A guide to the Water Allocation Plan

Southern Basins and Musgrave Prescribed Wells Areas, Eyre Peninsula

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Natural Resources
Eyre Peninsula

Government of South Australia
Eyre Peninsula Natural Resources Management Board

Contents

Overview of the WAP

The Water Allocation Plan (WAP) for Southern Basins and Musgrave Prescribed Wells Areas (PWAs) controls the taking and use of groundwater in the PWAs. It does this by working out the Resource Capacity which is the recharge rate multiplied by the recharge area (number 1 in Figure 1). The amount of rain that moves through the soil to the groundwater (recharge) varies year to year. Groundwater is held in or moves through rocks and sediments under the ground, which are called aquifers. For this WAP, the Resource Capacity is based on the 2008 recharge rate and the size of the freshwater lenses and brackish areas within the saturated Quaternary Limestone aquifer in April 2011.

The total amount of groundwater available to meet demands is split between consumptive and non-consumptive uses (number 2 in Figure 1). Non-consumptive uses include the water needed by Groundwater Dependent Ecosystems (GDEs) and to maintain aquifer processes including groundwater flows to the sea and springs.

Consumptive uses are human uses of water and are split into licensed and non-licensed parts (number 3 in Figure 1). Non-licensed uses include stock and domestic water as well as water kept aside by the Minister for public uses such as emergency fire-fighting and road building. Licensed uses include commercial irrigation, mining and town water supplies. There is also an amount of water that has not been allocated, which is excess to current demands.

The total amount of water available for licensed uses has been fixed for ten years (number 4 in Figure 1). Each license is a share in the water available. Each year, the groundwater storage level is measured. It is compared to the level in 1993, the reference level, which is considered to be 100% (number 5 in Figure 1). The next step is to look at where the storage level sits within the set trigger levels for each consumptive pool of water. From this, the allocation percentage for that pool for that year can be worked out by looking at the graphs in the WAP. This gives an annual allocation of water for each licence holder, that is, the amount of water that licence holder can use that year.

By doing this, the WAP protects the fresh groundwater that people and the environment of the Eyre Peninsula depend upon.

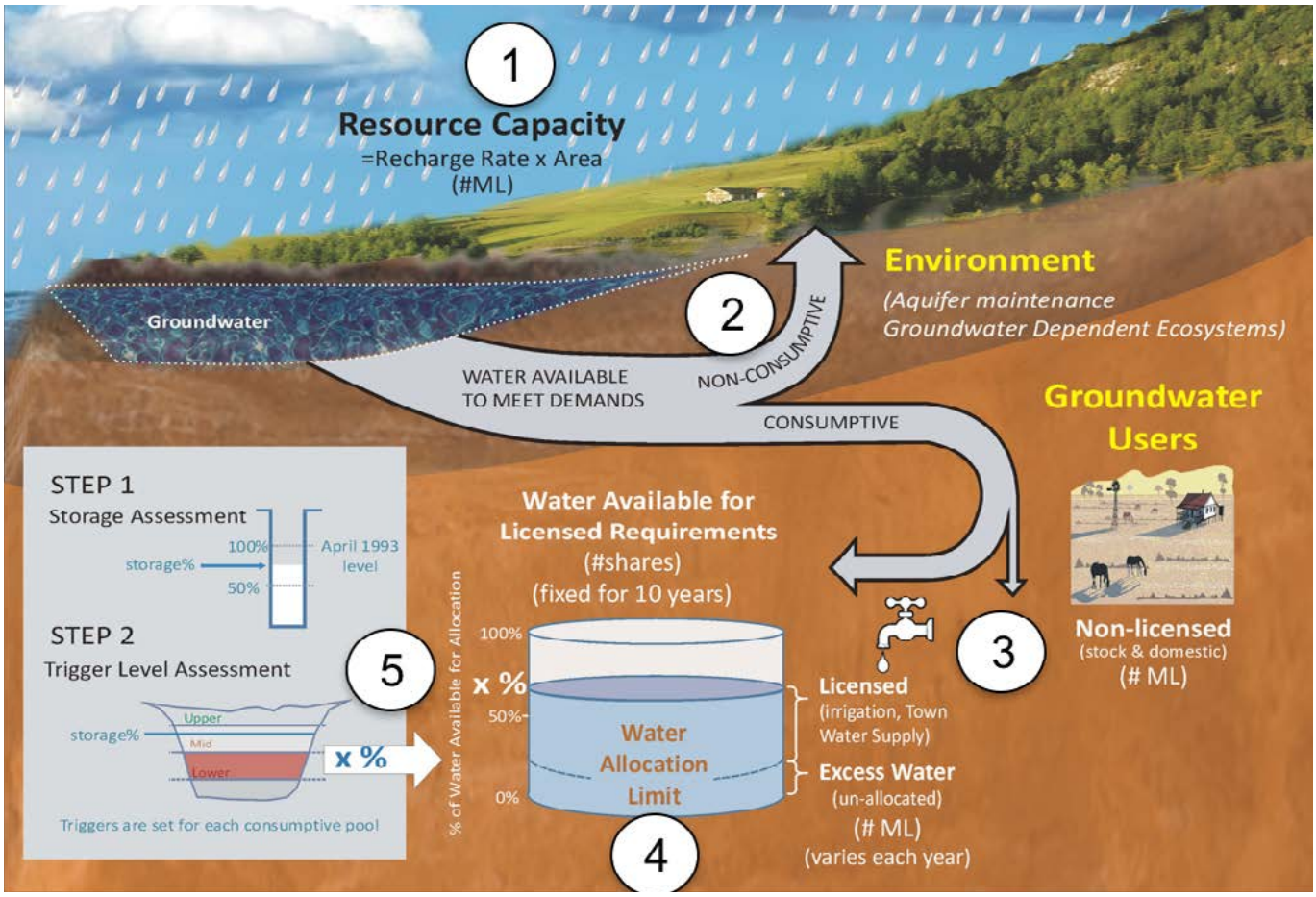


Figure 1: Summary of the Water Allocation Plan process.

1 How to use this Guide

This is a guide to the Water Allocation Plan for the Southern Basins and Musgrave Prescribed Wells Areas (the WAP) on Eyre Peninsula, South Australia.

It has been prepared to assist members of the public with interpreting the WAP at the request of community members who attended consultation meetings during the WAP review and development phase.

This guide and the WAP are part of a set of documents shown in Figure 2 below. Links to the various sections of the WAP and its supporting documents are given in order to make interpreting the WAP using this Guide easier.

The links to the WAP and supporting documents appear in coloured text boxes like this one throughout the Guide.

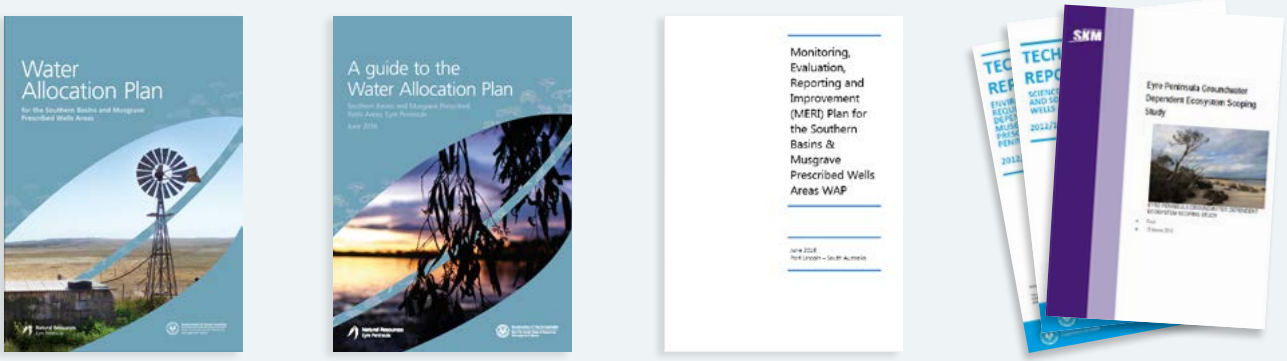
The WAP is a statutory document.

You must read the WAP alongside this Guide.

This Guide is not a replacement to the WAP.

This Guide does not offer a complete explanation of the WAP.

You may need to seek expert advice in interpreting sections of the WAP.



WAP | This guide | MERI Plan | Science supporting the WAP

Figure 2: The WAP and its supporting documents.

2 Introduction

This section should be read with WAP Section 1.1: Background to the Water Allocation Plan.

The Water Allocation Plan for the Southern Basins and Musgrave Prescribed Wells Areas (the WAP) was written as required by Chapter 4, Part 2, Divisions 2 and 3 of the *Natural Resources Management Act 2004* (SA) (the Act).

The WAP covers the taking and use of groundwater from within the Southern Basins and the Musgrave Prescribed Wells Areas (the PWAs).

2.1 Background to the Water Allocation Plan

WAP Figures 1 and 3 show indicative maps of the Southern Basins and Musgrave PWAs.

The WAP provides for the management of water property rights in both the Southern Basins and the Musgrave Prescribed Wells Areas (the PWAs) in several ways:

- It allows for managing the taking and use of water.
- It allows for licencing the taking and use of water.
- It separates water for licensed (e.g. public water supplies, irrigation, industry and mining) and non-licensed (e.g. stock, domestic, road-making and fire-fighting) consumptive use
- It allows for the transfer of water rights between users.
- It also shares water with ecosystems and natural groundwater processes (non-consumptive demands).

The WAP does not manage the taking and use of surface water or water in watercourses (e.g. streams) as these resources are not prescribed at this time.

2.1.1 Objectives

This section should be read with WAP Section 1.1.1: Objectives.

In managing groundwater in the PWAs the WAP aims to allow for the long-term viability of the water source, and minimise the impact of taking water on:

- Other water resources
- Groundwater dependent ecosystems (GDEs)
- Existing groundwater users

It also aims to minimise the risk of the groundwater getting saltier or seawater entering coastal aquifers.

2.2 Hydrogeology and aquifers of the PWAs

This section should be read with WAP Section 1.3: Hydrogeology of the Prescribed Wells Areas.

WAP Figures 5 and 6 show groundwater depth and flow direction in the Quaternary Limestone aquifers for the two PWAs.

WAP Figures 7 and 8 shows the saturated thickness of these aquifers.

Groundwater occurs at different depths under the soil surface. Aquifers are underground layers of rock or sediment that hold water and allow water to run through them. Groundwater can flow within connected aquifers and may flow underground, out to sea or to the soil surface as springs.

Figure 3 shows the layers of aquifers under the Southern Basins PWA and Figure 4 shows the layers under Musgrave PWA. Other, deeper aquifers in the PWAs are shown including the Tertiary Sands aquifers, the Jurassic aquifer and the Basement fractured rock aquifers.

The most important aquifer in the PWAs is the Quaternary Limestone aquifer. This aquifer gains water from rainfall passing down through the soil and rocks to the groundwater (recharge). The amount of water that recharges the groundwater on Eyre Peninsula each year changes because rainfall changes from one year to the next.

Within the Quaternary Limestone aquifer there are areas that are saturated with water (full) and other areas that are unsaturated (not full). These aquifers contain low-salinity (fresh) and brackish water. Brackish water is saltier than freshwater but less salty than seawater. Where there is a known pocket of freshwater under the ground it is called a 'lens', shown in Figure 4.

The freshwater in these aquifers across the PWAs, and especially in the lenses, are vital for the security of Eyre Peninsula's water supply.

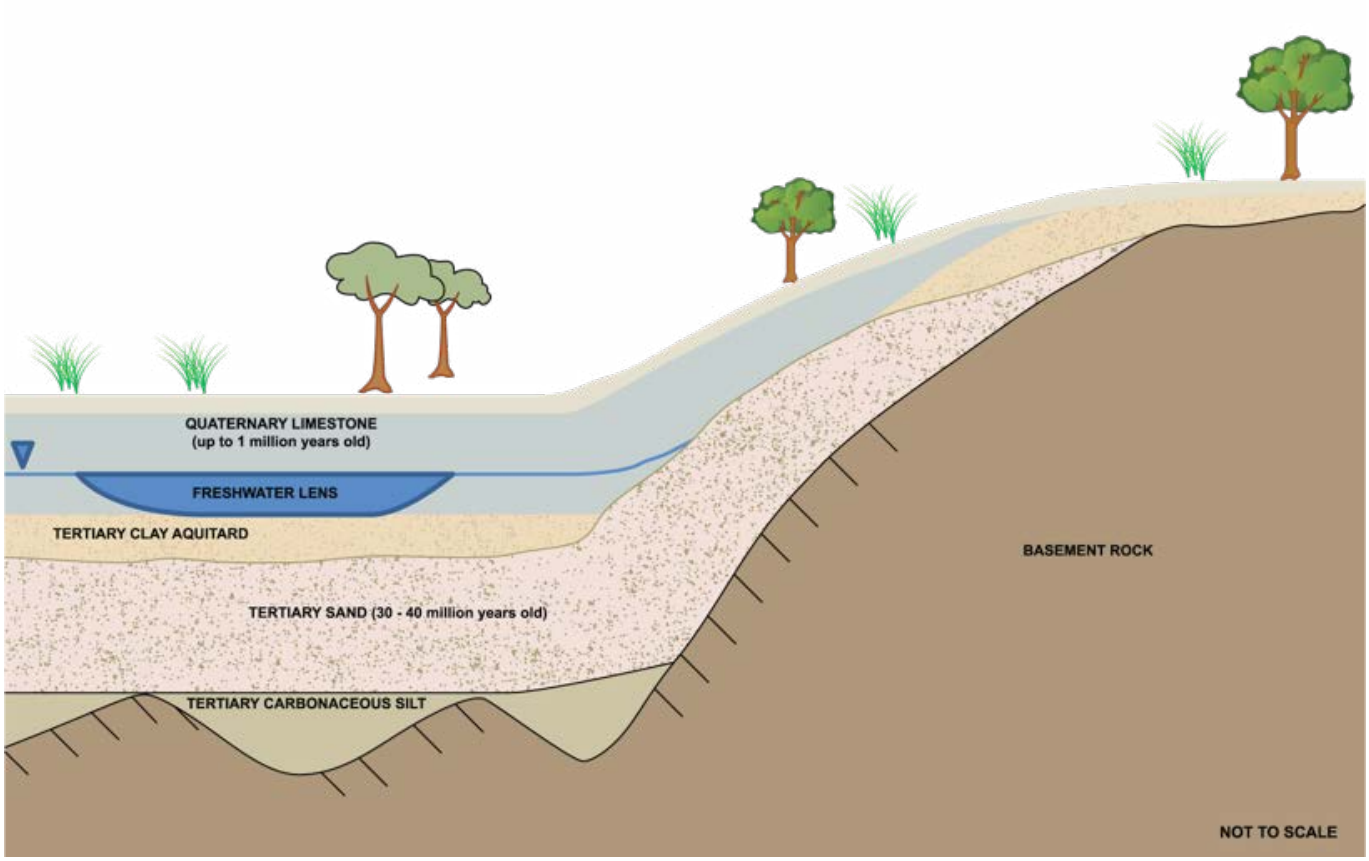


Figure 3: Layers of aquifers under the Southern Basins PWA.

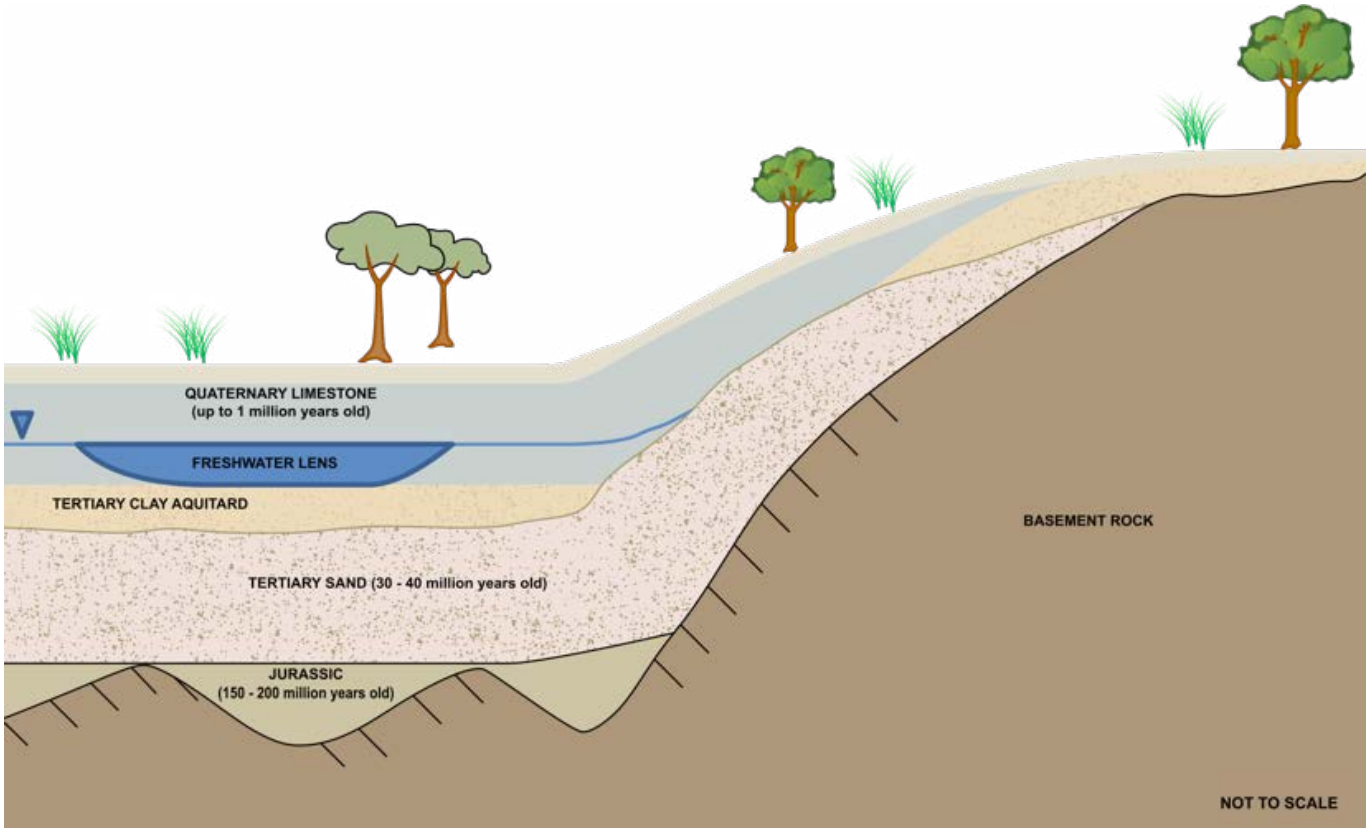


Figure 4: Layers of aquifers under the Musgrave PWA showing a freshwater lens in the Quaternary Limestone.

3 Determination of Management Areas

This section should be read with WAP Section 2: Capacity of Groundwater Resources.

WAP Figures 18 and 19 show Management Areas for the saturated and unsaturated Quaternary Limestone aquifer of the Southern Basins and Musgrave PWAs respectively.

Management Areas for the Tertiary Sands and Basement aquifers are shown in WAP Figures 20 (Southern Basins PWA) and 21 (Musgrave PWA). These align with the PWA boundaries.

The largest recorded areas of the saturated Quaternary Limestone aquifer are shown in Figures 14 and 15 in *Additional Science Support for the Eyre Peninsula Water Allocation Plan by Stewart* (2013).

The WAP refers to Management Areas in three different groups. These groups relate to the different aquifers in the PWAs.

The differences between aquifer types means differing methods are used to work out how much water is available and how to manage each type.

The Management Areas are also tied to cadastral boundaries (such as property boundaries or road sides) so that it is clear where the actual Management Area boundaries lie on the ground. This is shown in the report *Additional Science Support for the Eyre Peninsula Water Allocation Plan by Stewart* (2013).

Each Management Area relates to a fixed geographic location as well as a specific aquifer.

The Management Areas of the saturated Quaternary Limestone aquifer are based on the highest water levels in the past. This allows for the areas considered to be saturated areas to get bigger if there is a large amount of recharge (high rainfall periods).

4 Environmental Assets

This section should be read with WAP Section 3: Needs of Groundwater Dependent Ecosystems.

More information can be found in the NRM Act (2004) Section 76 and *Environmental Water Requirements of Groundwater Dependent Ecosystems in the Musgrave and Southern Basins Prescribed Wells Areas on the Eyre Peninsula* by Doeg and others (2012).

Groundwater dependent ecosystems (GDEs) are ecosystems that need groundwater for some or all of the year. There are many different types of plants, animals, fungi and microbes that live in GDEs that depend on water.

The WAP must work out how much water the GDEs need and the times and places where the water is needed. This work was done before the WAP was written and is reported in *Environmental Water Requirements of Groundwater Dependent Ecosystems in the Musgrave and Southern Basins Prescribed Wells Areas on the Eyre Peninsula* by Doeg and others (2012).

The WAP aims to balance the water needs of known GDEs with the water used by people.

The WAP also aims to maintain GDEs as they currently are. The WAP cannot return the GDEs to how they were before European settlement. This is because groundwater use prior to the WAP lowered the groundwater levels.

4.1 Location and description of Environmental Assets

The details for this section are in WAP Sections 3.2, 3.3 and 3.4.

Refer to WAP Figures 34 and 35 that show where the different environmental assets are found in the PWAs.

Groundwater dependent ecosystems (GDEs) are found in both the Southern Basins and Musgrave PWAs. Some GDEs are environmental assets in the WAP, that is, they are protected by Environmental Protection Zones (EPZs).

GDEs include watercourses, riparian zones (areas alongside watercourses), wetlands, floodplains, salt lakes and estuaries. There are also marine ecosystems close to the shore as well as ecosystems below ground and in caves that depend on groundwater.

The WAP needs to provide water for GDEs that depend on groundwater in the Quaternary Limestone within the PWAs. The Tertiary Sands and Basement aquifers are too deep to support GDEs (see WAP Section 3.2).

The GDEs that appear on the maps in the WAP and described below are the ones that have been identified and mapped. There may be other GDEs in the PWAs that have not been identified. The water needs of these GDEs are based on the plants that live in them and are discussed in detail in WAP Section 3.4 and *Environmental Water Requirements of Groundwater Dependent Ecosystems in the Musgrave and Southern Basins Prescribed Wells Areas on the Eyre Peninsula* by Doeg and others (2012).

4.1.1 GDE Wetlands

This section should be read with WAP Section 3.3: Groundwater Dependent Ecosystems within the PWAS, and WAP Section 3.3.1: Wetlands

WAP Figures 24 & 25 show the wetland GDEs in the Southern Basins and Musgrave PWAs respectively.

Wetlands in the PWAs depend on groundwater coming in occasionally (ephemeral), seasonally or all the time (continuous). Some wetlands are fresh and some are saline.

Freshwater springs at Sleaford Mere and Weepra Spring at Lake Newland can provide freshwater areas within a mostly saline lake.

The timing and amount of groundwater that enters a wetland will depend on the shape of the wetland and the groundwater level.

Wetlands are easy to identify and map because most are large and they all have wetland plants living in and around them. The most common plants in and around wetland GDEs on Eyre Peninsula are red gums (*Eucalyptus camaldulensis*), ti tree (*Melaleuca spp.*), reeds and samphires (Figure 4). The less common plants such as pennywort (*Hydrocotyle sp.*) are very important indicators of freshwater conditions and need to be better mapped across the region. Pennywort is shown in Figure 5.

The water needs of wetland plants are well known and because many are long-lived they have been used to work out the water needs of the whole wetlands *Environmental Water Requirements of Groundwater Dependent Ecosystems in the Musgrave and Southern Basins Prescribed Wells Areas on the Eyre Peninsula* by Doeg and others (2012) and WAP Section 3.4.

The photos in Figures 6 to 8 show a range of wetlands in the PWAs. The diagrams in these figures show the types of plants that grow in permanent wetlands,

Melaleuca halmatuorum and *Gahnia* sp.

Baumea juncea

Samphires

Phragmites australis

Charra spp.

Hydrocotyle spp.

Figure 5: Examples of wetland plants used to work out the environmental water needs of wetlands and other groundwater dependent ecosystems (GDEs).

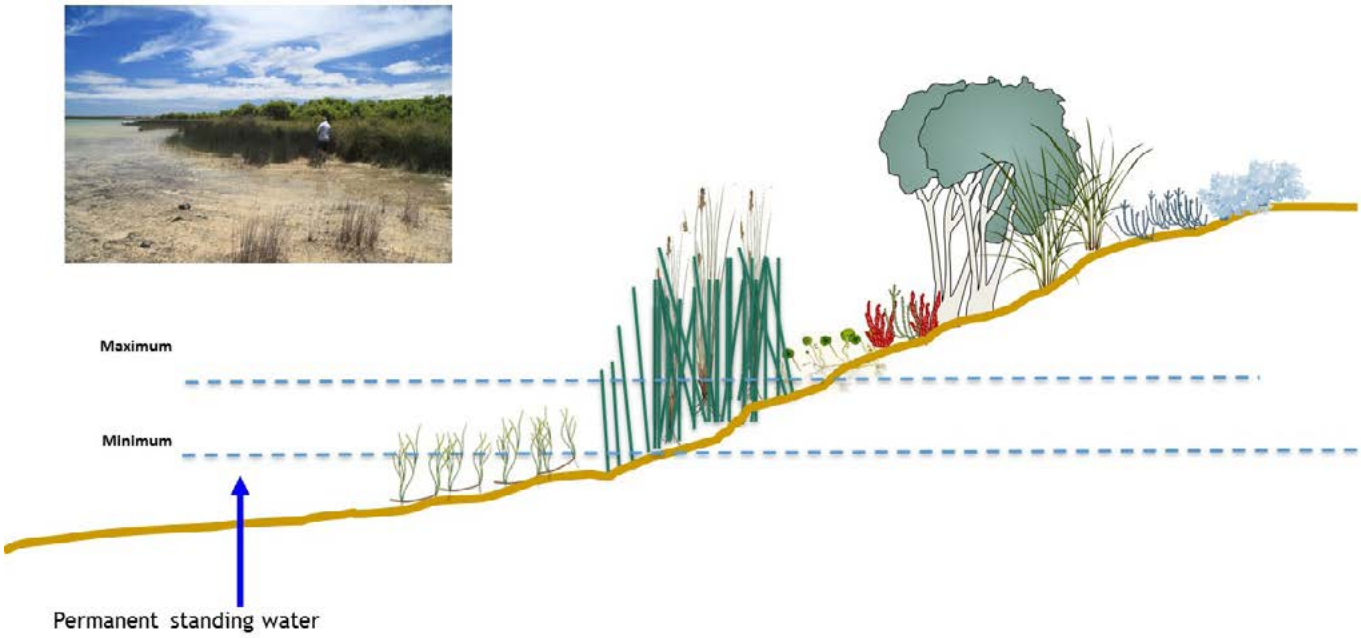


Figure 6: A permanent wetland that always contains standing water (e.g. Sleaford Mere).

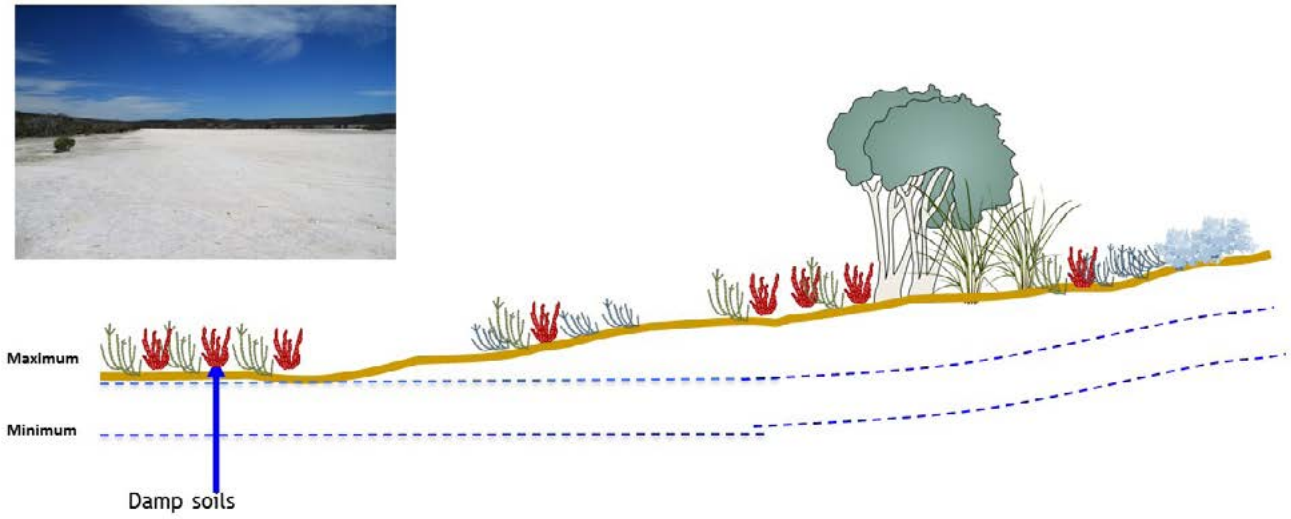


Figure 7: A dampland that only has water at or near the surface (e.g. Lake Pillie)

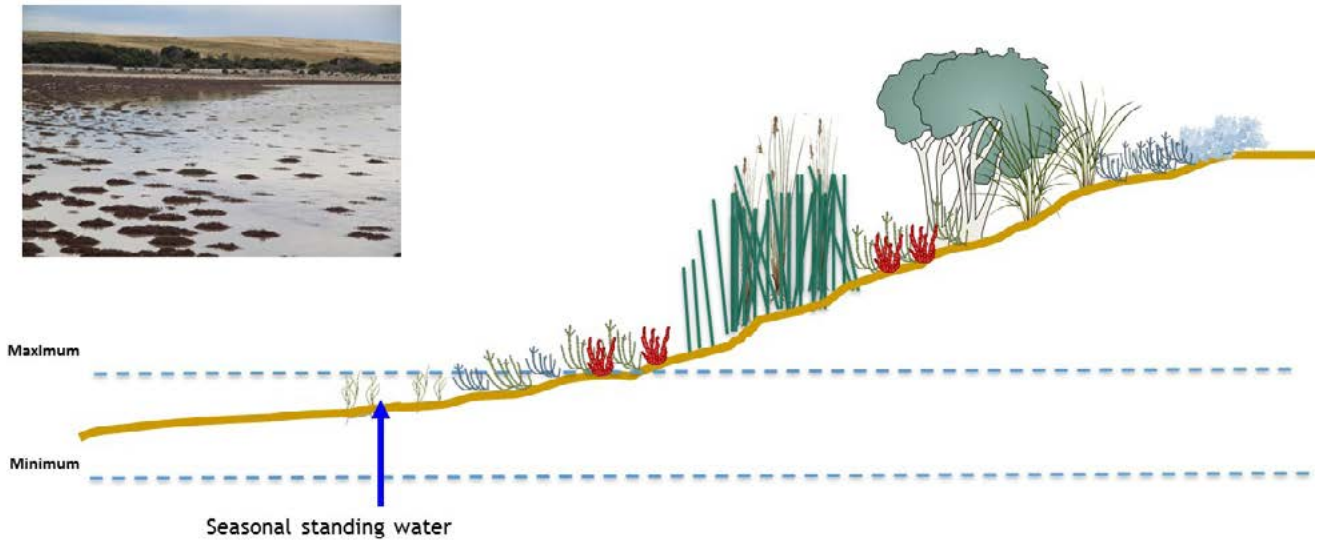


Figure 8: A seasonal wetland that only has standing water at some times of the year (e.g. Round Lake).

Figure 9: Big Swamp near Port Lincoln is not a groundwater dependent ecosystem (GDE) but rather it receives water from the surrounding catchment.

damplands and seasonal wetlands. The typical minimum and maximum levels for groundwater are also shown.

The WAP splits these wetlands into groups and provides more detail on the features of the different wetland groups (WAP Section 3.3.1).

4.1.2 Non-GDE wetlands

This section should be read with WAP Section 1.2.1: Southern Basins Prescribed Wells Area, WAP Section 2.2.3.3: Quaternary Lincoln North Management Area, WAP Section 3.3.1: Wetlands and WAP Section 4.2: Impact of Taking from One Resource on Another.

There are some wetlands within the PWAs that are not GDEs. This means that they do not depend on groundwater.

The WAP only manages groundwater and cannot protect the water they do depend on because it is surface water (e.g. run-off or watercourses) or rainfall.

Big and Little Swamps are important Australian wetlands. They receive rainfall that runs off the hills above them (catchment water), near Port Lincoln in the Southern Basins PWA (Figure 9).

A study by SKM called *Eyre Peninsula Groundwater Dependent Ecosystem Scoping Study* (2009) showed that these two wetlands were not connected to the groundwater (Quaternary aquifer). This means that the WAP cannot control water available to Big and Little Swamp but, based on community concerns, a conservative approach has been taken and environmental protection zones have been created around the (WAP Section 4.2).

4.1.3 Red gum and Water gum communities

This section should be read with WAP Section 3.3.2: Phreatophytes (especially Red Gum Forests and Woodlands).

WAP Figure 33 shows a conceptual model of phreatophytic red gum life cycle, roles of different water sources and management influences (EPZs and storage triggers).

Some of the Red gums (*Eucalyptus camalduensis*) and Water gums (*E. petiolaris*) in the PWAs depend on groundwater. Scientists call plants that depend on groundwater "phreatophtyes" (WAP Section 3). Red gums are found all over Australia but Water gums are only found on Eyre Peninsula.

Red and Water gums need more water than can be provided just by rainfall on Eyre Peninsula so they use groundwater and/or run-off to give them extra water. Little is known about Water gums water needs so the WAP assumes that their needs are the same as Red gums, which are better studied. That is, they need enough groundwater within their root zone often enough to grow and survive.

Some Red gum forests and woodlands depend on groundwater and are not near watercourses or wetlands.

Looking at the Red gums and talking with the community led to the model for the groundwater dependent Red gum life cycle on Eyre Peninsula that is in WAP Figure 33.

This model shows that these Red gums need groundwater to grow and survive. However, germination of new Red gum trees seems to depend on occasional heavy rains that cause water to pond around mature trees.

This means that the WAP cannot control the water that is needed for new trees to germinate but it can protect the groundwater that the older trees need by setting sustainable limits and using environmental protection zones (See Section 6 of this Guide).

4.1.4 Marine discharges

This section should be read with WAP Section 3.3.5: Marine Discharges.

Marine discharges are areas where groundwater comes out under the ocean or near the shore (Figure 10). To do this, the groundwater needs to be at least level with the sea and needs enough pressure to push out against the sea.

The groundwater makes the marine areas that it enters fresher than seawater, which allows wetland plants and animals to live in these areas. These areas are important for the ecology of the marine systems in which they occur.

The community have noticed less of these marine discharges over time. There are still marine discharges at Kellidie Bay, Bramfield and Tulka. These sites have been mapped and are GDEs in the WAP with environmental protection zones (EPZs) around them (Section 6 of this Guide).

4.2 Environmental Water Provisions for Environmental Assets

This section should be read with WAP Section 3.5: Assessment of Environmental Water Provisions.

Environmental water provisions (EWPs) are the parts of the water needs of GDEs that can be met by the WAP. Rainfall drives the recharge of the shallow groundwater that the GDEs depend on. The WAP can only control the taking and use of groundwater from the resources that GDEs share with people.

The WAP aims to make sure that GDEs get their share of the available groundwater by:

- keeping aside a share of the recharge for GDEs (WAP Section 5.1.1);
- actively managing the saturated Quaternary Limestone aquifer that GDEs share with people (WAP Section 6.1);
- using buffers and environmental protection zones around GDEs (WAP Sections 4.2.3 – 4.2.5);
- having considered GDEs when working out how much water was available for people to use (consumptive pool volumes; WAP Section 6.1).

By meeting these aims, the WAP will make sure the GDEs will get their share of recharge and in natural patterns driven by rainfall.

The WAP cannot protect GDEs from times of low rainfall or drought because rainfall drives recharge of the shallow groundwater they use.

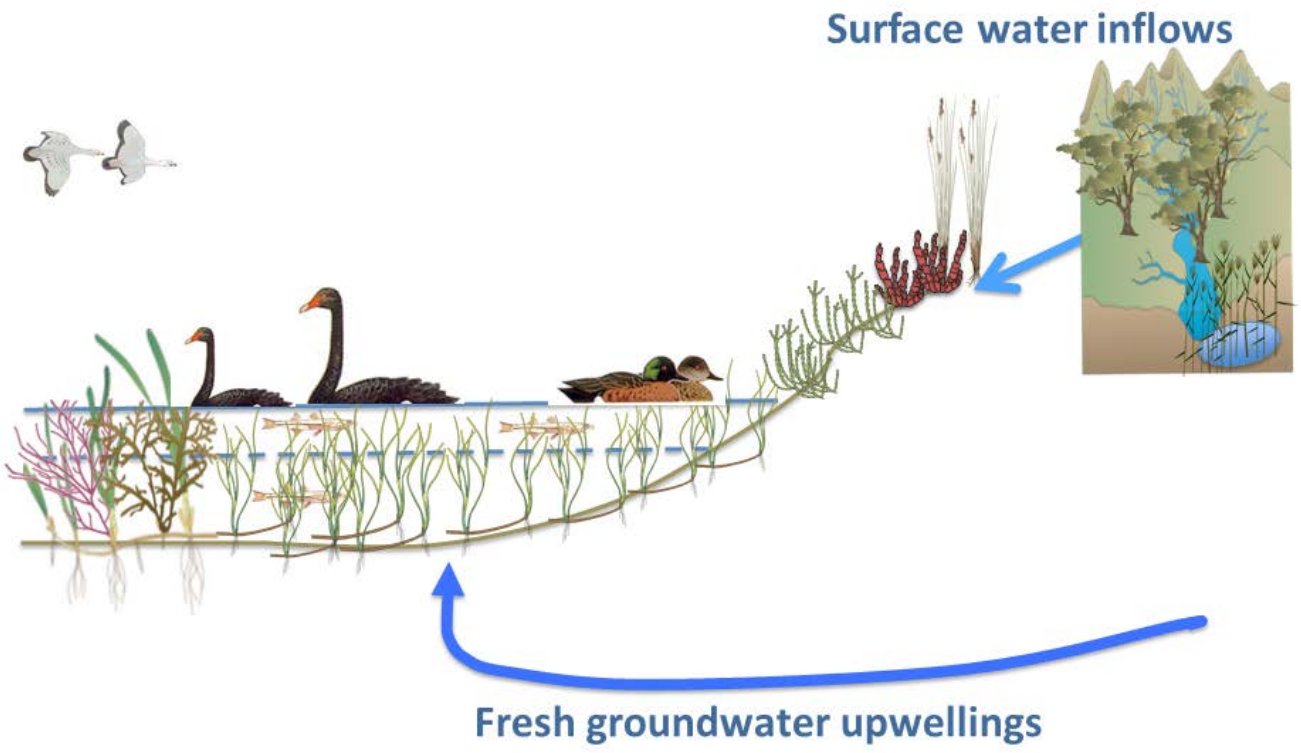


Figure 10: Marine discharges of fresh groundwater make the water less salty than the sea and allow plants and animals that prefer fresher water to live there.

5 Determining the Volume of Water Available

This section should be read with WAP Section 2: Capacity of Groundwater Resources.

5.1 Calculating the Resource Capacity

This section should be read with WAP Section 2.2: Resource Capacity of the Consumptive Pools.

The resource capacity is the upper volume of water available from the aquifer for all uses.

It is calculated for each Management Area and the portion available for consumptive use is called the Consumptive Pool.

The Consumptive Pool allows for licensed water use such as irrigation, industrial, mining, recreational and public water supply. It also includes unlicensed use like stock, domestic and other use authorised by the Minister.

The amount of water in the Consumptive Pools may be re-calculated each year. This allows for changes in the volume of water available, which is driven by rainfall recharge.

In the saturated Quaternary Limestone aquifer this is important as recharge can happen quickly and can vary year-to-year.

The resource capacity in these Management Areas is the estimated volume of recharge in 2008.

It is calculated using this formula:

Resource Capacity (ML) = Recharge Area (km2) x Recharge Rate (mm)

These terms are explained in Sections 5.1.1 and 5.1.2 below. The detailed method is shown in the Department of Environment Water and Natural Resources (DEWNR) *Technical Note Supporting Documentation for the Amendment of the Water Allocation Plan for the Southern Basins and Musgrave PWAs* (Stewart 2015) and WAP Section 2.2.1.2.

5.1.1 Determining the Recharge Rates

This section should be read with WAP Section 2.2.1.2: Recharge Rate.

Recharge rates were calculated for each recharge zone. The rates are based on the idea that groundwater levels rise due to rainfall passing the root zone of plants and entering the aquifer, thus recharging the water storage.

The recharge rate for each recharge zone was based on a range of values for specific yield, which is the amount of water going into the aquifer each year.

Water levels measured from a large number of groundwater wells were used to work out the recharge rate for 2008, which was the driest year during the Millennium Drought (2001-2009). This gives a conservative starting point for the capacity of the resource being managed by this WAP.

The Uley South fresh and brackish zones needed a different method from the other Management Areas to estimate the recharge rate.

5.1.2 Determining the Recharge Area

This section should be read with WAP Section 2.2.1.1: Recharge Zones.

Studies done in the autumn of 2011 were used to determine the water level in the saturated Quaternary Limestone aquifer reported in Science Support for the Musgrave and Southern Basins Prescribed Wells Areas Water Allocation Plan by Stewart and others (2012). Water levels are lowest at this time of year because water used, evaporated or discharged in summer has not yet been replaced by major rainfall recharge.

This gives a conservative estimate of the water level and thus, the recharge area.

Freshwater lenses vs. Brackish groundwater

The recharge zones (WAP Figures 22 and 23) show the freshwater lenses and the brackish areas of the aquifer.

Salinity tests in 2009/10 reported in *Science Support for the Musgrave and Southern Basins Prescribed Wells Areas Water Allocation Plan* by Stewart and others (2012) showed the areas of freshwater "lenses". Fresh water has less than 1 gram of salt per litre (1000mg/L). These freshwater lenses may be surrounded by brackish water that is more salty. Brackish water has many uses but is not suitable as potable (drinking) water.

The water levels were measured in a different year than the salt levels. This is acceptable because salt levels change less than, and much slower than, water levels.

In many cases (e.g. Uley South and North, Bramfield) there was only some salinity data. A conservative approach was taken so as not to overestimate the size of freshwater lenses. This means some of the brackish areas have unknown salinity.

6 Protection of Resources

This section should be read with WAP Section 4: Assessment on the Effect on Other Water Resources.

The objectives of the WAP include the protection of existing groundwater users, other water resources and groundwater dependent and other ecosystems.

6.1 Protection of the Public Water Supply

This section should be read with WAP Section 4.2.1: Protection of Public Water Supply Resources.

The WAP uses Groundwater Protection Zones (GWPZs) to protect the Quaternary Limestone aquifer Public Water Supply (PWS) management areas.

GWPZs control pumping from the deeper Tertiary Sands and Basement aquifers so that deep pumping does not make water leak downwards from the Quaternary Limestone aquifer.

GWPZs only occur on land owned by the public in PWS management areas and are not on private land. Private landholders within the PWS management areas can access the deep water in the Tertiary Sands and Basement aquifers.

6.2 Protection of the Quaternary Aquifer

This section should be read with WAP Section 4.2.2: Protecting the Saturated Quaternary Aquifer where the Tertiary Clay Aquitard is Absent.

Section 7 of the WAP provides rules for the siting of wells and the taking of water in the areas where the Tertiary clay aquitard is absent.

WAP Table 9 shows buffer distances around areas where the Tertiary clay is absent.

WAP Figures 30 and 31 show the buffer areas where the clay aquitard is absent.

Details of how the buffer zone distances have been determined are outlined on pages 48-51 of *Additional Science Support for the Eyre Peninsula Water Allocation Plan* by Stewart (2013).

The Tertiary clay aquitard is a layer of soil separating the water in the Quaternary Limestone aquifer from the deeper Tertiary Sands and Basement aquifers.

In some areas the clay layer is not present and the Quaternary aquifer may be connected to the underlying aquifers. These connections can work in two directions. Groundwater can leak downwards into deeper aquifers or can rise into more shallow aquifers.

Around these areas taking water from the deeper aquifers should be limited. This will help protect the Quaternary aquifer from downward leakage.

Buffer zones will be applied to limit new wells close to the zones where the aquitard is absent. Some areas where the Tertiary clay is absent may have other features, which separate the aquifers.

In such areas, subject to satisfying certain conditions new or additional extractions may be permitted.

6.3 Protection of Environmental Assets

6.3.1 Protection of Groundwater Dependent Wetlands

This section should be read with WAP Section 4.2.3: Protection around Wetland Groundwater Dependent Ecosystems.

WAP Figure 32 shows a conceptual diagram of how Environmental Protection Zones (EPZs) and consumptive limits protect wetland GDEs.

Groundwater flows into wetlands that are at the same level or lower in the landscape than the groundwater (WAP Figure 32a).

Wetland Groundwater Dependent Ecosystems (GDEs; Section 4 of this Guide) would be at risk if the taking and use of groundwater were unmanaged. The WAP manages this risk by managing the taking and use of groundwater.

High rates of groundwater pumping can create an area around a well where the groundwater level is lowered (a cone of depression; WAP Figure 32b). If the groundwater is lowered enough by pumping the groundwater flow can be reversed so that groundwater flows away from the wetland rather than towards it.

This can lead to changes in water levels or timing of changes in water levels in these wetlands.

If the water patterns change then the plants and animals that are able to live in and around the wetland may also change. If there are many changes in the wetlands, the whole ecology can be altered.

Environmental Protection Zones (EPZs) around GDEs will

require new wells for licensed use to be set back from Wetland GDEs in order to avoid negative impacts on the wetlands. Limits to the amount of water taken (consumption in the EPZs will also minimise the extent of cones of depression, further protecting the Wetland GDEs (Figure 32c).

6.3.2 Protection of other Wetlands

This section should be read with WAP Section 4.2.3: Protection around Wetland Groundwater Dependent Ecosystems. See also Section 4.1.2 of this Guide.

WAP Figure 32 shows a conceptual diagram of how Environmental Protection Zones (EPZs) and consumptive limits protect wetland GDEs.

Some wetlands depend on catchment water and are thought not to be connected to the Quaternary aquifer.

Big and Little Swamps are wetlands of this type. They are not considered to be GDEs because they receive catchment water from the surrounding hills (Section 4 of this Guide). It is thought that they are not adversely impacted by current groundwater extraction.

However, community consensus at WAP consultation meetings was that they should have EPZ protection as Big Swamp is listed on the register of nationally important wetlands.

The swamps and their surrounding red gums may be at risk from impacts of new groundwater extraction if allowed in areas close by or if too much groundwater is taken.

6.3.3 Protection of Red Gum Communities

This section should be read with WAP Section 4.2.4: Protection of Red Gum Communities.

WAP Figure 33 shows a conceptual model of phreatophytic red gum life cycle, roles of different water sources and management influences (EPZs and storage triggers).

Trigger levels are discussed further in Section 8.3 of this Guide and in WAP Section 6.1.1: Trigger Levels.

Some Red gums and Water gums on the Eyre Peninsula are groundwater dependent.

Managing groundwater use around these Red and Water gums is the best way for the WAP to protect them.

Therefore, Red and Water gum communities are protected by EPZs around them as well as storage triggers in relevant consumptive pools.

6.3.4 Protection of Marine Discharges

This section should be read with WAP Section 4.2.5: Protection of Marine Discharges.

WAP Table 11 shows buffer distances around identified marine discharge locations.

Figures 34 and 35 show Environmental Assets and EPZs in the Southern Basins and Musgrave PWAs respectively.

Details of the methods used to calculate EPZs can be found in WAP Section 4.2.5: Protection of Marine Discharges. This section also refers to information in two reports: *Additional Science Support for the Eyre Peninsula Water Allocation Plan* by Stewart (2013) and *Supporting Documentation for the Amendment of the Water Allocation Plan for the Southern Basins and Musgrave PWAs* by Stewart (2015).

Groundwater discharge provides fresh groundwater to estuarine systems such as Kellidie Bay and directly to the sea.

It also prevents seawater entering the aquifers.

The freshwater supports ecosystems that are different to other marine ecosystems and are at least partially dependent on groundwater discharges (see Section 4.1.4).

EPZs have been used as setback distances from the coast for new wells. This will protect marine discharges at Kellidie Bay, Tulka and Bramfield.

7 Determining the Demands on the Resource

This section should be read with WAP Section 5: Assessment of the Demands on the Resource.

Assessment of the capacity and demands for the Southern Basins and Musgrave PWAs water resources are shown in WAP Tables 20 and 21 respectively.

A key to the column headings in these tables is provided in Table 1 of this Guide.

Recharge Rate (mm)		• 2008 watertable rise for each recharge zone. • Multiplied by Area of Recharge to give Resource Capacity. • Refer to WAP Section 2.2.1.2. • Except in Uley South where the recharge rate comes from the report *Groundwater Recharge in a Topically Closed Sedimentary Aquifer: Uley South Basin, South Australia* by Ordens and others (2015).
Area of Recharge (km²)		• Area of saturated Quaternary Limestone aquifer contributing to a recharge zone. • Multiplied by Recharge Rate to give Resource Capacity. • Refer to WAP Section 2.2.1.1.
Resource Capacity (ML) (Total Demand)		• This is a fixed volume for unsaturated Quaternary Limestone, Tertiary Sands and Basement aquifers based on existing licensed volumes. • Estimated volume of water in megalitres (ML) that has recharged the saturated Quaternary Limestone aquifer over one year (2008). • Product of Recharge Rate and Recharge Area. • Equal to Total Demand (Consumptive Demand + Non-consumptive Demand).
Non-Consumptive Demand (ML [%])		• Estimated water volume in megalitres (ML) needed to maintain aquifer processes, GDEs and storage buffer. • The percentage value (%) refers to percentage of Resource Capacity for non-consumptive demand.
Consumptive Demand (ML)		• Licensed and non-licensed demands including irrigation, mining, public water supply, stock, domestic and Ministerially authorised uses. • Non-Licensed Demands + Maximum Volume of Water Available for Licensed Use.
Non-Licensed Demand	**Domestic Demands (ML)**	• Non-licensed demand for household use. • Fixed for life of WAP.
	Stock Demands (ML)	• Non-licensed demand for stock watering. • Fixed for life of WAP.
	Minister's Authorisations (ML)	• Non-licensed demand for uses such as emergency fire-fighting and public road-making. • Fixed for life of WAP.
Maximum Volume of Water Available for Licensed Use (ML)		• Maximum volume available at 100% allocation. • Equal to Consumptive Demands – Domestic Demands – Stock Demands – Ministers Authorisations
Licensed Demand (ML)*		• Volume allocated to licensed uses such as commercial irrigation, public water supply and mining. • Varies on an annual basis based on storage.
Excess Water (ML)*		• Water Available for Licensed Use that exceeds current demand.

**at the date of adoption of the WAP*

Table 1: A key to Tables 20 and 21 of the Water Allocation Plan.

7.1 Consumptive Demands

This section should be read with WAP Section 5.1.2: Consumptive Demands.

Consumptive demands include licensed and non-licensed uses.

Licensed uses include commercial irrigation, mining activities and public water supply.

Non-licensed uses include stock or domestic use and water authorised by the Minister such as that for emergency fire-fighting and public road-making.

7.1.1 Licensed demands

This section should be read with WAP Section 5.1.2.2: Licensed Demand.

Public Water Supply (PWS)

The licensed volumes for PWS were used as the PWS demands in this WAP.

In the Southern Basins PWA the use of PWS has fallen in recent years due to water restrictions, increased use of rainwater tanks and storm and wastewater re-use projects. In the Musgrave PWA, PWS allocations will differ in future years.

Irrigation/Industrial

The licensed volumes for irrigation and industrial uses were used as the demands in this WAP.

Irrigation of recreation areas is the dominant use in the Southern Basins PWA.

In the Musgrave PWA, fruit and nut tree irrigation is the main use.

Mining Industry

The licensed volumes for mining were used as the mining demands in this WAP.

These demands are from the Basement management area of the Southern Basins PWA.

7.1.2 Non-licensed demands

This section should be read with WAP Section 5.1.2.1: Non-Licensed Demand.

Stock Demands

Stock numbers on any given parcel of land are represented as Dry Sheep Equivalents (DSEs). This makes it easy to work out carrying capacity and water requirements for various types of stock.

On the Eyre Peninsula sheep are estimated to use 10L of water per sheep per day including an allowance for on-farm losses. This is equal to 7.14 L of water per DSE per day as shown in the *Eyre Peninsula Demand and Supply Statement* by the Department for Water (2011; now DEWNR).

Stock numbers in DSE and their locations in the PWAs were laid over maps of the recharge zones. This allowed the total stock water consumption for each management area or aquifer to be estimated.

Domestic Demands

The SA Geodata database records the number of wells nominated for domestic use. This number is multiplied by average household water use in order to estimate total domestic water demand.

The average use of 240kL of water per household per year is based on the amounts used before mains water use was restricted in Adelaide.

This gives a conservative estimate given that mains or rainwater are often available to supplement groundwater supplies.

Minister's Authorisations

A standard 5ML per Management Area has been set aside to meet Ministerial authorisations in the future. These uses include emergency fire-fighting and public road-building.

7.2 Non-consumptive Demands

This section should be read with WAP Section 5.1: Saturated Quaternary Limestone Management Areas, WAP Section 5.2: Unsaturated Quaternary Limestone Management Areas and WAP Section 5.3: Tertiary Sands, Basement and Quaternary Lincoln North Management Areas.

7.2.1 Saturated Quaternary Limestone Management Areas

This section should be read in conjunction with WAP Section 5.1.1: Non-Consumptive Demands.

WAP Table 17 shows the resource capacity reserved for non-consumptive and consumptive demand.

The variations to the risk assessment results are outlined in WAP Sections 5.1.1.5.1 to 5.1.1.5.3.

Non-consumptive demands include water needed to keep natural processes going. This includes maintaining groundwater flows to the sea and water required by GDEs.

Water is also needed to maintain an adequate aquifer storage buffer for periods of below average rainfall and recharge. Water table levels will drop during these periods regardless of extraction.

This is why not all of the recharge to the aquifer can be made available for consumptive use.

The percentage of recharge set aside for non-consumptive purposes is calculated for each of the saturated Quaternary Limestone Management Areas.

It is based on a risk assessment considering:

- Accessibility Risk – The risks to water users of restricting consumptive use.
- Environmental Risk – The risks to the aquifer and environment of taking water for consumptive use

This assessment makes a series of risk matrix tables that was used to set a preliminary percentage allocation of the resource capacity each to consumptive and non-consumptive demands.

The results of the risk assessment were varied in some cases to set final allocations.

7.2.2 Tertiary Sands, Basement and Quaternary Lincoln North Management Areas

This section should be read with WAP Section 5.3: Tertiary Sands, Basement and Quaternary Lincoln North Management Areas.

The non-consumptive demands for each of the management areas associated with these aquifers were unable to be determined due to limited knowledge of these aquifers.

8 Annual Allocation Calculations

This section should be read with WAP Section 6: Consumptive Pools, Water Access Entitlements and Water Allocations.

Refer also to *Science Support for the Musgrave and Southern Basins Prescribed Wells Areas Water Allocation Plan* by Stewart and others (2012) and *Additional Science Support for the Eyre Peninsula Water Allocation Plan* by Stewart (2013) for details of the methods for determining the variable component of consumptive pools, storage reference levels, trigger levels and rates of change in the proportional allocation relationship.

The Consumptive Pool is water for consumptive use, which includes licensed water use such as irrigation, industrial, mining, recreational and public water supply. It also includes unlicensed use like stock, domestic and other use authorised by the Minister.

Part of the volume of each consumptive pool is fixed from year to year. This includes the non-licensed demands such as water for stock and domestic uses and water authorised by the Minister under section 128 of the Act. These non-licensed demands are not likely to change.

The portion of the consumptive pool available for licensed uses is variable.

It is calculated annually according to trigger levels, which are key levels of storage related to aquifer sustainability.

The volume of water available for licensed uses in any given year is a percentage of the Maximum Volume of Water Available for Licensed Use (see Table 1 for description). If all the water on all the licences is available then 100% of the Maximum Volume of Water Available for Licensed Use will be allocated for that year.

8.1 The Method

This section should be read with WAP Section 6.1: Consumptive Pools for the Saturated Quaternary Limestone Aquifer.

Each water licence represents a share of the variable portion of the consumptive pool.

The share remains fixed but the volume may be reduced if the groundwater levels drop.

8.2 The Reference Level

This section should be read with WAP Section 6.1.2: Aquifer Storage Reference Level.

A reference storage level (at which storage is set to 100%) is determined for each Management Area.

The aquifer storage level in Autumn 1993 was chosen as an appropriate reference level, as aquifer levels were at their highest since the existing water level monitoring network has been in place. This ensures that monitoring data is comparable.

It is not the maximum recorded level nor the best level for sustainable use.

It is simply a baseline from which changes in storage levels can be measured and compared.

8.3 The Triggers

This section should be read with WAP Section 6.1.1: Trigger Levels.

WAP Figure 39 shows a schematic diagram of a trigger level in a typical aquifer.

WAP Figure 41 shows a schematic representation of trigger levels in a hypothetical consumptive pool.

Storage level triggers are calculated for each consumptive pool. These are based on risks to accessing groundwater and aquifer health and sustainability.

Each consumptive pool has its own triggers, which are percentages of the reference level.

They are used to allocate water each year in a way that minimises risk to the aquifer.

There are three levels of storage trigger: upper, mid and lower.

When storage levels are above the upper trigger, aquifer condition is good and 100% of the Maximum Volume Available for Licensed Use may be made available to licence holders.

When storage is between the upper and mid triggers, risk is low so the percentage of Maximum Volume which is made available may be reduced proportionally to the reduction in storage level.

Between the mid and low triggers risk is moderate and the percentage made available will be reduced more rapidly as storage levels drop.

Below the low trigger risk to the aquifer is high, and the percentage allocated will be zero.

8.4 The Proportional Relationship (for each consumptive pool)

This section should be read with WAP Section 6.1.3: Annual Variation of the Consumptive Pool Volume and WAP Section 6.1.4: Example.

WAP Table 22 shows Proportional relationship trigger levels and rates of change for the saturated Quaternary Limestone management areas.

WAP Figure 39 shows a schematic diagram of a trigger level in a typical aquifer.

Also refer Figure 41

The variable part of the consumptive pool is worked out using a relationship between aquifer storage level and risk to the resource for each Management Area.

Above the Upper Storage Trigger, allocations are 100%.

Below the Upper Storage Trigger, annual allocations drop at a rate shown by the Proportional Relationship graphs in the WAP.

Between the Upper and Mid Storage Triggers the Upper Rate of Change applies. Between the Mid and Lower Storage Triggers the Lower Rate of Change applies.

By looking at the percentage of aquifer storage level we can easily read off the portion of water available for licensed use using Figures 43 to 50 in the WAP.

9 The Annual Calculation

This section should be read with WAP Section 6: Consumptive Pools, Water Access Entitlements and Water Allocations and WAP Section 6.1.3: Annual Variation of the Consumptive Pool Volume.

Aquifer storage levels will be determined after groundwater monitoring each autumn.

These storage levels are expressed as a percentage of the reference level (100%).

The measured levels will be assessed against the Storage Trigger levels in each Management Area.

The proportional relationships will be used to work out the annual allocation (as a percentage of Maximum Water Available for Licensed Use) for the following water use year beginning July 1st.

10 Unbundled Water Rights

This section should be read with WAP Section 6: Consumptive pools, Water access entitlements and Water allocations and WAP Section 7.2: The Management of the Use of Water.

Under the old licencing system, there was just one piece of paper that showed the volume of water and any associated rights and approvals. Amendments to NRM Act 2004 allow for unbundling of water rights from 1 July 2009.

Unbundled water rights means that there are now multiple pieces of paper associated with water licences that show different authorisations (Figure 11):

1. **Water Access Entitlement** (Water licence) – ongoing right to a specified share of the resource (unit shares). This can be sold or transferred permanently or for a limited time;
2. **Water Allocation** – actual volume of water that can be taken in a given water use year. This volume may vary from year to year depending on how much water is available;
3. **Water Resources Work Approval** – permission to construct, operate and maintain works (such as a pump, meter, well or dam) in a particular location in a particular way. This is not transferable.
4. **Site Use Approval** – permission to use the water in a particular location in a particular way. This is not transferable. This is not required in the Southern Basins or Musgrave PWAs.

The benefits of unbundling include:

- Faster trading of licences
- Faster processing times making licence trading more flexible
- Opportunity to plan ahead
- Certainty for business development

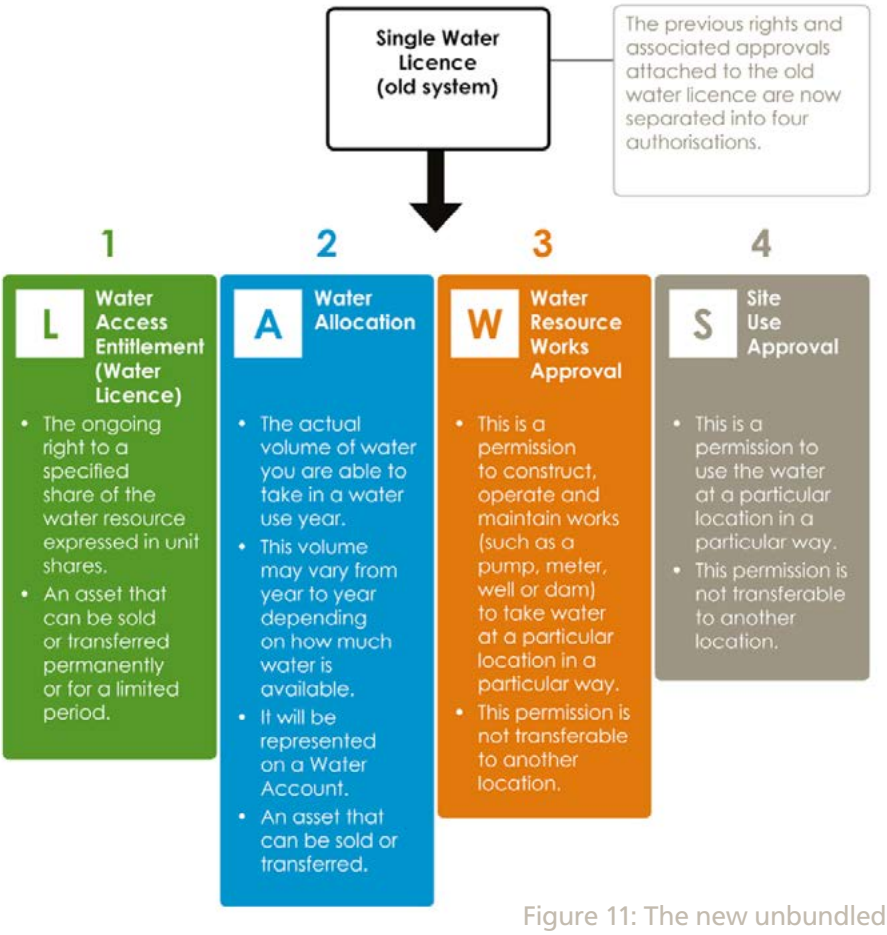


Figure 11: The new unbundled water licensing system.

11 Principles in the WAP

This section should be read with specific parts of WAP Sections 6 and 7, as shown for each set of principles below.

Principles 1-11 should be read with WAP Section 6.3: Consumptive Pools.

Principle 1: talks about how consumptive pools are determined.

Principle 2: talks about how the volume of the Saturated Quaternary Limestone consumptive pools will vary annually.

Principle 3: talks about the fixed volumes of the unsaturated Quaternary Limestone, Tertiary Sands, Basement and Quaternary Lincoln North consumptive pools.

Principles 4a to 4o: talk about the 15 consumptive pools and how each is defined.

Principle 5: talks about how additional consumptive pools may be determined.

Principle 6: talks about using scientific means to assess the risk of taking water from additional consumptive pools (for the purposes of Principle 5).

Principle 7: talks about how a low level of risk to environmental objectives will be defined (for the purposes of Principle 6).

Principle 8: talks about how the Minister will publish details of additional consumptive pools.

Principle 9: talks about how the Minister will issue new water access entitlements for additional consumptive pools.

Principle 10: talks about how water being drained or discharged via a well into the groundwater for storage and recovery will be considered as additional consumptive pools (in accordance with Principle 5).

Principle 11: talks about how water access entitlements relating to Principle 10 will be determined.

Principles 12-17 should be read with WAP Section 6.4: Water Access Entitlements.

Principle 12: talks about how the Minister may grant a water licence, which provides a water access entitlement.

Principle 13: talks about how a water access entitlement is a share of the water available for licensed use, expressed as units.

Principle 14: talks about how water access entitlements cannot be transferred or varied across consumptive pools.

Principle 15: talks about how the Minister may grant water licences for mining or petroleum leases or licences.

Principle 16: talks about the licensing stages for mining or petroleum leases or licences, that is, exploration needs one water licence whilst production needs a separate water licence under Principle 15.

Principle 17: talks about water licence expiry under Principle 15.

Principles 18-22 should be read with WAP Section 6.5: Transition Arrangements from Previous Plan.

Principle 18: talks about water access entitlements being expressed as units.

Principle 19: talks about "maximum volume of water available for licensed use" as units.

Principle 20: talks about the water access entitlements of current water licence holders (granted under previous Plan).

Principle 21: talks about how unallocated water is defined as excess water.

Principle 22: talks about how the Minister may issue a water access entitlement in relation to excess water.

Principles 23-25 should be read with WAP Section 6.7: Notices to be Published in *The South Australian Government Gazette*.

Principle 23: talks about how the Minister will publish annual storage levels and consumptive pool volumes on or about 1 June each year.

Principle 24: talks about how the Minister will notify of details of additional consumptive pools.

Principle 25: talks about how the Minister will notify of annual allocations and unit share values.

Principles 26-29 should be read with WAP Section 6.8: Transfers.

Principle 26: talks about transfers of water licences and water access entitlements.

Principle 27: talks about conditions on transfers under Principle 26.

Principle 28: talks about time periods for transfers of water allocations.

Principle 29: talks about conditions on transfers under Principle 28.

Principles 30-33 should be read with WAP Section 7.1.2: Location a Well.

Principle 30: talks about where new wells must not be located.

Principle 31: talks about the definition of an existing operational production well.

Principle 32: talks about when Principle 30 does not apply.

Principle 33: talks about situations when Principle 30 may not apply in addition to the exemptions listed in Principle 32.

Principles 34-36 should be read with WAP Section 7.1.3: Taking Water from a Well.

Principle 34: talks about when a water resource works approval is required before water can be taken from a well.

Principle 35: talks about when an annual water use report may be required and what the report may include.

Principle 36: talks about conditions in Principle 35 being additional to those conditions on a water resources works approval issued under Principle 43.

Principles 37-40 should be read with WAP Section 7.1.4: Draining or Discharging Water into a Well.

Principle 37: talks about water that is drained or discharged into a well under section 127(3)(c) of the Act.

Principle 38: talks about the granting of a permit to drain or discharge water into a well.

Principle 39: talks about when Principle 38 does not apply.

Principle 40: talks about draining or discharging water sourced from a different aquifer to the receiving aquifer.

Principle 41 should be read with WAP Section 7.1.5: Conversion of a Mineral Well to a Water Well.

Principle 41: talks about conversion of a mineral well to a water well.

Principle 42 should be read with WAP Section 7.2: The Management of the Use of Water.

Principle 42: talks about how site use approvals are not required to manage the use of water taken with a water allocation.

Principle 43 should be read with WAP Section 7.3: Transitional Provisions.

Principle 43: talks about transitional provisions for the holder of a current water licence granted under the previous Plan.

12 Monitoring

This section should be read with WAP Section 8: Monitoring and Evaluation as well as the *Monitoring, Evaluation, Reporting and Improvement (MERI) Plan for the Southern Basins & Musgrave Prescribed Wells Areas WAP* (2016).

The Monitoring, Evaluation, Reporting and Improvement (MERI) Plan aims to measure and assess data that is important for understanding the hydrogeology of the region, environmental assets and water use. The MERI Plan also aims to assess how well the WAP is working and if it meets its objectives.

The following questions will be used for the assessment:

- To what extent has the WAP been effective in allocating groundwater extraction for consumptive purposes?
- To what extent has monitoring of compliance with conditions on water licences, water resources works approvals and permits been effective in managing groundwater resources?
- To what extent has the WAP been effective in managing groundwater use within sustainable levels?
- To what extent has the WAP been effective in minimising the risk of seawater intrusion?
- To what extent has the WAP been effective in minimising the risks to groundwater salinity?
- To what extent has the WAP been effective in minimizing the impact of authorised groundwater extraction on other groundwater resources (adjacent or overlying), GDEs and existing users of groundwater?
- To what extent has the WAP been effective in meeting the community's expectations?

If the resource declines over time, studies may be needed to work out why the resource has declined and what can be done about it.

Under the NRM Act, the Board must review the WAP at least once every ten years. The MERI Plan is a living document that may be updated at any time.

13 Where to find more information

The website of Natural Resources, Eyre Peninsula
www.naturalresources.sa.gov.au/eyrepeninsula

The website of Department of Environment,
Water and Natural Resources
www.environment.sa.gov.au

14 Supporting documents

Department for Water (2011). *Eyre Peninsula Demand and Supply Statement,* Department for Water, Government of South Australia.

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