Marne Saunders Prescribed Water Resources Area
2018-19 water resources assessment

Department for Environment and Water
November, 2020

DEW Technical report 2020/29

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Department for Environment and Water

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Contents

1 Summary

Rainfall

- Rainfall typically ranges from 280 mm on the Murray Plains at the eastern boundary of the Marne Saunders Prescribed Water Resources Area (PWRA) to 800 mm in the higher elevations at the western boundary.
- Rainfall across the region was lower than average in 2018–19. Rainfall at Keyneton was 357 mm in 2018–19, 30% below average, while rainfall at Cambrai was 204 mm, 29% below average. This pattern was consistently observed across the PWRA. Long-term data trends indicate a decline in rainfall.
- Lower-than-average conditions were observed in early winter and spring 2018 and very dry conditions in summer 2018–19.

Surface water

- There are two principal streamflow gauging stations operational in the PWRA: Marne River at the Marne Gorge and the Saunders Creek, both of which recorded the lowest streamflow on record in 2018–19. Long-term data trends show a decline in streamflow.
- No streamflow has been recorded at the Marne Gorge gauging station since November 2017 and only 8 ML of flow was recorded at the Saunders Creek streamflow gauging station in 2018–19.
- No salinity data was recorded at the Marne Gorge streamflow gauging station due to insufficient flow recorded at the site.

Groundwater

- Water levels in the fractured rock aquifer system range from below average to lowest on record compared to their historic levels, with a median well level of 'very much below average'
- Water levels in the Murray Group Limestone are mostly at their lowest on record compared to their historic levels
- 12 (75%) of the 16 monitoring wells had lowest on record water levels in 2018–19 compared to historic levels. 3 wells were below average and 1 was very much below average.
- The majority of irrigation wells with salinity data show stable or decreasing salinities over the period 2015–19 (more than 80% of wells in each aquifer).

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 mains network.
- Water used for consumptive purposes in 2018–19 was 2803 ML, which includes 113 ML imported from the River Murray. Water sourced from within the PWRA included 334 ML from licensed surface water sources, 496 ML from non-licensed surface water demand and 1860 ML from licensed groundwater.

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 Marne Saunders 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 Marne Saunders PWRA is located along the northern extent of the Mount Lofty Ranges and is approximately 70 km north-east of Adelaide (Figure 1.1). The upper catchment of the PWRA is located in the Northern and Yorke Landscape Region, while the majority of the area occurs within the Murraylands and Riverland Landscape Region.

It is a regional-scale resource for which groundwater and surface water are prescribed under South Australia's Landscape SA Act 2019. A water allocation plan adopted in 2010 provides rules for the management of the water resources. The Murraylands and Riverland Landscape Board is responsible for the implementation and review of the plan.

The PWRA is located within the Murray-Darling Basin and is characterised by undulating hills and valleys with high rainfall to the west. The east is largely defined by flat plains with localised hills and rocky outcrops throughout with very low rainfall. The main watercourses within the PWRA are the ephemeral Marne River and Saunders Creek, which have their headwaters in the Mount Lofty Ranges. Groundwater is located in two types of aquifer, the fractured rock aquifers found in the hills area and the sedimentary aquifers found in the plains.

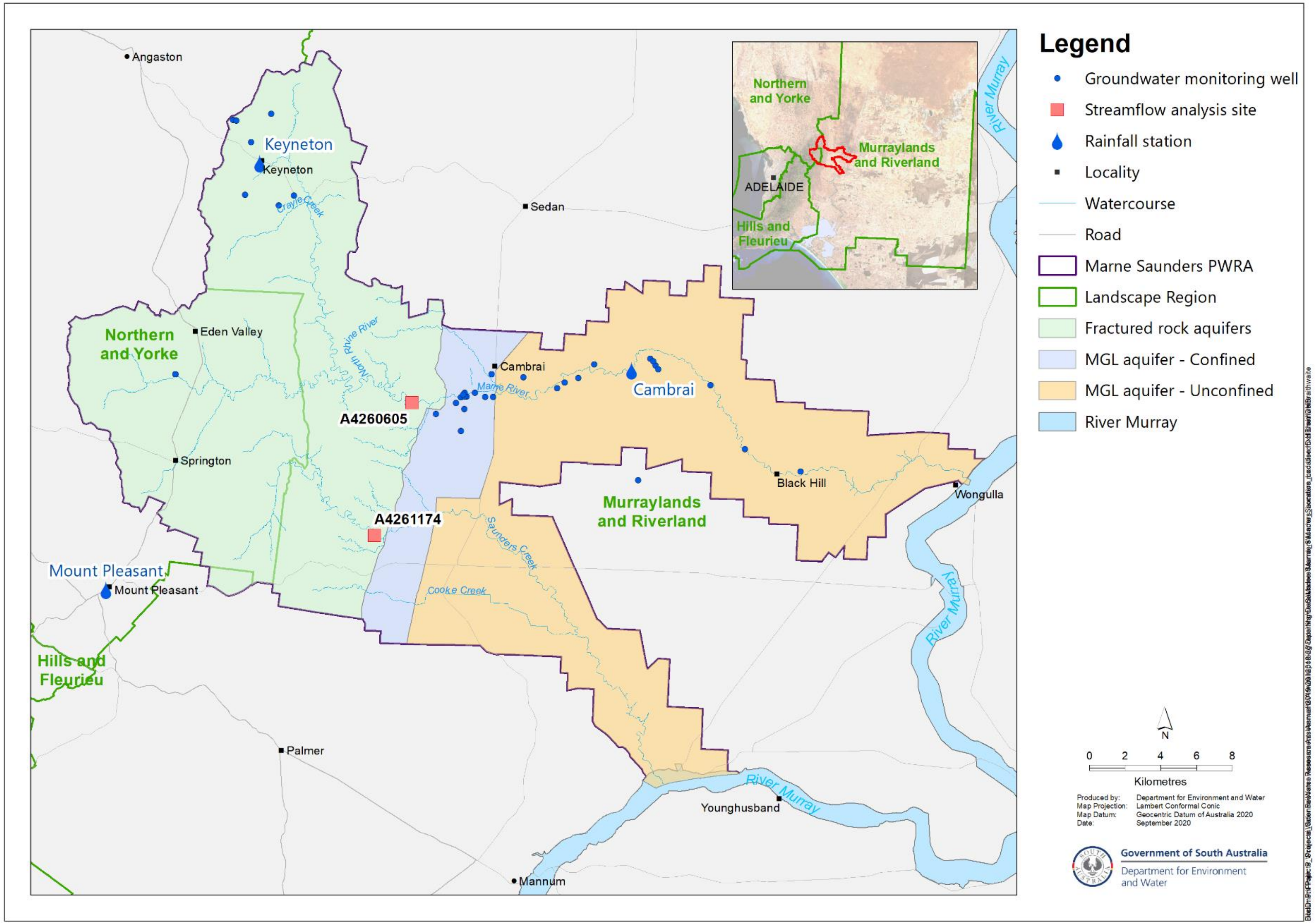


Figure 1.1. Location of Marne Saunders PWRA, including the extent of the Murray Group Limestone aquifer

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 3.4).

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 Marne River streamflow gauging station is 1973–74 to 2018–19. Streamflow data were then given a description based on their percentile and decile[1] (Table 2.1 and Figure 4.1).

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 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), 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).

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). However, no salinity was recorded at the Marne Gorge streamflow gauging station due to insufficient flow at the site.

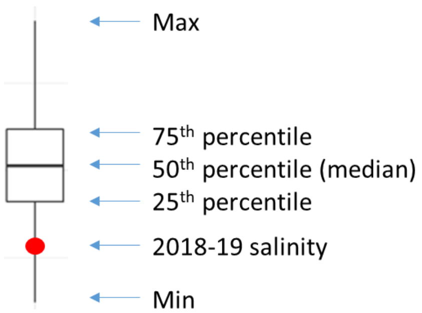


Figure 2.1 Box and whisker plot

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 Marne Saunders PWRA return to a recovered maximum level between July 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 Marne Saunders PWRA, any well with 10 years or more of recovered water level

[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).

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) and 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 and the status of 'stable' is intended to allow for demarcation of wells where water levels are changing at very low rates and would normally be considered stable, and also to accommodate very small human or instrument 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

Water samples from pumping irrigation wells are provided to DEW by licence holders in the Marne Saunders 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.

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 for each resource (e.g. Figure 5.4).

2.4 Water use

Meter readings are used to calculate 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 to 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, 2010). 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 Marne Saunders PWRA are:

- Summary reports on the surface water (DEWNR, 2014) and groundwater resources of the Marne Saunders PWRA (DEWNR, 2011), and annual surface water status reports such as DEW (2019a) and groundwater level and salinity status reports such as DEW (2019b, c);
- The Water Allocation Plan for the Marne Saunders Prescribed Water Resources Area (SAMDB NRM Board, 2019);
- Zulfic and Barnett (2002) provides detailed background of the hydrogeology of the Saunders Creek catchment and Barnett et al. (2001) on the Marne River catchment;
- Banks et al. (2006) provides information on groundwater recharge and flow processes in the Upper Marne River catchment;
- Harrington (2004) studied interaction between groundwater and surface water systems at lower reaches of Marne River near Black Hill; these studies were completed to support water planning in the Marne Saunders PWRA and the Eastern Mount Lofty Ranges PWRA;
- Penney et al. (2019) detail the surface water modelling to support South Australia's requirements under the Murray Darling Basin Plan in the Eastern Mount Lofty Ranges Water Resources Plan area;
- Savadamuthu (2002) assesses the impact of farm dams on streamflow in the Upper Marne catchment;
- Alcorn (2009) provides a surface water assessment of the Upper Saunders Creek catchment.

3 Rainfall

Rainfall is highest at the western edge of the Marne Saunders PWRA in the higher elevations, where the annual average rainfall ranges from 650–750 mm. Rainfall declines towards the east in the rain shadow of the Mount Lofty Ranges, down to approximately 250–300 mm at the eastern boundary of the PWRA on the Murray Plains.

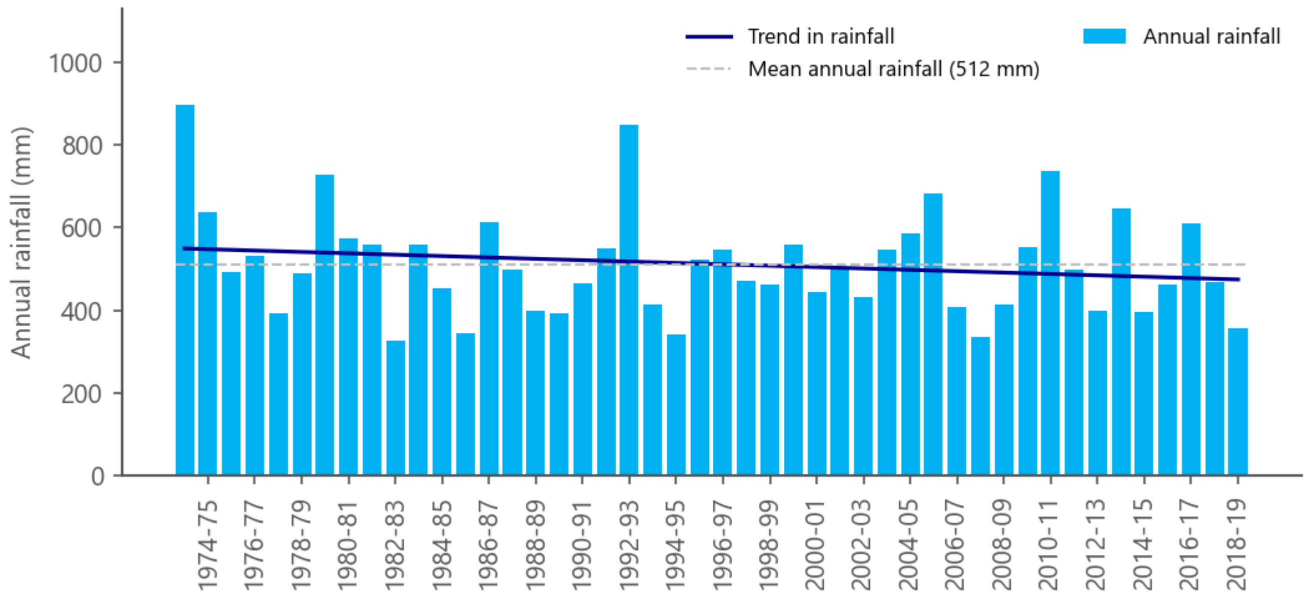


Figure 3.1. Annual rainfall for 1973–74 to 2018–19 at the Keyneton rainfall station (23725)

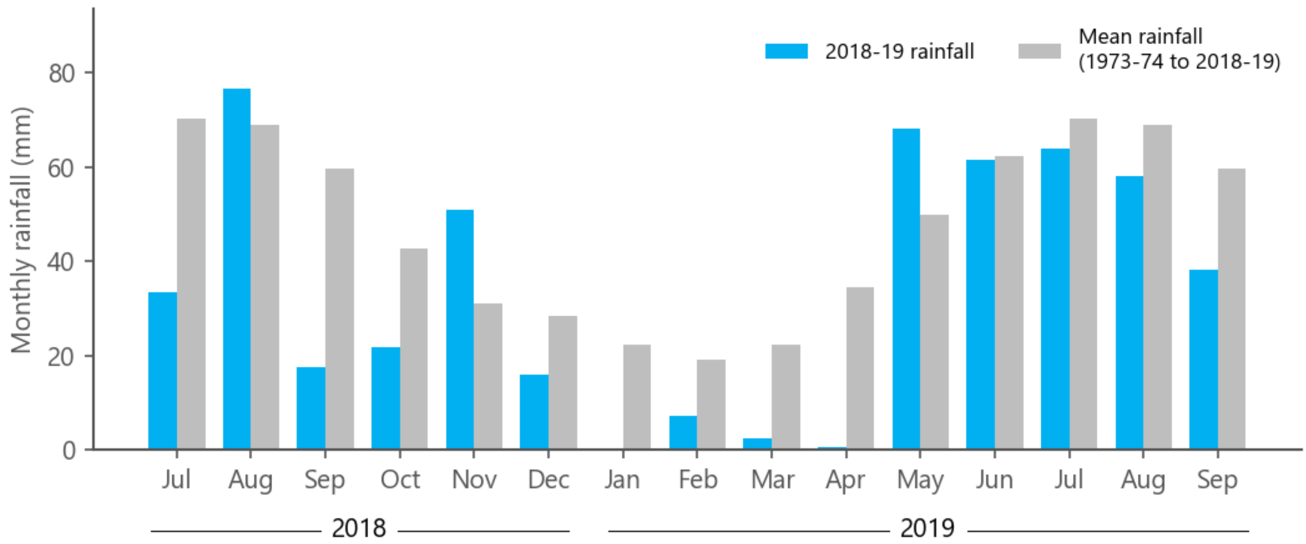


Figure 3.2. Monthly rainfall between July 2018 and September 2019 at the Keyneton rainfall station (23725)

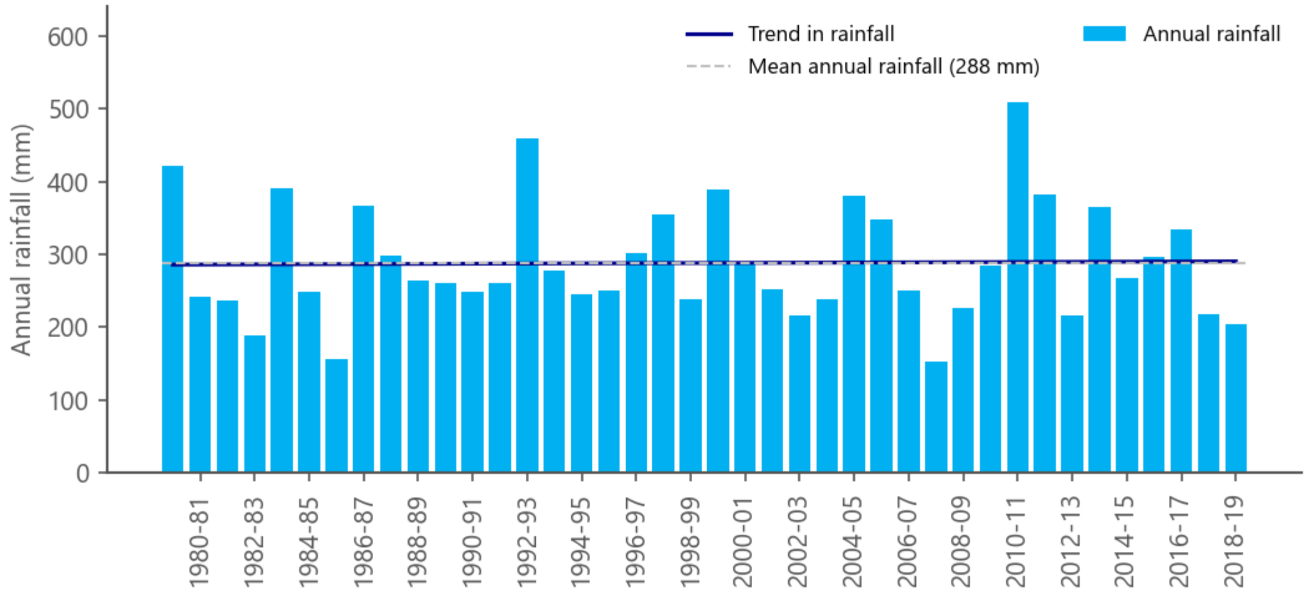


Figure 3.3. Annual rainfall for 1979–80 to 2018–19 at the Cambrai (Kongolia) rainfall station (24513)

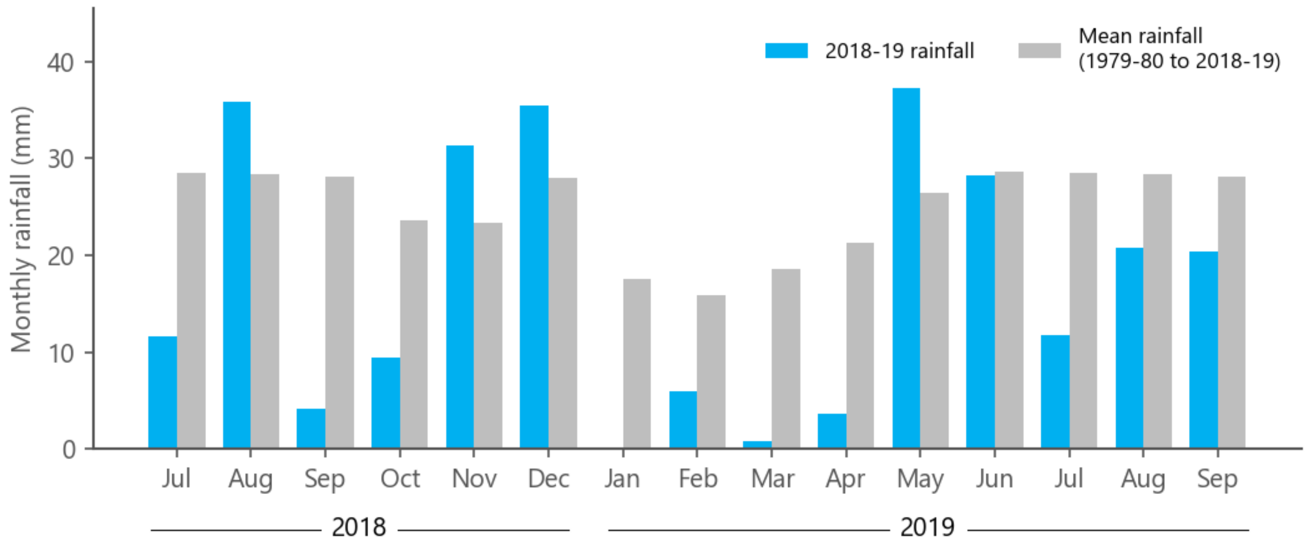


Figure 3.4. Monthly rainfall between July 2018 and September 2019 at the Cambrai (Kongolia) rainfall station (24513)

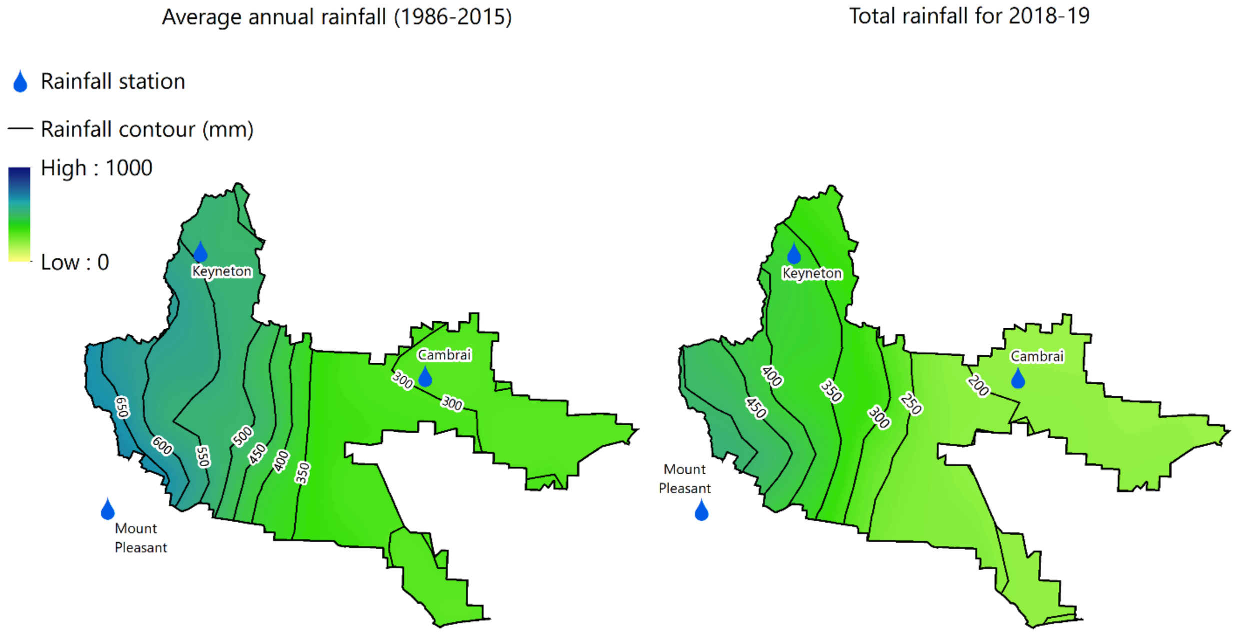


Figure 3.5. Rainfall in the Marne Saunders PWRA for 2018–19 compared to the standard 30-year climatological average (1986-2015)

- Keyneton rainfall station (BoM station 23725) represents the higher rainfall areas of the PWRA in the Mount Lofty Ranges. The annual total recorded for 2018–19 was 357 mm. This was 155 mm lower than the average annual rainfall of 512 mm (1973–74 to 2018–19). The long-term trend is decreasing over this period (Figure 3.1). Below-average rainfall was observed during 4 of the last 5 years.
- Cambrai (Kongolia) rainfall station (BoM station 24513) represents the lower rainfall areas of the Murray Plains. The annual total recorded for 2018–19 was 204 mm. This was 84 mm lower than the average annual rainfall of 378 mm (1979–80 to 2018–19). The long-term trend is stable over this period (Figure 3.3).
- Lower-than-average rainfall was also observed at other rainfall stations within and close to the PWRA. Mount Pleasant is located 5km outside of the western boundary and recorded an annual total of 487 mm in 2018–19. This was 142 mm lower than the average annual rainfall of 629 mm (1073–74 to 2018–19).
- Drier-than-average conditions were observed throughout the 2018–19 period with the 2018 winter having lower rainfall than the 2019 winter (Figure 3.2 and Figure 3.4). The spring and summer months were also extremely dry in comparison to the long-term average (Figure 3.2 and Figure 3.4). However, in May 2019, both Keyneton and Cambrai (Kongolia) rainfall stations recorded rainfall higher than the average monthly rainfall.
- 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 (greater than 650 mm) being present near Springton in the north-west of the PWRA, whereas these rainfall bands were not present in 2018–19[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 main watercourses within the PWRA are the ephemeral Marne River and Saunders Creek. They have their headwaters in the Mount Lofty Ranges, draining in an easterly direction across the Murray Plains, where the majority of the flow is lost to groundwater, before discharging into the River Murray.

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 Marne Saunders PWRA.

Two streamflow gauging stations are used as representative stations when assessing streamflow in the Marne Saunders PWRA (Figure 1.1):

- Marne Gorge (A4260605) on the Marne River, located 5 km west of Cambrai.
- Saunders Creek (A4261174), located north of the township of Sanderston.

In 2018–19, lower-than-average streamflow was recorded at the two gauging stations (Figure 4.1) with both of them recording 'lowest on record' streamflow. Further detail on the methodology used for analysis can be found in Section 2.

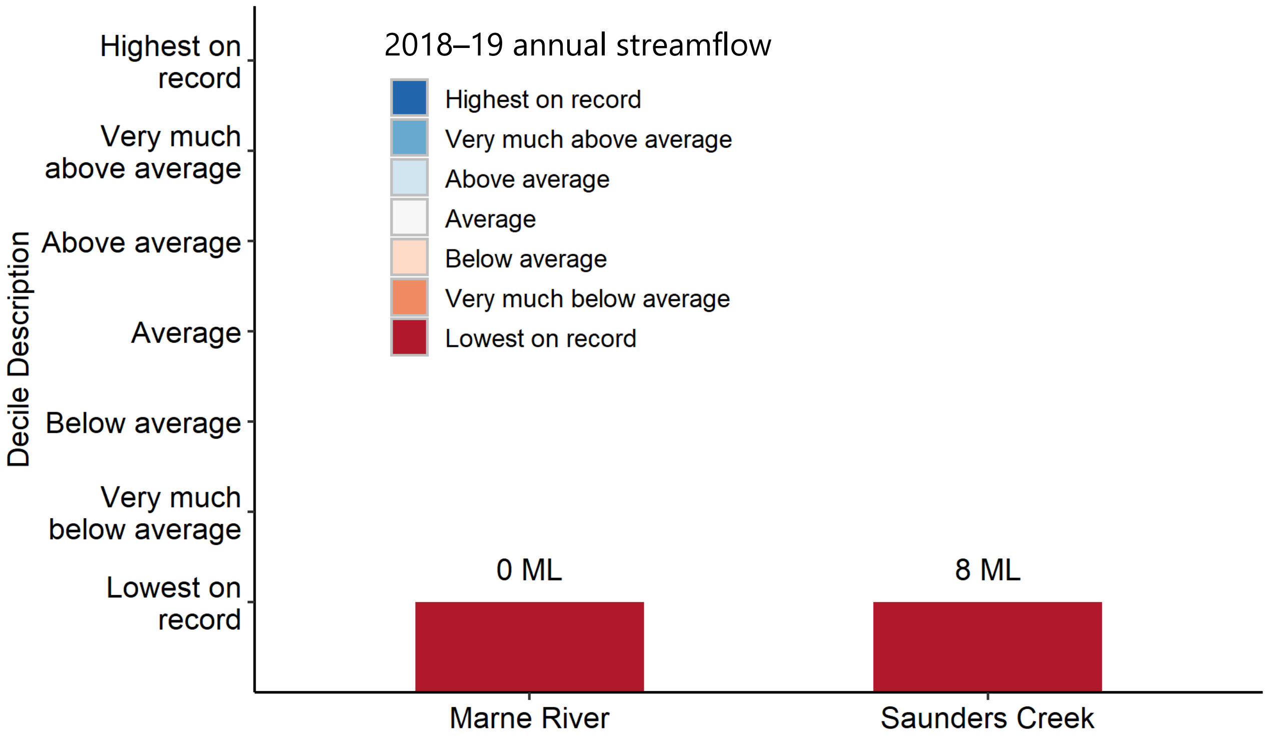


Figure 4.1 Marne Saunders PWRA annual streamflow summary 2018–19

4.1.1 Marne River: Marne Gorge (A4260605)

The principal long-term streamflow gauging station for the PWRA is located on the Marne River at the Marne Gorge. The station is located at the foothills of the Mount Lofty Ranges where the Marne River begins to flow across the Murray Plains, and covers a catchment area of 238 km^2.

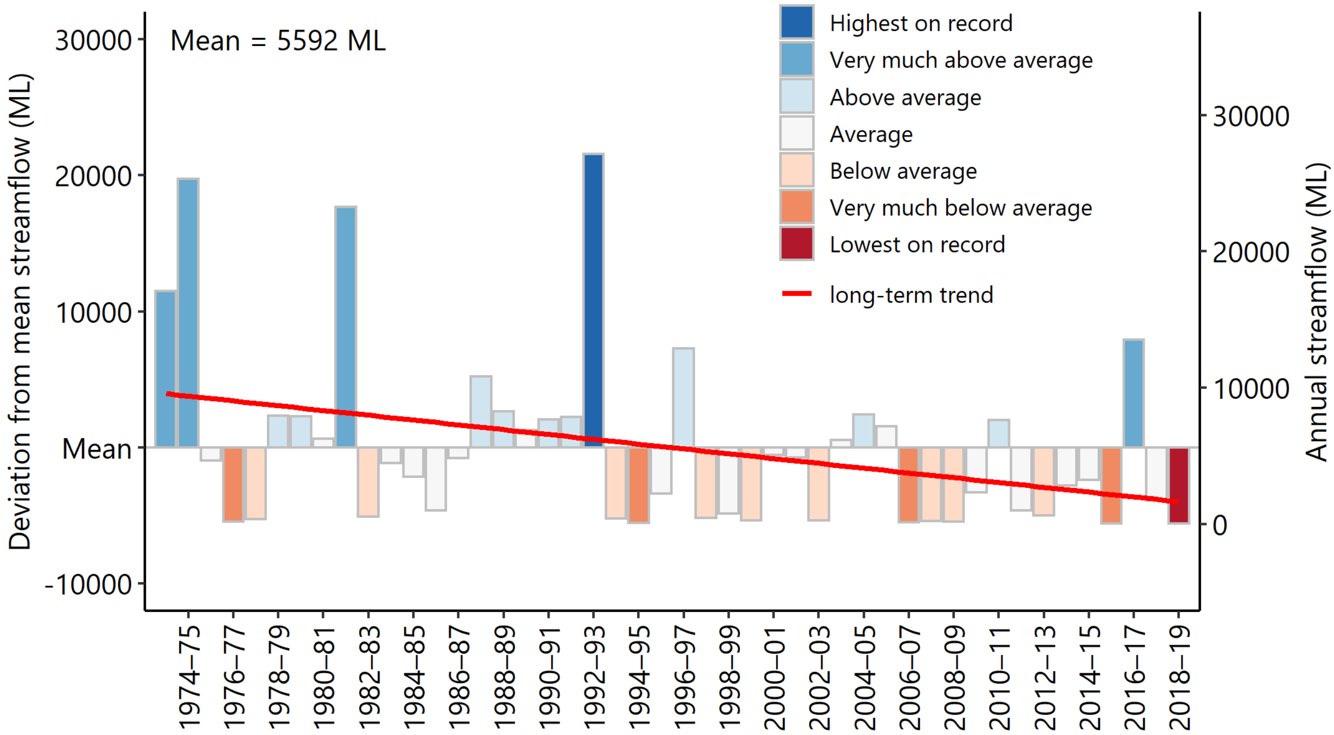


Figure 4.2 Annual deviation from mean streamflow at the Marne Gorge (1973–74 to 2018–19)

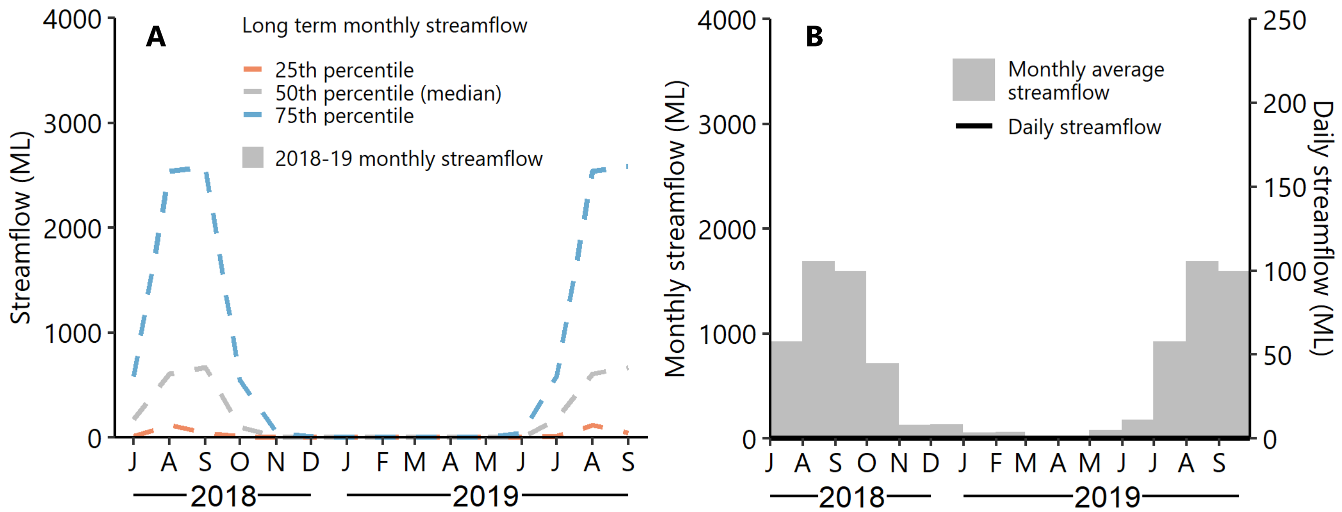


Figure 4.3 (A) Long-term monthly statistics and 2018–19 monthly streamflow at the Marne Gorge; (B) Long-term average monthly streamflow and 2018–19 daily streamflow at the Marne Gorge

The deviation of each individual year's streamflow from the long-term average streamflow (1973–74 to 2018–19) is shown in Figure 4.2. The streamflow gauging station at the Marne Gorge has not recorded any streamflow since November 2017.

The annual total is ranked as 'lowest on record' assessed for the period 1973–74 to 2018-19. Annual streamflow on the Marne River indicates a long-term declining trend with 4 out of the last 5 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 (1973–74 to 2018–19) for (a) low flows (25^{th} percentile), (b) median flows (50^{th} percentile) and high flows (75^{th} percentile). Historically, the majority of streamflow in the Marne Saunders PWRA occurs between July and October and typically accounts for approximately 90% of the total annual flow in any given year. However, all months were drier than average (and below the 25^{th} percentile streamflow) in 2018–19 due to zero flow recorded. In the period from July to September 2019, flows remained below the recordable range and there continued to be no flow recorded.

Figure 4.3B presents the long-term average monthly streamflow (1973–74 to 2018–19) and the daily flows for 2018–19. All days in 2018–19 were zero flow days.

The Saunders Creek station recorded an annual total of 8 ML in 2018–19, which was predominantly between July-September 2018. This was also ranked as 'lowest on record'.

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.

Surface water salinity in areas such as the Marne and Saunders catchments may be affected by a range of processes including dryland salinity, irrigation-induced salinity, impacts from dams via evaporative concentration and reduction in dilution when fresh runoff is captured. Salinity is recorded at the both the Marne Gorge and Saunders Creek streamflow gauging station in PWRA. Figure 4.4 shows the long-term salinity statistics for the period 2002–18 at the Marne Gorge gauging station.

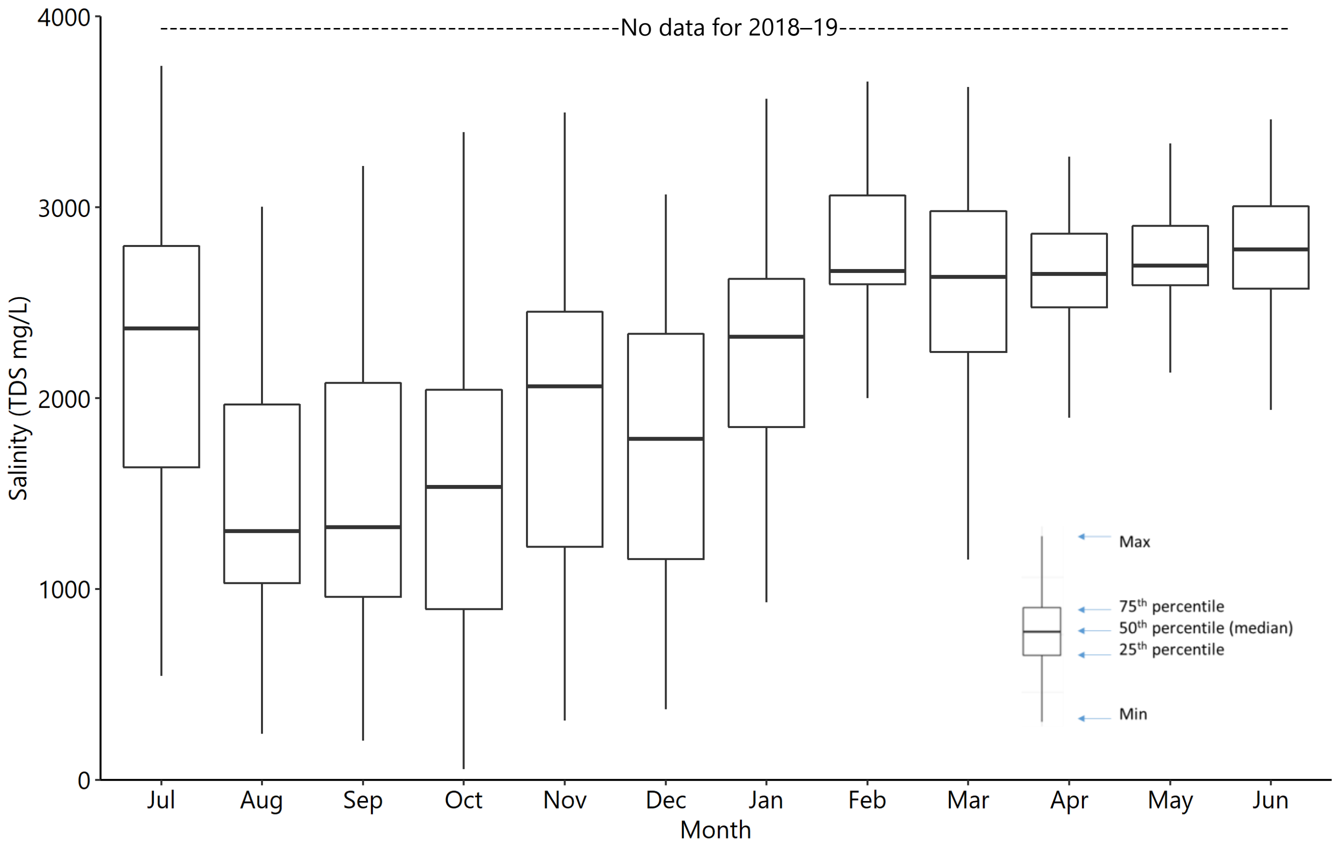


Figure 4.4 Long-term monthly salinity at Marne Gorge streamflow gauging station (A5060500)

Salinity in the Marne River at the Marne Gorge streamflow gauging station is generally lower than observed at the Saunders Creek gauging station and is typically less than 2500 mg/L for the majority of the data period. The long-term monthly data at this site indicates a higher variability in the winter months than the summer month, which is indicated by the greater range between the minimum and maximum values. This is likely due to the larger flow variability in the winter. No salinity values were recorded for 2018–19 due to insufficient streamflow experienced at the site. Salinity data collected at the Saunders Creek monitoring site from 2010 shows that 70% of the data is greater than 2500 mg/L. Limited streamflow occurred during 2018–19 but despite this, the highest salinity recorded was 6075 mg/L.

5 Groundwater

5.1 Hydrogeology

The Marne Saunders PWRA can be divided into two distinct groundwater regions; the Hills Zone and the Plains Zone. The Hills Zone comprises the consolidated basement rocks of the Mount Lofty Ranges, which form fractured rock aquifers while the Plains Zone is underlain by unconsolidated Quaternary and Tertiary sediments. This report focuses on fractured rock aquifers and Tertiary Murray Group Limestone (MGL) aquifer.

The movement of groundwater within the catchment generally follows topographic contours, flowing from high points to low points where discharge into streams occurs. Groundwater also moves eastward from the Ranges and discharges to the sedimentary aquifers of the Plains Zone. Recharge to the fractured rock aquifers of the Hills Zone occurs by rainfall percolation through the soil profile or exposed bedrock.

5.1.1 Fractured rock aquifers

Fractured rock aquifers of the Hills Zone comprise micaceous and feldspathic sandstones and siltstones of the Cambrian-aged Kanmantoo Group. The metamorphic rocks form fractured rock aquifers that are generally tight and impermeable with few fractures and joints to store and transmit groundwater. Consequently, boreholes produce relatively lower yields of ~2 L/s. The majority of metered groundwater use from the fractured rock aquifers is spread across the eastern extent of the aquifer with the majority of users in the vicinity of Keyneton, Eden Valley and Springton.

5.1.2 Murray Group Limestone aquifer

The MGL aquifer is highly fossiliferous and sandy with solution cavities present. This aquifer is confined in the west where it is overlain by the Quaternary-aged Pooraka Formation next to the Hills Zone and becomes unconfined east of Cambrai where the Pooraka Formation pinches out. The MGL aquifer is overlain by Quaternary sediments and underlain by the Ettrick Formation and the Renmark Group. Recharge to the MGL aquifer comes laterally from the adjacent basement rocks in the Hills Zone and from streamflow during flood periods where it is unconfined. Groundwater extraction from this aquifer mainly occurs along the Marne River for irrigation.

5.2 Fractured rock aquifers – water level

Following the 2018–19 irrigation season, 50% of fractured rock aquifer monitoring wells with long-term data recorded their lowest water level on record. These wells are located at Keyneton in the northwestern part of the aquifer (Figure 5.1). Further south, at Eden Valley, a below-average level was observed at JTL004.

Water levels over the last 20 years, in wells with suitable long-term records, declined in all wells ranging from 0.32 m to 3.07 m (the median change is a decline of 2.47 m).

Five-year trends in water levels are declining in all wells, with rates of decline ranging from 0.11 m/y to 0.56 m/y (the median rate of decline is 0.27 m/y) (Figure 5.2).

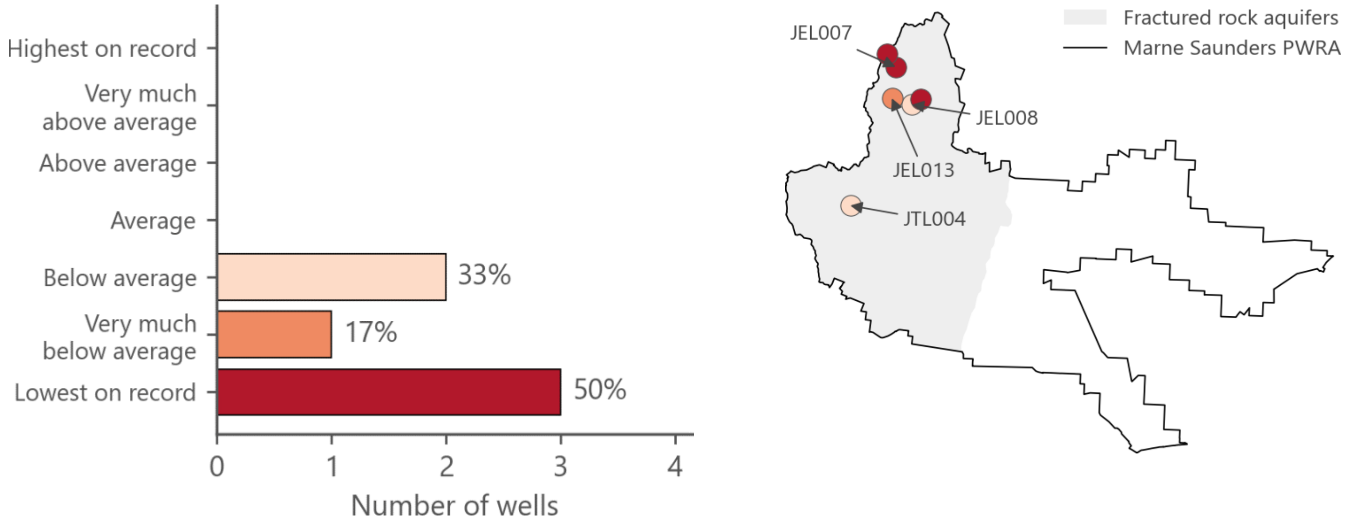


Figure 5.1 2019 recovered water levels for wells in the fractured rock aquifers

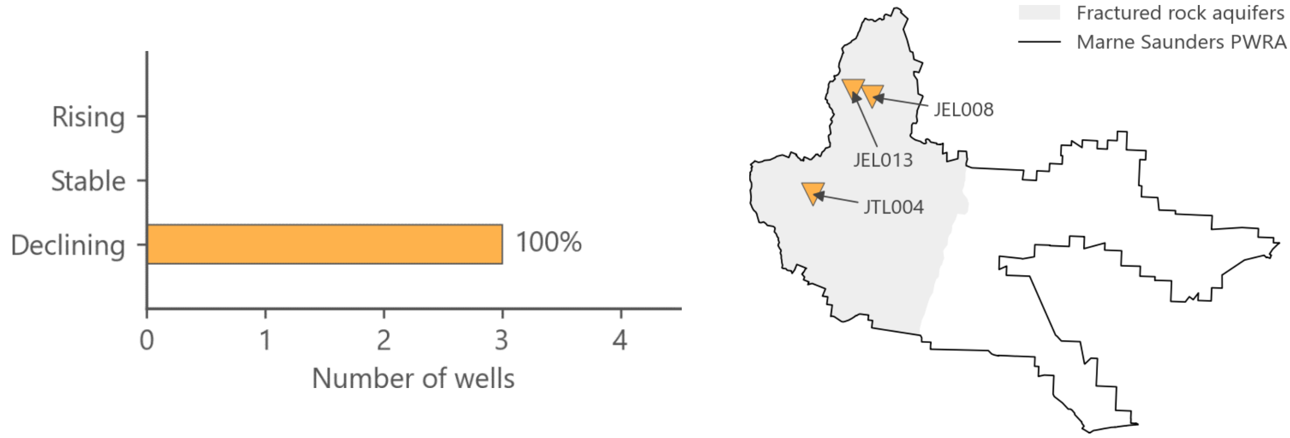


Figure 5.2 2015-2019 trend in recovered water levels for wells in the fractured rock aquifers

Figure 5.3 shows hydrographs from a selection of fractured rock aquifer monitoring wells. Regional trends in the fractured rock aquifer in the Hills Zone generally reflect rainfall trends, with groundwater levels rising in wet years (e.g. 2016–17).

Monitoring wells JEL013 and JEL007 are located near Keyneton in the north-western part of the aquifer. Groundwater levels have reduced gradually since the 1990s in this area as a result of decreased rainfall. Groundwater levels recorded in 2019 are similar to levels experienced at the end of the Millennium Drought in 2009.

The well JTL004 is located further south at Eden Valley- monitoring commenced in 2006. The groundwater levels are relatively stable over the monitoring period with marginal responses to high rainfall events. The lowest levels were observed in 2009 which is likely due to reduced recharge over the drought period. In 2019, a below average water level was observed.

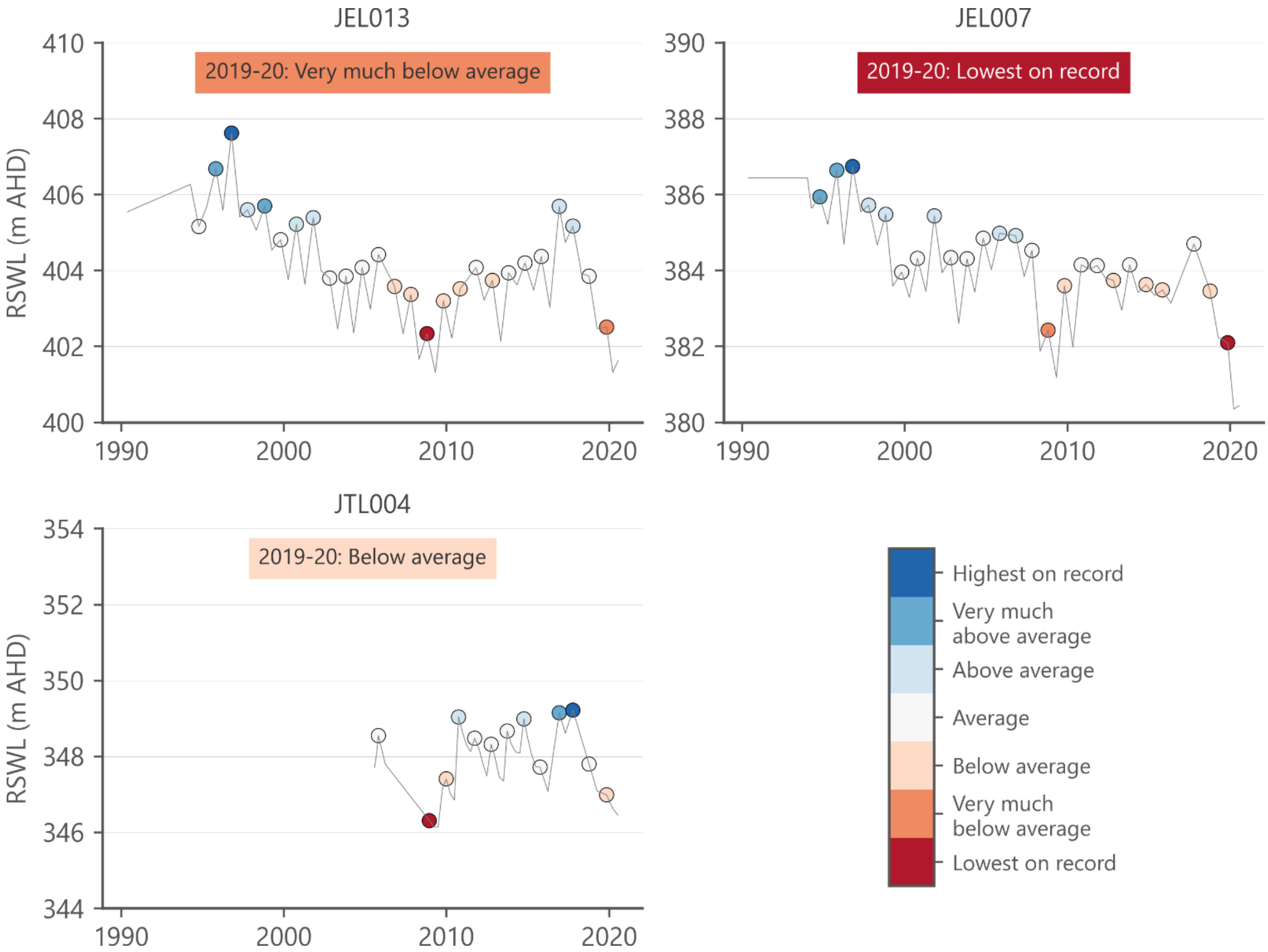


Figure 5.3 Selected fractured rock aquifers hydrographs

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. Since 2014, irrigators have submitted groundwater samples that DEW has tested for salinity. In 2019, results from 45 irrigation wells in the fractured rock aquifers ranged between 450 mg/L and 6302 mg/L with a median of 2227 mg/L (Figure 5.4).

In the five years to 2019, the majority of wells with available data showed stable (55%) or decreasing (27%) trends in salinity (Figure 5.5). Four wells (18%) showed an increasing trend in groundwater salinity, at rates ranging between 42 and 281 mg/L/y with a median increase of 166 mg/L/y.

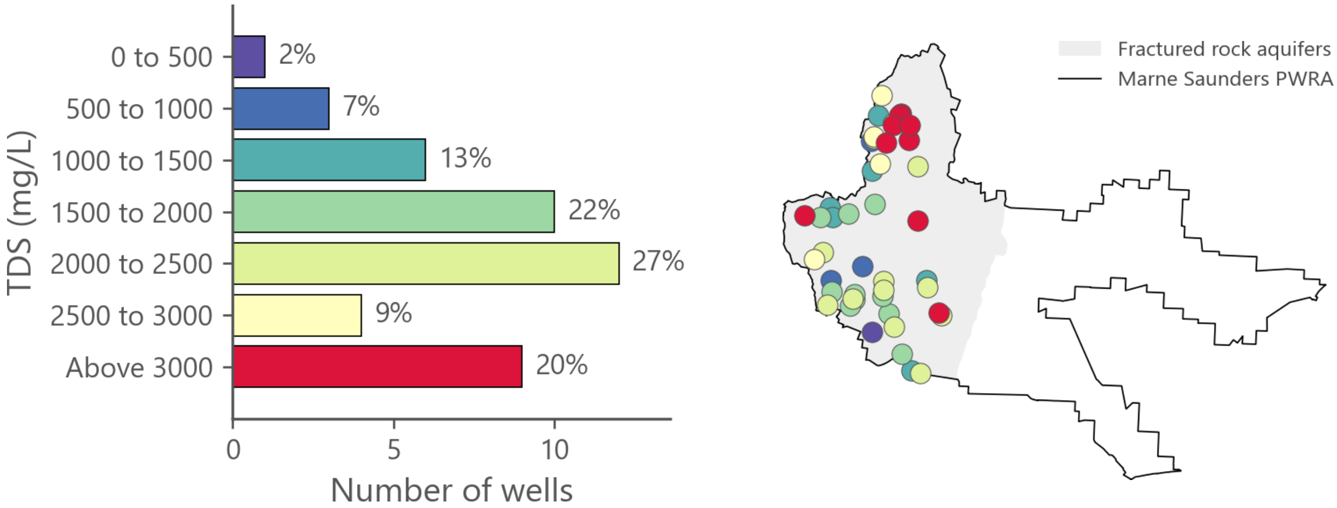


Figure 5.4. 2019 salinity observations from wells in the fractured rock aquifers

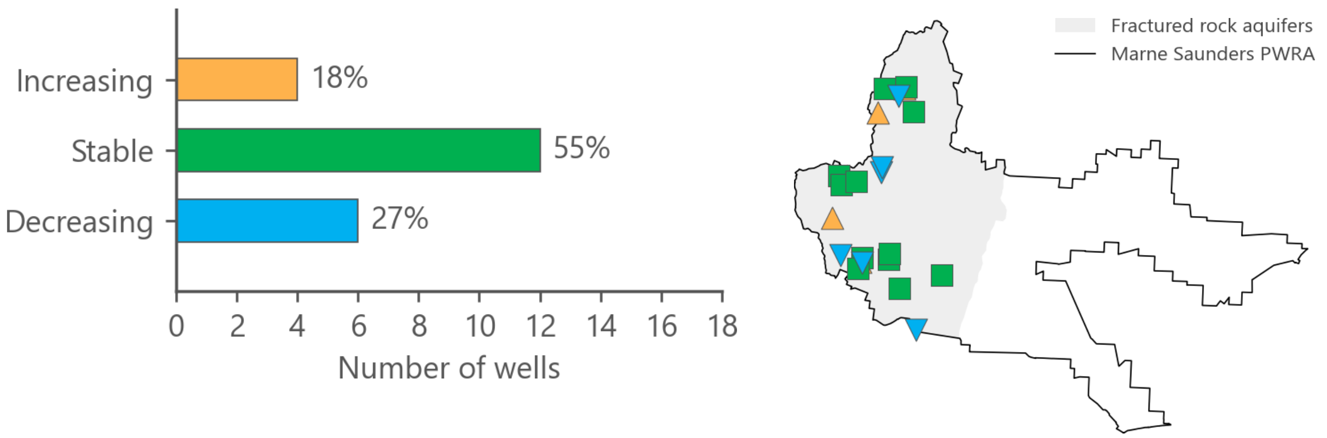


Figure 5.5 2015-2019 trend in groundwater salinities for wells in the fractured rock aquifers

5.4 Murray Group Limestone aquifer – water level

Following the 2018–19 irrigation season, all but one (90%) of the Murray Group Limestone aquifer monitoring wells recorded their lowest water level on record. These wells are primarily located along the Marne River valley (Figure 5.6).

Five-year trends in water levels are declining in all wells, with rates of decline ranging from 0.05 m/y to 2.13 m/y (the median rate of decline is 0.23 m/y) (Figure 5.7).

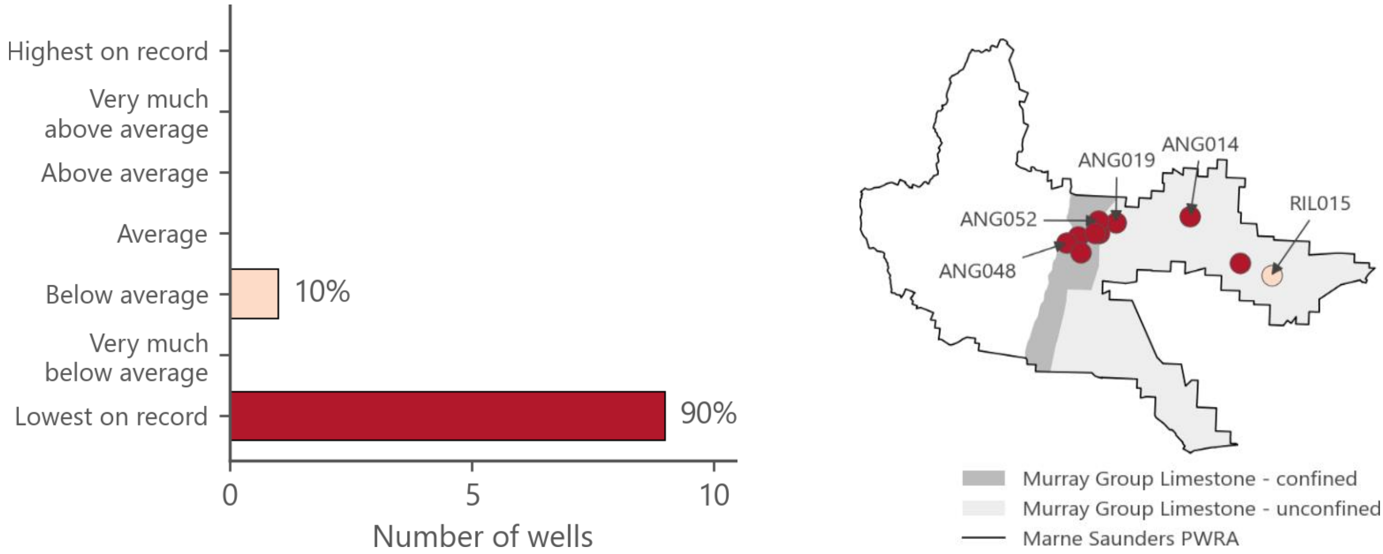


Figure 5.6 2019 recovered water levels for wells in the Murray Group Limestone aquifer

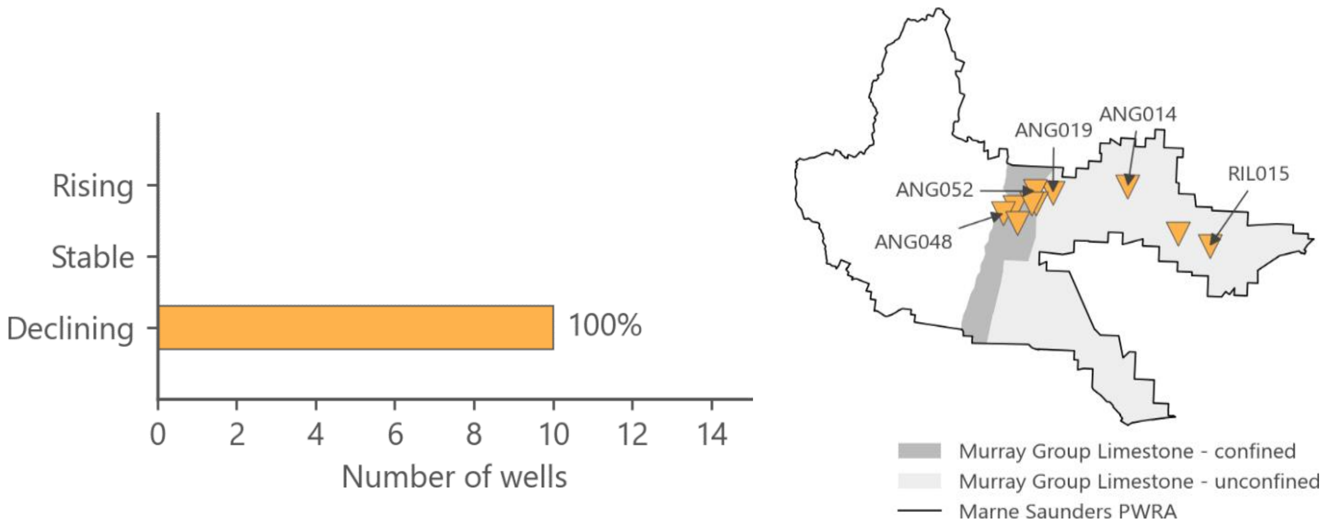


Figure 5.7 2015-2019 trend in recovered water levels for wells in the Murray Group Limestone aquifer

Figure 5.8 shows hydrographs from a selection of monitoring wells in the MGL aquifer. Monitoring wells ANG014 and RIL015 are located to the east of Cambrai where the aquifer is unconfined. They recorded a total decline of 3.32 m and 2.25 m over the last 15 years, respectively.

The aquifer is confined to the west of Cambrai and large seasonal fluctuations are visible at locations where the confining Pooraka Formation is greater in thickness (e.g. ANG048). Monitoring wells ANG052 and ANG019, located south and southeast of Cambrai, recorded a total decline of 2.94 m and 2.81 m over the last 15 years, respectively.

ANG048 is located near the western boundary of the aquifer and a considerable decline in winter water levels has occurred over the past four years. A total decline of 4.5 m has been recorded over the last 15 years.

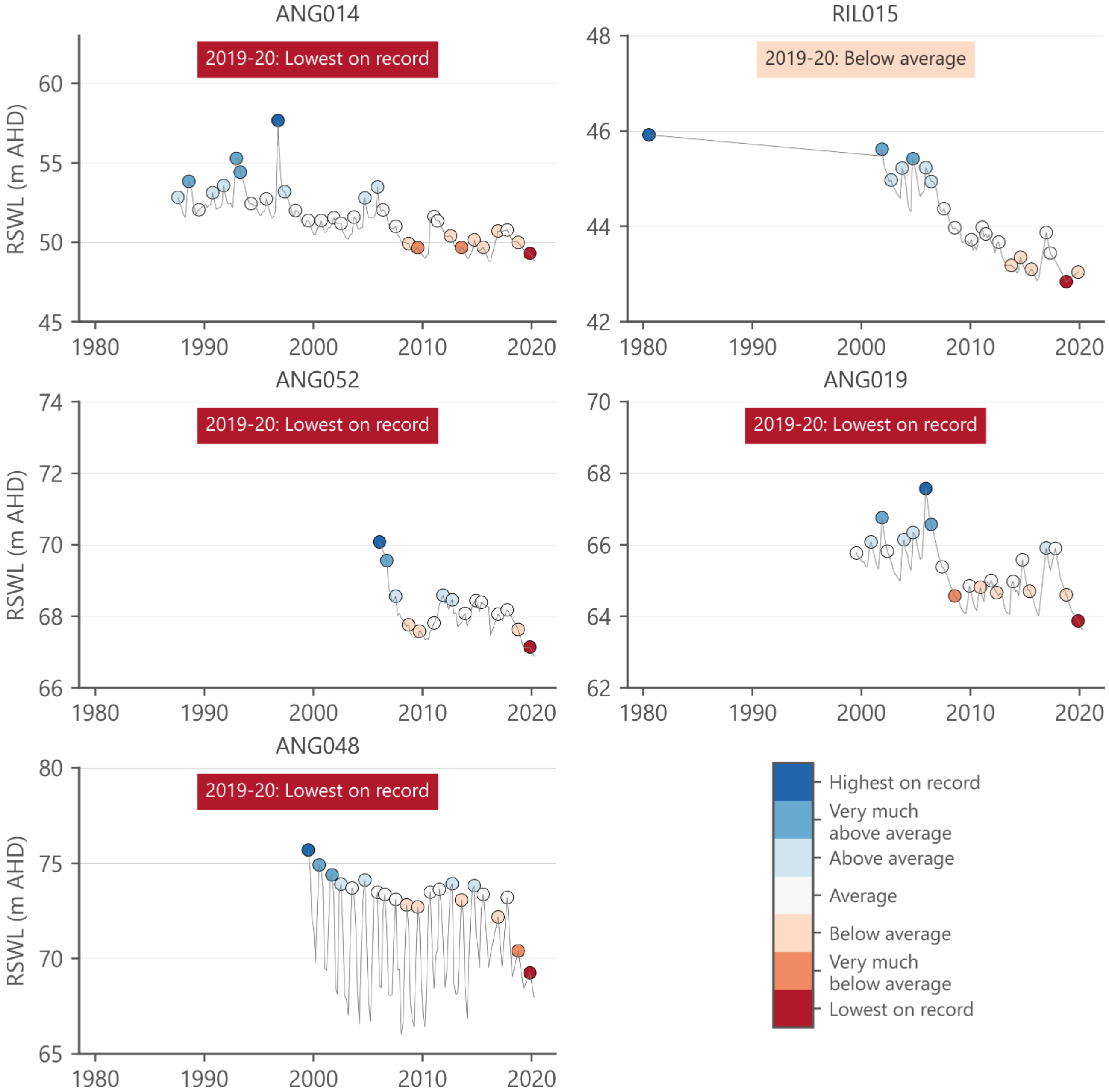


Figure 5.8 Selected Murray Group Limestone aquifer hydrographs

5.5 Murray Group Limestone aquifer – salinity

Since 2014, irrigators have submitted groundwater samples that DEW has tested for salinity. In 2019, results from 42 irrigation wells in the MGL aquifer ranged between 1121 mg/L and 2989 mg/L with a median of 1766 mg/L (Figure 5.9).

In the five years to 2019, the majority of wells with available data showed stable (18%) or decreasing (64%) trends in salinity. Two wells (18%) showed an increasing trend in groundwater salinity, at rates of 39 mg/L/y and 41 mg/L/y (Figure 5.10). Wells with available five-year data are only located in the unconfined portion of the aquifer, along the Marne River valley, at this point in time.

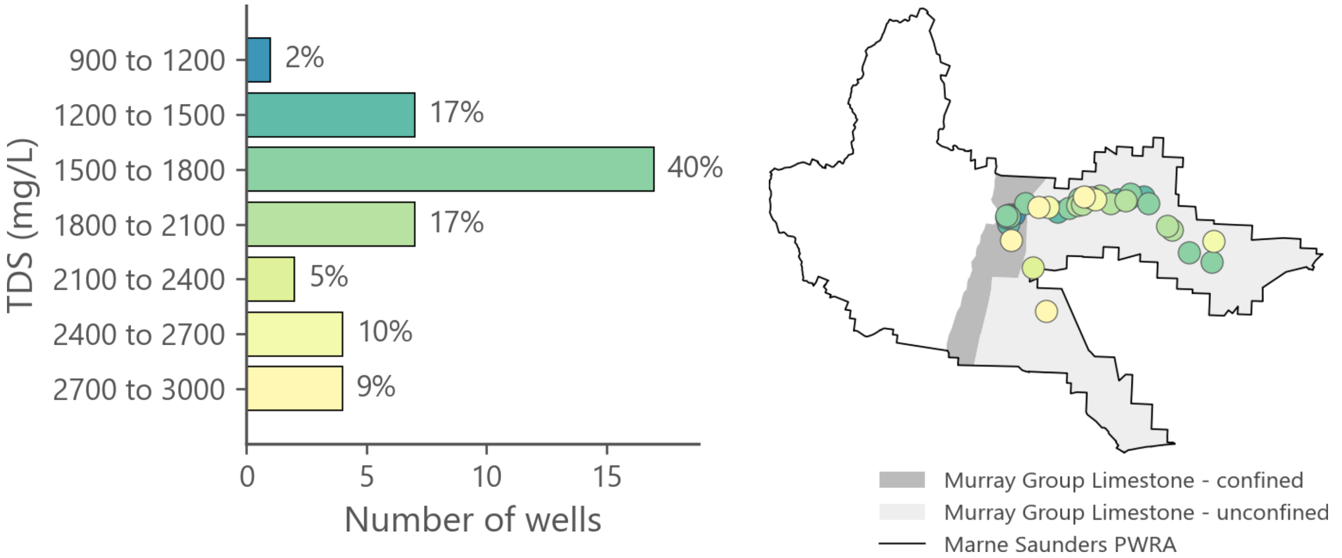


Figure 5.9. 2019 salinity observations from Murray Group Limestone aquifer wells

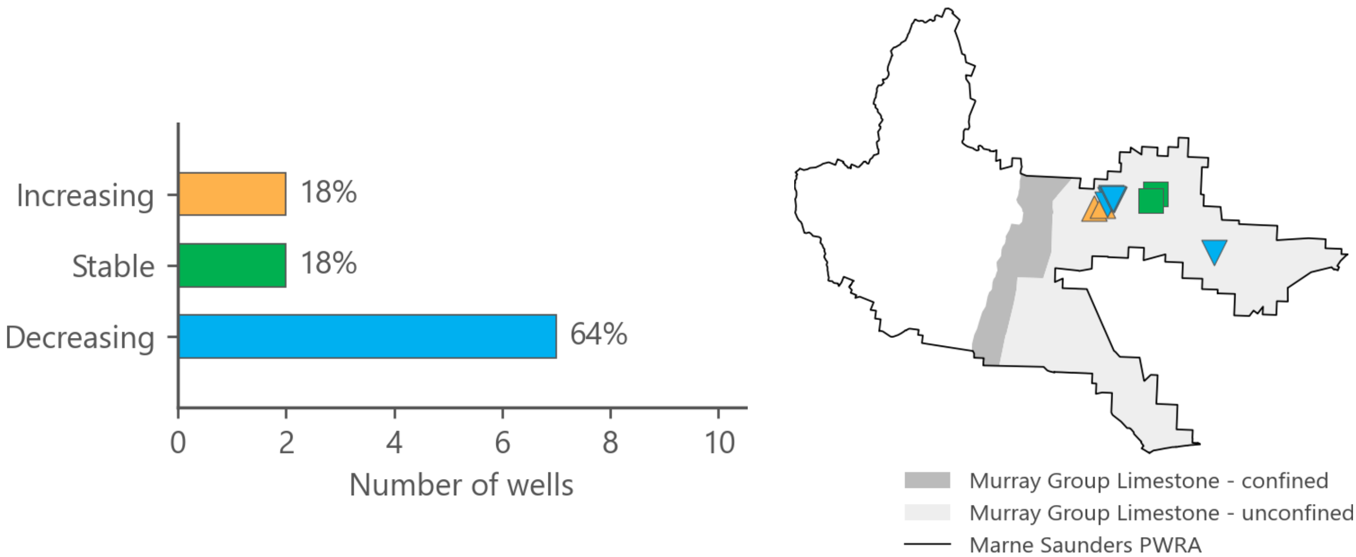


Figure 5.10. 2015-2019 trend in groundwater salinities for Murray Group Limestone wells

6 Water use

In the Marne Saunders PWRA, water sources include watercourses, farm dams, groundwater and imported water from the SA Water mains network. The imported water is transferred from the River Murray to the PWRA. There is also some limited re-use of wastewater. Reticulated water is supplied to Keyneton, Springton, Eden Valley and Cambrai and this mains water is also available along the pipe routes leading to these towns. Mains water is largely used for domestic supply and commercial use within the towns, although there is also some limited use for irrigation, industrial and stock purposes.

The water mains are also used to supply "off-peak" water, which is water allocated to River Murray licensees that can be accessed from April to October. Up to approximately 200 ML of off-peak water is supplied in the Marne Saunders PWRA, largely for irrigation, and it is understood that this is the maximum supply able to be provided through the current infrastructure.

Total water consumption was 2803 ML in 2018-19 (Figure 6.1). This includes licensed surface water and groundwater (Figure 6.2) extracted from within the Marne Saunders PWRA and River Murray water imported into the PWRA.

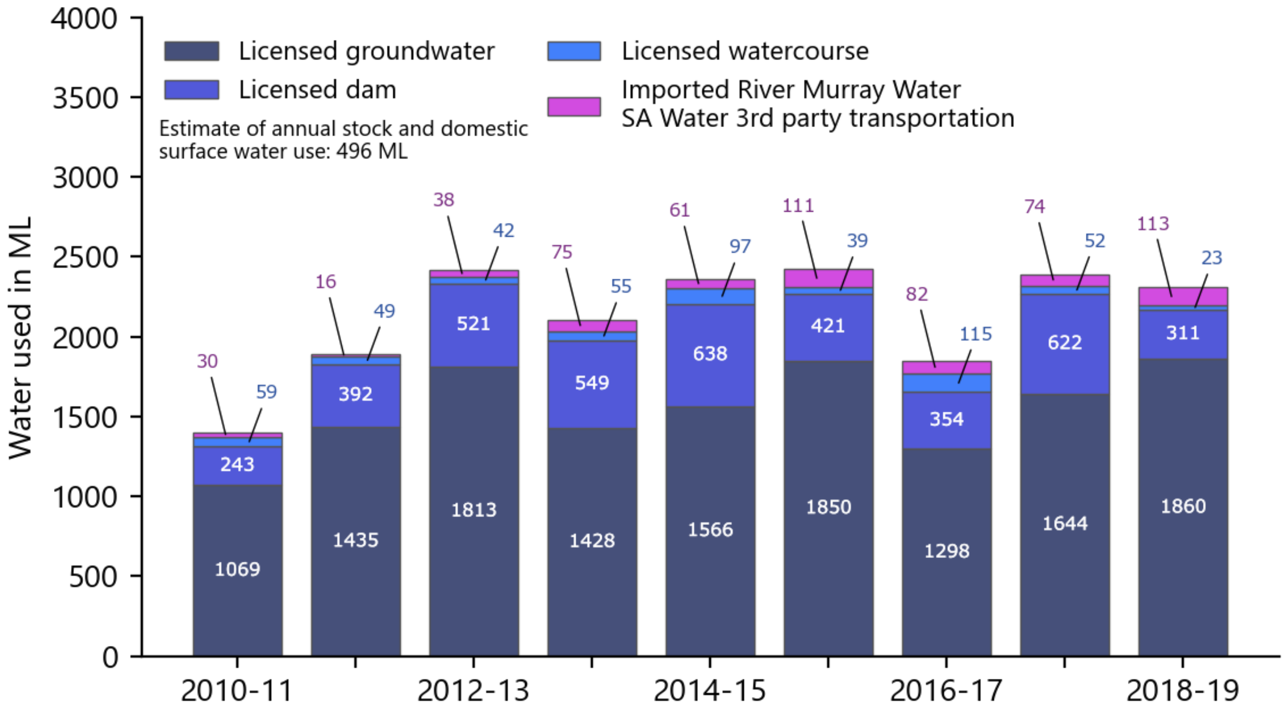


Figure 6.1 Water used from 2004–05 to 2018–19 for the Marne Saunders PWRA

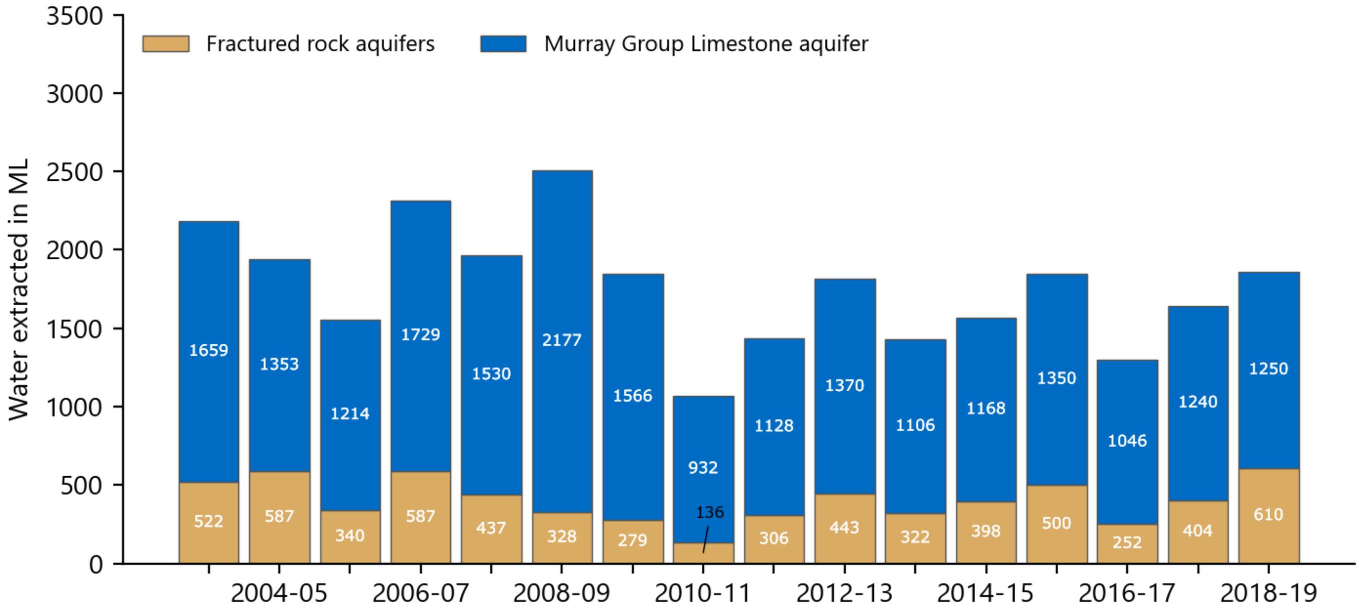


Figure 6.2 Metered groundwater extraction in aquifers of the Marne Saunders PWRA from 2003–04 to 2018–19

6.1 Surface water use

In 2018–19, use from licensed surface water sources (dams and watercourses) was 334 ML compared to 674 ML in 2017–18 (Figure 6.1). This data is based on meter readings from licensed water users in the upper part of the catchment. Non-licensed water demand (stock and domestic) was estimated at 496 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 (SAMDB NRM, 2010). The volume of imported water into the Marne Saunders PWRA from the River Murray was 113 ML in 2018-19.

6.2 Groundwater use

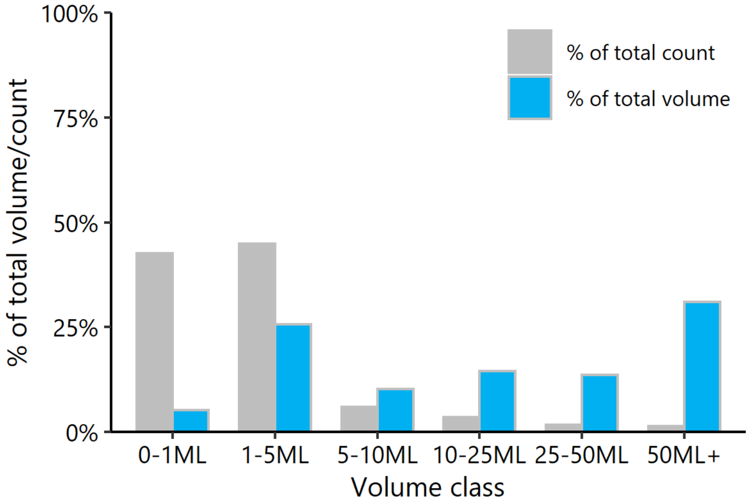
Groundwater is extracted for a range of purposes, such as irrigation of crops and stock and domestic use. Water taken for irrigation is metered and is managed through a water licensing system. Meters have been installed since 2002 in response to the prescription of the water resources. Water taken for stock and domestic purposes is exempt from metering.

In 2018–19, licensed groundwater extractions (from the fractured rock aquifers and the MGL aquifer) were 1860 ML compared to 1644 ML in 2017–18 (Figure 6.1). Of this total, 67% was extracted from the MGL aquifer and 33% from fractured rock aquifers (Figure 6.2).

6.3 Farm dams

There are a total of 964 farm dams in the Marne Saunders PWRA, 11% of which are licensed. Licensed dams represent 56% of the total estimated storage capacity of 3779 ML from all the dams.

Across the PWRA, smaller dams (capacity less than 5 ML) account for the majority of the number of dams (88%) but represent only a small proportion (31%) of the total storage capacity of dams. Larger dams with 5 ML capacity or greater make up only 12% of the total dam count but contribute to 69% of the total storage capacity (Figure 6.3). The average farm dam density is 9 ML/km^2 throughout the whole PWRA but higher densities are typically found in the headwaters and high rainfall areas (Figure 6.3).



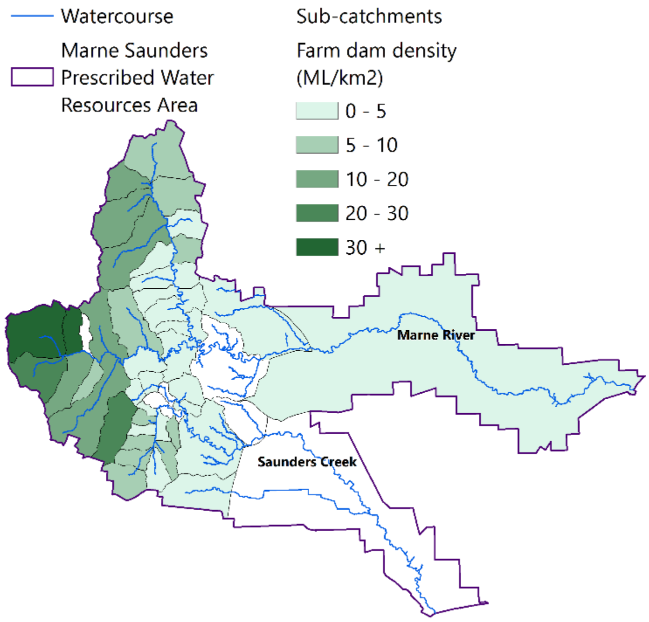


Figure 6.3 Farm dam volume, count analysis, and density in the Marne Saunders PWRA

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