwater assessment — South Para River Catchment, DWLBC report 2005/41, Department of Water, Land and Biodiversity Conservation, Adelaide.

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