Marne Saunders Prescribed Water Resources Area 2019–20 water resources assessment

Department for Environment and Water
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DEW Technical Note 2021/13

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Contents

1 Summary

Marne Saunders PWRA	Fractured rock aquifers	Very much below average
	Murray Group Limestone	Lowest on record
	Surface water	Lowest on record

LEGEND

- Highest on record
- Very much above average
- Above average
- Average
- Below average
- Very much below average
- Lowest on record

Rainfall

- Rainfall typically ranges from 280 mm/y on the Murray Plains at the eastern boundary of the Marne Saunders Prescribed Water Resources Area (PWRA) to 800 mm/y in the higher elevations at the western boundary.
- Rainfall across the region was below-average in 2019–20. Rainfall at Keyneton was 373 mm in 2019–20, 27% below average, while rainfall at Cambrai was 192 mm, 33% below-average.
- The data indicate a long-term declining trend in rainfall but the last 3 years have been below-average.
- Below-average rainfall was observed throughout the 2019–20 period with very dry conditions experienced in the spring and summer of 2019–20.

Surface water

- There are two principal streamflow gauging stations operational in the PWRA: Marne River at the Marne Gorge, which in 2019–20 is classified 'Lowest on record' annual streamflow; and the Saunders Creek, which is classified 'Below average' streamflow. Data show a long-term declining trend in streamflow.
- Streamflow has not been recorded at the Marne Gorge gauging station since November 2017 and only 10 ML of annual flow was recorded at the Saunders Creek streamflow gauging station in 2019–20.
- Salinity data was unavailable at the Marne Gorge streamflow gauging station due to insufficient flow at the site.

Groundwater

- Water level classifications in the fractured rock aquifers and Murray Group Limestone aquifers range from 'Below average' to 'Lowest on record' compared to their respective historical records. In 2020, the median water level classifications for the fractured rock aquifers and Murray Group Limestone aquifers are 'Very much below average' and 'Lowest on record', respectively.
- 56% of the monitoring wells (9 of 16) show lowest water levels on record in 2019–20, compared to their respective historical record. Five wells are classified 'Below average' and two are 'Very much below average'. The majority of monitoring wells (92%) show five-year trends of declining water levels.
- Eight-year salinity trends in the fractured rock aquifers are decreasing in most wells (66%) with a median rate of 0.27% decrease per year. Eight-year salinity trends in the Murray Group Limestone aquifer are variable with a median rate of 0.02% increase per year.

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 and imported water from the SA Water mains network.
- Water used for consumptive purposes in 2019–20 was 2601 ML, which includes 117 ML imported from the River Murray. Water sourced from within the PWRA included 356 ML from licensed surface water take, 496 ML from non-licensed surface water demand and 1632 ML from licensed groundwater take.

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) provide a detailed information and assessment 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 the main water resources across most regions in a quick-reference format.

This document is the Technical Note for the Marne Saunders Prescribed Water Resources Area (PWRA) for 2019–20 and collates rainfall, surface water and water use (i.e. surface water and groundwater) data collected between July 2019 and September 2020, and groundwater level and salinity data collected between July 2019 and December 2020.

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.

The regional-scale groundwater and surface water resources are prescribed under the *Landscape South Australia 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 statutory reviews of the plan.

The PWRA is located within the Murray-Darling Basin and is characterised by undulating hills and valleys of the Mount Lofty Ranges where the highest rates of rainfall occur in the west. The east is largely defined by flat plains overlying the Murray Basin with localised hills and rocky outcrops throughout with very low annual 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 resides in two types of aquifer – fractured rock aquifers in the hills area and sedimentary aquifers beneath the plains.

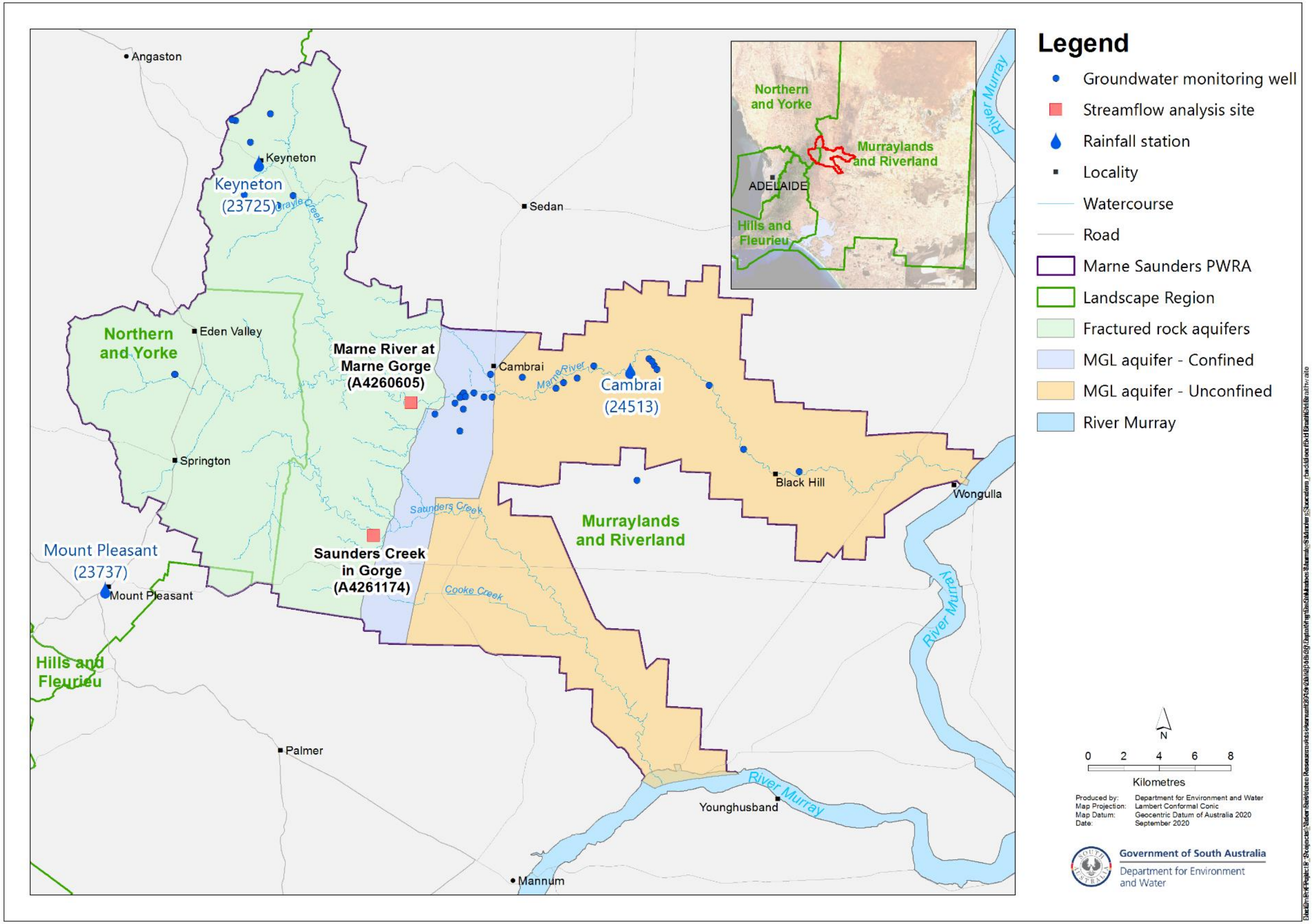

Figure 1.1. Location of Marne Saunders PWRA, including the prescribed extent of the Murray Group Limestone aquifer

2 Methods and data

This section describes the source of rainfall, surface water, groundwater and water use data presented in this assessment and the methods used to analyse and present these 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[1] 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[2]. The map of total rainfall in 2019–20 was compiled from monthly rainfall grids obtained for the months between July 2019 and June 2020 from the Australian Landscape Water Balance[3] 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[4] of the total period of data availability. The period of data availability for the Marne River streamflow gauging station is 1973–20. 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[5]

[1] https://www.data.qld.gov.au/dataset/silo-patched-point-data

[2] http://www.bom.gov.au/jsp/ncc/climate_averages/rainfall/index.jsp

[3] http://www.bom.gov.au/water/landscape/#/rr/Actual/year/-28.4/130.4/3/Point////2020/12/31/

[4] 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.

[5] Bureau of Meteorology Annual climate statement at http://www.bom.gov.au/climate/current/annual/aus/

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.

2.2.2 Monthly streamflow

Monthly streamflow for the applicable year is assessed alongside the long-term average monthly streamflow (Figure 4.3A), for the period 1973–20 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.

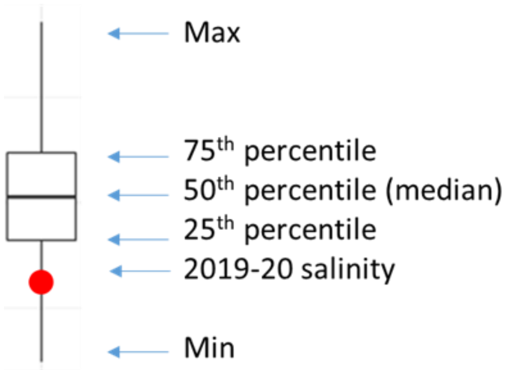

Figure 2.1 Box and whisker plot

2.3 Groundwater

2.3.1 Water level

Water level[6] data were obtained from wells in the monitoring network by both manual and continuous logger measurements. 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.

[6] "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).

For those wells that meet the selection criteria (see below), the annual recovered water levels are ranked from lowest to highest according to their decile range (Table 2.1) and given a description in a similar way as annual streamflow. The thresholds for criteria by which wells are selected 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 data is included. The number of wells in each description class for the most recent year is then summarised for each aquifer (e.g. Figure 5.1) and hydrographs are shown for a selection of wells to illustrate common or important trends (e.g. Figure 5.3).

Five-year trends are 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 (e.g. 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 2020.

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) from which 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.

Eight-year salinity trends are calculated where there are at least six 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:

$$\text{Percentage change in salinity (\%)} = \frac{\text{Slope of linear trend line (mg/L/y)} * 8}{\text{Value of trend line at start of period (mg/L)}} * 100$$

The percentage of change over the trend period is then summarised in categories depending on the range of change for each resource. The salinity measurements are based on the measurement of the electrical conductivity of a water sample and are often subject to small instrument errors (e.g. Figure 5.5).

Where data available salinity graphs are shown for a selection of wells with long-term data to illustrate common or important trends (e.g. Figure 5.8).

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[7]. For additional information related to groundwater monitoring well nomenclature, please refer to the Well Details page on WaterConnect[8].

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.

[7] https://www.waterconnect.sa.gov.au/Systems/GD/Pages/default.aspx

[8] https://www.waterconnect.sa.gov.au/Systems/GD/Pages/Well-Details.aspx

3 Rainfall

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

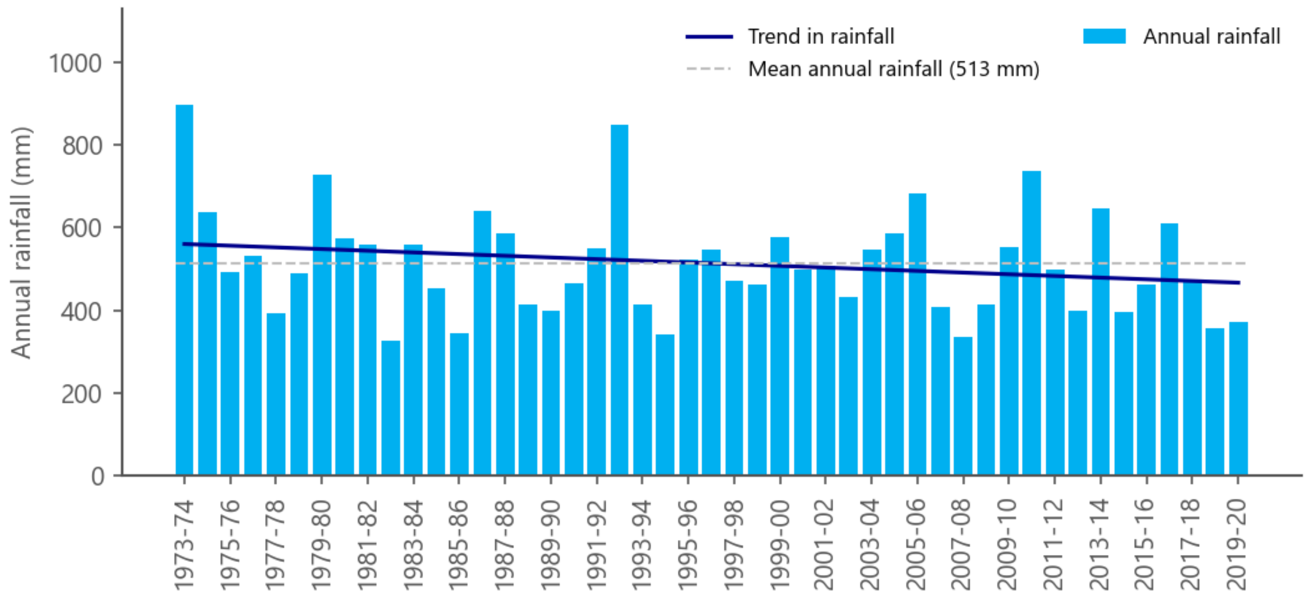

Figure 3.1. Annual rainfall for 1973–74 to 2019–20 at the Keyneton rainfall station (23725)

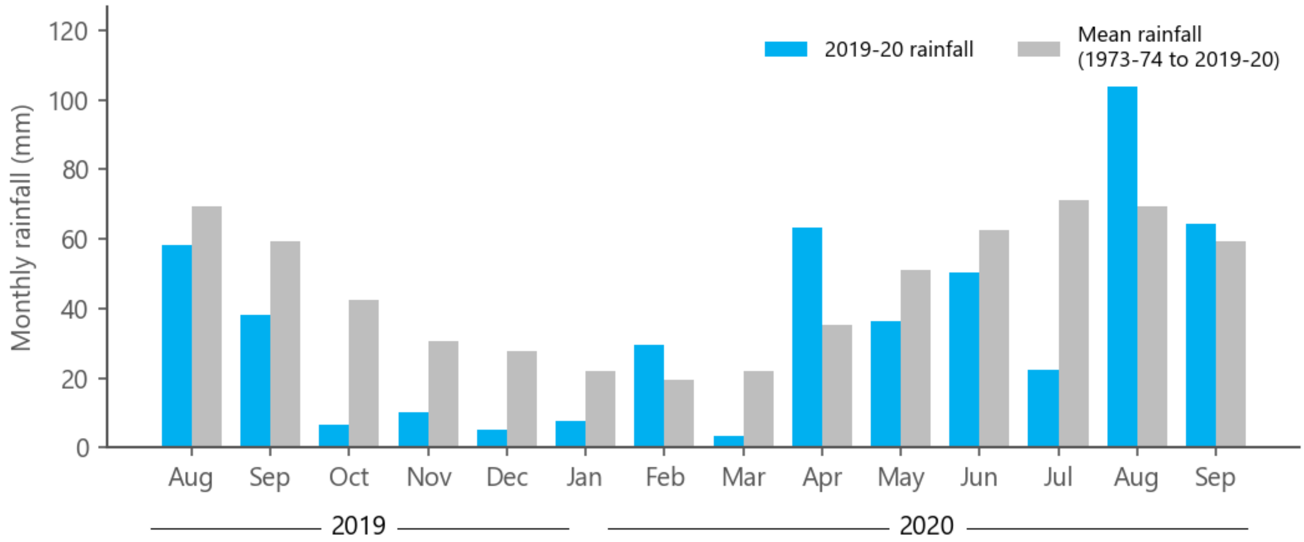

Figure 3.2. Monthly rainfall between July 2019 and September 2020 at the Keyneton rainfall station (23725)

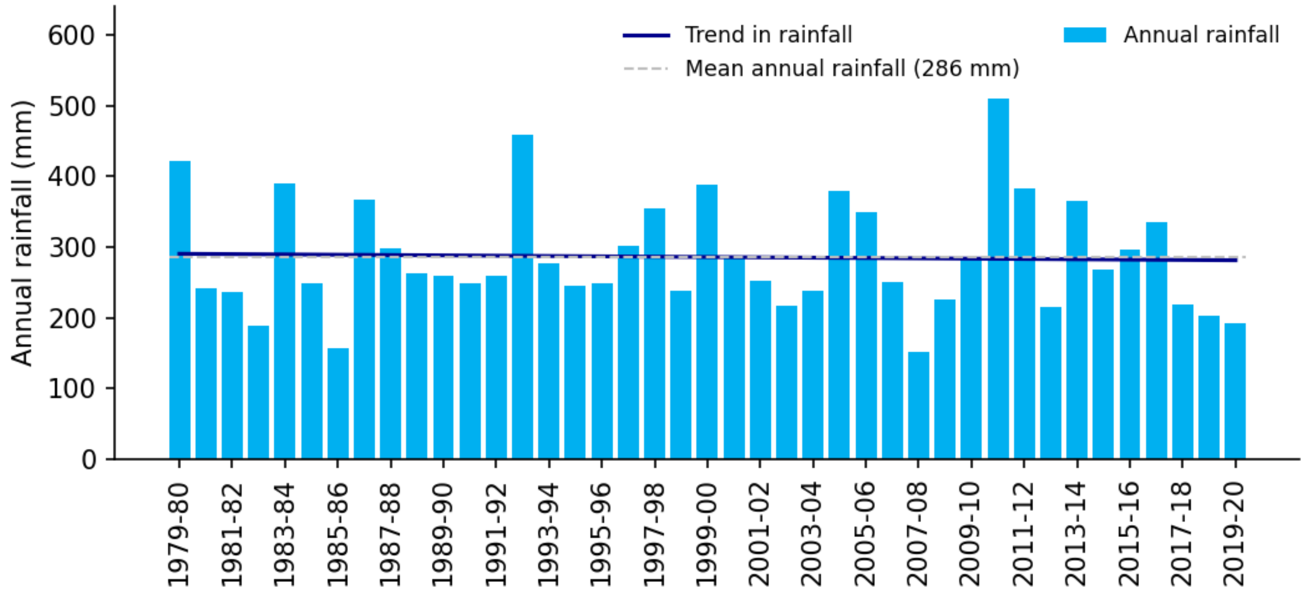

Figure 3.3. Annual rainfall for 1979–80 to 2019–20 at the Cambrai (Kongolia) rainfall station (24513)

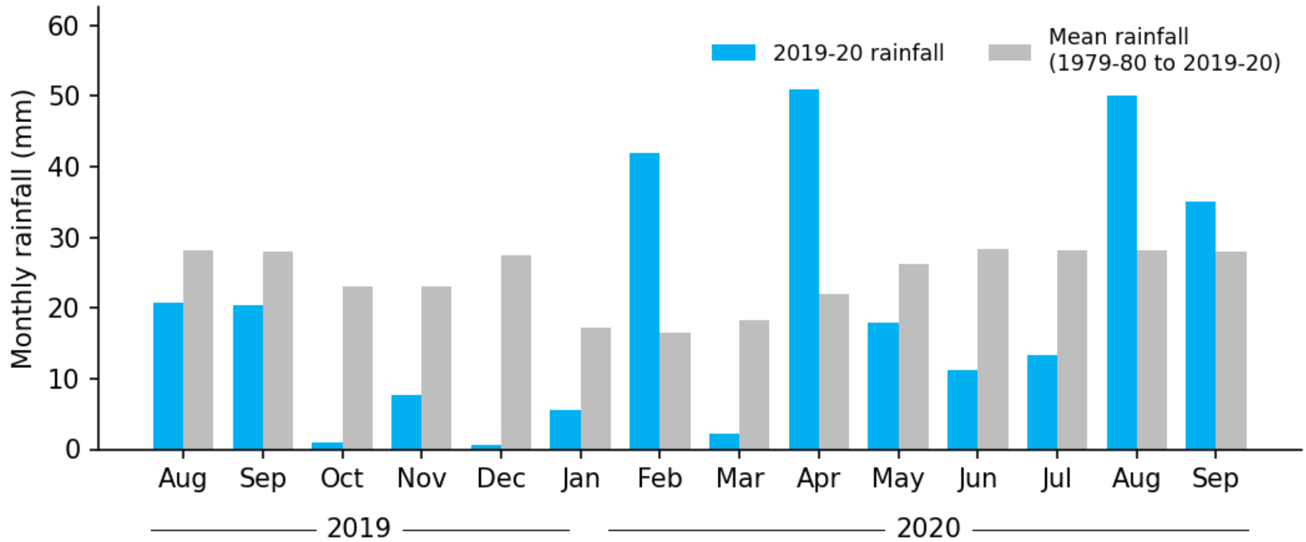

Figure 3.4. Monthly rainfall between July 2019 and September 2020 at the Cambrai (Kongolia) rainfall station (24513)

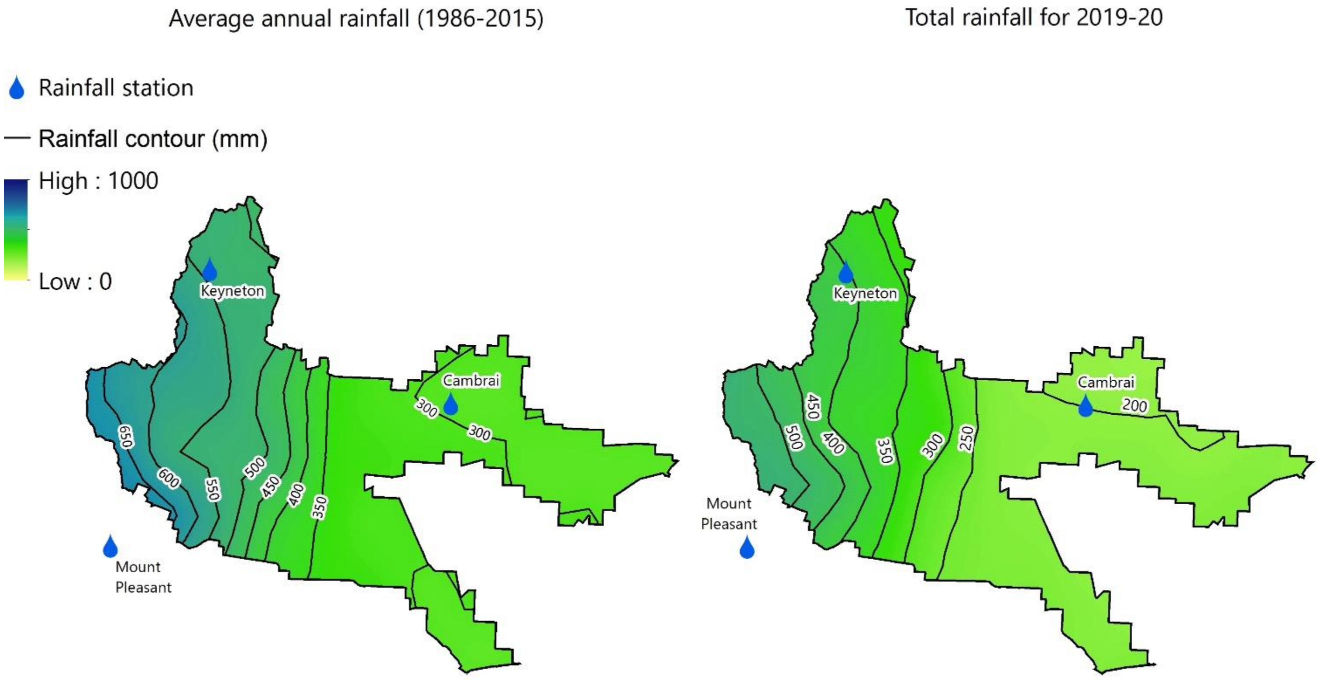

Figure 3.5. Rainfall in the Marne Saunders PWRA for 2019–20 compared to the standard 30-year climatological average (1986–2015)

- Keyneton rainfall station (BoM station 23725) represents the higher rainfall areas of the PWRA in the Mount Lofty Ranges. The annual total recorded for 2019–20 was 373 mm, 141 mm lower than the long-term average annual rainfall of 513 mm/y (1973–20). The long-term trend is declining over this period (Figure 3.1) but the last 3 years were below-average.
- Cambrai (Kongolia) rainfall station (BoM station 24513) represents the lower rainfall areas of the Murray Plains. The annual total recorded for 2019–20 was 192 mm, 94 mm lower than the long-term average annual rainfall of 286 mm/y (1979–20). The long-term trend is stable over this period (Figure 3.3) but the last 3 years have been below-average.
- Below-average rainfall was also observed at other rainfall stations within and close to the PWRA. Mount Pleasant is located 5 km outside of the south-western boundary (Figure 1.1) and recorded an annual total of 512 mm in 2019–20, 114 mm lower than the long-term average annual rainfall of 623 mm/y (1973–20).
- Below-average rainfall was observed throughout 2019–20. The spring and summer months were very dry in comparison to their respective long-term averages (Figure 3.2 and Figure 3.4). However, at both Keyneton and Cambrai (Kongolia) stations in 2020, the months of February, April, August and September were above-average.
- The spatial rainfall map for 2019–20 shows markedly lower rainfall in all parts of the PWRA compared to the long-term average (Figure 5.3). The long-term average annual rainfall map shows the higher rainfall band (>650 mm/y) present near Springton in the north-west of the PWRA, whereas this rainfall band is absent in 2019–20[9].

[9] 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 (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. below-average winter rainfall will result in reduced annual streamflow volumes. Conversely, higher rainfall will result in increased surface water availability.

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 2019–20, the Marne River recorded 'Lowest on record' streamflow, and the Saunders Creek was 'Very much below average' (Figure 4.1). Further detail on the methodology used for analysis can be found in Section 2.

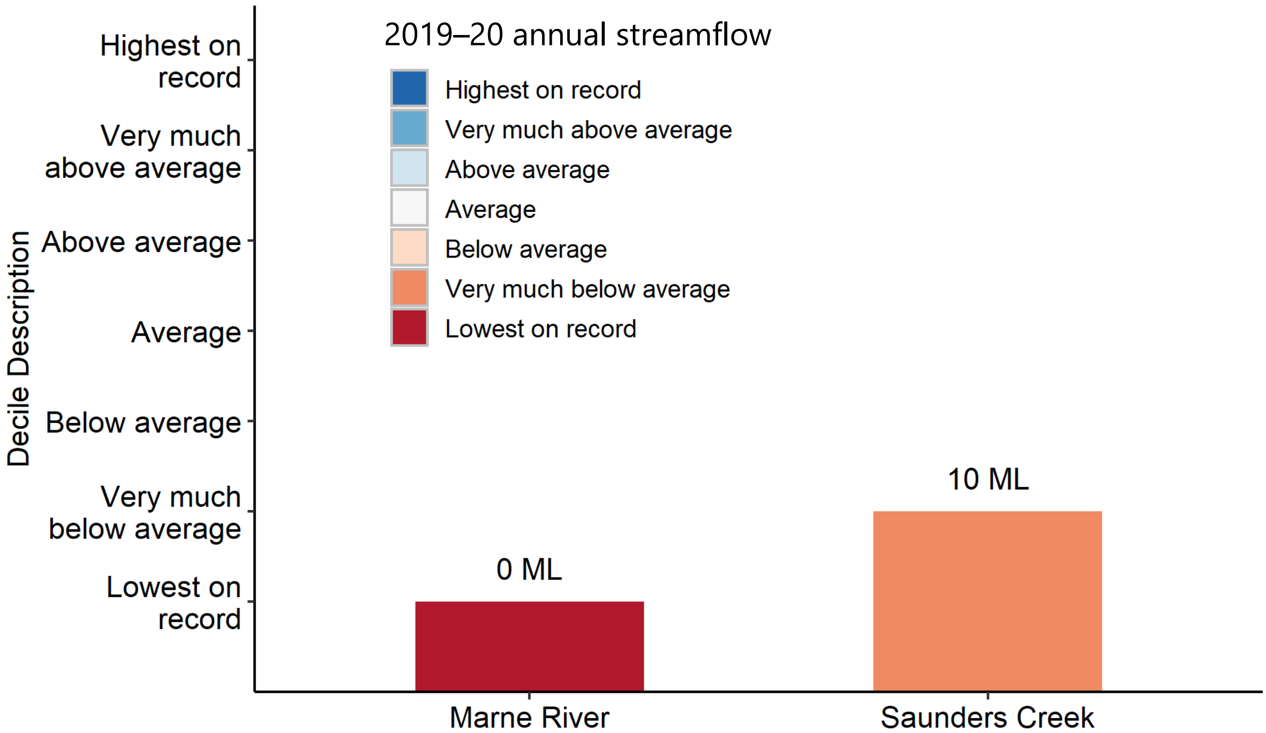

Figure 4.1 Marne Saunders PWRA annual streamflow summary 2019–20

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.

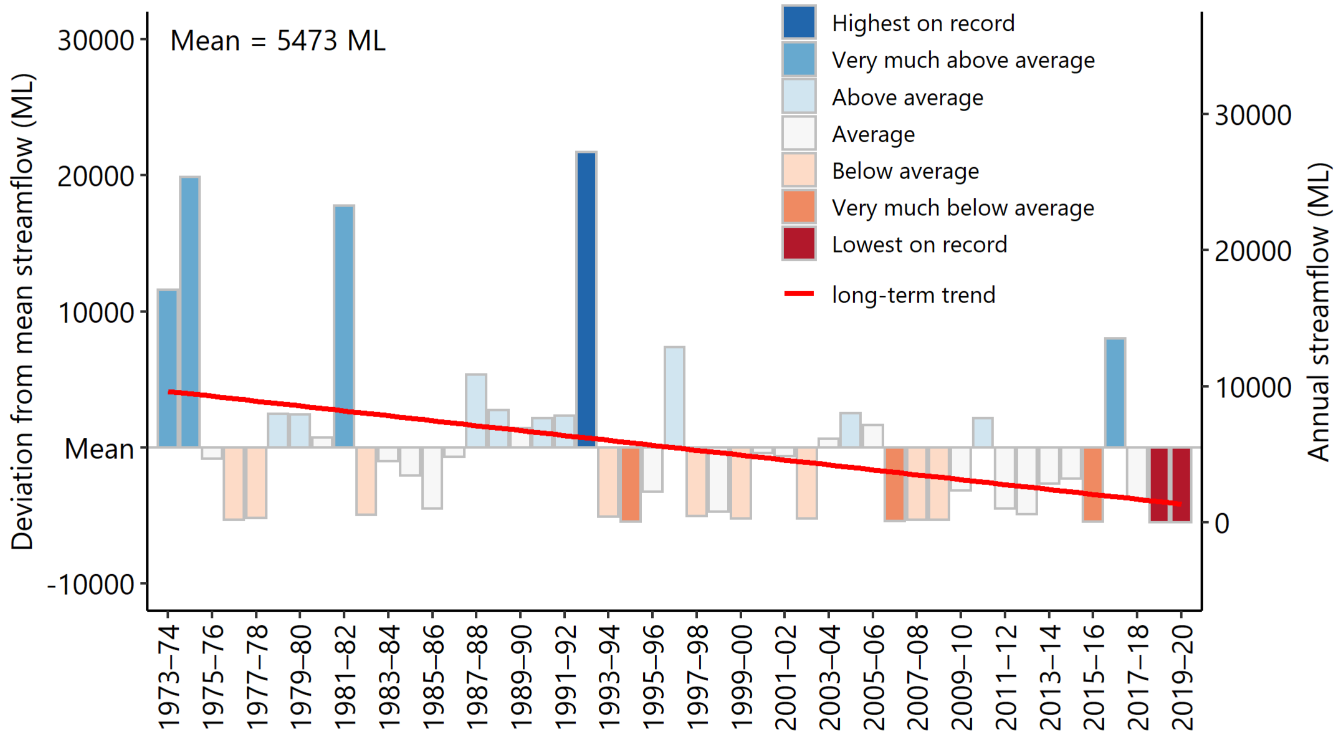

Figure 4.2 Annual deviation from mean streamflow at the Marne Gorge (1973–74 to 2019–20)

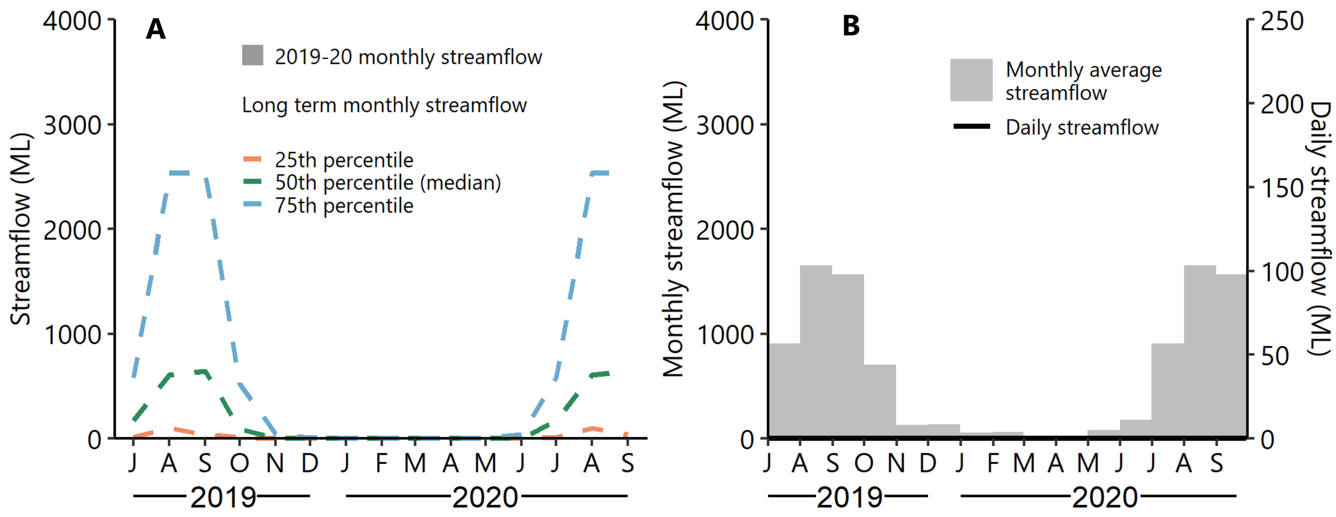

Figure 4.3 (A) Long-term monthly statistics and 2019–20 monthly streamflow at the Marne Gorge; (B) Long-term average monthly streamflow and 2019–20 daily streamflow at the Marne Gorge

The deviation of each individual year's streamflow from the long-term average streamflow (1973–20) 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 1973–20. 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). Since 1994, there have only been 6 years where above-average flow has occurred.

Figure 4.3A shows the monthly streamflow for 2019–20 (grey bars) relative to the long-term monthly streamflow (1973–20) for (a) low flows (25th percentile), (b) median flows (50th percentile) and high flows (75th 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, no streamflow was recorded at the site in 2019–20. 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 (1973–20) and the daily flows for 2019–20. As mentioned above, no streamflow was recorded in 2019–20.

The Saunders Creek station recorded an annual total of 10 ML in 2019–20, which was predominantly between August–September 2019. This was ranked as 'Very much below average'.

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 mobilised 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 both the Marne River and Saunders Creek streamflow gauging station in the PWRA. Figure 4.4 shows the long-term salinity statistics for the period 2002–20 at the Marne Gorge gauging station.

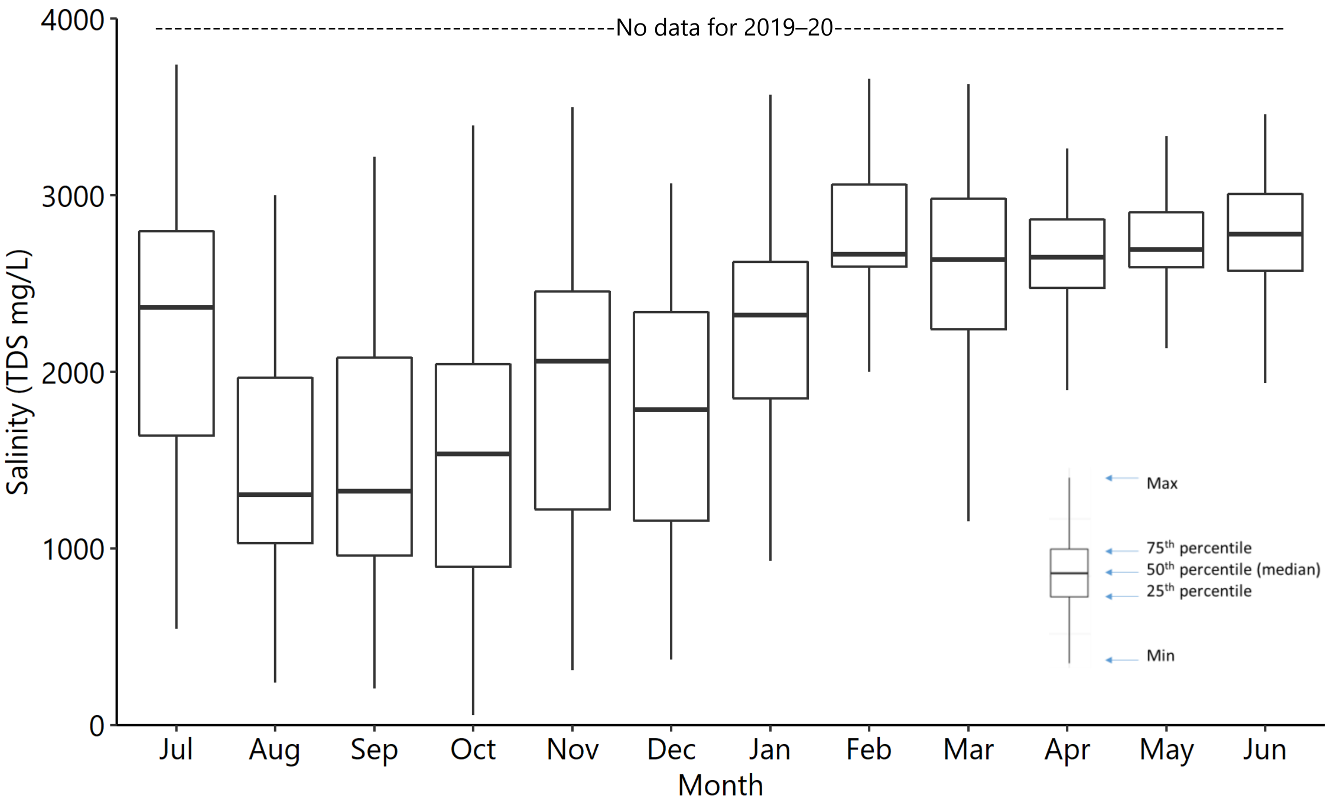

Figure 4.4 Long-term monthly salinity at Marne Gorge streamflow gauging station (A5060500)

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 2019–20 due to insufficient streamflow experienced at the Marne River site. Salinity data collected at the Saunders Creek monitoring site from 2010 shows that 70% of the data is greater than 2500 mg/L. However, there were also no salinity values recorded due to lack of streamflow.

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 assessment 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, wells produce relatively low 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 (Figure 1.1).

5.1.2 Murray Group Limestone aquifer

The MGL aquifer is overlain by Quaternary sediments and underlain by the Ettrick Formation and the Renmark Group. It is highly fossiliferous and sandy with solution cavities present. This aquifer is confined in the west next to the hills zone where it is overlain by the Quaternary Pooraka Formation, before transitioning to unconfined conditions east of Cambrai where the Pooraka Formation begins to pinch out. Recharge to the MGL aquifer flows laterally from the adjacent basement rocks in the hills zone and, where it is unconfined, from streamflow during periods of flood. Groundwater extraction from this aquifer mainly occurs for irrigation, in the vicinity of the Marne River.

5.2 Fractured rock aquifers – water level

During 2019–20, three of seven (43%) fractured rock aquifer monitoring wells show their lowest water level on record (Section 2.3.1). These wells are located at Keyneton, toward the northwestern extent of the PWRA (Figure 5.1). Further south, at Eden Valley, the level at JTL004 is classified as ‘Below-average’.

The change in water level over the past 20 years is declining in all wells, ranging from 0.71 m to 3.64 m. The median change is a decline of 2.98 m.

Five-year trends in three representative wells show declining water levels , with rates of decline of 0.50, 0.73 and 1.05 m/y for JEL008, JTL004 and JEL013, respectively (Figure 5.2).

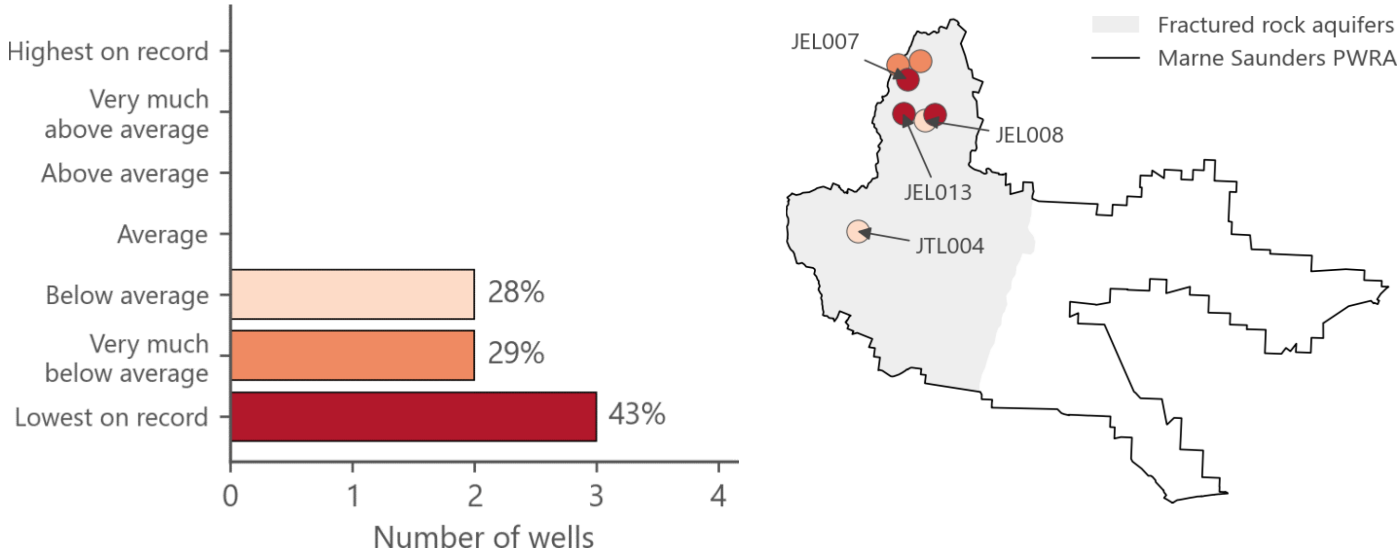

Figure 5.1 2020 winter-recovered water levels for wells in the fractured rock aquifers of the Marne Saunders PWRA

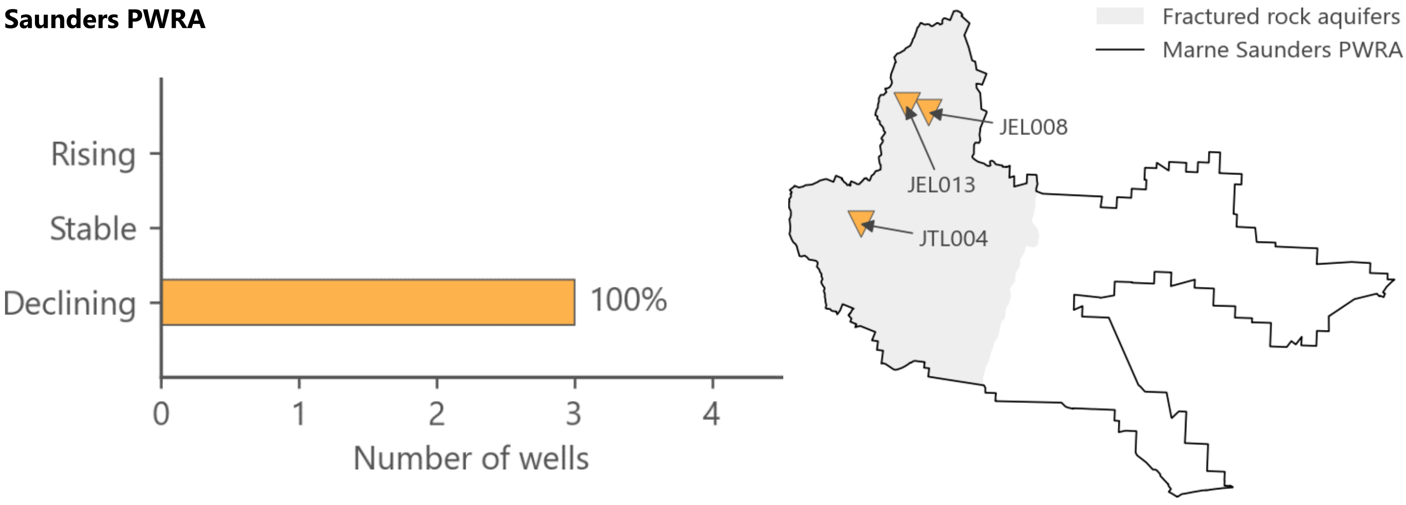

Figure 5.2 2016–20 trend in winter-recovered water levels for wells in the fractured rock aquifers of the Marne Saunders PWRA

Hydrographs from a selection of fractured rock aquifer monitoring wells in the hills zone show that regional water level trends generally reflect winter rainfall, with groundwater levels rising in wet years (e.g. 2016–17) (Figure 5.3).

Monitoring wells JEL013 and JEL007 are located near Keyneton in the north-western part of the aquifer. Groundwater levels in this area have fallen gradually since the 1990s. Groundwater levels in 2020 are lowest on record (Figure 5.3).

The well JTL004 is located further south, near Eden Valley. Groundwater levels here are relatively stable with only subdued responses to years with higher winter rainfall. The lowest levels were observed in 2009 which is likely due to reduced recharge and increased extraction over the Millennium drought. In 2020, the water level is classified 'Below average'.

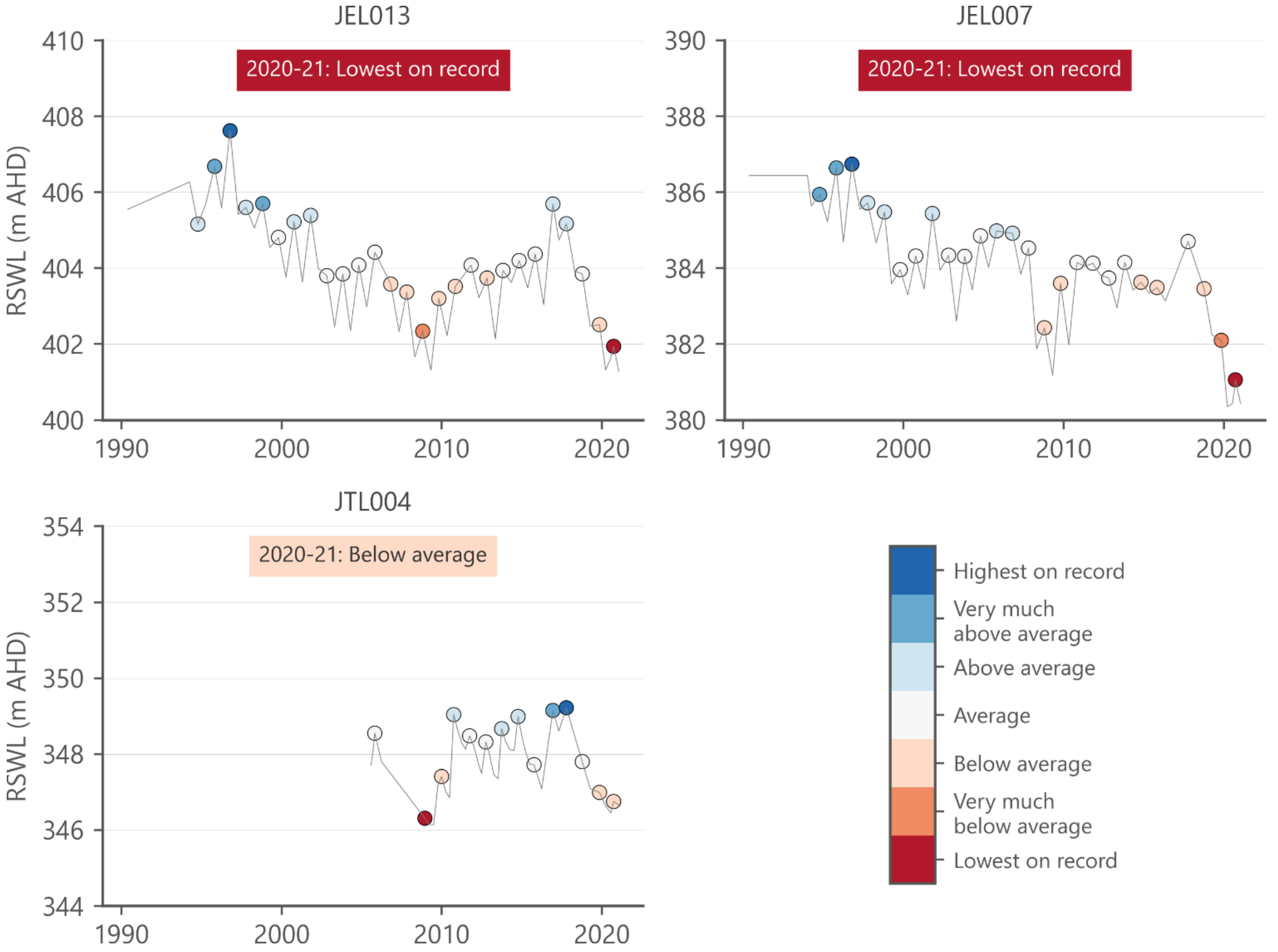

Figure 5.3 Selected fractured rock aquifers hydrographs of the Marne Saunders PWRA

5.3 Fractured rock aquifers – salinity

Groundwater salinity is often highly variable in fractured rock aquifers and is influenced by the type of rock in which fractures occur. Since 2013, irrigators have submitted groundwater salinity samples to DEW. In 2020, salinity from 37 irrigation wells in the fractured rock aquifers range between 465 mg/L and 7387 mg/L with a median of 1889 mg/L (Figure 5.4).

In the eight years to 2020, the majority of wells show trends of decreasing groundwater salinity (66%) (Section 2.3.2). Salinity trends vary from a decrease of 6.34% per year to an increase of 1.04% per year, with a median rate of 0.27% decrease per year (Figure 5.5).

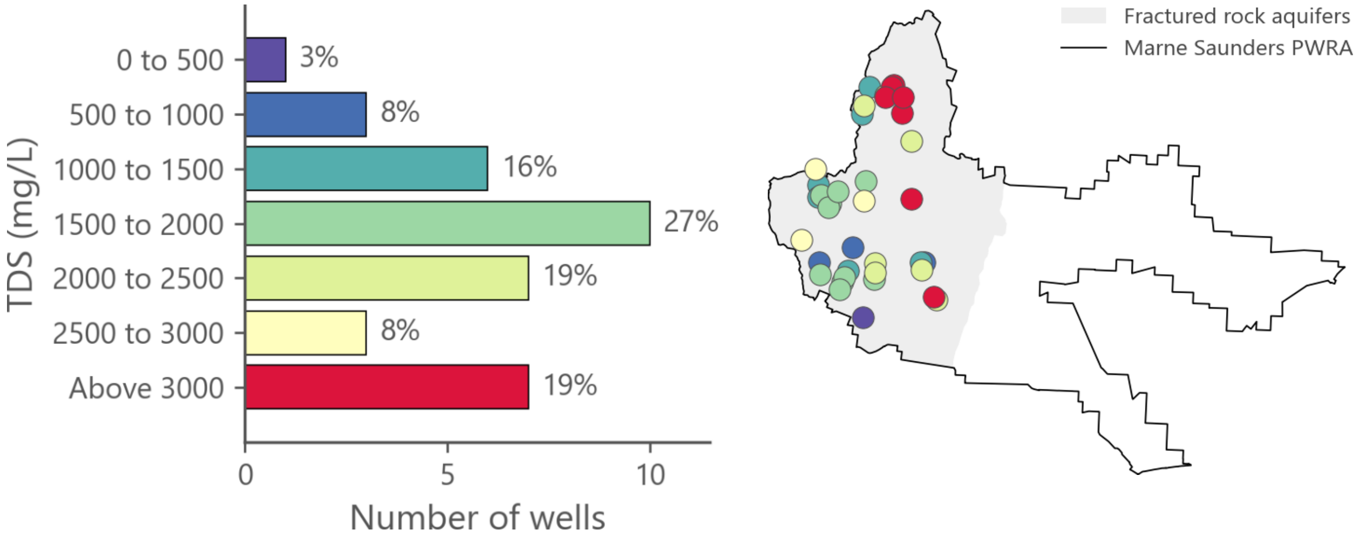

Figure 5.4. 2020 salinity observations from wells in the fractured rock aquifers of the Marne Saunders PWRA

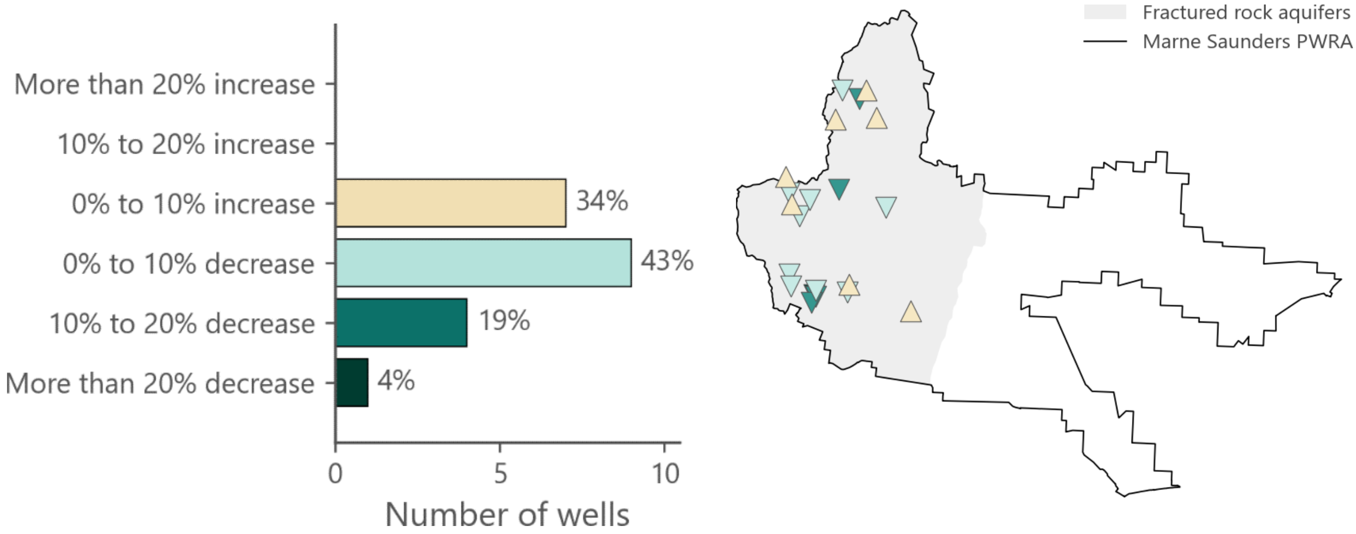

Figure 5.5 Salinity trend in the 8 years to 2020 for wells in the fractured rock aquifers of the Marne Saunders PWRA

5.4 Murray Group Limestone aquifer – water level

During 2019–20, 67% of MGL aquifer monitoring wells show their lowest water level on record. These wells are primarily located along the Marne River valley (Figure 5.6).

Five-year trends show declining water levels in 90% of wells, with rates of decline ranging from 0.17 m/y to 0.74 m/y (the median rate of decline is 0.41 m/y) (Figure 5.7).

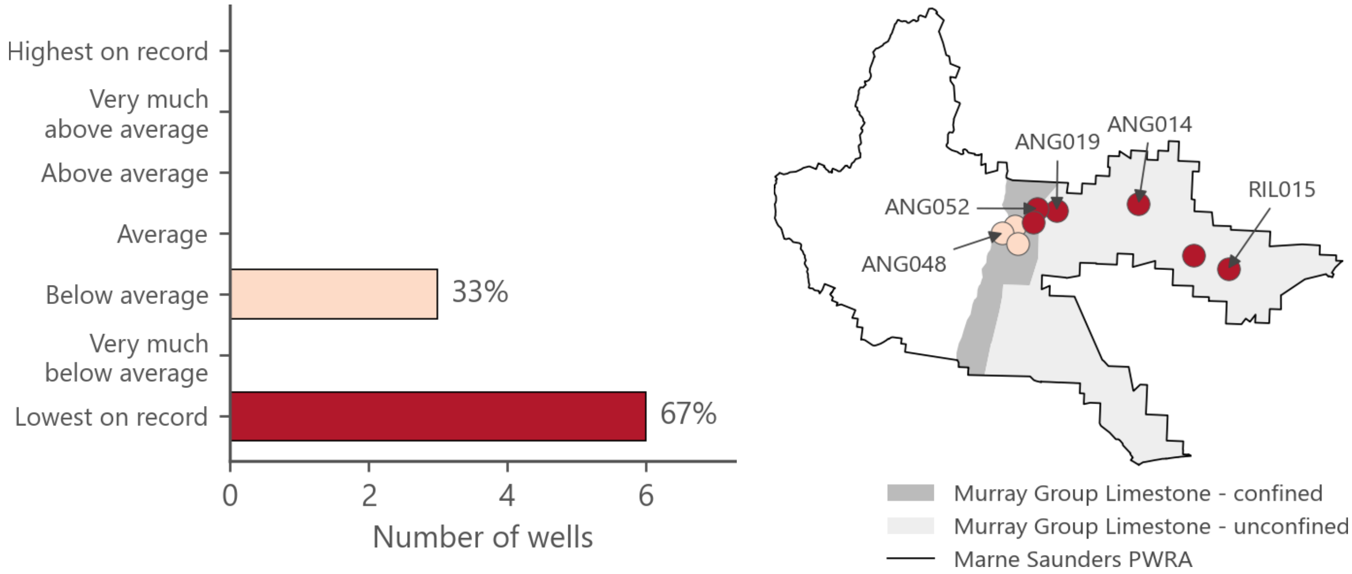

Figure 5.6 2020 winter-recovered water levels for wells in the Murray Group Limestone aquifer of the Marne Saunders PWRA

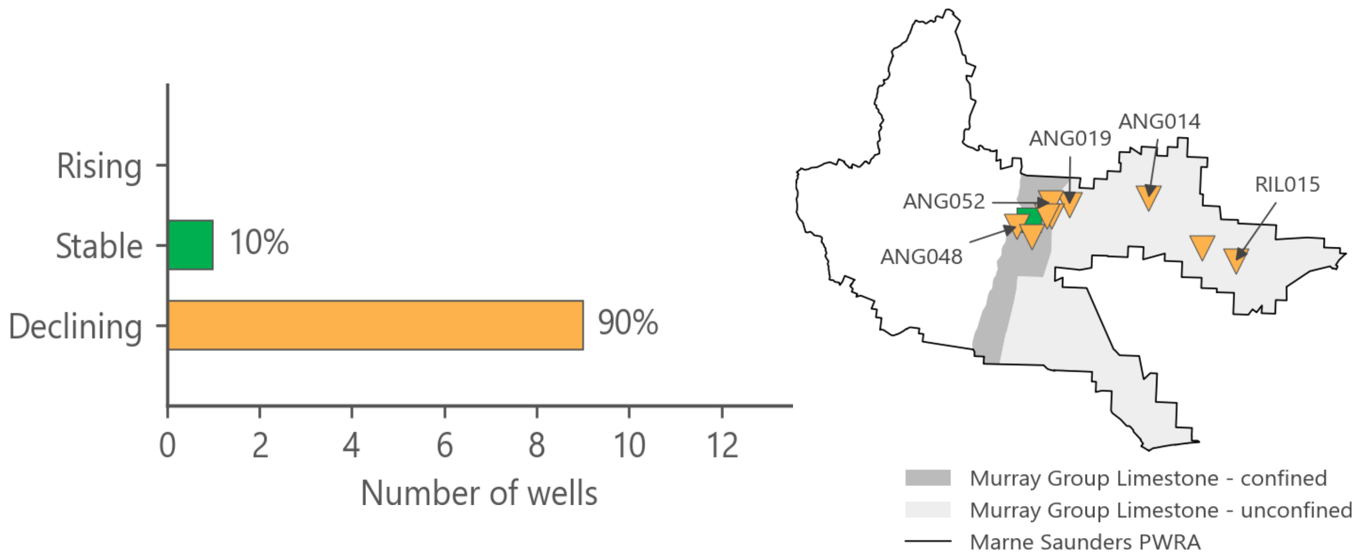

Figure 5.7 2016–20 trend in winter-recovered water levels for wells in the Murray Group Limestone aquifer of the Marne Saunders PWRA

Hydrographs from monitoring wells located to the east of Cambrai are representative of the unconfined MGL aquifer. Here, monitoring wells ANG014 and RIL015 (Figures 5.6 and 5.8) show a total decline of 2.32 m and 2.61 m over the past 20 years, respectively.

The aquifer is confined to the west of Cambrai where large seasonal fluctuations can be observed, which correspond with areas where the confining Pooraka Formation is greatest in thickness. Monitoring wells ANG052 and ANG019, located south and southeast of Cambrai (Figure 5.6), show their lowest level on record in 2020.

ANG048 is located near the western boundary of the aquifer and a declining trend in water levels is observed over the past few years.

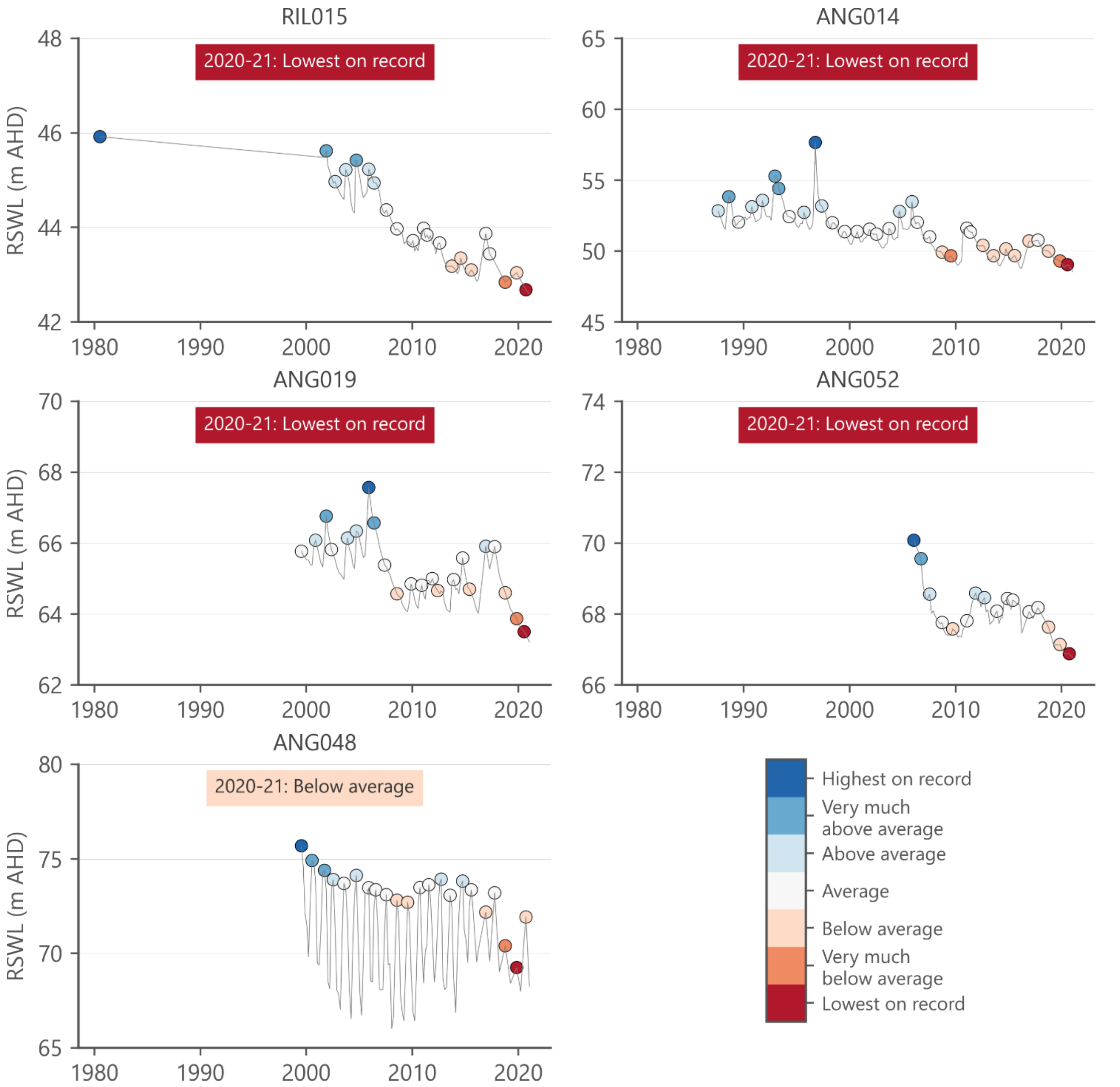

Figure 5.8 Selected Murray Group Limestone aquifer hydrographs of the Marne Saunders PWRA

5.5 Murray Group Limestone aquifer – salinity

Since 2013, irrigators have submitted groundwater salinity samples to DEW. In 2020, salinity from 42 irrigation wells in the MGL aquifer ranges between 749 mg/L and 2978 mg/L with a median of 1759 mg/L (Figure 5.9).

In the eight years to 2020, trends in salinity across the MGL aquifer were variable. Trends in salinity varies from a decrease of 5.99% per year to an increase of 7.93% per year, with a median of stable salinity (0.02% increase per year; Figure 5.10).

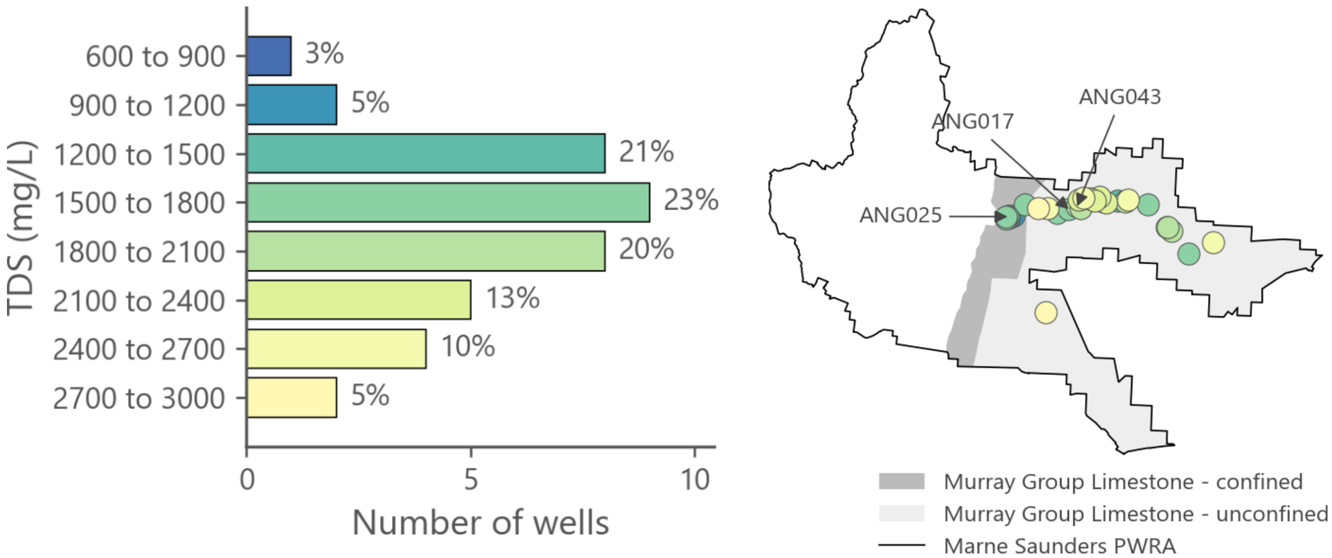

Figure 5.9. 2020 salinity observations from Murray Group Limestone aquifer wells of the Marne Saunders PWRA

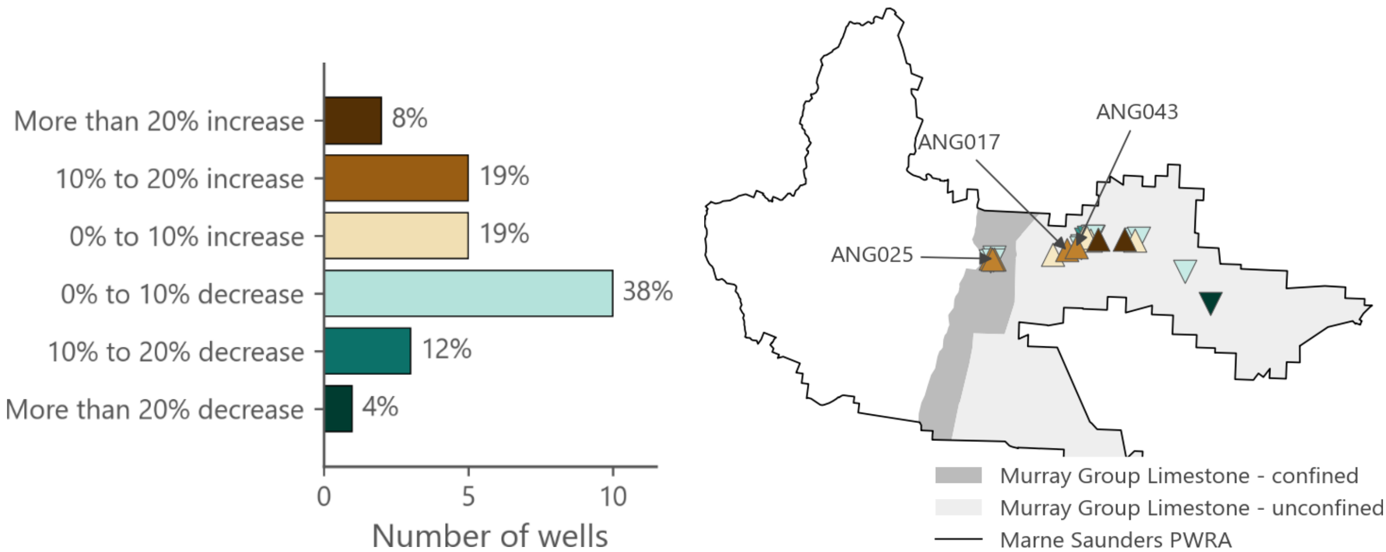

Figure 5.10. Salinity trend in the 8 years to 2020 for wells in the Murray Group Limestone aquifer of the Marne Saunders PWRA

Representative salinity monitoring wells completed in the MGL aquifer are located to the east of Cambrai (ANG043 and ANG017) where the aquifer is unconfined (Figures 5.9 and 5.11), and show trends of increasing salinity.

Within the confined portion of the limestone aquifer to the west of Cambrai, groundwater flows from west to east and salinity increases along the flow path. Excessive pumping from the confined aquifer can create a cone of depression that may cause a reversal in groundwater flow, which increases the risk of entrainment of higher-salinity groundwater from the east. ANG025 shows an increase of salinity from early to late 2000s.

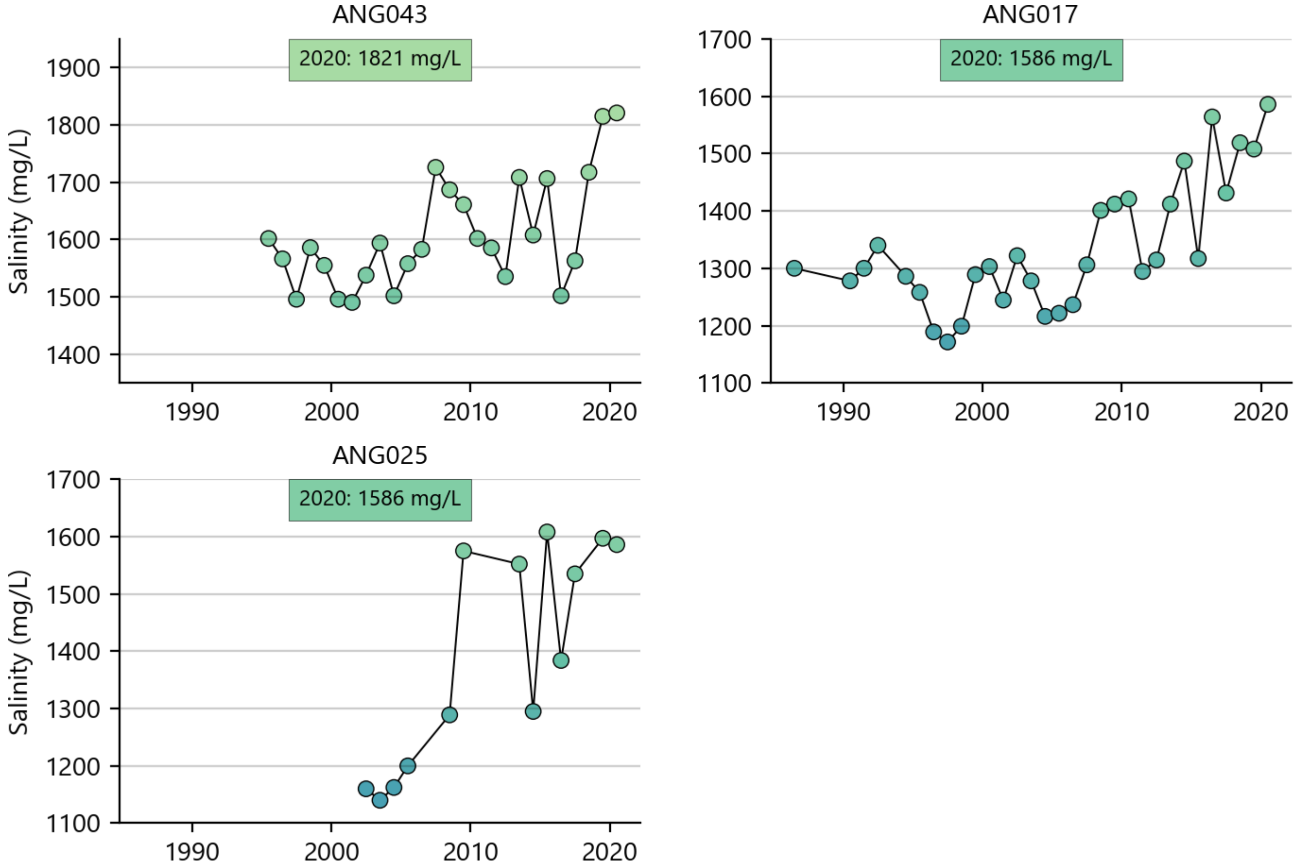

Figure 5.11 Selected Murray Group Limestone aquifer salinity graphs of the Marne Saunders PWRA

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 water.

SA Water mains supply is 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.

Total consumptive water use in 2019–20 is 2454 ML (Figure 6.1). This includes prescribed surface water and groundwater (Figure 6.2) extracted from within the Marne Saunders PWRA and River Murray water imported into the PWRA.

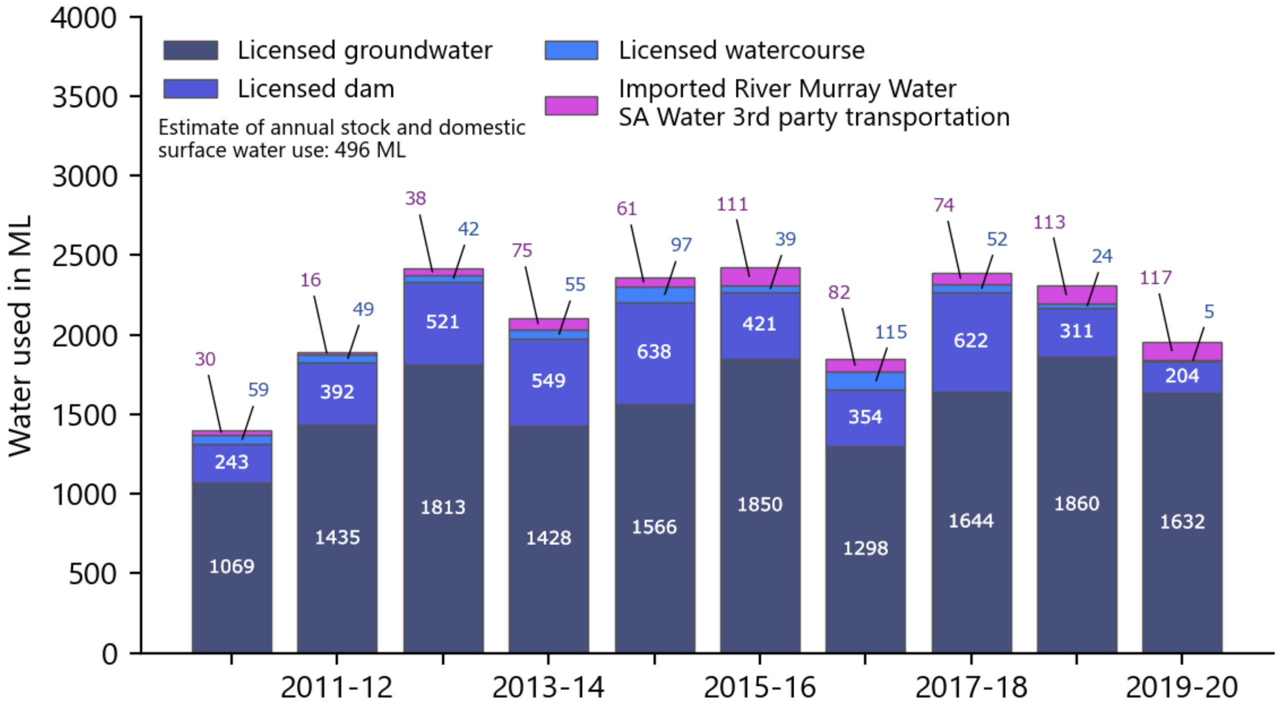

Figure 6.1 Water use from 2010–11 to 2019–20 for the Marne Saunders PWRA

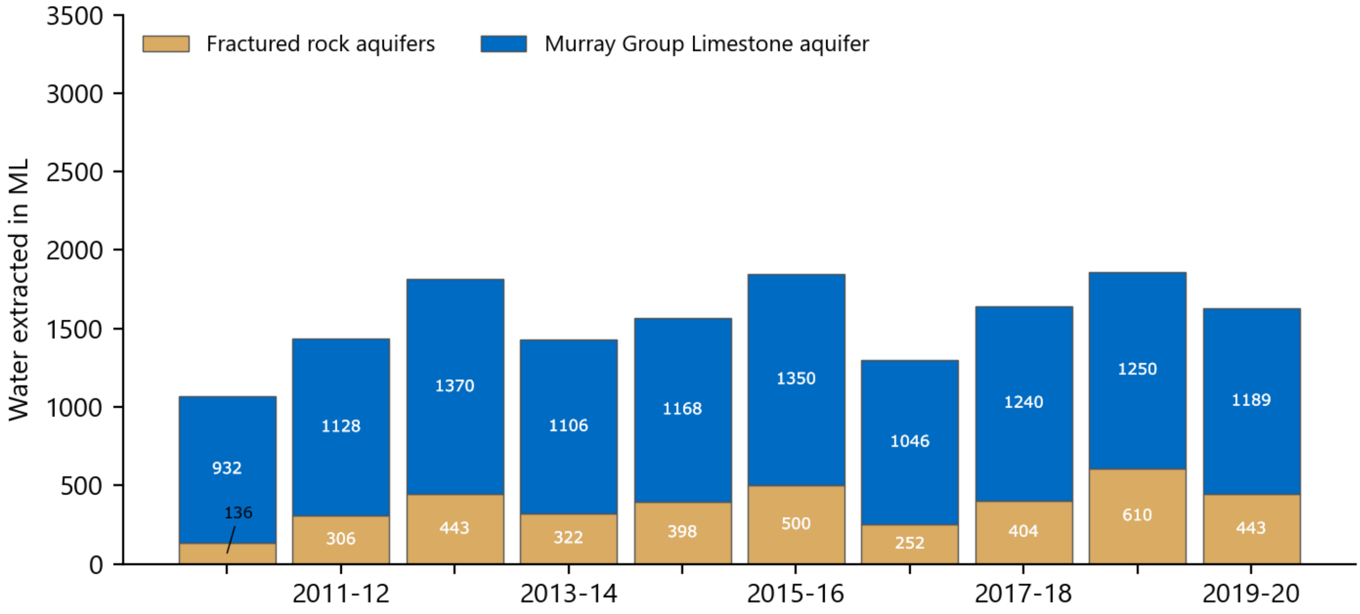

Figure 6.2 Metered groundwater extraction in 2010–11 to 2019–2020 from aquifers of the Marne Saunders PWRA

6.1 Groundwater use

Groundwater is extracted for a range of purposes, such as irrigation of crops and stock and domestic use. Water take for irrigation is metered and is managed through principles in the water allocation plan. Water take for stock and domestic purposes is not licensed and as such, is exempt from metering.

In 2019–20, licensed groundwater extractions (from the fractured rock aquifers and the MGL aquifer) are 1632 ML, compared with 1860 ML in 2018–19 (Figure 6.1). Of this total, 73% was extracted from the MGL aquifer and 27% from fractured rock aquifers (Figure 6.2).

6.2 Surface water use

In 2019–20, licensed surface water take (from dams and watercourses) was 209 ML compared to 335 ML in 2018–19 (Figure 6.1). These data are based on meter readings from licensed water use in the upper part of the catchment. Non-licensed water demand (stock and domestic) is estimated at 496 ML based on 30% of dam capacity analysis per the water allocation plan (SAMDB NRM, 2010). The stock and domestic demand has not been specifically represented in the bar chart due to being estimated but is included within the total consumptive use. The volume of imported water into the Marne Saunders PWRA from the River Murray was 117 ML in 2019–20.

6.2.1 Farm dams

There are a total of 883 runoff-capturing farm dams in the Marne Saunders PWRA, 12% of which are licensed. Licensed dams represent 56% of the total estimated storage capacity of 7558 ML from these dams.

Across the PWRA, smaller dams (capacity less than 5 ML) account for the majority of the number of dams (87%) but represent only a small proportion (30%) of the total storage capacity of dams. Larger dams with 5 ML capacity or greater make up only 13% of the total dam count but contribute to 70% 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).

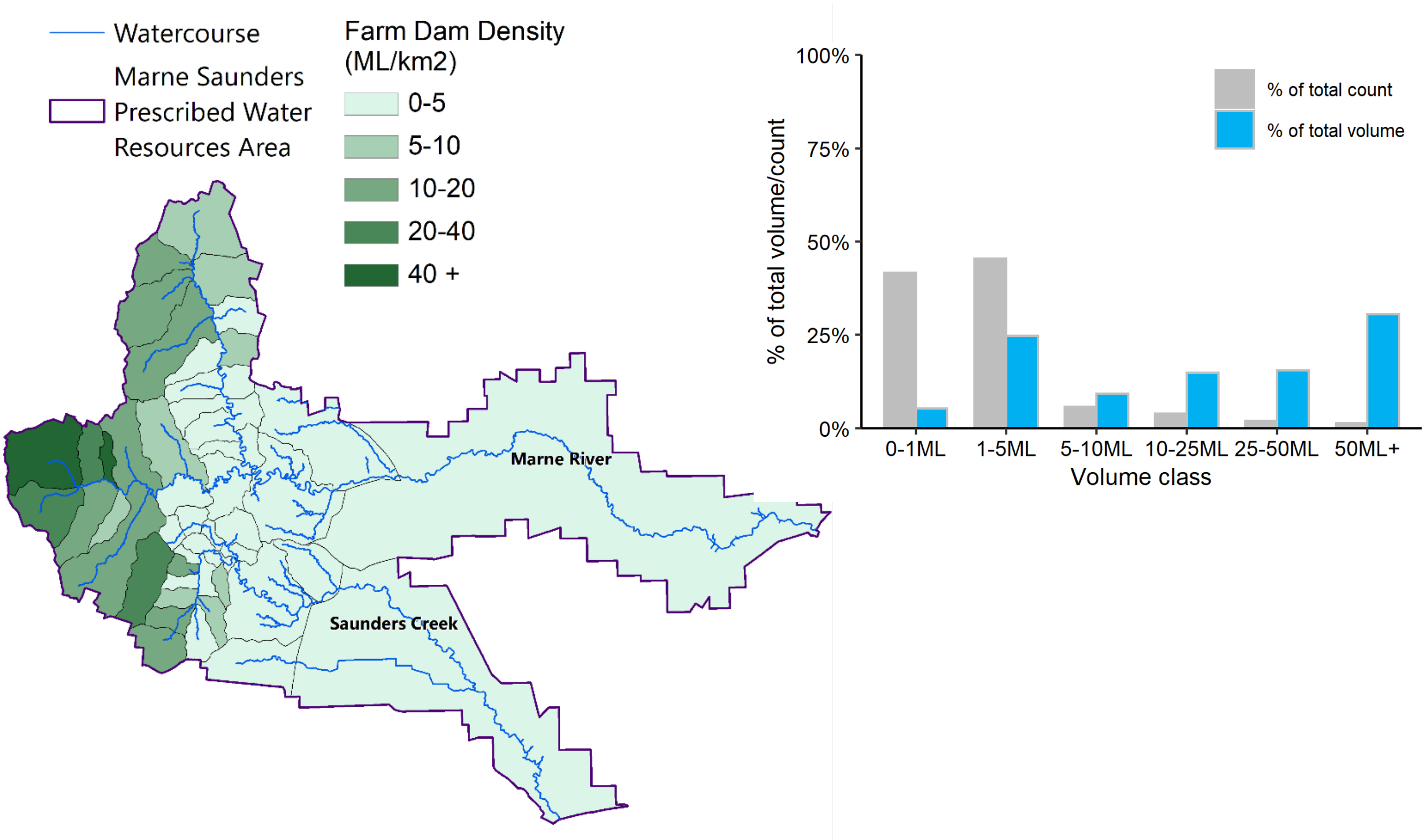

Figure 6.3 Farm dam volume, count analysis, and density in the Marne Saunders PWRA

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