

**DRAFT WATER ALLOCATION
PLAN FOR THE BAROSSA
PRESCRIBED WATER
RESOURCES AREA 2025**

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1 – Introduction

Information for public consultation

Note: while this Plan may be approved soon, it will not come into effect until 1 July 2026.

The Objectives of the Plan are to manage water in a manner which:

- ensures that prescribed water resources are managed within acceptable resource condition limits.
- maximises security of access to prescribed water resources for current and future users within the constraints of the resource.
- provides protections for water-dependent ecosystems designed to maintain system sustainability.
- provides for the flexible and variable use of water resources in response to seasonal climate variability and availability.
- provides the ability to respond to declining resource condition at a consumptive pool scale.
- recognises and incorporates the importance of water to First Nations, and the existence of native title interests in water.
- manages risks associated with the construction and use of infrastructure for extracting water, for undertaking water affecting activities including the storage and use of imported water or effluent on land.

This document is the Water Allocation Plan (the Plan) for the Barossa Prescribed Water Resources Area (Barossa PWRA). It replaces the previous 2009 Water Allocation Plan for the Barossa PWRA (2009 WAP). The purpose of the Plan is to set out the management arrangements for the allocation and use of prescribed groundwater, surface water, watercourse water, recharged water, and runoff water within the Barossa PWRA. In addition, it outlines the processes that guide the transaction (issuing, transferring, or varying) of water licences, water access entitlements and water allocations, the issuing of permits for water affecting activities in the Barossa PWRA, and the monitoring and evaluation requirements to inform adaptive management of the resource and the next review of the Plan due five years after adoption of this plan. The development of the Plan meets the requirements of Section 52 of the *Landscape South Australia Act 2019* (the Act) which states that when water resources are prescribed, a water allocation plan must be developed for the prescribed water resources.

The Plan also identifies the key objectives to be achieved, which will be used in future to evaluate the Plan, along with the results of monitoring activities. The Plan acknowledges that a secure water future for the Barossa may need to be supported via mechanisms outside of the Plan, including possible delivery of alternative water supplies.

The Plan takes into account the high level of water resource development that, combined with a changing climate, is placing pressure on the availability of water resources and the condition of the ecosystems which depend on them. These factors also affect security of supply to water users. The Plan introduces a flexible and adaptable management approach and aims to minimise the risk of decline in security of supply of water resources for existing users, and in the condition of water-dependent ecosystems. While the Plan goes some way to manage issues facing water resources in the Barossa, further scientific and economic investigations are required to corroborate and support preliminary data collected to date. This will help inform longer-term management options being considered to improve the long-term sustainability of water resources.

The flexible and adaptable management approach employed in this Plan follows a clear and robust approach to managing the native water resources of the Barossa PWRA and is underpinned by monitoring 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 equity of supply between all users (including the environment), based on a series of flow metrics and trigger levels that are used to vary the volume of water available to be allocated. Each of the components that has been used in the development of this framework is covered in the sections below (principally section 6.5) but is summarised here in Table 1.1. It is important to note that the Minister has discretion over this framework and could vary the framework or employ other processes should they deem it necessary.

The surface water monitoring data collected across the Barossa PWRA will be collated and assessed between December and February each year. Based on the assessment, the appropriate management response will be enacted based on the framework summarised in table 1.1. Under the framework, the volume of water allocated can be varied by changing the value of a water access entitlement share (explained in further detail in section 6.3).

Table 1.1: High level summary of the adaptive management framework for surface water, watercourse water and groundwater resources.

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 for more details). - This will likely require several above average rainfall/flow years in succession to reach this point.
Surface water and watercourse tier 2	Between 8 and 17 flow metrics being met No permanent pool or intermittency triggers reached	- When between 8 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 for more details). That is, since entitlements were issued, there is 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 eight flow metrics being met OR Any permanent pool or intermittency triggers reached	- When less than eight of the flow targets are being met or any of the other surface water thresholds are triggered (see section 3 for more details), 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 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, notice will be provided to 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). - 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.

Section 53(1)(d)(ii) of the Act specifies that a water allocation plan must set out principles associated with the determination of water access entitlements and for the taking of water so that the rate of taking and use of water is sustainable. The pressures on the water resources of the Barossa PWRA, described above, are significant, and management of these resources presents multiple challenges, key among these is maintaining the resources in a sustainable condition.

For the purpose of this Plan, sustainability is considered as the ability to provide sufficient access to water for consumptive users to allow for the continued prosperity of the Barossa PWRA while ensuring that the water-dependent ecosystems of the region maintain their current diversity at a regional scale and water resource condition is maintained. Specifically, sustainability is defined as

- **Surface Water**
Water is allocated such that the flow regime across the Barossa PWRA is maintained within the bounds of the 1997-2016 baseline flow metric calculation period used for the flow regime assessment. The achievement of the expected flow regime will not only provide water for the environment but assist in the management of issues with equity of supply.
- **Groundwater**
Water is allocated for productive outcomes in a manner that leads to the maintenance of aquifer groundwater levels within the resource condition limits that have been defined in this Plan.
- **Water-dependent ecosystems**
Water is provided to the environment in a manner that allows for the overall species diversity to be maintained at the regional scale. It is expected that dry conditions may result in temporary fluctuations in ecological community condition, however, overall diversity is maintained and ecological condition is able to improve once/if average/wetter conditions return.

This definition of sustainability reflects the current condition of the Barossa PWRA water resources and the ecosystems that depend on them. It is acknowledged that the variable allocation rates used in this plan to manage the risk to water resources and water-dependent ecosystems may not be sufficient to maintain sustainability, especially during prolonged below average rainfall periods. Therefore, the board are actively pursuing additional actions outside the Plan to support water resources and Water-Dependent Ecosystems (WDE).

Key changes to the Plan since the 2009 WAP include:

- updated resource capacity estimates for groundwater, surface and watercourse water resources based on more recent information
- new management zones for surface¹ and watercourse water resources
- the ability to vary annual allocations in response to resource conditions (entitlements remain the same)
- Reduction in surface water resource capacity reflective of the 24% reduction since initial entitlements were issued
- quantitative environmental water requirements in line with legislative requirements
- development of environmental thresholds to inform future management options

¹ Pursuant to section 53(2) of the Landscape SA Act 2019 (the Act), water in prescribed watercourses within the surface water prescribed area is declared to form part of the surface water prescribed resource, and therefore references to the surface water consumptive pool will also apply to water in prescribed watercourses and the combination of both resources will thereby be referred to as 'surface water resources' throughout this Plan (as per Figure 2.1 and Principle 2 in section 7).

- updated water trade policies
- consideration of cultural water requirements
- inclusion of principles for the management of runoff water

The Plan will be supported by a Monitoring, Evaluation, Reporting, and Improvement Plan (MERI Plan) that will set out the details of the monitoring to be undertaken to assess the condition of water resources and ecosystems and to recognise when a management response may be needed. The MERI Plan will also document the further science needed to inform the assessment and implementation of future management options (further details in section 8).

A future review of the Plan after five years of operation will consider this additional knowledge in the context of determining appropriate management options to ensure equity of supply for water users, including water-dependent ecosystems. Further information on the capacity of surface and groundwater resources is provided in section 2, and the environmental outcomes expected during the period of this Plan is provided in section 3.

1.1 Consistency with other legislation and plans

The development of the Plan has also taken into account consistency with the following Acts and Agreements:

- Environment Protection Act 1993 and related policies
- Mining Act 1971
- Native Vegetation Act 1991
- Planning, Development and Infrastructure Act 2016 and related Planning Rules made under it
- Native Title (South Australia) Act 1994
- Aboriginal Heritage Act 1988
- Relevant plans of management under the *National Parks and Wildlife Act 1972*

1.2 Incorporation of First Nations' interests in water planning and management

The Northern and Yorke Landscape Board recognises the importance of and is committed to seeking and incorporating First Nations' interests in the development of water allocation plans. Drafting of the Plan involved Ngadjuri, Peramangk and Kurna First Nations to ensure their interests and voices were included, as a step towards improved recognition of First Nations' perspectives. The information in section 4 of the Plan was developed in consultation with the First Nations as a starting point to an ongoing conversation and involvement in future water planning for the Barossa PWRA.

This is a preliminary step towards recognising First Nations' knowledge of the relationship between healthy water, lands, and all living things. The Plan identifies opportunities to address First Nations' objectives and outcomes. Some objectives (or components of) are outside of the scope of the Plan as set out in section 53 of the Act and will be progressed via other processes.

1.3 Area and water resources managed by the Plan

The Barossa PWRA is centred approximately 60 km north-east of Adelaide (Figure 1.1). The prescribed water resources include groundwater in aquifers, surface water in watercourses, and rainfall runoff.

The groundwater resources of the Barossa Valley floor were first prescribed on 1 July 1989. On 14 May 1992, the Governor of South Australia declared that the North Para River and its tributaries, within the area bounded by the bold broken line in GRO Plan No. 327/1992 ("the defined area"), are proclaimed watercourses pursuant to Section 33(1) and (2) of the *Water Resources Act 1990* (now

administered under the Act). The proclamation also applied to existing wells and any future wells to be drilled within the defined area.

On 17 December 1998, the surface waters within the defined area were proclaimed by the Governor of South Australia pursuant to Section 8 of the *Water Resources Act 1997* (now administered under the Act).

On 19 May 2005, the Governor of South Australia declared that all watercourses and surface water in the Greenock Creek catchment area, as delineated on GRO Plan No. 128/2004, are prescribed as part of the Barossa PWRA, pursuant to Section 8(1) of the *Water Resources Act 1997* (now administered under the Act).

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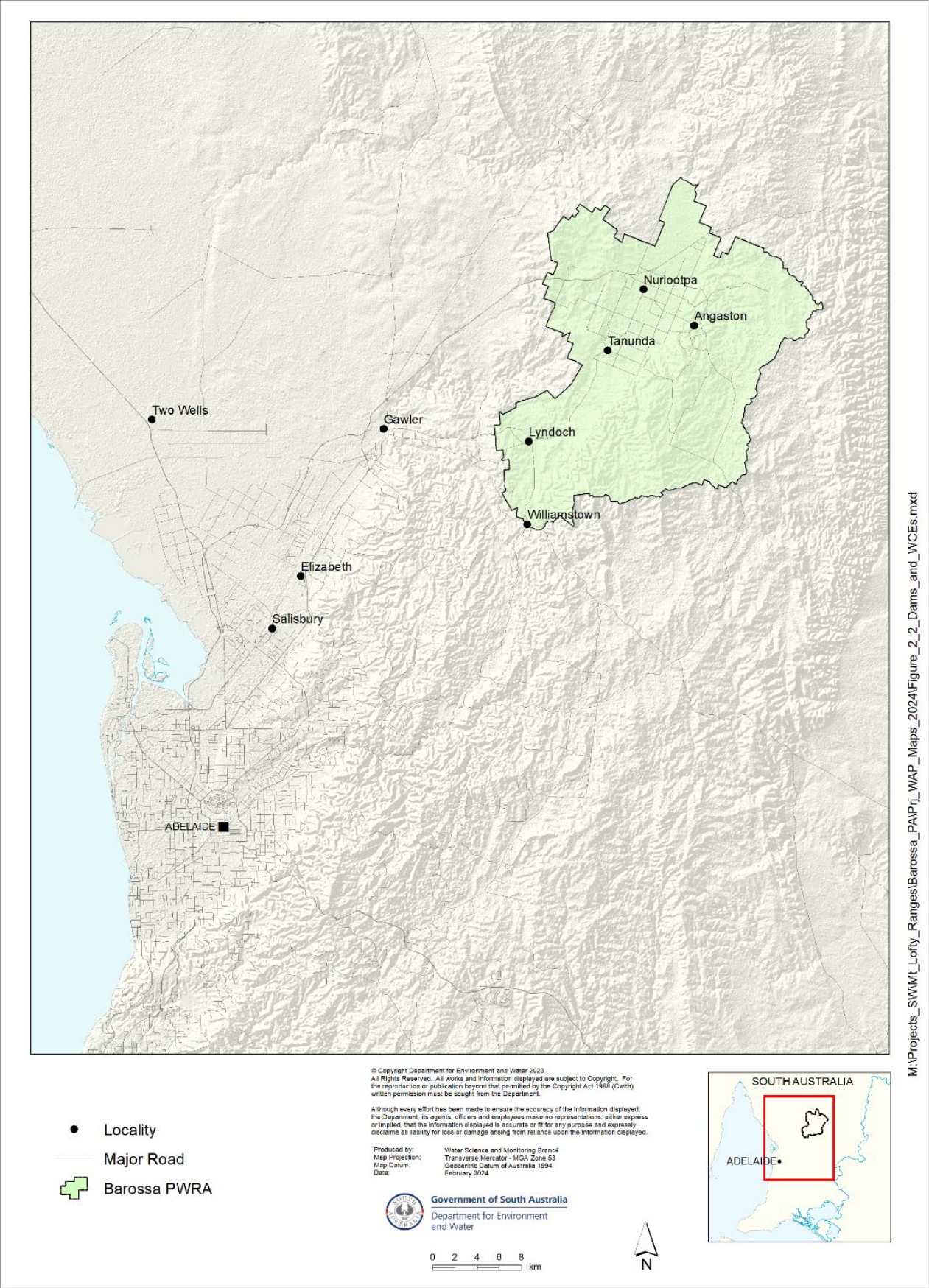


Figure 1.1: Prescribed Water Resources Area of the Barossa

1.4 Objectives

The objectives of this Plan are to license, allocate and manage water (and water extraction infrastructure) and authorise water affecting activities in a manner which:

- ensures that prescribed water resources are managed within acceptable resource condition limits.
- maximises security of access to prescribed water resources for current and future users within the constraints of the resource.
- provides protections for water-dependent ecosystems designed to maintain system sustainability.
- provides for the flexible and variable use of water resources in response to seasonal climate variability and availability.
- provides the ability to respond to declining resource condition at a consumptive pool scale.
- recognises and incorporates the importance of water to First Nations people, and the existence of native title interests in water.
- manages risks associated with the construction and use of infrastructure for extracting water, for undertaking water affecting activities including the storage and use of imported water or effluent on land.

1.5 Steps in developing this Plan

Review of 2009 Water Allocation Plan

A review of the 2009 WAP was commenced in 2016 by the (then) Adelaide and Mount Lofty Ranges Natural Resources Management Board as a requirement of the *Natural Resources Management Act 2004* (NRM Act). The review included consideration of updated science and the formation of an Advisory Committee, a representative group of stakeholders. Following the replacement of the NRM Act with the Act and the resulting regional boundary changes, the Barossa PWRA was located within the Northern and Yorke Landscape region. As a requirement of the Act, the new Northern and Yorke Landscape Board, with the support of a new Advisory Group, completed the amendment of the 2009 WAP to produce this Plan.

Prescription and issuing of licences

While most water users in the Barossa PWRA already have water licences, the incorporation of the Greenock Creek area into the PWRA for the first time in 2005 initiated a process to issue new water licences to eligible existing water users. The licensing process is the responsibility of the Minister responsible for water through the relevant department of the South Australian Government and is being conducted as a separate process to the development of this Plan.

Scientific investigations

This Plan draws on the results of multiple scientific investigations, which include the use of groundwater and surface water models developed by the Department for Environment and Water (the Department). The surface water model was also used to estimate the impacts of future climate on surface and watercourse flows under different extraction and climate projection scenarios. Investigation on the potential shift in rainfall patterns since the Millennium drought and the resulting change in hydrological behaviour of the Barossa PWRA was also undertaken by the Department. Issues that were investigated include:

- extent and nature of water-dependent ecosystems and their requirements.
- surface water/groundwater interactions.

- rainfall and streamflow behaviour and patterns.
- potential change in rainfall and streamflow patterns since the Millennium-drought.
- resource development (farm dams, watercourse extractions) extent and pattern.
- impacts of capture and evaporative losses (from farm dams), and diversion and extraction from watercourses on surface water resources.
- impacts of extraction on groundwater resources.
- climate change impacts on water resources.
- monitoring requirements.

Investigation of consumptive demand

Within the Barossa PWRA, water resources are used extensively to support commercial industry. In addition, the region is heavily reliant on imported River Murray water delivered via the Barossa Infrastructure Limited scheme and the use of SA Water mains peak and off-peak supplies. Some water licensees hold River Murray licences, which are delivered through SA Water infrastructure. Many licensees in the Barossa use multiple sources of water on their properties.

As described in section 5, data and information about the current and possible future demand for water for consumptive purposes were considered in the development of the principles in section 7. The information utilised included:

- volumes currently allocated for licensed extraction (Barossa and Eden Valleys) and expected allocations to be issued in relation to the existing user water requirements (Greenock Creek).
- data from metered extraction.
- estimation of demand for non-licensed stock or domestic uses and other non-licensed uses of water.
- consultation with stakeholders about the quality, quantity, and reliability of the supply of water required for current enterprises.
- information regarding current and future demand received during the consultation process for the Barossa Water Security Strategy and the Barossa New Water project.

Analysis of risk

The development of the Plan included the consideration of risks to the water resources, the environment, community values, and the ability to implement the Plan's principles (see Table 1.2). The key risks were analysed and where possible measures were developed to mitigate these risks.

Table 1.2: Risk assessment

Category of risk	Processes to analyse risk	Measures to address risks in the draft Plan
Risks to the groundwater resources	Risks to aquifers and groundwater resources were identified through a review of monitoring data and modelling of water resource trends and extraction scenarios.	Resource capacities have been identified using the most up-to-date and relevant climate period. Annual allocations can be varied, and buffers are in place, in response to the level of observed or perceived risk to groundwater resources and groundwater-dependent ecosystems.

Risks to the surface water resources	Risks to surface water resources were identified through a review of monitoring data, climate data, and modelling of extraction and climate scenarios.	Resource capacities have been identified using the most up-to-date and relevant climate period. Thresholds have been included that will be used to trigger management response, which could include variation of annual allocations in response to the level of risk to surface water resources and water-dependent ecosystems.
Risks to the watercourse water resources	Risks to watercourse water resources were identified through a review of monitoring data, climate data, and modelling of extraction scenarios.	Resource capacities and management policies have been set to support sustainability of watercourse water resources in the expected near future climate conditions. Thresholds have been included that will be used to trigger a management response in response to an increased level of risk to watercourse water resources and water-dependent ecosystems.
Risk to water-dependent ecosystems	The values of water-dependent ecosystems were identified through scientific investigations and community consultation. The water needs of these values were identified and the ongoing risk to those needs was assessed using observed and modelled data.	Management policies have been designed to maintain the sustainability of the condition and functions of the targeted water-dependent ecosystems.
Risks to community values	Consultation on the impacts of the proposed management policies was undertaken.	Management policies have been developed to support equity of access and flexibility to adapt to seasonal and climate variability, whilst aiming to minimise social and economic impacts as much as possible.
Risks to First Nations water values	Consultation with the three First Nation groups to identify the values, objectives, and interactions with the proposed management policies.	Management policies have been developed to complement and support the identified values and objectives where possible, including recognition of cultural water needs.
Risks to the implementation of this Plan	Consultation with the Department about the ability to administer water licences and permits, undertake compliance actions concerning licence and permit conditions, and continue monitoring of water resource condition.	Where possible, principles in this Plan were developed in consideration of feasibility of monitoring, implementation, and enforcement.

A key risk identified in the development of this Plan is the high level of dam development. Surface water from dams is widely used for irrigation, stock and domestic use in the Barossa PWRA. The Plan recognises that the current level of dam development has a significant detrimental impact on flows in watercourses, equity of access between different users and the availability of water to water-dependent ecosystems. This iteration of the Plan aims to take initial steps towards managing the risks associated with high levels of water resource development, while further scientific investigations on the effects of dams are undertaken, and while alternative water supplies to the Barossa are under consideration.

Development of principles to achieve the objectives

The Plan draws on the results of scientific investigations and modelling (sections 2 and 5), together with an understanding of First Nations' and environmental water needs (sections 3 and 4). Understanding of the risks to water resources helped develop objectives for the Plan through consultation with the community and with input from the Advisory Group.

The principles in the Plan were developed to ensure the objectives are addressed and the identified risks are minimised. These principles are set out in sections 6 and 7. They are consistent with the requirements of the Act in relation to water licences, water access entitlements, water allocations and other permits and authorisations. The principles:

- establish the framework within which available water will be allocated annually from each consumptive pool within the prescribed area.
- set out the circumstances for issuing, varying or transferring water licences, water access entitlements and water allocations, to reduce localised impacts on third parties and maintain an acceptable condition of the resources and water-dependent ecosystems.
- for some consumptive pools, set out the resource condition triggers which, if exceeded, will initiate a management response to help protect the condition of the resources and water-dependent ecosystems.
- set out the environmental water requirements and identify how the Plan takes into account environmental water provisions to protect water-dependent ecosystems, and the buffer zones needed to protect the environment, as well as other water users, from new or additional water extraction.
- outline the requirements for issuing authorisations and approvals for the management of relevant water affecting activities that are not addressed within the Northern and Yorke Water Affecting Activities Control Policy.

1.6 Reviewing this Plan

Under the Act, this Plan must be reviewed at least once within 10 years of adoption. However, considerations made during the development of this Plan have highlighted the rapidly developing body of knowledge, both for the Barossa PWRA and for water planning in South Australia more generally. For this reason, the Board has committed to review the effectiveness and relevance of this Plan after five years of operation.

Due to the complexities and substantial amendments made in this Plan, and the intended development of the associated Monitoring, Evaluation, Review, and Improvement (MERI) Plan (see section 8), a flexible and adaptive management approach has been incorporated. Principles have been developed that consider annual variability in water resource conditions, and in some consumptive pools, a management response will be enacted should resource condition triggers be exceeded.

Alongside the adaptive management principles in the Plan, the MERI Plan will provide a framework for assessing the success of the principles in this Plan in addressing its objectives and will include annual monitoring and review of data trends. This ongoing review process will identify whether further review or amendment to this Plan is required at the 5-year review point or prior to the 10-year statutory timeframe to manage the uncertainty of future climate and resource condition, and associated risks.

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2 – Prescribed Water Resources

2.1 Background

There is a strong body of scientific knowledge related to the water resources within the Barossa PWRA, derived from studies over many decades. This knowledge has informed the development of numerical models, which have been used to help develop the management strategies in this Plan. These models, in conjunction with long-term monitoring of water use, are currently the best scientific tools available to understand the likely effects of water extraction from the main productive aquifers, surface water and watercourse water in the Barossa PWRA.

Drawing on this information, this section provides a description of the prescribed surface water and groundwater resources in the Barossa PWRA, with a focus on the features which need to be considered when managing these water resources. This includes their characteristics, current and expected near-future condition and contribution to environmental water requirements. The capacity of the water resources under an expected near-future climate is also described. The key management issues, and this Plan's management responses, are outlined. Section 5 provides additional analysis of the demand for water and the ability of the prescribed water resources to meet this demand.

This information underpins the principles in section 7. In particular, understanding of the characteristics of the prescribed water resources and their ability to support extraction informs the delineation of consumptive pools², and the maximum annual volumes of each consumptive pool.

2.2 Consumptive Pools

A water allocation plan must “determine, or provide a mechanism for determining, from time to time, a consumptive pool, or consumptive pools for the water resource”. A consumptive pool is defined in the Act as the water “that will from time to time be taken to constitute the resource within a particular part of a prescribed water resource for the purposes of Part 8...”³. This Plan must therefore determine a consumptive pool or pools, so as to account for all of the water that may be lawfully taken from the Barossa PWRA for consumptive purposes (such as irrigation, stock and domestic, commercial and any other consumptive use). The Minister must further determine, from time to time, the volume of water that is to be made available for allocation from a consumptive pool pursuant to section 121(4) of the Act⁴.

The following sections discuss the development of consumptive pools for surface water and groundwater. Further, an additional consumptive pool has been established for the Managed Aquifer Recharge activities as discussed in section 7.1 of this Plan.

2.3 Capacity of the water resources

To ensure water using activities can continue sustainably into the future, an assessment of the consumptive pool volume has been developed for each of the consumptive pools described in sections 2.4.1, 2.5.1 and 7, with the exception of the Managed Aquifer Recharge Consumptive Pool (further

² It should be noted that the consumptive pools based on catchments and aquifers described in this section are derived from the ‘management zones’ and/or ‘project zones’ described in reports from scientific investigations undertaken in the development of this Plan. For consistency, these terms are not used – rather, the term ‘consumptive pool’ is used hereafter in this Plan.

³ Sections 53(1)(c) and 3(1) of the [Landscape Act](#)

⁴ Section 121(4) of the [Landscape Act](#)

discussed in section 6.6). The consumptive pool limit is the volume of water available to meet all consumptive purposes (both licensed and non-licensed water use).

As stock and domestic water use is not licensed within this region, the provisions in the Plan cannot contain rules which vary the volume of water available to meet this demand. As such, this Plan defines a **Maximum volume of water available for allocation** for each consumptive pool. This is the volume of water that can generally be taken from the resource to meet licensed demand, when the resource is deemed to be in 'good condition'. However, it is acknowledged that sustained extraction at this rate, under current climatic conditions, may result in unacceptable impacts to the resource.

These unacceptable impacts therefore need to be defined, and proposed actions need to be put in place should resource condition degrade toward these levels. An adaptive trigger-level management approach is considered appropriate to manage this risk and works by limiting the volume of water that can be taken (allocation) within a consumptive pool during periods when the resource is at higher risk. An adaptive management approach is reliant on a clear delineation of resource condition indicators, resource condition limits, resource condition triggers and mitigation strategies, as discussed further below.

Resource Condition Indicators (RCI) are typical parameters which can be directly monitored such as groundwater level, the number of stream flow days, or the number of low flow days, for example.

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. RCLs are therefore defined for the different RCIs. For example, a groundwater level RCL may be a defined groundwater level which, if the level falls below, would result in disconnection from a permanent pool. A RCL for the stream flow RCI may be a specified number of flow days which, if not achieved annually, may result in adverse outcomes for ecological communities reliant on that flow.

To minimise the risk that the licensed extraction of water from a consumptive pool will result in the RCL to be breached, **resource condition triggers (RCT)** need to be developed.

A RCT acts as an early warning system that the RCL is at risk of being breached and provides guidance on a management response that minimises the risk of this occurring.

An adaptive trigger management approach results in flexibility of water use by the licensee, by enabling extraction of water at a higher rate when the resource is deemed to be in good condition. However, it also acknowledges that sustained extraction of the water resource at the 'maximum volume of water able to be allocated annually' is likely to result in adverse impacts to the resource and therefore requires a restriction to the volume of water that can be taken (allocation) when the risk of these impacts occurring is increased to a resource extraction limit. The resource is likely to be able to sustain short-term increased extraction occasionally – as long as a management approach has the ability to restrict extraction should the increased extraction pose a risk to the resource.

The RCIs, RCLs and RCTs for the aquifers and surface water systems are further discussed in the following sections. The adaptive management approach is dependent on a monitoring regime of specific RCIs within the consumptive pools, which is further discussed in section 8.

2.4 Surface water

This section describes the hydrology, condition, and trends for the prescribed surface water resources⁵, defines the surface water consumptive pools and quantifies the maximum volume of water available in each pool, taking into account climate change impacts. It then outlines the management responses that are established in this Plan.

Catchments and watercourses

Within the Barossa PWRA there are ten major sub-catchments, most of which flow into the North Para River within the PWRA. The river originates and flows north-westward through the Flaxman Valley of the Barossa Ranges and then turns and flows south-westward along the Barossa Valley floor (Figure 2.1). The major tributaries to the North Para River generally flow in a westward direction and include Duck Ponds Creek, Angaston Creek, Tanunda Creek and Jacob Creek. Lyndoch Creek is located in the south-western corner of the Barossa PWRA and flows ephemerally towards the north where it meets the North Para River downstream of the Yaldara gauge.

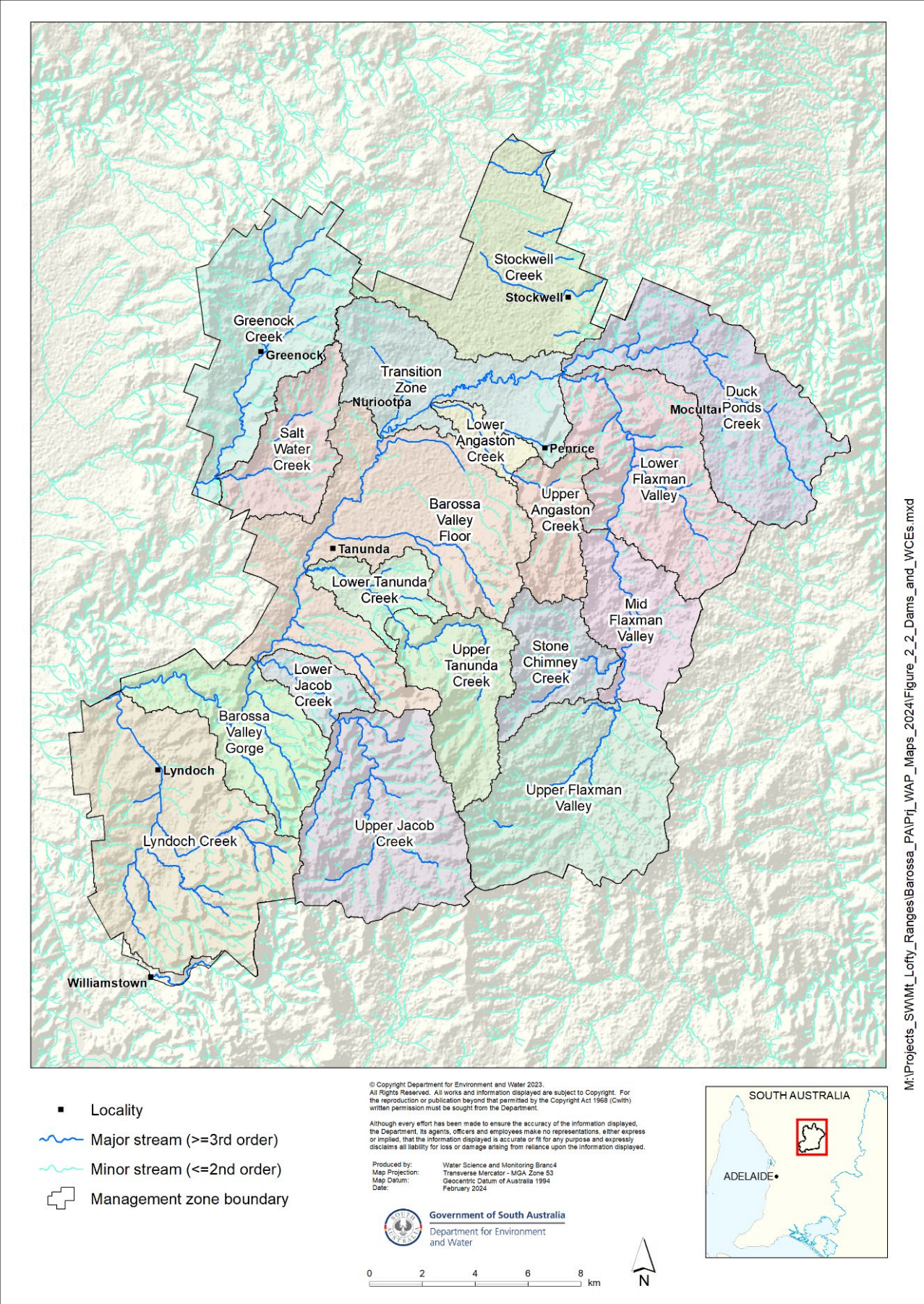
The majority of watercourses in the Barossa PWRA flow seasonally, with numerous permanent pools maintained by groundwater discharge (Figure 2.2). These permanent pools are important for maintaining ecosystems and aquatic species (see section 3).

The Barossa PWRA also includes the upper sections of Greenock Creek catchment in the north-west, which joins the river outside of the Barossa PWRA boundary. Small catchment areas of the Mid Light River (Stockwell Creek) and the South Para River (Victoria Creek) are also included within the Barossa PWRA boundary.

⁵ Unless otherwise referenced, material in this section is drawn primarily from:

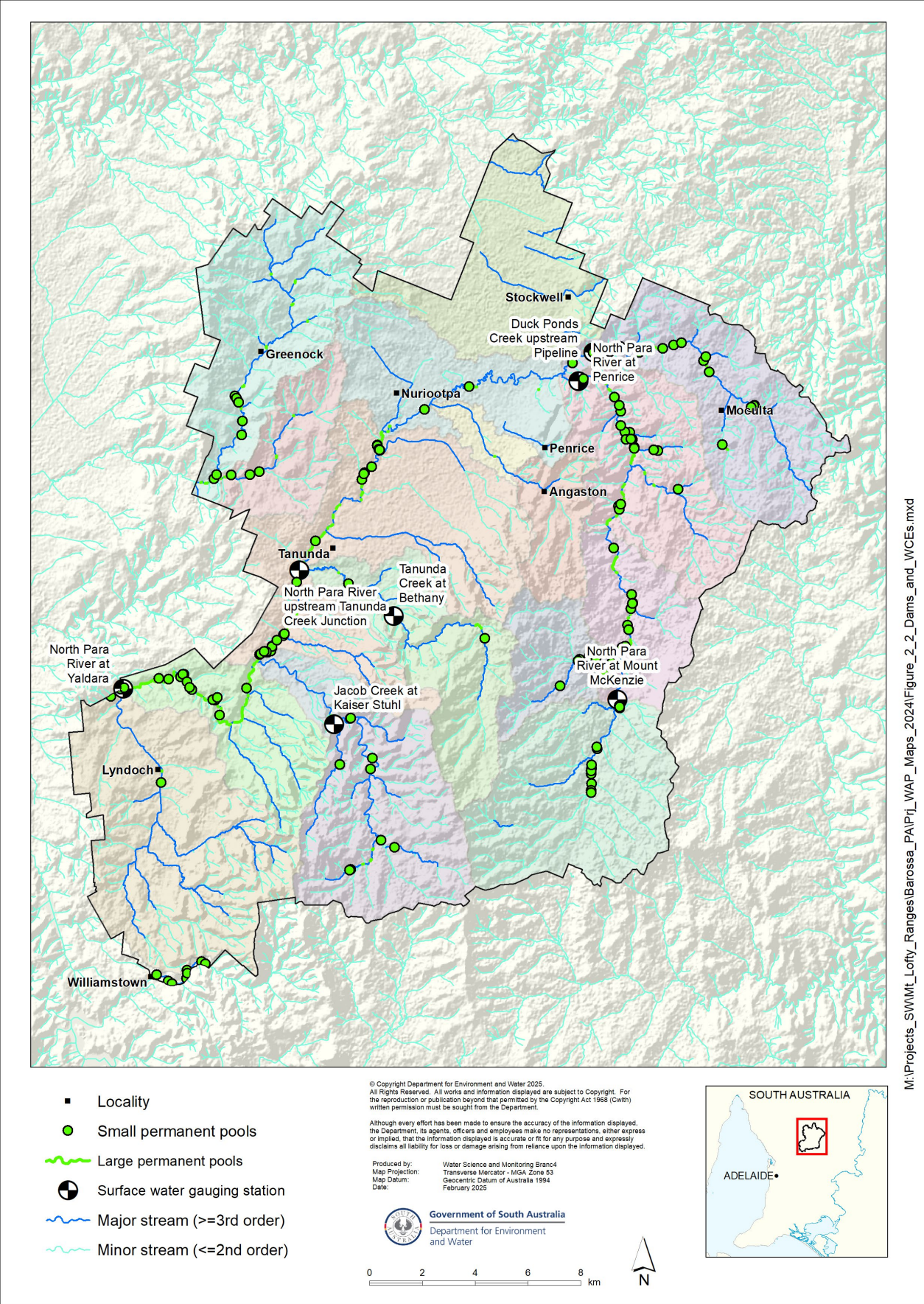
Jones-Gill A and Savadamuthu K, 2014, Hydro-ecological investigations to inform the Barossa PWRA WAP review – Hydrology Report, DEWNR Technical Report 2014/14, Government of South Australia, through Department of Environment, Water and Natural Resources, Adelaide (WaterConnect.sa.gov.au)

Department for Environment and Water (2022a). Modelling the impacts of current water use, urban development and climate projections on surface water resources in the Barossa Prescribed Water Resources Area, DEW-TR-2022-13, Government of South Australia, Department for Environment and Water, Adelaide (



M:\Projects_SWM\Lofty_Ranges\Barossa_PA\Pj Maps_2024\Figure_2_2_Dams_and_WCEs.mxd

Figure 2.1: Catchments and watercourses of the Barossa PWRA



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Figure 2.2: Map of the Barossa PWRA showing the locations of the seven operating surface water gauging stations and the locations of permanent pools.

Rainfall and runoff

The Barossa PWRA experiences a highly variable annual rainfall, both spatially and temporally, with average annual rainfall for the period 1997-2002 ranging from around 650 mm in the headwaters of Tanunda Creek and Jacob Creek to around 400 mm in the headwaters of Duck Pond Creek in the north. Streamflow (runoff that makes its way into watercourses) in the Barossa PWRA also reflects this variability, reaching peak discharge volumes of 64.5 GL (1992), and dropping as low as 0.5 GL (2018) at the Yaldara gauging station. The long-term mean annual discharge recorded at the Yaldara gauging station, which is the drainage point for the majority of the PWRA, is ~12 GL. Catchment characteristics that influence runoff generation vary spatially within the PWRA, with some sections of the Jacob Creek sub-catchment indicating perennial flows, and other sub-catchment streams flowing for less than 30% of the time. A general increase in the duration of flowing period is observed in downstream sections compared to the upstream reaches of the main North Para River.

Dam development

Since European settlement, the Barossa region has been extensively cleared of native vegetation. Streamflow is heavily regulated (controlled) by infrastructure such as dams or in-stream weirs. Dam development in the Barossa PWRA is particularly concentrated at higher elevations where access to groundwater and other alternative water sources is less reliable (Figure 2.3). There are a total of 1,780 dams within the Barossa PWRA - of these, approximately 10% are used for licensed extraction of water.

As shown in Table 2.1, significant volumes are captured, stored and diverted throughout the system. The capture of surface water resources by farm dams accounts for approximately 8,692 ML of the total surface water resource capacity across the whole of the Barossa PWRA. This equates to 56% of surface water resource capacity. Combined with reduced rainfall and runoff, this is a significant factor that contributes to impacts on the security of supply for existing users and the condition of water-dependent ecosystems. Figure 2.3 shows the location of dams and watercourse extractions points across the Barossa PWRA.

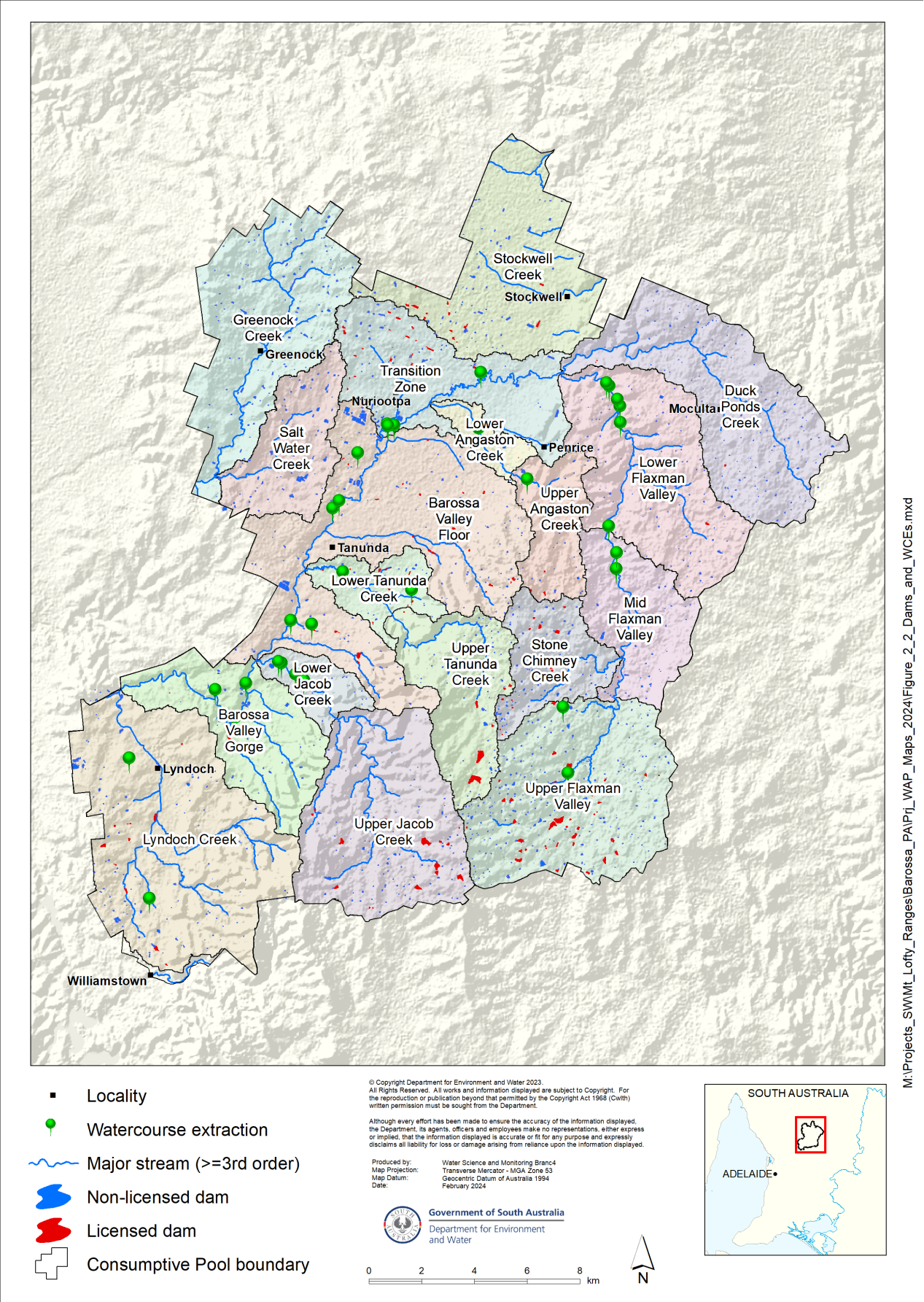


Figure 2.3: Dams and watercourse extraction points within the Barossa PWRA

Climate change impacts on surface water

Climate modelling undertaken by the Department and Adelaide University projects a drier and hotter future climate for the Barossa PWRA⁶. The results from this modelling also show that changes to rainfall seasonality and pattern are expected alongside decreasing long-term average annual rainfall totals. Recent rainfall observations are consistent with these predictions. Such changes to rainfall within a catchment have direct and non-linear effects on runoff generation processes that affect surface water availability (quantity and flow regime). Evidence shows these issues have already had a direct impact within the Barossa PWRA, on both the security of supply to water users and the components of the flow regime that are critical to functionality of the ecological process of water-dependent ecosystems.

The recent Millennium drought, spanning from 1997 to 2009, was a major climate event observed across Australia, having a major impact on water resources across the country (CSIRO, 2010). Numerous studies into the impact of the drought on rainfall-runoff processes of catchments pre-, during and post-drought periods have since been undertaken. Results of these studies showed that, in some areas of South Australia, a catchment's ability to produce runoff from a given amount of rainfall post-drought had returned to pre-drought conditions, while others, like the Barossa PWRA, did not return or recovery was suppressed (DELWP, 2020).

Extensive analyses of rainfall records from the Barossa PWRA indicate a significant 'shift' or 'step change' in annual and seasonal rainfall patterns have occurred since the beginning of the Millennium drought. Increased variability in rainfall has also been observed in recent years with extremely dry years (2018 and 2019) and wet years (2022). These shifts are consistent with climate projection modelling undertaken previously.

The rainfall-runoff response or relationship for a catchment is expected to be stable under stable climatic conditions i.e., a certain amount of runoff could be expected for a given amount of annual rainfall, accounting for the preceding year's rainfall. However, changing rainfall patterns (i.e. seasonality and intensities) over extended periods under a changing climate is expected to result in a shift in runoff response (Petheram et al., 2011; Tan and Neal, 2018).

It is evident from the analysis of rainfall and streamflow records that there is a clear shift in the rainfall-runoff response in the Barossa PWRA during the drought compared to the pre-drought period, with the post-drought period yet to recover to pre-drought conditions. Whether this shift is temporary, prolonged, or permanent is uncertain and requires ongoing monitoring and evaluation, along with validation of climate projections.

Streamflow records from the Yaldara gauging station, located at the drainage point for much of the Barossa PWRA (Figure 2.2), show a reduction of around 50% in average annual streamflow since the

⁶ Unless otherwise referenced, material in this section is drawn primarily from:

Department for Environment and Water (2022a). Modelling the impacts of current water use, urban development and climate projections on surface water resources in the Barossa Prescribed Water Resources Area, DEW-TR-2022-13, Government of South Australia, Department for Environment and Water, Adelaide. (<https://www.waterconnect.sa.gov.au>)
 Savadamuthu, K., McCullough, D. P., and Green, D. 2023. Changing climate and the uncertainties in allocating water for consumptive and environmental needs in highly developed catchments, Department for Environment and Water, Government of South Australia, Adelaide. 25th International Congress on Modelling and Simulation, Darwin, NT, Australia, 2023 (<https://mssanz.org.au/modsim2023/files/savadamuthu.pdf>).
 Leigh, R., Knowling, M., Beh, E., Devanand, A., Thyer, M., Leanonard, M., Maier, H., Zecchin, A., Culley, S., McInerney, D., Westra, S., 2021. Assessment of current and future water security in the Barossa and Eden Valleys using Climate Resilient Assessment Framework and Tools (CRAFT), Water Research Centre, University of Adelaide, Adelaide.

beginning of the drought. The average number of flowing days at Valdara has reduced from 283 to 235 days per year (~20%) since the beginning of the drought. The data also indicate that ecologically significant aspects of the flow regime have been negatively impacted. These factors suggest that a shift in the flow regime in the Barossa PWRA has occurred, with minimal evidence of recovery since the beginning of the drought.

Based on the available evidence of a potential shift in rainfall and catchment behaviour since the beginning of the drought and its consistency with future climate projections, the combined drought and post-drought (1997-2022) period, or 'changed climate' period, was selected as the 'expected near-future' climate for the life of this Plan. The surface water resource capacity data presented in Table 2.1 and the flow data used in section 3 relate to this 'changed climate' period.

2.4.1 Surface water consumptive pools, resource capacity and extraction limits

The 18 surface water consumptive pools in this Plan are based on the catchments described above and include both prescribed watercourse water and prescribed surface water (as shown in Figure 2.1).

The surface water resource capacity is the capacity of the watercourse and surface water resources that is expected to be available annually, for all human and environmental demands. For each of the consumptive pools, the resource capacity volume has been calculated. The calculation is based on the rainfall and streamflow behaviour since 1997, the beginning of the Millennium drought, and takes into account the implications of long-term climate projections. It uses the mean annual adjusted runoff, which is the modelled mean annual runoff over the period 1997–2022, adjusted to remove the impacts of dams, watercourse diversions and captured runoff. This resource capacity volume in turn informs the maximum volume able to be allocated annually from each consumptive pool.

Table 2.1 shows the resource capacity, the number and capacity of farm dams and the current potential demand based on allocations for each surface water consumptive pool. The non-licensed demand has been estimated based on 30% of total capacity of stock and domestic dams. Stockwell Creek was not included in resource capacity calculations as it is hydrologically disconnected from the rest of the Barossa PWRA. Although current demands (licensed and non-licensed) are accounted for in the table, a large number of dams in the region store more water than the licensed allocation or non-licensed requirements, so while the current demand represents only a portion of the resource capacity, this does not mean that all the remaining capacity is free to flow, as much of it is captured and remains stored in dams.

Table 2.1: Resource capacity, dams, and surface water demand

Surface Water Consumptive Pool	H or R ¹	Resource capacity (RC) (ML)		Farm dams		Dam capacity as % of CP RC	Current Demand (ML)			Current Demand as %	
		CP RC ²	Total upstream ³ RC	Number	Capacity (ML)		Licensed allocation (ML) ⁴	Non-licensed demand (ML) ⁵	Total (ML)	CP RC	Total up stream RC
Upper Flaxman Valley	H	1670	1670	283	1555	93%	837	121	958	57%	57%
Stone Chimney Creek	H	275	275	110	459	167%	146	38	184	67%	67%
Mid Flaxman Valley	R	235	2181	46	149	63%	109	44	153	65%	7%
Lower Flaxman Valley	R	637	2818	102	159	25%	136	39	175	27%	6%
Duck Ponds Creek	H	346	346	141	120	35%	10	33	43	12%	12%
Upper Angaston Creek	H	520	520	40	94	18%	10	15	25	5%	5%
Lower Angaston Creek	R	100	620	8	28	28%	115	8	123	123%	20%
Transition Zone	R	1154	4938	81	416	36%	248	56	304	26%	6%
Barossa Valley Floor	R	1690	8192	185	745	44%	473	77	549	33%	7%
Upper Tanunda Creek	H	1323	1323	72	700	53%	199	33	233	18%	18%
Lower Tanunda Creek	R	241	1564	45	229	95%	226	17	243	101%	16%
Upper Jacob Creek	H	2209	2209	117	1062	48%	557	50	607	27%	27%
Lower Jacob Creek	R	136	2344	18	259	191%	219	17	236	174%	10%
Barossa Valley Gorge	R	570	14272	47	321	56%	298	32	330	58%	2%
Lyndoch Creek	H	3166	3166	148	678	21%	325	110	435	14%	14%
Salt Water Creek	H	363	363	91	462	127%	49	96	145	40%	40%
Greenock Creek	R	687	1050	147	821	120%	0	113	113	16%	11%
Stockwell Creek ⁶	H	-	-	99	433	-	174	71	245	-	-
Total		15322	15322	1780	8692	56%	4130	971	5101	32%	32%

¹Table 2.1 identifies each zone as a headwater zone (H) or a receiving zone (R). Headwater zones don't receive inflow from another zone, while receiving zones do receive inflows from one or more upstream zones. For example, 'Lower Flaxman Valley' is a receiving zone as it receives inflows from upstream zones 'Upper Flaxman Valley', 'Stone Chimney Creek' and 'Mid Flaxman Valley' (Refer Figure 2.1).

² This refers only to the individual zone's Resource Capacity

³ This is the resource capacity for the total upstream area at any point of consideration within the PWRA. Upstream RC is applicable only to 'Receiving zones' as these zones receive surface flows from not just the relevant zone but all upstream zones. RC is defined as 'mean annual runoff from zone for the period 1997 to 2022, adjusted to remove the impacts of farm dams and watercourse extractions through modelling'.

⁴Sum of allocations to licensed dams and watercourse extractions. Rollover allocations not included. Data source - WILMA, DEW Water Licensing Branch, July 2023; The data on actual 'Source type' of the individual allocations i.e. which one is a 'dam' allocation, and which one is a 'watercourse' allocation, is different between the data used in modelling and data in WILMA. This is to be reviewed and finalised.

⁵30% of total capacity of stock and domestic dams identified in the modelling.

⁶Stockwell Creek is disconnected from the PWRA and was not used in modelling and resource capacity calculations.

The resource capacity and demand data have been used to establish the maximum volumes of the surface water consumptive pools, as shown in Table 2.2 below. The surface water consumptive pools maximum volumes have been established based on the current allocations for each pool plus the assumed non-licensed use. These values were determined via the existing user process for the Barossa PWRA. This Plan makes no attempt to modify existing entitlements to provide additional water to downstream users (including the environment). This Plan will use an adaptive management approach, whereby annual allocations may vary dependent on resource condition to maintain system sustainability, while still allowing for full entitlement when resource conditions allow.

Table 2.2: Surface water consumptive pools maximum volumes

Consumptive Pool	Current licensed entitlement (ML)	Non-licensed volume (ML/yr)	Maximum volume able to be allocated annually (ML/yr)	Maximum consumptive pool volume (ML/yr)
Upper Flaxman Valley	837	121	837	958
Stone Chimney Creek	146	38	146	184
Mid Flaxman Valley	109	44	109	153
Lower Flaxman Valley	136	39	136	175
Duck Ponds Creek	10	33	10	43
Stockwell Creek	174	71	174	245
Transition Zone	248	56	248	304
Upper Angaston Creek	10	15	10	25
Lower Angaston Creek	115	8	115	123
Barossa Valley Floor	473	77	473	550
Greenock Creek	0	113	0	1
Salt Water Creek	49	96	49	145
Upper Tanunda Creek	199	34	199	233
Lower Tanunda Creek	226	17	226	243
Upper Jacob Creek	557	50	557	607
Lower Jacob Creek	219	17	219	23
Lyndoch Creek	325	110	325	435
Barossa Valley Gorge	298	32	298	330

Investigations undertaken to inform the resource capacity of the surface water consumptive pools identified a reduction in the total resource capacity from the values presented in the 2009 WAP due to the changing climate (Table 2.3). The resource capacity for the 2009 WAP was developed based on the period 1974 – 2006, while this WAP refers to the period 1997-2022 as discussed above. This reduction in resource capacity is key in considering how the resource will be managed into the future and the setting of allocation rates. Modelling shows a 24% reduction in the average surface water

resource capacity and a 46% reduction in the median surface water resource capacity for the Barossa PWRA. This reduction is not uniform across the different consumptive pools with some pools showing less change (e.g. Mid Flaxman Valley showed only a 7% reduction in median resource capacity). Other pools showed higher changes such as Duck Ponds Creek which showed a 55% reduction in median resource capacity.

Table 2.3: Comparison of the resource capacity volumes for the 2009 WAP (1974-2006) and the resource capacity values for this Plan (1997 – 2022) and the relative reduction in the mean and median volumes.

Consumptive pool	Baseline WAP (1974-2006) Mean (ML)	Baseline WAP (1974-2006) Median (ML)	Drought Post Drought (1997-2022) Mean (ML)	Drought Post Drought (1997-2022) Median (ML)	Reduction in Mean (%)	Reduction in Median (%)
Upper Flaxman Valley	2606	2305	1670	1226	-36%	-47%
Stone Chimney Creek	415	357	275	175	-33%	-51%
Mid Flaxman Valley	300	240	235	223	-21%	-7%
Lower Flaxman Valley	852	822	637	455	-25%	-45%
Duck Ponds Creek	521	451	346	203	-33%	-55%
Stockwell Creek	NA	NA	NA	NA	NA	NA
Transition Zone	1343	1265	1154	1012	-14%	-20%
Upper Angaston Creek	610	595	520	479	-15%	-19%
Lower Angaston Creek	130	121	100	79	-23%	-34%
Barossa Valley Floor	1968	1932	1690	1362	-14%	-29%
Greenock Creek	933	866	687	552	-26%	-36%
Salt Water Creek	435	426	363	307	-16%	-28%
Upper Tanunda Creek	2019	1876	1323	1044	-34%	-44%
Lower Tanunda Creek	255	260	241	205	-5%	-21%
Upper Jacobs Creek	3311	3373	2209	1909	-33%	-43%
Lower Jacobs Creek	186	171	136	87	-27%	-49%
Lyndoch Creek	3474	3250	3166	2981	-9%	-8%
Barossa Valley Gorge	731	680	570	418	-22%	-38%
Total	20091	19727	15322	10604	-24%	-46%

The data presented in Table 2.3 shows two key aspects to the change in the resource capacity values across the Barossa PWRA. Firstly, the consistent reduction in the volume of water available across all

zones. Secondly, it shows the increasing variability and negative skew observed in the resource capacity values between the two different time periods, shown by the increase in the difference in the mean and median values.

2.4.2 Surface water management issues and strategies

Management issues to be addressed within the Plan

Information for public consultation

Surface water monitoring data and modelling shows a 24% reduction in the overall surface water resource capacity and thereby on average 24% less surface water available per year to be allocated within the Barossa PWRA since the 2009 WAP was developed.

Consideration of this observed decline and the likely continuation of this declining trend within the life of this Plan, it is likely to result in the need to reduce the volume of surface water available for allocation in years when water availability is reduced.

The characteristics of surface water resources mean that specific issues need to be managed. Some of these can be addressed via this Plan, and others require complementary actions to be taken outside the scope of this Plan.

In particular, as described in section 2.4.1 above, the volume of surface water available annually (resource capacity) has been reduced since the Millenium drought (Table 2.3). As surface water resource capacity varies from year to year, management approaches need to be flexible and adaptive. When less water is available within the system due to reduced rainfall and runoff, actions may be required to reduce the volume of water available to be taken. This requires the identification of resource condition limits and triggers to inform when such action is necessary. These limits and triggers are discussed in section 2.3 and described in sections 3 and 6.5. It should be noted that because dams capture water regardless of the volume of allocation authorised, reducing the volume of annual allocations may not have a significant impact on the availability of water for the environment, and management responses other than variations to allocations may be more appropriate and are the subject of ongoing investigations.

Despite this, the ongoing reduction in median water availability of 46% observed throughout the life of the previous 2009 WAP, warrants a consideration of a reduced volume of water available for allocation across all surface water consumptive pools when resource condition is similar to that observed during 1997-2022, whereby 'full' allocations only become applicable after significant wet periods (similar to that observed during the development of the 2009 WAP). While the Minister holds discretion for determining the volume of water available for allocation pursuant to section 121(4) of the Act, the Plan provides guidance to the Minister as to the conditions which should be observed to enable allocations to be issued commensurate with the "maximum volume able to be allocated annually" per Table 2.2 and when allocations would better be issued at 75% of this value in an attempt to recover resource sustainability (see section 6.5), or a lower volume if the resource declines beyond critical triggers.

If the license holder has entered into a voluntary agreement with the Northern and Yorke Landscape Board to undertake scheduled environmental releases in accordance with an Environmental Water Release Plan, accredited by the Minister, and has undertaken the agreed releases as intended throughout the water use year, this action may offset any water usage, limited to the equivalent of 100% entitlement value during periods when allocations are issued at less than 100% of the entitlement value.

Calculation of the surface water resource capacity shows that the total current demand for surface water extraction (licensed and non-licensed) across the whole PWRA equates to 32% of the resource capacity. This is considered high compared to demand as a proportion of resource capacity in other areas of the state. In some consumptive pools, this proportion is higher (e.g., Upper Flaxman Valley and Stone Chimney Creek at 57% and 67% respectively). It is noted that although use is currently less than licensed allocation, risks to downstream water users and water-dependent ecosystems would increase if surface water use increased beyond current levels. Sustainability, for the purpose of this Plan is reflective of this high development level, though it is acknowledged that the sustainability of the resource is likely to be placed at extreme levels of risk during prolonged periods of below average rainfall alongside of the high development level.

Based on the information about surface water characteristics, condition and capacity, the main management responses in this Plan are:

- setting a maximum limit for annual extraction (for licensed purposes) from each consumptive pool (as set out in Table 2.2).
- requiring buffers of up to 200 m between points of increased extraction and third order or above watercourses
- providing for actions to be taken, including reduction of water available for allocation, if resource condition triggers are exceeded, to prevent the rate of take and use of water from becoming unsustainable (as per section 6.5).
- Provide a framework for the voluntary release of environmental water from licenced dams in exchange for an ability to take water up to 100% of entitlement value when allocations are issued at a lower rate.

While further action is likely required to address flows through catchments in the future, based on the flexible and adaptive management approach set out in this Plan, the 'maximum volume able to be allocated annually' is considered to be the upper limit of a rate of take that could be deemed sustainable should the climate remain similar to that experienced since the development of the 2009 WAP. The actual allocations will be based on the resource condition in relation to the resource condition triggers and will be set when the Minister determines, from time to time, the volume of water available from a consumptive pool for allocation in accordance with section 121(4) of the Act.

Additional management responses outside the scope of this Plan

The management approaches in this Plan aim to minimise the risk of a further decline in security of supply for existing users and in the condition of water-dependent ecosystems (as discussed in section 3). In the longer-term, further action is likely to be needed to ensure the sustainability of the prescribed water resources into the future and to achieve an equitable balance between environmental, social, cultural and economic needs for water. Monitoring over the life of this Plan, and outcomes of projects underway at the time of developing this Plan, (see section 3.6) will inform any future management options needed to address the impacts of climate change, which will likely exacerbate the impacts of historic water resource development.

Investigations undertaken in the development of this Plan indicate that the most effective actions to improve flow conditions and contribute to environmental water requirements are:

- passing low flows around storages and watercourse diversions.
- initiating environmental flow releases.
- reducing dam capacities.
- removing dams.

Each of these actions requires further investigation and, at the time of developing this Plan, trials and pilot projects were underway (see section 3). The outcomes of these processes will be considered when this Plan is reviewed after 5 years of operation.

2.5 Groundwater

The groundwater resources of the Barossa PWRA comprise several aquifers that can be broadly grouped by aquifer type and defined further based on geography as well as important resource condition indicators⁷.

The three broad aquifer types in the Barossa PWRA are the upper aquifer (UA) (unconfined, sedimentary), lower aquifer (LA) (confined, sedimentary), and the fractured rock aquifers (FRA) (confined and unconfined) systems (see Figure 2.4). These aquifer systems are hydraulically connected, to varying degrees, and can act as sources of recharge or discharge to one another depending on the location within the Barossa PWRA.

The upper and lower sedimentary and confined FRAs generally run the length of the Barossa Valley floor, while the unconfined FRA is present in the hills to the east and the west, and in the Lyndoch catchment (where it is overlain by the Lyndoch alluvial aquifer). Groundwater generally flows from the higher elevation eastern hills of the Barossa PWRA towards the lower valley floor.

The upper sedimentary and unconfined FRAs are dependent on rainfall for recharge, either as diffuse recharge or via losses from watercourses, and their condition is influenced by climate variability, as well as extraction to a lesser extent. There are also numerous locations where these aquifers discharge water as baseflow to watercourses. The lower sedimentary and confined FRAs are recharged via throughflow from the upper sedimentary and unconfined FRAs, and so their condition is affected by extraction but is not directly influenced by short-term climate variability or change (although they are likely to be influenced by long periods of reduced recharge to the overlying or adjacent unconfined aquifers).

The aquifers, or parts of aquifers described in the following sections have been designated as consumptive pools in this Plan based on their particular characteristics and management issues and are illustrated in Figure 2.5.

⁷ Unless otherwise referenced, material in this section is drawn primarily from:
Department for Environment and Water (DEW) 2022b. Barossa Valley Prescribed Water Resources Area Groundwater Assessment. DEW Technical Note 2022/26, Government of South Australia, Adelaide.

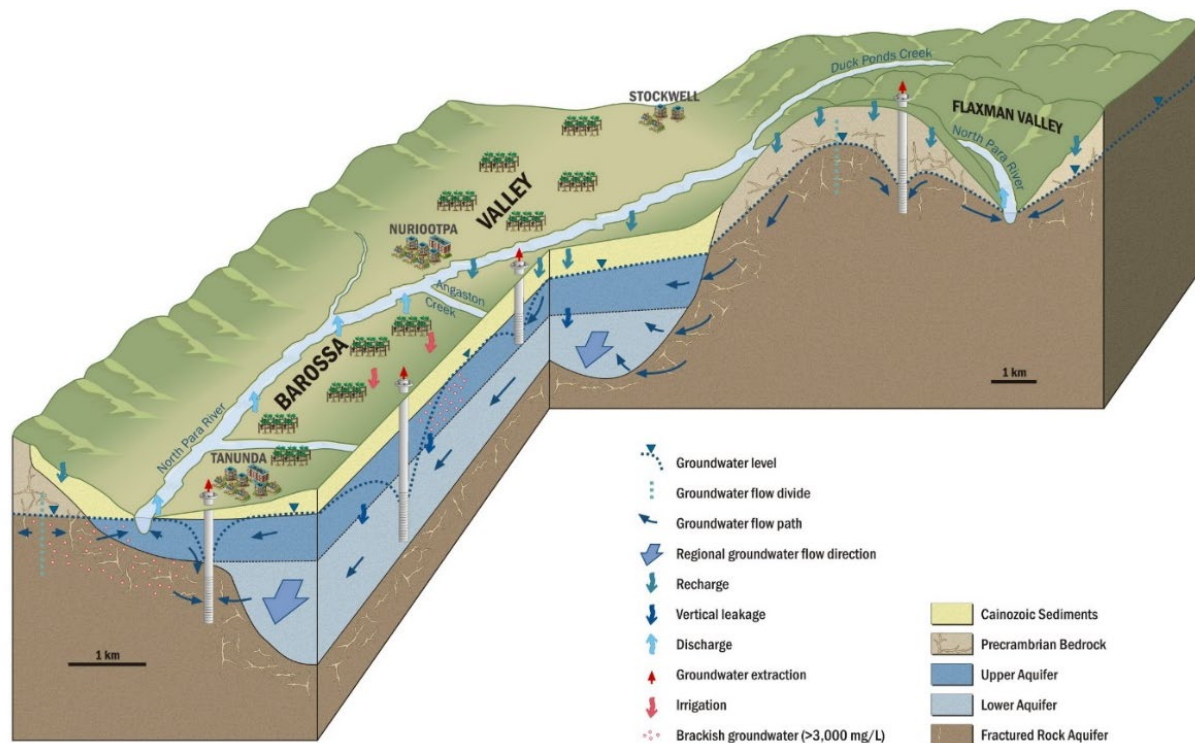


Figure 2.4: Cross-section of the aquifer systems in the Barossa PWRA

Upper Aquifer

The Upper Aquifer (UA) is comprised of a series of interconnected sub-aquifers, including Tertiary non-carbonaceous sands, lenticular sands and gravels, and Holocene gravels and sands associated with drainage channels incised into the Quaternary clay. The UA is generally unconfined, however some of the sub-aquifers can be confined, as evidenced by notable drawdowns during the irrigation season. Extraction from the UA accounts for less than 500 ML/yr.

The UA is recharged from rainfall and from infiltration of streamflow from the North Para River and its tributaries where they flow across the Barossa Valley floor, with groundwater discharge occurring back into the North Para River downstream of Nuriootpa. Groundwater flow is generally south-westerly along the length of the valley floor.

Water Level

Annual fluctuations in groundwater level in the UA suggest that the UA is directly influenced by rainfall recharge, although this varies in relation to the overlying sediments across the Barossa PWRA. Monitoring has shown relatively stable trends close to the North Para River with a muted relationship with rainfall apart from years when well below average rainfall was experienced. Elsewhere, there are some declining trends, particularly in the central Nuriootpa-Angaston-Tanunda area and to the south of Lyndoch (upper Lyndoch Creek catchment). These trends are most likely related, but not limited, to an extended period of below average rainfall. The main factor influencing water level trends is rainfall, either by streamflow infiltration or diffuse recharge. This means that this aquifer could be vulnerable to a long-term decline in storage due to reduced rainfall as a result of climate change.

Salinity

The UA experiences spatially variable salinity patterns. Lower salinity groundwater, of around 1000 mg/L to 1500 mg/L, is found in the vicinities of the North Para River and other watercourses,

with higher salinities of up to 6000 mg/L to the north of Nuriootpa. The eastern and north-western extents of the aquifer also experience more saline or variable salinity groundwater. This is indicative of the recharge to the UA from losing watercourses having a localised 'freshening' effect.

Impacts of current extraction

Overall, the UA is relatively robust and can withstand short term increases in extraction. A key management issue is to try to minimise the impacts of licensed extraction on permanent pools along the North Para River on the valley floor.

There is an area of concentrated extraction in the central region of the aquifer around Nuriootpa and Angaston where a sustained significant increase in extractions closer to allocated volumes could potentially exacerbate climate-driven declines in water level. To enable specific policy approaches to manage these risks, this portion of the aquifer has been delineated as a separate consumptive pool - the Upper Aquifer Central Consumptive Pool. The remainder of the Upper Aquifer forms the Upper Aquifer Regional Consumptive Pool (Figure 2.5).

Lower Aquifer

The Lower Aquifer (LA) is confined in most areas and consists of Tertiary carbonaceous clays, gravels, sands, and silts (Figure 2.4). The main sand and gravel aquifer is separated from the overlying UA by clay confining layers. Extraction from the LA is generally less than 1,300 ML/yr.

The LA is thought to be predominantly recharged by lateral flow from the FRA, and there is a possibility that downward leakage from the UA occurs. Groundwater flow is generally south-westerly along the valley axis, while east-west flow can be induced during periods of intense groundwater pumping.

Water Level

Water levels in the LA show marked seasonal variations which indicate a pressure level response controlled by extraction, whereby the potentiometric surface varies during the irrigation season. There is an overall decline in the groundwater pressure level over time which may warrant continued monitoring and further investigation if continued. Pressure levels at the end of the winter recovery period in the centre of the valley have generally been stable except for minor variations due to climate-induced drivers of extraction. Seasonal drawdowns have decreased since 1990 in response to reduced extraction. Pressure levels have declined by 2-3 m in recent years corresponding to very much below average rainfall and the corresponding increase in groundwater extraction during periods of reduced rainfall.

Salinity

Salinity levels in the LA are relatively similar across the aquifer, ranging between 500 mg/L and 1,500 mg/L. This is interspersed with areas of higher salinity (1,500 mg/L to 3,000 mg/L), predominantly to the north of the Barossa PWRA, north of Nuriootpa, and along the eastern extent of the aquifer east of Tanunda. Some wells along the western margin of the LA between Nuriootpa and Tanunda are showing gradual rising salinity trends since 2005, most likely because of upward leakage from the underlying confined FRA. The spatial variability of salinity within the LA is evidenced by wells near one another showing greatly different salinities.

Salinity monitoring has detected gradual increases in salinity along the western margin of the LA, and targeted salinity monitoring will assist to refine the trends and confirm the cause of the increases.

Lyndoch Valley

The Lyndoch Valley consumptive pool includes both the semi-confined alluvial aquifer and the underlying confined FRA. Due to the limited connection with groundwater-dependent ecosystems (GDEs) and low risks from depressurisation, the risks from extraction are low. Extraction may lead to small declines in the overlying water table aquifer in the long term. However, any reduction in the small volume of extraction from the alluvial aquifer is highly unlikely to have any influence on the declining trend. Depressurisation will occur at the southernmost part of the aquifer first and will result in a stabilisation of trends as the aquifer becomes unconfined. No adverse impacts are expected to result from this process.

Salinity monitoring has detected isolated increases in salinity, most likely due to upward leakage from the underlying FRA. Further targeted salinity monitoring will assist to refine the trends and confirm the cause of the increases.

The Lyndoch Valley has been designated as a single consumptive pool (Figure 2.5) due to its specific management issues.

Fractured Rock Aquifers

The unconfined Fractured Rock Aquifer covers the areas of higher topography within the Barossa PWRA where the aquifer outcrops or is covered by thin unsaturated Tertiary sediments. While the confined FRA includes the central part of the basin where the aquifer occurs at depths of over 75 m beneath the Upper and Lower aquifers and is confined by the overlying Tertiary sediments. It is also confined in the Lyndoch Valley by alluvial sediments.

In the FRAs, groundwater is stored and flows through the fractures and fissures in the basement rocks, generally sandstones and siltstones. The volumes of water stored within the FRAs are generally low, providing low extraction yields with a few exceptions. Extractions from this aquifer system account for less than 2,500 ML/yr.

In highland areas, the aquifer is recharged by direct rainfall and the water table follows a subdued form of the local topography. Recharge and movement through the FRA can occur quickly or slowly depending on the preferential flow paths that dominate the system. Groundwater flow within the FRA is generally to the south-west on the western side of the Barossa Ranges and towards the North Para River on the eastern side of the Barossa Ranges.

Within the western part of the unconfined aquifer, there has been little groundwater development due to high groundwater salinities. The only licensed extractions occur near the North Para River. In the eastern part, salinities are lower and there is a higher level of extraction.

Based on these different characteristics, the FRA aquifers have been delineated as three separate consumptive pools. These are the Western FRA, Eastern FRA, and Confined FRA Consumptive Pools (Figure 2.5).

Water levels

Within the unconfined FRA, the water levels show a relationship with rainfall patterns, with declines mainly driven by periods of below average rainfall such as the Millennium drought. Long term trends vary from relatively stable to a gradual decline.

The confined FRA trends are comparable to those of the confined LA. The trends are generally stable with seasonal drawdowns reflecting the magnitude of annual extractions which appear to have

decreased after 2010. There is a lack of influence from rainfall trends except for areas adjacent to the highland that experience higher rainfall.

Salinity

Salinities in the FRA are highly variable across the Barossa PWRA, with areas of lower salinity generally located at higher elevations within the Barossa PWRA where rainfall is high. Salinity ranges from 500 mg/L to greater than 3,000 mg/L, with groundwater to the western side of the Barossa PWRA (west of a line between Nuriootpa and Tanunda, below the approximate western boundary of the LA) being above 1,500 mg/L and to the eastern side lower than 1,500 mg/L, however this boundary is not well defined due to limited data.

Long term trends in the unconfined FRA are stable in areas of low salinity where recharge is high, however in higher salinity areas, where recharge is less reliable, some rising trends are evident. These patterns most likely reflect local conditions, including the fact that salinity often increases with depth in fractured rock aquifers, and that increased extraction in drier years may draw on this deeper more saline resource.

2.5.1 Groundwater consumptive pools and extraction limits

Consumptive Pools

The groundwater consumptive pools established by this Plan are based on the main aquifer types and areas of localised impacts within these aquifers that need to be managed. The seven consumptive pools are:

1. Upper Aquifer Central Consumptive Pool
2. Upper Aquifer Regional Consumptive Pool
3. Lower Aquifer Consumptive Pool
4. Lyndoch Valley Consumptive Pool
5. Eastern Fractured Rock Consumptive Pool
6. Western Fractured Rock Consumptive Pool
7. Confined Fractured Rock Consumptive Pool

These consumptive pools are defined by spatial extent as shown in Figure 2.5. The key management strategy used in this Plan to manage groundwater is limiting annual extraction. A maximum annual volume available from each consumptive pool for licensed or non-licensed extraction is set out in Table 2.4 and reflected in the principles in section 7. These annual volumes can be varied if required to manage the condition of groundwater resources.

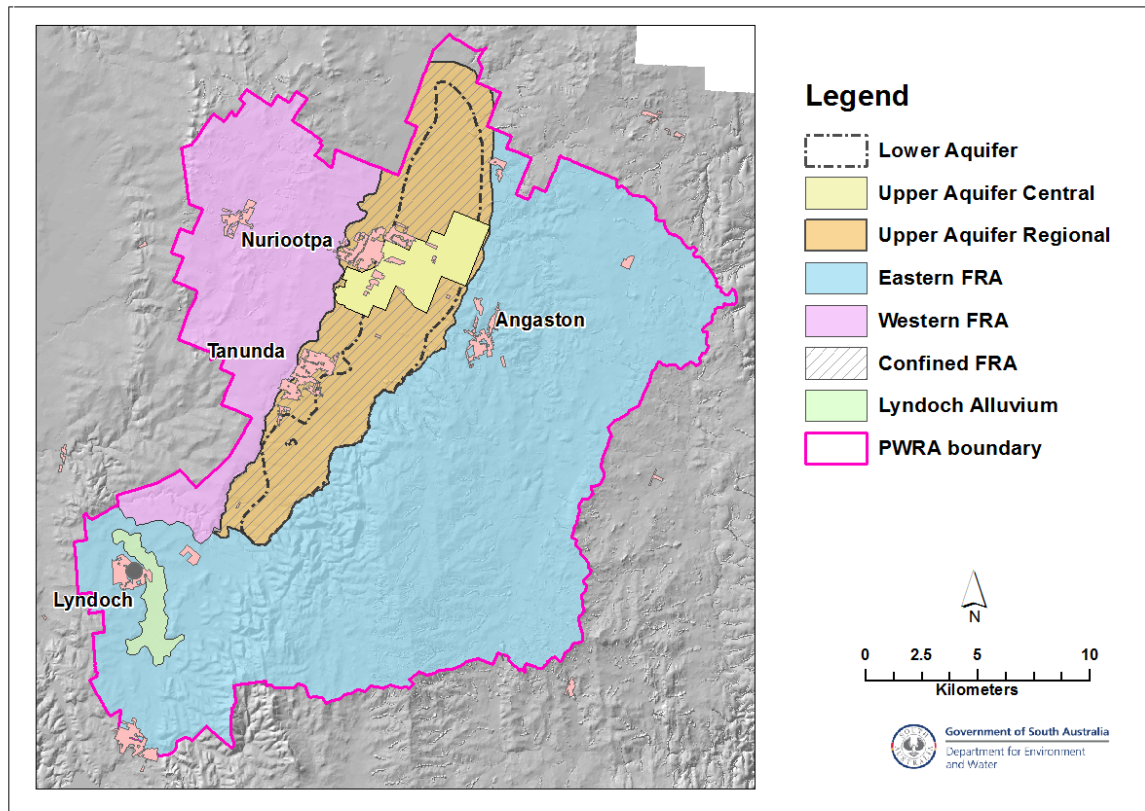


Figure 2.5: Spatial extent and location of groundwater consumptive pools

Resource extraction limits

The total resource capacity for each aquifer has not been quantified, but each consumptive pool has a defined resource extraction limit and a “Maximum volume able to be allocated annually” (Table 2.4).

In 2016, Li and Cranswick developed a range of modelling scenarios which represent varying degrees of impact on the groundwater resources and associated ecosystems based on changes in groundwater extraction and climatic impacts. The modelling incorporated testing the following extraction scenarios:

1. average extraction over the ten-year period 2006-2015.
2. the average of the 5 highest annual extraction volumes in the ten-year period 2006-2015.
3. the average of the 5 highest annual extraction volumes in the ten-year period 2006-2015, but with full allocations in years which are deemed to be dry in the future (15 of 40 modelled years).
4. full allocations.

Each of these scenarios was run with both the historical climate data (1975-2015) being replicated for the 40-year model period (2015-2055), and with the historical climate data being altered by climate change projections to consider the influence the change in climate may have on the resource into the future.

The modelling results indicated that generally, should extraction limits remain similar to the average extraction for the period 2006-2015, the resource should remain neutral, even with future climate projections applied. However, as extraction increases towards full allocations, some areas of the resource are at risk of salinity impacts, depressurisation, accessibility issues or groundwater-dependent ecosystem health effects.

Analysis of more recent climate and extraction data, drivers of water level changes and the location of the licensed extractions combined with a more detailed examination of sustainability issues, has refined the sustainability risks of current extraction levels (DEW, 2022b). This more recent analysis shows that, under the current extraction regime (2015-2022), there are no adverse monitoring trends that indicate the sustainability of the groundwater resource or GDEs are presently threatened. This conclusion is consistent with the Li and Cranswick (2016) prediction that the resource condition should remain neutral (even with future climate projections applied) for an extraction rate averaged over the ten-year period 2006-2015. Table 2.4 therefore provides a maximum volume able to be allocated annually in addition to a resource extraction limit which can be taken into consideration should a management response need be initiated, as discussed further in section 2.5.2.

Table 2.4: Groundwater consumptive pool maximum volumes

Groundwater Consumptive Pool	Licensed allocation (ML)	Estimated non-licensed demand, (ML/yr)	Maximum volume able to be allocated annually (ML/yr)	Resource Extraction Limit (ML/yr)*	Maximum volume of consumptive pool (ML/yr)
Upper Aquifer Regional	164	6	164	164	170
Upper Aquifer Central	917	3	917	500	920
Lower Aquifer	2,166	6	2,166	1,500	2,172
Lyndoch Valley	407	15	407	407	422
Eastern Fractured Rock	3,929	80	3,929	3,929	4,009
Western Fractured Rock	208	20	208	208	228
Confined Fractured Rock	240	8	240	240	248

*unless further varied by the Minister

2.5.2 Groundwater management issues and strategies

The main management concern for groundwater in the Barossa PWRA is extractions increasing towards full allocation. If this occurs, in some areas, there is likely to be adverse impacts such as decline in water level, depressurisation, and salinity increases. While the maximum volume able to be allocated annually as described above is based on maintaining current allocations, active management of allocations may be required in specific consumptive pools.

Groundwater allocations in many of the consumptive pools far exceed the current extraction regime or the average extraction rate over the ten-year period 2006-2015. As such, in areas where the resource has been identified as being at risk of unacceptable impacts (the Upper Aquifer Central and Lower Aquifer consumptive pools) in response to climate change – either directly through reduced recharge, or indirectly through increased extraction due to reduced rainfall availability - there is a need to implement an adaptive management approach to enable a response should an increase in extraction towards full allocations result in unacceptable impacts to the aquifer.

The resource condition limits and triggers for the Upper Aquifer Central and Lower Aquifer consumptive pools are described in detail in section 6.5. Should these triggers be breached, the

Minister may, in their discretion of determining the volume of water available for allocation from the consumptive pool under section 121(4) of the Act, seek to reduce allocations commensurate with the Resource Extraction Limits, as defined in Table 2.4, for these consumptive pools.

This Plan also manages the condition of groundwater by requiring buffer distances to be maintained between new or increased groundwater extraction points and environmental assets (environmental buffers) and/or other wells to avoid unacceptable impacts on GDEs or existing users. Principles in section 7 set out the buffer distances for each groundwater consumptive pool, for different volumes of new or additional extraction.

Minimising the impacts of licensed extraction on permanent pools is a key management issue for the unconfined Eastern and Western FRAs. Environmental buffer distances of up to 250 m between new wells or increased extraction and third order or above watercourses are included in section 7 to manage the impacts of extraction from these aquifers.

2.6 Effects on other water resources

The extraction and use of water in the Barossa PWRA could potentially affect other water resources outside the prescribed area. Section 53(9) of the Act provides that a water allocation plan must include an assessment of whether the extraction or use of water from the prescribed water resource will have a detrimental impact on the quantity or quality of water available from any other water resource.

The neighbouring prescribed areas are the Western Mount Lofty Ranges and the Marne Saunders Prescribed Water Resources Areas.

The extraction of surface water and watercourse water from the Barossa PWRA will not affect the quantity or quality of water from these neighbouring areas because these resources are hydrologically unconnected (as defined by their respective surface water catchment boundaries).

There may be some interaction with groundwater resources in the neighbouring prescribed areas due to the level of interconnection between these resources, as discussed below. The principles in section 7 of this Plan aim to reduce the impacts of the extraction of water in the Barossa PWRA on other water resources, water users and the environment.

While not hydrologically connected to the River Murray Prescribed Watercourse (PWC), River Murray water is used in the Barossa PWRA. The principles in the Water Affecting Activity Permits section of this Plan aim to manage the impacts of imported water use on groundwater, surface water, ecosystems and the productive capacity of land (see section 7.12).

Western Mount Lofty Ranges Prescribed Water Resources Area (WMLR PWRA)

Surface, watercourse, and groundwater resources in the Western Mount Lofty Ranges were first prescribed on 20 October 2005. The Barossa PWRA borders the WMLR PWRA to the south, in the Lyndoch Valley area.

The eight catchments in the WMLR PWRA are divided into groundwater management zones for the purposes of managing the extraction and use of groundwater. The boundaries of groundwater management zones are based on surface water sub-catchment boundaries and hydrogeology.

The same boundaries that distinguish the surface water consumptive pools in the Barossa PWRA from those in WMLR PWRA also distinguish the underlying fractured rock aquifers. The adjacent aquifers in the Barossa PWRA have limited permeability and to date there has been a low demand, mainly due to the unsuitability of the steeper terrain for irrigation and poor groundwater yields. The extraction and

use of water in the Barossa PWRA is therefore unlikely to have a significant impact on the quantity and quality of groundwater in the WMLR PWRA.

It should be noted that a small section of Victoria Creek Catchment, a tributary of the South Para River is located within the Barossa PWRA on the southern boundary. Despite being in the Barossa PWRA, this section of Victoria Creek Catchment is managed under the Western Mount Lofty Ranges Water Allocation Plan.

Marne Saunders Prescribed Water Resources Area

Fractured rock aquifers, present throughout the hills region of Marne Saunders PWRA, are an important source of water for irrigation, stock and/or domestic use, and the environment. Water yields are generally low. At a regional scale, the general movement of water is towards the east where the hills slope down to the Murray Plains.

Similarly to the WMLR PWRA, the same boundaries that distinguish the surface water resources and watercourses in the Barossa PWRA from those in Marne Saunders PWRA also distinguish the underlying fractured rock aquifers. In the Barossa PWRA, there is a low demand for water from these aquifers, mainly because the steeper terrain is unsuitable for irrigation and groundwater yields are poor. The extraction and use of water in the Barossa PWRA is therefore unlikely to have a significant impact on the quantity and quality of water in Marne Saunders PWRA.

River Murray Prescribed Watercourse

There is no direct hydrological connection between the water resources in the Barossa PWRA and the River Murray Prescribed Watercourse (PWC). The extraction and use of water in the Barossa PWRA will not impact on the River Murray PWC, however water from the River Murray PWC is used in the Barossa PWRA.

SA Water provides water from the River Murray for reticulated water supplies. In addition, Barossa Infrastructure Limited has the capacity to supply up to 11 GL of supplementary irrigation water from the River Murray. Water imported from the River Murray has allowed for the expansion of planted areas and demand has increased over time. River Murray water is generally less saline than groundwater within the Barossa PWRA and when used for irrigation purposes, it poses a low risk to the native water resources. Salinity impacts of the application of this water to land are managed through the principles in section 7 of the Plan.

The availability and allocation of River Murray water is managed through the Water Allocation Plan for the River Murray PWC. River Murray water used in the Barossa PWRA is accessed in accordance with the rules and Sustainable Diversion Limits set out in that water allocation plan.

3 – Environmental Water

3.1 Context

In accordance with the requirements of Section 53 of the *Landscape SA Act 2019*, this section:

- describes the type, extent and condition of the ecosystems in the Barossa PWRA which depend on water.
- describes the environmental values of these ecosystems.
- assesses the water quantity, quality and flow regime needed by the ecosystems (environmental water requirements).
- provides information about the water that is to be set aside for the environment (environmental water provisions); and
- provides a statement of the environmental outcomes expected to be delivered.

3.2 Ecosystems that depend on water

The water-dependent ecosystems (WDEs) in the Barossa PWRA comprise an array of plant, animal and micro-organism communities and their non-living environment. They have a complex dependence on water availability and flow. Not only is the total volume of water these systems receive important for their survival, but also how and when that water is delivered.

The WDEs of the Barossa PWRA have been investigated several times during the period 2012-2024. The major study was conducted in 2013-2014 by the (then) Department of Environment, Water and Natural Resources (Green et al., 2014). This was a comprehensive study that investigated vegetation communities at nearly all the permanent pools and conducted a detailed assessment of the fish community at over 40 sites. This information was used to describe a detailed snapshot of the WDEs of the Barossa PWRA, delineate potential management zones based on ecological communities, describe hydro-ecological response models, and describe the level of risk to WDEs under several different water management scenarios.

The three main groups of WDEs are fish, macroinvertebrates, and vegetation. These are described in the following sections.

Fish

The watercourses of the Barossa PWRA currently support a degraded fish community. Fish surveys undertaken between 2013 and 2024 show low species diversity and a dominance of alien species, predominantly Eastern Gambusia (*Gambusia holbrooki*) (~77% of total fish population by number in 2024). Other alien species of fish found since 2013 include Redfin Perch (*Perca fluviatilis*), Goldfish (*Carassius auratus*), Tench (*Tinca tinca*) and translocated native species, Carp Gudgeon (*Hypseleotris klunzingeri*) and Silver Perch (*Bidyanus bidyanus*).

Native species are still present in the area in low numbers. Species such as the bottom-dwelling Flathead Gudgeon (*Philypnodon grandiceps*) and Western Blue Spot Goby (*Pseudogobius olorum*), are still found in larger pools along the main river channel in the Barossa Valley. The regionally rare Mountain Galaxias (*Galaxias olidus*), is found in the upper sections of Jacob Creek and in good flow years will disperse out to other areas, principally Tanunda Creek, though these dispersers do not appear to survive the following summer. Following the extremely dry years of 2018 and 2019, Mountain Galaxias were not detected for several years. However, targeted surveys since 2022 have detected them in low, but recovering, numbers.

Species of fish that were recorded in the past, such as Climbing Galaxias (*Galaxias brevipinnis*) and Short Fin Eels (*Anguilla australis*), have not been observed in the area since the mid-20th century. Two native diadromous species (species that require both fresh and salt water to complete their lifecycle), Common Galaxias (*Galaxias maculatus*) and Congolli (*Pseudaphritis urvillii*), have been recorded in the lower reaches of the North Para River, up to the Yaldara Gauging Station, and appear periodically up to this point depending on the connectivity between pools beyond the Barossa PWRA boundary (Whiterod et al., 2018).

Macroinvertebrates

The diversity of macroinvertebrate communities varies across the Barossa PWRA. The community generally consists mostly of generalist species tolerant of poor water quality, such as non-biting midges (Chironomidae), water boatmen (Corixidae: *Micronecta*) and amphipods (Amphipoda). Flowing sections of the river have blackfly larvae (Simuliidae: *Simulium ornaticipes*), a common and tolerant rheophilic (flow requiring) species, and mayfly nymphs (Leptophlebiidae) are also commonly recorded. These taxa are typical of highly modified agricultural catchments elsewhere in the state. Most species are native, except for two alien snails (*Physa acuta*, *Potamopyrgus antipodarum*), from Europe and New Zealand, respectively.

Streams that have continuous or near-continuous flow, such as the lower North Para River (sections of the Barossa Valley Gorge) and Upper Jacob Creek, recorded high levels of biodiversity (50+ species) in Environmental Protection Authority Aquatic Ecosystem Condition Reports (SA EPA, 2022). The flow regime of Jacob Creek (in particular, sections with perennial flow) supported the presence of rare and sensitive species, such as Water Pennies (Psephenidae species). In contrast, Greenock Creek, Tanunda Creek, and the North Para River in the Flaxman Valley (all zones), had sparse-moderate invertebrate diversity (25-40 species). This is most likely due to intermittent flow, and the impact of alien predators (Gambusia and Redfin), combined with the impacts of land use change and water resource development.

Vegetation

The most recent vegetation survey from Nicol (2013) includes records of 99 species from 163 sites across the Barossa PWRA. The 55 alien species observed include five Weeds of National Significance (Blackberry, *Rubus fruticosus* agg.; Bridal Creeper, *Asparagus asparagoides*; Gorse, *Ulex europaeus*; French Broom, *Genista monspessulana*; and Willow, *Salix nigrum*). Blackberry, Bridal Creeper, French Broom and Gorse are also Declared species under the Act.

Most sites were dominated by emergent species, with the native Common Reed (*Phragmites australis*) and Cumbungi (*Typha domingensis*) present at 60% of sites. No native species of conservation significance were found in the most recent round of vegetation surveys. The most abundant alien species was Water Couch (*Cynodon dactylon*), present at 26% of sites. Submerged native plants (*Myriophyllum verrucosum*, *Nitella* sp.) were recorded at only two sites.

Headwater areas and ephemeral streams were dominated by alien terrestrial grasses and some common native sedges (*Cyperus* and *Juncus* spp.). The abundance of terrestrial plants attests to the limited presence of water in these areas. North Para River, Flaxman Valley, Duck Ponds Creek and Greenock Creek were dominated by stands of Common Reed, to the exclusion of most other species. Emergent species like Cumbungi were common around larger pools, especially pools where stock access was limited.

Groundwater-dependent ecosystems

Groundwater-dependent ecosystems (GDEs) are those that have a reliance on groundwater for some or all of their water requirements. In the Barossa there are two distinct groups of GDEs.

The first are those that are reliant on the surface expression of groundwater for some of the year. These are the permanent pools and small perennial flowing reaches located throughout the Barossa PWRA. Groundwater in the form of either spring discharge or gradual seepage enters the watercourse and maintains pool levels or flow conditions once runoff and subsurface (hyporheic) flows have stopped. These groundwater discharges are predominantly from the fractured rock aquifer in the headwaters through the Flaxman Range, or from the upper unconfined aquifer or alluvial channel. These permanent pools and permanently flowing reaches are mainly managed by managing surface water in conjunction with groundwater extraction buffer zones around watercourses.

The second group of GDEs in the Barossa PWRA are the phreatophytic vegetation that access the groundwater via deep root systems. The most common example of this are the large remnant paddock river red gums that occur across the whole of the Barossa PWRA. These deep-rooted trees access the unconfined upper aquifer to supply their water needs when surface soils dry. As noted in section 2.5, these systems are robust responding primarily to rainfall. The condition of these trees has been noted to be declining over the past decades. The reason for this is unclear and likely not linked to water availability.

3.3 Ecological values

The primary ecological values of the WDEs in the Barossa PWRA derive from the ecosystem processes and services to which they contribute. They include providing habitat refugia and connectivity, contributing to the ecological foodchain and maintaining biodiversity. It is also important to note the social and cultural values of these systems. These values were considered to be degraded but stable in the Barossa PWRA between 1997 and 2016. They have been significantly impacted by development and changes in land and water use, to the extent that many of the more sensitive species or species of note have already been expatriated from the system or have had their spatial extent significantly limited. The remaining species are either tolerant to the degraded conditions or are localised to areas where better flow and water quality conditions persist.

The ecological monitoring programs currently underway in the Barossa PWRA allow for a contemporary understanding of the current diversity and distribution of species across the region. The ecological value of the remaining flora and fauna is critical for the ongoing functioning of the system, provision of ecological services and the ongoing viability of the ecosystems of the Barossa PWRA.

3.4 Environmental water requirements

For the purposes of water allocation planning in South Australia, environmental water requirements (EWRs) are defined as those water requirements that must be met in order to sustain the ecological values of ecosystems that depend on the water resource, including their processes and biodiversity, at a low level of risk. In this Plan, a low level of risk is defined as 'the water regime required to maintain self-sustaining populations resilient to drought.'

Surface water EWRs

To assess the EWRs for the surface water-dependent ecosystems, flow metrics were developed to quantify the different parts of the flow regime that are ecologically relevant. The six metrics used in this Plan (Table 3.1) were developed specifically for the Barossa PWRA (Green and Savadamuthu, 2024a). The relevant bounds for these flow metrics were then defined using a baseline time period.

In the case of the Barossa PWRA, the period 1997 to 2016 (inclusive) was used, as this was identified as a period where the WDEs of the Barossa PWRA were considered to be in a stable, albeit degraded state (Green and Savadamuthu 2024a).

Table 3.1: Description of the key flow metrics used to determine the EWRs

Flow regime area	Flow metric	Ecological functions
Intermittency	Number of flowing days per year	• Considered the master variable for intermittent rivers (Datry et al., 2014) • Longer cease to flow periods leads to deteriorating water quality in refuge habitat (Chapin et al., 2014, Schmarr et al., 2014) • Length of flow period dictates habitat availability and expected lifecycle completion (Bonada et al., 2007)
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 (Vander Vorste et al., 2020) • Watering of in channel riparian vegetation over low flow season (Nicol, 2013) • Opportunities for dispersal (Baumgartner et al., 2014)
Break of season	Number of days past the 1 st of April the watercourse commenced substantive flow	• Cues for migration and breeding (Lucas and Baras, 2008, Mackay, 1992, Pires et al., 2014) • Increased stress on refuge habitats (Vander Vorste et al., 2020) • Likelihood of lifecycle completion (Mackay, 1992)
Spring flows	Mean daily runoff (ML/day/KM ²) for August – November (inclusive)	• Promotes resilience leading into the low flow/cease to flow period (eWater, 2022) • Promotes fish recruitment success (Green et al., 2014) • Migration of obligate aquatic fauna (Lucas and Baras, 2008) • Discourages exotic fish species (Seebacher and Kazerouni-Ghanizadeh, 2021)
Medium flows	Number of days above the median flow (50 th percentile) per year	• Promotes large-scale fish migration (Lucas and Baras, 2008) • Discourages exotic fish species (Moore et al., 2008) • Expand riffle habitat for macroinvertebrate species (Bonada et al., 2007) • Inundate vegetation on benches and lower banks (Maxwell et al., 2015) • Control terrestrial vegetation in channel (Maxwell et al., 2015)
High flows	Number of days above the high flow threshold (80 th percentile) per year	• Inundate vegetation higher on banks (Maxwell et al., 2015) • Habitat maintenance including silt removal and algae scouring (Fuller et al., 2010, Loire et al., 2019) • Entrain organic material from banks (Caraco and Cole, 2004) • Plant propagule transport (Stromberg et al., 2007) • Management of reed beds (Stromberg et al., 2007)

As the surface water systems of the Barossa PWRA are naturally variable, the method of assessing EWRs took this into account. The ecosystems of the area are adapted to this variability, so rather than use a static annual threshold to define whether the EWRs have been met, upper and lower bounds were established based on a three-year moving average for the baseline period (1997 – 2016) (Figure 3.1). For each of the flow metrics described in Table 3.1, flow data were used to define limits of variability observed or modelled over the period 1997 – 2016. (These flow data were derived either from measurements from long-term flow monitoring stations, or modelled flow data for un-monitored locations.)

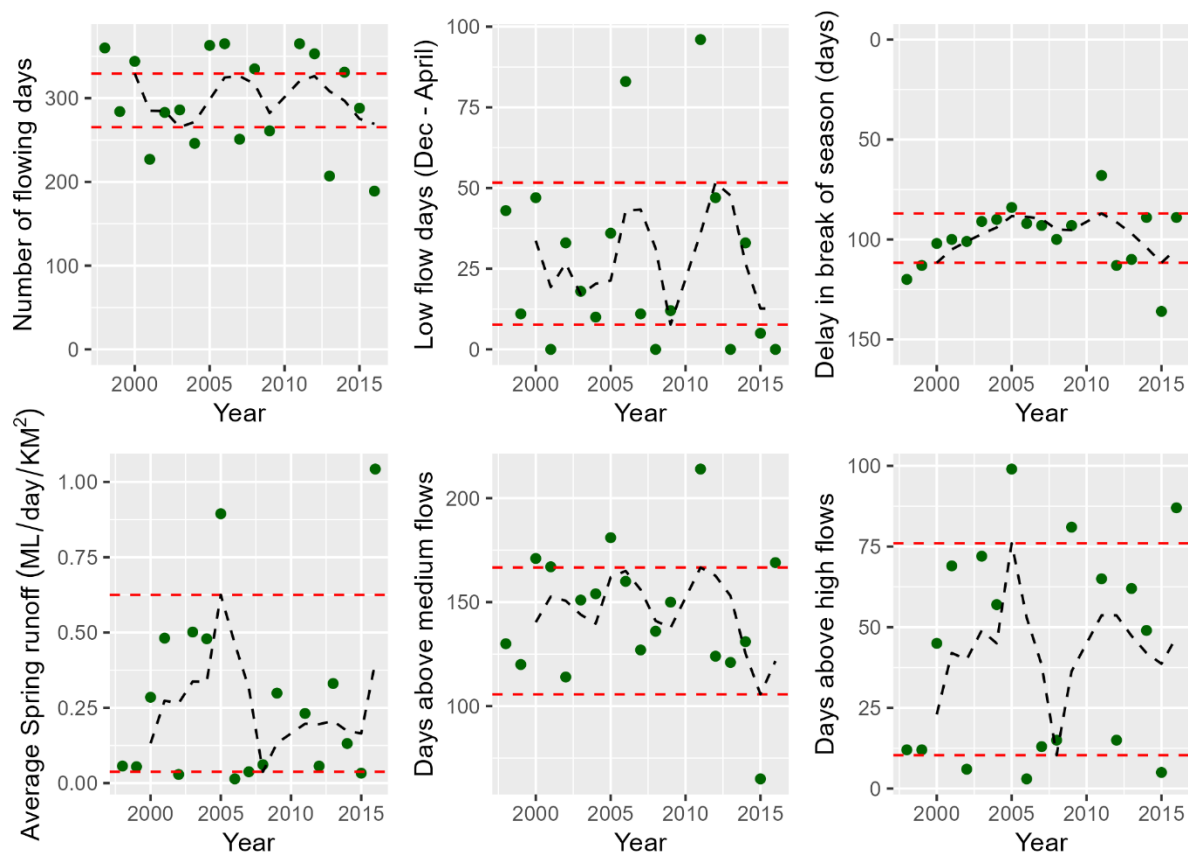


Figure 3.1: Upper and lower bounds for each flow metric. Visualisation of the EWR bound setting process for the Barossa Valley Gorge zone (as an example). [The green dots represent the value for the metric recorded for each year, in this case actual flow data from the Yaldara Gauging Station. The black dashed line represents the three-year moving average (average of the current year and the preceding two years). The red lines represent the EWR bounds for the moving average.]

Groundwater-dependent ecosystem EWRs

Some of the ecosystems of the Barossa PWRA are groundwater-dependent ecosystems (GDEs). Key among these are the permanent pools and perennial flowing reaches distributed across the PWRA, as well as groundwater-dependent vegetation such as paddock river red gums.

To the extent of current knowledge, all the GDEs are dependent on the upper unconfined aquifer or alluvial channels along the watercourses or spring discharge from the fracture rock systems in the hills, systems that are not heavily developed and, in the case of the alluvial channels, are protected from future development by buffers.

The EWRs for GDEs of the Barossa PWRA have not received the same attention as the surface water ecosystems, primarily due to the lower level of risk faced by these systems due to the low level of

extraction from the systems. The key requirement for these systems is to maintain the ecosystem's access to water. For this reason, the EWRs for GDEs are defined as:

- Maintain permanent pool levels within historical ranges.
- Maintain perennial flow in spring fed reaches (Upper Jacob Creek).
- Maintain groundwater levels within the root zone of phreatophytic vegetation.

Monitoring is currently underway to quantify these EWRs.

Water quality requirements

The water quality requirements of the water-dependent ecosystems of the Barossa PWRA are broad. The rivers and streams of the Barossa, as with most parts of the Mount Lofty Ranges, are naturally slightly saline. In response to this, the species that inhabit these ecosystems are tolerant of a level of salinity. The specific level is dependent on the species and a host of contributing factors such as other stressors.

The natural variability of the water quality within the rivers of the Barossa PWRA makes it hard to identify specific requirements or bounds, as these bounds would be overly dependent on other aspects such as time of year, population densities, interaction between different water quality stressors and species of interest.

Water quality in systems such as the Barossa PWRA surface water systems is driven by flows, when the systems are flowing the incoming fresh water is sufficient to remove salinity and other pollutants, maintain dissolved oxygen levels and maintain water quality. Once flows cease, the water quality conditions become progressively worse as non-permanent pools evaporate and permanent pools contract and evapo-concentrate. The only mechanism to alleviate this deterioration in quality is to provide flows to the pool. For this reason, no specific water quality requirements are provided in this Plan, rather, water quality is considered to be managed by providing the environmental flow requirements.

3.5 Assessment of the capacity of the resource to meet environmental water requirements

Surface water

Section 53(1)(b)(i) of the Act requires a WAP to assess the capacity of the water resource to meet EWRs, as described above. This is interpreted as the ability of the water resources to meet the EWRs for each of the assets, in each of the consumptive pools, given the level and nature of current water resource development.

Following methods described in Section 3.4, EWR metrics were calculated and assessed up to 2022. These are used to assess whether the surface water resource has the capacity to meet the EWRs under the current level and nature of water resource development. Where available, this assessment was based on actual data - for other areas it was based on modelled data (aligning with the development of the EWR bound values). It was determined that the surface water resource capacity can meet the EWRs if the three-year moving average for each of the metrics remains above the lower bound, as shown in Table 8.2. For more information, refer to Green and Savadamuthu (2024a).

Each year there are six metrics assessed per zone - therefore the maximum possible passing in any given year is six. Given that the WDEs of the Barossa PWRA are adapted to a variable climate, it was acknowledged that assessing metrics over a single year was not overly relevant, rather it was identified that assessing the metrics over a three-year rolling period would provide a more ecologically relevant

insight into the condition of the flow regime, and the likely impacts to the WDEs of the area (Green and Savadamuthu 2024b). Over the rolling 3-year period 18 metrics are therefore assessed.

As shown in Table 3.2, over the period 2020 - 2022, the maximum number of EWRs met was 15 out of 18 in Lyndoch Creek, while the lowest was one out of 18 metrics at both Upper and Lower Jacob Creek.

The number of metrics passed was compared to the thresholds identified in Green and Savadamuthu (2024b). The shading on the total column reflects whether the consumptive pool condition is above or below the threshold (eight or more metrics passing in the three-year window) - red indicating below minimum acceptable condition, green means zone is meeting minimum acceptable condition.

This evidence suggests that the resource capacity based on the current level and nature of water resource development is variable and may be insufficient to meet EWRs in all consumptive pools in every rolling 3-year period. It is acknowledged that the dry conditions experienced in the Barossa PWRA over the 2018-2020 period have impacted on the environment and that the current flow conditions are insufficient to meet the surface water EWRs (see section 3.4).

Table 3.2: Summary of the number of EWR metrics passed over the period 2020 – 2022. [Each year there are six metrics assessed per zone, therefore the maximum passing in any given year is six. Shading on the total column reflects meeting the ecological threshold assessment, red means zone is below minimum acceptable condition, green means zone is meeting minimum acceptable condition.]

Data used	Zone	2020	2021	2022	Total
Actual	Barossa Valley Gorge	0	2	3	5
Actual	Lower Flaxman Valley	1	N/A	3	4*
Actual	Upper Flaxman Valley	5	5	4	14
Actual	Upper Tanunda Creek	2	3	6	11
Modelled	Barossa Valley Floor	2	4	6	12
Modelled	Duck Ponds Creek	2	3	4	9
Modelled	Lower Angaston Creek	1	1	5	7
Modelled	Lower Jacob Creek	0	0	1	1
Modelled	Lower Tanunda Creek	1	1	5	7
Modelled	Lyndoch Creek	5	5	5	15
Modelled	Mid Flaxman Valley	2	3	4	9
Modelled	Stone Chimney Creek	1	2	5	8
Modelled	Transition Zone	2	4	6	12
Modelled	Upper Angaston Creek	1	1	5	7
Modelled	Upper Jacob Creek	0	0	1	1
Modelled	Greenoch Creek	3	4	5	12
Modelled	Saltwater Creek	2	5	6	13

* Flow data for 2021 from the Penrice flow station (Lower Flaxman Valley zone) has missing data and therefore metrics were not accessed at this site for this year, so this assessment is out of a possible 12 metrics passing.

An adaptive management approach has been developed in order to adjust water availability in accordance with the degree of risk facing the EWRs being achieved. This is discussed in detail in sections 6.5 and 7.4 of this Plan.

Groundwater

As discussed in section 2, the upper unconfined aquifer is relatively undeveloped and water levels within these aquifers are primarily dependent of recharge from either rainfall or streamflow. In the absence of quantified EWRs and appropriate modelling processes to assess the relative impact of rainfall and streamflow, it is assumed that providing the surface water EWRs will provide the groundwater EWRs given the dependence on each other.

3.6 Environmental water provisions

EWRs are defined by this Plan as those parts of environmental water requirements that this Plan aims to meet at any given time, with consideration of existing water users' rights and social and economic impacts. EWRs do not necessarily aim to return WDEs to a pristine condition, but to keep them at an acceptable level of risk, as determined through the water planning process.

This section refers to the development of resource condition indicators (RCI) that are the indicators that will be used to assess the current condition of the resource from the environmental perspective and resource condition triggers (RCTs) which are the thresholds that, if breached will result in a response. Responses to RCTs being breached are discussed in detail in section 6.5. This process aims to ensure the sustainability of the environment over the life of this plan.

Surface water EWRs

Environmental water provisions (EWRs) are provided through this plan by managing the amount of water that can be legally taken from the various surface water resources. Based on annual averages, total licenced entitlement is currently 32% of the overall surface water resource capacity. The remaining water, while protected from licenced consumptive use is not considered to be environmental water. Much of this water is captured in dams where it is used for stock and domestic uses or stored for security of supply and subject to evaporation. Environmental water provision is only considered to be the water that spills from dams in the headwaters and reaches the WDEs of the more downstream watercourses (generally third or fourth stream order), minus the water taken for stock and domestic use that is unlicensed and unmetered.

It is also important to note that this water identified as environmental water also is the water available to meet cultural and social outcomes, i.e. this water is protected for outcomes that include environmental, social and cultural.

As described in section 3.4, the total volume of water is not the key issue when considering environmental water. Most of the water, volumetrically, comes in short-lived high flow events which do have environmental value (see table 3.1 in section 3.4) but are only a small part of the flow regime. Previous work undertaken in the Mount Lofty Ranges identified that, without the provision of low flows (small environmental flows from larger storages), the percentage of water required by the environment to maintain a low level of risk was identified as 95% by volume. This dropped to 75% or 80% once low flows were provided to the environment, as total flow volume is not as important as flow regime. By way of illustrating this, Table 3.3 details the summary statistics for the volume of free to flow water available at end of each zone based on the current use of water across the Barossa PWRA. Environmental water available here is calculated as the percentage of the resource capacity that is still present at the end of each zone under current water use. Further, Table 3.4 details the change in the key flow metric (number of flowing days) due to water resource development. These tables are reflective of the current water use, not full use of entitlement. Prior to implementing aspects of the adaptive management framework, the Minister may seek advice on relative impacts to volumes and flow metrics.

Table 3.1: Summary statistics of available free to flow water volume across the WAP development time window (1997-2022)

Zone	Average available (%)	Median Available (%)	Standard deviation (%)	Min available (%)	Max available (%)
Barossa Valley Gorge	75.4	74.6	7.9	50.2	85.5
Lower Flaxman Valley	57.9	54.8	17.8	16.4	81.9
Upper Flaxman Valley	52.6	47.2	20.1	26.8	81.7
Upper Tanunda Creek	77.9	81.1	12.0	46.6	88.9
Barossa Valley Floor	74.8	73.0	7.4	53.0	85.5
Duck Ponds Creek	68.9	66.9	13.2	47.4	92.6
Lower Angaston Creek	83.1	84.3	9.9	39.6	90.5
Lower Jacob Creek	79.1	81.0	10.4	47.8	88.1
Lower Tanunda Creek	77.3	79.2	10.7	43.6	87.8
Lyndoch Creek	88.1	91.8	7.2	71.8	96.8
Mid Flaxman Valley	49.1	45.0	22.6	2.0	79.9
Stone Chimney Creek	52.0	45.0	12.8	37.8	75.7
Transition Zone	71.5	69.5	8.6	50.4	84.5
Upper Angaston Creek	89.8	90.0	4.5	74.4	95.1
Upper Jacob Creek	83.3	83.3	4.7	73.0	88.8

Table 3.2: Summary statistics of the change in the number of flowing days owing to the development of water resources water across the WAP development time window (1997-2022)

Zone	Average reduction	Median reduction	Standard deviation of reduction	Minimum reduction	Maximum reduction
Barossa Valley Gorge	39	28	25	0	81
Lower Flaxman Valley	91	77	58	0	217
Upper Flaxman Valley	73	63	29	27	121
Upper Tanunda Creek	119	117	34	14	171
Barossa Valley Floor	57	61	23	0	100
Duck Ponds Creek	62	60	25	0	109
Lower Angaston Creek	139	139	38	53	209
Lower Jacob Creek	152	155	31	66	213
Lower Tanunda Creek	136	132	31	43	188
Lyndoch Creek	114	130	42	0	158
Mid Flaxman Valley	235	233	43	142	321
Stone Chimney Creek	46	38	26	5	111
Transition Zone	62	66	22	2	106
Upper Angaston Creek	48	44	21	0	100
Upper Jacob Creek	26	36	21	0	61

There is provision within the Plan to vary the amount of surface water allocated from year to year in response to resource condition. The average reduction in resource capacity since entitlements were issued (24% reduction) and the assessment that the current allocation and water use regime has resulted in a flow regime that does not meet the EWRs will be considered as part of the flexible and adaptive management during the life of this Plan.

The adaptive management approach provides guidance to the Minister when utilising their discretion under section 121(4) of the Act to determine the volume of water which is available for allocation. Section 6.5 discusses how the metrics discussed in this section will act as resource condition triggers which suggest appropriate reductions in resource capacity and therefore the volume of water the Minister may wish to make available for allocation.

It is understood that managing allocation levels alone will not provide sufficient additional water to fully manage risk to WDEs in the Barossa, i.e. maintain the current condition (Green et al., 2014). For this reason, the Landscape Board are actively investigating options for environmental water outside this Plan including voluntary environmental flow releases, additional water resources and, in partnership with the Department, water security strategies.

In the absence of other supporting actions, the environmental outcomes expected under this Plan are highly dependent on rainfall over the life of the Plan. A return to rainfall as experienced between 1997-2016 should see the volumes of water returning to levels that meet the EWRs as long as water use does not increase. However, if the dry conditions experienced since 2018 continue through the next decade, or if water use increases towards full allocation levels, it is highly likely that there will be a continued decline in conditions, likely leading to enacting of the environmental triggers and hence reduced water available for allocation. This decline will manifest in the following ways:

- Macroinvertebrate community composition will shift, with flow and salinity sensitive species being forced into increasingly smaller areas of the PWRA as suitable habitat reduces. Tolerant species such as diving beetles, water boatmen, backswimmers, worms and midges will become the dominant species altering the trophic structure and nutrient processing within the water. Eventually, flow sensitive species will be isolated to Jacob Creek, leaving them highly vulnerable to regional loss.
- The trigger values are specifically focused on preventing the loss of the native fish species Mountain Galaxias from Jacob Creek and if suitable actions are applied, the population should be maintained, though at high risk of regional loss. However, without suitable flows, it is likely that the population will not experience good recruitment events associated with this boom-bust species. More likely, the population will continue in low numbers within isolated pockets in Jacob Creek.
- The encroachment of terrestrial vegetation into the watercourses will continue as the persistent water flow required to drown them and prevent the encroachment are no longer present. Ultimately this will lead to a reduction in diversity across much of the PWRA with many flow-sensitive and shallow water specialists being limited in their distribution to Jacob Creek.

Surface water resource condition triggers

For the purposes of this Plan, a number of resource condition limits for these resource condition indicators (metrics) was established to identify a point beyond which the WDEs of each consumptive pool become unsustainable (Green and Savadamuthu, 2024b).

Based on the EWR metrics described in section 3.4, a resource condition trigger (RCT) was developed for the indicators collectively, based on previous observed conditions that were an extreme risk to the ongoing survivability of current water-dependent ecosystems. This RCT (the Metric RCT) is breached when less than 8 of the 18 RCIs (metrics) are met over the previous 3-year period. This Plan aims to maintain EWRs that support at least a total of 8 out of 18 RCIs(metrics) being met over any rolling 3-year period. It is important to note that this limit has been established to prevent the loss of species at the regional scale, not to maintain the current condition of water-dependent ecosystems at each individual site. To maintain the current condition of water-dependent ecosystems at each individual site, all RCIs should be met.

Should the Metric RCT be breached, the adaptive management framework of this Plan will be enacted allowing for the adjustment of allocation rates to reflect the contemporary conditions among other potential management options. These are discussed further in section 6.5.

In addition to the RCT related to the flow metrics associated with the EWRs, a second RCT has been established based on the number of flowing days observed for each consumptive pool (Flow days RCT). Due to the importance of the number of flowing days to the overall condition of the water-dependent ecosystems of the Barossa PWRA, it was considered that a separate RCT specifically for this metric is required. This RCT was established as the lowest number of flowing days observed in the period 1997 – 2016. Should the number of flowing days fall below this RCT for **two consecutive years**, the trigger is considered breached. This RCT will be assessed across the surface water flow monitoring locations active across the Barossa PWRA and on modelled data.

Should the flow days RCT be breached, the adaptive management framework of this Plan will be enacted allowing for the assessment of appropriate responses. The primary mechanism of managing the flow regime in this Plan is variations to allocations, however, variations to allocations is a longer-term response that will not have immediate impact should the RCT be breached. For this reason, the response to this RCT being breached may include mechanisms within the Plan or broader mechanisms under the Act. It is likely that breaches of the flow days RCT will be accompanied by breaches in other RCTs. The adaptive management framework is discussed further in section 6.5.

Groundwater EWRs

No quantified EWRs for groundwater are provided in this plan. The water resources that the GDEs depend on are not overly developed and the risk to ecosystem values based on consumptive use of water from these aquifers is considered to be minimal. However, the surface expression of groundwater in the form of permanent pools has been identified as key GDE and critical habitat for the obligate aquatic flora and fauna of the Barossa PWRA.

Surface water flows will top up permanent pools and recharge the alluvial channel or upper unconfined aquifer that provide water to these pools. Therefore, management of the flow regime to these pools is considered critical for their ongoing viability.

While water is not accounted for from the groundwater resource to meet the EWRs of these GDEs, the use of buffers around permanent pools seeks to reduce the risk of flow reversal and impacts to these permanent pools by the taking of groundwater in close proximity and therefore support the likelihood of these GDEs EWRs being maintained.

Groundwater resource condition triggers

An RCT has been identified for the permanent pools of the Barossa PWRA due to their critical role as refuge habitat for aquatic flora and fauna over the cease to flow period (the Permanent Pool RCT).

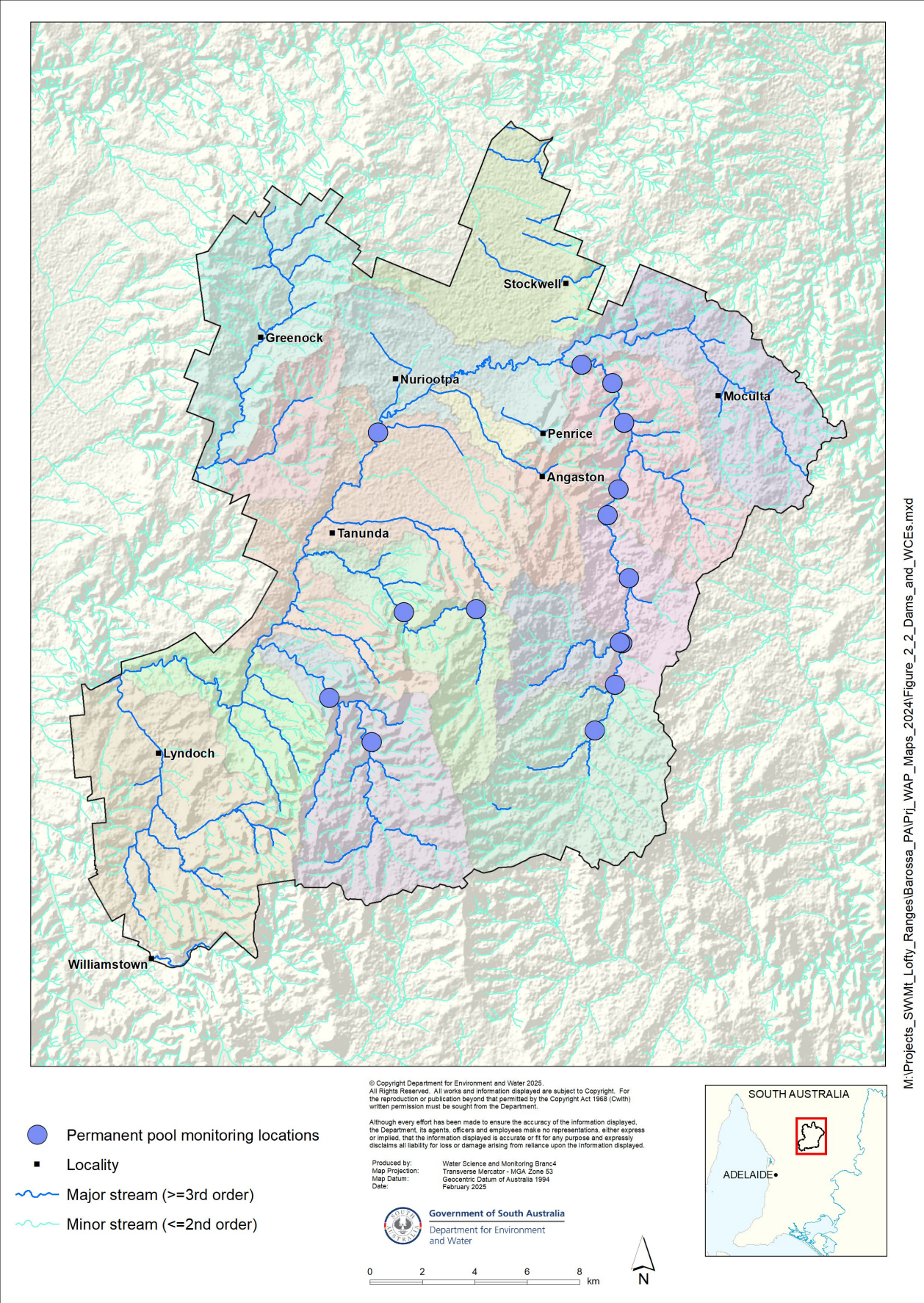
The permanent pool RCT is designed to provide a trigger for action to prevent the condition of these critical habitats declining to a point that where the viability of the habitat is compromised, be that either through water quality decline or through drying out entirely.

The assessment of permanent pools across the Barossa PWRA was introduced in early 2024, with a series of 16 key permanent pools being monitored across the PWRA (Figure 3.2). Given the extremely dry nature of 2024 and visual comparison of pools levels against previously observed levels across summer 2024-25, it is considered that pool levels across the summer of 2024-25 represent critical levels. Therefore, in the absence of long-term monitoring data and the observed conditions across summer 2024-25, the permanent pool RCT is set to the minimum level observed over 2024-25 water year within the permanent pools monitored across the Barossa PWRA (Table 3.5).

Table 3.5: Minimum depth of monitored permanent pools that serves as the permanent pool RCT

*Note for consultation – Table 3.5 will be included in final WAP and is dependent on completion of monitoring over the 2024-25 summer/autumn period.

As with the surface water resource condition triggers, should the permanent pool RCT be breached the adaptive management framework of this Plan will be enacted allowing for the assessment of appropriate responses. The adaptive management framework is discussed further in section 6.5.



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Figure 3.1: Location of current permanent pool monitoring locations in the Barossa PWRA.

3.7 Statement of environmental outcomes

Surface water

This section describes the statement of the environmental outcomes expected to be delivered on account of the provision of environmental water under this Plan as required under Section 53 (1)(b)(iii) of the Act.

Based on the investigations that have informed the development of this Plan, conceptual understanding of the WDEs of the Barossa PWRA and broader ecological understanding of WDEs in the wider Mount Lofty Ranges, it is considered that managing the surface water resources in accordance with this Plan will lead to the ecosystems of the Barossa PWRA being sustained over the life of this Plan. In practice, this is reflective of the following

- The maintenance of a population of Mountain Galaxias in the Barossa Valley, likely limited to Jacob Creek
- No loss of native species at the scale of the whole PWRA, i.e., species may expand or contract their range within the PWRA, but they will still maintain a presence within the PWRA.
- Continued functioning of WDEs and the provision of ecosystem services such as maintenance of nutrient cycling within water bodies.

Modelling shows that following a recent period of dry conditions, the WDEs in a number of consumptive pools were at an increased level of risk under the current management arrangements. However, a return to rainfall closer to the past 20-year average would see an improvement in the flow conditions and therefore in the ability to meet the expected outcomes.

Groundwater

It is considered that the low development levels in the upper unconfined aquifer, combined with the use of defined groundwater resource condition limits and resource condition indicator triggers to enact action, results in a low level of risk to GDEs dependent on it. For GDEs in the alluvial channels, the key source of recharge to this system is surface water flows and therefore, EWRs for surface water are expected to provide for alluvial channel systems as well.

3.8 How the Plan aims to achieve the outcomes

Section 7 of this Plan includes principles that aim to maintain the condition of WDEs above the threshold for low level of risk. These include not allowing additional allocations or increased dam capacity and establishing water-dependent ecosystem buffers between WDEs and extraction points. The Plan also establishes an adaptive management approach, by:

- identifying key flow metrics (Table 3.1) for each consumptive pool.
- establishing a monitoring program to measure against these key flow metrics.
- identifying a threshold of unsustainable ecological condition for each consumptive pool, based on these metrics, to guide a response if breached.
- allowing for the variable allocation of surface water resources based on resource condition indicators.
- providing incentives to licence holders to engage in voluntary environmental flow release programs, reflective of the current understanding that flow releases are a more effective method of attaining ecological outcomes.

Ongoing monitoring of the condition of water resources and WDEs is required to implement the policies in this Plan, and to inform its next review. There is a good surface water monitoring network across the Barossa PWRA, with seven gauging stations operating. More recently, the Northern and Yorke Landscape Board has committed to an ecological monitoring program across the Barossa PWRA including fish monitoring and a community-based macroinvertebrate monitoring program (the 'BioBlitz'). These programs seek to increase the understanding of the WDEs of the Barossa PWRA, their dynamics through time and response to flow conditions. Information gathered from these programs will form an integral part of future evaluations of the WAP and future amendments.

Actions outside this Plan to support environmental outcomes

It should be noted that water allocation plans are part of a broader landscape planning framework and have a specific role in the management of water resources. The Plan does not have the ability to manage all pressures on WDEs in the Barossa PWRA. In particular, it is acknowledged that action taken under this Plan to reduce allocations would not have as significant an impact on flows as other strategies such as low flow releases, environmental flow releases, dam modifications and dam removals.

At the time of developing this Plan, and in acknowledgement of the risks to the condition of water-dependent ecosystems, a number of complementary initiatives were underway to address water security risks, including for the environment. These include:

- A Barossa Water Security Strategy (DEW 2022c), sets out strategic actions to provide water security out to 2070, with a key action being to investigate the feasibility of providing alternative water to the Barossa and Eden Valleys. An alternative source of water has the potential to provide a secure source of water for licensees, while taking pressure off local native water resources.
- An Environmental and Cultural Flows Project in 2023-2025, was used as a pilot project to improve the science and monitoring data collected and explore how to increase flows through catchments.
- Regional organisations and landholders are working together to progress complementary on-ground activities to regenerate catchments including through best practice farm management, revegetation projects and pest plant and animal management in watercourses.

Projects to implement actions outside of this Plan will be encouraged on a voluntary basis in the short-term. In the longer-term, if no improvements to flow conditions or the health of water-dependent ecosystems are measured, a future iteration of this Plan, or the Minister, may require further action to address risks.

4 – First Nations Water

4.1 Incorporation of First Nations interests in water planning and management

As the relevant First Nations for Country intersecting in the Barossa area, the Ngadjuri, Peramangk and Kurna peoples' science and knowledge of the relationship between flow, water-dependent ecosystems and sustainable livelihoods is a valuable addition to contemporary scientific knowledge addressing gaps in the understanding of water resources. In relation to water allocation planning this knowledge has only been partially considered to date. Through ongoing meaningful engagement with all three Nations in water planning, future iterations of this Plan can make further progress to achieving the stated objectives set out below.

There is a need for ongoing discussion on how the notion of water use and cultural perspectives can co-exist within the water management regulatory framework to achieve water management outcomes that have integrity and demonstrate respect for First Nations and the wider communities.

As part of amending this Plan, targeted engagement with the three First Nations was undertaken. This has resulted in the inclusion of First Nations (cultural) Water interests in this Plan. Noting, that a water licence/allocation would not be required to take water if taken pursuant to existing native title rights and interests, as per the Native Title Act and the existing [authorisation under section 105 of the Act](#) which enables water to be taken for Native Title Purposes without the requirement for a licence. This engagement process has also identified cultural objectives of the First Nations people that have been incorporated as part of this Plan and will be addressed via mechanisms that align but are outside of this Plan.

4.2 Recognition of First Nations water interests

The European colonisation of South Australia significantly impacted First Nations' care, control, maintenance, and governance of their Country. Water flow and connectivity has been disrupted with obstructions such as dams and weirs being built, and water quality and quantity has changed due to extraction. First Nations peoples' way of life significantly changed as they were forcibly removed from their Country and their lands and waters were granted to European settlers. This has impacted the ability of First Nations people to undertake cultural practices on Country - knowledge and associated values and connection to Country that have continued to be passed down through generations. Nations have had to struggle to maintain their identity through language, Native Title and Aboriginal organisations and adapting to a loss of control of, and access to, large parts of their Country. Today the management of water requires the uniting of all people, communities, and users for a more sustainable future.

4.3 History of the Ngadjuri, Peramangk and Kurna First Nations in the Barossa

For thousands of generations the Ngadjuri, Peramangk and Kurna First Nation people have cared for the waters and lands of their Country, including the place where all three Countries meet in the Barossa area (Figure 4.1). Country is not traditionally defined with straight borders, but rather by landmarks and stories. As a guide, Ngadjuri are Native Title holders for Country that extends north in the Rangelands to Orroroo, east to the Mallee, west to the Clare Valley, and south to the northern half of the Barossa PWRA. Peramangk Country includes Murraylands in the east, and the eastern Mount Lofty Ranges from the Fleurieu Peninsula in the south to the southern half of the Barossa PWRA. Kurna are Native Title holders for Country that encompasses the western parts of the Fleurieu Peninsula, the Adelaide metropolitan area, the Mid North to Redhill, and part of the southern half of the Barossa PWRA. First Nations people have a belief system known as the Dreaming, which describes how ancestral beings created Law, land, water, animals, plants and the cosmos. The Ngadjuri,

Peramangk and Kurna First Nations people have an ongoing cultural obligation to care for and protect the waters and lands of their Country today and into the future.

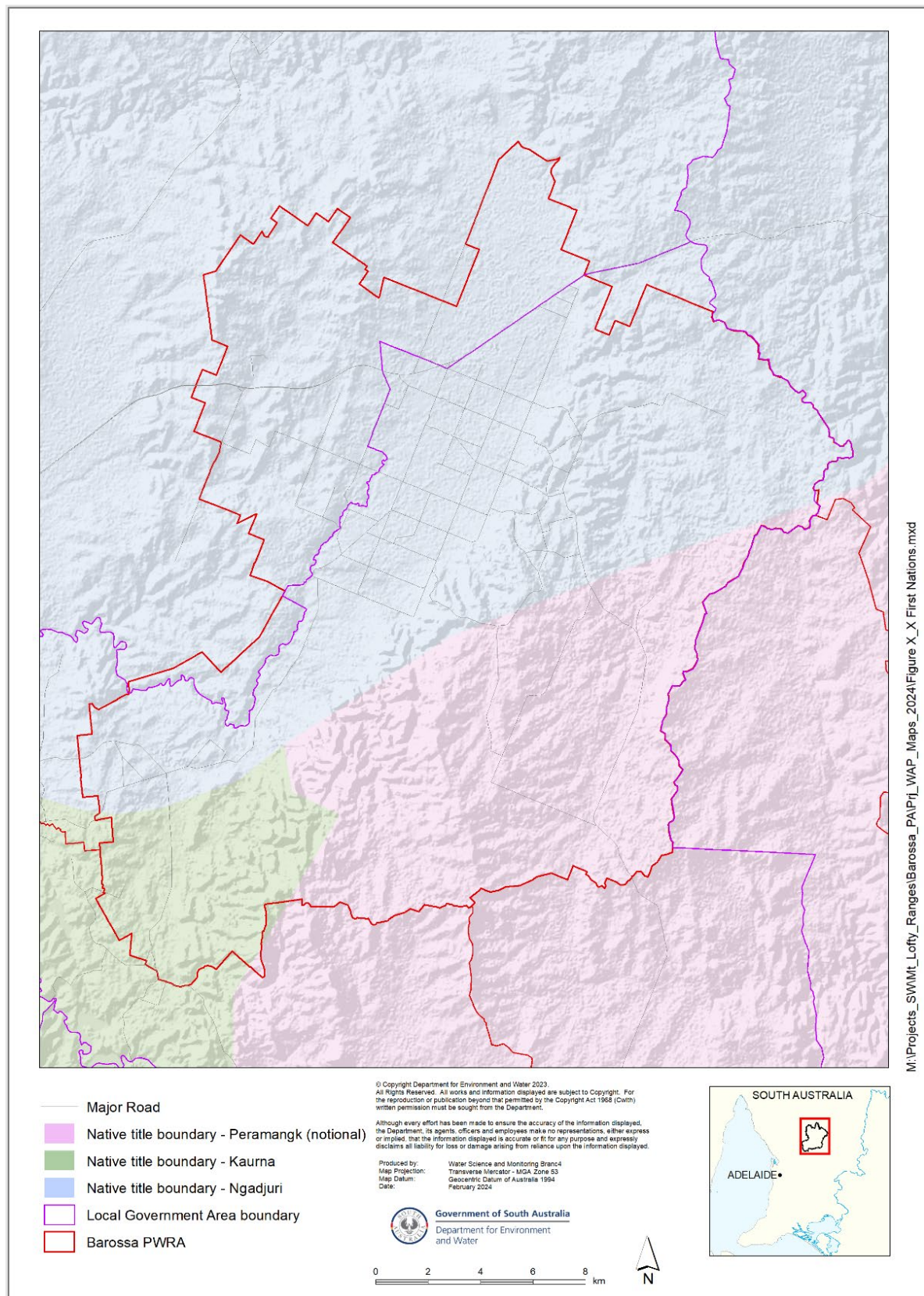


Figure 4.1: First Nations Country associated with the Barossa PWRA.

4.4 Collaborative partnerships caring for Country

Collaborative partnerships caring for Country and Culture are essential to Country and can help make lands and waters healthy for everyone. If land is sick, then people are sick. Actions we take today can lead to cultural and spiritual wellbeing of Country and people. It is also important to continue to pass cultural knowledge and practices onto the next generation and teaching young or disenfranchised people through practices, storytelling, ceremonies, and gatherings. Private ownership of land has made access to cultural sites and continuation of cultural knowledge and activities difficult in some areas. The people of the Ngadjuri, Peramangk and Kurna First Nations recognise that partnerships are key to helping improve the health of Country, as is raising awareness about their culture, history, and heritage. Building collaborative relationships with landholders and local organisations are an important part of working together to care for Country.

The Ngadjuri, Peramangk and Kurna First Nations would like to work towards improved access to cultural sites for their communities, in conjunction with increased awareness and protection of cultural heritage. They are keen to explore opportunities to improve community awareness about culture, their history, and First Nations perspectives about land, waters, and Country. And where appropriate to share cultural knowledge and incorporate First Nations practices into land and water management practices to help improve outcomes, including through seasonal caring. Cultural heritage surveys and Aboriginal Waterways Assessment are established methods used to identify cultural sites and the actions required to maintain and protect them. The Ngadjuri, Peramangk and Kurna First Nations seek equal partnerships and voice when it comes to matters affecting their Country, and to be included, heard, and have agency in decisions that relate to land and water management, to allow them to fulfil their cultural obligations and continue to care for Country.

4.5 Ngadjuri, Peramangk and Kurna First Nations peoples cultural objectives for Country including the Barossa

The Northern and Yorke Landscape Board have collaborated with the three First Nations to identify priority objectives that are key to caring for the lands, waters, plants, animals, and people that comprise healthy Country.

Engagement with the First Nations peoples on this Plan was conducted through various mechanisms based on needs, interests, and capacity. A key objective of undertaking good engagement is to continue to build on previous engagement. Collective engagement through the nominated representatives of each group of First Nation people was identified as the preferred approach during the drafting of this Plan. Future water planning and management will also include individual Nation engagement via the respective representative bodies, these being the Ngadjuri Nation Aboriginal Corporation (NNAC) Board, the Peramangk Aboriginal Corporation, and the Kurna Yerta Aboriginal Corporation.

This process has been a preliminary step towards recognising First Nation understanding of the relationship between healthy water, lands, and all living things. This Plan acknowledges the cultural objectives identified, noting that some objectives (or components of) are outside of the scope of this Plan as set out in section 53 of the Act. The Board will continue to work with the First Nation people to address these objectives via mechanisms that align with but are outside of implementation of this Plan.

Objectives identified by the three First Nations for healing Country are:

- To teach young people, including language, about healing Country, to improve the cultural and spiritual wellbeing of Country.
- To have access to, and work with landholders to protect and maintain cultural sites and the stories connected to them and continue to practice the cultural obligations that have been inherited.
- To incorporate First Nations practices into land and water management.
- To raise awareness about cultural history and First Nations perspectives about land, waters, and Country.
- To improve flows through waterways to make creeks healthy.
- To have equal partnerships and voice for decisions that relate to lands and waters.
- To build partnerships with local organisations and landholders to care for Country together to make lands and waters healthy for everyone.
- For water resources to be managed in a way that embeds cultural obligations and facilitates the ongoing spiritual, cultural, environmental, social, and economic needs of current and future generations.
- To be involved in monitoring and evaluation of the aspects of the Plan that interact with the cultural obligations' requirements.

5 – Capacity of Water Resources to Meet Demand

5.1 Introduction

The native (naturally occurring) water resources of the Barossa PWRA support the needs of people and the environment. In section 3, the requirements of water-dependent ecosystems were described, along with an assessment of how this Plan considers environmental water provisions. Section 4 described how water is needed for cultural purposes and values, to address Native Title Act requirements, First Nations interests and health of Country.

This section assesses the capacity of the water resources to meet other consumptive demands on a continuing basis (as required by section 53(1)(f) of the Act). It draws on the information in section 2, which outlined the volumes of water that can be allocated for consumptive purposes, based on scientific investigations of the overall resource capacity. ‘Consumptive’ purposes include licensed extraction, and other non-licensed uses of water, such as for stock and domestic supply, roadmaking and firefighting and cultural needs.

In this section, the current and expected future water needs within the Barossa PWRA are described. The capacity of the native groundwater and surface water resources to meet this demand is then assessed, considering future availability of water in a changing climate.

Understanding the demand for water for licensed and non-licensed purposes, and how well the native water resources can meet this demand, underpins the principles in section 7 of this Plan. The principles aim to provide for the allocation of water for all types of consumptive purposes, consistent with the objectives.

5.2 Water use in the Barossa

Within the Barossa PWRA, water use supports a wide range of production industries, dominated by grape and wine (14,000 hectares), with approximately 100 sheep and cattle businesses, and other horticulture enterprises (DEW, 2022c). Irrigation of public open spaces for recreational, amenity and sporting purposes also occurs in the area. Many properties within the Barossa PWRA, particularly in the Flaxman Valley, have no access to alternative water sources such as SA Water mains water supply.

Total demand for water for production in the Barossa PWRA can be separated into metered water use for licensed purposes and estimated non-licensed water use, such as for stock, domestic and First Nations water needs. Within the Barossa PWRA there are water extraction licences for the use of groundwater from wells, surface water via dams, and watercourse water via instream off-takes. Demand for water for licensed purposes can be accurately quantified through metered extraction data. The volume used for non-licensed stock, domestic, and other uses is not metered and has been estimated. Water required for First Nations uses is difficult to quantify however with consideration for the long-term displacement of the First Nations people from the areas of Country in the Barossa PWRA and the nature of the relevant activities, the potential volume required to meet their cultural water needs is not deemed to be substantial.

For the purposes of developing this Plan, data and information about these demands were obtained from:

- metered extraction data for the groundwater, surface and watercourse water resources in the Barossa PWRA, where available.
- allocation data for the water resources in the Barossa PWRA, which indicates the total volume of water on licence that could be taken.

- volumes specified on historical authorisations issued in the Greenock Creek area, where metering data is not yet available.
- estimation of non-licensed demand, including stock and domestic use.

5.3 Current water demand

Primary Production and Industrial water use

Throughout the Barossa PWRA, most licensed water use is for the purposes of primary production and irrigated agriculture – predominantly wine grapes. The average annual licensed use of naturally occurring water resources in the Barossa Valley is approximately 4 gigalitres (GL) per year, however this varies between approximately 2 GL and 5 GL depending on climatic variability (DEW, 2022c). In contrast, the average annual licensed use of native water resources in the Flaxman Valley is approximately 2.5 GL and varies between approximately 2 GL to 3.5 GL (DEW, 2022c).

In parts of the Barossa PWRA, use of native water resources is supplemented by imported, recycled water and/or SA Water mains water, with use at 23 GL in 2022 (DEW, 2022c).

Irrigation of Public Open Space

Irrigation of public open space, including for recreational, amenity and sporting purposes within the Barossa PWRA is undertaken by both The Barossa Council and Light Regional Council and is currently allocated 165 ML/yr for this purpose.

Non-licensed Use

Native water resources are used for non-licensed purposes across the Barossa PWRA, as SA Water mains water supply is not widely available except in the Barossa Valley floor. The volume of water needed for stock and domestic and other purposes has been estimated (Tables 7.1 and 7.2), to provide a total estimated demand for water for non-licensed purposes per year. Water for First Nations cultural water needs is included as a category of non-licensed use, although a volume has not been estimated, this category of use is not deemed to be substantial.

Groundwater - Water Allocation and Use

There are approximately 520 licensed extraction wells across the Barossa Valley and Flaxman Valley areas combined. Table 5.1 shows that the total volume of groundwater allocations has increased since the adoption of the 2009 WAP, but that actual use is less than half of the total allocated. The 2009 WAP did not define a limit to the volume of water which could be allocated from the groundwater resources. Rather the principles in the Plan limited the issuance of any new allocations. A volumetric limit for groundwater was not defined in the Plan because the process of transitioning area-based licences to volumetric allocations was still underway, as such the total volume of water allocated was unknown upon adoption of the Plan. However, it was acknowledged that additional allocations should not be issued in the absence of a comprehensive understanding of the existing demands on the resource. While some estimates were provided in the Plan as to the percentage of groundwater allocations which were used per aquifer, there were no individual allocation limits defined per aquifer. This explains why allocations have increased from the adoption of the 2009 WAP until now.

Table 5.2 shows the allocation and use for each groundwater consumptive pool used in this Plan (note: Upper Aquifer regional and central have been combined).

Table 5.1: Groundwater Allocation and Use in 2015-16 and 2021-22 by Category.

Allocation Purpose category	Total Allocation at 2009 WAP (kL)	2015-16 Allocation (kL)	2015-16 Use (kL)	2021-22 Allocation (kL)	2021-22 Use (kL)
Recreational		165,329		165,329	
Industrial		365,690		470,300	
Irrigation		7,284,195		7,141,095	
Total	7,147,000	7,847,414	3,827,000	7,776,724	2,929,205

Table 5.2: Groundwater Allocation and Use for 2021-22 and Long-term (10 year) Average Use by Consumptive Pool

Aquifer	2021-22 Allocation (kL)	2021-22 Use (kL)	Long-term average use (10-year) (kL)
Upper Aquifer (regional & central combined)	1,028,429	292,037	383,000
Lower Aquifer	2,108,961	919,568	1,058,000
Lyndoch Valley	389,400	79,982	164,000
Eastern Fractured Rock Aquifer (FRA)	3,850,034	1,520,903	1,735,000
Western FRA	187,700	48,893	58,000
Confined FRA	212,200	64,822	83,000
Total	7,776,724	2,926,205	3,481,000

Surface Water - Water Allocation and Use

Surface water taken from dams

In the Barossa PWRA there are a total of 1780 dams with approximately 10% used for the licensed take of water. The total capacity of dam storage is approximately 8,692,000 kL, with 60% of this volume being in licensed dams (the volume of actual licensed water allocations is significantly lower than this at 1,814,000 kL/yr (Table 2.1)).

The 2009 WAP estimated total surface water allocations from dams at approximately 1,491,000 kL, in 2015-16 it was 1,602,000 kL, and in 2021-22 it was 1,814,000 kL. This represents an increase of approximately 323,000 kL since the adoption of the 2009 plan (Table 5.3). Similarly, total surface water use from dams was approximately 308,000 kL in 2015-16, and 450,000 kL in 2021-22, representing an increase of 142,000 kL.

Surface water taken from watercourses

In the Barossa PWRA there are a total of 141 licensed watercourse extractions. The 2009 WAP estimated total watercourse water allocations at 2,317,000 kL, in 2015-16 it was approximately 3,629,000 kL, and in 2021-22 it was approximately 3,150,000 kL. This represents fluctuations in increased allocations of at least 1,312,000 kL since the adoption of the 2009 WAP (Table 5.3). In contrast, total watercourse water use was approximately 1,123,000 kL in 2015-16, and 919,000 kL in 2021-22, representing a decrease of 204,000 kL.

Table 5.3: Water Allocation and Use from dams and watercourses in 2015-16 and 2021-22

Water Source	2015-16 Allocation (kL)	2015-16 Use (kL)	2021-22 Allocation (kL)	2021-22 Use (kL)
Dams	1,601,592	308,316	1,813,738	450,224
Watercourse	3,629,437	1,123,342	3,149,844	918,946

Greenock Creek Authorisations

Licences and allocations have not yet been issued for the Greenock Creek catchment area. Initial Authorisations have been issued to existing users, and the current area authorised is presented in Table 5.4. Licences will be issued to these users via a licensing process which is not part of this Plan.

Table 5.4: Greenock Creek Catchment Area Existing User Authorisations

Allocation Purpose	Total Area (Ha)	Number of Authorisations
Wine grapes	478	26
Fruit trees, olives, other	12.7	3
Total	490.7	29

5.4 Future water demand

It is predicted that the demand for water within the Barossa PWRA will continue to increase, due to new enterprises, desire for expansion of traditional crops, and the impacts of climate change.

Irrigation

Climate change is projected to increase irrigation water demand. A mid-range estimate for the next 30 years is that there will be 6% less rainfall and 3.5% more potential evapotranspiration than during a 1976 to 2005 baseline period. This would result in reduced streamflow and groundwater recharge and more variable seasonal climate conditions. If the current planted area and viticultural practices in the Barossa were maintained, the average irrigation water demand is projected to increase by approximately 23% (3 GL/yr) under a mid-range climate change scenario for the 2050s compared to the baseline period. This increases to a 27% (4.4 GL/yr) increase in demand under a high-end climate change scenario (noting that this is across wider area than the Barossa PWRA) (all statistics from the DEW, 2022c).

Under a mid-range climate change scenario, it is estimated an additional 8 GL per annum of water would be needed to ensure on average there is no irrigation shortfall for the existing planted area of the Barossa in the driest years (DEW, 2022c).

Residential and Urban

The population of the Barossa PWRA is predicted to continue to increase, with further development of the rural urban towns in line with continued expansion of industry and growing numbers of jobs in the area (DEW, 2022c). However, there is not expected to be a significant increase in demand for water from the prescribed water resources for urban and residential purposes as population growth will largely be contained within existing town boundaries and reliant on SA Water mains water supply. In addition, runoff from new housing developments is expected to be captured with some volumes utilised for watering local parks and gardens.

5.5 Capacity to meet demand

Capacity of Groundwater in the Prescribed Area

Numerical models have been used to help develop the management strategies in this Plan. The models, in conjunction with long-term monitoring of water use, are currently the best scientific tool available to understand the likely effects of water extraction from the groundwater resources of the Barossa PWRA.

Examination of recent climate and extraction data, and a detailed examination of sustainability issues, drivers of water level changes and the location of licensed extractions has shown that the primary driver of resource condition across the Barossa PWRA over the life of this plan is expected to be climatic conditions.

Existing levels of use are not considered to present a significant risk to future condition of the resource in any of the groundwater consumptive pools. However, it has been identified that an increase in extractions closer to the total allocation volume in the Lower Aquifer and/or Central Upper Aquifer Consumptive Pools could exacerbate any climate-driven declines in resource condition in these areas. The adaptive management approach for these two consumptive pools detailed in section 6.5 of this Plan aims to minimise this risk.

There is no capacity for any future increase in volume available for allocation from the groundwater consumptive pools above the existing total volume of allocations.

Capacity of Surface and Watercourse Water in the Prescribed Area

The 2009 WAP concluded that the then current level of dam development and watercourse use approximated the sustainable extraction level for surface water and watercourse water allocations for that iteration of the WAP.

Across the Barossa PWRA, dam capacity has exceeded surface water allocations by a considerable volume due to several factors including:

- a high number of stock and domestic dams
- dams historically being oversized to ensure water security in the face of variable seasonal conditions and/or large losses through evaporation and seepage.

Recent use of surface water has been well below total allocation across the Barossa PWRA, although this varies across the consumptive pools. Use being significantly less than the allocation volume is partly due to a lack of rainfall and runoff in the past few years, impacting on volumes captured in dams and available for use.

The capacity of surface water resources to meet demand in recent years has been limited, and there is no additional capacity to meet any future increase in demand.

5.6 Summary of capacity of all water resources to meet demand

The highly modified landscape and substantial population increases of the Barossa PWRA post-European settlement has led to a heavy reliance on water for agriculture, primary production, stock, and domestic use. As a result, there has been significant development of infrastructure for the capture and storage of surface water, diversion and/or extraction of watercourse water, extraction of water from aquifers, and delivery of alternative supplies, including imported water and the reuse of treated wastewater.

Information about the capacity of native water resources, combined with assessment of demands, indicates that the water resources of the Barossa PWRA are not sufficient to meet the likely current and future demands. However, alternative water sources are increasingly being used as an essential source of supply, and investigations into the options and feasibility of increasing access are currently underway. The reliance on reuse of water (whether it be stormwater, treated wastewater etc.) is likely to be exacerbated by the effects of climate change, as discussed in section 2.5.

The use of alternative water resources is already substantial compared to the use of the native water resources (Figure 5.1) from year-to-year, and further development of alternatives is the only viable way in which the increased demand for water within the Barossa PWRA will be met. The Barossa Water Security Strategy has been developed to guide the development of strategic actions to improve water security with alternative water sources.

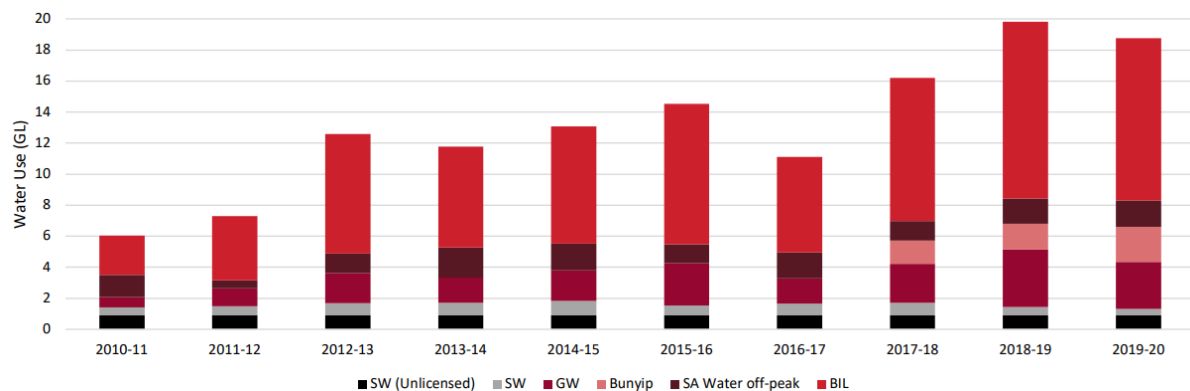


Figure 5.1: Water use in the Barossa Valley 2010-11 to 2019-20 (Source: DEW, 2022c).

As set out in section 2, particularly for surface water, resource capacity is showing a decline since the Millennium drought. Resource capacity will vary from year to year with a likely overall decrease on average over the longer-term. Further action, including the implementation of adaptive management as a response to climatic conditions and rainfall, will likely be required to reduce the impact of historic water resource development, to ensure the sustainability of the water resources for future generations. In addition to alternative water supplies, volumes stored or diverted from watercourses will need to be addressed to ensure that water resources have the capacity to meet demand over the long-term.

6 – Water Management Framework

6.1 Introduction

This section summarises and explains the water management framework that is established by the principles in section 7 of this Plan. The framework applies to the allocation and use of the prescribed water resources of the Barossa PWRA – that is, the native, or naturally-occurring groundwater, surface water and watercourse water, as well as water that has been collected from runoff collection points, or intentionally drained or discharged into aquifers for subsequent recovery. It also includes principles relating to permitting requirements for certain Water Affecting Activities.

It should be noted that the principles set out in section 7 may include important exceptions, caveats or additional detail to the information provided in this summary. Relevant principles should be read in full, to understand how the principles operate under this Plan.

The overarching objective of the water management framework is to allow for water to be taken and used in a way that, as far as possible:

- ensures the water resources are managed within sustainable resource condition limits.
- provides for the flexible and variable use of water at times and in areas where needed to maximise economic, social, and cultural outcomes.
- Maintains water-dependent ecosystems at an acceptable level of risk.

The framework comprises the following key elements:

Consumptive pools - based on the water resources in specified areas as set out in section 7.1.

Water management authorisations - the regulatory tools that are used to manage how, when, where and by whom water is taken as set out in section 7.2 – 7.4.

Issue and Transfer Principles – rules for how water management authorisations may be issued, amended, or transferred as set out in sections 7.2, 7.3 and 7.10.

Adaptive management principles - a monitoring and response system to act as a ‘safety net’ to respond to any future decline in water resource condition as described in sections 6.5 and 7.5.

Transitional arrangements – interim provisions for how water management authorisations will be managed from the date of approval of the Plan, until the designated day upon which licenses are issued in a new format, as set out in section 7.7.

Water Affecting Activity permit principles – rules for how permits will be issued for specified activities that may impact on water resources (such as drilling wells, building dams, or undertaking works in watercourses) as set out in section 7.12.

6.2 Consumptive Pools

The Act states that a water allocation plan must “determine, or provide a mechanism for determining, from time to time, a consumptive pool, or consumptive pools for the water resource”.

A consumptive pool is defined in the Act as the water “that will from time to time be taken to constitute the resource within a particular part of a prescribed water resource for the purposes of Part 8...” (Sections 53(1)(c) and 3(1)). This Plan must therefore determine a consumptive pool or pools, to account for all water that may be lawfully taken from the Barossa PWRA for consumptive purposes (such as irrigation, commercial, forestry, stock and domestic and any other consumptive use). The

Minister must further determine, from time to time, the volume of water that is to be made available for allocation from a consumptive pool (Section 121(4) of the Act).

Section 7 of the Plan defines consumptive pools, which are the parts of the prescribed water resources available for either licensed or authorised allocation, or for extraction water for specific unlicensed purposes. The consumptive pools for the native water resources are delineated as follows:

- 18 surface water consumptive pools based on catchment boundaries; and
- 7 groundwater consumptive pools based on aquifers, or parts of aquifers that require specific management.

The maximum volume for each of these consumptive pools is the maximum volume that may be allocated on licences, plus an estimated volume for non-licensed extraction (for example, stock and domestic uses, firefighting, road making, and cultural purposes).

The maximum volume of water able to be allocated annually in these pools has been set at the level of current allocations, recognising that in years of favourable climatic conditions, water availability will be sufficient to enable this level of take. This enables existing licence holders to retain their current entitlements in periods of favourable conditions, with resource condition triggers and responses introduced to manage the risk of degradation of the prescribed water resources in periods of reduced availability (refer to section 6.5). This means the total volume of surface water or groundwater allocated in each of these consumptive pools cannot increase, although the location of water extraction can change, subject to the principles in section 7. This approach has drawn on the results of scientific investigations and modelling, as described in section 2.

In addition, two specific purpose-based consumptive pools are established, each of which covers the entire Barossa PWRA. Water use from these pools is not part of the surface water or groundwater consumptive pools. These consumptive pools are:

- **the Managed Aquifer Recharge Consumptive Pool**, which is defined volumetrically as the volume of water that has been drained or discharged into aquifers as part of Managed Aquifer Recharge schemes, and not subsequently taken. This water becomes available for allocation in addition to the naturally occurring groundwater.
- **the Captured Runoff Consumptive Pool**, which is comprised of water that runs off new roofs and hard surface areas, from the date of approval of this Plan. This water is prescribed surface water and therefore requires a licence in some circumstances (discussed further in section 6.7) to enable the collection of the runoff from roofs or hard surfaces of new developments.

6.3 Water management authorisations

Section 7 sets out the various water management authorisations, and how they may be used to manage the extraction and use of water. As these authorisations need to be brought into effect on a date following the approval of the Plan, section 7 also includes principles that establish transitional arrangements. These will apply to current water licences, from the date of approval of the Plan until the designated day, when licences are re-issued in a new format.

The key authorisations are ‘water licences’, ‘water access entitlements’ and ‘water allocations’.

A **water licence** is an ongoing personal property right which is related to a particular consumptive pool. The key function of the water licence is to provide the licence holder with a water access entitlement to gain to a share of the water available within the consumptive pool to which the licence relates. The licence also lists the sources through which water can be taken and may include other conditions. Recharge licences and runoff licences are special categories of water licences.

A **water access entitlement**, provided under a water licence, is an ongoing right to access water that is available to be allocated from the relevant consumptive pool. These entitlements are expressed in different ways depending on the type of consumptive pool, as follows:

- a water access entitlement related to a groundwater or surface water consumptive pool is expressed as a specified number of entitlement shares within the consumptive pool.
- a recharge water access entitlement, related to the managed aquifer recharge (MAR) consumptive pool, is based on the 'available balance' of the relevant MAR scheme, which is the cumulative volume of water that has been recharged under the scheme, minus any volume which has subsequently been taken.
- a runoff water access entitlement issued in relation to the Captured Runoff consumptive pool is defined volumetrically based on the estimated annual volume of water collected as roof runoff or from hard surfaces of new development.

A **water allocation** is issued annually to licensees and is the volume of water the licensee can extract in that water use year. It is subject to any conditions on the licence, such as the source from which water may be taken.

For the groundwater or surface water consumptive pools, the annual water allocation is based on the number and value of water access entitlement shares held. Under this Plan, it is intended that the maximum value of each share, and therefore the maximum annual allocation volume, will be issued at the rate of 1 share = 1 kL. If the resource condition declines below identified RCTs as described in the adaptive management section, (see description in section 6.5 below) the Minister may choose to reduce the volume of water which is able to be allocated from the consumptive pool (section 121(4) of the Act), thereby changing the value of the entitlement share, as part of the action response.

For the Upper Aquifer Central and the Lower Aquifer Consumptive Pools the recommended total volume of the reduced allocations may be guided by the Resource Extraction Limit calculated in Table 2.4. With regards to surface water, guidance is provided in section 6.5 regarding how allocations might best be varied in response to changes in resource condition.

The Plan also enables 10% of unused groundwater allocation to be carried over to be used over the following one or two years (carryover allocation).

For the MAR Consumptive Pool, a recharge allocation is based on the volume of the available balance of the MAR scheme to which the licence relates, however individual MAR schemes will have a specified maximum annual recovery volume as described in the associated Risk Management and Monitoring Plan to ensure the recovery of water does not have adverse impacts on GDEs or other users of the resource.

For the Captured Runoff Consumptive Pool, the annual runoff allocation is equivalent to the water access entitlement based on the area from which water is running off, and the relevant rainfall. The formula for determining these volumes is set out in section 7.

Water resource works approvals and site use approvals

Water resource works approvals and site use approvals are other water management authorisations that may be issued under the Act. Within the Barossa PWRA, water may only be taken in accordance with a water licence issued under this Plan or through an authorisation under the Act. As the water licence will list the source/s through which water allocations may be taken, and may include other conditions, a water resource works approval is not required to authorise the taking of water in any

circumstances. Further, a site use approval is not required to authorise the use of water taken from the Barossa PWRA in any circumstances.

6.4 Management of the take and use of water

The principles in section 7 set out how water management authorisations can be issued, varied, or transferred. The aim of these principles is to provide flexibility of water use for social and economic purposes, whilst still protecting other water users and the environment. Some key principles to achieve this are:

- there will be no net increase in the volume of water allocated from the native groundwater or surface water consumptive pools. However, a new licence can be issued if needed - for example to allow a licence holder to transfer some entitlement to a new water user.
- licences or allocations can only be transferred within the same consumptive pool, subject to relevant principles to protect other water users and the environment.
- there will be no net increase in the combined capacity of dams in a surface water consumptive pool.
- any construction of new dams must not result in the capacity of dams on the property exceeding 30% of the annual property runoff.
- surface water licences or allocations cannot be transferred upstream of the existing location of extraction, so as not to impact on other water users.
- new or increased extraction of surface water or groundwater at a location must ensure the specified buffer distance between the location of extraction and wells or water-dependent ecosystems is not exceeded.
- new or increased extraction of water from watercourses can only occur above a specified threshold flow rate.
- sources for the extraction of water (i.e. dam or well) must be managed in a way that provides for measurement of the volume of water taken.

Note that in this Plan, 'dam' means a dam, wall, weir, embankment or other structure placed on, or constructed across, a watercourse or flow path for the purpose of holding back and storing the flow of that watercourse or the surface water runoff flowing along that flow path. This does not include off-stream storage structures which do not capture any flows and are filled by pumping or siphoning from another water source (e.g. water tanks or turkey-nest dams).

6.5 Adaptive management

Section 7 includes principles which establish a 'safety net' system to respond to any future decline in the condition of water resources or the ecosystems which depend upon them. To give effect to these principles, the Plan identifies RCTs which if exceeded, may initiate a response or action.

Given the uncertainties in how and when climate changes in the future, an adaptive management approach will allow sufficient flexibility to respond as the condition and availability of water resources varies. This Plan adopts this adaptive approach using RCLs and RCTs that can be used to guide action if it becomes necessary, until the resource returns to above these RCTs (these terms are introduced in section 2.3). The approach will be supported by targeted monitoring of the water resources aimed at evaluating their status and condition relative to these RCTs and RCLs. Regular reviews of the Plan will also provide an opportunity to measure the effectiveness of the adaptive management principles in the Plan, and if necessary, respond by amending the Plan.

Further actions that may be taken by the Minister if an ecological trigger is continued to be breached despite the adaptive management responses. This may include investigating the issue further,

consulting with affected water users, conducting additional monitoring, or reviewing and amending the Plan.

Surface Water

In an attempt to increase the likelihood of the EWRs being met, a number of ecological triggers have been developed to guide the Minister in utilising their discretion under section 121(4) of the Act to determine the volume of water that is to be made available from a surface water consumptive pool for allocation.

Metric RCT

The primary trigger is the metric RCT based on flow regime and ecological health measures ('metrics') discussed previously in section 3.4 of this Plan. This provides a quantifiable method to determine when action needs to be taken, supported through monitoring activities. The principles in section 7, and discussion below, specify how the defined metrics may be used to determine when action is taken. The information used to identify the metrics is covered in section 3.4 and specific details of the metrics are included in section 8.

Each surface water consumptive pool has 6 flow metrics which have been developed to quantify the different parts of the flow regime that are ecologically relevant. For each metric an upper and lower bound has been defined based on the baseline period of 1997 – 2016 (inclusive) on the basis that this is a period when WDEs were deemed to be in a stable, albeit degraded state. Table 8.3 provides the lower bound for each metric for each consumptive pool. In acknowledgment that surface water resources vary annually in response to climatic conditions, it was deemed that the EWRs are met if the 3-year rolling period for each metric remains above the lower bound. As each consumptive pool has 6 metrics measured over a 3-year rolling period, there are 18 metrics to be assessed for each consumptive pool on an annual basis.

It is proposed that in instances where all 18 of the flow metrics are met (i.e. all measurements fall above the lower bound for each metric) when reviewing the 3-year rolling data annually, for a particular consumptive pool, the Minister may seek to allocate water commensurate with the "Maximum volume able to be allocated annually (kL/yr)" as listed in Table 2.2. for the relevant consumptive pool such that 1 entitlement share has a value of 1 kL (i.e. allocation is 100% of the water access entitlement value).

In instances where less than 18 but more than 8 of the flow metrics are met when reviewing the 3-year rolling data annually, the first ecological trigger for the consumptive pool will be deemed to have been breached and measures may be enacted in an attempt to achieve EWRs. In consideration of determining the volume of water available for allocation from a consumptive pool, the Minister may seek to reduce the value of the entitlement share such that 1 entitlement share = 0.75 kL to reflect the reduced water availability within the surface water system observed throughout the life of the 2009 WAP.

As downstream consumptive pools may be reliant on inflows from adjacent consumptive pools, consideration will be given to extending this reduction in entitlement share value to consumptive pools which can have a direct impact on the flow regime in the consumptive pool where the metrics are not achieved.

Subsequently in instances where less than 8 of the flow metrics are met when reviewing the 3-year rolling data annually, the second ecological trigger for the consumptive pool will be deemed to have been breached and measures may be enacted to further reduce the value of the entitlement share.

The Minister may consider reducing the value of each entitlement share up to a percentage in line with the contemporary resource capacity (calculated as the average of the resource capacity for the three preceding years). Again, as downstream consumptive pools may be reliant on inflows from adjacent consumptive pools, consideration will be given to extending this reduction to consumptive pools which can have a direct impact on the flow regime in the consumptive pool where the metrics are not achieved.

Further actions may be taken by the Minister if an ecological trigger is continued to be breached despite the abovementioned actions. This may include investigating the issue further, consulting with affected water users, conducting additional monitoring, or reviewing and amending the Plan.

In addition to this adaptive management approach, water levels in designated permanent pools will also be used as a means to adaptively manage the surface water resource.

Flow days RCT

The flow days RCT, described in section 3, is a focused assessment on the key flow metric identified in the flow regime assessment. Given the importance of the number of flowing days to the water-dependent ecosystems of the Barossa PWRA it was determined that a specific RCT should be developed based on this metric.

The RCT itself is considered breached if the number of flowing days is below the 1997 – 2016 minimum value for two consecutive years. The minimum flow day values are shown in Table 6.1. Should this trigger be breached, there is a need to provide water to the system as a matter of urgency. For this purpose, an adjustment to the volume of water available for allocation will not be the most appropriate mechanism and is therefore not considered to be the sole focus of an appropriate management response.

Table 6.1: Resource condition trigger values for the flow days RCT, based on the minimum number of flowing days recorded for each zone between 1997 and 2016.

Data used	Zone	Threshold
Actual	Barossa Valley Gorge	189
Actual	Lower Flaxman Valley	87
Actual	Upper Flaxman Valley	124
Actual	Upper Tanunda Creek	173
Modelled	Barossa Valley Floor	269
Modelled	Duck Ponds Creek	151
Modelled	Lower Angaston Creek	145
Modelled	Lower Jacob Creek	177
Modelled	Lower Tanunda Creek	182
Modelled	Lyndoch Creek	209
Modelled	Mid Flaxman Valley	65
Modelled	Stone Chimney Creek	107
Modelled	Transition Zone	265
Modelled	Upper Angaston Creek	188
Modelled	Upper Jacob Creek	284
Modelled	Greenock Creek	235
Modelled	Saltwater Creek	83

If the Flow Days RCT is breached independent of the other RCTs, the minister will consider appropriate management actions in consultation with licence holders, the Board and the Department.

Permanent pools RCT

The permanent pools RCT, described in section 3, is a focused assessment on the key habitat of permanent pools across the Barossa PWRA. Given the importance of these habitats to the obligate aquatic flora and fauna of the Barossa PWRA it was determined that a specific RCT should be developed for these habitats.

The RCT itself is considered breached if the level of the permanent pool falls below the minimum level observed over the 2024-25 water year (Table 3.5). Should this trigger be breached, there is a need to provide water to the system as a matter of urgency similar to the flow days RCT. For this purpose, an adjustment to the volume of water available for allocation will not be the most appropriate mechanism and is therefore not considered to be the focus of an appropriate management response.

If the permanent pools RCT is breached independent of the other RCTs, the Minister will consider appropriate management actions in consultation with licence holders, the Board and the Department.

Groundwater

To minimise the risk that the taking of water from a groundwater consumptive pool causes the resource condition limit to be breached, a groundwater resource management framework is required. Of the 7 groundwater consumptive pools, there are two where the sum of entitlement shares (once issued under the transitional provisions of this Plan at a rate of 1 kL per share) is likely to result in adverse impacts should full utilisation of these allocations be realised. Although the water use in these consumptive pools is currently lower than the total volume of water that is permitted to be taken,

these consumptive pools are at the highest risk of exceeding resource condition limits if the average annual water use increases. These consumptive pools are the Upper Aquifer Central Consumptive Pool and the Lower Aquifer Consumptive Pool. A proposed adaptive management approach for these pools is provided below.

Upper Aquifer Central Consumptive Pool

The main control on water level trends is currently rainfall, either by streamflow infiltration or diffuse recharge. This means that this aquifer could be vulnerable to a long-term decline in storage due to reduced rainfall as a result of climate change.

The Upper Aquifer Central Consumptive Pool includes the area of concentrated extraction along the North Para River where reducing extractions would likely have immediate benefit. Specifying a RCL related to the potential long-term decline in groundwater levels would represent a precautionary approach. Table 6.2 presents a watertable elevation RCL for six monitoring wells (Figure 6.1) with a decline in storage of 25% below the current level (i.e. unacceptable impacts are likely to be observed if water levels reach this limit, such as yield declines as well as some bores becoming dry). The RCT is set above this limit to trigger a management action within a sufficient time for it to be successful.

Table 6.2 RCTs and RCLs for the Upper Aquifer Central Consumptive Pool

Observation well	NTP 10	MOR 80	MOR 83	MOR 102	MOR 199	MOR 212
Current Water Level (mAHD)	260.7	265.5	264.9	269.0	268.0	269.3
RCT Water Level (mAHD) - 10% decline	259.5	263.3	262.4	266.16	265.4	266.9
RCL Water Level (mAHD) - 25% decline	257.7	260.1	258.7	261.9	261.4	263.3
Base of aquifer	248.7	243.82	240.1	240.6	241.7	245.3

The adaptive management approach is dependent on a monitoring regime of the specific wells outlined within Table 6.2. Following winter recovery, if groundwater levels do not rise above the RCT for at least two of the six monitoring wells, then a management response is initiated for the entire consumptive pool. For example, if the winter groundwater levels do not recover to above 259.5 m AHD for monitoring well NTP 10 and to above 265.5 m AHD for MOR 80 then a management response would be triggered for the Upper Aquifer Central Consumptive Pool.

This Plan suggests that the management response is a staged process and, while the Minister maintains discretion regarding the volume of water which can be allocated from the consumptive pool, the following adaptive approach is provided for consideration:

1. The first water-use year that the end of winter groundwater level does not rise above the RCT level for two of the six wells specified in Table 6.2, the triggered condition is breached and a notice will be issued to all licensees within the Upper Aquifer Central Consumptive Pool advising that future allocations may be reduced.
2. If the end of winter groundwater level recovery in the second water-use year remains below the trigger level for two or more wells, to minimise the risk of breaching the resource condition limit, restrictions to the volume of water which can be taken may be

announced for the Upper Aquifer Central Consumptive Pool commencing 1 July of the next (third) water-use year.

3. If restrictions have been announced, in the third water use-year, the value of the entitlement shares may not be determined at the rate of 1 share = 1 kL and may instead be reduced proportionally to a value that results in the total volume of allocations issued for the Upper Aquifer Central Consumptive Pool not exceeding the resource extraction limit for the consumptive pool as defined in Table 2.4.
4. Whilst the end of winter groundwater level recovery remains below the trigger level for two or more wells, the value of the entitlement share will remain reduced. However, when the end of winter groundwater level recovers to above the trigger level for five or more wells, the value of the entitlement share will revert to 1 share = 1 kL for the following water-use year.

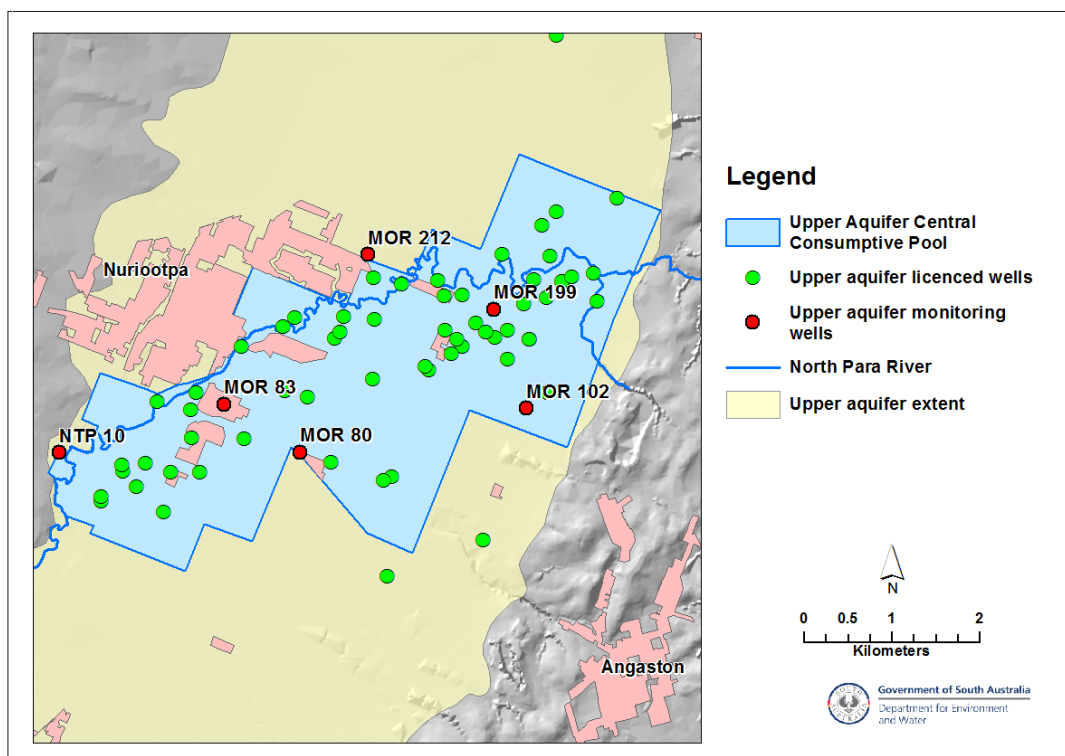


Figure 6.1: Location of Upper Aquifer Central Consumptive Pool, licensed wells (green) and monitoring observation wells (red)

Lower Aquifer Consumptive Pool

Pressure levels have generally been stable except for minor variations due to climate-induced changes in extraction and recent declines. Depressurisation has been identified as a sustainability issue for the Lower Aquifer Consumptive Pool and currently, the recovered winter pressure level varies from 10 to 30 m above the top of the confining layer.

A pressure level RCI related to depressurisation is recommended for the central part of the valley where extractions are concentrated and where the confining bed is deep and the risk from depressurisation is highest. Given the consistency of the pressure level variations across approximately 50 years of monitoring data any change in this variation should be considered statistically significant and warrant a management response.

Table 6.3 presents a groundwater pressure elevation RCL for three monitoring wells (Figure 6.2) of 5 m above the confining layer (i.e. unacceptable impacts are likely to be observed if water levels reach this limit, such as depressurisation of the aquifer). The RCL is set 5 m above the confining layer rather than at the height of the confining layer itself to account for a sufficient margin for error and any local variations in the location of the confining layer. The RCT is set 4 m above this RCL to trigger a management action within a sufficient time for it to be successful.

Table 6.3: RCTs and RCLs for the Lower Aquifer Consumptive Pool

Observation well	MOR 92	MOR 202	MOR 205
Current Groundwater Pressure Level (mAHD)	260.74	246.6	264.2
RCT Groundwater Pressure Level (mAHD) - 9m above confining layer	244.4	250.8	245.4
RCL Groundwater Pressure Level (mAHD) - 5m above confining layer	240.4	246.8	241.4
Top of confining layer	235.4	241.8	236.4

As with the Upper Aquifer Central Consumptive Pool, the adaptive management approach is dependent on a monitoring regime of the specific wells outlined within Table 6.3. Following winter recovery, if groundwater pressure levels do not rise above the RCT for one of the three monitoring wells, then a management response is initiated for the entire consumptive pool.

This Plan suggests that the management response is a staged process and, while the Minister maintains discretion regarding the volume of water which can be allocated from the consumptive pool, the following adaptive approach is provided for consideration:

1. The first water-use year that the end of winter groundwater pressure level does not rise above the RCT level for at least one of the three wells specified in Table 6.3, the triggered condition is breached and a notice will be issued to all licensees within the Lower Aquifer Consumptive Pool advising that future allocations may be reduced.
2. If the end of winter groundwater pressure level recovery in the second water-use year remains below the trigger level for one or more well/s, to minimise the risk of breaching the resource condition limit, restrictions to the volume of water which can be taken may be announced for the Lower Aquifer Consumptive Pool commencing 1 July of the next (third) water-use year.
3. If restrictions have been announced, in the third water use-year, the value of the entitlement shares may not be determined at the rate of 1 share = 1 kL and may instead be reduced proportionally to a value that results in the total volume of allocations issued for the Lower Aquifer Consumptive Pool not exceeding the resource extraction limit for the consumptive pool as defined in Table 2.4.
4. Whilst the end of winter groundwater level recovery remains below the trigger level for one or more wells, the value of the entitlement share will remain reduced. However, when the end of winter groundwater level recovers to above the trigger level for all three wells, the value of the entitlement share will revert to 1 share = 1 kL for the following water-use year.

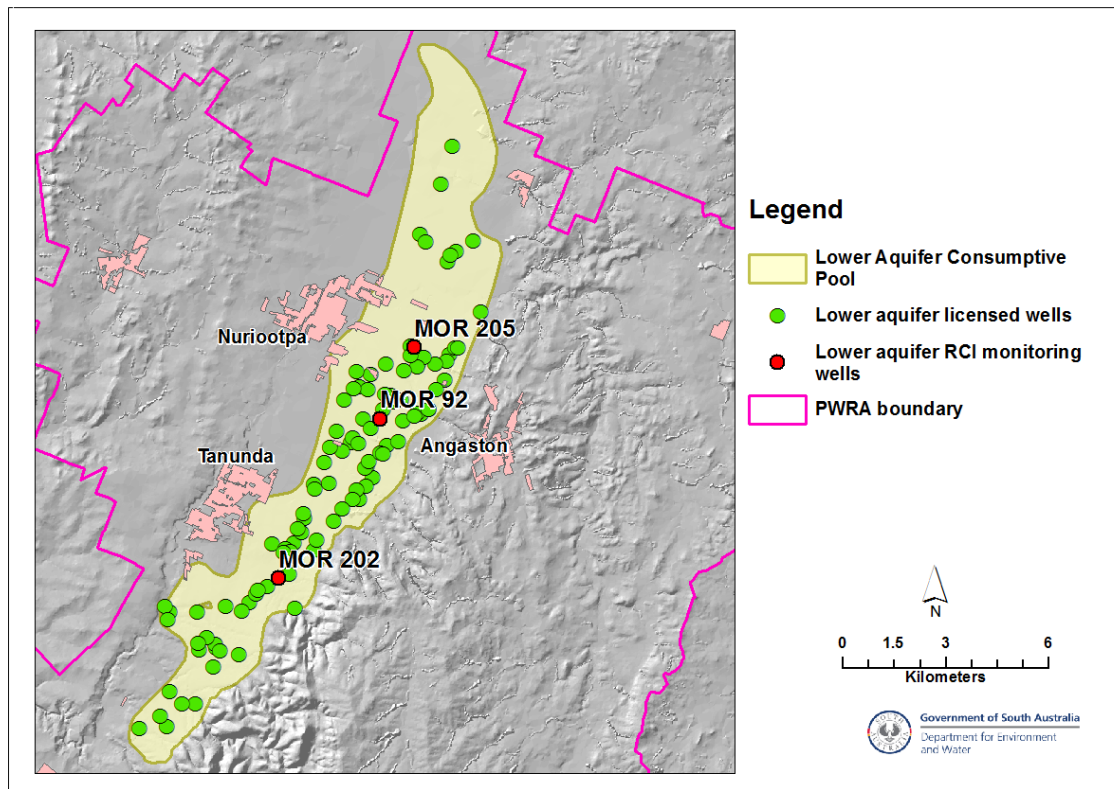


Figure 6.2: Location of Lower Aquifer Consumptive Pool, licensed wells (green) and monitoring wells (red)

6.6 Management of managed aquifer recharge schemes

Managed Aquifer Recharge refers to the intentional draining or discharging of water to aquifers for subsequent use or environmental benefit. Managed Aquifer Recharge offers numerous benefits, including: storage to improve security of water supply; natural water treatment⁸; a low-cost, low-energy water supply option; a freshening of regional aquifer salinity; and replenishing over-exploited aquifers. This Plan sets out the provisions for the draining or discharging of water into an aquifer, and the recovery of water in relation to the water previously drained or discharged.

Operators of Managed Aquifer Recharge schemes are required to operate in accordance with a risk management and monitoring plan to protect the resource from any adverse impacts from draining or discharging of water into the resource that may result in artesian conditions. As these risk management and monitoring plans will be the key document to which the Managed Aquifer Recharge operators will align their activities, the water licence will be subject to conditions specifying the operation must work in accordance with the risk management and monitoring plan and will require updating as the scheme operation changes.

A permit is required under section 104(3)(c) of the Act for the draining or discharging of water directly or indirectly into a well. However, if the water to be drained or discharged has undergone antibiotic or chemical water treatment with a discharge volume greater than 50 kilolitres per day, the person draining or discharging water into the aquifer is required to hold a licence for an 'activity of environmental significance' under section 36 of the [Environment Protection Act 1993](#). The permit is

⁸ The intentional discharge of surface water, can for example, reduce the localised groundwater salinity or concentration of other minerals, leading to the availability of higher quality water for subsequent take.

granted by the Environment Protection Authority under section 40(1) of the [Environment Protection Act 1993](#).

The water drained or discharged into the aquifer and used in relation to Managed Aquifer Recharge schemes constitutes a single consumptive pool for the purposes of this Plan. This consumptive pool is a separate administrative consumptive pool to the 'native groundwater' consumptive pools and is not volumetrically constrained (i.e. has no maximum capacity).

The volume of water in the Managed Aquifer Recharge Consumptive Pool will change over time in relation to the scheme operator's activities. Individual water access entitlements within this consumptive pool are based on the 'available balance' for the Managed Aquifer Recharge scheme. The 'available balance' takes into account the total volume of water drained or discharged (under a permit issued pursuant to either section 104(3)(c) of the Landscape Act or an environmental authorisation issued under section 40(1) of the [Environment Protection Act 1993](#)) throughout the life of the scheme's operation, minus any volume that has subsequently been taken. The total volume that can be recovered in a single water-use year will be limited to a 'maximum annual recovery volume' as identified in the risk management and monitoring plan for the scheme to ensure no adverse impacts are observed at the site of recovery.

Water licences issued pursuant to Managed Aquifer Recharge schemes only authorise the taking of water which has previously been drained or discharged into the aquifer and not subsequently taken (the 'available balance'). Noting that unless previously authorised by the Minister, the water is to be recovered from well/s located within the same spatial extent as the corresponding 'native groundwater consumptive pool' that aligns with the location and aquifer within which the water was previously drained or discharged. If the scheme operator requires more water than the available balance they must acquire additional access to water. Additional access to water may be acquired by transferring allocation from another scheme operator, subject to meeting the transfer criteria outlined in section 7 or by applying for a water licence and allocation in the spatially relevant 'native groundwater' consumptive pool. The water licence for the 'native groundwater' consumptive pool will be separate to the licence in relation to the Managed Aquifer Recharge Consumptive Pool and will be managed separately. If a scheme operator has both a licence in relation to the Managed Aquifer Recharge Consumptive Pool and a licence in relation to a 'native groundwater' consumptive pool and the water is to be taken from the same well/s, the allocation in relation to the 'native groundwater' consumptive pool will be considered to be taken first, to enable the 'banking' of the water that was intentionally drained or discharged.

6.7 Management of captured runoff water

A Notice of Authorisation to Take Water exists within all surface water prescribed areas of the State for the taking of roof runoff (surface water) for the purposes of commercial (including irrigation), industrial, environmental or recreational use in instances where the volume deemed to be collected from the connected roof area is equal to, or less than, 1,500 kilolitres per annum.

The volume deemed to be collected from the connected roof area is determined as follows:

$$\text{Capture Amount (kL)} = \frac{\text{roof area (m}^2\text{)} \times \text{average annual rainfall (mm)}}{1000}$$

The average annual rainfall is determined as per the instructions in the authorisation in the South Australian Government Gazette and relates to the relevant location where the roof intercepts the rainfall.

Any water taken pursuant to the abovementioned authorisation must be directed into closed water storage facilities (e.g. holding tanks, storage dams) and if overflow occurs, this must be released to the environment through existing surface water drainage arrangements and must not be recaptured or redirected.

If the volume of water captured from a roof exceeds this volume, or if the water is captured off a hard surface, a water licence is required and will relate to the Captured Runoff Consumptive Pool.

New licences may be issued from the Captured Runoff Consumptive Pool and are subject to the principles described in section 7.9. However, licenses related to this consumptive pool may only be transferred due to a change in ownership and are not able to be transferred to another location.

6.8 Water affecting activity permits

The Plan allows for the issuing of Water Affecting Activity (WAA) permits. These permits are required to undertake specific activities, as defined in the Act. Section 7 of the Plan sets out the matters that the Minister must consider when deciding whether to grant or refuse a WAA permit. Some WAAs are regulated by the Northern and Yorke Water Affecting Activities Control Policy, and others by this Plan.

The WAAs covered by this Plan are related to:

- drilling new wells or altering existing wells – the principles in section 7 require appropriate construction and maintenance of specified buffer distances between the well and other wells or groundwater-dependent ecosystems.
- draining or discharging water directly or indirectly into a well – the principles in section 7 address risks to water quality in the receiving aquifer, groundwater-dependent ecosystems, other water users' ability to access water, waterlogging of soils, and buildings, or infrastructure.
- storing and using effluent water and imported water on land – the principles in section 7 apply in situations where imported water or effluent water is applied to land of area greater than 1 hectare, at a rate exceeding 1 ML per hectare per water use year. They address the risks of rising groundwater levels, soil sodicity or salinity, and adverse effects on water-dependent ecosystems. The principles also set out how imported water or effluent must be stored to minimise risk to the environment.

7 – Principles

7.1 Consumptive Pools

1. For the purposes of this Plan, there shall be 18 surface water consumptive pools, 7 groundwater consumptive pools, and two purpose-based consumptive pools, as set out in principles 3 - 6.
2. Pursuant to section 53(2) of the *Landscape SA Act 2019* (the Act), water in prescribed watercourses within the surface water prescribed area is declared to form part of the surface water prescribed resource, and therefore the principles in this Plan that relate to the surface water consumptive pool apply to water in prescribed watercourses.
3. The 18 surface water consumptive pools, as listed in Table 7.1 below, are defined geographically, as shown in Figure 2.1, and volumetrically as the sum of the 'maximum volume able to be allocated annually' and the 'non-licensed volume'.

Table 7.1: Surface Water Consumptive Pools

Consumptive Pool	Maximum volume able to be allocated annually (kL/yr)	Non-licensed volume (kL/yr)	Maximum consumptive pool volume (kL/yr)
Upper Flaxman Valley	837, 000	121, 000	958, 000
Stone Chimney Creek	146, 000	38, 000	184, 000
Mid Flaxman Valley	109, 000	44, 000	153, 000
Lower Flaxman Valley	136, 000	39, 000	175, 000
Duck Ponds Creek	10, 000	33, 000	43, 000
Stockwell Creek	174, 000	71, 000	245, 000
Transition Zone	248, 000	56, 000	304, 000
Upper Angaston Creek	10, 000	15, 000	25, 000
Lower Angaston Creek	115, 000	8, 000	123, 000
Barossa Valley Floor	473, 000	77, 000	550, 000
Greenock Creek	0	113, 000	113, 000
Salt Water Creek	49, 000	96, 000	145, 000
Upper Tanunda Creek	199, 000	34, 000	233, 000
Lower Tanunda Creek	226, 000	17, 000	243, 000
Upper Jacob Creek	557, 000	50, 000	607, 000
Lower Jacob Creek	219, 000	17, 000	236, 000
Lyndoch Creek	325, 000	110, 000	435, 000
Barossa Valley Gorge	298, 000	32, 000	330, 000

4. The 7 groundwater consumptive pools, as listed in Table 7.2 below, are defined geographically, as shown in Figure 2.5, and volumetrically as the sum of the 'maximum volume able to be allocated annually' and the 'non-licensed volume'.

Table 7.2: Groundwater Consumptive Pools

Consumptive Pool	Maximum volume able to be allocated annually (kL/yr)	Non-licensed volume (kL/yr)	Maximum consumptive pool volume (kL/yr)
Upper Aquifer Regional	164, 000	6, 000	170, 000
Upper Aquifer Central	917, 000	3, 000	920, 000
Lower Aquifer	2,166, 000	6, 000	2,172, 000
Lyndoch Valley	407, 000	15, 000	422, 000
Eastern Fractured Rock	3,929, 000	80, 000	4,009, 000
Western Fractured Rock	208, 000	20, 000	228, 000
Confined Fractured Rock	240, 000	8, 000	248, 000

5. The Managed Aquifer Recharge Consumptive Pool is defined as the water available for allocation as a result of metered drain or discharge activities (excluding water discharged for dewatering purposes) undertaken within the prescribed area managed by this Plan, in accordance with an environmental authorisation issued under section 40 (1) of the *Environment Protection Act 1993*, or a permit issued pursuant to section 104 (3) (c) of the Act.
6. The Captured Runoff Consumptive Pool is defined as the water available for allocation as a result of runoff collection from roofs or from hard surfaces of new developments, within the prescribed area managed by this Plan. This excludes the collection of water not requiring a licence as described in section 6.7.
7. Water from within the prescribed area managed by this Plan is available to be used by native title holders for the purposes of satisfying their personal, domestic, or non-commercial communal needs in the exercise or enjoyment of their Native Title rights and interests, as per the Native Title Act. As water for this purpose is authorised for taking under section 105 of the Act a water licence is not required to take water for this purpose.

7.2 Water Licences

8. A water licence provides a water access entitlement to the holder of the licence to gain access to water available in the consumptive pool to which the licence relates.
9. A water licence issued shall specify the sources (well, dam, watercourse extraction point or runoff collection point) through which water is authorised to be taken.
10. Notwithstanding principle 9, a water licence may be issued without a listing of the source/s through which the water is to be taken, but the licence must relate to a specific consumptive pool and shall be subject to a condition that any allocation issued in relation to the licence cannot be taken until the licence is varied to include the source/s through which the water will be taken. The variation to list the sources on the licence must meet the Assessment Criteria as specified in section 7.11.
11. A recharge water licence authorises the recovery of water previously drained or discharged into a well in accordance with a permit issued pursuant to the Act or the *Environment Protection Act 1993* and relates only to the Managed Aquifer Recharge Consumptive Pool.
12. A runoff licence authorises the collection and use of water captured from roofs or from hard surfaces of new developments.

7.3 Water Access Entitlements

13. The Minister may grant a new, or vary an existing water access entitlement, to provide access to a share of a consumptive pool. The granting of new entitlement shares shall not cause the total volume of water able to be allocated in relation to the entitlement shares for each surface water consumptive pool or groundwater consumptive pool to exceed the 'Maximum volume able to be allocated annually' specified in Tables 7.1 or 7.2 respectively and shall be consistent with the Assessment Criteria as specified in section 7.11.
14. A water access entitlement issued on account of a water licence in relation to a surface water or groundwater consumptive pool will be expressed as a number of entitlement shares that the licence holder has access to, of a total number of entitlement shares that are available.
15. A water access entitlement issued on account of a recharge water licence in relation to the Managed Aquifer Recharge Consumptive Pool will be known as a recharge water access entitlement. and is calculated as the 'available balance' of the water licence by taking into account the total volume of water drained or discharged to a designated aquifer at a particular location under a permit issued pursuant to either section 104(3)(c) of the Act or an environmental authorisation under section 40(1) of the *Environment Protection Act 1993* throughout the life of the scheme's operation, minus any volume that has subsequently been taken.
16. A water access entitlement issued on account of a runoff water licence in relation to the Captured Runoff Consumptive Pool is an entitlement to extract a specified volume of water annually, calculated as per principles 38 – 41, and will be known as a runoff water access entitlement.
17. A water access entitlement provided for under a water licence is subject to the conditions attached to the licence.

7.4 Water Allocations

18. A water allocation is issued annually on account of a water access entitlement under a water licence, on the basis that the water allocation is being issued by the Minister under the terms of the water licence and will initially relate to a period not exceeding 12 months.
19. Subject to principle 21 a water allocation obtained on account of an entitlement share will be determined at the rate of 1 share = 1 kilolitre.
20. Principle 19 does not apply to a water allocation in relation to a recharge water access entitlement or a runoff water access entitlement.
21. A recharge water allocation may be obtained on account of a recharge water access entitlement. The volume of water allocated in any given water-use year shall be the lesser of a) the 'available balance' or b) the 'maximum annual recovery volume' of water authorised to be taken per water use year as a condition on the water licence.
22. A runoff water allocation is volumetrically equivalent to the runoff water access entitlement.

7.5 Adaptive Management

23. The Minister may, from time to time, by notice in the South Australian Government Gazette, determine the volume of water that is to be made available for allocation in accordance with section 121(4) of the Act. In doing so they may take into consideration the resource condition

limits, resource condition triggers and management responses as outlined in section 6.5 of this Plan.

7.6 Carryover Allocations

24. In relation to the groundwater consumptive pools listed in principle 4, and subject to principles 25 – 26, if part of a water allocation is not taken during the initial 12-month period, the unused allocation at 30 June may be carried over for a period not exceeding 2 years. This carryover is capped at 10% of the allocation which was on the licence as of 1 July of the water use year for which the carry-over is being accrued.
25. The allocation that may be obtained by a water access entitlement holder from allocations arising in the current water use year plus any carry-over volume from the previous two water use years shall not exceed 110% of entitlement shares held by the water access entitlement holder as of 1 July of the current water use year.
26. Carryover of unused allocation may only be issued if:
 - (a) the water has been taken through a water meter for the whole of the water use year for which carry-over is determined, unless the quantity of water taken can be determined on another basis to the satisfaction of the Minister; and
 - (b) the final water meter reading(s) for the quantity of water taken during the previous water use year have been provided to the Department as per the condition of the licence.
27. Carryover allocation is deemed to have been used prior to any other allocation on the water account.
28. Carry-over is not permitted for the consumptive pools listed in principles 3, 5 or 6.

7.7 Transitional Arrangements

29. Subject to principle 30, from the designated day, the holder of an existing water licence will be provided with a water licence and therefore a water access entitlement under this Plan. The water licence shall list the source through which the water is authorised to be taken. The number of entitlement shares issued to the water access entitlement holder shall be determined by converting the volume of water on allocation in the previous water use year to that licensee into entitlement shares, at a rate of one kilolitre per unit share (excluding carryover allocation or allocations on account of a temporary transfer).
30. Separate water licences will be issued in relation to each consumptive pool listed in principles 3 – 6 based on the sources listed on the existing licence. Where an existing licence has sources that relate to multiple consumptive pools, a portion of the entitlement share will be issued to each consumptive pool in consultation with the licensee, but the final determination will be made by the Minister.
31. If the designated day for the issuing of new water licences does not align with the date that this Plan comes into operation, administration of this Plan will, until the designated day, be undertaken with existing licences operating as if they were authorisations issued under this Plan.
32. A water licence provided under the transitional arrangements in principle 29 may be subject to the conditions outlined in principles 33 – 35.

7.8 Terms and Conditions for Consideration on a Water Licence or Water Allocation

The Landscape Act allows for a water licence or water allocation to be subject to conditions endorsed on the water management authorisation by the Minister. When issuing, amending or transferring a water licence or water allocation, the Minister may give consideration to endorsing the conditions to the following effect on the management authorisation.

33. When issuing, amending or transferring a water licence or water allocation, the Minister may give consideration to endorsing conditions on the management authorisation to the effect that:
 - (a) water must only be taken from the sources listed on the authorisation;
 - (b) water taken from the sources listed on the authorisation must be taken in a manner consistent with the Barossa Meter Implementation Plan;
 - (c) the take of water from the sources listed on the authorisation must not exceed the allocation issued to be taken from the source;
 - (d) the infrastructure through which water is taken pursuant to a water management authorisation must be maintained and constructed so that the volume of water taken from the source can be accounted for without interference;
 - (e) the authorisation holder must report the volume of water taken through a water meter during the water use year (i.e. closing readings) to the Department by the specified date; and
 - (f) the conditions listed on the authorisation may be varied by the Minister at annual intervals if, in the opinion of the Minister, the variation is desirable to more effectively regulate the use of water from the resource in accordance with this Plan.
34. When issuing, amending or transferring a water licence or water allocation in relation to a surface water consumptive pool, the Minister may give consideration to endorsing a condition on the management authorisation that water may only be taken during periods when the threshold flow rate for that location is exceeded. The threshold flow rate is calculated as the unit threshold flow rate⁹ (litres/sec/square kilometre) multiplied by the area of catchment (square kilometres) that contributes to the watercourse or drainage line located above the point where the water is captured in a dam or diverted from the watercourse; or 1 litre/second, whichever is the greater value.
35. When issuing or amending a water licence or water allocation for the recovery of water previously drained or discharged into a well, the Minister may endorse conditions on the water licence or water allocation to the effect that, unless previously authorised by the Minister:
 - (a) the water taken pursuant to the water allocation must only be taken from the aquifer into which the water was drained or discharged;
 - (b) the water taken pursuant to the water allocation must only be taken from well/s located within the same spatial extent as the corresponding native groundwater consumptive pool that aligns with the location and aquifer within which the drain or discharge activities occurred;

⁹ The unit threshold flow rate of a consumptive pool is calculated by dividing the 10th percentile flow rate (litres/second) for the consumptive pool by the area of catchment (square kilometres) upstream of the point of take, where the 10th percentile flow rate is the flow rate (litres/second) obtained from a time weighted annual flow duration curve (with the time step being 1 day – mean flow) which is greater than or equal to 10% of all flows during that period.

- (c) the volume of water taken in a single water use year must not exceed the 'maximum annual recovery volume' specified;
 - (d) the licensee must operate in accordance with a risk management and monitoring plan approved by the Minister;
 - (e) the risk management and monitoring plan must be updated as the Managed Aquifer Recharge scheme's operations change, and as requested from time to time by the Minister;
 - (f) the licensee must report the drained or discharged and recovery volumes in a manner approved by the Minister; and
 - (g) the water taken pursuant to the water allocation will be deemed to have been taken after any other allocation authorised for extraction from the same well/s.
36. The conditions specified in principles 33 – 35 are additional to, and subject to the conditions endorsed on a water licence issued pursuant to principles 29 – 32 and any other conditions endorsed by the Minister or as may be prescribed from time to time by the Regulations.

7.9 Captured Runoff

37. Principles 38 – 41 apply only to the taking of captured runoff from hard surfaces or captured roof runoff when the volume of roof runoff exceeds 1,500 kL/yr as per the Notice of Authorisation to Take Water published in the South Australian Government Gazette on 27 June 2019, page 2287 (or a varied volume as authorised by a subsequent Gazette Notice) in relation to the Captured Runoff Consumptive Pool.
38. Approval to capture runoff water from new hard surface or roof may be issued only where:
- (a) the pre-existing runoff is returned to the environment:
 - (i) by as close as practicable to the natural path;
 - (ii) as soon as reasonably practicable following precipitation; and
 - (iii) in a manner that does not cause significant detrimental impacts to the environment, including (but not limited to) erosion; and
 - (b) the water taken is directed to water storage facilities with no seepage losses and that are designed to minimise evaporation losses.
39. For the purposes of principle 38 'pre-existing runoff' means the runoff that would have occurred without the hard surface or roof being in place, calculated as the area (in square meters) multiplied by the annual adjusted runoff in millimetres, calculated as per Appendix 2.
40. Construction of buildings/structures with a water capture area of 500 m² or greater, may capture a maximum of 85% of rainfall, allowing the remaining 15% (or relevant pre-existing runoff whichever is the larger value) to return through release or non-capture, back to the environment.
41. Construction of impervious surfaces greater than 500 m² (roads, hard stands, carparks etc.) must consider how rainfall is used on site or captured and returned to the environment. Where possible 15% of rainfall (or relevant pre-existing runoff, whichever is the larger value) must be returned to the environment through water sensitive urban design or other mechanisms.

7.10 Transfers

42. Subject to principle 43, the holder of a water licence:

- (a) may apply to transfer the water licence or a water access entitlement, or one or more entitlement shares under the licence, to another person permanently or for a temporary period; or
 - (b) may apply to transfer a water allocation, in part or in full, to another person for the period for which the allocation is current (up to 12 months).
43. Principle 42 does not apply to:
- (a) a water licence or water access entitlement issued pursuant to the Managed Aquifer Recharge Consumptive Pool, unless the transfer is in relation to a change in ownership of the scheme;
 - (b) a water licence or water access entitlement issued pursuant to the Captured Runoff Consumptive Pool, unless the transfer is in relation to a change in ownership of the property where the runoff is collected; or
 - (c) a water allocation issued pursuant to the carryover provisions in section 7.6, unless the transfer is in relation to a change in ownership of the licence with respect to which the water allocation was initially issued.
44. A water management authorisation may only be transferred (temporarily or permanently) to another person where it remains related to the same consumptive pool from which it was initially issued.
45. A water management authorisation cannot be transferred to become an authorisation related to a different prescribed water resource.
46. The transfer of a water management authorisation within a surface water consumptive pool will only be approved if the location of new or increased water take is from a dam or watercourse extraction point downstream of, and on the same flow path as, the original location of extraction.
47. Where a transfer results in a change in the location of take listed on a surface water authorisation from a dam to a watercourse extraction point, the Minister may approve the transfer only on the basis that an equivalent reduction in dam capacity is made at the original location, such that there is no overall increase in potential net-take from the consumptive pool.
48. The transfer of a water management authorisation within a surface water consumptive pool will only be approved if it meets the Assessment Criteria as specified in section 7.11.
49. The transfer of a water management authorisation within a groundwater consumptive pool will only be approved if it meets the Assessment Criteria as specified in section 7.11.
50. Notwithstanding principle 49, the Minister may authorise the transfer of a water management authorisation to enable water to be taken from a particular well, where the applicant has demonstrated to the satisfaction of the Minister that the issuing or varying of the authorisation to take water would not result in any undesirable impacts to water resources, water-dependent ecosystems, existing users (including any future return of currently transferred entitlement shares), or Managed Aquifer Recharge operators.

7.11 Assessment Criteria

51. For the purposes of this section:
- (a) A well buffer zone is a circular area centred upon the site of a new or existing operational well located within the listed consumptive pool from which new or additional water is

proposed to be taken, with a radius in relation to the listed consumptive pool determined in accordance with Table 7.3.

- (b) An environmental buffer zone is a set-back distance of 100 meters on either side of the centre line from a third order, and above, watercourse (such that the total width of the buffer zone is 200 meters).

Table 7.3: Well Buffer Distances

Consumptive Pool	Proposed New or Additional Volume of Extraction (kL)	Well Buffer Radius (m)
Eastern Fractured Rock Western Fractured Rock Confined Fractured Rock	Any volume	50
Upper Aquifer Regional	0 – 10,000	0
Upper Aquifer Central	10,001– 25, 000	100
Lower Aquifer	25,001– 50,000	150
Lyndoch Valley	>50,000	200

52. Subject to principle 54 and the transitional provisions in section 7.7 of this Plan, the taking of water from a new well or an increase in water to be taken from an existing operational well within a groundwater consumptive pool listed in principle 4, will not be granted or varied where:

- (a) the volume and location of potential authorised take of water from a well results in the well buffer zone (determined in accordance with Table 7.3) of the well overlapping with the well buffer zone of an existing operational well in the same consumptive pool; or
- (b) the well from which a new or increased volume of water is authorised to be taken will fall within:
 - (i) an environmental buffer zone, as defined in principle 51(b), if located in the Eastern Fractured Rock, Western Fractured Rock, Confined Fractured Rock, Upper Aquifer Regional, Upper Aquifer Central or Lyndoch Valley consumptive pools; or
 - (ii) 300 metres of an existing operational well completed in the same aquifer, where one or both wells are used for the purposes of managed aquifer recharge, unless the new location of take is associated with the Managed Aquifer Recharge scheme.
- (c) the taking of water is equal to or greater than a total of a volume of 50,000 kL unless the applicant has undertaken a hydrogeological investigation to determine that the impact on the resource and existing users would be negligible.

53. Subject to principle 54 and the transitional provisions in section 7.7 of this Plan, the taking of water from a source or an increase in water to be taken from an existing source within a surface water consumptive pool listed in principle 3 will not be granted or varied where the source from which a new or increased volume of water is authorised to be taken will fall within an environmental buffer zone as defined in principle 51(b).

54. Notwithstanding principles 52 and 53, the Minister may issue or vary a water management authorisation that authorises a new or increased volume of water to be taken from a particular well, where the applicant has demonstrated to the satisfaction of the Minister that the issuing or varying of the authorisation to take water would not result in any undesirable impacts to

water resources, water-dependent ecosystems, existing users (including any future return of currently transferred entitlement shares), or Managed Aquifer Recharge operators.

7.612 Water Affecting Activity Permits

7.612.1 Water storage and diversion permits

55. A water affecting activity permit is required for water diversion and storage, including the erection, construction, modification, enlargement, or removal of a dam, wall, or other structure.
56. A water affecting activity permit for the erection, construction, modification, or enlargement of a dam within a surface water consumptive pool may only be issued if the relevant authority is satisfied that:
 - (a) the total capacity of all dams in a surface water consumptive pool will not exceed the total capacity of dams in that consumptive pool at the date of approval of this Plan;
 - (b) the location of a new or enlarged dam related to the removal or reduction in capacity of another such structure for the purpose of a transfer of a water management authorisation is downstream of, and on same flow path as, the location of the original structure;
 - (c) the combined capacity of all dams, and all water diversions including lined catchments, on a property (allowable volume) does not exceed or further exceed 30% of the annual run-off of that property, where the allowable volume is calculated as:

$$\text{Allowable Volume} = (0.3 \times R \times A) - \text{existing dam storage}$$

Where:

R = local adjusted runoff (as calculate per Appendix 2)

A = area of the catchment above the proposed dam or diversion within the property boundary (km²);

- (d) the dam will be fitted with a device that prevents the dam from collecting or diverting water flowing at or below the threshold flow rate as per principle 34, and this water must remain in the watercourse or drainage path or re-enter the original drainage path or watercourse as soon as it is reasonably practicable and must be of better or equal quality than the water that was diverted;
 - (e) the works are not within an environmental buffer zone as defined in section 7.11;
 - (f) the applicant provides details of the proposed purpose for the water in the dam; and
 - (g) construction will be undertaken in a manner that prevents silt or sediments entering the watercourse. [This can be achieved in a number of ways, including, but not limited to the use of erosion and sediment control measures such as catch/diversion drains, re-vegetation, hay bale barriers, filter fences, sediment traps and basins.]
57. Principle 56(d) does not apply:
 - (a) to a dam that has a capacity of no more than 2 ML and that collects or diverts water only for non-licensed purposes; or
 - (b) if the relevant authority is satisfied that:
 - (i) the construction, installation or use of a device referred to is not reasonably practicable in the circumstances;
 - (ii) the water flowing at or below the threshold flow rate that will be collected or diverted by the dam will be returned to the same watercourse or drainage path immediately downstream of that dam as soon as it is reasonably practicable to do so after the water has been collected or diverted; and

- (iii) the water flowing at or below the threshold flow rate that will be returned in accordance with principle 56(d) will be of better or equal quality than the quality of the water that was collected or diverted.

7.12.2 Well construction permits

- 58. A water affecting activity permit is required for well construction and repair, including drilling, plugging, backfilling, sealing, replacing, repairing or altering a well or drilling a monitoring well.
- 59. A water affecting activity permit to drill a well in the prescribed area may only be issued if the Minister is satisfied that the proposed well will be installed in accordance with the *General Specifications for Well Drilling Operations Affecting Water in South Australia* and constructed in accordance with the most current edition of the *Minimum Construction Requirements for Water Bores in Australia*.
- 60. A water affecting activity permit to drill a well in the prescribed area may only be issued if the Minister is satisfied that the proposed location of the well (coordinates) will meet the criteria set out in section 7.11.
- 61. Principle 60 does not apply to a well if:
 - (a) the well is a replacement well and the volume proposed to be taken from the well is equal to or less than that from the existing production well, and the well will:
 - (i) replace an existing production well owned by the existing owner or another party, that is authorised for the purpose of extracting a licensed water allocation or other authorised take; and
 - (ii) be located no farther than 20 metres from the well being replaced; and
 - (iii) be constructed in the same consumptive pool as the well being replaced; and
 - (iv) be used for the same purpose as the existing well; and
 - (v) if located within an environmental buffer, not be located closer to the environmental asset protected by the buffer; or
 - (b) the well is for the extraction of water authorised under section 105 of the Act for purposes that do not require a water licence; or
 - (c) the well is to be used for scientific purposes including, but not limited to, the monitoring of the groundwater resource.

7.12.3 Permits for use of imported water and effluent

- 62. For the purposes of this Plan, a water affecting activity permit for the use of imported water or effluent water is only required where imported water or effluent water is applied to an area greater than 1 hectare at a rate exceeding 1 ML per hectare per water use year.
- 63. A permit for the use of imported water or effluent water must ensure that the application of imported water to the lands surface does not:
 - (a) cause a rise in the groundwater level sufficient to detrimentally affect structures or ecosystems; or
 - (b) result in unacceptable impacts to the natural flow of water or the quality of surface water, groundwater or water in a watercourse or lake; or
 - (c) result in unacceptable impacts to the productive capacity of the land by causing salinity, sodicity, waterlogging, perched water tables or other such impacts; or
 - (d) result in unacceptable impacts to the condition, biodiversity, or extent of water-dependent ecosystems.

64. A permit for the use of imported water or effluent water will only be issued if, in relation to the storage of the imported or effluent water:

- (a) the storage facility for untreated water (imported or effluent) has no natural catchment, is located outside of a watercourse, and is constructed to prevent leakage to the surrounding soils (other than in an approved aquifer storage and recovery scheme), to prevent overflow to the surface of the land surrounding the storage facility and to prevent overflow into a watercourse; and
- (b) the storage facility for treated water (imported or effluent) must be located outside of a watercourse and minimise the risk of overflow into a watercourse; and
- (c) any water containing residual chlorine or other treatment chemicals must not be intentionally discharged into a watercourse.

7.12.4 Permits for draining or discharge of water directly or indirectly into a well

A permit is required for the draining or discharging of water directly or indirectly into a well. However, if the water to be drained or discharged has undergone antibiotic or chemical water treatment with a discharge volume greater than 50 kilolitres per day, an authorisation issued by the Environment Protection Authority under section 40(1) of the *Environment Protection Act 1993* is required instead. In issuing the authorisation, the Environment Protection Authority may take into account the principles listed below.

65. Prior to the issuing of a water affecting activity permit to drain or discharge water into a well, the applicant must undertake the following to the satisfaction of the Minister:

- (a) a risk assessment that is consistent with the *National Water Quality Management Strategy – Australian Guidelines for Water Recycling: Managing Health & Environmental Risks, Phase 2- Managed Aquifer Recharge (2009)*, as amended from time to time or any subsequent guidelines current at the time;
- (b) a risk management and monitoring plan, based on the findings of the risk assessment, which demonstrates that operational procedures and risk mitigation strategies are in place to avoid any negative consequences identified through the risk assessment; and
- (c) any other investigations or documentation required by the Minister.

66. Principle 65 does not apply to:

- (a) water drained or discharged into a well by means of gravity; or
- (b) roof or hard surface runoff (surface water) which is proposed to be drained or discharged into a well via a closed system of capture and transport, provided that the system is equipped with a mechanism to divert first flush water and is drained under gravity.

67. A water affecting activity permit may only be issued for the draining or discharging of water to an aquifer where the applicant can demonstrate to the satisfaction of the Minister that such draining or discharge will only present a low level of risk to:

- (a) the quality of the water in the receiving aquifer;
- (b) the integrity of the receiving aquifer (e.g. must not cause the overlying confining beds to hydraulically fracture or fail);
- (c) groundwater-dependent ecosystems or native vegetation;
- (d) the ability of another water licence holder to access water through an existing operational production well;
- (e) surface and near-surface drainage including, but not limited to, waterlogging of soils, creating perched water tables or excessive increase in the height of water tables; and

- (f) buildings, roads, and infrastructure due to direct or indirect damage.
68. A water affecting activity permit may only be issued for the draining or discharging of water to an aquifer where:
- (a) the water taken pursuant to the recharge water allocation will only be taken from the aquifer into which the water was drained or discharged; and
 - (b) the water taken pursuant to the recharge water allocation will only be taken from well/s located within the same spatial extent as the corresponding native groundwater consumptive pool that aligns with the location and aquifer within which the drain or discharge activities occurred.
69. When issuing a water affecting activity permit to drain or discharge water into a well the Minister may endorse a condition on the permit that requires the permit holder to provide an annual draining or discharge report that includes the following information:
- (a) the total amount of water drained or discharged into a well, as measured by each meter, in the water use year, and at any period as determined by the Minister;
 - (b) the groundwater level/pressure for the relevant aquifer accessed by the well/s through which water was drained or discharged, as measured by wells specified on the permit, at intervals specified on the permit (where applicable); and
 - (c) the salinity and other specified chemical components of the water drained or discharged into a well, as well as the receiving native groundwater (as determined on a case-by-case basis).

Additional authorisations may be required under the *Environment Protection Act 1993*.

8 – Monitoring, Evaluation, Reporting, and Improvement

8.1 Overview

This section sets out:

- the parameters and required elements of a monitoring, evaluation, reporting, and improvement (MERI) Plan which will be developed to guide MERI processes to support this Plan; and
- the monitoring that must be undertaken to support the implementation of the adaptive management principles in section 7.

MERI is part of the systematic process of optimising performance, through measurements against an agreed reference point. For this Plan, the reference points are the Plan's objectives as they relate to condition of the water resources, environments and cultural values, and the associated effectiveness of the relevant policies. There is a need to monitor and evaluate against the Plan's objectives to make sure that the water resources are used sustainably; environmental, and cultural outcomes are being progressed and that the Plan's policies remain relevant and effective.

Section 53 of the Act requires a water allocation plan to provide for regular monitoring of the capacity of the resource to meet the demands for water on a continuing basis. Section 54 of the Act requires that this Plan be reviewed on a comprehensive basis at least once every 10 years. This must include a review of the success of this Plan after considering the outcomes sought to be achieved by this Plan, as per Section 54(2)(a)(ii) of the Act. Additionally, there must be an assessment of whether this Plan remains appropriate or requires amendment, as per Section 54(2)(b) of the Act.

This Plan will be complemented by a MERI Plan, which will develop a comprehensive program aimed at measuring and assessing hydrological, hydrogeological, ecological, cultural, and water use parameters, the analysis of which will provide clarity regarding progress against the Plan's objectives, which are to:

- ensures that prescribed water resources are managed within acceptable resource condition limits.
- maximises security of access to prescribed water resources for current and future users within the constraints of the resource.
- provides protections for water-dependent ecosystems designed to maintain system sustainability.
- provides for the flexible and variable use of water resources in response to seasonal climate variability and availability.
- provides the ability to respond to declining resource condition at a consumptive pool scale.
- recognises and incorporates the importance of water to First Nations people, and the existence of native title interests in water.
- manages risks associated with the construction and use of infrastructure for extracting water, for undertaking water affecting activities including the storage and use of imported water or effluent on land.

The MERI Plan will specify detail regarding the purpose, scope and timing of the monitoring, evaluation, and reporting activities relevant for this Plan.

8.2 Monitoring the capacity of the resource

The principles in this Plan are based on maintaining the current condition of water resources, as described in sections 2.4, 2.5 and 7.4 of this Plan. Maintaining the water resources at their current condition should enable existing users to continue to access available water, whilst simultaneously

supporting water-dependent ecosystems to be maintained at a low level of risk and enabling progress of the cultural outcomes. To manage the water resources regular monitoring is required. This will inform a future review of the Plan. In addition, specific, targeted monitoring is needed enable management responses to be initiated if the condition of water resources starts to decline.

8.3 Current monitoring

Groundwater level and salinity monitoring

Descriptions of the current monitoring networks at the time of writing this Plan are presented below. It should be noted that the number and location of observation wells in any network may change during the life of this Plan due to several factors, including physical access, well construction issues and new groundwater extractions. The monitoring requirements may be reviewed on an as needs basis dependent on these factors. Any review of monitoring requirements must aim to maintain monitoring at a spatial and temporal scale sufficient to enable the assessment of the change in water levels and salinities of the groundwater resources within the Barossa.

Monitoring of the resource will be tailored through the development of the MERI Plan to ensure that the monitoring undertaken is sufficient to address the key evaluation questions. The Department currently undertakes groundwater level and salinity monitoring in the Barossa PWRA. Regular groundwater and salinity monitoring commenced in 1975 and up to 273 wells were monitored at some stage during the subsequent years. Currently, there are 111 observation wells used for monitoring water levels: 37 in the Upper Aquifer, 22 in the Lower Aquifer and 52 in the Fractured Rock Aquifer. There are 14 wells monitoring salinity (5 in Upper, 2 in Lower and 7 in the Fractured Rock). If any of the wells become unavailable for monitoring purposes, the nearest suitable observation well may be chosen as a replacement.

In addition to the observation wells, irrigators have been voluntarily submitting water samples for salinity analysis.

Groundwater monitoring results are reported annually by the Department and the status is assessed against the recent historical records.

The Department also compile and monitor metered groundwater extractions. Metered groundwater use data is available from 2007, although estimates of extraction based on the area irrigated were made back to 1970.

Monitoring of Managed Aquifer Recharge in the Barossa PWRA

No licensed Managed Aquifer Recharge (MAR) schemes are currently located within the Barossa PWRA. If a MAR scheme is developed, its monitoring and reporting requirements will be spelt out in the associated Risk Management and Monitoring Plan.

Surface and Watercourse Water monitoring

The regional monitoring requirements for watercourse and surface water resources of the Barossa PWRA will be met through a network of stream flow gauges, which will monitor flow and salinity (Figure 8.1, Table 8.1). The data will be collected on a continuous basis and stored as part of the State Water Archive. This data is publicly accessible and available from the Water Data web portal (www.water.data.sa.gov.au).

Flow data from the four longer-term monitoring stations across the Barossa PWRA will be used to inform on current flow regime, including the assessment of the RCIs for the surface water flow regime.

The remaining three flow gauges will provide contextual information but will not be used for the assessment of the flow regime RCIs due to lack of long-term data. To provide an assessment of the flow regime RCIs, data from the flow monitoring stations will need to be supplemented by modelled data for areas that are not covered by a stream flow gauge. The Barossa Source Model will therefore be required to be updated with up-to-date climatic information and run on an annual basis.

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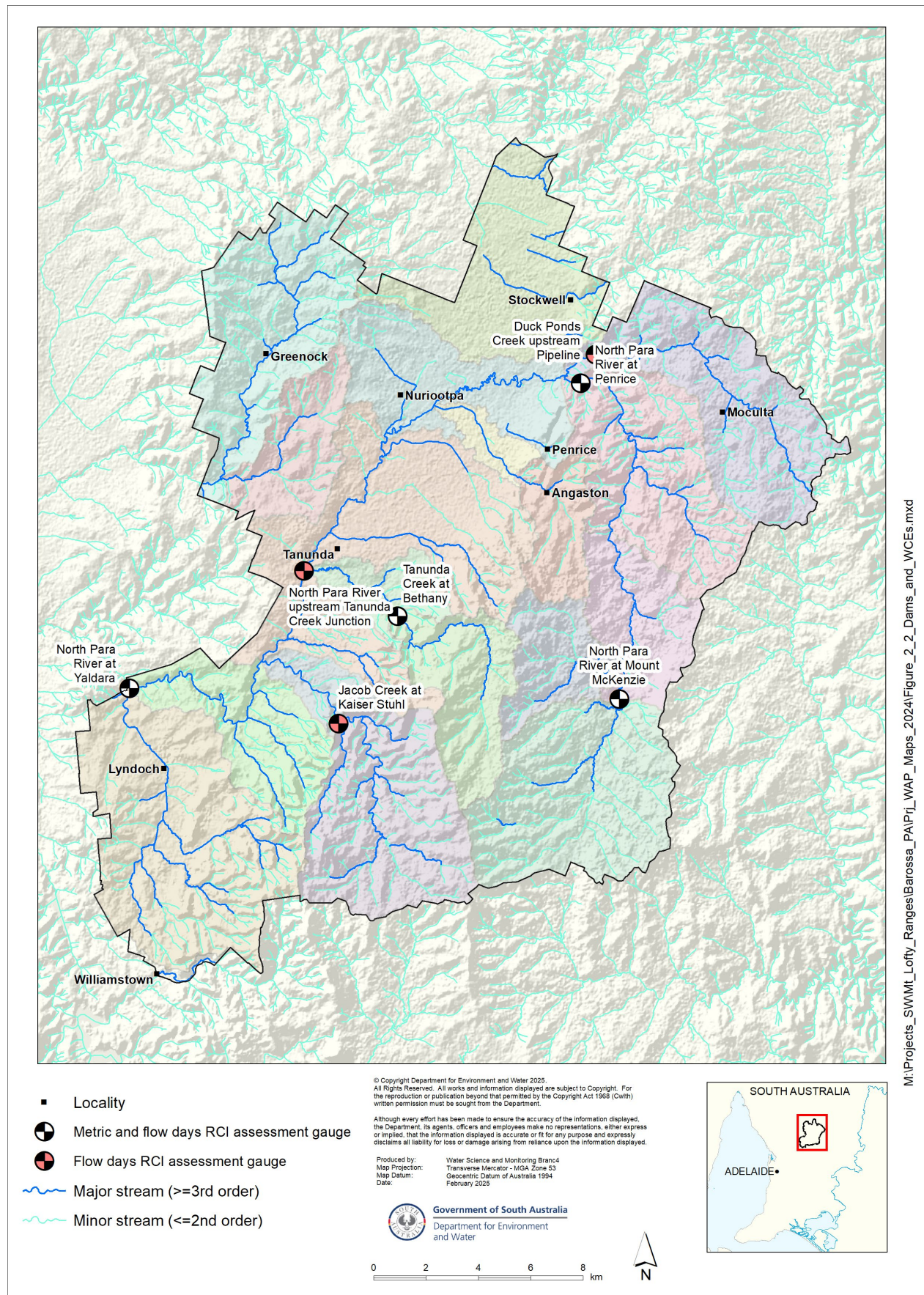


Figure 8.1: Map of the surface water gauging stations of the Barossa PWRA classified regarding their use for assessment of RCI.

Table 8.1: Operational streamflow monitoring stations in the Barossa PWRA

Station name (number)	Operational from
North Para River at Yaldara (A5050502)	1944
North Para River at Penrice (A5050517)	1977
North Para River at Mt McKenzie (A5050533)	1989
Tanunda Creek at Bethany Reserve (A5050535)	1991
Greenock Creek (Greenock Road (A5051032))	2019
Duck Pond Creek (A5050543)	2002
North Para River at Tanunda (A5050536)	1991
Jacob Creek (A5050518)	1977

Environmental monitoring

Ecological monitoring has increased significantly since 2018 in response to the elevated risk to water-dependent ecosystems. Prior to 2018, there were limited assessments of the water-dependent ecosystems of the Barossa PWRA that included a detailed 'snapshot' of fish and vegetation communities in 2013 (Green et al., 2014; Nicol, 2013), a small number of South Australian Environmental Protection Authority aquatic ecosystem condition reports and historic records of flora and fauna.

Since 2018, the Northern and Yorke Landscape Board have invested in fish and macroinvertebrate monitoring on an annual basis. While there are no specific targets or quantified outcomes linked directly to the fish and macroinvertebrate communities, the ongoing collection of this information is vital to linking the management of the water resources to the water-dependent ecosystems that depend on these resources. This data will also provide crucial information for the next iteration of the water allocation plan, which will seek to include these quantified environmental outcomes for ecological indicators.

8.4 First Nations objectives monitoring and review

Ngadjuri, Peramangk and Kaurna First Nations have identified a desired outcome in this Plan that First Nations culture and heritage values and sacred water sites are protected and enhanced in the planning and implementation of water resource management activities. The Board is addressing this desired outcome as part of the MERI Plan through supporting programs to:

- Raise the awareness of landholder legal obligations in the *Aboriginal Heritage Act 1988*.
- Ensure compliance with the *Native Title Act 1993* (Cth), determinations of native title, in particular as it relates to water, and any future Indigenous land use agreements that may be registered.

Ngadjuri, Peramangk and Kaurna First Nations see the monitoring of their lands and waters as an ongoing process, embedded as part of their responsibility to speak for, care for and protect their Country. The First Nations have each expressed the need for adequate monitoring and evaluation of the Plan to assess whether its objectives for sustainable water resource management are being achieved.

Through the outcomes delivered under this Plan, the Department and the Board will aim to:

- Provide opportunities for the involvement of Ngadjuri, Peramangk and Kaurna First Nations in the management, planning and monitoring of water resources.

- Provide opportunities for the capacity and experience building of Ngadjuri, Peramangk and Kurna First Nations in water resource management.

As part of the review of this Plan, the Board will directly consult with the Ngadjuri, Peramangk and Kurna First Nations in relation to the cultural objectives identified in this Plan.

8.5 Monitoring required for the adaptive management approach

Sections 6.5 and 7.5 of this Plan set out an adaptive management approach for surface water resources and some designated parts of the groundwater resources. These sections provide guidance to the Minister in using discretion under section 121(4) of the Act in determining the volume of water to be allocated from a consumptive pool, if the condition of water resources declines below a defined trigger (the identified RCTs). To determine if the RCTs have been exceeded, some targeted monitoring is required – either through modelling or direct measurement. These requirements are set out below.

Surface water monitoring required for adaptive management

For each surface water consumptive pool:

- 1) use recorded flow data or modelling of the flow parameters as specified in Table 8.2, to:
 - a) determine the cumulative number of environmental flow metrics passed over the preceding three years; and
 - b) determine whether there have been two consecutive years in which the number of days of flow is below the lowest on record up to 2016 (Table 8.3); and
 - c) use updated rainfall and runoff data to update and run modelling of surface water flows throughout the Barossa for assessment of modelled locations.
- 2) use data loggers to determine the annual patterns of water level in each of the designated permanent pool monitoring sites identified in Table 8.4 and continue to monitor to detect whether the level at any site falls below the minimum level observed in the 2024-25 water year (Table 3.5), or a site-specific level determined by the Minister.

Table 8.2: Lower bound for each of the flow metrics for each surface water consumptive pool in the Barossa PWRA

Zone	Data used	Flow days	Low flow days	Break of season	Spring runoff	Median flow days	High flow days
Barossa Valley Gorge	Actual flow data (A5050502)	263.7	7.7	87.0	0.0	105.7	10.3
Lower Flaxman Valley	Actual flow data (A5050517)	148.0	0.0	119.7	0.0	90.7	22.3
Upper Flaxman Valley	Actual flow data (A5050533)	143.3	3.3	80.3	0.0	133.3	6.3
Upper Tanunda Creek	Actual flow data (A5050535)	179.7	2.7	80.7	0.1	174.0	29.7
Barossa Valley Floor	Modelled data	285.7	37.0	48.3	0.0	132.3	21.3
Duck Ponds Creek	Modelled data	204.3	5.3	114.7	0.0	165.7	24.0
Lower Angaston Creek	Modelled data	181.7	11.0	33.3	0.1	166.0	48.0
Lower Jacobs Creek	Modelled data	197.0	1.3	39.7	0.1	167.7	45.3
Lower Tanunda Creek	Modelled data	206.7	12.7	63.0	0.0	162.3	28.7
Lyndoch Creek	Modelled data	227.7	11.7	55.0	0.1	163.7	31.3
Mid-Flaxman Valley	Modelled data	102.7	0.0	106.0	0.0	11.7	0.7
Stone Chimney Creek	Modelled data	137.3	0.7	110.7	0.0	160.0	19.3
Transition Zone	Modelled data	281.7	48.0	18.0	0.2	159.3	29.7
Upper Angaston Creek	Modelled data	240.3	26.3	33.0	0.1	146.7	51.7
Upper Jacob Creek	Modelled data	323.3	16.3	38.7	0.1	163.3	45.3

Table 8.3: Flow gauging sites in the Barossa PWRA

Zone	Data used	Minimum number of flow days in or before 2016 (Year)
Barossa Valley Gorge	Actual flow data (A5050502)	189 (2016)
Lower Flaxman Valley	Actual flow data (A5050517)	92 (1999)
Upper Flaxman Valley	Actual flow data (A5050533)	129 (2008)
Upper Tanunda Creek	Actual flow data (A5050535)	171 (2016)
Barossa Valley Floor	Modelled data	269 (2008)
Duck Ponds Creek	Modelled data	132 (2015)
Lower Angaston Creek	Modelled data	135 (2015)
Lower Jacobs Creek	Modelled data	173 (1996)
Lower Tanunda Creek	Modelled data	176 (2012)
Lyndoch Creek	Modelled data	208 (2016)
Mid-Flaxman Valley	Modelled data	57 (1994)
Stone Chimney Creek	Modelled data	92 (1994)
Transition Zone	Modelled data	265 (2008)
Upper Angaston Creek	Modelled data	141 (2015)
Upper Jacob Creek	Modelled data	261 (2016)

Table 8.4: Location of permanent pool monitoring sites in the Barossa PWRA

Consumptive Pool monitoring location	Latitude	Longitude
Upper Flaxman Valley	-34.5879	139.0719
Upper Flaxman Valley	-34.5719	139.0796
Lower Flaxman Valley	-34.5046	139.0779
Lower Flaxman Valley	-34.4817	139.0791
Lower Flaxman Valley	-34.4622	139.0606
Lower Jacob Creek	-34.5647	138.9406
Lower Jacob Creek	-34.5801	138.9611
Upper Jacob Creek	-34.6100	138.9796
Upper Tanunda Creek	34.5497	138.9907
Upper Tanunda Creek	-34.5477	139.0206
Transition zone	-34.4882	138.9772
Barossa Valley Gorge	-34.5729	138.8792
Barossa Valley Floor	-34.5304	138.9484
Barossa Valley Floor	-34.5626	138.9303

Groundwater monitoring required for adaptive management

Groundwater level monitoring will be undertaken annually within the Upper Aquifer Central and Lower Aquifer Consumptive Pools to determine when specific management responses may be required. Monitoring data will be compared to the resource condition triggers defined in section 6.5. Groundwater levels will be measured at the end of winter (August – September) to determine the maximum recovery in groundwater levels. The wells to be monitored for this purpose are outlined in Tables 6.2 and 6.3.

Annual evaluations required to inform adaptive management

As part of the adaptive management framework outlined in section 6.5, annual evaluations are needed to inform on the state of the resources. This annual evaluation will be required to include:

- Assessment of the flow regime against the metrics and thresholds (Metric RCT and flow days RCT) identified in section 3 (described in Table 8.2). This will require an annual update and rerun of the Barossa Valley Source Model (including the Greenock Creek Model).
- Assessment of the groundwater levels against the RCTs described in Tables 6.2 and 6.3.
- Assessment of the permanent pool levels against the permanent pools RCT described in Table 3.5.

8.6 Evaluating the success and appropriateness of this Plan

This section outlines a MERI framework to inform a comprehensive review of the success and appropriateness of this Plan as required by section 54 of the Act. This framework is intended to inform the development of a more detailed MERI Plan which will cover:

- a framework to measure and evaluate the success of this Plan at achieving its objectives
- a framework for assessing whether this Plan remains appropriate or requires amendment.

Review of this Plan

A comprehensive review of this Plan must occur at least once in the five years following adoption. Under normal circumstances it is proposed that the review should occur towards the end of the five-year period. This is shorter than the legislated 10 year review period and has been shortened to reflect the rapidly evolving body of knowledge and rapidly changing conditions for the Barossa PWRA.

A review may be undertaken earlier in response to observed changes in resource condition or changes in legislation or for any other reason. An early review may be targeted to address any specific issues that have been identified.

The review aims to evaluate the effectiveness and appropriateness of this Plan consistent with the requirements of the Act. The outputs of the review are decisions regarding the need for amendments. The key evaluation questions (KEQ) to be addressed by the review include:

1. To what extent has this Plan been successful in achieving its objectives?
2. To what extent has the implementation of the policies and principles in this Plan been effective in contributing to the objectives?
3. To what extent does this Plan remain appropriate or require amendment?

Specific to this Plan and the future plans for the Barossa PWRA, the review of this Plan needs to consider the fact that this Plan does not have fully developed environmentally sustainable extraction limits (ESELs). Rather it defines sustainability in terms of broader scale sustainability at regional scales

and allows for site scale degradation. The review of this Plan needs to consider the implications for not having these ESEs and the ramifications for environmental sustainability in the Barossa PWRA.

The evaluation of the appropriateness of this Plan (KEQ 3) should be informed by the evaluation of the success and effectiveness of this Plan (KEQs 1 and 2). Therefore, the review is undertaken in two stages, with the first stage focused on effectiveness and success and the second stage addressing appropriateness of this Plan and the need for amendment. A MERI Plan will be developed to set out how these evaluation questions will be addressed.

Stage 1 Evaluation – success and effectiveness of this Plan

A MERI Plan to address the success of this Plan and the effectiveness of its principles should include:

- a program logic showing the rationale for how this Plan is anticipated to succeed in achieving its objectives
- the assumptions that underpin the achievement of the objectives
- the suggested lines of evidence, including monitoring and stakeholder consultation
- the evaluation method.

Program logic and assumptions inform the scope of the evaluation process and the evidence required.

Stage 2 Evaluation – appropriateness and need for amendment

Evaluation to address KEQ 3 (appropriateness) will be based on a forward-looking assessment as it must have regard for potential future scenarios regarding use and resource capacity. Therefore, a risk-based approach is appropriate. To implement such an approach, the MERI Plan will cover the following steps consistent with the Department's guidelines for a risk-based review to water allocation plans (DEWNR, 2012) as follows:

- Establish context
- Risk assessment:
 - o Risk identification
 - o Risk analysis
 - o Risk evaluation
- Risk treatment.

Criteria for the risk assessment will be based on the likelihood and consequences of deviation from the objectives for water resource management. The risk assessment should measure the risks associated with a continuation of the existing, un-amended Plan – i.e. a “business as usual” scenario. In this way, it provides an argument for amendments based on the level of risk identified at the time.

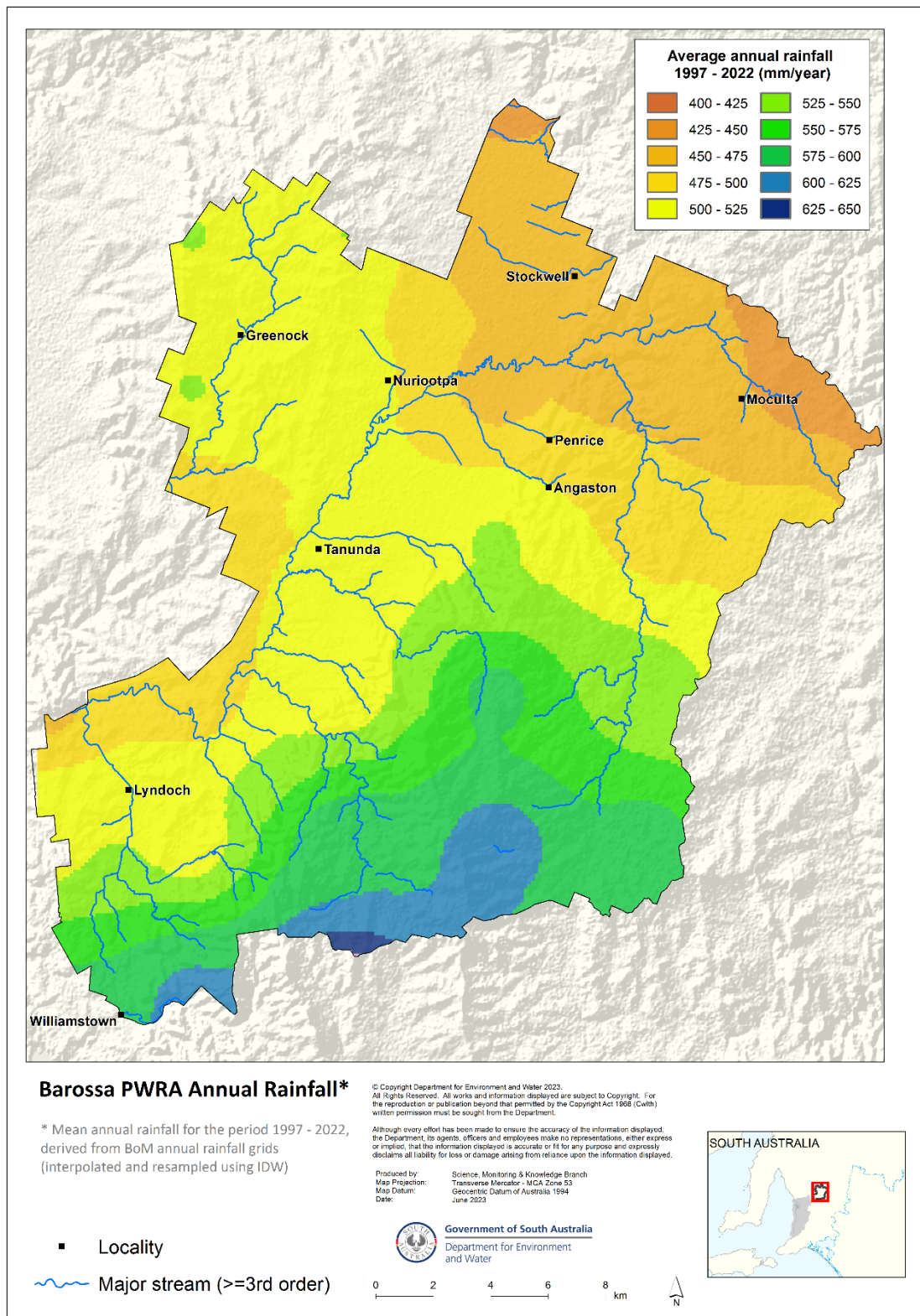
The risk treatment step considers the question of whether amendments are needed to ensure that risks to water resources and community, cultural and environmental values are managed at an acceptable or tolerable level.

The MERI Plan will establish a framework for determining the need to amend this Plan based on the level of risk. The framework is likely to specify that high risks must be treated, while the decision to treat other risks (medium and low) should have regard for the benefits relative to the costs of treatment. Benefits of treatment can be ascertained by assessment of residual risk, which considers the anticipated effectiveness of the proposed Plan amendment for treating risk.

The review of this Plan (Stage 1 and 2 evaluations) should be documented in a public report and, if deemed necessary, this Plan will be amended following the risk assessment.

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Appendix 1: Rainfall Map



Appendix 2: Calculating Local Adjusted Runoff for Barossa PWRA

Annual adjusted runoff¹⁰ for locations within the Barossa PWRA can be calculated using the chart shown in Figure A1 or data provided in Table A1 or using Equation 1. Local annual adjusted runoff for locations within the Barossa PWRA can be calculated using Equation 2. Mean annual rainfall for locations within the Barossa are provided in Appendix 1.

Annual Adjusted Runoff is calculated as per Equation 1:

$$\text{Annual Adjusted Runoff (mm)} = \text{rainfall (mm)} - 1100 \times \tanh\left(\frac{\text{rainfall (mm)}}{1100}\right)$$

Where:

- Annual adjusted runoff is the mean annual amount of runoff (expressed in millimetres) at a point on the landscape, if there were no dams or watercourse extractions in the catchment area draining to this point.
- Rainfall is the mean annual rainfall (expressed in millimetres) for the catchment area draining to a point on the landscape for the period 1997 to 2022. Refer to the average annual rainfall band relevant for the specified location in Appendix A.
- 1100 is a constant in the relationship.

Local Adjusted Runoff is calculated as per Equation 2:

$$\text{Local Adjusted Runoff (ML)} = \text{Annual Adjusted Runoff (mm)} \times \text{Catchment Area (km}^2\text{)}$$

Where:

- Local Adjusted Runoff is the total volume of surface water (expressed in megalitres) that would be expected to flow and be available at a point on the landscape if there were no dams or watercourse extractions in the catchment area draining to this point.
- Catchment area for a point on the landscape is the area across the landscape from which surface water drains to the point (expressed in square kilometres).

Table A1: Annual adjusted runoff for 25mm rainfall bands across the Barossa PWRA.

Rainfall Band (from Appendix 1)	Annual adjusted runoff (mm)
400-425	18
425-450	22
450-475	25
475-500	30
500-525	34
525-550	39
550-575	44
575-600	50
600-625	56
625-650	63

¹⁰ Annual adjusted runoff is defined mean annual adjusted runoff for the WAP climate period (1997-2022), adjusted to remove the impacts of farm dams and watercourse extractions on runoff through modelling.

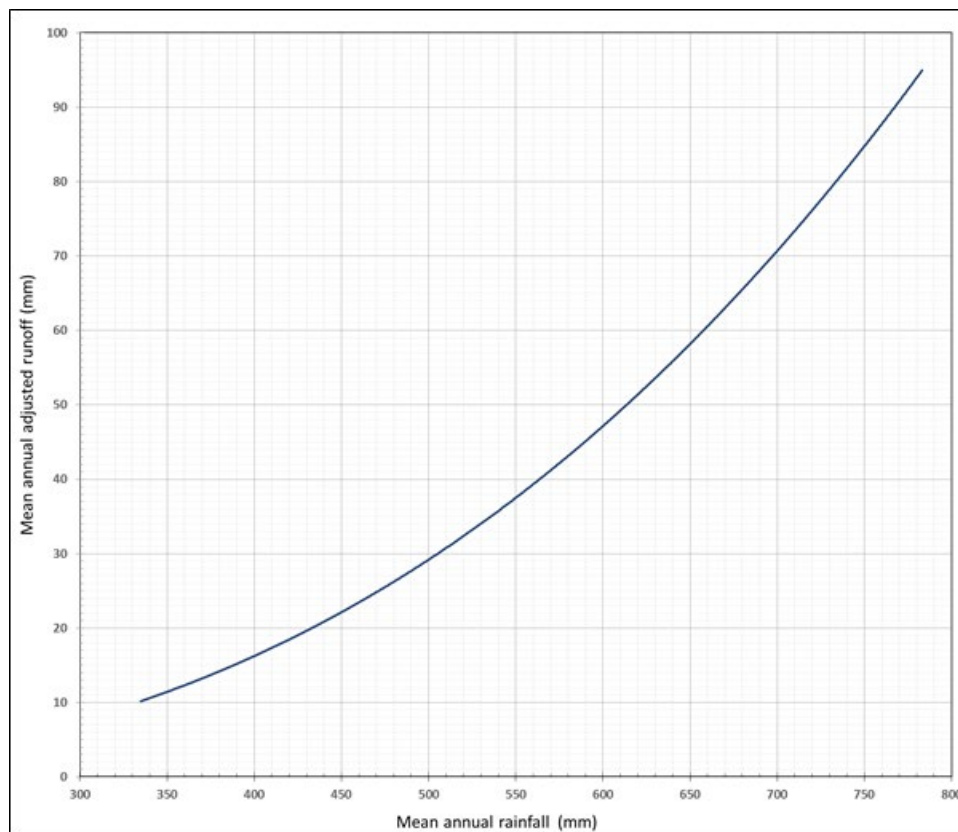


Figure A1: Annual rainfall to annual adjusted runoff for the Barossa PWRA.

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Units of Measurement

km² = Square kilometres

kL = Kilolitre (1000 litres)

ML = Megalitre (1,000,000 litres)

Shortened Forms

Board – Northern and Yorke Landscape Board

DEW/Department – Department for Environment and Water

EWP – environmental water provisions

EWR – environmental water requirements

GDE – groundwater-dependent ecosystem

MERI – monitoring, evaluation, reporting and improvement

WAP/Plan – Water Allocation Plan

PWRA – Prescribed Water Resources Area

WDE – water-dependent ecosystem

Definitions

Act (the): The *Landscape South Australia Act 2019*.

Allocation: See Water Allocation.

Annual adjusted runoff: the mean annual adjusted runoff for the Plan's climate period (1997-2022), adjusted to remove the impacts of dams and watercourse extractions on runoff through modelling.

Aquifer: An underground layer of rock or sediment that holds water and allows water to percolate through.

Available balance: The total volume of water drained or discharged by a Managed Aquifer Recharge scheme under a licence, or a permit issued pursuant to either section 104(3)(c) of the Act or an environmental authorisation issued under section 40(1) of the *Environment Protection Act 1993* throughout the life of the scheme's operation, minus any volume that has subsequently been taken.

Baseflow: the component of flow in a watercourse that results from the discharge of groundwater.

Captured runoff: Water that is additional runoff over and above 'pre-existing runoff' and is taken from a collection point after running off any building/structure or impervious surface fixed to land after having fallen as rain or hail or having precipitated in any other manner. 'Pre-existing runoff' means the runoff that would have occurred without the hard surface being in place, calculated as the area (in square meters) multiplied by the annual adjusted runoff in millimetres, calculated as per Appendix 2.

Catchment Area: The catchment area of a particular point means all the land, determined by natural topographic features, from which runoff has potential to naturally flow to that point.

Confined aquifer: An aquifer that is bound above and below by a confining layer of low permeability. Water in a confined aquifer is usually under pressure, causing water level in wells completed in that aquifer to rise above the top of the confining layer.

Consumptive pool: The water that will from time to time be taken to constitute the resource within a particular part of a prescribed water resource for the purposes of Part 8 of the Act, as determined by this Plan.

Consumptive Use: Licensed and non-licensed water use for the purposes of Part 8 of the Act.

Country: 'Country' is a term that recognises the connections, relationships, authority, and responsibilities of particular First Nations people (including native title holders and claimants) where native title rights are concerned and or as described in an ILUA) to the living entities of land and sea. For First Nation people they are a part of the living body of their Country, they are Country. Country is capitalised when used. Country also refers to area(s) that a First Nation person has rights and responsibilities for and where the First Nation person is a native title holder or claimant will include responsibilities according to the laws and customs that form the native title rights and interests. All parts of South Australia, the lands, waters, seas, sky and even metropolitan and townships are the Country of a First Nation.

Dam: a dam, wall, weir, embankment or other structure placed on, or constructed across, a watercourse or flow path for the purpose of holding back and storing the flow of that watercourse or the surface water runoff flowing along that flow path. Does not include off-stream storage structures which do not capture any flows and are filled by pumping or siphoning from another water source (sometimes referred to as a 'turkey nest dam').

Date of Approval: The date that the Minister approves this Plan.

Department: The administrative unit designated from time to time, by the Minister, by notice in the South Australian Government Gazette as being the Department primarily responsible for assisting the Minister in the administration of the Act (at the date of approval of this Plan it is the Department for Environment and Water).

Designated day: The day upon which licences are issued in a new format in relation to sections 88 and 102(1) of Schedule 5 of the Act.
Domestic purpose: As per the Act, being "*In relation to the taking of water, domestic purpose does not include: (a) taking water for the purpose of watering or irrigating land, other than land used solely in connection with a dwelling; or (b) without limiting paragraph (a) – taking water for the purpose of watering or irrigating more than 0.4 of a hectare of land; or (c) taking water to be used in carrying on a business (except for the personal use of persons employed in the business).*"

Draining and discharge: The intentional draining or discharging of water to aquifers for subsequent recovery and use or for environmental benefit.

Drainage line or path: A fold, depression or contour in land or path along which surface water flows.

Drawdown: A reduction in water level and/or pressure level in an aquifer as a result of the extraction of groundwater from that aquifer.

Ecosystem: A community of organisms, which may include humans, interacting with one another and including the physical, chemical, and biological processes inherent in their interaction and the environment in which they live.

Effluent: Domestic or industrial wastewater.

Entitlement shares: The individual shares which comprise a water access entitlement within a particular consumptive pool.

Environmental buffer zone: An area around an environmental asset within which specific principles apply in order to protect a water-dependent ecosystem.

Environmental water requirements: As defined in the Act, those water requirements that need to be met in order to sustain the ecological values of ecosystems that depend on the water.

First flush water: The initial surface runoff from a rain event. During this phase, water pollution is typically more concentrated when compared to the remainder of the rain event.

First Nation people: Descendants of the original inhabitants existing in a land from the earliest times or from before the arrival of colonists. The term 'First Nation' is applied throughout this Plan instead of 'Aboriginal' or 'Indigenous' as agreed by the Northern and Yorke Five Nations Landscape Committee.

Groundwater: Water occurring naturally below ground level, and water pumped, drained, discharged, diverted or released into a well for storage underground.

Groundwater-dependent ecosystem (GDE): An ecosystem that requires access to groundwater, on a permanent or intermittent basis, to meet all or some of its water requirements to maintain the community of plants and animals, and the ecological processes and ecosystem services they provide.

Groundwater extraction: The process of extracting water from a groundwater source, either temporarily or permanently.

Hydrogeology: The study of groundwater, which includes its occurrence, recharge and discharge processes and the properties of aquifers.

Hydrology: The study of the characteristics, occurrence, movement and utilisation of water on and below the earth's surface and within its atmosphere.

Imported water: Water which has been brought into the prescribed area by means of a pipe or other channel, and the water (including surface water) has been taken and piped, or directed into a channel, under licence or permit under the Act. Imported water excludes water that would have, prior to diversion, formed part of the water balance of the prescribed groundwater resource.

Kaurna: Kaurna people assert traditional interests in part of the area of the Barossa water allocation plan. Currently their interests are represented by Kaurna Yerta Aboriginal Corporation who represents Kaurna First Nation in relation to those interests. The Barossa PWRA is part of a native title claim, and thereby both Kaurna Yerta Aboriginal Corporation and the claimants or holders of native title are entitled to be consulted and dealt with in the area about their respective responsibilities within the Kaurna First Nation.

Licence: see 'water licence'.

Licensed purposes: The purposes for extraction water, for which a licensed water allocation is required to extract water under the Act.

Licensee: A person or entity who holds a water licence pursuant to section 121 of the Act.

Local adjusted runoff: the total volume of surface water (expressed in ML) that would be expected to flow and be available at a point on the landscape if there were no dams or watercourse extractions in the catchment area draining to this point. It is calculated as per the relevant principles in section 7, and the information in Appendix 2.

Managed Aquifer Recharge (or draining or discharging): The intentional draining or discharging of water to aquifers for subsequent recovery and use or for environmental benefit.

Managed Aquifer Recharge scheme: An enterprise operated by a legal entity which is licensed or authorised under either the Act, or the *Environment Protection Act 1993*, to undertake the intentional draining or discharging of water into aquifers for the purposes of either subsequent recovery, disposal of water or environmental benefit.

Managed Aquifer Recharge well: An operational well into which a person is authorised to drain and discharge water as part of a managed aquifer recharge scheme.

Maximum annual recovery volume: A volumetric limit stipulated as a condition on a recharge water licence which limits the volume of water which may be taken in a single water use year.

Megalitre (ML): one million litres.

Minister: The Minister responsible for the administration of the Act.

Monitoring: The systematic measurement of variables and processes over time to address a clearly defined set of objectives.

Native groundwater: Water occurring naturally below ground level that exists in the relevant aquifer (i.e. absent of any water drained or discharged into that aquifer by artificial means).

New development: development that is (or was) authorised by a development approval under the *Planning Development and Infrastructure Act 2016* and that is (or was) commenced after adoption of this plan.

New well: Either a newly drilled or existing well which has not previously been authorised for the extraction of water on a licence this Plan.

Ngadjuri: Ngadjuri people assert traditional interests in part of the area of the Barossa water allocation plan. Currently their interests are represented by Ngadjuri Nation Aboriginal Corporation who represents Ngadjuri First Nation in relation to those interests. The Barossa PWRA is part of a native title claim, and thereby both Ngadjuri Nation Aboriginal Corporation and the claimants or holders of native title are entitled to be consulted and dealt with in the area about their respective responsibilities within the Ngadjuri First Nation.

Non-licensed purposes: The extraction of groundwater for a purpose for which a licensed water allocation is not required under the Act.

Operational well: A well that is used, or is able to be used, to supply water for consumptive use; is known to the Department; and is owned by the existing owner or another party.

Peramangk: Peramangk people assert traditional interests in part of the area of the Barossa water allocation plan. Currently their interests are represented by Peramangk Aboriginal Corporation who represents Peramangk First Nation in relation to those interests. The Barossa PWRA is part of a native title claim, and thereby both Peramangk Aboriginal Corporation and the claimants or holders of native

title are entitled to be consulted and dealt with in the area about their respective responsibilities within the Peramangk First Nation.

Permanent pool: a pool, or body, of water that remains within a watercourse throughout the year, although the level of water present may fluctuate.

Person: As per the *Acts Interpretation Act 1901* being “expressions used to denote persons generally (such as “person”, “party”, “someone”, “anyone”, “no-one”, “one”, “another” and “whoever”), include a body politic or corporate as well as an individual”.

Pre-development runoff: The volume of water that had run off land before the new development on that land.

Prescribed Water Resources Area (PWRA): An area of land within which water resources assigned to consumptive pools to which a management framework for the extraction and use of the water is outlined within the relevant Water Allocation Plan.

Prescribed well: A well declared to be prescribed under section 101 of the Act.

Recharge water: Water that has been intentionally drained, discharged or injected into an aquifer.

Recharge water access entitlement: A water access entitlement issued in relation to the Managed Aquifer Recharge Consumptive Pool based on the ‘available balance’, where the ‘available balance’ takes into account the total volume of water drained or discharged under a permit issued pursuant to either section 104(3)(c) of the Act or an environmental authorisation issued under section 40(1) of the *Environment Protection Act 1993* throughout the life of the scheme’s operation, minus any volume that has subsequently been taken.

Recharge water allocation: A water allocation obtained on account of a recharge water access entitlement. The volume of water allocated in any given water use year shall be the lesser of a) the ‘available balance’ or b) the ‘maximum annual recovery volume’ of water authorised to be taken per water use year as a condition on the water licence.

Recharge water licence: A water licence issued for the recovery of water previously drained or discharged into a well in accordance with a permit under either section 104(3)(c) of the Act in accordance section 7.12 of this Plan or an environmental authorisation issued under section 40(1) of the *Environment Protection Act 1993*. The licence will relate to the Managed Aquifer Recharge Consumptive Pool.

Relevant authority: an approval authority as determined by the Minister or their delegate/s.

Runoff collection point: a gutter, drain, pipe or other device from which water is collected for storage, after having run off from a roof or hard surface of a new development.

Same spatial extent as the corresponding native groundwater consumptive pool: Within the consumptive pool boundaries for the corresponding native groundwater consumptive pool of the same aquifer and location, in relation to the site of draining or discharging.

Source: a well, dam, watercourse extraction point or collection point for roof or hard surface runoff from new development.

Stream Order: A method of classifying the size of a part of a watercourse, based on the hierarchy of connecting watercourse segments. The Strahler stream ordering system is used in this Plan. The most upstream part of a watercourse is a first order stream. Two first order watercourses join to become a

second order watercourse. Two second order watercourses join to become a third order watercourse and so on. Arthur Strahler first proposed the approach in 1952 in an article in the Geological Society of America Bulletin. The network of watercourses is defined in the basis of current 1:50,000 topographic maps produced by the state government.

Surface water:

- (a) water flowing over land (except in a watercourse)—
 - (i) after having fallen as rain or hail or having precipitated in any other manner;
or
 - (ii) after rising to the surface naturally from underground; or
- (b) water of the kind referred to in paragraph (a) that has been collected in a dam or reservoir;
or
- (c) water of the kind referred to in paragraph (a) that is contained in any stormwater infrastructure; or
- (d) as declared by this Plan, water in a prescribed watercourse or a particular part of a watercourse.

Take/taking (water): taking water is any of the following.

- a) taking water by pumping or syphoning the water
- b) stopping, impeding or diverting the flow of water over land (whether in a watercourse or not) for the purpose of collecting the water
- c) stopping, impeding or directing the flow of water in any stormwater infrastructure for the purpose of collecting the water, or to take any water from stormwater infrastructure
- d) diverting the flow of water in a watercourse from the watercourse
- e) releasing water from a lake
- f) permitting water to flow under natural pressure from a well
- g) permitting stock to drink from a watercourse, a natural or artificial lake, a dam or reservoir
- h) causing, permitting, or suffering any activity referred to above.

Threshold flow rate: The flow rate of a watercourse or drainage line (litres/sec) determined by multiplying the unit threshold flow rate (litres/sec/square kilometre) by the area of catchment (square kilometres) that contributes to the watercourse or drainage line located above the point where the water is captured in a dam or diverted from the watercourse; or 1 litre/second, whichever is the greater value; and

Transaction: Issuing, varying, or transferring a water management authorisation.

Unconfined aquifer: An aquifer in which the upper surface has free connection to the ground's surface and the water surface is at atmospheric pressure.

Unit threshold flow rate: the rate determined by dividing the 10th percentile flow rate (litres/second) for the consumptive pool by the area of catchment (square kilometres) upstream of the point of extraction, where the 10th percentile flow rate is the flow rate (litres/second) obtained from a time weighted annual flow duration curve (with the time step being 1 day – mean flow) which is greater than or equal to 10% of all flows during that period.

Water access entitlement: An entitlement to the holder of a water licence to gain access to a share of water available in the consumptive pool or pools to which the licence relates as per section 121(2) of the Act.

Water allocation (licensed and authorised): A licensed water allocation is the water obtained on account of a water access entitlement under a water licence as per section 127(1)(a) of the Act. A licensed water allocation may also be obtained by a person, whether or not the person is a holder of a water licence, on the basis of a transfer of a licensed water allocation that has been provided by the Minister under the terms of a water licence as per section 127(2)(b) of the Act. A licensed water allocation will relate to a specified period of no more than 12 months as per section 127(8) of the Act. An authorised water allocation is the maximum quantity of water that can be taken and used over a specified period pursuant to an authorisation under section 105 of the Act.

Water allocation plan: A plan prepared under Part 4 Division 2 of the Act.

Water-dependent ecosystem (WDE): Those parts of the environment, the species composition, and natural ecological processes, which are determined by the permanent or temporary presence of flowing or standing water. Water-dependent ecosystems include riparian vegetation, springs, wetlands, floodplains, estuaries, in-stream areas of watercourses, hyporheic fauna (in wetted sediments below and alongside watercourses) and stygofauna (living in aquifers).

Water licence: A licence granted by the Minister under section 121 of the Act that provides the holder with a water access entitlement, which entitles the holder to gain access to a share of the water available for licensed allocation in the consumptive pool as per section 121(2) of the Act.

Water management authorisation: a water licence; or a water access entitlement; or a licensed water allocation; or a water resource works approval; or a site use approval.

Watercourse: a river, creek or other natural watercourse (whether modified or not) in which water is contained or flows whether permanently or from time to time, including:

- a) a dam or reservoir that collects water flowing in a watercourse
- b) a lake through which water flows
- c) a channel (but not a channel declared by regulation to be excluded from the ambit of this definition) into which the water of a watercourse has been diverted
- d) part of a watercourse

Watercourse extraction point: a location where licensed water is taken directly from a watercourse, not including sources defined as a dam.

Water use year: A water use year runs from 1 July to 30 June in the following calendar year.

Well: As defined by the Act, means (a) an opening in the ground excavated for the purpose of obtaining access to groundwater; (b) an opening in the ground excavated for some other purpose but that gives access to groundwater; and/or (c) a natural opening in the ground that gives access to groundwater.

Well buffer zone: A circular area around a well within which specific principles apply in order to protect the existing extraction point from the impacts of additional extractions from the resource.

Winter groundwater pressure level: The pressure level to which the groundwater in a confined aquifer will rise post the winter recovery period but prior to the commencement of the irrigation season. Usually measured in early spring.