Adaptive Management Fact Sheet

Draft amended Barossa Water Allocation Plan

The draft amended Barossa Water Allocation Plan (the Plan) takes into account the high level of water use and storage that, combined with a changing climate, is placing pressure on the availability of water resources for all users, including the environment. Preliminary results of recent modelling indicate a reduction in resource capacity of at least 25%.

The Plan introduces a flexible and adaptable management approach that aims to minimise the risk of decline in water resources, and in the condition of water-dependent ecosystems, while maximizing the water available in a sustainable manner. While the Plan goes some way to manage issues currently facing water resources in the Barossa, ongoing scientific and economic investigations will help inform future management options being considered to improve the long- term sustainability of water resources.

The flexible and adaptable management approach will continue to be informed by emerging data and information, and this Updated Adaptive Management Fact Sheet has been produced to provide the most up to date surface water and groundwater data to provide confidence in the process and transparency for licence holders. The adaptive management framework employs a tiered approach, managing the level of risk to supply equity between all users (including the environment). This is based on a series of flow metrics (for surface water) and trigger levels (for both surface water and groundwater) that will be used to provide recommendations to the Minister regarding necessary variations to the volume of water available to be allocated. Each of the components used in the development of this framework is covered in more detail within the Plan (principally section 6.5). It is important to note that the Minister has discretion over this framework and could vary the framework or employ other processes should it be deemed necessary.

The water monitoring data collected across the Barossa PWRA will continue to be collated and assessed between December and February each year. Based on the assessment, a management response will be recommended to the Minister, following the framework in the Plan. Under the framework, the volume of water allocated can be varied by changing the value of a water access entitlement share (further detail is provided in section 6.3. of the Plan).

Tables explained

1 High level summary of the adaptive management framework for the prescribed surface water, watercourse water and groundwater resources of the Barossa Prescribed Water Resources Area.

2 Flow metrics

3 Updated Flow metrics and Pool assessments passed for surface water zones during 2022-2024

4 Updated Post Winter Pressure Levels for 2023 and 2024, Resource Condition Triggers (RCT), Resource Condition Limits (RCL), and Top and Base of Confining Layer for the updated monitoring bores of the Lower Aquifer in the Barossa PWRA

Table 1: High level summary of the adaptive management framework to be implemented at the consumptive pool scale for the prescribed surface water, watercourse water and groundwater resources of the Barossa PWRA to be implemented at the consumptive pool scale.

Green, red and yellow shading in Table 1 explained on next page. It reflects meeting the assessment criteria and likely impacts on annual allocations.

Resource	Applicable trigger	Management response
Surface water and watercourse tier 1	All flow metrics being met No permanent pool or intermittency triggers reached	• When all flow targets (18 out of 18) are being met within a consumptive pool, it is considered that the risk to equity of supply between users and environmental risk is low, therefore surface water and watercourse allocations will be equivalent to 100% of entitlement value. • Flow targets are based on the flow observed in the Barossa PWRA over the period 1997 to 2016 (see section 3 of the Plan for details). • **This will likely require several above average rainfall/flow years in succession to reach this point.**
Surface water and watercourse tier 2	Between 10 and 17 flow metrics being met No permanent pool or intermittency triggers reached	• When between 10 and 17 of the 18 flow targets are being met within a consumptive pool, surface water and watercourse allocations will be equivalent to 75% of entitlement value. • The reduction in allocation rate is reflective of the reduction in the average volume of water available across the Barossa PWRA since entitlements were issued (see section 2 of the Plan for details). That is, since entitlements were issued, there is at least 25% less surface water available on average, therefore under average conditions all water users share this reduction. • **It is likely that this is the tier the Plan will operate under for most years (i.e. under average conditions).**
Surface water and watercourse tier 3	Less than 10 flow metrics being met OR Any permanent pool or intermittency triggers reached	• When less than 10 of the flow targets are being met or any of the other surface water thresholds are triggered within a consumptive pool (see section 3 of the Plan), surface water and watercourse allocations will be reduced in line with recent water availability conditions. • Reductions will be based on the average reduction in available water over the preceding three years relative to when entitlements were issued. • Allocation rates will be assessed each year and updated based on the number of metrics passing and the inclusion of the most recent full year of flow data.
Groundwater tier 1	Aquifer water/pressure levels show suitable winter recovery	• Should no groundwater pressure or level triggers within a consumptive pool have been breached (see section 2 for more details), allocations will be equivalent to 100% of entitlement value.
Groundwater tier 2	Aquifer water/pressure levels do not show suitable winter recovery in a single year	• When water/pressure levels in the aquifers do not show sufficient winter recovery in a given year within a consumptive pool, notice will be provided to the relevant licence holders to inform them of the initial breach of the trigger level, though no reductions will be made.
Groundwater tier 3	Aquifer water/pressure levels do not show suitable winter recovery across subsequent years	• If water/pressure levels in the aquifers do not show sufficient recovery in a second year, the volume of water available for allocation will be reduced. The rate of reduction will be based proportionally to a value that results in the total volume of allocations issued for the Consumptive Pool not exceeding the resource extraction limit (see section 6.5 and Table 2.4 in the Plan). • Should subsequent years show sufficient winter recovery in water/pressure levels such that triggers are no longer breached, allocations will return to 100% of entitlement value.

Surface/watercourse water adaptive management

To assess the environmental water requirements (EWRs) for the surface water-dependent ecosystems (WDEs), flow metrics were developed to quantify the different parts of the flow regime that are ecologically relevant. The six metrics used in this Plan (see Table below) were developed specifically for the Barossa PWRA. The relevant bounds for these flow metrics were initially defined using a baseline period of 1997 to 2016 as this was identified as a period where the WDEs of the Barossa PWRA were considered to be in a stable state. Each year there are six metrics assessed per consumptive pool zone. Given that the WDEs of the Barossa PWRA are adapted to a variable climate, assessing the metrics over a three-year rolling period provides a more ecologically relevant insight into the condition of the flow regime, and the likely impacts to the WDEs. Thereby a total of 18 metrics (6 metrics over the rolling 3-year period) are assessed for each of the consumptive pool zones.

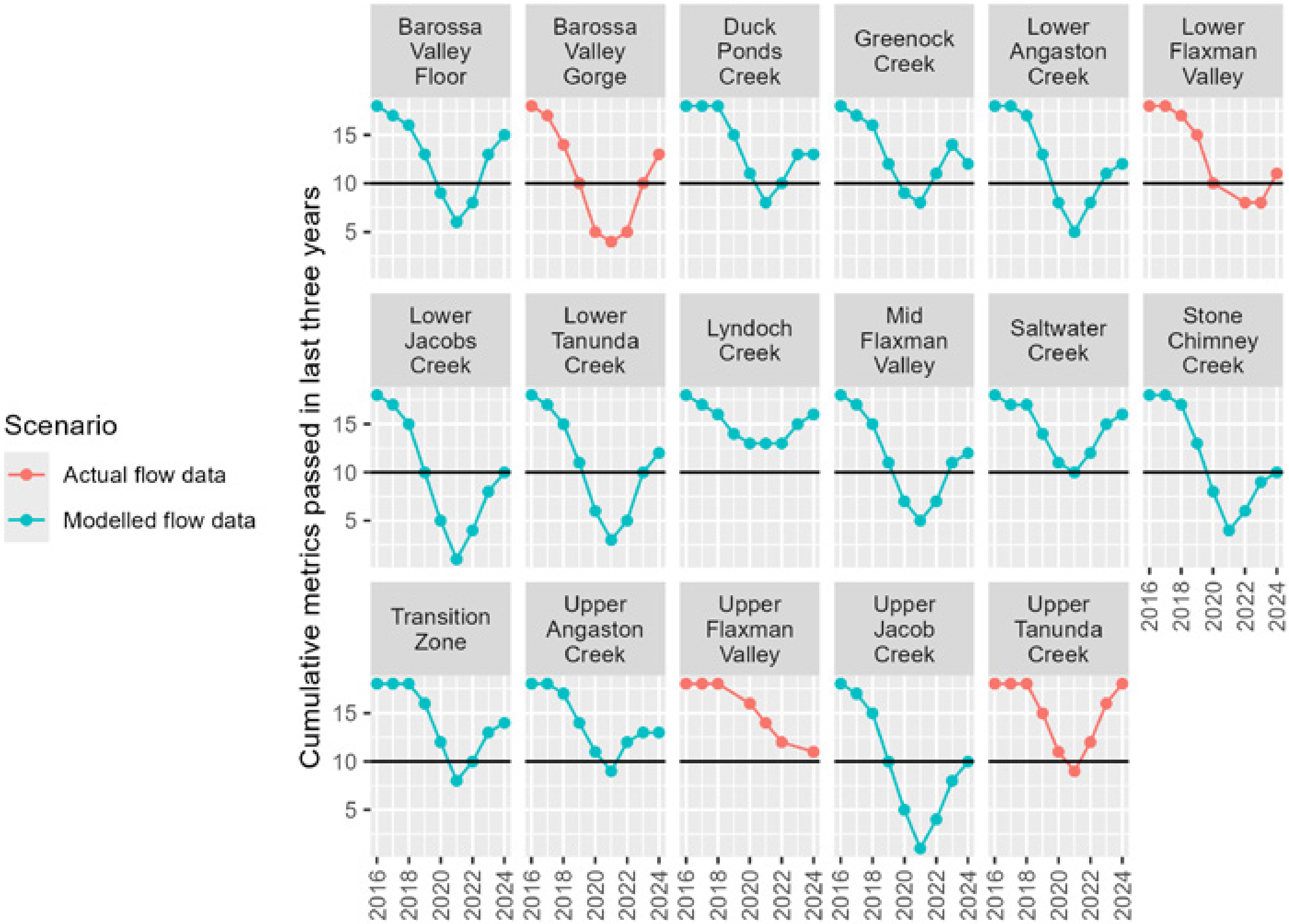
Table 2: Description of the key flow metrics used to determine the environmental water requirements of the Barossa PWRA

Flow regime area	Flow metric	Ecological functions
Intermittency	Number of flowing days per year	• Considered the master variable for intermittent rivers • Longer periods of no flows leads to deteriorating water quality in refuge habitat (permanent pools) • Length of flow period dictates habitat availability and expected lifecycle completion for river fauna
Low flows over the low flow season (Dec – April)	Number of days above the low flow threshold over the low flow season per year	• Flushing of permanent pools • Maintenance of habitat • Watering of in channel riparian vegetation over low flow season • Opportunities for dispersal of fauna
Break of season	Number of days past 1 April that the watercourse commenced substantive flow	• Cues for migration and breeding • Increased stress on refuge habitats • Likelihood of lifecycle completion
Spring flows	Mean daily runoff (ML/day/km^2) for August – November (inclusive)	• Promotes resilience leading into the low flow/cease to flow period • Promotes fish recruitment success • Migration of obligate aquatic fauna • Discourages exotic fish species
Medium flows	Number of days above the median flow (50th percentile) per year	• Promotes large-scale fish migration • Discourages exotic fish species • Expand riffle habitat for macroinvertebrate species • Inundate vegetation on benches and lower banks • Control terrestrial vegetation in channel
High flows	Number of days above the high flow threshold (80th percentile) per year	• Inundate vegetation higher on banks • Habitat maintenance including silt removal and algae scouring • Entrain organic material from banks • Plant propagule transport • Management of reed beds

With the collection of data continuing up to 2024, the model used to produce the metrics has been updated and recalibrated to provide a higher level of confidence in the calculations. In the figure below, graphs have been produced for the period of 2016 onwards and show which of the zones have passed or not passed the updated minimal acceptable 3 year average score of 10.

Figure 1: Charts of the 3 year average scores for each zone over the period since 2016

In Figure 1, the **black** line represents the minimum acceptable 3 yr average score of 10.



As shown in Table 3, over the updated period 2022 - 2024, the maximum number of 2024 EWRs met was 18 out of 18 in Upper Tanunda Creek; however, the zone failed the permanent pool assessment; while the lowest was 10 out of 18 metrics at both Upper and Lower Jacob Creek and Stone Chimney Creek.

The number of metrics passed was compared to the thresholds derived from the framework developed in Green and Savadamuthu (2024)*. The shading in each column reflects whether the most current available consumptive pool condition for that year is above or below the updated threshold (ten or more metrics passing in the three-year window). Yellow means zone is meeting minimum acceptable condition, i.e., 3 year average. falls in 10-17, thereby the 75% allocation is recommended. Red indicates below minimum acceptable condition, i.e. 3 year average <10, thereby a further reduction of allocations may be recommended. The EWR 3 year average is then combined with the permanent pool assessment to produce an overall rating of condition. This updated combined evidence suggests that the current resource capacity, based on the level and nature of water resource development combined with the dry conditions, is variable but insufficient to meet all EWRs in all consumptive pools.

Table 3: Summary of the number of EWR metrics passed over the period 2022 – 2024 and permanent pool assessments for 2024

Each year there are six metrics assessed per zone, therefore the maximum passing in any 3 year assessment is 18. Shading on each column reflects meeting the ecological threshold assessment. Green means zone is meeting all acceptable conditions, i.e. 3 year average is 18, thereby the 100% allocation is recommended. Yellow means zone is meeting minimum acceptable condition, i.e. 3 year average falls in 10-17, thereby the 75% allocation is recommended. Red means zone is below minimum acceptable condition, i.e. 3 year average <10, thereby a further reduction of allocations may be recommended.

Data used	Zone ^	2022	2023	2024	Pool level
Actual	Barossa Valley Gorge	5	10	13	NA
Actual	Lower Flaxman Valley	8	8	11	Fail
Actual	Upper Flaxman Valley	12	NA	11	Fail
Actual	Upper Tanunda Creek	12	16	18	Fail
Modelled	Barossa Valley Floor	8	13	15	NA
Modelled	Duck Ponds Creek	10	13	13	NA
Modelled	Lower Angaston Creek	8	11	12	NA
Modelled	Lower Jacob Creek	4	8	10	NA
Modelled	Lower Tanunda Creek	5	10	12	NA
Modelled	Lyndoch Creek	13	15	16	Pass
Modelled	Mid Flaxman Valley	7	11	12	NA
Modelled	Stone Chimney Creek	6	9	10	Fail
Modelled	Transition Zone	10	13	14	NA
Modelled	Upper Angaston Creek	12	13	13	NA
Modelled	Upper Jacob Creek	4	8	10	Pass
Modelled	Greenock Creek	11	14	12	NA
Modelled	Saltwater Creek	12	15	16	Pass

^ Stockwell Creek zone is not included in the metric assessment due to the limited surface water features and its disconnection with the catchments of the other zones.

* Green, D. and Savadamathu, K. 2024. Seasonal rivers -the conundrum of determining environmental water requirements and environmental triggers. 11th Australian Stream Management Conference - Interweaving water knowledge, Victor Harbor, 2024.

Groundwater adaptive management of the Lower Aquifer Consumptive Pool

The Lower Aquifer is one of the groundwater resources that has been identified as being at risk of unacceptable impacts where an adaptive management approach will be implemented in the draft WAP.

The proposed approach in the draft WAP includes initial notification followed by reduced allocation to protect the integrity of the aquifer and sustainable use of the resource if the ongoing combination of climate and extraction level results in groundwater levels that continue to breach the trigger.

This approach is based on the features of the aquifer and draws from the monitoring data collected for the recovering winter groundwater pressure level in the aquifer. The structure of this approach is shown in the conceptual model Figure 2, and includes several reference features as described below and shown in the model.

Resource Condition Indicators (RCI) are typical parameters which can be directly monitored such as groundwater pressure level for the Lower Aquifer and are used to determine Resource Condition Triggers and Limits.

Resource Condition Limits (RCL) are quantifiable limits for these RCIs that represent a state beyond which the impact on the physical condition of the resource becomes unacceptable.

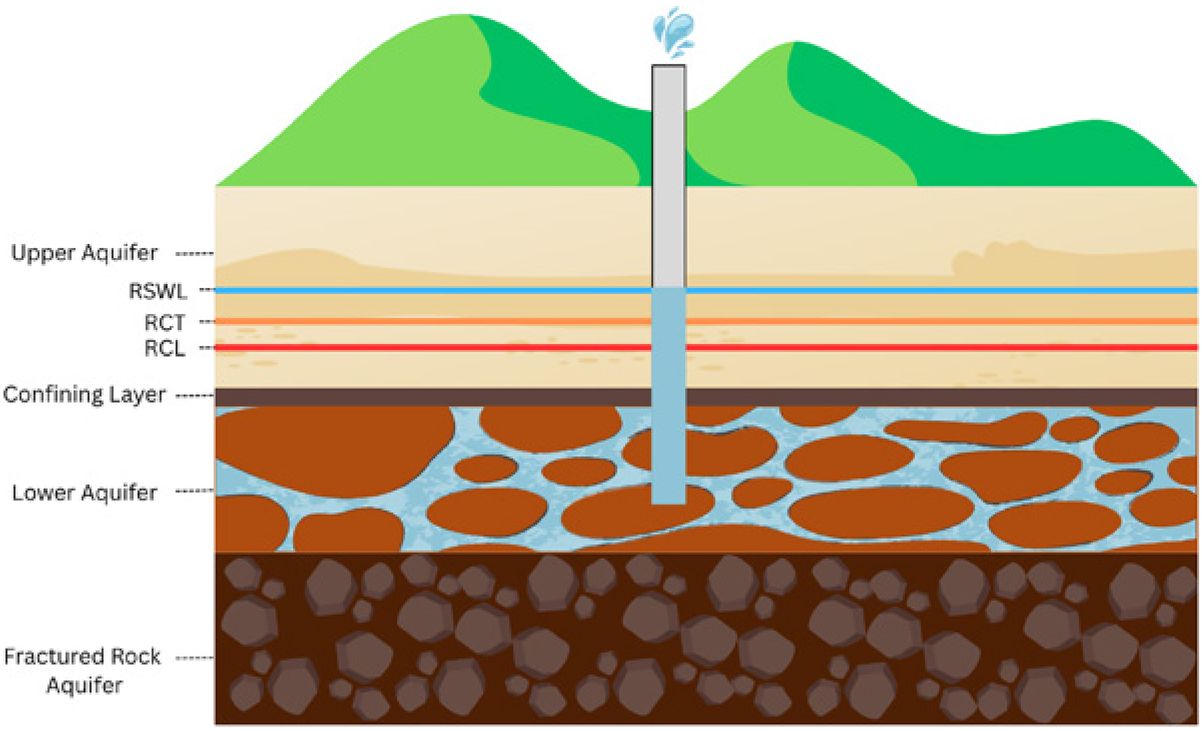
For the Lower Aquifer, the groundwater pressure level RCL has been set at 5m above the top of the confining layer in order to protect this layer from sustained dry periods. If this layer dries out it can crack which may allow water to move between aquifers.

This is a problem because water in the upper aquifer is generally more saline than that in the lower aquifer. If water leaks from the upper aquifer to the lower aquifer it could not only reduce the water quality in the lower aquifer but also the water supply in the upper aquifer

To minimise the risk that the RCL is breached, **Resource Condition Triggers** (RCT) are established. For the Lower Aquifer the RCT has been set at 4m above the RCL to act as an early warning that the RCL is at risk of being breached.

An adaptive trigger management approach results in flexibility of groundwater use by enabling extraction of groundwater at a higher rate when the resource is deemed to be in good condition. However, it also acknowledges that continued extraction of the water resource, when the triggers are breached for a sustained period, is likely to result in adverse impacts to the resource and therefore requires a restriction to the volume of groundwater that can be taken (allocation).

Figure 2: Conceptual model of the groundwater resource triggers proposed in the draft Barossa WAP (RSWL= Reduced Standing Water Level; RCT=Resource Condition Trigger; RCL=Resource Condition Limit)



Lower Aquifer Central Consumptive Pool

The RCT and RCLs are based on approximately 50 years of monitoring data. These data show a level of consistency so that any change can be considered statistically significant. This is particularly important in the central part of the valley where extractions are concentrated and where the confining bed is deep and the risk from depressurisation is highest.

Table 4 presents 2023 and 2024 post winter groundwater pressure elevation and the respective RCT, RCL (resource condition limit) and top of the confining layer for six monitoring wells of the Lower Aquifer. The use of these six wells was determined based on the length of monitoring and/or geographic position. As shown in red, two of the six wells have shown post winter levels that have breached the RCT and/or the RCL in the last two years. Figure 3 shows a map of the location of the six monitoring bores for the Lower Aquifer and hydrographs for the historical data for each of the bores compared with the RCT, RCL and Top and Bottom of confining layer for each bore location.

Following winter recovery, if groundwater pressure levels do not rise above the RCT for at least one of the two triggered wells of the six monitoring wells (as has occurred for MOR 201 in Table 4), then a management response of allocation reduction to the Resource Extraction Limit is recommended to be initiated for the entire consumptive pool.

Table 4: Post Winter Pressure Levels in 2023 and 2024, Resource Condition Triggers (RCT), Resource Condition Limits (RCL), and Top of confining layer for the updated monitoring bores of the Lower Aquifer in the Barossa PWRA

Observation well	MOR 062	MOR 277	MOR 097	MOR 96	MOR 202	MOR 201
2024 Post Winter Pressure Level (mAHD)	248.98	250.03	247.91	265.6	245.27	223.49
2023 Post Winter Pressure Level (mAHD)	249.81	258.56	262.41	266.42	247.0	225.86
RCT Pressure Level (mAHD) - 9m above confining layer	247.95	257.22	243.47	249.54	232.76	233.57
RCL Pressure Level (mAHD) - 5m above confining layer	243.95	253.22	239.47	245.54	228.76	229.57
Top of confining layer	**238.5**	**248.22**	**234.47**	**240.54**	**223.76**	**224.57**

Red or green shading in Table 4 above reflects meeting the RCT/RCL assessment. Red means level is below the RCT/RCL. Green means level is above the RCT. If annual monitoring shows that the level of any two wells has breached the RCT, the management approach of notification of aquifer license holders is recommended. If the following year of annual monitoring shows this breach has continued, the management approach of allocation reduction to the Resource Extraction Limit in the Plan is recommended.

Figure 3: Map of the location of the six monitoring bores and hydrographs of the historical data for each bore being used to assess the groundwater resource triggers proposed in the draft Barossa WAP.

(RSWL= Reduced Standing Water Level; T of CL=Top of Confining Layer; RCT=Resource Condition Trigger; RCL=Resource Condition Limit; Base of CL=Bottom of Confining Layer)