MARNE SAUNDERS PWRA

Surface Water Status Report

2010-11

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Department of Environment, Water and Natural Resources

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PURPOSE AND CONTEXT

This status report provides a snapshot of the surface water resources in the Marne Saunders Prescribed Water Resources Area (PWRA) for the financial year 2010-11. Surface water status reports are limited to reporting on the 'hydrological status' of the PWRA. Available data on climate, streamflow, salinity and water use are summarised and compared with recent and long–term data to provide an indication of the hydrological status of its water resources. Each element is discussed with reference to recent or more long-term trends where they are present in the data. A similar separate report has been released previously for the associated groundwater resources of this PWRA. This surface water report is in a format consistent with that already adopted for the groundwater report. These status reports seek to support informed management decisions by resource managers and those responsible for, or reliant on, the water resources.

Development of the Natural Resource Management (NRM) State and Condition Reporting Framework (Government of South Australia 2012) was identified as a priority in the State NRM Plan (Government of South Australia 2012a) to strengthen the NRM system. Implementation of the NRM State and Condition Reporting Framework seeks to include an assessment of state and condition of natural resources through the development of Report Cards. The Department of Environment, Water and Natural Resources (DEWNR), in consultation with key stakeholders is developing the Report Card *"Trends in condition of rivers, streams, wetlands and drains"*, which assess resource condition and the Report Card "*Proportion of SA's water resources managed within sustainable limits*" which reports on management outcomes. For further information on the condition compared to status of water resources, visit the NR Connect site's NRM Reporting page: http://www.nrconnect.sa.gov.au/NRM-Reporting

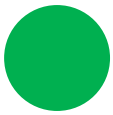
MARNE SAUNDERS PWRA

The Marne Saunders PWRA is located approximately 60 km north-east of Adelaide (Figure 1). Surface water (including within watercourses) and groundwater resources in the PWRA have been prescribed under South Australia's *Natural Resources Management Act 2004*. Following prescription, a Water Allocation Plan (WAP) was developed by the South Australian Murray-Darling Basin NRM Board in 2010, which seeks to provide for the sustainable management of water resources.

The PWRA covers an area of 743 km^2 and includes the towns of Springton, Eden Valley, Keyneton and Cambrai. The topography is characterised by a hills zone and plains zone, as a result of the Palmer Fault that defines the eastern limit of the hills zone. The hills zone on the western side of the PWRA is part of the Mount Lofty Ranges region, while the plains zone is part of the Murray Basin region. The climate of the PWRA is characterised by hot, dry summers and cool to cold, wet winters, with rainfall varying from over 700 mm in the west to less than 300 mm in the east. The major surface water catchments of the PWRA are the Marne River and the Saunders Creek catchments, drained by the Marne River and the Saunders Creek, respectively. The Marne River drains to the River Murray at Wongulla, while the Saunders Creek drains to the River Murray at Pellaring Flat.

Surface water use for irrigation, industrial, recreational, stock and domestic purposes comes from a variety of sources including pumping from streams and rivers, rainwater capture and interception and storage by farm dams. Licensed water use for the Marne Saunders PWRA is administered under the WAP by the Department of Environment, Water and Natural Resources.

SUMMARY 2010-11

STATUS 2010-11  "no adverse hydrological trends, indicating a stable or improving situation"

This hydrological status for 2010-11 is supported by:

- above average rainfall
- above average streamflow at Marne Gorge
- freshening salinity levels at Marne Gorge
- a negligible ratio of water use to streamflow.

Rainfall, streamflow, salinity and water usage can be highly variable from year to year. It is therefore important to acknowledge that hydrological trend, and therefore the hydrological status can also vary greatly from year to year. However this does not necessarily translate to the variability in the condition of water dependent ecosystems. On this matter, environmental water requirements and condition of water dependent ecosystems have not been considered when assigning the hydrological status for 2010-11. The section titled 'water dependent ecosystems' provides a brief overview of the water dependent ecosystems in the PWRA.

(green) No adverse trends, indicating a stable or improving situation

Trends are either stable (no significant change), or have improved over the reporting period, indicating that there is insignificant risk of impact to the beneficial use of the resource.

(yellow) Adverse trends indicating low risk to the resource in the short–term (1 to 3 years)

Observed adverse trends are gradual and if continued, are unlikely to lead to a change in the current beneficial uses of the surface water resource in the short–term.

(amber) Adverse trends indicating medium risk to the resource eventuating in the short–term

Observed adverse trends are significant and if continued, moderately likely to lead to a change in the current beneficial uses of the surface water resource in the short–term.

(red) Adverse trends indicating high risk to the resource within the short–term

Trends indicate degradation of the resource is occurring. Degradation will very likely result in a change in the beneficial use (e.g. reduced ability to access surface water entitlements and/or decline in the condition of environmental assets).

(grey) Unclear

Trends are unable to be determined due to a lack of adequate information on which to base a sound judgement of status.

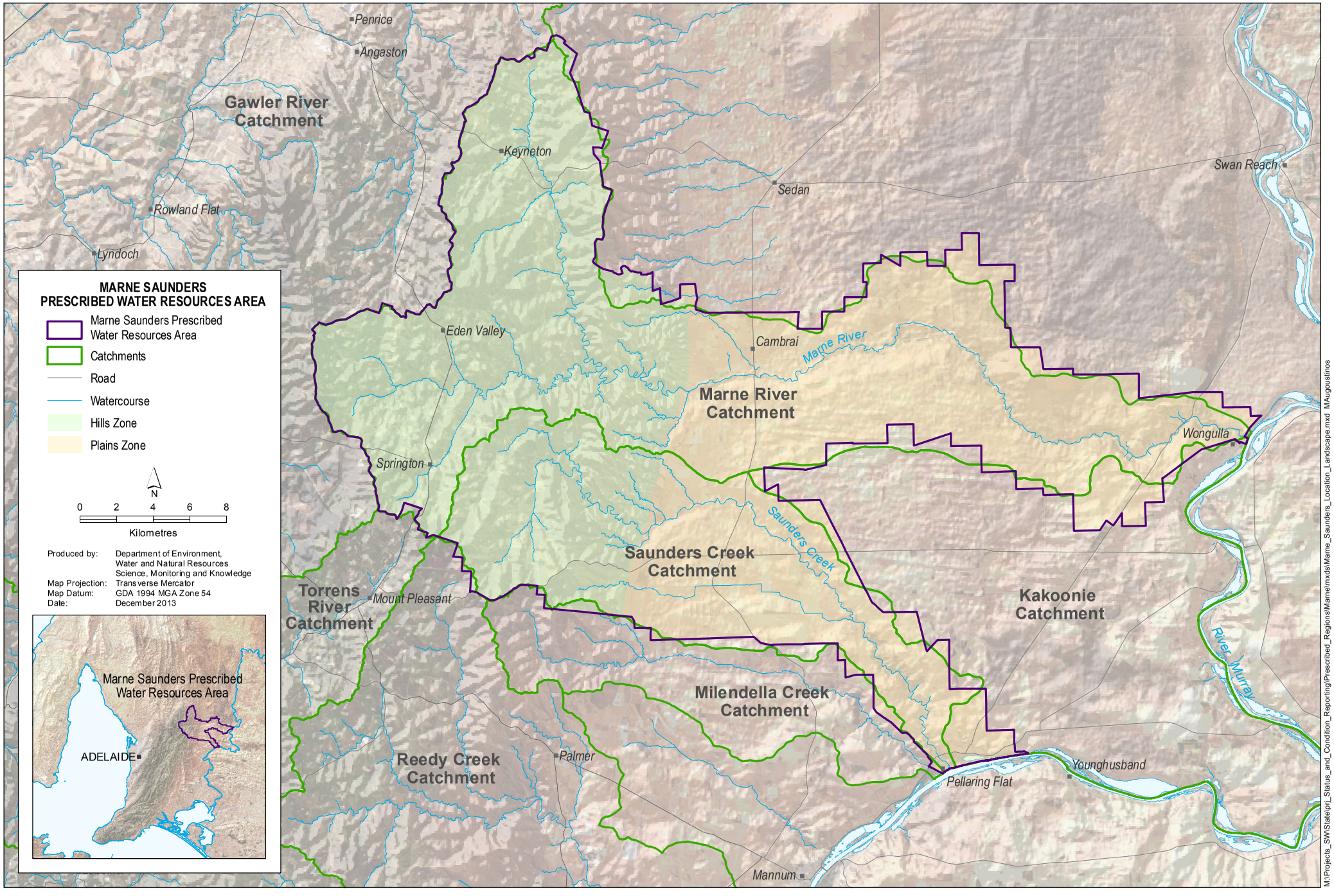


Figure 1. Marne Saunders PWRA and surface water catchments of the region

RAINFALL

Status	Degree of Confidence	Comments on recent historical context
Above average rainfall across most of the region	High: good coverage of rainfall stations representing the rainfall variation across the region	Second year of above average rainfall in a row at Keyneton and Mount Pleasant after three years of below average rainfall. Above average rainfall at Cambrai after four years of below average rainfall.

Rainfall in the PWRA varies from over 700 mm in the west to less than 300 mm in the east. Rainfall declines from west to east in the rain shadow of the Mount Lofty Ranges. There are six rainfall stations within the PWRA (Figure 5). Data from two of these long–term stations, Keyneton (M023725) and Cambrai (M024513) were chosen for analysis of rainfall trends. Mount Pleasant Bureau of Meteorology (BoM) rainfall station (M023737) is located just outside of the PWRA and was chosen to represent the high rainfall trends in the west of the PWRA. Rainfall data has been sourced from SILO and is Patched Point Data. Further information on SILO climate data is available at: http://www.longpaddock.qld.gov.au/silo/index.html.

The Keyneton BoM rainfall station is located in the township of Keyneton. The long–term average annual rainfall (1889–2010) is 511 mm at Keyneton. The Cambrai BoM rainfall station, located about 7 km east of the township of Cambrai, has a long–term average annual rainfall (1889–2010) of 291 mm. The Mount Pleasant BoM rainfall station, located just outside of the PWRA in the township of Mount Pleasant, has a long–term average annual rainfall (1889–2010) of 668 mm.

RECENT RAINFALL

During 2010-11, large rainfall events were experienced during the months of December and March at all stations (Figures 2 to 4). The rainfall recorded in these months pushed the rainfall totals to well above long–term averages. The Keyneton BoM rainfall station recorded 738 mm in 2010–11. Above average rainfall was recorded for five months in the year, with August, December and March receiving well above average rainfall (Figure 2).

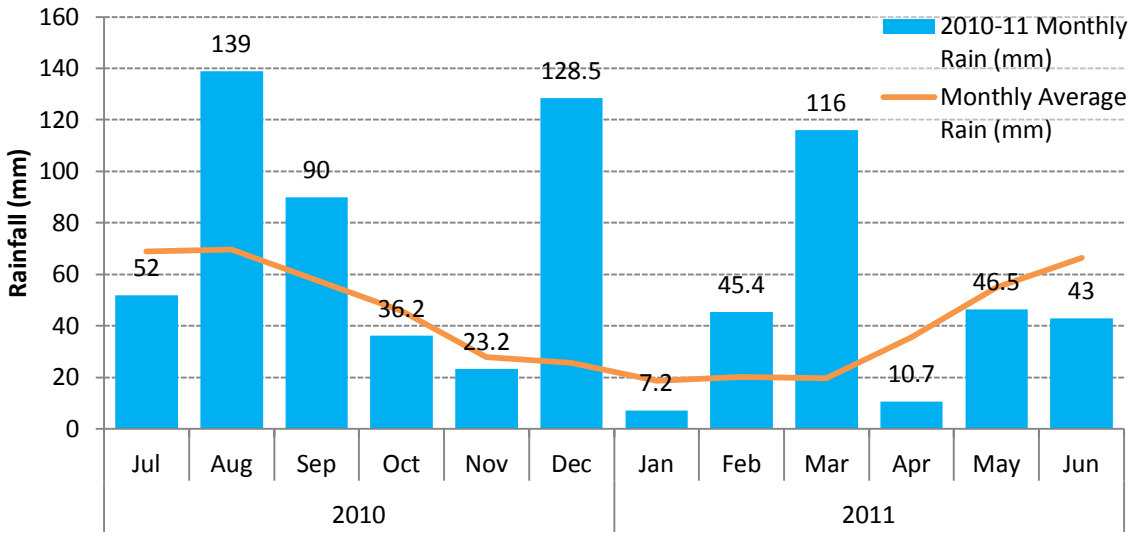


Figure 2. Monthly rainfalls at Keyneton (M023725)

The Cambrai BoM rainfall station recorded 510 mm in 2010–11. Above average rainfall was recorded for six months in the year, with December, February and March receiving well above average rainfall (Figure 3). Monthly average rainfall at Cambrai is lower and has less seasonal variation when compared to Keyneton.

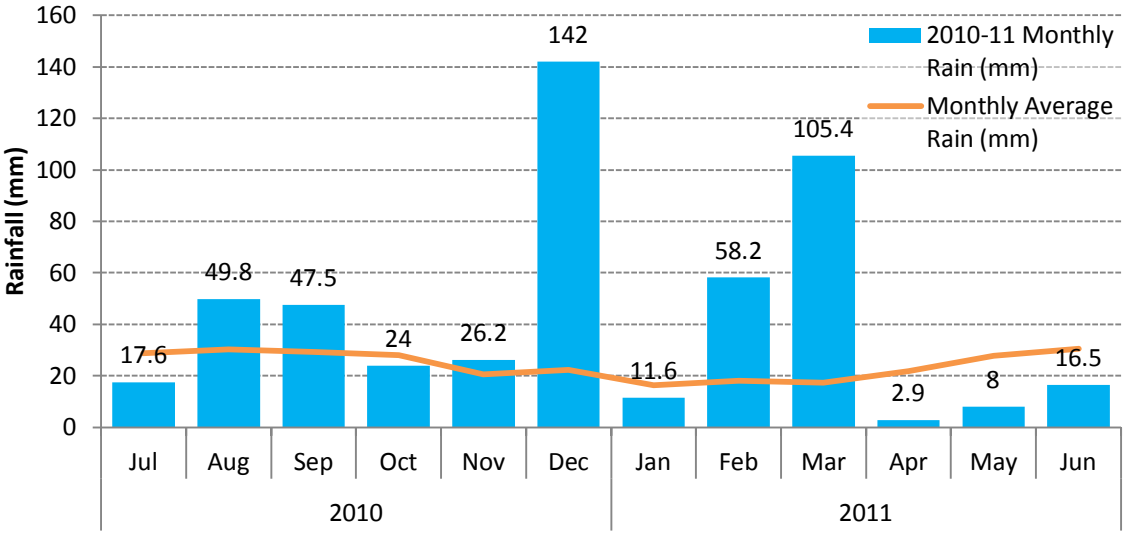


Figure 3. Monthly rainfalls at Cambrai (M024513)

The Mount Pleasant BoM rainfall station recorded 949 mm in 2010–11. Above average rainfall was recorded for six months in the year, with August, September, December, February and March receiving well above average rainfall (Figure 4).

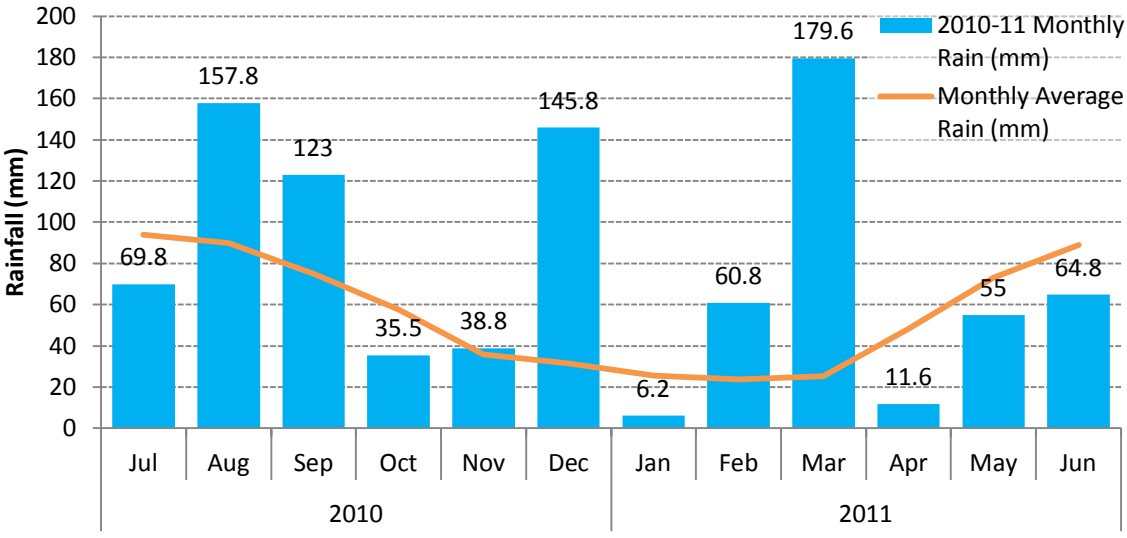


Figure 4. Monthly rainfalls at Mount Pleasant (M023737)

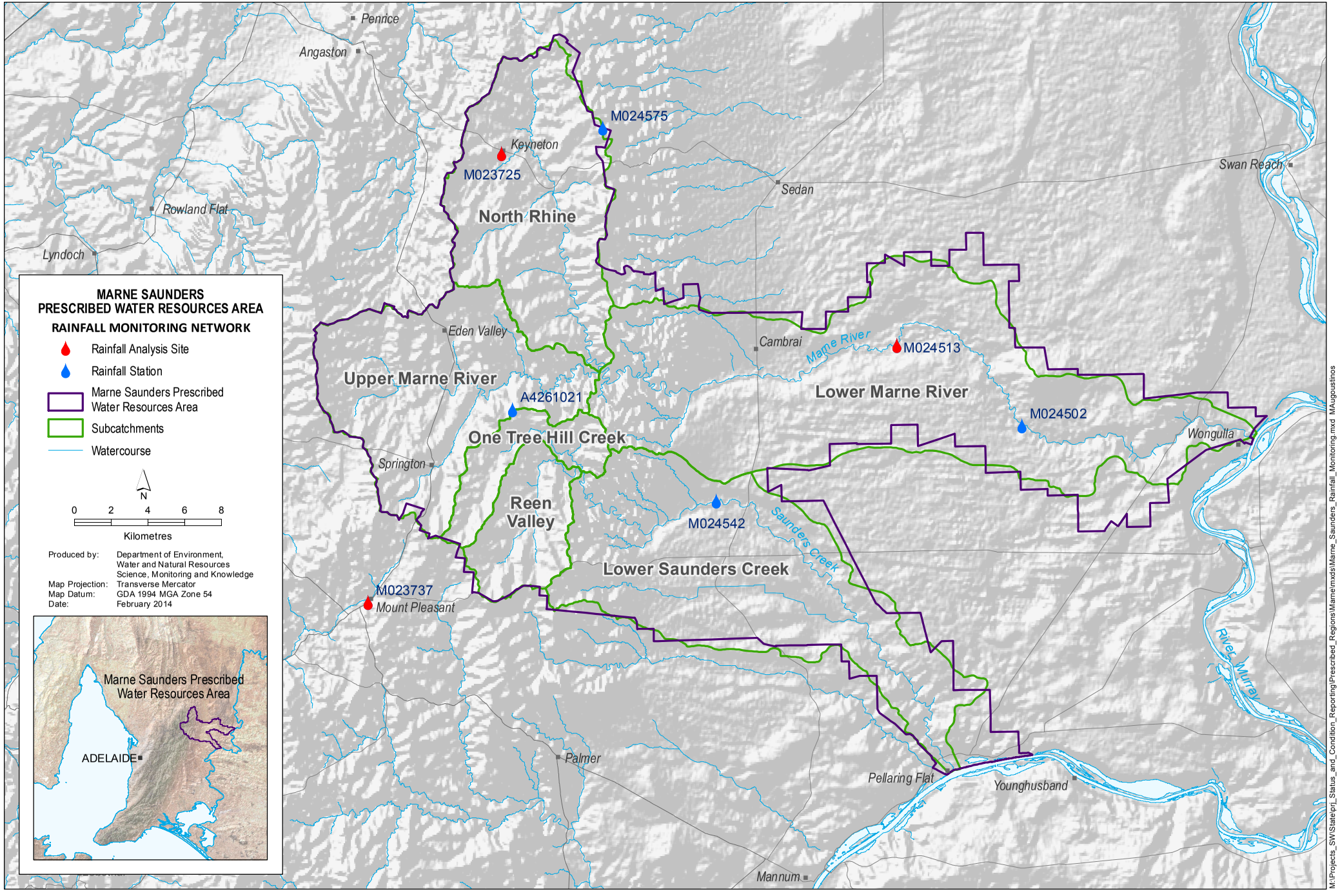


Figure 5. Location of rainfall monitoring sites in the Marne Saunders PWRA

LONG AND SHORT–TERM TRENDS

Figure 6 shows the spatial distribution of rainfall over the PWRA for the:

1. long–term average annual rainfall from 1900–2010
2. short–term average annual rainfall of the previous 10 years (2001–10)
3. annual rainfall for 2010

The three panels of Figure 6 indicate that over much of the PWRA, rainfall for the year 2010 (Panel 3) was above the long and short–term averages (Panel 1 and Panel 2). The PWRA for 2010 received between 400–800 mm of rainfall, with the Lower Marne River and Lower Saunders Creek catchments receiving well above the long and short–term average. Panel 2 shows the average annual rainfall for the years 2001-10 and this shows slightly lower rainfall in the eastern and western parts of the PWRA when compared to the long–term average.

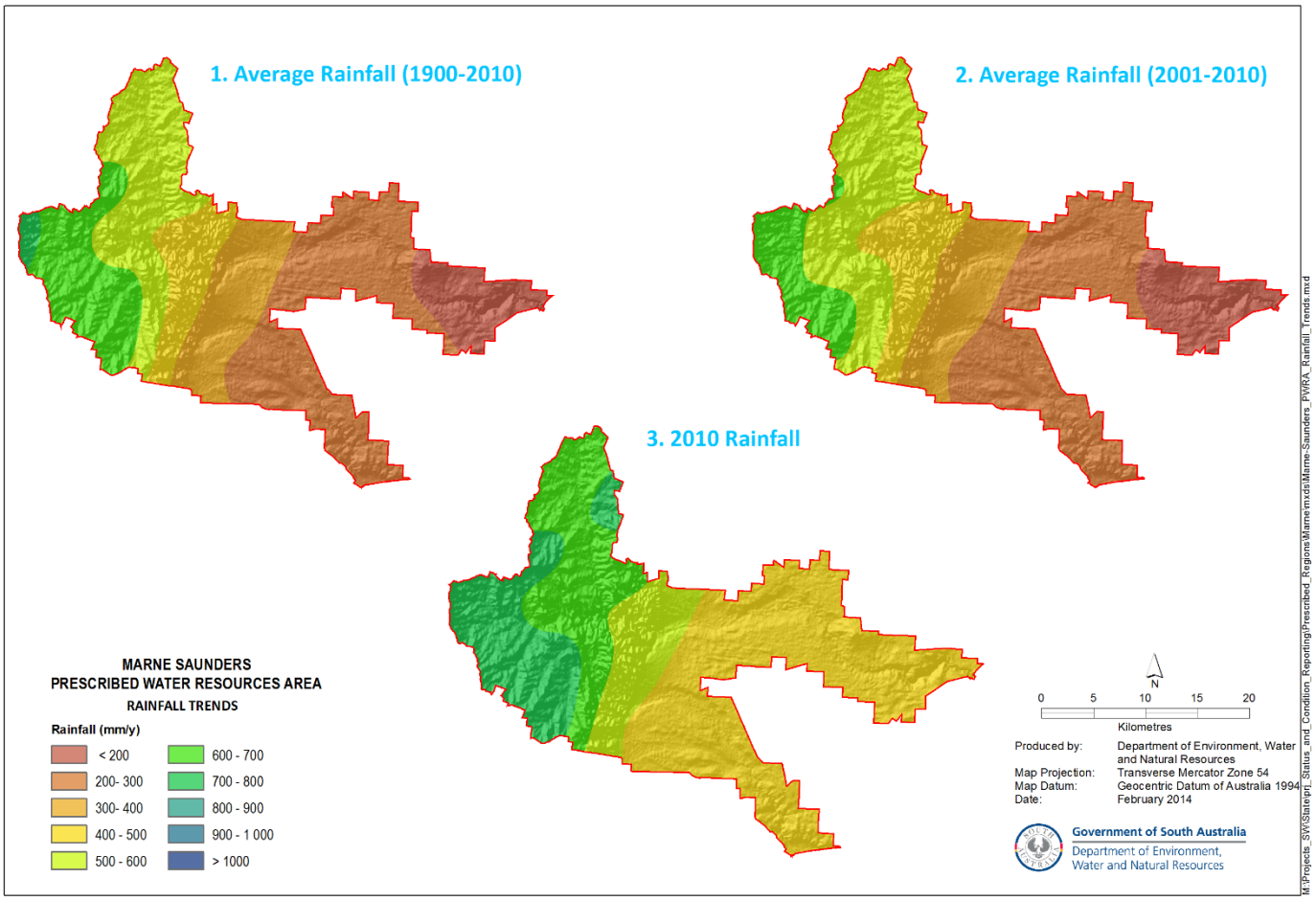


Figure 6. Annual rainfall distributions for the Marne Saunders PWRA

To identify periods of above or below average trends, the cumulative deviation from average annual rainfall (residual mass curve) is plotted in orange on Figure 7 to 9. An upward slope indicates a period of above average rainfall, while a downward slope indicates a period of below average rainfall. Annual rainfall over the PWRA is highly variable.

Cumulative deviation data from Keyneton shows highly variable rainfall trends across the data period (Figure 7). After a period of below average rainfall from 1889, the rainfall from around 1909 to 1925 was predominantly above average before a decrease in rainfall between 1925 and 1945. After 30 years of variable above and below average rainfall from 1945, rainfall from the early 1970s

shows an inclining trend in rainfall followed by another period of below average rainfall. Since the early 1990s, the trend in rainfall at Keyneton fluctuates with a few years of above average rainfall followed by a few years of below average rainfall.

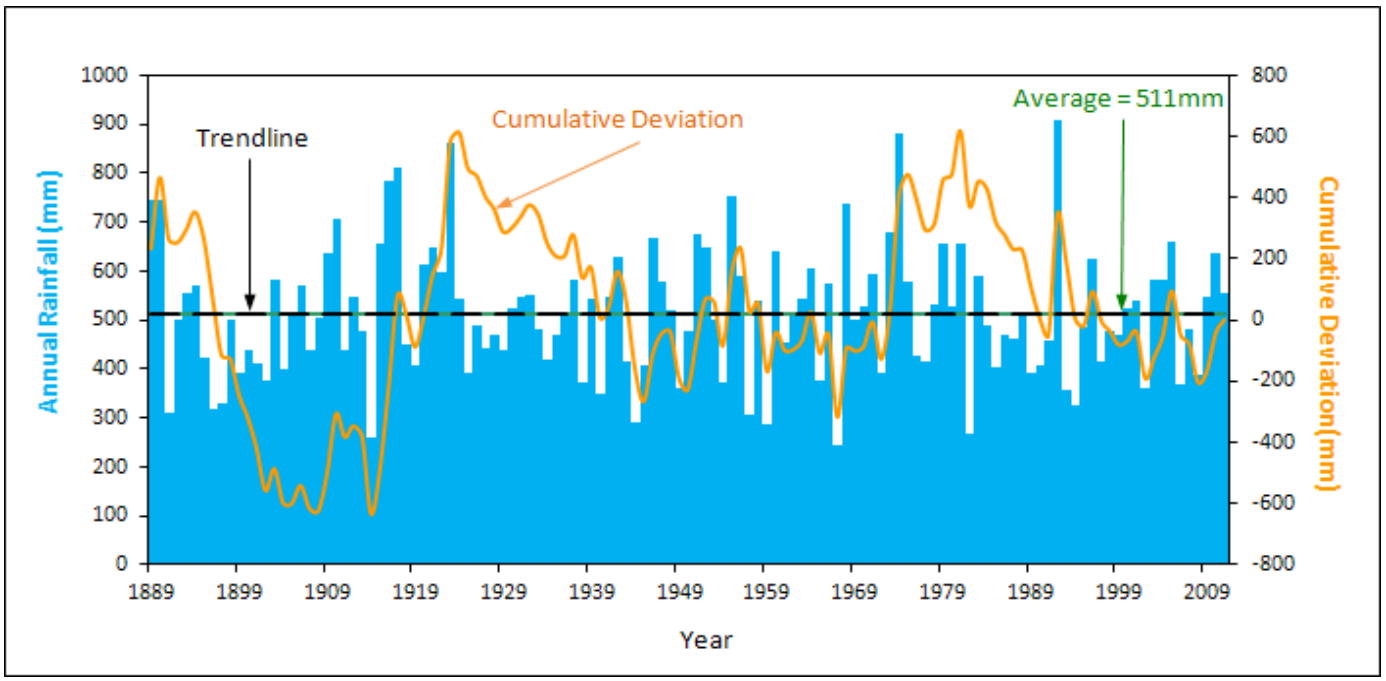


Figure 7. Keyneton annual rainfall showing long–term trend and cumulative deviation

The period of record at Cambrai shows a predominantly declining trend in rainfall between 1889 and 1940. This includes a short period of above average rainfall between the early 1900s and 1910. From 1940, the rainfall shows an inclining trend to the mid 1960s before a slight decline and return to fluctuating above and below average rainfall (Figure 8).

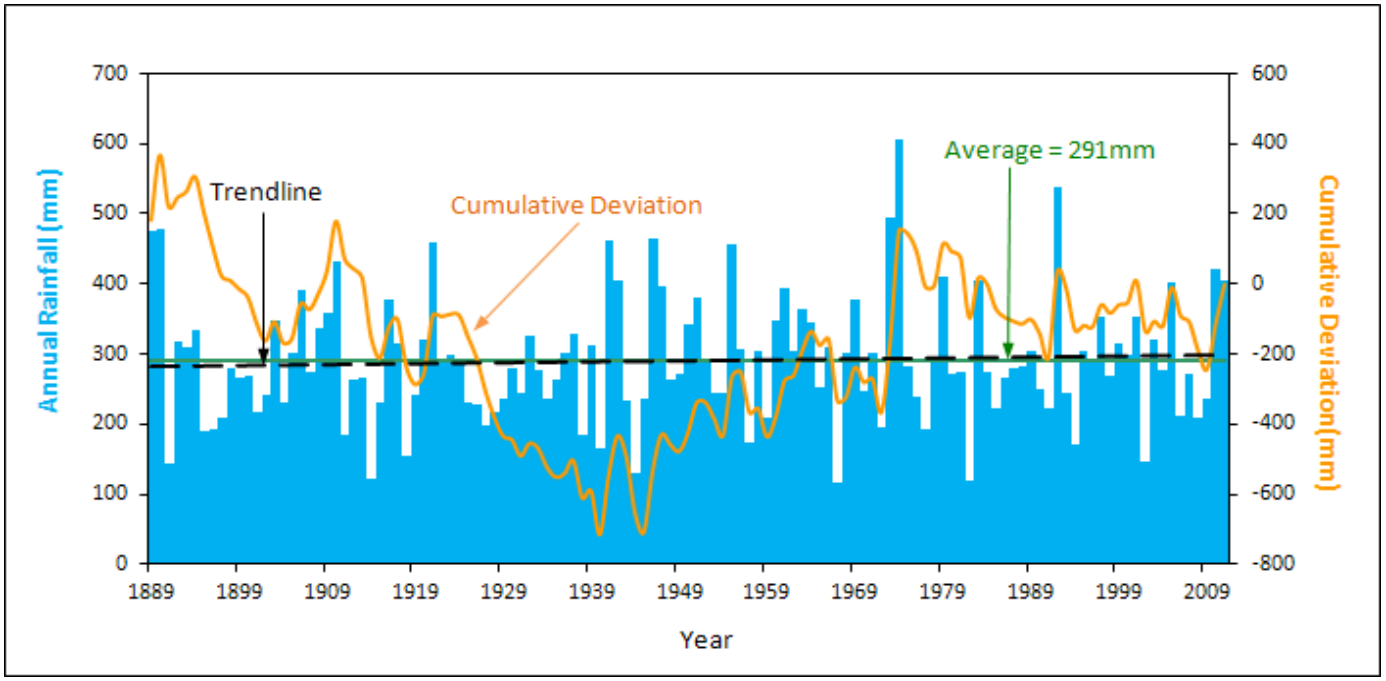


Figure 8. Cambrai annual rainfall showing long–term trend and cumulative deviation

The period of record at Mount Pleasant shows fluctuating above and below average rainfalls between 1889 and 1913 before an inclining trend in rainfall to the mid 1920s. A declining trend in rainfall between the mid 1920s and mid 1940s was followed by an inclining trend to the mid 1970s. From the mid 1970s the rainfall shows a predominantly declining trend (Figure 9).

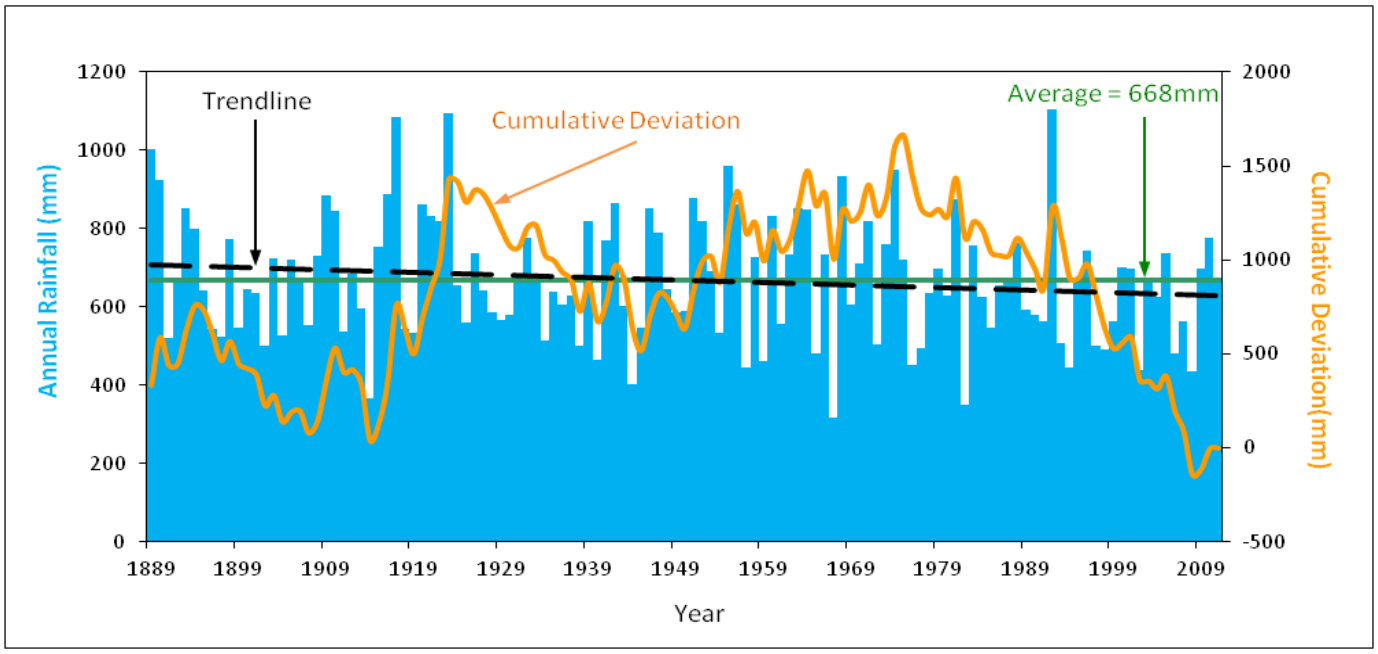


Figure 9. Mount Pleasant annual rainfall showing long–term trend and cumulative deviation

STREAMFLOW

Status	Degree of Confidence	Comments on recent historical context
Above average streamflow at Marne Gorge	High: data derived from long–term streamflow station	Above average streamflow returned to Marne Gorge in 2010–11 for the first time since 2005–06

The streamflow monitoring network for the PWRA is summarised in Table 1 and shown in Figure 10. Parameters recorded at the monitoring sites include water level, streamflow, temperature and salinity. Streamflow data is available via WaterConnect: http://www.waterconnect.sa.gov.au.

There are nine active monitoring stations within the PWRA. The period of record available at each site varies from the early 1970s at Marne Gorge to more recently established stations such as the Saunders Creek in Gorge from 2009. There are six subcatchments within the PWRA, the two largest being Lower Marne River and Lower Saunders Creek (Figure 5). Other subcatchments in the PWRA include North Rhine, Upper Marne River, One Tree Hill Creek and Reen Valley.

The Marne River at Marne Gorge has a gauging station catchment area of 238 km^2 and a mean annual flow of 6095 ML for the period 1973–2010. This period of streamflow is a combination of data from the old (A4260529) and new (A4260605) gauging stations at Marne Gorge. The new gauging station is located approximately 30 m upstream of the old gauging station and commenced monitoring in 2001. Streamflow monitoring at the Saunders Creek in Gorge gauging station commenced in August 2009. This station has a catchment area of approximately 66 km^2 and in 2010–11 the recorded streamflow was 670 ML.

The remaining monitoring stations are water level detectors, located primarily along the lower reaches of the Marne River and the Saunders Creek, to better understand and predict water flow in these losing reaches (SAMDBNRMB 2010).

The majority of streamflow in the PWRA is generated in the upper subcatchments where rainfall is greatest. Little runoff occurs in the lower subcatchments and any streamflow that occurs here has generally flowed down from the upper subcatchments. As flows into the River Murray from the Marne River and the Saunders Creek are now uncommon, it is believed that a large proportion of lower subcatchment streamflow is lost through recharge of the underlying aquifers (SAMDBNRMB 2010).

Table 1. Summary of monitoring stations in the Marne Saunders PWRA

Monitoring station	Station No.	Period of Record	Average annual streamflow	
			ML	mm
North Rhine River near Kappalunta	A4261014	2001-10	-	-
Marne River d/s Jutland Rd Crossing	A4261030	2002-10	-	-
Marne River at Marne Gorge	A4260605	1973-10	6095	26
Marne River u/s Redbanks Rd Ford Crossing	A4261007	2001-10	-	-
Marne River u/s Black Hill Springs	A4261011	2001-10	-	-

Gauging station	Station No.	Period of Record	Average annual streamflow	
			ML	mm
Marne River at Black Hill Springs	A4261104	2006-10	-	-
Saunders Creek in Gorge	A4261174	2009-10	*	*
Saunders Creek d/s Gorge	A4261100	2006-10	-	-
Saunders Creek at Lenger Reserve	A4261029	2002-10	-	-

-Water level only

*Only 1 year of data was available to 2010 so no average is given

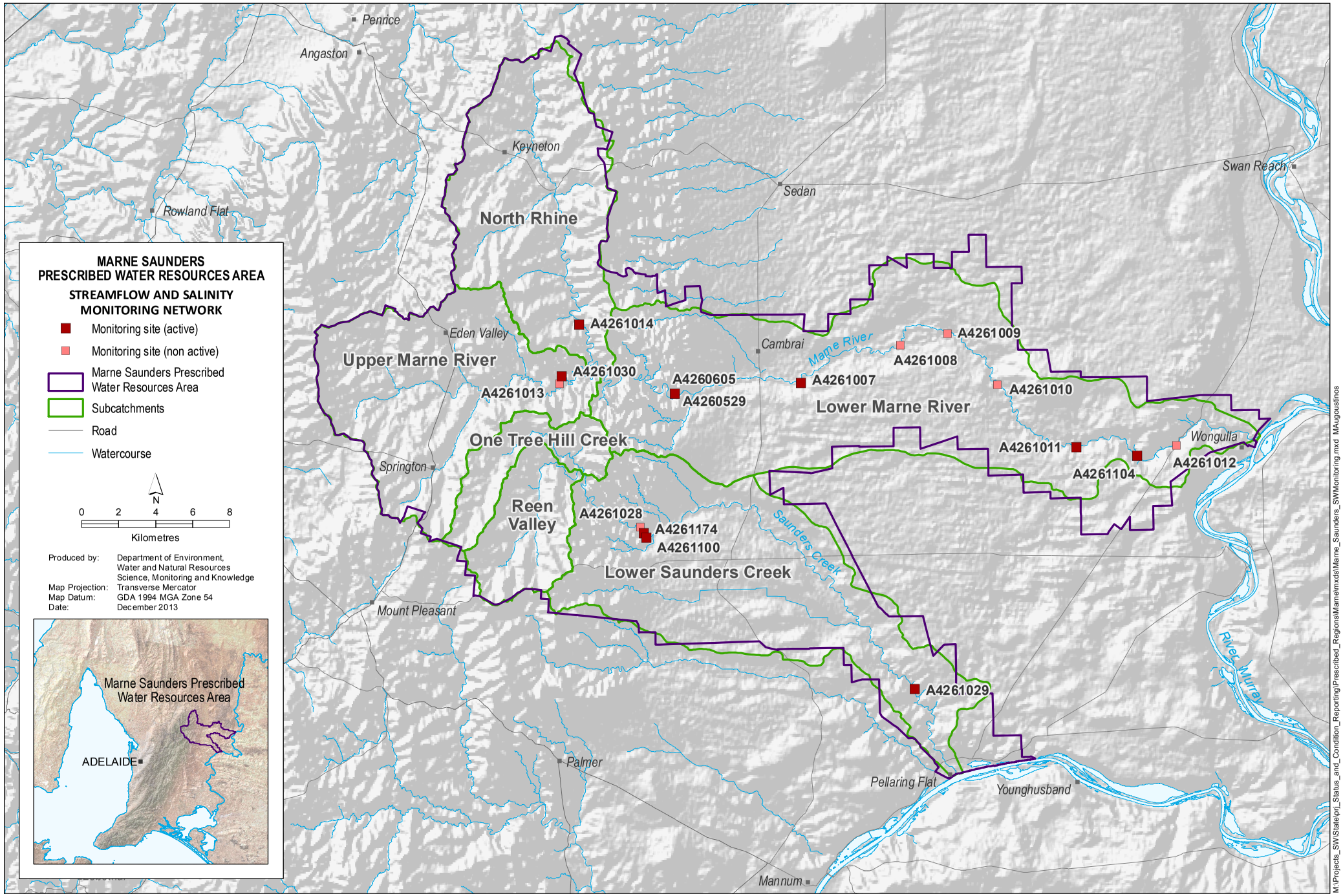
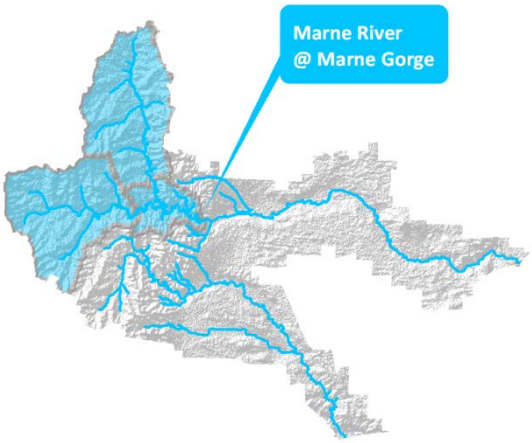


Figure 10. Location of streamflow and salinity monitoring sites in the Marne Saunders PWRA

STREAMFLOW DATA – MARNE RIVER AT MARNE GORGE



The Marne River at Marne Gorge experienced an above average annual streamflow for 2010–11, as highlighted in green in Figure 11. The 7890 ML total was 29% higher than the 6095 ML long–term average. Prior to above average flows in 2010–11, Marne Gorge experienced below average streamflow since 2006–07. During the thirty eight year period since 1973–74, seventeen of these years had streamflows that were above the long–term average. Since 1992–93, an eighteen year period, above average streamflows were observed for only five years.

The monthly breakdown of streamflow for 2010–11 (Figure 12) highlights that September and December were both well above average. September alone contributed 62% of the annual total, December contributing 25% of the annual total and more than sixteen times the average for that month. All other months recorded below average streamflow.

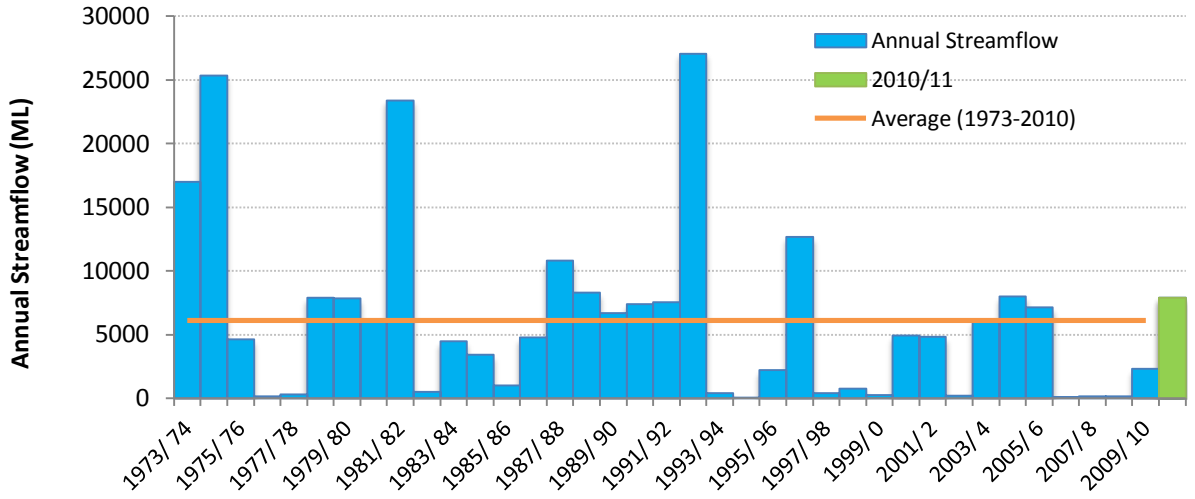


Figure 11. The Marne River at Marne Gorge annual streamflow (ML)

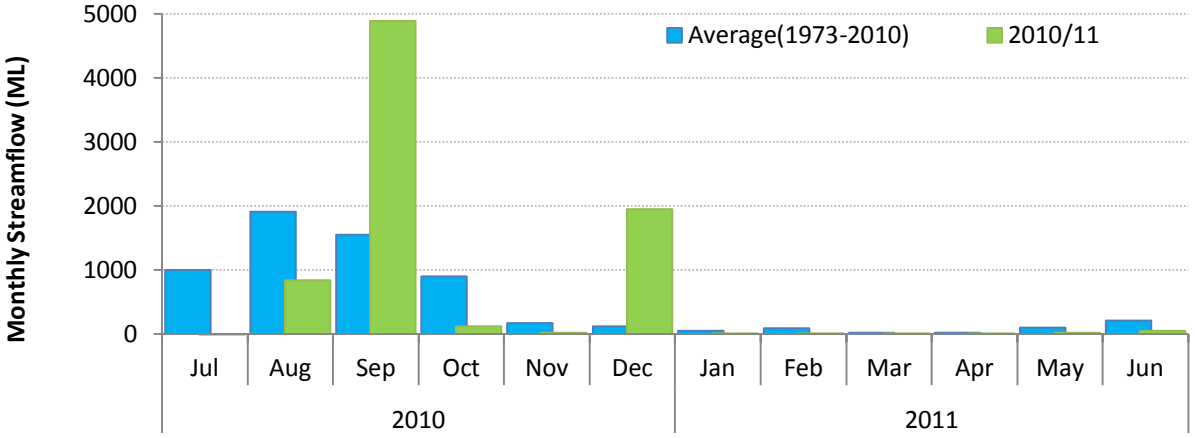
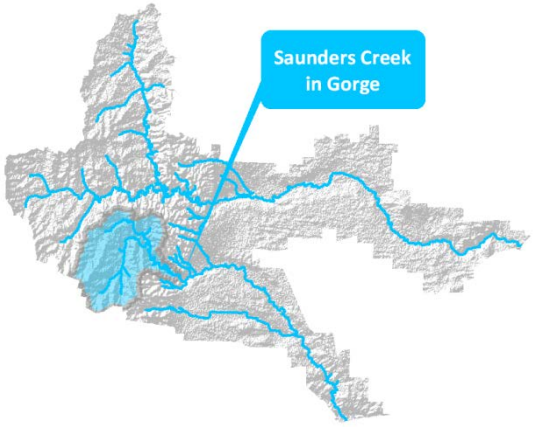


Figure 12. The Marne River at Marne Gorge monthly streamflow (ML)

STREAMFLOW DATA – SAUNDERS CREEK IN GORGE

The Saunders Creek in Gorge gauging station commenced operating in August 2009 and 670 ML of streamflow was recorded for 2010–11, as highlighted in green in Figure 13. The 670 ML total was considerably higher than the 60 ML of streamflow recorded during 2009–10.



The monthly breakdown of streamflow for 2010–11 (Figure 14) highlights that September, December and March contributed the majority of the total streamflow. September alone contributed 74% of the annual total, with December contributing 20%. No flow was recorded in the months of July, November, January and February. Recorded flow in the other months was negligible.

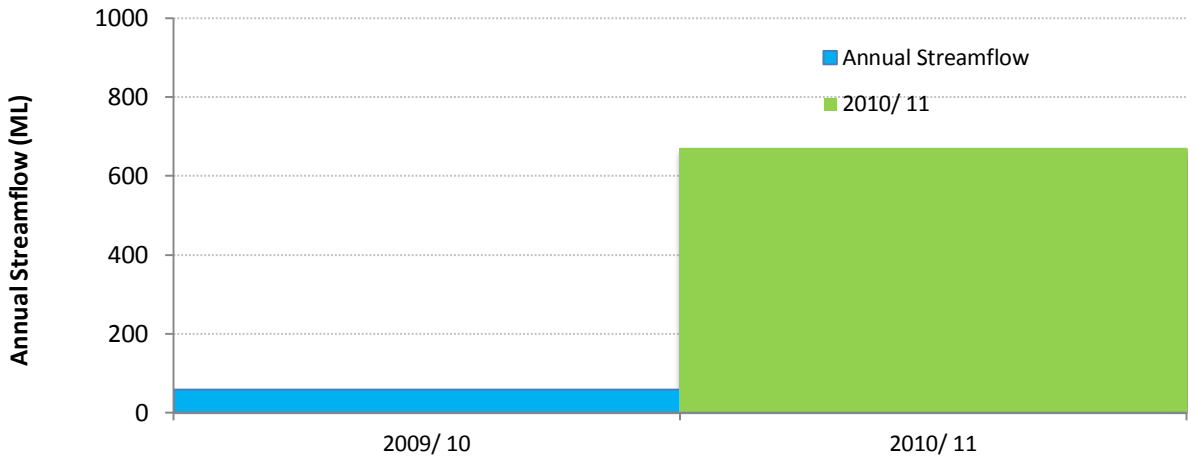


Figure 13. The Saunders Creek in Gorge annual streamflow (ML)

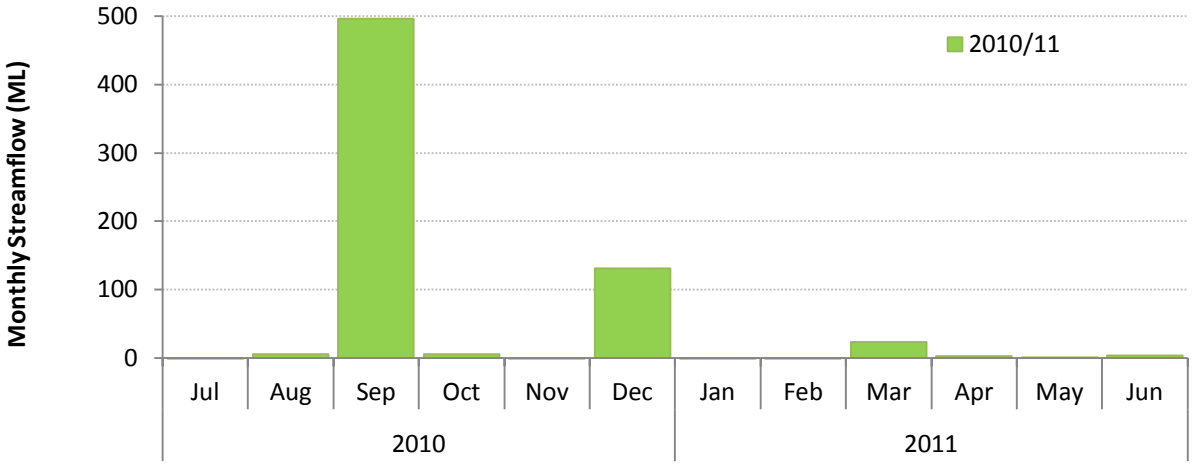
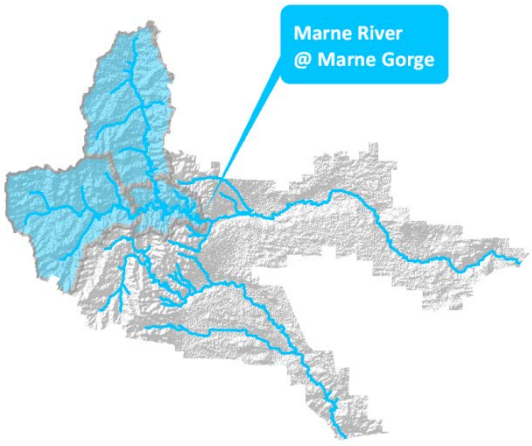


Figure 14. The Saunders Creek in Gorge monthly streamflow (ML)

SALINITY

Status	Degree of Confidence	Comments on recent historical context
Freshening salinity at Marne Gorge	High: data derived from long–term salinity monitoring at Marne Gorge	Above average rainfall and streamflow during 2010-11 ensured the high range of salinity was less than previous years of the data record

MARNE RIVER AT MARNE GORGE



Salinity data have been recorded at the Marne River at Marne Gorge since 2001. Despite some data gaps with no recorded information, the station provides a good indication of salinity (TDS) variation in the river from July 2002–June 2011 (Figure 15).

The station drains 238 km^2 of the PWRA. Prior to archiving in Hydstra, DEWNR's surface water archive, data is coded according to the relative quality of the time series data. For Marne River at Marne Gorge, 58% of the recorded salinity data are rated as good or fair quality and 42% as either missing or outside the recordable range. Data rated as missing or outside the recordable range includes low or cease-to-flow periods where the salinity probe is above the height of water and unable to register a measurement.

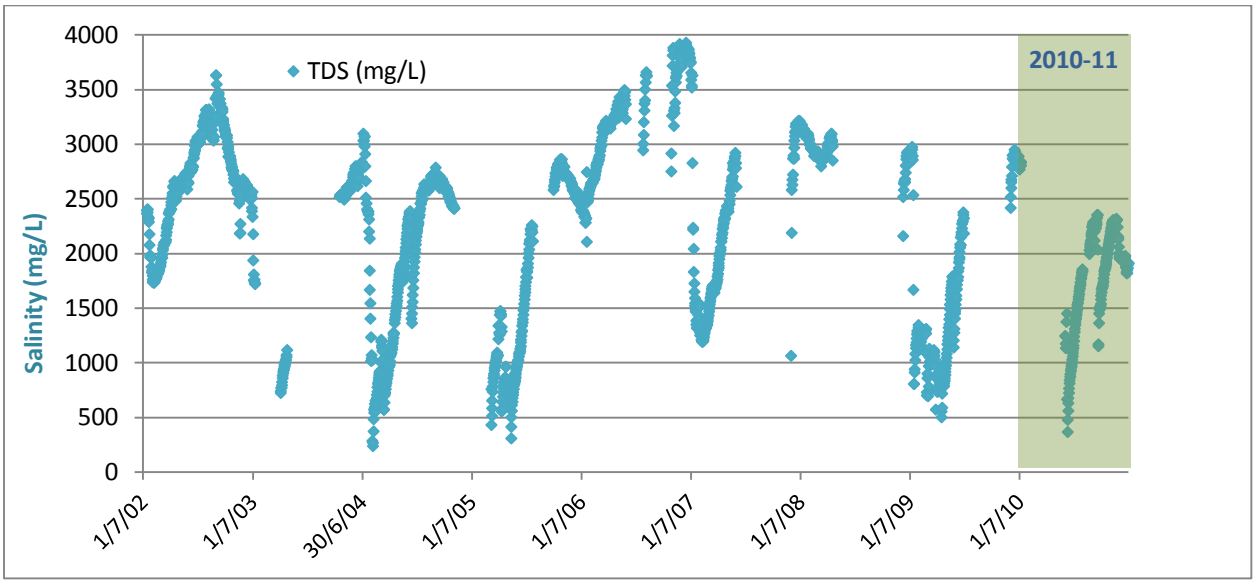
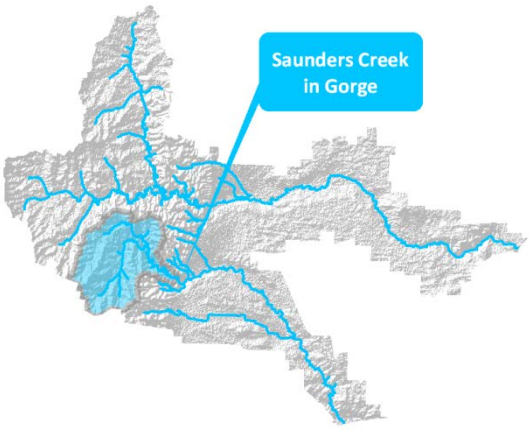


Figure 15. Salinity data at the Marne River at Marne Gorge from 2002-11

The range of salinity data is broad. Of the record from 2002–11, 10% was recorded as <1000 mg/L, 40% of the record was between 1000–2500 mg/L and 50% between 2500–4000 mg/L. The salinity range in 2010–11 is similar to 2009–10 but the high range was less saline when compared to previous years. A high value of 3929 mg/L occurred during June 2007 (a period of reduced streamflow) while a low of 242 mg/L occurred during August 2004 (a period of increased streamflow). Salinity data is available via WaterConnect: http://www.waterconnect.sa.gov.au.

Low stream salinity is often associated with high flow events, although analysis of salt load discharged from the Marne River by Jolly *et al.* (2000) and Hyder Consulting (2007) shows the highest amount of total salt is exported in higher flow years (SAMDBNRMB 2010).

SAUNDERS CREEK IN GORGE



Salinity data have been recorded at the Saunders Creek in Gorge since 2009 (Figure 16). The record is currently not long enough to provide a good indication of salinity (TDS) in the creek. The high range of salinity is higher than that recorded at Marne Gorge.

The station drains 66 km^2 of the PWRA. 40% of data recorded are rated as good or fair quality and 60% as either missing or outside the recordable range. Data rated as missing or outside the recordable range is inclusive of reduced or cease-to-flow periods where the salinity probe is above the height of water and unable to register a measurement. As salinity is expected to be higher during reduced streamflow events, the ability to monitor potentially higher salinities is reduced.

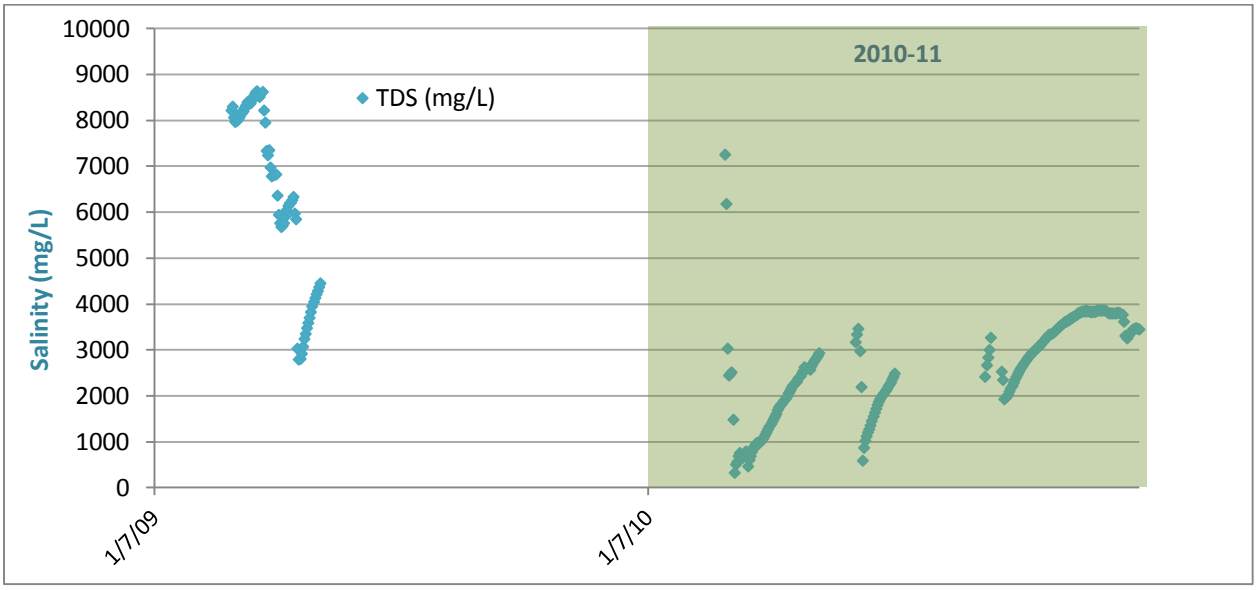


Figure 16. Salinity data at the Saunders Creek in Gorge from 2009-11

Of the salinity record from 2009–11, 8% was recorded as <1000 mg/L. 26% of the record was between 1000–2500 mg/L and 45% between 2500–4000 mg/L. 21% of the record was above 4000 mg/L. A historical high value (for the period of record) of 8633 mg/L occurred during September 2009 while a low of 321 mg/L occurred during September 2010.

SURFACE WATER USE

Status	Degree of Confidence	Comments on recent historical context
Negligible use	Medium-High: medium confidence in data that was estimated, high confidence in metered data	Surface water use decreased in 2010-11 in comparison to use reported in 2009-10 (921 ML; 28% of total streamflow)

This section includes description and estimates of the type and distribution of farm dams and use in the PWRA. Groundwater use is described in the Groundwater Level and Salinity Status Report available for this region on the WaterConnect website: http://www.waterconnect.sa.gov.au.

Surface water use for irrigation, industrial, recreational, stock and domestic purposes comes from a variety of sources including pumping from streams and rivers, rainwater capture and interception and storage by farm dams. Licensed water use is managed by the WAP for the PWRA, which is administered by the Department of Environment, Water and Natural Resources. The allocation limit for surface water and watercourse water in the PWRA, as stated in the WAP, is approximately 1285 ML and has been set as the total volume of water allocated to existing users. This means that the surface water and watercourse water resources are currently fully allocated and no new allocations will be made under the current WAP.

FARM DAMS

The Marne Saunders WAP (SAMDBNRMB 2010) states that total capacity of farm dams in the PWRA is estimated to be 3778 ML. A breakdown of farm dam statistics from the WAP is given in Table 2 below for licensed irrigation and non-licensed stock and domestic dams. Farm dam volumes were estimated by measurements from aerial photography (from 2005) and where available, dam wall heights and dam surveys provided by landholders.

Table 2. Summary of farm dams in the Marne Saunders PWRA

Catchment	Volume (ML)		
	Licensed Irrigation	Non-Licensed Stock and Domestic	Total Volume
Marne River	1869	1356	3225
Saunders Creek	257	296	553
Total	**2126**	**1652**	**3778**

As irrigated water use from farm dams and watercourse extractions are metered, those numbers are reported in the following section on surface water use.

SURFACE WATER USE 2010-11

Water use includes irrigated water use from surface water and watercourses and estimated non-licensed surface water demand.

Estimated non-licensed surface water demand

Existing stock and domestic dams are not managed through the Marne Saunders WAP (i.e. the volume taken from them is not limited to an allocated volume and they are not metered), therefore an estimate is used to report on non-licensed water demand. The estimated non-licensed water demand is 496 ML. This volume is based on estimating these needs as 30% of non-licensed dam capacity, as used in water accounting calculations in the Marne Saunders WAP (SAMDBNRMB 2010). This means that as long as the estimated non-licensed dam capacity remains unchanged from one year to the next, so too will the estimated non-licensed surface water demand, irrespective of variations in annual rainfall and streamflow. As such, the limitations of this estimation method should be kept in mind when considering estimated non-licensed surface water demand, especially when considered alongside metered licensed use data.

Licensed surface water demand

Water usage from licensed surface water sources in 2010–11 totalled approximately 302 ML (Table 3 and Figure 17), which is down from the previous year's total of 425 ML. This includes a decrease in water use from licensed dams but an increase in watercourse extractions. It is suspected that water use is down due to above average summer rainfall received in December and March, which may have reduced irrigation requirements for crops during the normal irrigation season. The increase in watercourse extractions in 2010–11 may be due to the absence of larger streamflow events in 2009–10 compared with the higher streamflows observed in September and December 2010–11 (refer Figures 12 and 14).

Table 3. Summary of surface water use in the Marne Saunders PWRA

		2009–10	2010–11
Marne Saunders PWRA surface water resources (ML)	Watercourse extractions	<1	59
	Surface water extractions (licensed farm dams)	424	243
	Total licensed extractions*	**425**	**302**
	Estimated non-licensed water demand	496	496
Total water extractions (ML)		**921**	**798**

*This value refers to metered extraction only.

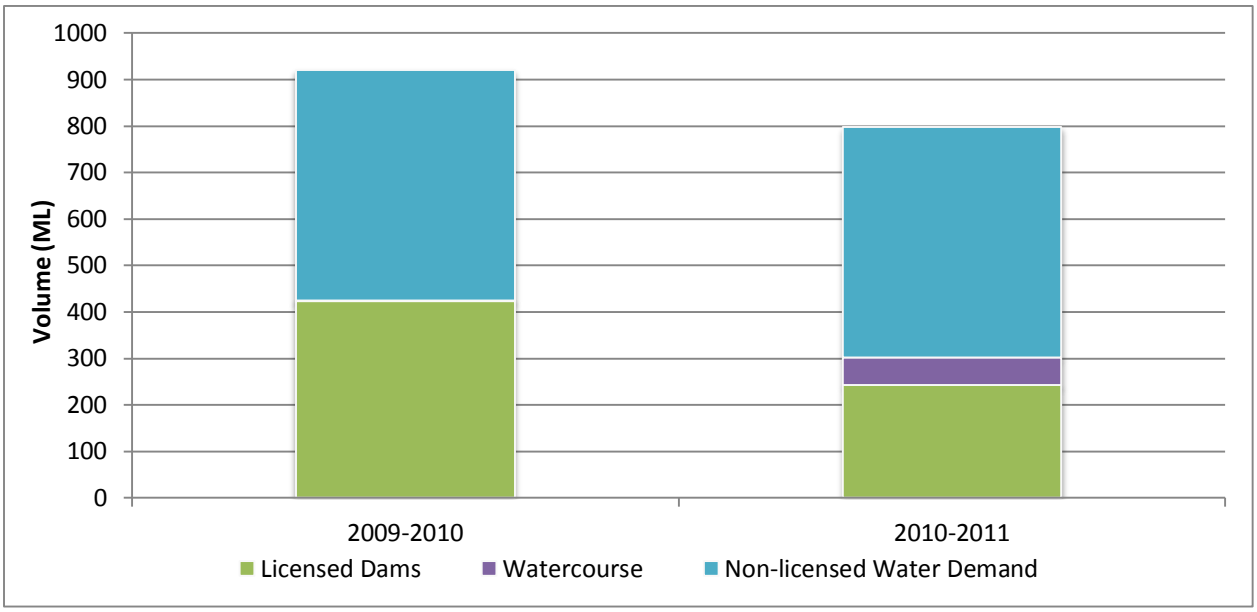


Figure 17. Surface water use in the Marne Saunders PWRA from 2009-11

USE RATING

An assessment of use was carried out using a rating from 1 to 6 to indicate the estimated percentage of the year's surface water resources used for irrigation, commercial, or stock or domestic purposes. This annual approach is slightly different to that used in the State's NRM Plan 2006 water allocation and management guidelines, which stipulate that 25% of median annual adjusted runoff is considered to be an indicator of sustainable use limits, outside prescribed areas, until additional information becomes available. This is to protect the needs of downstream users, including water dependent ecosystems. In prescribed areas, use limits are defined in the various WAP's developed by NRM Boards and currently range between 15–30% and are generally based on long–term average values. The 25% rule is consistent with peer reviewed independent scientific studies in south eastern Australia (SKM 2003, RMCWMB 2003). As such, Table 4 was developed whereby 25% of streamflow used is considered moderate (21–30%). Any percentage of streamflow used greater than 30% is considered high, very high or extreme and therefore above use limit guidelines.

The year 2010–11 was an above average rainfall year, which produced above average runoff to the rivers and creeks of the PWRA. In order to determine the impact of water extractions, a comparison of recorded streamflow and recorded and estimated water use is provided below.

Recorded streamflow for the PWRA in 2010–11 (recorded at the Marne Gorge and the Saunders Creek) was approximately 8560 ML (7890 plus 670), with approximately 798 ML recorded or estimated as being extracted. As such, of the 9358 ML (8560 plus 798) 2010–11 total estimated PWRA streamflow volume (not including evaporation from farm dams), it is estimated that 9% was extracted for use (28% in 2009–10). In terms of the rating system described by Table 4, the PWRA has been assigned a use rating of 1 (Negligible use) for 2010–11.

Table 4. Use Rating System

Rating	% of streamflow used in current year	Description
1	0 – 10 %	Negligible use
2	11 – 20 %	Low use
3	21 – 30 %	Moderate use
4	31 – 40 %	High use
5	41 – 50 %	Very high use
6	Greater than 50 %	Extremely high use

WATER DEPENDENT ECOSYSTEMS

This status report for the Marne Saunders PWRA does not include an assessment of aquatic ecosystem condition and trend. However, it is important to recognise the ecological components of the watercourses in the area. The Marne River and the Saunders Creek are ephemeral systems with permanent pools dispersed along their length, which are thought to be dependent on groundwater (SAMDBNRMB 2010). Permanent pools provide a refuge for aquatic flora and fauna during periods of surface water disconnection (no flow) (SAMDBNRMB 2010). Increasing times in isolation leads to deterioration of the water quality and hence, the viability of the habitat as a refuge (VanLaarhoven and Van Der Wielen 2009).

The aquatic and riparian vegetation within the PWRA is generally limited to common dryland species; a total of 74 species of plants have been recorded in the Marne River catchment and 46 in the Saunders Creek catchment (SAMDBNRMB 2010), of which a significant portion are exotic (20 species and 10 species respectively). The areas between the permanent pools are dominated by terrestrial grasses and semi-aquatic plants such as sedges and rushes, while Bulrush (*Typha domingensis)* and Common Reed (*Phragmites australis)* dominate the area in and around the permanent pools. There are several species of conservation concern including Spikey Club-rush (*Schoenoplectus pungens*), Ribbon weed (*Vallisneria americana*) and several species of sedges (*Isolepis spp.*) (SAMDBNRMB 2010). The over storey is mainly remnant river red gums (*Eucalyptus camaldulensis*) with patches of short-leaf honey myrtle (*Melaleuca brevifolia*).

The macroinvertebrate community is limited to species tolerant of variable environmental conditions. Sampling has been undertaken in these catchments as part of the Environment Protection Authority's (EPA) aquatic ecosystem condition reporting. In the 2010 sampling period, ten species of macroinvertebrate were collected in the Marne River near Walker Flat with the community being dominated by mosquito larvae (EPA 2010a). The overall community sampled by the EPA (2010a) consisted of early colonisers tolerant of saline conditions. A more diverse community was collected in the Marne River near Cambrai. A total of 21 species were collected, all of which were tolerant of poor water quality, though salinity levels were moderately fresh (EPA 2010b). There were 19 species of macroinvertebrate collected from the Saunders Creek in the 2010 sampling period (EPA 2010c). The community was dominated by species tolerant of higher salinity levels and poor water quality (EPA 2010c). The main species present were corixid waterbugs, amphipods and leptocerid caddisflies. Some larger predatory species were also found such as Dragonfly and Damselfly species.

The fish community within the PWRA varies between the hills and plains zones. Surveys undertaken in 2011 by Aquasave (N. Whiterod, Unpub. data) have identified the native Mountain Galaxias (*Galaxias olidus*) in the hills area of the Marne River, and several native species of fish in the permanently flowing Black Hill Springs area on the plains of the Marne River, including Carp Gudgeon (*Hypseleotris klunzingeri)*, River Blackfish (*Gadopsis marmoratus*), and Dwarf Flathead Gudgeon (*Philypnodon macrostomus*). River Blackfish and Mountain Galaxias are considered to be species of conservation concern in South Australia (Hammer, Wedderburn and van Weenen 2009). Non-native fish were only found in the Black Hill Springs area of the Marne River and include Carp (*Cyprinus carpio*) and Mosquito Fish (*Gambusia holbrooki*) (N. Whiterod, Unpub. data). At the time of fish surveys in 2008–09, it was observed that, despite generally improved water quality across the Marne River and the Saunders Creek, it appeared insufficient time had passed for recolonisation of many upstream reaches since local-scale population losses of Mountain Galaxias during the drought of the mid to late 2000s (Hammer, Wedderburn and van Weenen 2009). Further investigations would be required to determine if the system has become reconnected for dispersal with the large flow events of 2010-11 and also if any barriers may be present that are preventing the recolonisation of these species throughout the PWRA following drought-driven fragmentation.

Surveys undertaken in 2011 on the Saunders Creek by Aquasave (N. Whiterod, Unpub. data) identified both the native Carp Gudgeon (*Hypseleotris klunzingeri*) and the exotic mosquito fish (*Gambusia holbrooki)* in the lowland part of the catchment at the spring-fed section near Lenger Reserve.

Threats to the aquatic ecosystem in the PWRA include large numbers of exotic species (particularly weeds), limited riparian vegetation, diffuse nutrient input and reduction in flow, including increased periods of no flow between permanent pools.

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