

Water Allocation Plan

For the Far North Prescribed Wells Area

South Australian Arid Lands Landscape Board



FEBRUARY 2021

Water Allocation Plan

for the

Far North Prescribed Wells Area

I, David Speirs, Minister for Environment and Water,
hereby adopt this Water Allocation Plan pursuant to section 56 (2) (a)
of the *Landscape South Australia Act 2019*.



David Speirs

Minister for Environment and Water

Date: 28th February 2021

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1 INTRODUCTION

1.1 Background to the Water Allocation Plan

This document is the amended *Water Allocation Plan for the Far North Prescribed Wells Area* (this Plan) and supersedes the Water Allocation Plan for the Far North Prescribed Wells Area (SAALNRMB 2009). It has been prepared pursuant to the *Landscape South Australia Act 2019* (the Landscape Act) and is consistent with the objects and requirements of the Landscape Act.



This Plan has been produced using the *Intergovernmental Agreement on a National Water Initiative* (NWI) (COAG 2004) as a guiding document. The NWI is an agreement signed by all state and territory governments (with the exception of Western Australia and Tasmania) and the Australian Government. It provides for a nationally compatible market, regulatory and planning based system of managing surface and groundwater resources for rural and urban use that optimises economic, social and environmental outcomes.

The agreed outcomes and commitments to specific actions of the NWI by signatory States are set out on the basis of the following key elements:

- i) Water Access Entitlements and Planning Framework;
- ii) Water Markets and Trading;
- iii) Best Practice Water Pricing;
- iv) Integrated Management of Water for Environmental and Other Public Benefit Outcomes;
- v) Water Resource Accounting;
- vi) Urban Water Reform;
- vii) Knowledge and Capacity Building; and
- viii) Community Partnerships and Adjustment.

The NWI therefore provides principles which relate to matters such as the need for science-based water planning, adaptive management of the resource, open engagement with communities, secure water rights for consumptive purposes, and the provision of environmental water requirements which are managed through this Plan.

This Plan is a statutory document that provides for:

- management of water property rights through a legally robust water licensing regime,
- protection of existing user's ability to maintain access to water,
- protection of water dependent ecosystems and sites of cultural significance dependent on the water resource, and
- management of the taking and use of water for current and future users of the resource and the transfer of water rights between users where applicable.

Further, this Plan has been developed using the *Great Artesian Basin Strategic Management Plan* (GAB SMP) as a guiding document. The GAB SMP (Australian Government 2020) was used to assist in setting the objectives and principles in this Plan to deliver consistent water management objective with other states who manage the water resources of the basin.

This Plan is therefore consistent with the seven guiding principles in the GAB SMP, that have been developed by basin governments and community and industry representatives to achieve economic, environmental, cultural and social outcomes, those being:

- 1) coordinated governance,
- 2) a healthy resource,
- 3) Aboriginal and Torres Strait Islander values, cultural heritage and other community values,
- 4) secure and managed access,
- 5) judicious use of groundwater,
- 6) information, knowledge and understanding for management, and
- 7) communicate and educate.

The agreed principles capture the collective values and objectives for future management of the basin and have guided the development of this Plan's desired outcomes.

This Plan aims to achieve judicious use of water with an equitable balance between the economic, social and environmental needs for water and also sets out rules for those water affecting activities that are in addition to those contained in the South Australian Arid Lands Landscape Board's Water Affecting Activities Control Policy. These extra controls on water affecting activities apply only to the prescribed groundwater resources covered by this Plan. It does not encompass the management of the take and use of surface water or water in watercourses as these resources are not prescribed within this region.

The Board will comprehensively review this Plan at least once within 10 years of the date of adoption¹. The review will consider the success of the principles in achieving the objectives of the Plan and will provide an assessment of whether the Plan remains appropriate or requires amendment. The Board may also review the Plan at any time to align the Plan with the new information or respond to emerging issues, and where appropriate, amend the Plan to incorporate the new information and/or to address the issues.

¹ Section 54(1) of the Landscape Act

1.2 History of Groundwater Management

In the Far North Prescribed Wells Area (PWA), groundwater is the principal source of water for commercial, irrigation, industrial, town water supply, domestic, bore-fed wetlands, watering stock, petroleum and mining production purposes. The surface expression of groundwater, for example springs, continues to support traditional Aboriginal cultural values, as well as more recent cultural values from European settlement.

Pursuant to the *Water Resources Act 1997*, the wells in the Far North PWA were declared as prescribed wells on 27 March 2003 as a means of encouraging responsible use of groundwater. Subsequently a water allocation plan (the previous Plan) was developed for the Far North PWA, pursuant to the *Natural Resources Management Act 2004* (NRM Act), to regulate the taking of water from wells and to facilitate the broader management of the groundwater resources. The previous Plan aimed to eliminate wasteful practices (such as requiring water for stock and/or domestic purposes to be delivered through a water-tight delivery system within 10 years of the Plans adoption), stabilise the decreasing groundwater pressures in the Great Artesian Basin (GAB), clarify the rights and responsibilities of users of the groundwater in this region and ensure the health of ecosystems dependent on the prescribed resources. With respect to the latter point, such ecosystems specifically referred to as the 'community of native species dependent on natural discharge of groundwater from the Great Artesian Basin' are identified as endangered on the list of threatened ecological communities under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and therefore require protections from the taking of groundwater from within the Far North PWA. The previous Plan was adopted on 16 February 2009. The then South Australian Arid Lands Natural Resources Management Board (SAALNRMB) reviewed the previous Plan and made the decision to amend it in line with the provisions in the NRM Act and subsequently, the Landscape Act.

1.3 Economic, Social and Cultural Information

The Great Artesian Basin (GAB) is Australia's largest underground water resource, underlying approximately 1.7 million km², or 22% of the Australian continent (Habermehl 1980). It is also one of the world's largest and deepest artesian basins, with measured water temperatures ranging from 30 to above 100 degrees Celsius.

The GAB provides the only reliable source of fresh water through much of inland eastern and central Australia. It has been vital in sustaining Aboriginal people over thousands of years, has important cultural, environmental and heritage values, and for more than 100 years, it has sustained much of the pastoral and community needs living in a fifth of Australia's landmass. The first artesian bore was drilled in the GAB in the late 1870s and since then groundwater has been instrumental in the economic and social wellbeing of the pastoral and town people who live in the Basin (Australian Government 2020).

The Far North PWA is vast and sparsely populated. Much of the land is leasehold and utilised for pastoral production, mining, gas and petroleum production, with the potential for irrigation of crops in suitable areas, or via approval by the Pastoral Board to irrigate on pastoral leases. Maintaining the social infrastructure, industries and ecology in this area is vital to South Australia. The GAB is the life blood of many communities, landholders and industries, and it supports diverse natural ecosystems and cultural values that have national and international significance. It provides most of the groundwater supplies in the Far North PWA, with minor supplies provided by other aquifers. The active participation of water users and other community interests has always been an essential part of managing use of the GAB to sustain water supplies and protect community values. It is one of the few major artesian basins in the world that has not been severely over exploited (Australian Government 2020).

The first people to make use of GAB water were First Nations for whom it was critical to survival. There are a number of native title claims and determinations over the area and there is evidence that water from the GAB sustained Aboriginal people for thousands of years prior to European settlement. The natural springs of the GAB provided a critical source of fresh water, and supported valuable food sources including birds, mammals, reptiles, crustaceans and insects, creating an abundant hunting ground for First Nations. The plants and trees around the artesian springs were used for food, medicine, materials and shelter. The springs provided semi-permanent oases in the desert and supported trade and travel routes which evolved around them. Ceremonies and other events were held at spring wetland areas which remain precious cultural and sacred sites. Numerous Creation stories feature a connection to groundwater. Many people from these nations live in the area and continue to care for their country.

1.4 The Prescribed Area

The Far North PWA covers an area of approximately 315 000 km² (32% of the State) in the north east corner of South Australia and lies within the unincorporated areas of South Australia, with the exception of Coober Pedy. The main townships, settlements and the smaller service centres located on arterial roads near or through the South Australian Arid Lands region within the PWA are displayed in [Figure 1.1](#). Additionally, Santos Ltd maintains a large oil and gas processing plant and camp at Moomba, however this is a restricted company settlement which excludes public access.

The Far North PWA is located in the South Australian Arid Lands (SAAL) Landscape Region which takes its name from the distinctive arid landscapes that cover the north of the State. There are few reliable permanent fresh surface water resources within the arid lands, with a number of salt lakes scattered across the landscape. Sandy and gibber stone deserts dominate the Far North PWA, with the Gawler Ranges and the Flinders Ranges located south of the PWA.

Rainfall is generally less than 250 mm per year, with measured average annual rainfall ranging across the Far North PWA from 153 mm/year (McDouall Peak, weather station 16027) to 234 mm/y (Marla Police Station, weather station 16085) (BoM 2018). However, rainfall in the arid areas of the State is unpredictable and consequently, averages can be misleading. Rainfall occurrence can be sporadic; sometimes the region may go without significant rainfall for years, while the intensity of rainfall can be highly variable with a single event capable of delivering average annual totals. Rainfall is predominantly generated from weak winter cold fronts and can vary significantly from year to year and location to location. Average potential annual evaporation can be around 3500 mm, resulting in the rapid evaporation of accumulated surface water. As such rainfall cannot be relied upon as a secure source of water to meet the demand of the communities which reside within the PWA.

1.5 Hydrogeology

The groundwater resources of the Far North PWA are found within:

- the shallow Quaternary and Tertiary sedimentary aquifers, including the Lake Eyre Basin,
- the Jurassic to Cretaceous sediments of the Great Artesian Basin (GAB) aquifers,
- the underlying Permo-Carboniferous to Early Triassic sediments of the Cooper, Arckaringa and Pedirka basins, and
- the crystalline fractured rock aquifer of pre-Permocarboniferous (basement) strata.

The GAB provides most of the groundwater supplies in the Far North PWA, although there is also significant groundwater extraction from other aquifers including the Arckaringa and Lake Eyre basins. In addition, minor volumes of water are extracted from the Cooper basin.

Within the Far North PWA, the aquifer units within the GAB of primary importance are the Cadna-owie Formation and Algebuckina Sandstone (and other lateral stratigraphic equivalents). As a single unit, they are described as the Jurassic-Cretaceous (J-K) aquifer with the acronym “J-K” derived from the abbreviations for the Jurassic and Cretaceous geological periods. The GAB refers to both a stratigraphic and hydrogeological entity which is synonymous with the Eromanga Basin within South Australia. The majority of wells completed in the GAB (J-K) aquifer within the Far North PWA are non-artesian wells.

The hydrogeology of the PWA is displayed and described in [Appendix A – Hydrostratigraphy of the Far North Prescribed Wells Area](#), [Figure A.1](#) and [Figure A.2](#) and [Table A.1](#), [Table A.2](#) and [Table A.3](#). More detailed information on the hydrogeology of the Far North PWA can be found in the following documents:

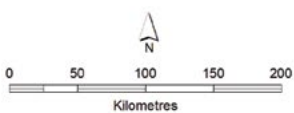
- [Hydrogeological Framework of the Western Great Artesian Basin \(Keppel *et al.* 2013\)](#)
- [Hydrostratigraphy, hydrogeology and system conceptualisation of the Great Artesian Basin \(Ransley and Smerdon 2012\)](#)
- [Water Resource Assessment for the Great Artesian Basin \(Smerdon *et al.* 2012\)](#)
- [Arckaringa Basin and Pedirka Basin Groundwater Assessment Projects \(Wohling *et al.* 2013\)](#)
- [Lake Eyre Basin Bioregional Assessment Reports \(Australian Government 2018\)](#)
- [Far North PWA Groundwater Level and Salinity Status Report \(DFW 2011\)](#)
- [Far North Prescribed Wells Area Groundwater Model \(in preparation\) \(DEW 2020a\)](#)

FIGURE 1.1.

Location of the Far North PWA



- Locations
- Rainfall Station (station number)
- Road
- ▭ Far North Prescribed Wells Area
- ▭ SAAL Landscape Region



Produced by: Water Group
 Department for Environment and Water
 Map Datum: Geocentric Datum of Australia 1994
 Date: May 2020



J:\GIS\Workspace\SA\AridLands\SustainableLandscapes\SustainableIndustries\Water\WAP\msd\Figure1_1_location.mxd

1.6 Impacts of Climate Change

Rainfall projections (Goyder Institute for Water Research 2020) for the combined previous Alinytjara Wilurara and South Australian Arid Lands Natural Resources Management regions indicate predicted reductions in average annual rainfall of around 58% by 2030 (compared with 1986-2005 rainfall) and reductions of around 10% by 2050 (again compared with 1986-2005 rainfall). This is an update of the data produced by Gibbs *et al.* in their 2012 report on the Impacts of Climate Change on Water Resources within the SAAL region, which predicted reductions in average annual rainfall of around 56% in a 2030 climate with either high or low emissions scenarios, and reductions of up to 15% in a 2070 climate with a high-emission scenario. Additionally, the frequency of large, recharge-generating rainfall events (months with greater than 100 mm of rainfall), particularly in the north of the region, were projected to decrease by 21% under a low-emissions scenario for 2030 and by 47% under a high-emissions scenario for 2070. The rainfall projections for a given location, such as Maree, Innamincka or Oodnadatta may be different to these reductions for the region as a whole, but they are unlikely to indicate a future rainfall increase.

The reduced rainfall may impact on the water availability in the shallow unconfined aquifers as local rainfall is the key recharge mechanism for many of these aquifers. Recharge to the GAB aquifer however, occurred a long time ago, with groundwater ages in the central portion of the basin (near the SA-QLD border) being up to 2 million years old (Herczeg 2008), therefore the projected reductions in rainfall outlined above are unlikely to impact directly upon recharge to the confined groundwater resources within the PWA. However, the projected rainfall decline means that as time goes on there will likely be more years when surface water availability is diminished and therefore reliance on, and demand for, groundwater may increase to meet demand. Diminishing surface water availability is likely to increase demand for water from pastoral watering points by native and feral animals. Contrastingly, diminished surface water availability will likely also result in a diminished food supply, which may result in less stock being carried on a pastoral lease and hence result in a reduction of water demand.

Further, the Goyder Institute projections indicate predicted increases in average annual maximum temperatures of up to 1.3°C by 2030 (compared with 1986-2005 temperatures) and by up to 2.1°C by 2050 (compared with 1986-2005 temperatures). Increased temperatures and increased frequency and duration of heatwaves are likely to result in increased water demand from the stock and domestic water use sectors to appropriately respond to human safety and wellbeing and animal welfare (Bastin *et al.* 2014).

Gibbs *et al.* (2012) also considered the likely impacts on evapotranspiration under a changing climate and identified that the projected increases in potential evapotranspiration are relatively small. For even the high emissions scenario in a 2070 climate only a 4% increase in annual potential evapotranspiration and a 5% increase in summer potential evapotranspiration results. Given average annual potential evapotranspiration is over 10 times greater than average annual rainfall within the PWA, this small increase in potential evapotranspiration is likely to have a limited effect on the regions surface water systems.

The changes in rainfall, temperatures and evapotranspiration are likely to result in greater fluctuation in stocking rates due to the changed availability of water and feed. Further, sustained periods of hotter weather will require increased robustness in stock water supply, for example: additional water points may be required so that water supply is closer to available forage; undertaking repairs following well failure will become time critical to avoid the risk of stock perishing or being exposed to conditions that threaten their welfare and production; and having a drought preparedness plan, with regard to destocking following a failure of sufficient summer rainfall, will be necessary (Bastin *et al.* 2014).

A changing climate may result in alternative uses of groundwater in order to offer economic diversification opportunities, particularly for pastoralists (if authorised by the Pastoral Board to use the land for a purpose other than pastoralism²) in drier times when stock or feed numbers reduce, for example, irrigation of arid horticulture crops (such as dates or pistachios) or fodder.

2 Section 22(1)(b)(iii) of the *Pastoral Land Management and Conservation Act 1989*

1.7 Management Approach

The management approach adopted by this Plan must take into account the unique characteristics of the groundwater resources within the Far North PWA. Therefore, this Plan contains principles which allows for water to be taken only from locations where the take of water would not cause unacceptable impacts³. Taking water from the Far North PWA will only be authorised if the proposed location of take for licensed purposes is deemed not to cause an unacceptable impact upon pressure levels within the GAB aquifer maintaining springs, upon the flow of groundwater toward sites of cultural significance or other ecological sites, or upon an existing user's ability to access water.

This means that there will not be a set limit to the volume of water which can be licensed from the Far North PWA as is the case in many of the other prescribed areas across the State. The poorly understood parameters of the aquifers over the extensive area of the Far North PWA, makes volumetrically quantifying the large storage capacity of the SA portion of the GAB and other aquifers of the water resource difficult. Current estimates of the capacity of the J-K aquifer in the South Australian portion alone are in excess of 7 million GL (DEW 2020a). Understanding the volume, conditions and processes that maintain groundwater pressure levels that sustain artesian flows will ensure that the management regime will maintain flows to groundwater dependent ecosystems and sites of cultural significance while maintaining existing user's ability to access water. Given the nature of the aquifers of the Far North PWA, it is reasonable that new allocations be granted to provide for the taking of water for licensed purposes, as long as it does not detrimentally impact on the capacity of the groundwater resource to continue to meet the water requirements of the environment and the existing users.

Excessive water extraction in an area may have unacceptable impacts on the water pressure or levels within an aquifer. This may impact on the water balance and result in effecting an existing user's ability to access water or reduce natural discharges to sites of cultural or ecological significance. Changes to groundwater pressures and natural flow directions may result, which would affect groundwater flow gradients toward the GAB springs. Such gradients are important in maintaining functional ecological communities and refugia within the landscape.

3 See [Glossary](#)

Applicants need to be aware that the granting of a water licence does not result in an ability to take the water. The approval to take water is the issuance of a water resource works approval and this is dependent on meeting the specific criteria in relation to the location of take, outlined in [section 7](#) of this Plan. The limit to the volume of groundwater that can be extracted for licensed purposes from the Far North PWA is governed by the location of the take of water. An approval to take water must meet the principles in [section 7](#) of this Plan and a water access entitlement cannot be issued without a water resource works approval authorising the location of take.

The absence of a specified volumetric limit to water take for licensed purposes, does not mean that the resources of the Far North PWA are infinite. Rather, particularly for the GAB, recent investigations (Love *et al.* 2013, Ransley and Smerdon 2012 and Welsh *et al.* 2012) indicate that the groundwater pressures are in a state of natural decline, albeit over very long timescales, due to discharges from the resource, both natural and anthropogenic, exceeding the recharge to the system. Even if humans were not extracting water, the volume of water and water pressure in the GAB would continue to fall, albeit at a very slow rate. The extraction of water for stock, mining, petroleum and other purposes has increased the speed of this decline. However, applying a volumetric limit to the volume of water which can be taken from the resource would not halt this gradual decline, but would halt any further sustainable economic development of the resource. As such, managing the resource by the likely impacts the taking of water would have, rather than through an arbitrary volumetric limitation, is a more pragmatic approach to management for this unique resource. Additionally, this Plan seeks to encourage actions which ensure judicious use of water by all water users, to protect key environmental and cultural assets and maximise economic opportunities within the Far North PWA.

1.8 Water for People, Industries and the Environment

The management approach adopted by this plan must take into account the needs and values of all water users and the unique characteristics of the Far North PWA. The GAB and the overlying shallow aquifers are the only reliable sources of water for almost all human activity in the Far North PWA. Providing access to sustainable water supplies for the industries, pastoralists and other residents and visitors to the Far North is essential to the prosperity of South Australia.

GAB water supports the mining, petroleum, pastoralism, irrigation and tourism industries which collectively are worth more than \$3 billion/year (Frontier Economics 2016, DEM 2019). The high value industries dependent on GAB water in SA include:

- stock (pastoral and intensive)- \$105 million annually,
- mining- \$2.8 billion annually,
- petroleum production- \$1.2 billion annually, and
- tourism at GAB springs and areas using artesian water in mineral spas. The tourism value for the entire Flinders Ranges and Outback region, which includes the GAB springs was approximately \$462 million in 2018 (SATC 2019).

While not financially quantified, the GAB springs have not only environmental value, but also cultural and social value. Brake *et al.* 2020 discusses the value of GAB springs and provides a GAB Springs Adaptive Management Template to assist in maintaining the value of springs by providing a decision framework for assessing the risks to the springs and thereby determine appropriate management actions to address those risks.

Significant public and private funds have been invested in developing and protecting the GAB water resource to support and sustain its economic, social and environmental values. Pastoralists and other residents in the Far North PWA have traditionally provided critical human and land management services across these more remote parts of the State, and the outback community continues in this role today (Yelland and Brake 2006).

1.9 Objectives

This Plan aims to achieve the following objectives:

- Provide security of access to water for current and future users of the resource.
- Ensure that the taking of water for licensed purposes is undertaken in a manner that provides for the long-term viability of the water resource.
- Support Aboriginal people's water interests through the provision of access to the water resource.
- Recognise and incorporate the traditional knowledge of Aboriginal people in the management of the take and use of water from the groundwater resource.
- Ensure the placement of a well will not damage, disturb or interfere with any site of cultural significance.
- Authorise the taking of water, for equitable economic and social development within resource management limits and sustainable environmental limits.
- Ensure that the authorised taking of water does not unacceptably impact upon:
 - the ability of current licence holders to access groundwater,
 - other water resources (adjacent, underlying or overlying water resources), and
 - GAB springs and refuge non-spring groundwater dependent ecosystems.

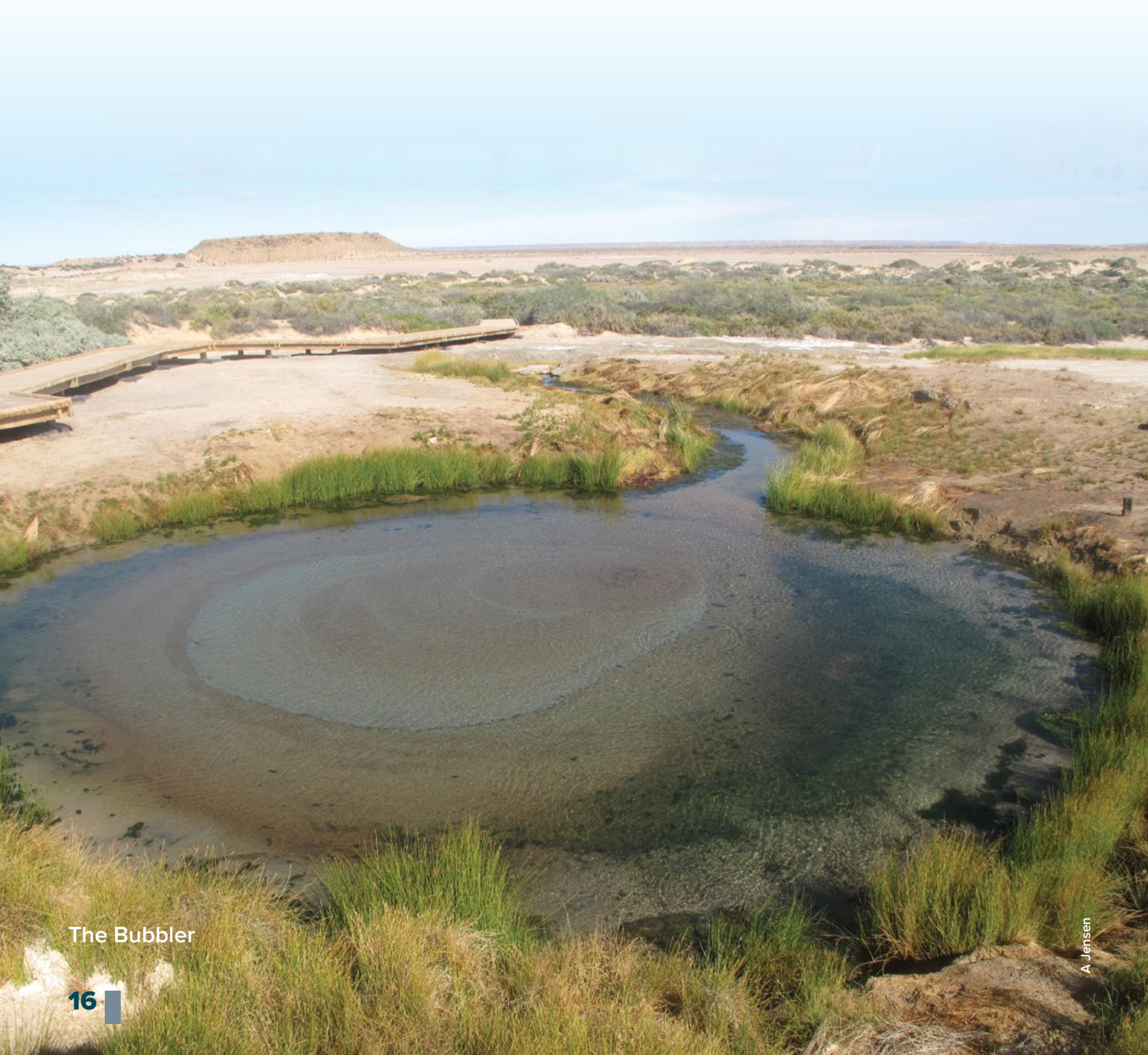
1.10 Data Locations

A number of Geographical Information Systems (GIS) shapefiles/layers are referred to throughout this document to enable the assessment of an application against the principles outlined in [sections 6](#) and [7](#) of this Plan. These layers will be updated as required throughout the life of this Plan and as such the figures used in this Plan should be considered indicative only, with the latest data publicly available on [NatureMaps](#) for consideration by applicants:

- Far North Prescribed Wells Area (the boundary within which wells situated in the Far North PWA, and wells drilled in that area after the commencement of the regulations published in the South Australian Government Gazette on 27 March 2003 page 1249, are declared to be prescribed (GRO Plan No 593/2001)).
- Far North PWA GAB Springs (springs which are either fully or partially supported by water from the GAB aquifer and identified in the South Australian SA_Geodata Database GAB springs dataset)
- Far North PWA Zone A (5km buffer around the Far North PWA GAB Springs)
- Far North PWA Zone B (45km buffer around the Far North PWA Zone A)
- Far North PWA Refuge Non-Spring GDEs (non-spring GDEs identified to be at risk due to the taking of water and considered refuges within the landscape)
- Far North PWA Environmental Buffer (100m buffer around the Far North PWA Refuge Non-Spring GDEs)
- Far North PWA Existing Users (wells authorised for the taking of water on a valid water resource works approval). Data in this layer may require verification of the Department and should be considered accurate at a point in time only.

2 ASSESSMENT OF THE WATER NEEDS OF GROUNDWATER DEPENDENT ECOSYSTEMS

The arid zone of South Australia is one of the driest locations in Australia. It does, however, contain a diverse and dynamic range of ecosystems and land types, including wetlands that have been isolated by desertification of the surrounding environment over the past 25 million years (Krieg 2000).



Surface water from floods and in watercourses is ephemeral (not always present) and thus groundwater is the only reliable water source for the ecosystems that depend on it as well as the people inhabiting the region. Wetland species that were once widespread during wetter climatic periods are now restricted to isolated areas where their water needs can be met; this makes them vulnerable to impacts from groundwater development. There are a number of ecosystems in the Far North PWA that are considered to be Groundwater Dependent Ecosystems (GDEs). This means that they require access to groundwater, on a permanent or intermittent basis, to meet all or some of the water needed to maintain their community of plants and animals, and the ecological processes and ecosystem services they provide. The Landscape Act requires this Plan to assess the water needs of these GDEs and include information about water that is to be set aside for the environment.

This Plan identifies two distinct types of GDEs:

- 1) 'Springs' that depend on the GAB or other aquifers; and
- 2) 'Non-spring GDEs' which are GDEs that are not springs but which have been identified by this Plan to be features or locations within the landscape which have a high probability of groundwater connection in the Far North PWA.

The dependence of the springs and the non-spring GDEs on groundwater is described in further detail in Appendix B in terms of their 'environmental water requirements' (EWRs). Risks to these environmental assets from extracting water will be managed through the policies and principles described in [sections 6](#) and [7](#) of this Plan.

Terrestrial fauna that drink from groundwater, such as migratory and wetland birds, can be considered receptors of the GDE types identified above. For the purposes of this Plan it is assumed that their water needs will be met by providing water to the GDEs listed below, and as such are not specifically considered in this Plan.

2.1 Springs

Springs are important ecological features of the arid zone providing permanent habitats for aquatic flora and fauna (e.g. fish) that need standing water, and a reliable source of water for visiting fauna. These habitats are like isolated islands where species that depend on a continuous flow of groundwater for their existence have evolved independently of each other (Harris 1981). The springs have great environmental, cultural, social and tourism value. The ecological communities associated with these springs, especially those dependent on the GAB (J-K) aquifer, are rich in species that do not live anywhere else (endemic). The presence of permanent freshwater in arid environments, and this high level of uniqueness of the plants and animals that inhabit them, gives the springs an ecological importance much greater than would be expected from their small area (Harris 1992).

The Great Artesian Basin Springs (GAB Springs) are a key focus of management of this Plan. A number of State and National policy documents refer to their protection, for example The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin are listed as endangered on the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) List of Threatened Ecological Communities. This listing means that the communities of native species dependent on the GAB Springs are considered a Matter of National Environmental Significance for which the highest level of protection from threatening processes are afforded. They are amongst the most important groundwater dependent ecosystems in Australia and are considered to be ecological and evolutionary ‘hot spots’ (Gotch *et al.* 2008; Murphy *et al.* 2009; Fensham *et al.* 2010; Murphy *et al.* 2010; Hale and Brooks 2011, NWC 2013). It is important to note that some springs in the Far North PWA, for example, Tarlton Spring, are fed by aquifers other than the GAB or may only be partially supported by GAB aquifers.

2.1.1 Locations of Springs in the PWA

In the Far North PWA there are more than 170 spring groups containing an estimated 5000-6000 vents (NWC 2013). Since the adoption of the previous Plan, additional GAB springs and springs supported by other aquifers (both partially and fully) have been identified. The GAB springs occur mostly around the margin of the GAB and are clustered into 13 major regional spring supergroups (NWC 2013). Springs dependent on other aquifers are scattered throughout the PWA. As information on the GAB springs within the Far North PWA is likely to grow and change throughout the life of this Plan, the springs identified in the South Australian SA_Geodata database (those which are assumed to be partially or fully supported by water from GAB aquifer), as amended from time to time, is considered the point of truth at any point in time. At the date of adoption of this Plan, the GAB springs identified in the South Australian SA_Geodata database are displayed in **Figure 2.1**. The layer identified as “Far North PWA GAB Springs” on NatureMaps is the publicly available exact replicate of the springs in the South Australian SA_Geodata database.

2.1.2 Environmental Water Requirements (EWRs) of Springs

For the entire year, sufficient groundwater pressure and volume is required to maintain an open spring vent and over the long term needs to maintain the spatial extent of the associated spring tail wetland, allowing for seasonal and multi-year fluctuations.

2.1.3 Environmental Water Provisions (EWPs) of Springs

Environmental water provisions are those portions of the EWRs (presented above) that can be met at any given time by controlling the levels and/or locations of groundwater extraction through water allocation policies and principles ([sections 6 and 7](#)).

The GAB and partially GAB fed springs rely on artesian pressure for the provision of their water needs. Therefore, it is essential that this pressure and hydraulic gradient is maintained at a level that provides a continuous flow of groundwater at rates required to maintain the ecological value of the springs, whilst allowing sustainable extractions for consumptive purposes.

The principles in [section 7](#) of this Plan reflect the importance of managing the take of water from the resource in a manner which does not result in a decline in groundwater pressures or levels that would adversely impact on groundwater discharge to the springs.

This Plan employs the use of buffer zones around GAB and partially GAB fed springs (Zone A – 5 km from a spring, and Zone B – 5 to 50 km from a spring, [Figure 2.1](#)) within which specific principles outlining the acceptable change in water pressure applies to the taking of water ([sections 6 and 7](#)).

Zone A is carried over from the previous Plan, formerly known as the spring exclusion zone, which is based on the Deglee equation. The equation assumes that when taking water from within Zone B, a 0.5 m cumulative drawdown in water pressure at the boundary of Zone A (5 km from a GAB spring) would result in no material decline in water levels/pressures at the spring itself. Any cumulative decline in water pressure which exceeds this threshold is likely to impact on the water pressures required to sustain spring flow and is therefore likely to impact upon the spring itself and the ecology dependent on it. The cumulative decline in water pressure is measured in relation to February 2009, the starting date of the previous Plan.

Zone B replaces the south west spring zone in the previous Plan. The existing south west spring zone was a fixed boundary and was therefore unable to adapt when new information either identified new springs or found that existing springs were not fed by the GAB, the result being that there was a presence of springs either near the margin or outside of the south west spring zone. Consequently the southwest spring zone has been replaced with a zone which can be applied to all springs equally without the need to redefine a static boundary constantly. The 50 km distance was chosen because it roughly approximated the area covered by the south west spring zone.

The previous Plan had a volumetric limit to the water which could be allocated within the south west spring zone, this Plan removes the volumetric limitation in relation to Zone B, however new water can not be issued unless it can be proven that the drawdown limitation of 0.5 m at the boundary of Zone A will not be exceeded.

These principles do not apply to existing users, unless the user is applying to increase the volume of water they wish to take from within these buffer zones, or change the location of take to a well which is located within the buffer zone, where the well is accessing the GAB.

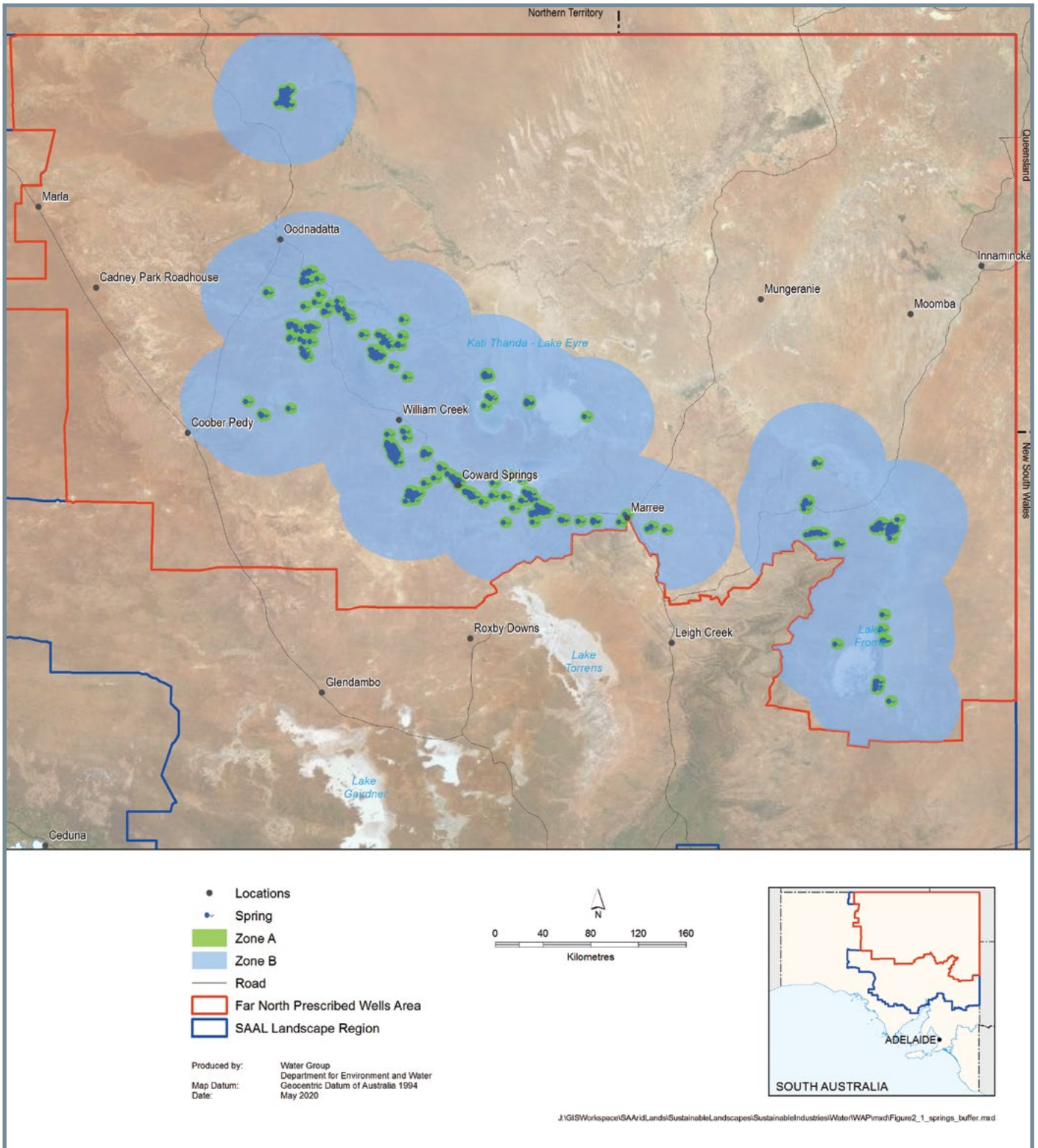
It should be noted however, that the transitional provisions in [section 7.9](#) of this Plan may result in the issuance of site use approvals to existing users, in relation to priority springs, to ensure that the taking of water by stock directly from the spring will not disturb the processes or structures required to maintain the ecological functionality of these springs.

Priority springs will be identified through the implementation of this Plan, with site use approvals being issued in a staged approach which may include consideration of the following factors:

- the spring has particular significance to First Nations people;
- the spring has other cultural significance (e.g. associated with early European exploration and settlement);
- the spring contains species or ecological communities of particular conservation significance (e.g. State or National significance);
- the spring has geomorphological features of particular significance or interest;
- is a spring group or complex that is large and diverse enough to rank as arid lands refugia;
- the spring has particular importance by virtue of being part of a larger spring group;
- the spring has been disturbed but has a good potential to recover.

FIGURE 2.1

Location of the GAB springs, Zone A and Zone B in the Far North PWA



2.2 Non-spring GDEs

Recent studies (Scholz and Deane 2010, Mancini 2013, Gotch 2013, Hooper and Miles 2015, Hobbs *et al.* 2018) have identified important GDEs or features within the landscape which have a high probability of groundwater connection, other than springs, that were not considered in the previous Plan but are considered for protection measures in this Plan, including:

- Diffuse discharge areas: areas where groundwater expressed to the soil surface supports wetland plants;
- Wetlands: areas of permanent or periodic/intermittent inundation that support wetland plants and rely on groundwater inflows (some or all of the time) as a critical component of their water regime;
- Refuge waterholes: significant regional refuge areas of deep, permanent standing water that rely on groundwater inflows (some or all of the time) to maintain their water quality and minimum levels, especially during cease-to-flow periods. In the PWA, this refers to large, permanent waterholes such as Cullyamurra and Algebuckina;
- Riparian vegetation: vegetation alongside some watercourses and wetlands that relies on shallow groundwater, some or all of the time, but especially in between river flows or floods;
- Phreatophytic vegetation: deep-rooted vegetation that relies on shallow aquifers, or the unsaturated soil above them, for some or all of their water needs; and
- Salt lakes: groundwater dependency is primarily driven by discharge from shallow aquifers but there may also be upward leakage from the deeper GAB aquifers into some salt lakes. Examples include Lake Eyre (South and North)/*Kati Thanda* and Lake Frome, which support a number of endemic terrestrial invertebrates.

Despite specific investigations and assessments undertaken in recent years there are believed to be many individual non-spring GDEs in the Far North PWA which have not been surveyed in detail. As further studies are undertaken on non-spring GDEs within the prescribed area, more information on the environmental water requirements will become available.

2.2.1 Locations of non-spring GDEs in the PWA

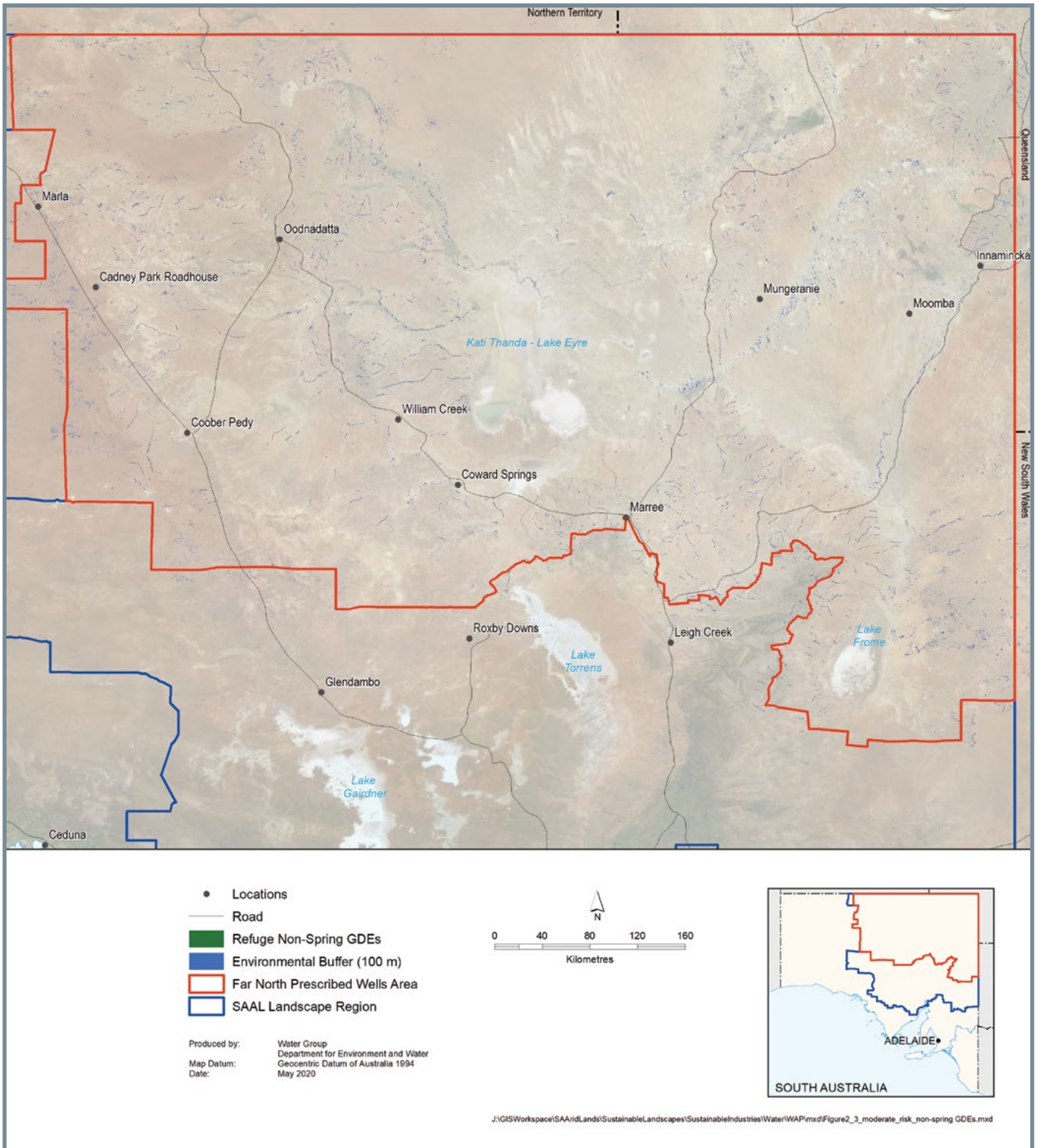
While the types of GDEs listed above exist in many places within the Far North PWA ([Figure B.2](#)), there are locations where it is considered likely that the taking of shallow groundwater in close proximity to these features has the potential to impact upon these GDEs. Of these features, those which have been identified as refuges within the landscape (<5 ha area within a 5 km radius) known as Refuge Non-Spring GDEs, are the non-spring GDEs which have been afforded protection measures under this Plan ([Figure 2.2](#)). These locations are generally difficult to visualise on [Figure 2.2](#) given their small size for the area, however an example of the Innamincka area can be seen in [Figure B.3](#) and the layer is available on NatureMaps for site specific detail.

2.2.2 Environmental Water Requirements of non-spring GDEs

To maintain the groundwater components of the overall water and salinity regime within the range that the GDEs' ecological communities and species need or can successfully adapt to.

FIGURE 2.2

Location of refuge non-spring GDEs and the 100 m environmental buffer in the Far North PWA



2.2.3 Environmental Water Provisions (EWPs) of refuge non-spring GDEs

Environmental water provisions are those portions of the EWRs (presented above) that can be met at any given time by controlling the levels and/or locations of groundwater extraction through water allocation policies and principles ([sections 6](#) and [7](#)).

Non-spring GDEs could be placed at unacceptable levels of risk if unmanaged groundwater extraction occurs close to a GDE, as it may generate a localised reduction in groundwater level that could reverse the groundwater flow direction or reduce flows and thus deprive the GDE of sufficient water to meet its environmental water needs (Gotch 2013).

Excessive groundwater extraction that results in significant drawdown of groundwater levels is therefore, a primary threat to the provision of a non-spring GDE's environmental water requirements. The principles in [section 7](#) of this Plan reflect the importance of managing the take of water from the resource in a manner which does not result in a decline in groundwater pressures or levels that would adversely impact on groundwater discharge to the non-spring GDEs.

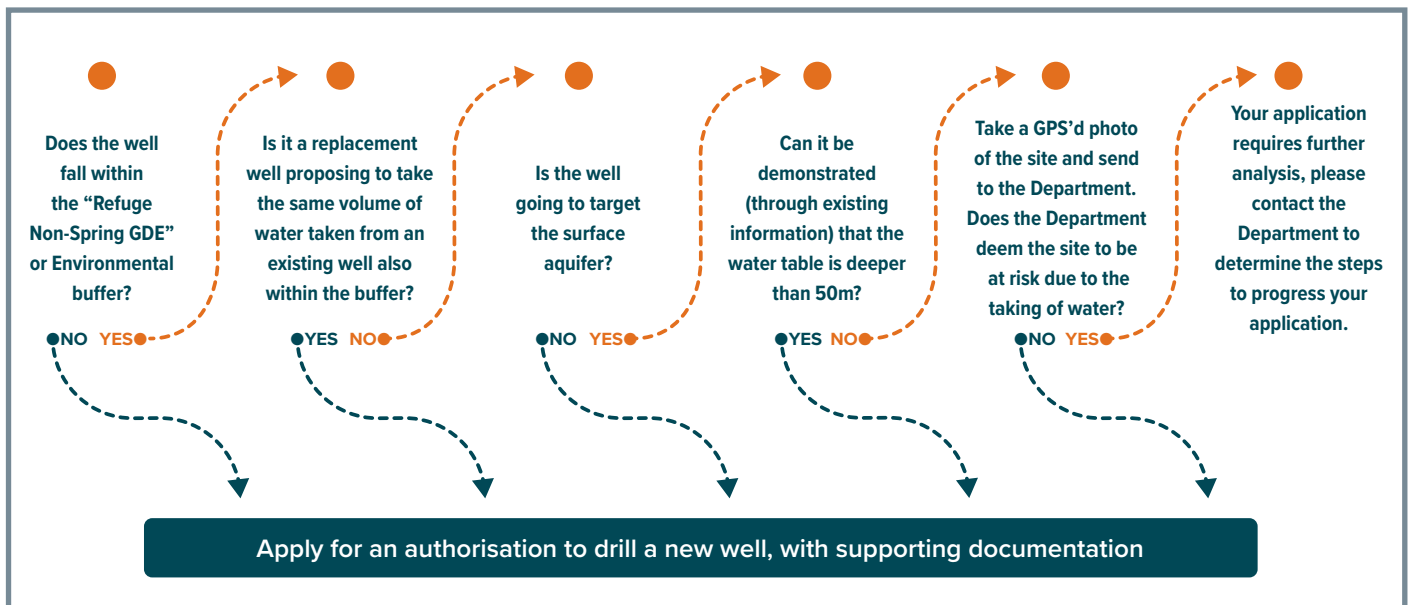
The Department for Environment and Water (DEW) (2020b) completed a risk assessment to determine which types of non-spring GDEs were likely to be impacted upon due to the taking of shallow groundwater. Further, DEW identified which of these GDEs would be considered refuges within the landscape for fauna. These are the non-spring GDEs which have been afforded protection measures under this Plan (see Appendix B – Assessment of the Water Needs of Groundwater Dependent Ecosystems: Environmental Water Requirements and Provisions). Information on the locations of refuge non-spring GDEs which are likely to be impacted upon by the taking of shallow groundwater within the Far North PWA is likely to grow and change throughout the life of this Plan through further scientific investigations or through input from landholders. As such, the non-spring GDEs identified in the Department's Far North PWA Refuge Non-Spring GDE Database, as amended from time to time, is considered the point of truth of the refuge non-spring GDEs which are protected by the use of management controls through this Plan, at any point in time. At the date of adoption of this Plan, the refuge non-spring GDEs identified in the Far North PWA Refuge Non-Spring GDE Database are displayed in [Figure 2.2](#). The layer identified as "Far North PWA Refuge Non-Spring GDEs" on NatureMaps is the publicly available exact replicate of the refuge non-spring GDEs identified in the Department's database.

This Plan utilises a 100 meter environmental buffer around the refuge non-spring GDEs identified in the Far North PWA Refuge Non-Spring GDE Database (Figure 2.2) within which specific principles apply to the drilling of new wells (section 7). These principles do not apply to existing users, unless the user is applying to drill a new well within these buffer zones.

The following flow chart (Figure 2.3) should be consulted by applicants when considering where to drill a new well with regards to the Refuge Non-Spring GDEs or the associated 100 m environmental buffer.

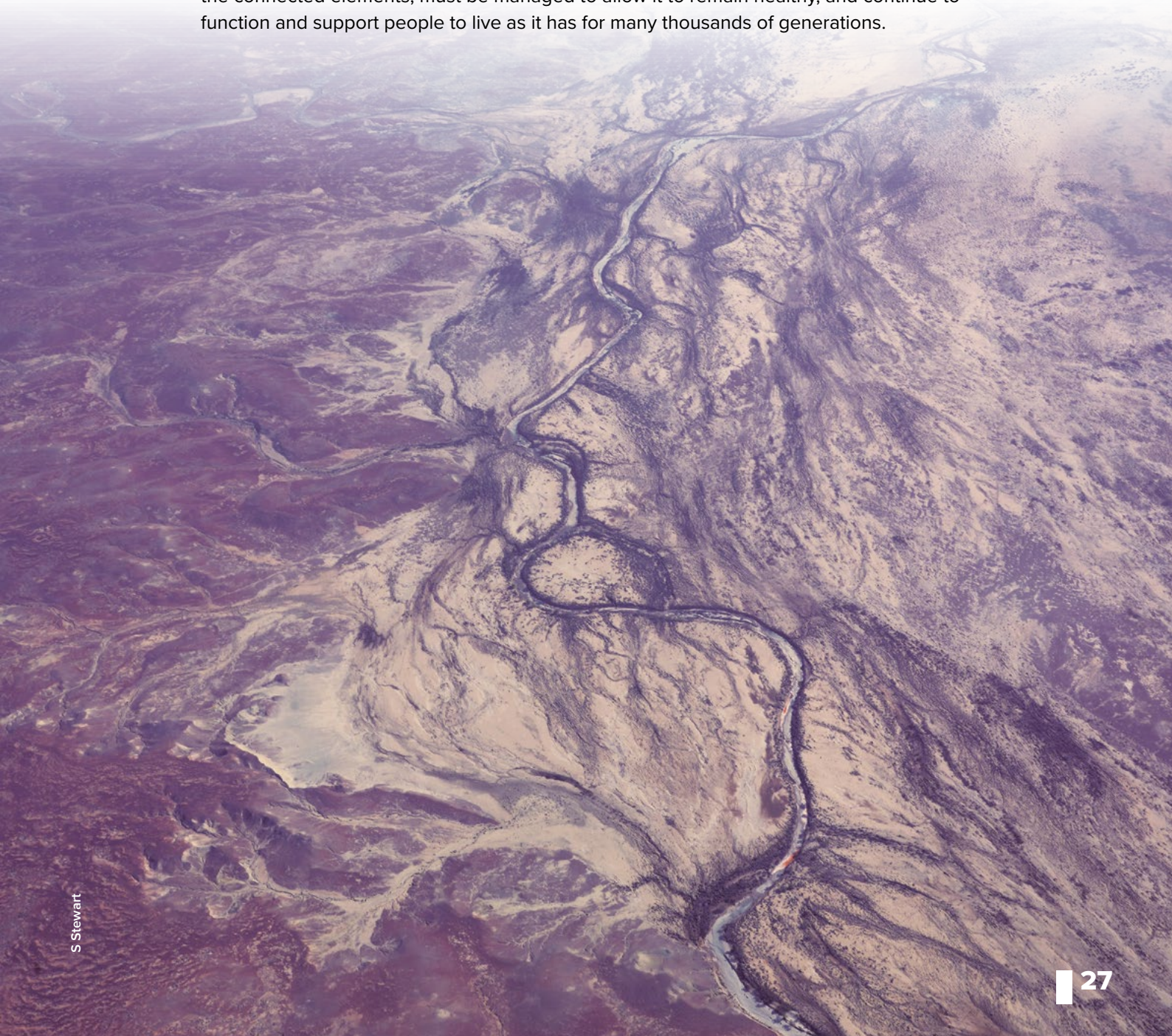
FIGURE 2.3

Flow chart to be considered when drilling a new well within 100 m of a refuge non-spring GDE



3 ASSESSMENT OF THE WATER NEEDS OF ABORIGINAL PEOPLE

Aboriginal connection to the Far North area is expressed through creation stories (cultural and spiritual histories) about the Country. These stories reveal the significance of the relationship between the Country and the people, both practically and spiritually. For Aboriginal nations, water is life – it provides life to everyone and everything that ever lived, and everyone and everything that ever will live. In this way, water is the lifeblood of the landscape and is intimately connected to all the other elements of the landscape, supporting spiritual, cultural, environmental, social and economic life. Water, and all of the connected elements, must be managed to allow it to remain healthy, and continue to function and support people to live as it has for many thousands of generations.



The springs of the Lake Eyre region have particular cultural importance to Aboriginal people. Numerous stories and song lines are associated with different springs and it is essential that the cultural values of the landscape are protected for all future generations of Australians.

The Landscape Act requires that a water allocation plan must, when allocating water, “take into account the present and future needs of the occupiers of land...”⁴ where an occupier includes a person “who is entitled to use the land as the holder of native title in the land”⁵. Native title has been determined to exist over the majority of land within the Far North PWA under the *Native Title Act 1993*. The native title rights and interests which exist include the right to access, use and enjoy the land within the Far North PWA.

A ‘native title holder’ is defined as ‘the person or persons who hold, or claim to hold, the native title in relation to the lands and waters according to their traditional laws and customs’⁶. Areas with native title determinations applicable at the date of adoption of this Plan are shown in [Figure 3.1](#). The native title areas are managed through the Registered Native Title Body Corporates as listed.

The present and future needs for water by native title holders and nations which have not claimed title, must therefore be taken into account when allocating water.

In relation to the assessment of the water needs of Aboriginal People, the objectives of this Plan aim to:

- Support the water interests of Aboriginal people through the provision of access to the water resource.
- Recognise and incorporate the traditional knowledge of Aboriginal people in the management of the take and use of water from the groundwater resource.
- Ensure the taking of water from a particular location will not damage, disturb or interfere with any site of cultural significance.

The NWI demonstrates a commitment by states and territories to include Aboriginal representation and incorporate Aboriginal social, spiritual and customary objectives and values in water planning, and take account of the existence of native title rights to water (COAG 2004).

Recognising the social, spiritual and customary objectives and values of Aboriginal people in water planning has been limited to date, with the exception of the SA Murray-Darling Basin. There is, however, recognition of the need to work in partnership with Aboriginal Nations to better understand the water landscape and apply the cultural knowledge learnt over thousands of years to the management of water as a resource. This approach takes time. Therefore, this version of the Far North WAP does not identify or quantify current and future Aboriginal water needs. Instead, the drafting process of this Plan was used to start conversations with Nations to begin to understand cultural objectives for the prescribed water resource.

4 Section 53(1)(e) of the [Landscape Act](#)

5 Section 3 of the [Landscape Act](#)

6 As per definition in the [Notice of Authorisation to Take Water for Native Title Purposes](#) in The South Australian Government Gazette published 13 September 2012, page 4437

3.1 Supporting the Water Interests of Aboriginal People Through the Provision of Access to the Water Resource

In consultation with the Aboriginal people of the Far North PWA, the following preliminary objectives in relation to the provision of access to the water resource were identified:

- 1) an ability to take water in the future for any purpose;
- 2) an ability to take water for amenities at sites of cultural significance to encourage more Aboriginal people to visit these sites; and
- 3) an ability to take water for the maintenance of cultural sites including the springs (including not taking the water but leaving the water in the ground to assist in preserving these sites for cultural purposes).

This Plan contributes to meeting these objectives as follows:

1. **An ability to take water in the future for any purpose** – The ability to take water for economic development may be met through the principles outlined in [sections 6](#) and [7](#) of this Plan. The taking of water by Aboriginal people for economic/commercial purposes is subject to the same requirements as any other prospective licensee, these being:
 - issuance of a water access entitlement, authorising access to a portion of the resource,
 - issuance of a permit to authorise the drilling and construction of a water well, and
 - issuance of a water resource works approval, which enables the water access entitlement and corresponding allocation to be taken from a specified well or wells within the prescribed area.

It is acknowledged that while Aboriginal people have the same rights to take water for economic/commercial purposes as other prospective licensees, there are still barriers for Nations in achieving economic/commercial water use. While this Plan is an enabler for water related business, continued conversations with Nations to both clarify barriers and consider options to reduce these barriers is necessary to aid in progressing Aboriginal economic/commercial use of the water resources in the area.

2. **An ability to take water for amenities at sites of cultural significance to ensure more Aboriginal people will visit these sites** – Pursuant to section 105 of the Landscape Act, a notice of authorisation to take water for native title purposes was published in the South Australian Government Gazette on 13 September 2012, page 4437. This authorisation allows for *“the taking of water from any prescribed watercourse, lake or well, or surface water prescribed area within the State of South Australia by a person who is a native title holder in relation to the land or waters on or in which that watercourse, lake, well, or surface water prescribed area is situated and the taking is for the purpose of satisfying that person’s personal, domestic, cultural, spiritual or non-commercial communal needs where they are doing so in the exercise or enjoyment of their native title rights and interests, providing that the taking does not involve stopping, impeding or diverting the flow of water for the purpose of collecting the water or diverting the flow of water from a watercourse.”*

Native title holders therefore have the right to take and use water within a particular area in relation to satisfying their personal, domestic, cultural, spiritual or non-commercial communal water needs. Given the importance of access to water for cultural purposes, including the use of water for this purpose by Aboriginal people who are not native title holders, this Plan authorises the use of groundwater through the creation of a Cultural Water Consumptive Pool. Water from this pool is authorised to be used for the purpose of satisfying an Aboriginal person’s personal, domestic, cultural, spiritual or non-commercial communal needs where they are doing so in the exercise or enjoyment of their cultural interests. Water licences are not required to be issued in relation to this consumptive pool, rather the Cultural Water Consumptive Pool acknowledges the inherent right of Aboriginal people to have access to water to continue to practice culture upon Country.

If the intention is to access groundwater via a well in order to supply water for amenities such as toilets at the ceremonial site, the principles in [sections 6](#) and [7](#) of this Plan are relevant as they manage the location and construction specifications for drilling a well. Other legislation, such as the *Planning, Infrastructure and Development Act 2016* or the *Pastoral Land Management and Conservation Act 1989*, may be applicable in providing for the permits to undertake construction of the amenities.

In order to take water for these purposes, the following is required:

- a water access entitlement, which provides a right to a portion of the resource,
- a permit to authorise the drilling and construction of a water well; and
- a water resource works approval, which enables the water access entitlement and corresponding allocation to be taken from a specified well or wells within the prescribed area.

Depending on the volume of water being used and the purpose of use, this water may be defined under the Landscape Act as being utilised for a domestic purpose, that being the taking of water which 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*
- (ab) without limiting paragraph (a)—taking water for the purpose of watering or irrigating more than 0.4 of a hectare of land; or*
- (b) taking water to be used in carrying on a business (except for the personal use of persons employed in the business)*

Under the Landscape Act, water for domestic purposes is exempt from being charged a levy⁷.

3. **An ability to take water for the maintenance of cultural sites including the springs (including not taking the water but leaving the water in the ground to assist in preserving these sites for cultural purposes)** – This objective relates to maintaining the current groundwater dependent sites of cultural significance within the landscape. The overarching objectives of this Plan aim to minimise the impact of the taking of water on the groundwater pressure levels required to maintain the GAB springs and Refuge Non-Spring GDEs, whilst ensuring that the taking of water will not damage, disturb or interfere with any site of cultural significance. As such, an entitlement for the purposes of maintaining groundwater flow to these sites is not required as the principles in [sections 6](#) and [7](#) of this Plan specify that water cannot be taken from the resource if it will result in unacceptable changes to the groundwater pressures which maintain these sites.

⁷ Section 76(14) of the [Landscape Act](#)

3.2 Recognising and Incorporating the Traditional Knowledge of Aboriginal People in the Management of the Take and Use of Water from the Groundwater Resource

Incorporating the traditional knowledge of Aboriginal people in the management of the take and use of water from the groundwater resource is integral in achieving successful water planning outcomes. Collaboration with Aboriginal people in the Far North PWA in relation to water management will take time and whilst the drafting of this Plan commenced conversations with Nations there is still significant work to be undertaken to truly incorporate the traditional knowledge of Aboriginal people in the water planning framework. While these conversations continue, it is imperative that Aboriginal voices are heard in the decision making process for the placement of new wells and for the taking of water from wells which may compromise the cultural significance of particular sites.

3.3 Ensuring the Taking of Water will not Damage, Disturb or Interfere with any Site of Cultural Significance

There is an opportunity for Aboriginal input into the decision making process in relation to where new wells can be drilled. In order to ensure that Aboriginal sites of cultural significance are respected and protected, an application for a well construction permit by any applicant within the Far North PWA requires consideration whether the taking of water is likely to damage, disturb or interfere with any site of cultural significance.

In line with existing practices, in instances where a permit falls within an area where a native title determination exists, or native title has not been extinguished, the Department refers the application to the relevant native title holder (for example the Registered Native Title Body Corporate or the South Australian Native Title Service⁸) to provide the opportunity for comment. The relevant native title holder has 60 days to respond to the request (principle 45). In cases where an Indigenous Land Use Agreement⁹ (ILUA) exists which refers to matters relating to water, this will be consulted prior to referring the application.

If a culturally significant site is identified, engagement with the relevant Aboriginal community is required to determine if the taking of water is likely to damage, disturb or interfere with the culturally significant site.

Further, principles [32](#) and [50](#) of this Plan require Aboriginal input into the decision making process where an applicant wishes to breach the groundwater pressure levels specified in principles [31](#) or [48](#) and [49](#), but in doing so they can demonstrate that the taking of water would not result in any undesired impacts to the groundwater resource, GAB springs, Refuge Non-Spring GDEs or to existing users of the resource, and will not damage, disturb or interfere with any site of cultural significance, or diminish the cultural value of a spring or site of ecological significance. This principle acknowledges that whilst an impact to a spring or site of ecological significance may be assessed as acceptable from an environmental perspective, the impact may diminish the cultural value of the site. In order to determine if the taking of water is likely to impact upon the cultural value of the site, the applicant must consult the relevant Registered Native Title Body Corporate and/or other relevant Aboriginal peoples and communities.

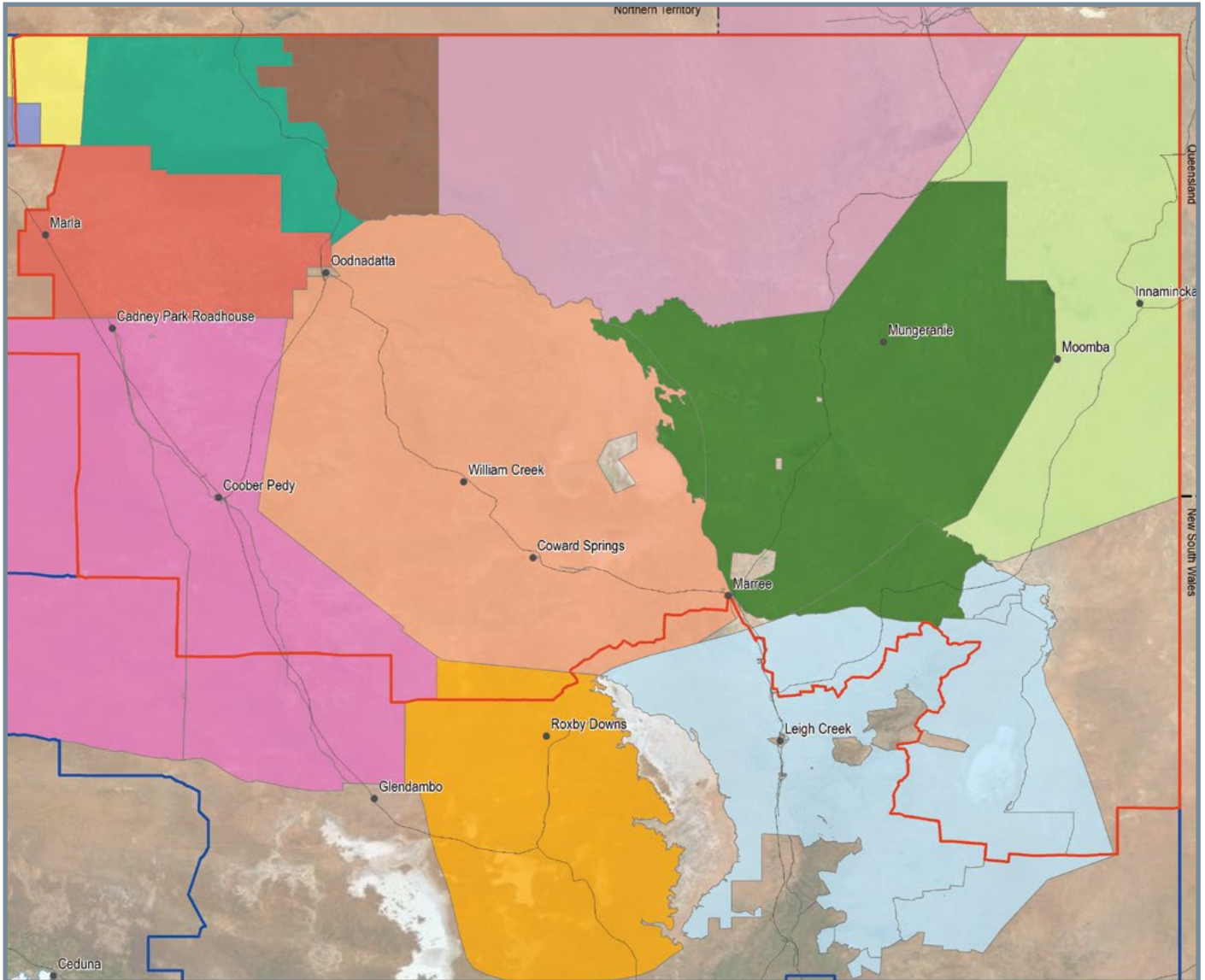
Identifying the Aboriginal peoples, communities and representative organisations relevant to a proposal is a crucial element to ensure an engagement process is effective. This is especially important in situations where there is more than one relevant Aboriginal community or traditional owner group (Commonwealth of Australia 2016). Engagement should be commenced as early as possible.

8 SANTS is the Native Title Service Provider for South Australia under the [Native Title Act 1993](#) (Cth)

9 See [Glossary](#)

FIGURE 3.1

Far North PWA Native Title Determinations

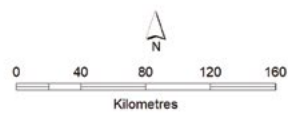


Native Title Determinations
by Registered Native Title Body Corporate

- Adnyamathanha
- Antakirinja Matu-Yankunytjatjara
- Arabana
- De Rose Hill - Ilpalka
- Irrwanyere
- Kokatha
- The Dieri
- Tjayiwara Unmurru
- Walka Wani
- Wangkangurru Yarluyandi
- Yandruwandha Yawarrawarrka
- Yankunytjatjara

- Locations
- Road
- Far North Prescribed Wells Area
- SAAL Landscape Region

Produced by: Water Group
 Department for Environment and Water
 Map Datum: Geocentric Datum of Australia 1994
 Date: May 2020

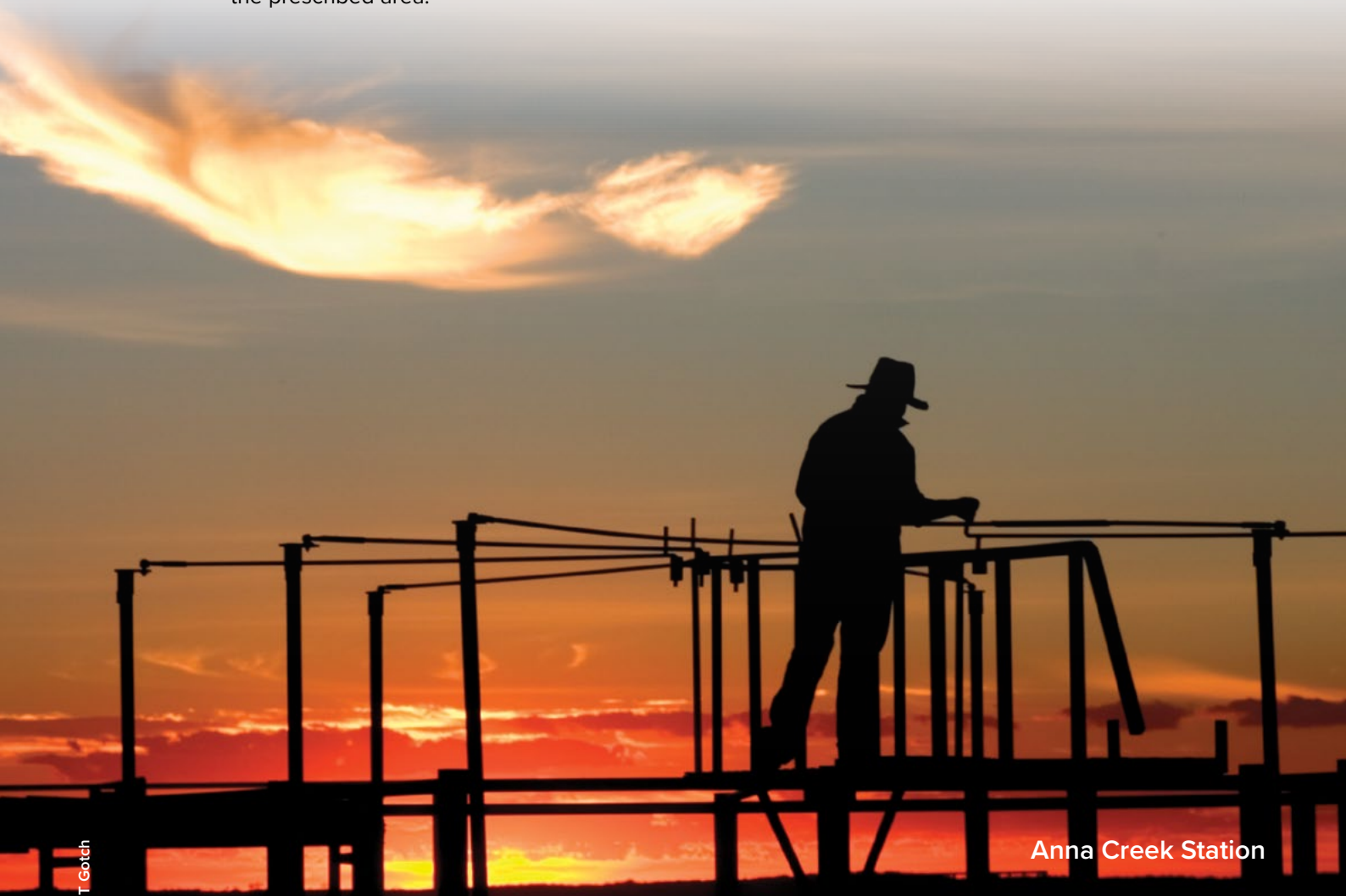


J:\GIS\Workspace\SA\AridLands\SustainableLandscapes\SustainableIndustries\Water\WAP\mxd\Figure3_1_NTDeterminations.mxd

4 ASSESSMENT OF THE EFFECTS OF TAKING WATER ON OTHER WATER RESOURCES

The extraction of groundwater will have some impact on the groundwater resource, and the principles in this Plan ensure that any potential impacts on the groundwater resource itself, users of the resource and ecosystems dependent on the resource are within acceptable limits. Around each point of extraction, there is likely to be a zone of influence where drawdown (or a decline in water level, often referred to as a 'cone of depression') may be observed. Outside of this zone, the impact on water levels and groundwater flow is likely to be insignificant, not only within the same aquifer from which the extraction is occurring but also in nearby aquifers, particularly where hydraulic connectivity may be limited, however impacts on the regional water budget may be observed.

The following sections outline the connections and likely effects of extraction on other water resources or extraction from other resources on the groundwater resource within the prescribed area.



4.1 Surface Water

There are a number of major rivers and watercourses that drain into Lake Eyre/*Kati Thanda* (Macumba, Arckaringa, Neales, Finke, Warburton and Cooper Creeks); wetlands (e.g. Coongie Lakes and Strzelecki Creek Wetlands); and other salt lakes (e.g. Lakes Frome and Callabonna) within the prescribed area. Many of the river and creek systems in this area are ephemeral and dependent on rainfall and surface runoff to maintain flows. In this area rainfall events are sporadic; sometimes the region may go without significant rainfall for years, while the intensity of rainfall may be highly variable with a single event capable of delivering average annual totals. Large rainfall events fill these rivers and creeks which may result in recharge to some of the shallow unconfined aquifers within the prescribed area. In dry periods, water in the rivers and creeks can be sustained as a result of high rainfall events further upstream in Queensland.

There are some waterholes along these rivers which remain wet for an extended period of time after a rainfall event. It is thought that Algebuckina and Peake Creek waterholes may have some connection with groundwater as they remain wet almost permanently. This is likely to be from shallow aquifers which would be locally recharged and is unlikely to be affected by the take of groundwater from deeper artesian aquifers.

Similarly, there are wetlands which may depend on shallow groundwater for some or all of their water needs, for example Coongie Lakes and the Strzelecki Creek Wetlands. These wetlands have the potential to be impacted by the taking of groundwater from the shallow aquifers.

Vertical leakage from the shallow aquifers can occur to the salt lakes of the region. The impact of reduced vertical leakage, due to the taking of water on the water balance of the shallow aquifer and the significance of this groundwater discharge on the salt lake ecosystems is not known.

4.2 Groundwater

The extraction of groundwater from one aquifer is likely to impact on connected aquifers, however, the highly variable nature of the connections and the limited knowledge of hydraulic connectivity means that it is difficult to define or quantify the effect that taking water from one resource may have on a connected resource, which will vary across the PWA.

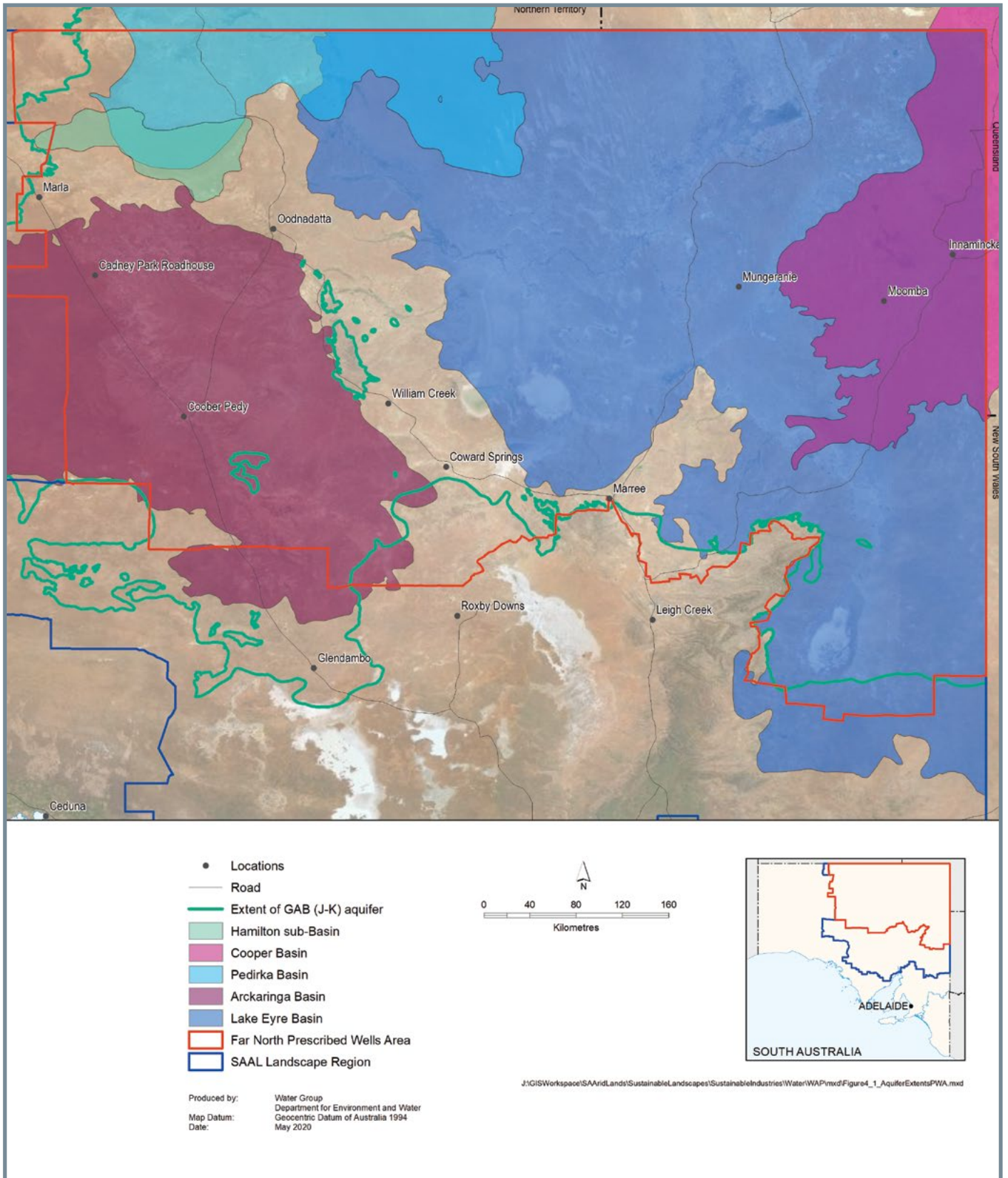
4.3 Water Resources in adjacent Non-Prescribed Wells Areas

The groundwater resources in the adjacent non-prescribed areas are generally of poor quality and are low-yielding, however, it should be noted that many of the basins present within the prescribed area including the GAB, the Lake Eyre Basin, the Hamilton Basin, the Pedirka Basin, the Cooper Basin and the Arkaringa Basin extend beyond the boundary of the PWA ([Figure 4.1](#)). Depending on the extent of the extraction, there is potential for extensive extraction in the non-prescribed adjacent resource to have significant impact on the resources of the Far North PWA. Likewise, significant extraction within the prescribed area close to the boundary of the Far North PWA is also likely to have a significant effect on the non-prescribed groundwater resources.

The taking of water from aquifers can potentially have a detrimental effect on users of the same aquifer in New South Wales, Queensland and the Northern Territory, for example the GAB, the Lake Eyre Basin, the Cooper Basin and the Pedirka Basin. Principles in [section 7](#) of this Plan require the interstate jurisdictions be consulted in relation to an application to take water from the GAB (J-K) aquifer if it is likely to result in a cumulative drawdown in excess of 10% of the potentiometric surface measured above ground level, measured at the State border.

FIGURE 4.1

Extent of groundwater basins which extend outside of the Far North PWA



5 ASSESSMENT OF THE DEMANDS ON THE WATER RESOURCE

The Landscape Act requires this Plan to consider the current and future demands for water from the resource by the occupiers of the land. The needs for water by the occupiers of the land, both current and future, can be referred to as the consumptive demands on the resource. Consumptive demand refers to both the taking of water for a purpose which does not require an authorisation under the Landscape Act (non-licensed water use), and the taking of water for a purpose which does require an authorisation under the Landscape Act (licensed water use).



5.1 Current Non-Licensed Demand

Non-licensed demand includes the provision of water for domestic use if taking less than 100 litres per day for the purposes of drinking and cooking¹⁰ and any water taken pursuant to an authorisation under section 105 of the Landscape Act. Whilst authorisations the Minister may make in relation to the taking of water are subject to change, at the date of adoption of this Plan the following authorisations in relation to section 105 of the Landscape Act were relevant either statewide or for the SAAL region and were issued through Notice in the *South Australian Government Gazette*:

- a) authorisation to take water for the purposes of drilling, construction or testing of a hydrocarbon exploration well by a person authorised under the *Petroleum and Geothermal Energy Act 2000* to – published 30 August 2001, page 3442
- b) authorisation to take water for the purposes of public road making – published 27 November 2003, page 4268
- c) authorisation to take water for the purposes of firefighting – published 27 November 2003, page 4268
- d) authorisation to take water for the purpose of the application of chemicals to non-irrigated crops and non-irrigated pasture and for the control of pest plants and animals – published 16 February 2006, page 559
- e) authorisation to take water in the Far North PWA for the purpose of supply of water to exploration camps including, but not limited to seismic and drilling camps, for the extraction of water for the drilling and construction of wells, for the extraction of water for pump testing of wells, for the extraction of water for the construction of private roads required for exploration purposes, excluding the take of water within 5 km of a spring – published 14 January 2010, page 44
- f) authorisation to take water for Native Title purposes, for the purpose of satisfying a person's personal, domestic, cultural, spiritual or non-commercial communal needs where they are doing so in the exercise or enjoyment of their native title rights and interests – published 13 September 2012, page 4437

Non-licensed demands are difficult to quantify as there is no requirement for the person taking water to meter their extraction or estimate and report the volumes of water being used, as such, an estimate of the non-licensed demand is not able to be determined. However, the volume of water used for these purposes should not be underestimated, especially in relation to mining and petroleum exploration where water use varies from 0.42 ML/year per well for conventional oil, to 5.7 ML/year per well for unconventional gas. However, in some cases, water required for exploration is provided for through re-use of co-produced water which is already licensed under this Plan rather than in addition to water licensed under this Plan. The taking of water from the Far North PWA for the purposes listed above is not required to be compliant with the principles in [sections 6 and 7](#) of this Plan.

¹⁰ Section 100(7) of the *Landscape Act* and regulation 17 of the *Landscape South Australia (Water Management) Regulations 2020*

5.2 Current Licensed Demand

Since the 2008-09 water use year, the Department has kept a record of the licensed groundwater allocations for the Far North PWA in the State Water Register. In addition the *Roxby Downs (Indenture Ratification) Act 1982* (the Indenture) provides for specific arrangements for the taking of water for the Olympic Dam Mine and associated productions. The provisions of the Indenture take precedence over the provisions of the Landscape Act. In instances of inconsistency between the provisions in the Indenture and the provisions in the Landscape Act, the Indenture prevails. Water taken for the mine from the Far North PWA is not subject to the licence provisions under this Plan. Table 5.1 and [Figure 5.1](#) show the volumes of water authorised for taking for various purposes from all aquifers as at May 2019.

TABLE 5.1

Annual volumes of water authorised for taking from all aquifers in the Far North PWA as at May 2019

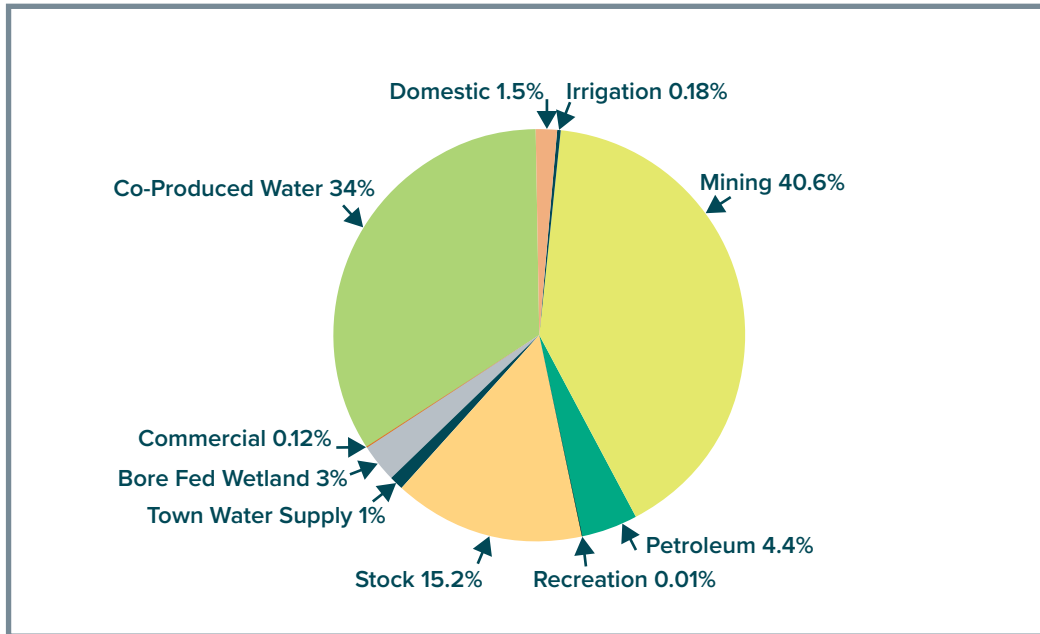
PURPOSE	CURRENT DEMAND (ML/yr)	CURRENT DEMAND (%)
Recreation	6	0.009
Commercial	79	0.122
Irrigation	115	0.178
Town Water Supply	630	0.977
Domestic	940	1.457
Bore-Fed Wetland	2025	3.138
Petroleum	2859	4.431
Stock ¹	9779	15.154
Co-Produced Water	21900	33.937
Mining	26199 ²	40.598
TOTAL	64532	100

1 Includes the 20% buffer to account for the water use of native and feral animal as this is a component of the stock allocation

2 Includes the water currently authorised for taking by Olympic Dam Mine (42 ML/day being 15,300 ML/yr) via the Special Water Licence dated 30 November 1995 issued pursuant to the *Roxby Downs (Indenture Ratification) Act 1982*

FIGURE 5.1

Percentage of water authorised for taking in the Far North PWA for various purposes from all aquifers as at May 2019



While [Figure 5.1](#) displays the percentages of water authorised for differing purposes from all aquifers within the prescribed area, [Figure 5.2](#) provides an insight into the percentage of water authorised to be taken from the various basins/aquifers within the prescribed area, the majority of which (76%) is sourced from the Great Artesian Basin. [Figure 5.3](#) displays the portion of water authorised for taking for various purposes from the Great Artesian Basin alone, where co-produced, mining and petroleum activities account for 81% of the total volumes of water authorised. With regard to pastoral water, while it accounts for 78% of the water authorised for taking from the Lake Eyre Basin aquifers and 81% of the water allocated from the basement aquifers, by far the largest volumes of water authorised to meet pastoral demand are supplied from the Great Artesian Basin (61% of all pastoral water authorised).

FIGURE 5.2

Percentage of water authorised for taking from the various basins/
aquifers as at May 2019

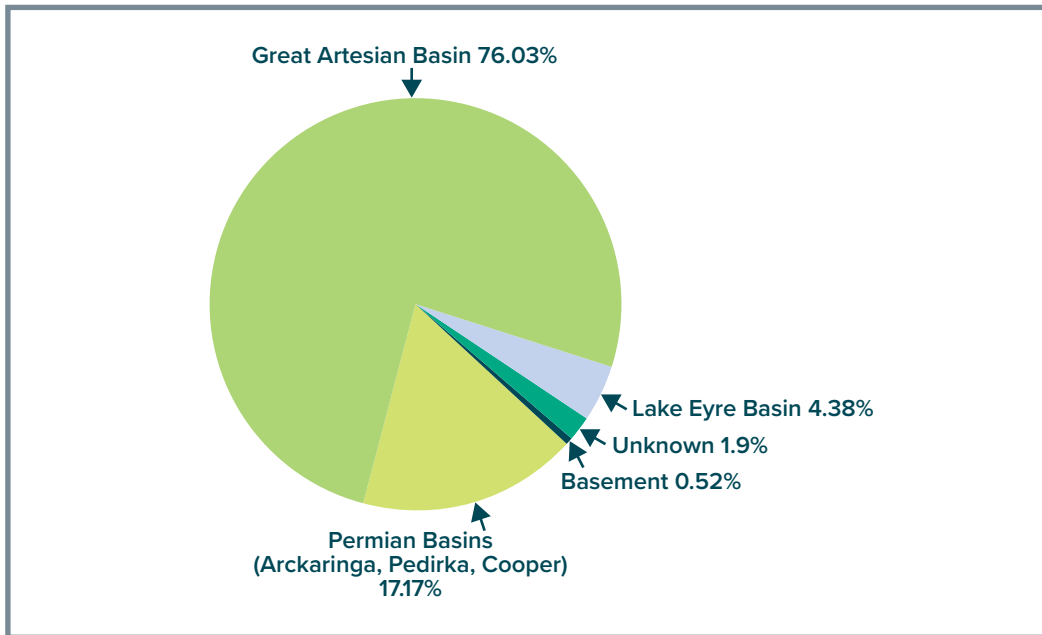
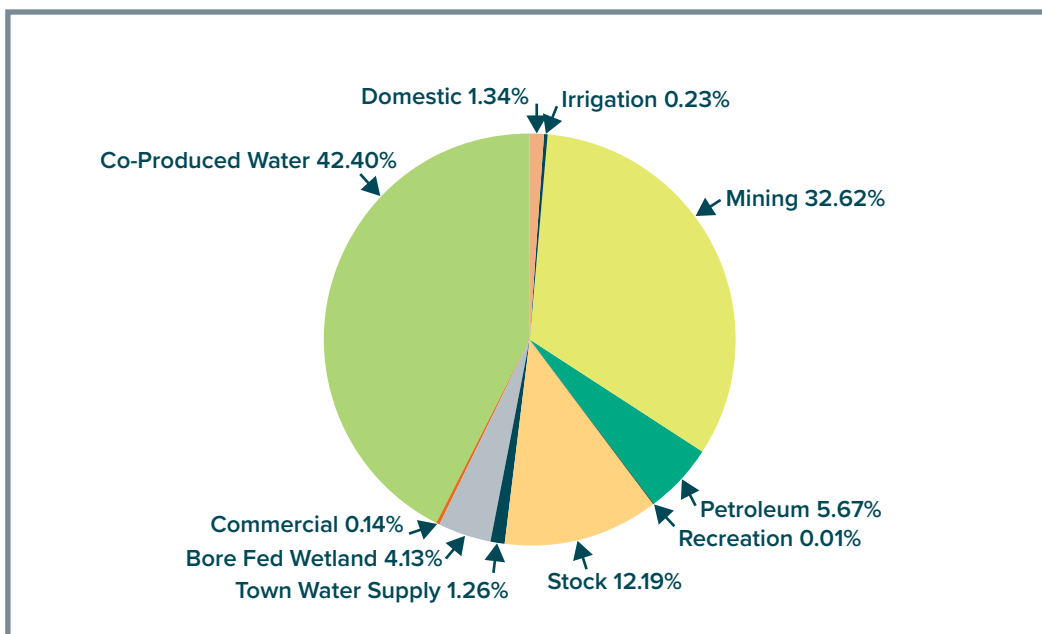


FIGURE 5.3

Percentage of water authorised for taking for various purposes from the
Great Artesian Basin as at May 2019



5.3 Future Demands

The content of this section has been mostly informed by the South Australian Arid Lands Demand and Supply Statement (DEWNR 2013), which provides a long-term (40 years) overview of water supply and demand in the previous South Australian Arid Lands (SAAL) Natural Resources Management region. The SAAL Demand and Supply Statement (DSS) outlines the state of all water resources in the region for drinking water and non-drinking water and lists the major demands on these water resources. The SAAL DSS was based on the previous SAAL Natural Resources Management Region and therefore also provides information on the demand for, and supply of, water outside of the Far North PWA.

It should be noted that whilst the demand for water is likely to increase throughout the life of this Plan, the objectives of this Plan to use water in a judicious manner (for example; taking water in accordance with wetland management plans for bore-fed wetlands, taking water through closed delivery systems for pastoral use, and limiting the ability to dispose of non-contaminated water to the surface for evaporation from the mining and petroleum industries), changes in industry practices to reduce, reuse and reinject water, and investment in the Great Artesian Basin Sustainability Initiative (GABSI) all work to conserve water within the PWA which may reduce the current demands on the resource.

The GABSI - Phases 1-4 (1999-2013) saved the South Australian portion of the GAB approximately 48,961 ML of GAB water per year through controlling 51 bores, eliminating 342 kilometers of bore drains and through the installation of 344 km of efficient piping. This involved extensive funding and facilitation of governments (State - \$13.8 million and Commonwealth - \$11.5 million) and landholder contributions of approximately \$3.7 million (Frontier Economics 2016, Australian Government 2019).

Future demand for water is likely to be required from the following sectors.

5.3.1 Mining, Petroleum, Gas and Geothermal Demand and Expansion

Demand for water from the Far North PWA is likely to increase in the future due to expansion occurring in oil production, mining, to a lesser extent gas production and possibly geothermal activities. In accordance with State Government policy (DWLBC 2009), mining ventures must source their own water supplies within the sustainable framework of landscape planning. Within prescribed areas, with the exception of taking water for the purposes of mining and hydrocarbon exploration authorised by a Notice under section 105 of the Landscape Act (see [section 5.1](#)), mining and petroleum companies are required to hold a water licence and therefore a water access entitlement to take water in the same way as other water users would be required to do so.

5.3.2 Road Building and Maintenance Demand

The SAAL DSS advises that the Department of Planning, Transport and Infrastructure manages around 9,500 km of sealed and unsealed roads in the South Australian Arid Lands Landscape Region and estimate an annual water usage for road building and maintenance activities of approximately 140 ML. Mining and petroleum expansion in the region may require additional road building and maintenance activities increasing the water requirements for this purpose.

5.3.3 Pastoral Demand

Current water licences for pastoral purposes were issued based on the maximum stock levels specified on the associated pastoral lease provided by the Pastoral Board in line with the *Pastoral Land Management and Conservation Act 1989*, therefore licensees are currently limited in the number of stock they can run. If the limitation of a maximum stock level were varied, stock rates may increase and the demand for water from this sector may grow, similarly if stocking rates reduce then demand for water will also reduce.

Changes in rainfall, temperatures and evapotranspiration are likely to result in greater fluctuation in stocking rates due to the availability of water and feed. This may result in the need for additional water points (not necessarily additional water allocations) so that water supply is closer to available forage.

Water demand from the pastoral industry may also increase in response to a variation in the stock water requirements (volume of water per day) currently assigned to stock, natives and ferals in this Plan. Currently stock water requirements are determined at a rate of 100 L per day per head of cattle and 20 L per day per head of sheep with an additional buffer of 20% to the entire stock water licence (included in the licensed volume) to account for water use by native and feral animals from stock watering points. These volumes have been carried over from the previous Plan due to the absence of any updated stock water requirement estimates specific to the Far North PWA. However, should future evidence exist to support the variance of stock and/or native and feral animal water use rates, existing water license holders will be able to apply to increase their allocation respectively. The increased allocation would be subject to meeting the principles of this Plan.

A changing climate may result in alternative uses of groundwater in order to offer economic diversification opportunities, particularly for pastoralists (if approved by the Pastoral Board to use the land for a purpose other than pastoralism¹¹) in drier times when stock or feed numbers reduce, which may reduce the demand for water from this sector, but may result in increased demand from other sectors such as irrigation of arid horticulture or fodder crops.

11 Section 22(1)(b)(iii) of the *Pastoral Land Management and Conservation Act 1989*

5.3.4 Population and Tourism Growth

Population growth trends will be largely influenced by the timing of the decision to expand the Olympic Dam mine at Roxby Downs. Whilst Roxby Downs falls outside of the prescribed area, it obtains water from the GAB aquifer within the prescribed area, which is then supplied to the mine site and surrounding townships, including Andamooka. Any increase in population will have a corresponding increase in the water supply from the prescribed area to meet the water demand.

The South Australian Visitor Economy Sector Plan 2030 (SATC 2019) projects a 74% increase in tourism expenditure over the period 2018 (\$462 million) to 2030 (\$804 million) for the Flinders Ranges and Outback Region. Increased tourism expenditure would likely result from growth in tourism numbers, where increased tourism will result in increased water demand, particularly from the accommodation sector. Tourism to the area may be further increased if access to the region is improved through such initiatives such as sealing of roads or even through advances in car manufacturing, making the current roads more accessible.

5.3.5 Town Water Supply

Improved services and infrastructure within the current towns in the Far North PWA may encourage population growth resulting in additional requirements for water through the public water supply system. Further, transitions to more secure water supplies for townships through a change from reliance on surface water systems to groundwater supplies may place further demands on the groundwater resource, in the absence of population growth.

5.3.6 Domestic Water Supply

Pastoral properties within the Far North PWA generally source their water supply from the groundwater resources. It is possible that existing pastoral properties may expand and therefore construct additional dwellings on the lease. While existing allocations for domestic purposes will remain unchanged, for consistency with existing allocations for domestic purposes, water issued on licence for future domestic purposes under this Plan shall be determined at the following rate:

- 3.65 ML per dwelling per year; this allocation includes water to be used in the running of the dwelling including cooking, cleaning and bathing, in addition to water required to maintain gardens and swimming pools associated with the property, enable wash down of trucks and other vehicles as required, and any other domestic purposes required by the owner or lessee.

If a property has more than one dwelling present, for example if a pastoral property has three dwellings on the lease, each dwelling would be allocated 3.65 ML/year, resulting in a total of 10.95 ML/year for the domestic portion of the water licence in relation to the property. For the purposes of this Plan 'dwelling' means a structure on the property which is able to house people for all or part of the year and water would be required to enable usage of the dwelling.

5.3.7 Irrigation Demand

Currently, there is only one licence issued for the purposes of irrigation. This is likely due to the fact that much of the prescribed area is pastoral land and approval is required from the Pastoral Board under the *Pastoral Land Management and Conservation Act 1989* to use the land for a purpose other than pastoralism. If the projected reductions in rainfall and increasing temperatures result in pastoralism becoming increasingly unviable in the prescribed area, there is the potential for pastoralists to look to diversify their income through alternative activities, such as the irrigation of arid zone horticulture crops or fodder (if approved by the Pastoral Board). If this type of diversification is undertaken in the future, it may result in an increased demand for water from the irrigation sector, which will likely be balanced by a reduction in demand from the pastoral industry. Any water authorised for the purposes of irrigation would require a separate licence which relates to the All Purpose consumptive pool. This is separate to any existing stock and domestic water licence a pastoralist may already own.

6 CONSUMPTIVE POOLS, WATER ACCESS ENTITLEMENTS AND WATER ALLOCATIONS

Within the Far North PWA, a person may only lawfully take water from the prescribed water resource:

- a) pursuant to an authorisation under section 105 of the Landscape Act;
- b) pursuant to a water allocation that relates to the water resource (which includes taking water for stock or domestic purposes¹²); or
- c) for the purposes of drinking or cooking if the rate of taking does not exceed the rate prescribed by regulation, namely 100 litres a day¹³.

The Landscape Act requires that a water allocation plan be prepared for each prescribed water resource. A key aspect of a water allocation plan is that it establishes a water licensing regime to regulate the taking of water from the resource. The first step in establishing this licensing regime is determining a consumptive pool or pools.

Cooper Creek, Innamincka

12 Section 7(5) and (6) of the *Water Resources Act 1997* and regulation 4(2) of the *Water Resources (Far North Prescribed Wells Area) Regulations 2003*

13 Section 100(7) of the *Landscape Act* and regulation 17 of the *Landscape South Australia (Water Management) Regulations 2020*

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 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...*”¹⁴. This Plan must therefore determine a consumptive pool or pools, so as to account for all the water that may be lawfully taken from the Far North PWA. The Minister must further determine, from time to time, the volume of water that is to be made available for allocation from a consumptive pool¹⁵. The consumptive pools determined for this Plan are outlined in [section 6.1](#) and are based on purpose of use. Each of the consumptive pools relate to all of the aquifers within the geographical boundary of the Far North PWA.

A water licence provides the holder with a water access entitlement, which entitles the water licence holder to gain access to a share of the water available for allocation in the consumptive pool¹⁶. A water allocation may be obtained on account of a water access entitlement under a water licence. While a water access entitlement represents the licence holder’s ongoing right to a share of the resource, a water allocation will relate to a specified period of no more than 12 months¹⁷ and is the volume of water that may be taken during the specified period. [Section 6.2-6.5](#) of this Plan outline the process for granting of water licences, water access entitlements and water allocations.

The water management provisions in the Landscape Act have been amended since the previous Plan for the Far North PWA was adopted in 2009. This Plan therefore provides for the transition of existing water licences and allocations in the Far North PWA to water licences which provide a water access entitlement and a subsequent water allocation. Licensees also require a water resource works approval in order to take the allocation and in some cases a site use approval in order to apply the water to a site. Where wells are maintained or operated for a purpose, other than the purpose of taking water, for example for the purposes of taking petroleum, a water resource works approval is not required as these wells are regulated under the *Petroleum and Geothermal Energy Act 2000*. In this case the conditions in relation to the taking of water are provided for in relation to the allocation. The water management authorisations to be administered under this Plan and how they relate to a water licence under the previous Plan can be seen in [Figure 6.1](#).

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

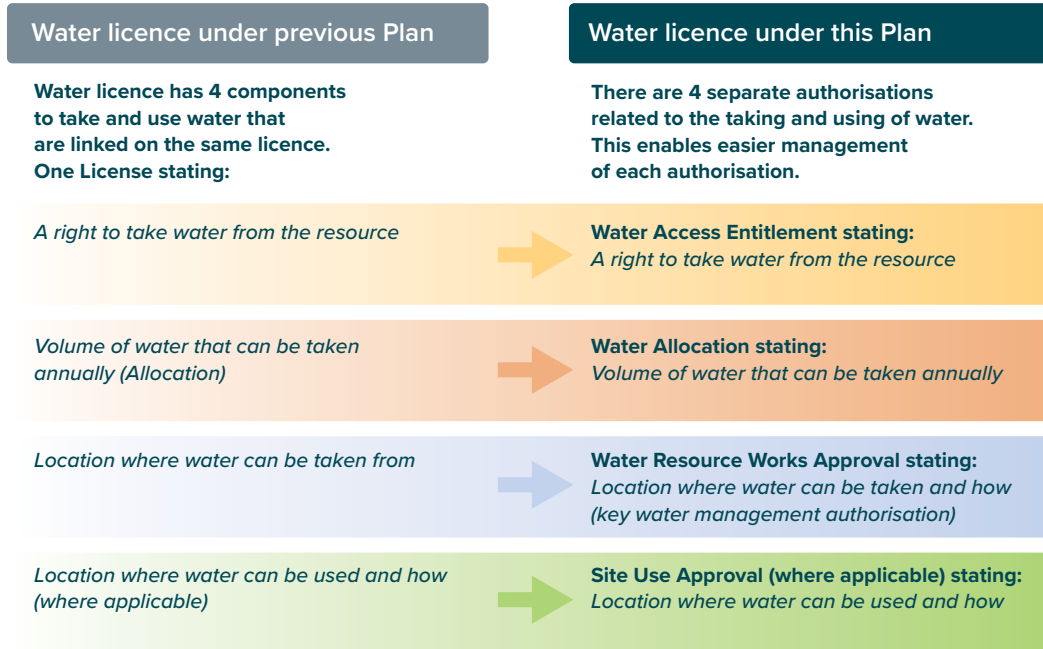
15 Section 121(4) of the [Landscape Act](#)

16 Section 121(2) of the [Landscape Act](#)

17 Section 127(8) of the [Landscape Act](#)

FIGURE 6.1

Water licence structure under the previous Plan and under this Plan



The Minister may grant new water licences with respect to the wells in the Far North PWA in accordance with this Plan and the Landscape Act. The taking and use of such water will be subject to the principles outlined in [section 7](#) of this Plan, to ensure the taking of water will not cause undesired impacts to the GAB springs (for example, will not cause physical disturbance of spring structures or ecosystems, nor result in groundwater pressure level declines which would result in reduced flows to springs), refuge non-spring GDEs or existing users of the resource, and will not damage, disturb or interfere with any site of cultural significance. With the exception of petroleum producers, applicants are required to secure a water resource works approval prior to applying to the Minister for a water licence and subsequent water access entitlement, or seeking a transfer of water from another user, to ensure the water is authorised to be extracted from the chosen location.

[Sections 6](#) and [7](#) of this Plan require the provision of information to support an application for an authorisation in some circumstances. This information allows for the Minister to consider the application against the requirements of this Plan, and informs their decision to either grant or refuse an application. Where an applicant is required to demonstrate a matter to the satisfaction of the Minister, the onus of undertaking the relevant hydrogeological or other investigation necessary to satisfy the Minister of the relevant matter, and the associated cost, lies with the applicant and not the Minister or the South Australian Government.

Applicants are advised to consider if the proposed taking of water is consistent with other legislation including, but not limited to, the *Pastoral Land Management and Conservation Act 1989*, the *Aboriginal Heritage Act 1988*, the *Native Title Act 1993*, the *Environment Protection and Biodiversity Conservation Act 1999*. For example if the proposed extraction of water could have a significant impact on ‘the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin’, then the proposed action may be required to be referred to the relevant Commonwealth Minister for consideration pursuant to the *Environment Protection and Biodiversity Conservation Act 1999*.

It should be noted that while this Plan provides provisions for the allocation of water, it does not ensure that the water which is being allocated is of suitable quality for the intended purpose of use. It is the responsibility of the licensee to ensure that the water being utilised on account of a water allocation is of an appropriate water quality (e.g. salinity) for the end use. This may mean, in some circumstances, desalination may be required.

Purchasers of land within the Far North PWA should be aware that the *Water Resources Act 1997* (the Water Act) formally separated water rights from land rights in South Australia. Prior to this legislation being enacted, water was regarded as a public asset or public property common to all who had a right to access it, where access to water resources was an incident of the ownership of land. Common law rights to take water (e.g. water rights based on land ownership or possession) were abolished in the Water Act.

As such, under the Water Act, and subsequently the NRM Act, and Landscape Act water licences and water allocations are personal property that can be sold independently of land. Therefore, upon purchase of land which has a current water licence and water resource works approval, the purchaser should ensure that the purchase includes the transfer of all water management authorisations with sale of the land, otherwise the new occupier will need to apply for a new licence under the provisions of this Plan.

The principles in [sections 6](#) and [7](#) of this Plan, numbered 1 to 65 below, apply to all applications for new water management authorisations made after the date of adoption of this Plan, and to all applications to vary existing water management authorisations. The transitional arrangements in [sections 6.5](#) and [7.9](#) of this Plan discuss how licensees under the previous Plan will be issued water management authorisations under this Plan.

6.1 Consumptive Pools

1. For the purposes of this Plan, there shall be three consumptive pools determined by way of fixed geographic boundary and purpose of use. The consumptive pools are defined as:
 - a) the “Cultural Water Consumptive Pool”,
 - b) the “Stock and Domestic Consumptive Pool”, and
 - c) the “All Purpose Consumptive Pool”.

Each consumptive pool applies separately to the total of the geographical boundary of the Far North PWA as defined by the red line in [Figure 1.1](#).

2. The Cultural Water Consumptive Pool is the water which is available to be used by an Aboriginal person from within the Far North PWA, for the purposes of satisfying an Aboriginal person’s personal, domestic, cultural, spiritual or non-commercial communal needs where they are doing so in the exercise or enjoyment of their cultural interests.
3. The Stock and Domestic Consumptive Pool is the water which is available to be taken from any well within the Far North PWA for stock and/or domestic purposes¹⁸.
4. The All Purpose Consumptive Pool is the water which is available to be taken from any well within the Far North PWA for any purpose with the exception of the purposes assigned to the Cultural Water Consumptive Pool defined in principle 2 or the Stock and Domestic Consumptive Pool defined in principle 3 of this Plan.
5. The Minister may, from time to time, by publishing a notice in *The South Australian Government Gazette*, advise of the determination of an additional consumptive pool, and in determining the consumptive pool, may assign a particular purpose to that consumptive pool.

6.2 Water Licences

6. A water licence is not required to authorise the taking of water in relation to the Cultural Water Consumptive Pool.
7. The Minister may grant a water licence in respect of the Stock and Domestic Consumptive Pool or the All Purpose Consumptive Pool. A water licence provides a water access entitlement to the holder of the licence to gain access to a specified volume of the water available within the consumptive pool.

¹⁸ As defined in the [Glossary](#) of this Plan.

6.3 Water Access Entitlements

8. The Minister may grant a new water access entitlement in respect of the Stock and Domestic Consumptive Pool or the All Purpose Consumptive Pool. Subject to principle 11, a water access entitlement will not be granted without a water resource works approval to enable the take of the water issued. The water resource works approval is subject to the principles outlined in [section 7](#) of this Plan to ensure the taking of water will not cause undesired impacts to the GAB springs, refuge non-spring groundwater dependent ecosystems in the prescribed wells area or existing users of the resource, including interstate users of the resource and will not damage, disturb or interfere with any site of cultural significance.
9. For the purpose of this Plan, any additional water that is available for licensed use but has not yet been granted on a water access entitlement will be known as unallocated water.
10. The Minister may issue a new water access entitlement or amend an existing water access entitlement in relation to unallocated water, on the basis of applications submitted to the Minister under procedures determined by the Minister as being appropriate in the relevant circumstances¹⁹.
11. The Minister may issue a new water access entitlement or amend an existing water access entitlement in relation to the extraction of petroleum without the requirement to hold a water resource works approval.
12. A water access entitlement issued for domestic purposes shall not exceed 3.65 megalitres per dwelling per year²⁰.
13. A water access entitlement issued for stock purposes shall not exceed 100 litres per day per head of cattle or 20 litres per day per head of sheep, in addition to a 20% buffer to account for native and feral animal water losses²¹.
14. A water access entitlement, provided by a water licence in respect of principle 8, will be expressed as a specified maximum volume of water over a specified period of time.
15. The period specified for the purposes of a water access entitlement under principle 14, is the recurrent water-use year.
16. Where water from the wells in the Far North PWA is required to be taken in the conduct of activities permitted by a lease or licence granted pursuant to the *Mining Act 1971*, the Minister shall grant a separate water access entitlement to the holder of each lease or licence issued pursuant to the *Mining Act 1971* including, but not limited to retention licences or production licences.

¹⁹ Section 122(2) of the *Landscape Act*

²⁰ See [section 5.3.6](#) of this Plan.

²¹ As per the previous Plan

17. Where water from the wells in the Far North PWA is required to be taken in the conduct of activities permitted by a lease or licence granted pursuant to the *Petroleum and Geothermal Energy Act 2000*, with the exception of the water licence held in relation to the generation of co-produced water, the Minister shall grant a separate water access entitlement to the holder of each lease or licence issued pursuant to the *Petroleum and Geothermal Energy Act 2000*, including, but not limited to retention licences or production licences.

6.4 Water Allocation

18. A water allocation may be obtained on account of a water access entitlement under a water licence either:
 - a) by the holder of the relevant water licence, on the basis that the water allocation is being granted by the Minister under the terms of the water licence; or
 - b) by a person, whether or not the person is the holder of a water licence, on the basis of a transfer of a water allocation that has been provided by the Minister under the terms of a water licence.
19. A water allocation provided under principle 18 may be subject to the conditions outlined in [section 6.7](#) of this Plan.

6.5 Transitional Arrangements

20. At the date of adoption of this Plan, all water access entitlements in respect of the wells in the Far North PWA will relate to the Stock and Domestic Consumptive Pool or the All Purpose Consumptive Pool.
21. At the date of adoption of this Plan, the holder of a water licence granted under the previous Plan will be provided with a water licence and therefore a water access entitlement under this Plan. The volume of water to be granted to the water access entitlement holder shall be determined by converting the volume of water on allocation in the 2020/21 water-use year to the licensee as an equivalent specified maximum volume of water over a specified period of time.
22. A water access entitlement provided under the transitional arrangements in principle 21 may be subject to the conditions outlined in [section 6.7](#) of this Plan.

6.6 Allocation of Water Drained or Discharged into a Well

The following principles apply to the allocation of water previously drained or discharged to a well/s, excluding waste water disposal, in accordance with a permit under Section 104(3)(c) of the Landscape Act or an environmental authorisation under section 40(1) of the *Environment Protection Act 1993* (EPA Act) and [section 7.5](#) of this Plan.

23. The Minister may grant a water licence for the recovery of water previously drained or discharged into a well during a water use year (recharge water licence) in accordance with a permit under Section 104(3)(c) of the Landscape Act or an environmental authorisation under section 40(1) of the *Environment Protection Act 1993* (EPA Act) and [section 7.5](#) of this Plan.
24. The water access entitlement issued on account of the recharge water licence will be calculated as²²:
 - a) 80% of the volume of water drained or discharged in the previous water use year, or
 - b) a specified percentage of the water drained or discharged in the previous water use year if the applicant can demonstrate to the satisfaction of the Minister that the taking of up to 100% of the water drained or discharged into the well would not contravene the criteria specified in principles 48 to 50.
25. Subject to principle 26 a water allocation (recharge allocation) may be obtained on account of the water access entitlement referred to in principle 24. The water allocation will be credited to the licensee's water account in the water-use year following injection.
26. The water allocation issued in relation to principle 25 will initially relate to a period not exceeding 12 months. If the allocation is not taken during that period, the unused allocation may be carried over for a period not exceeding 1 year, but only in circumstances where it does not contravene the criteria specified in principles 48 to 50.

²² Section 53(5)(e) of the *Landscape Act*

6.7 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 Minister²³. The licence remains in force unless it expires under the terms of the licence²⁴.

27. For the purposes of this and subsequent sections:

- a) GAB springs are the springs which are either fully or partially supported by water from the GAB aquifer, identified in the South Australian SA_Geodata Database GAB springs dataset and displayed as the areas coloured dark blue in [Figure 2.1](#).
- b) Zone A is a 5 km buffer around each of the GAB springs within the Far North PWA identified in the South Australian SA_Geodata database, as amended from time to time. At the date of adoption of this Plan, the areas comprising Zone A are displayed as the areas coloured green in [Figure 2.1](#).
- c) Zone B is the 45 km buffer around Zone A, as amended from time to time. At the date of adoption of this Plan, the areas comprising Zone B are displayed as the areas coloured blue in [Figure 2.1](#).
- d) Refuge non-spring GDEs are groundwater dependent ecosystems (GDEs) identified in the Department's Far North PWA Refuge Non-Spring GDEs Database, as amended from time to time. At the date of adoption of this Plan, the Refuge Non-Spring GDEs are displayed as the areas coloured green in [Figure 2.2](#).
- e) the buffer around refuge non-spring GDEs is the 100m buffer surrounding the Refuge Non-spring GDEs identified in the Department's Far North PWA Refuge Non-Spring GDEs Database, as amended from time to time. At the date of adoption of this Plan, the areas comprising the refuge non-spring GDE buffer are displayed as the areas coloured blue in [Figure 2.2](#).

The South Australian Geodatabase with regards to the Far North PWA GAB Springs and the Department's Far North PWA Refuge Non-Spring GDEs Database will be updated throughout the life of this Plan to reflect the results of ongoing monitoring and investigations in the Far North PWA, the buffers in relation to these databases will subsequently be updated. The publicly accessible location of these databases and associated buffers is discussed in [section 1.10](#) of this Plan.

23 Section 123(c)(ii) and section 127(6)(b) of the [Landscape Act](#)

24 Section 123(e)(ii) of the [Landscape Act](#)

28. When issuing, granting or transferring a water licence or water allocation, the Minister may give consideration to endorsing a condition to the effect that:
- a) unless it is demonstrated to the satisfaction of the Minister, that it is not reasonably practicable to do so, the water that is the subject of the authorisation must be taken, used and/or disposed of in a judicious manner so that:
 - i) water wastage is reduced; or
 - ii) water is taken and distributed through a water tight delivery system, or
 - iii) water exceeding a total volume of 21,900 ML/year in relation to the production of petroleum is not disposed of by means of evaporation on the land's surface; or
 - iv) water up to a total volume of 21,900 ML/year in relation to the production of petroleum, which is currently disposed of by means of evaporation to the land's surface, is to be minimised within 10 years from the date of adoption of this Plan; or
 - v) water taken as part of mine dewatering or depressurisation activities in relation to the *Mining Act 1971*, is not disposed of by means of evaporation on the land's surface.
29. Principle 28(a)(v) does not apply to:
- a) water stored in an above ground storage facility for usage,
 - b) mine process waste water, including reverse osmosis waste – brines,
 - c) water entrained in tailings,
 - d) water entrained in mine wastes after processing, or end of life heap leach pads,
or
 - e) water remaining in an open pit after the mining tenement has been surrendered.
- As described in a Program approved under the *Mining Act 1971*.
30. If the Minister is satisfied that the ability of third parties who are authorised to take water under the Landscape Act will be affected by the grant of the licence, the Minister may determine and impose a condition on the licence requiring the licence holder to provide an alternative supply of water to such parties.

31. In addition to principles 28 and 30, when issuing, granting or transferring a water allocation for use in the coproduction of water in the course of activities permitted by a licence granted pursuant to the *Petroleum and Geothermal Energy Act 2000*, the Minister may give consideration to endorsing a condition on the water allocation to the effect that:
- a) the water taken pursuant to the allocation must not be taken unless the applicant can demonstrate to the satisfaction of the Minister that the taking of the allocation will not:
 - i) negatively impact on the ability of another water licence holder to access water through an existing operational production well; or
 - ii) detrimentally impact upon the groundwater pressure levels and gradients required to maintain the ecology of a spring or springs if taken from a well located within Zone A; or
 - iii) result in a cumulative decline in groundwater pressure of 0.5 m or more at the boundary of Zone A in the Great Artesian Basin, in reference to February 2009, when measured anywhere at the boundary of Zone A or as measured by any other means determined by the Minister; if the water proposed to be taken from a well located in Zone B; or
 - iv) result in a cumulative decline in groundwater pressure of 1 m or more at the boundary of Zone B in the Great Artesian Basin, in reference to February 2009, when measured anywhere at the boundary of Zone B or as measured by any other means determined by the Minister, if the water is proposed to be taken from a well located outside of Zone A or Zone B; or
 - v) result in a cumulative drawdown in excess of 10% of the potentiometric surface measured above ground level in the Great Artesian Basin, measured at the state border with Queensland, New South Wales or the Northern Territory, in reference to February 2009, or as measured by any other means determined by the Minister, unless allocated in consultation with the relevant interstate authority.
 - b) the water taken pursuant to the water allocation must be taken from wells operated in a manner consistent with provisions of the statement of environmental objectives required under the *Petroleum and Geothermal Energy Act 2000*.
 - c) the total volume of water taken for use in the coproduction of water in the course of activities permitted by a licence granted pursuant to the *Petroleum and Geothermal Energy Act 2000*, during the water use year, must be provided to the Minister by [insert relevant date].
 - d) the holder of this water allocation must provide, to the Minister by 30 September following the relevant water use year:
 - i) a list of the wells through which the water allocation was taken for the relevant allocation period;
 - ii) the salinity of the aquifer from which the water was taken, measured at least once throughout the relevant allocation period; and
 - iii) the volumes of water extracted per well.

32. Notwithstanding principle 31, the Minister may issue, grant or transfer a water allocation for use in the coproduction of water in the course of activities permitted by a licence granted pursuant to the *Petroleum and Geothermal Energy Act 2000*, where the applicant identifies that the criteria in principle 31 cannot be met, but that the applicant can demonstrate to the satisfaction of the Minister that the issue, grant or transfer of a water allocation would not result in any undesired impacts to the groundwater resource, GAB springs, Refuge Non-Spring GDEs or existing users of the resource, and will not damage, disturb or interfere with any site of cultural significance or diminish the cultural value of a spring. In determining the impact upon the cultural value of the site, the applicant must consult the relevant Registered Native Title Body Corporate and/or other relevant Aboriginal peoples and communities.
33. When issuing, granting or transferring a water licence intended to be used in the conduct of activities permitted by a lease or licence pursuant to the *Mining Act 1971*, the Minister may give consideration to endorsing a condition on the water allocation to the effect that:
- a) the water licence remains in force only for the period that the associated mining lease or licence remains in force, or a valid renewal application is being processed, and will expire on 30 June following the cancellation, cessation, relinquishment, surrender or expiry of the associated mining lease or licence; and
 - b) the holder of the licence must notify the Minister within 6 months of cancellation, cessation, relinquishment, surrender or expiry of the associated mining lease or licence.
34. When issuing, granting or transferring a water licence intended to be used in the conduct of activities permitted by a lease or licence pursuant to the *Petroleum and Geothermal Energy Act 2000*, the Minister may give consideration to endorsing a condition on the water licence to the effect that:
- a) the water licence remains in force only for the period that hydrocarbon production continues by the water licence holder, and will expire on 30 June following the cessation of hydrocarbon production by the water licence holder; and
 - b) the holder of the licence must notify the Minister within 6 months of cessation of hydrocarbon production.

35. When issuing a water allocation for the recovery of water previously drained or discharged into a well, the Minister may give consideration to endorsing a condition on the water allocation to the effect that:
- a) the water taken pursuant to the water allocation must only be taken from the aquifer into which the water was drained or discharged; and
 - b) the water must be taken at a distance no further than 15 kilometers from the site of injection, unless the applicant can demonstrate that recovering the water at a distance further than 15 kilometers will not result in undesired impacts to the groundwater resource, GAB springs, refuge non-spring GDEs, existing users of the resource, or the originating location of recharge; and
 - c) the water taken pursuant to the water allocation will be deemed to have been taken prior to any other allocation listed on the water account.

6.8 Transfers

36. Subject to the Landscape Act²⁵, the holder of a water licence:
- a) may transfer the water licence to another person; or
 - b) may transfer a water access entitlement, or part of a water access entitlement under the licence, to another person.
37. A water licence or water access entitlement may only be transferred to another person where it remains a water licence or water access entitlement for the Consumptive Pool from which it was initially granted.
38. The transfer of a water licence or water access entitlement may be absolute or for a limited period.
39. Subject to the Landscape Act²⁶, the holder of a water allocation may transfer the water allocation, in part or in full, to another person for the period of time for which the allocation is current (up to 12 months).
40. A water allocation may only be transferred to another person where it remains a water allocation for the Consumptive Pool from which it was initially granted.

25 Section 125 of the Landscape Act

26 Section 132 of the Landscape Act

7 MANAGEMENT OF THE TAKE AND USE OF WATER

Water affecting activities are managed by the objectives and principles set out in the South Australian Arid Lands Landscape Board's Water Affecting Activities Control Policy (WAA policy). The WAA policy sets out the matters that the relevant authority will take into account when exercising a power to grant or refuse a permit for a water affecting activity²⁷. In the case of the Far North PWA, the WAA policy should not overlap with the provisions of this Plan²⁸.

The Minister is the relevant authority for the granting of permits for the drilling, decommissioning, sealing, repairing, replacing or altering the casing, lining or screen of a well; and the draining or discharging of water directly or indirectly into a well. The SAAL Landscape Board is the relevant authority for all other water affecting activity permits.



27 Section 102(3)(c) of the Landscape Act

28 Section 102(2) of the Landscape Act

This Plan sets out the matters which the Minister must take into account when deciding whether to grant or refuse a permit with respect to wells within the Far North PWA. To the extent that any of the matters set out in this Plan are inconsistent with the matters set out in the WAA policy, the matters set out in this Plan prevail.

The Landscape Act provides that a water resource works approval is required to construct, maintain or operate any works for the purposes of taking water from a prescribed water resource²⁹. A water resource works approval must specify the site where the work/s are located and the nature and extent of the work/s that are authorised³⁰.

A water resource works approval enables a person with a water licence to extract their water allocation from the resource through the works (well) listed on the approval. Water cannot be taken from the resource without a water resource works approval. The only exception to this is if the works are maintained or operated for a purpose other than the purpose of taking water, for example for the purposes of taking petroleum. In this case a water resource works approval is not required, as such management for this purpose of use is controlled through conditions on the water allocation (see [section 6.7](#) of this Plan). As a water resource works approval is specific to a particular location, applicants are advised to secure a water resource works approval prior to applying to the Minister for a water licence to ensure the water will be authorised to be extracted from the chosen location of take.

7.1 General Principles

The principles in the following sections aim to ensure that an authorisation to construct, maintain, operate, and take water from a well in the Far North PWA only be granted in circumstances where the Minister is satisfied that the construction, maintenance and operation of the well and the taking of water from the well and the proposed manner of taking, will not damage disturb or interfere with a site of cultural significance and will not have an undesired impact upon, and has consideration of:

- a) the water resource;
- b) GAB springs;
- c) refuge non-spring GDEs; or
- d) existing water users.

29 Section 104(5)(a) of the Landscape Act

30 Section 135(1)(a) of the Landscape Act

7.2 The Management of Water Wells

A permit is required for the drilling, decommissioning or sealing of a well and the repairing, replacing or altering of the casing, lining or screen of a well³¹. Further, the Landscape Act states that a person must not construct, maintain or operate any works for the purposes of taking water from the relevant water resource unless authorised to do so by a water resource works approval³².

Wells constructed, operated and maintained for the purpose of taking water that does not require a water allocation are exempt from requiring a water resource works approval³³. However, a permit under the Landscape Act is still required.

For the purpose of this Plan, 'well' has the same meaning as stated in the Landscape Act and means:

- *An opening in the ground excavated for the purpose of obtaining access to groundwater;*
- *An opening in the ground excavated for some other purpose but that gives access to groundwater; or*
- *A natural opening in the ground that gives access to groundwater.*

It should be noted that springs comprise natural openings in the ground that give access to groundwater, and therefore they are wells for the purposes of the Landscape Act. The owner of the land on which a spring resides requires a water access entitlement if water from the springs is to be used for a purpose which requires a licence, such as stock watering.

The occupier of land on which a well is situated is subject to a general obligation to ensure that the well, including the casing, lining, and screen of the well, the headworks of the well and the mechanism (if any) used to cap the well, are properly maintained³⁴. Similarly, it is the responsibility of the holder of a water management authorisation to purchase, install and maintain an appropriate water accounting mechanism³⁵ as defined within the Far North Prescribed Wells Area Water Accounting Implementation Plan, and not the Minister or the Department.

41. A permit to drill a well in the Far North PWA may only be granted 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 current edition of the *Minimum Construction Requirements for Water Bores in Australia*, as amended from time to time, or any subsequent edition.

31 Section 104(3)(a) and (b) of the Landscape Act

32 Section 104(5)(a) of the Landscape Act

33 Section 104(6)(a) of the Landscape Act and regulation 19(4) of the Landscape South Australia (Water Management) Regulations 2020

34 Section 119 of the Landscape Act

35 South Australian Licensed Water Use Metering Policy

42. A permit to drill a well in the Far North PWA may only be granted if the Minister is satisfied that the proposed location of the well (coordinates) will meet the criteria set out in [sections 7.3](#) and [7.4](#) of this Plan.
43. Principle 42 does not apply if the well is:
- a) replacing an existing production well, that is authorised for the purpose of taking a water allocation and is to be located no further than 50 metres from the well being replaced, and if located within the 100 m environmental buffer for Refuge Non-Spring GDEs, is located no closer to the Refuge Non-Spring GDEs protected by the buffer than the well being replaced; or
 - b) located outside of both Zone A and the 100m buffer for Refuge Non-Spring GDEs, is not going to intercept the GAB aquifer, is further than 300m from an existing operational production well intercepting the same aquifer owned by another party, and the volume proposed to be extracted from the well is equal to, or less than, that authorised for taking from the existing works on the applicants existing water resource works approval; or
 - c) drilled into the unconfined aquifer within the areas identified as Refuge Non-Spring GDEs or environmental buffers in [Figure 2.2](#), the volume proposed to be extracted from the well is equal to, or less than, that authorised for taking from the existing works on the applicants existing water resource works approval, and the applicant has demonstrated to the satisfaction of the Minister that the taking of water from the well will not detrimentally impact upon the groundwater levels required to maintain the ecology of the associated groundwater dependent ecosystem by providing the relevant information required by the flow chart in [Figure 2.3](#); or
 - d) to be used solely for monitoring purposes³⁶.
44. Principle 43(a) does not apply to wells located within Zone A.
45. A permit to drill a well within a native title determination area, or an area where native title has not been extinguished within the Far North PWA is subject to referral for comment. The referral recipient has 60 days to respond to the request. In cases where an Indigenous Land Use Agreement (ILUA) exists which refers to matters relating to water and the drilling of wells, this will be consulted prior to referring the application. The native title determination areas current at the date of adoption of this Plan are displayed in [Figure 3.1](#).

36 See [Glossary](#)

7.3 The Management of the Taking of Water

46. A water resource works approval for the taking of water from a 'new well'³⁷ will only be granted if the proposed taking of water meets the criteria for 'Taking Water from a Well' in [section 7.4](#) below.
47. Principle 46 does not apply where the well is to be used for investigation purposes, where the total volume to be extracted does not exceed 2 ML per program, per year, and the well is located further than 5 km from a spring (outside of Zone A).

7.4 Taking Water from a Well

48. Subject to principle 50 and the transitional provisions in [section 7.9](#) of this Plan, a water resource works approval, which permits the taking of water from a 'new well', will only be granted or varied where:
- a) the applicant has demonstrated to the satisfaction of the Minister that the taking of water from the well is unlikely to impact on the ability of another water licence holder to access water through an existing operational production well unless by agreement with the existing licence holder; and
 - b) the water is proposed to be taken from a well located outside of Zone A and Zone B within the Great Artesian Basin and the applicant has demonstrated to the satisfaction of the Minister that the taking of water from the well will not result in a cumulative decline in groundwater pressure of 1 m or more at the boundary of Zone B, in reference to February 2009, when measured anywhere at the boundary of Zone B or as measured by any other means determined by the Minister; or
 - c) the applicant has demonstrated to the satisfaction of the Minister that the taking of water from the well within the Great Artesian Basin will not result in a cumulative drawdown in excess of 10% of the potentiometric surface measured above ground level, measured at the state border with Queensland, New South Wales or the Northern Territory, in reference to February 2009, or as measured by any other means determined by the Minister. In cases where the drawdown exceeds 10% a water resource works approval can be granted or varied only in consultation with the relevant interstate authority; or
 - d) the well, having previously been used for mining or petroleum production purposes, and being proposed to be used for an alternative purpose:
 - i) has been converted from a mineral or petroleum well to a water well and meets the current edition of the *Minimum Construction Requirements for Water Bores in Australia*; and
 - ii) a transfer of ownership has been sought through the Department and a deed of transfer has been signed by both parties and provided to the Department.

37 See [Glossary](#)

49. Subject to principle 50 and the transitional provisions in [section 7.9](#) of this Plan, a water resource works approval will not be granted or varied:
- a) for the taking of water from a well located within Zone A, unless, the applicant has demonstrated to the satisfaction of the Minister that the water taken from the well will not detrimentally impact upon the groundwater levels or groundwater pressure levels and gradients required to maintain the ecology of the associated spring or springs; or
 - b) for the taking of water from a well within the Great Artesian Basin located within Zone B, unless the applicant has demonstrated to the satisfaction of the Minister that the taking of water from the well will not result in a cumulative decline in groundwater pressure of 0.5 m or more at the boundary of Zone A, in reference to February 2009, when measured anywhere at the boundary of Zone A or as measured by any other means determined by the Minister; or
 - c) for the taking of water from a well which has access to the water resources below the Eromanga Basin in the Cooper region, unless the applicant can demonstrate the capability to manage the take of water with high pressures and temperatures.
50. Notwithstanding principles 48 and 49, the Minister may grant or vary a water resource works approval where the applicant identifies that the criteria in principles 48 and 49 cannot be met, but can demonstrate to the satisfaction of the Minister that the granting or varying of the water resource works approval would not result in any undesired impacts to the groundwater resource, GAB springs, Refuge Non-Spring GDEs or existing users of the resource, and will not damage, disturb or interfere with any site of cultural significance or diminish the cultural value of a spring. In determining the impact upon the cultural value of the site, the applicant must consult the relevant Registered Native Title Body Corporate and/or other relevant Aboriginal peoples and communities.

7.5 Draining or Discharging Water into a Well

A permit is required for the draining or discharging of water directly or indirectly into a well³⁸. In addition, the drainage and discharge of water into a well must comply with the *Environment Protection Act 1993* and any associated policy.

Note: Injection of water containing water treatment chemicals or antibiotics, with a discharge volume greater than 50 kilolitres per day, also requires authorisation under the *Environment Protection Act 1993* which may be in the form of a licence issued by the Environment Protection Authority.

51. Prior to the granting of a permit to drain or discharge water into a well the following is required to be undertaken by the applicant 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 (DOE 2008)*, 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.
52. Principle 51 does not apply to water drained or discharged into a well by means of gravity, or roof 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.
53. A permit may only be granted 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 discharging will have no negative consequence on:
 - 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; or
 - f) buildings, roads and infrastructure due to direct or indirect damage.

38 Section 104(3)(c) of the *Landscape Act*

54. When granting a permit to drain or discharge water into a well the Minister may give consideration to endorsing a condition on the permit which requires the permit holder to provide an annual drain and discharge report which 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 where applicable each month;
 - b) the groundwater level/pressure for the relevant aquifer accessed by the injection well/s, as measured by wells specified on the permit, at intervals specified on the permit (where applicable);
 - 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*

7.6 Conditions on Water Resource Works Approvals

Pursuant to the Landscape Act³⁹, a water resource works approval is subject to conditions prescribed from time to time by the regulations, specified from time to time by the relevant water allocation plan, or endorsed on the approval by the Minister.

55. All water resource works approvals which authorise the taking of water from a well are subject to the following conditions:
- a) water must only be taken from the nominated works described on this approval; and
 - b) water taken from the well authorised by this approval must be taken in a manner consistent with the Water Accounting Implementation Plan for the Far North PWA and the approval holder must report the volume of water actually taken during the water use year to the Department by the following date [insert relevant date]; and
 - c) the headworks of the well from which the water is taken pursuant to this approval must be maintained and constructed so that the extraction of water from the well can be accounted for without interference; and
 - d) the taking of water from the well authorised by this approval must not exceed the maximum annual water extraction limit of [insert maximum annual water extraction limit for the works]; and
 - e) the approval holder must complete an Annual Water Use Report if authorised to take more than 1 ML/day, in a form approved by the Minister for each water use year. Water resource works approvals issued for the purpose of stock and domestic water use are exempt from requiring to complete an Annual Water Use Report. The Annual Water Use Report must be submitted to the Minister on or before 31 December after the end of the water use year to which the report relates and will include:
 - i) the volume of water actually taken through a water accounting mechanism during the water use year (at intervals specified by the Minister);
 - ii) the salinity of the water taken from the aquifer measured once throughout the water use year; additionally if the taking of water from the well results in a salinity rise of greater than 10%, in relation to the groundwater salinity measured over the preceding 5 years at the point of taking, the cause for the rise of salinity may be required to be investigated by the licensee; and
 - f) where appropriate additional monitoring may be required at the request of the Minister; and if the land upon which the well authorised by this approval is located is subject to a change of ownership or, in the case of a pastoral lease, a change in the holding of that lease (e.g. by expiry, cancellation, relinquishment or surrender) then, unless this approval has been varied to reflect that change, it will expire on the following 30 June.

³⁹ Section 135(1)(c) of the Landscape Act

56. Further to principle 55(d), the maximum annual water extraction limit for the works can be varied as required in relation to a trade of allocation, or increase in water access entitlement, subject to meeting the criteria specified in principles 48 to 50.
57. Further to principle 55(d), the maximum annual water extraction limit for the works will reduce in response to a permanent reduction in the water access entitlement (either through transfer or surrender) associated with the approval.
58. The conditions specified in principle 55 are additional to, and subject to the conditions endorsed on a water resource works approval issued pursuant to [section 7.9](#) of this Plan and any additional conditions endorsed by the Minister⁴⁰.

7.7 The Management of the Use of Water

The Landscape Act states that a person must not use water taken from a prescribed water resource unless authorised to do so by a site use approval, except in prescribed circumstances⁴¹. A site use approval must specify the purposes for which the water is proposed to be used, the place at which the water is proposed to be used and prescribed information about the proposed extent, manner and rate of use of the water⁴². A person is exempt from the requirement to have a site use approval if the water allocation plan for the prescribed resource provides the specified circumstances or situations in which no site use approval is required⁴³.

59. For the purposes of this Plan, a site use approval is not required, except where water is used for:
 - a) bore-fed wetlands; or
 - b) watering of stock, where the water is taken from a priority spring (natural well).

40 Section 135(1)(c)(iii) of the Landscape Act

41 Section 104(6)(b) of the Landscape Act

42 Section 141(1)(a) of the Landscape Act

43 Section 104(6)(b) of the and Landscape Act and regulation 19(2) of the Landscape South Australia (Water Management) Regulations 2020

7.8 Conditions on Site Use Approvals

A site use approval may be subject to conditions as specified by the relevant water allocation plan⁴⁴.

60. Subject to principle 59(a), a site use approval for a bore-fed wetland is subject to the following conditions:
- a) the water must be used in accordance with the relevant Wetland Management Plan, or
 - b) if a Wetland Management Plan does not exist, one shall be prepared by the applicant to the satisfaction of the Minister, which outlines the rate at which water can be used at the site to maintain the values of the wetland with a minimal amount of bore flow (the maximum permissible volume of bore flow), and
 - c) the use of water at the site shall not exceed the maximum permissible volume of bore flow as identified by the relevant Wetland Management Plan.
61. Subject to principle 59(b), a site use approval for the watering of stock where the water is taken from a priority spring, is subject to the following conditions:
- a) the use of water from a priority spring must not disturb the processes or structures required to maintain the ecological functionality of the spring.
62. Additional conditions may be endorsed on a site use approval at the Ministers discretion.

7.9 Transitional Arrangements

63. At the date of adoption of this Plan, the holder of an existing water licence may be granted a water resource works approval or a site use approval under this Plan. The Minister may give consideration to endorsing conditions on the approval consistent with the conditions specified in [section 7.6](#) or [7.8](#) of this Plan.
64. When issuing a water resource works approval pursuant to principle 63, the Minister may give consideration to endorsing a condition on the approval which restricts the volume of water which may be extracted by means of the works to which the approval relates (“maximum annual water extraction limit”).
65. The maximum annual water extraction limit referred to in principle 64 should be equivalent to the volume of water issued on the water access entitlement at the date of adoption of this Plan.

44 Section 142(1)(c)(ii) of the [Landscape Act](#)

8 MONITORING, EVALUATION, REPORTING AND IMPROVEMENT

The objectives of this Plan ([section 1.9](#)) aim to ensure that water is allocated from the groundwater resources within the Far North PWA in a manner which does not result in undesired impacts to the GAB springs, refuge non-spring GDEs, the ability of existing users to maintain access to water, and will not damage, disturb or interfere with any site of cultural significance.

In order to assess the success of this Plan in achieving the objectives, a Monitoring, Evaluation, Reporting and Improvement (MERI) Plan shall be prepared to guide the development of a suitable monitoring program of; groundwater levels/pressures, groundwater salinity, extraction of groundwater and ecological characterisation, throughout the life of this Plan. The information collected through the MERI Plan will enable a robust review of the effectiveness of the principles in [sections 6](#) and [7](#) in achieving the objectives of this Plan.

The monitoring requirements below provide an outline of the monitoring required, refinement of the monitoring may be undertaken by the Board at intervals throughout the life of this Plan.



8.1 Groundwater Monitoring

Sufficient monitoring of groundwater levels/pressures and groundwater salinity is required to enable an assessment of whether the principles in this Plan have been successful in achieving the objectives.

The Department maintains a baseline monitoring groundwater level and salinity network for the GAB aquifers which provides for *“regular observations to allow evaluation of the state and condition of a water resource and to inform knowledge of the long term baseline trend of the resource. Baseline surveillance sites provide a continuous long term data-set that provides information for assessing the health of a resource over time”* (Carboon and Chapman 2015).

The baseline monitoring network currently consists of 65 wells in the GAB aquifer which monitor groundwater level/pressure and 50 wells which monitor salinity on a bi-annual to annual basis. The monitoring needs may be reviewed, but will be maintained at a spatial and temporal scale sufficient to enable the assessment of the change in condition of water levels/pressures and salinities in the regional GAB aquifers. The monitoring locations at the date of adoption of this Plan can be seen in [Figure 8.1](#). Groundwater monitoring sites in the aquifers overlying and underlying the GAB may be required to assess the impacts on the resource due to the taking of water from these aquifers.

Holders of water resource works approvals, if taking more than 1 ML/day, are required to complete an Annual Water Use Report as a condition of the approval. Water resource works approvals issued for the purpose of stock and domestic water use are exempt from requiring to complete an Annual Water Use Report. The Annual Water Use Report requires the holder of the approval to collect a salinity sample from the aquifer/s from which the wells listed on the approval are authorised to take water, once throughout the water use year. This will provide valuable information about the salinity of water resources utilised for the taking of water from within the Far North PWA.

Monitoring of the water level and salinity throughout the life of this Plan will provide information to assess the success of the principles in this Plan to achieve the objectives.

8.2 Groundwater Dependent Ecosystem Monitoring

Sufficient monitoring of representative groundwater dependent ecosystems is required to enable an assessment to determine if the principles in this Plan have been successful in achieving the objectives.

The water needs of groundwater dependent ecosystems are described in [section 2](#) and [Appendix B](#) of this Plan and the principles for the maintenance and protection of GAB springs and refuge non-spring GDEs are included in [sections 6](#) and [7](#). In order to evaluate the success of these provisions, a program targeting priority environmental assets in areas where extraction is occurring and at representative control sites is required to observe changes in critical hydrogeological and ecosystem parameters.

8.3 Accounting for Water Use from the Groundwater Resource

The Department will keep a record of the licensed groundwater extractions from the Far North PWA in the State Water Register. South Australia's default policy is that all licensed water use shall be metered. However, the policy allows for implementation to be sufficiently flexible to recognise on-ground regional implementation issues. Meter (water accounting) implementation plans are the mechanism used to document and consistently apply any exemptions or alternative methods of measurement. It is acknowledged that there are a number of complexities associated with metering in the Far North PWA, such as artesian conditions and measuring water at high pressures and temperatures. The Department will work with the Board and water users to determine how water take can be accounted for in a reasonable manner. This feedback will be considered in the development of a Water Accounting Implementation Plan for the Far North PWA.

8.4 Compliance with Conditions on Authorisations

The monitoring data obtained in [sections 8.1 to 8.3](#) will assist in determining compliance with any conditions placed on a water licence, water access entitlement, water allocation, water resource works approval or site use approval and any relevant permits.

8.5 Evaluation

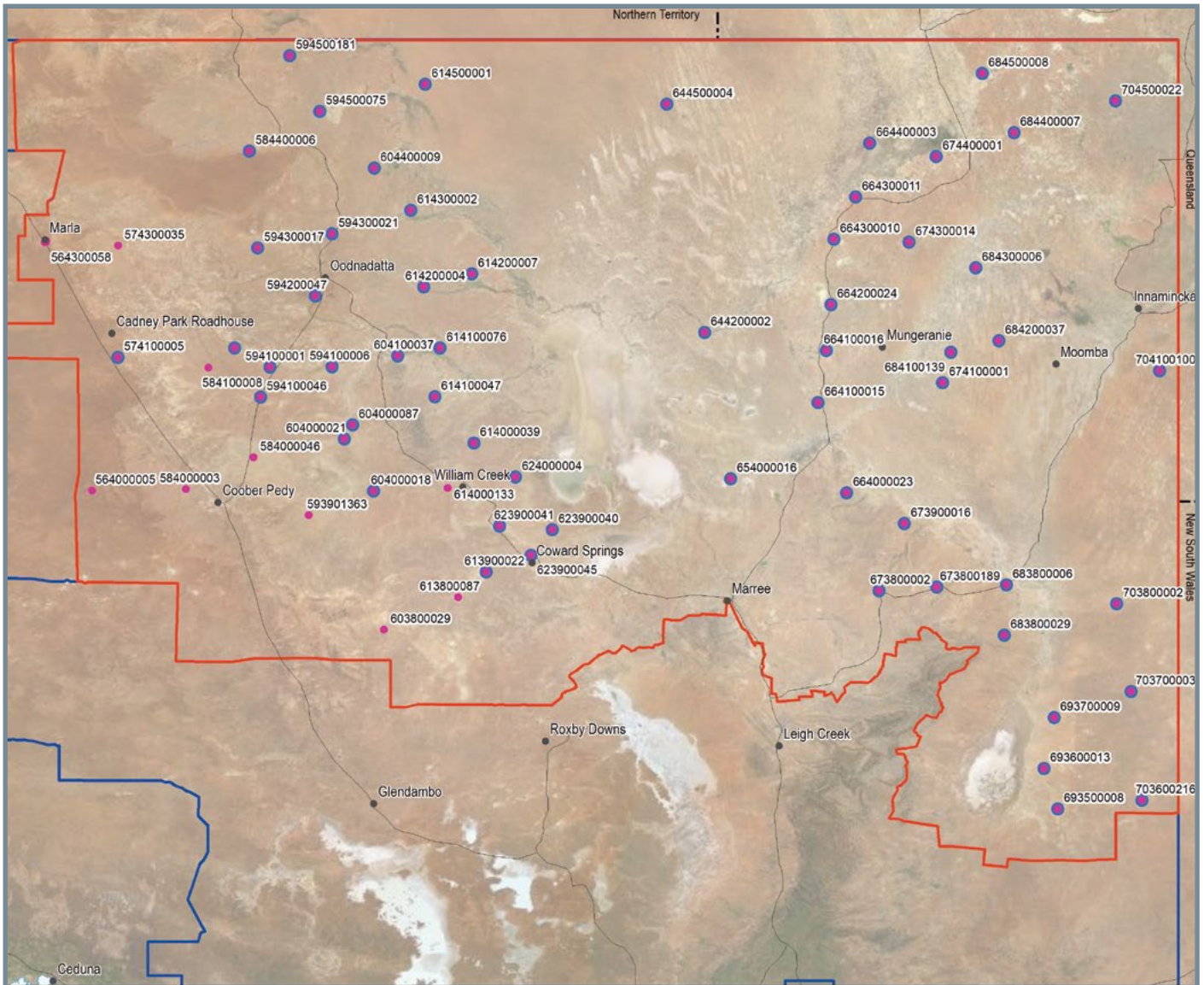
Evaluation is required at different stages to assess changes in the condition of groundwater resources and dependent ecosystems, to periodically assess the effectiveness of this Plan in meeting objectives, and to inform future reviews.

Evaluation of monitoring data will be undertaken in a manner that considers the groundwater and groundwater dependent ecosystems condition trends, primarily in relation to the proximity of water affecting activities in the vicinity of GDEs, but also recognising that other factors such as climate variability and land management may be contributing to observed GDE condition.

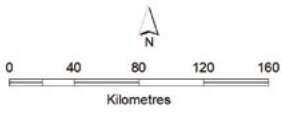
Further detail regarding the content, timing and responsibility for evaluation activities, including stakeholders to be engaged throughout the process (such as Departmental and Board personnel, industry representatives, university researchers, First Nations groups and relevant conservation-based non-governmental organisations) will be determined by the Board in their MERI Plan which will be developed as an implementation task of this Plan.

FIGURE 8.1

Groundwater Monitoring Locations in the Far North PWA



- Locations
- Water Level Monitoring Network
- Salinity Monitoring Network
- Road
- ▭ Far North Prescribed Wells Area
- ▭ SAAL Landscape Region



Produced by: Water Group
 Department for Environment and Water
 Map Datum: Geocentric Datum of Australia 1994
 Date: May 2020

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9 CONSISTENCY WITH OTHER PLANS AND LEGISLATION

This Plan was developed having regard to:

- the Aboriginal Heritage Act 1988
- the Development Act 1993
- the Environment Protection Act 1993
- the Environment Protection and Biodiversity Conservation Act 1999 (Cth)
- the Intergovernmental Agreement on a National Water Initiative , Council of Australian Governments 2004
- the Landscape South Australia Act 2019
- the Mining Act 1971
- the Natural Resources Management Plan for the South Australian Arid Lands Natural Resources Management Region 2017
- the Pastoral Land Management and Conservation Act 1989
- the Petroleum and Geothermal Energy Act 2000
- the Planning Development and Infrastructure Act 2016
- Water for Good: A Plan to Ensure our Water Future to 2050, Government of South Australia 2010
- the Great Artesian Basin Strategic Management Plan (Cth)
- the Water Act 2007 (Cth)



Units of Measurement

km² = Square kilometers

kL = Kilolitre (1000 litres)

ML = Megalitre (1,000,000 litres)

ML/d = Megalitres per day

GL = Gigalitre (1,000 megalitres)

Shortened Forms

Board – South Australian Arid Lands Landscape Board

BoM – Bureau of Meteorology

DEW – Department for Environment and Water

GDE – Groundwater Dependent Ecosystem

NWI – the Intergovernmental Agreement on a National Water Initiative

PIRSA – Department of Primary Industries and Regions South Australia

Plan – Water Allocation Plan

PWA – Prescribed Wells Area

Glossary

Aboriginal: Descendants of the original inhabitants existing in a land from the earliest times or from before the arrival of colonists. Aboriginal is used throughout this Plan instead of “Indigenous” as endorsed by the former SA Aboriginal State-wide Advisory Committee.

Allocation: See Water Allocation.

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

Aquitard: A layer in the geological profile that separates two aquifers and restricts the flow between them.

Artesian: An aquifer in which the water surface is bounded by an impervious rock formation; the water surface is at greater than atmospheric pressure, and hence rises in any well which penetrates the overlying confining aquifer.

Bore-fed wetland: A wetland which is maintained by water supplied by a well.

Buffer zone: An area within which certain management objectives exist in order to protect a specific water resource or groundwater dependent ecosystem.

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 Landscape Act, as determined by this Plan.

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

Date of adoption: The date that the Minister adopts this Plan.

Decommissioning: The permanent closure of a well no longer in use.

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 Landscape Act, at the date of adoption of this Plan it is the Department for Environment and Water.

Domestic purpose: Water to be used in the running of a dwelling including cooking, cleaning and bathing, in addition to water required to maintain gardens and swimming pools associated with the property, enable wash down of trucks and other vehicles as required, and any other domestic purposes required by the owner or lessee.

Dwelling: a structure on the property which is able to house people for some or part of the year and water would be required to enable usage of the dwelling.

Eromanga Basin: A large Mesozoic sedimentary basin, which in South Australia is synonymous with the Great Artesian Basin.

Existing operational production well: Either a well (unit number) that is identified on a water resource works approval issued for the Far North PWA, or a well which is known by the Department as part of a condition on an allocation as an existing operational production well.

Existing user: A person who held a water licence under the previous Far North Prescribed Wells Area Water Allocation Plan.

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

First nations: A group or community of Aboriginal people who identify as descendants of the original inhabitants of the Plan area and may share a single common territory, or may be located as a nation within another larger nation. Where a native title determination has been made the native title holders will have native title interests within the nation and is the body that the Board will deal with for native title. It may also be the legal entity that represents the nation for other purposes or be included as a member of a wider group representing a nation (e.g. a Regional Authority).

Groundwater: Water occurring naturally below ground level or water pumped, diverted and 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 taking water from an underground source, either temporarily or permanently.

Hydraulic gradient: In unconfined groundwater, the mean watertable gradient in the direction of groundwater flow. In confined aquifers, the pressure gradient in the direction of flow.

Hydrocarbon: a compound of hydrogen and carbon, such as any of those which are the chief components of petroleum and natural gas.

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

Indigenous Land Use Agreement (ILUA): a voluntary agreement between a native title group and another party about the use of lands and waters within the native title area to allow people to negotiate flexible, pragmatic agreements to suit their particular circumstances, An ILUA can exist where native title has or has not yet been determined and can be part of a native title determination or settled separately from the native title claim.

Intensive farming: As per the Landscape Act as being “*a method of keeping animals in the course of carrying on the business of primary production in which the animals are usually confined to a small space or area and usually fed by hand or by a mechanical means*”.

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

Licence: see ‘water licence’.

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

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

Megalitre (ML): one million litres.

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

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

Monitoring purposes: For the purposes of monitoring the groundwater resource, including water level/pressure or salinity. Excludes any purpose which requires the taking of water, such as aquifer pump tests.

Native groundwater: Water occurring naturally below ground level that exists in the relevant aquifer absent of any such water drained or discharged to that aquifer by artificial means.

New well: Either a newly drilled or existing well which has not previously been authorised for the taking of water on a licence under the previous Plan or on a water resource works approval under this Plan

Non-consumptive use: water for maintaining natural processes, including but not limited to aquifer throughflow and discharge, and water for groundwater dependent ecosystems.

Non-spring GDEs: Locations in the Far North Prescribed Wells Area where it is considered likely based on data available that the taking of shallow groundwater has the potential to impact upon GDEs.

NRM Act (the): The *Natural Resources Management Act 2004*.

Opening and closing readings: The likely volume of water extracted during the water use year, being the period 1 July to 30 June, as determined/estimated by the water accounting mechanism.

Person: As per the *Acts Interpretation Act 1901* being “expressions used to denote persons generally (such as “person”, “party”, “someone”, “anyone”, “noone”, “one”, “another” and “whoever”), include a body politic or corporate as well as an individual”.

Potentiometric surface: The level to which water rises in a well due to the water pressure in the aquifer, measured in meters above sea level.

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

Prescribed Wells Area (PWA): An area of land within which wells are prescribed.

SA Geodata database: A collection of linked databases storing geological and hydrogeological data, which the public can access through the offices of the Department of Primary Industries and Regions SA. Custodianship of data related to minerals and petroleum and groundwater, is vested in PIRSA and DEW, respectively. DEW should be contacted for database extracts related to groundwater.

Site of cultural significance: Sites identified as a site of cultural significance by a Registered Native Title Body Corporate or an Aboriginal person.

Site use approval: An approval which permits the use of water at a specific site for a particular purpose, issued under section 142 of the Landscape Act.

Stock water use: The taking of water to provide drinking water for stock other than stock subject to intensive farming.

Throughflow: Shallow groundwater flow through a soil sub-parallel to a hillside. If the underlying rock is reasonably permeable, then the infiltrated water percolates vertically, and there is no throughflow.

Unacceptable impact: An impact, or likely impact, upon the groundwater resource due to the taking of water, which exceeds the thresholds specified in the principles within this Plan.

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

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 Landscape Act, as specified by the licence and after taking into account any factors specified by the relevant water allocation plan or prescribed by the regulations.

Water Accounting Implementation Plan: A publicly available plan for the implementation of water accounting measures for a particular prescribed water resource. The plan identifies the flexibility provisions and the process for seeking metering flexibility to sufficiently recognise on-ground regional implementation issues. In other prescribed areas this is known as a Metering Implementation Plan.

Water allocation: The water obtained on account of a water access entitlement under a water licence as per section 127(1)(a) of the Landscape Act. A 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 water allocation that has been provided by the Minister under the terms of a water licence as per section 127(2)(b) of the Landscape Act. A water allocation will relate to a specified period of no more than 12 months as per section 127(8) of the Landscape Act.

Water allocation plan: A plan prepared by a landscape board and adopted by the Minister in accordance with Part 4 Division 2 of the Landscape Act.

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

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

Water resource works approval: An approval which permits the construction, operation and maintenance of works for the purpose of taking water from a prescribed water resource at a specific location and in a particular manner, issued under section 135 of the Landscape Act.

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

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

Wetland: An area that comprises land that is permanently or periodically inundated with water (whether through a natural or artificial process) where the water may be static or flowing and may range from fresh water to saline water and where the inundation with water influences the biota or ecological processes (whether permanently or from time to time).

Wetland Management Plan: A plan for a bore-fed wetland which, amongst other things, outlines the rate at which water can be used at the site to maintain the values of the wetland with a minimal amount of bore flow.

Zone of influence: The area around a pumped well in which there is detectable drawdown due to the taking of water.

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DEWNR – see Department of Environment, Water and Natural Resources

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NWC – see National Water Commission

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SAALNRMB – see South Australian Arid Lands Natural Resources Management Board

SARIG – see South Australian Resources Information Gateway

SATC – see South Australian Tourism Commission

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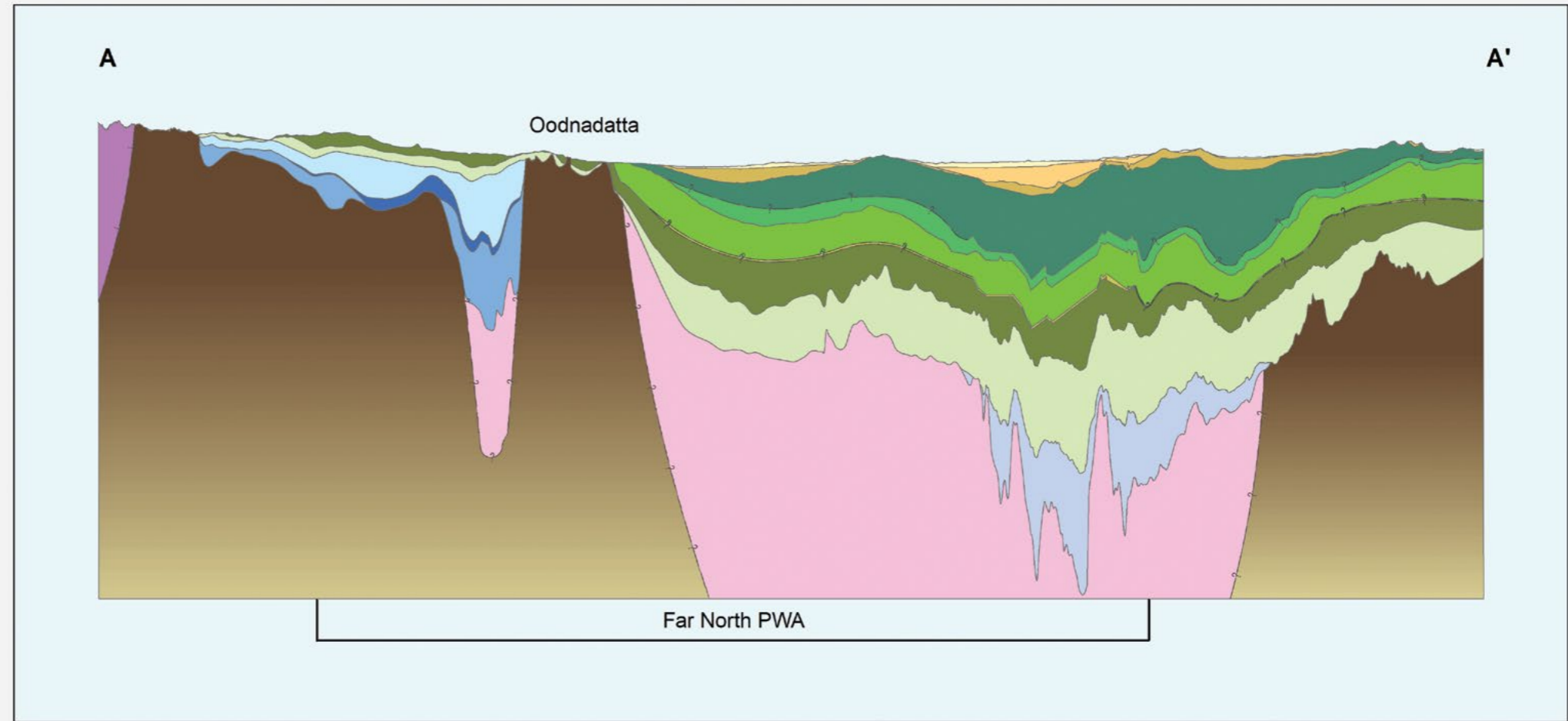
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APPENDIX A

Hydrostratigraphy of the Far North Prescribed Wells Area

FIGURE A.1

Cross section schematic of the Far North PWA Hydrostratigraphy (prepared by Mark Keppel)



Hydrostratigraphy

- | | |
|--|---|
| <p>Lake Eyre Basin</p> <ul style="list-style-type: none"> Quaternary sediments Namba Formation Eyre Formation <p>Rolling Downs Group</p> <ul style="list-style-type: none"> Winton Formation Mackunda Formation Oodnadatta Formation/ Allaru Mudstone Coorikiana Sandstone Bulldog Shale <p>Great Artesian Basin</p> | <p>Arckaringa Basin</p> <ul style="list-style-type: none"> J-K aquifer (GAB) Mount Toondina Formation Stuart Range Formation Boorthanna Formation Cooper Basin (Permian) sediments Officer Basin sediments Warburton Basin sediments Precambrian Basement |
|--|---|



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 SA_Geodata, DEWNR, DSD
 18 January, 2017
 Projection Lambert Conformal Conic
 Datum Geocentric Datum of Australia, 1994

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FIGURE A.2

Far North PWA Hydrostratigraphy (See Figure A.3 for locations and legend, adapted from DEW 2020a)

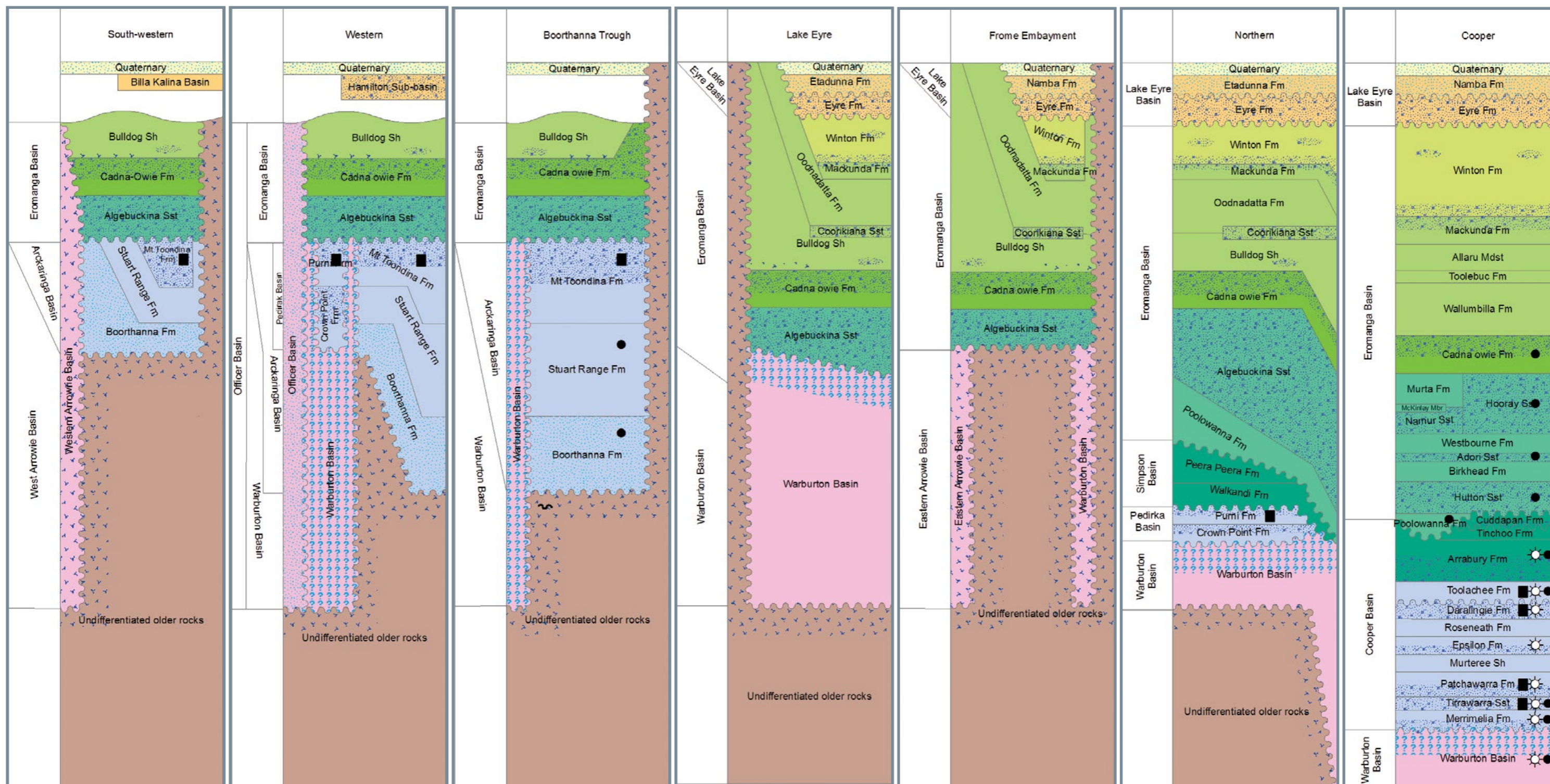


FIGURE A.3

Far North PWA Hydrostratigraphy Zones
(legend for Figure A.2 adapted from DEW 2020a)

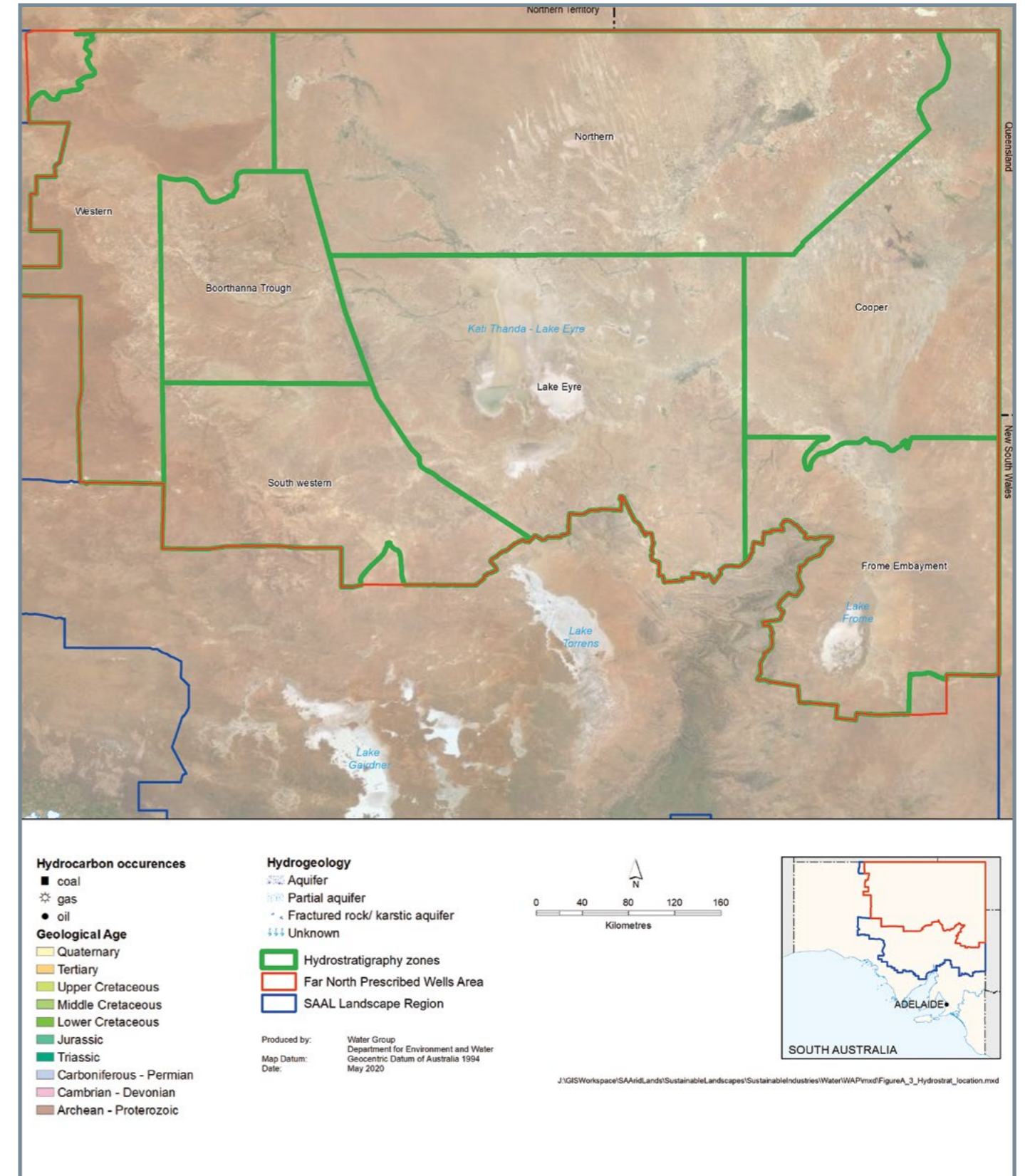


TABLE A.1

Stratigraphy and hydrostratigraphy of the units of the South Australian portion of the Lake Eyre, Great Artesian and Cooper Basins (adapted from DFW 2011)

AGE	BASIN	UNIT	LITHOLOGY	HYDROGEOLOGY		
Cenozoic	Lake Eyre Basin (Hamilton sub basin)	Undifferentiated	Aeolian sands and alluvium, lacustrine and fluvial sands, silts and clays, occasional limestone beds	Unconfined aquifer		
		Namba Formation	Alternating fine to medium-grained sand, silt and clay, with thin dolomite and limy, often oolitic, dolomite interbeds	Unconfined and confined aquitard; aquifer in many places		
		Etadunna Formation	White dolomite and limestone overlain by green and grey magnesium-rich claystone and fine sand	Unconfined and confined aquifer; aquitard in places		
Mesozoic	Great Artesian Basin (Eromanga Basin)	Eyre Formation	Fluvial, fine to medium-grained, quartz sandstone with lignite interbeds and a basal conglomerate	Unconfined, confined and artesian aquifer		
		Winton Formation	Interbedded fine to coarse-grained sandstone, carbonaceous and pyritic shale, siltstone and coal seams with conglomerates	Confined aquifers and aquitards		
		Mackunda Formation	Interbedded, partly calcareous very fine-grained sandstone, siltstone and shale	Confined aquifers and aquitards		
		Oodnadatta Formation	Laminated and thin-bedded claystone and siltstone with interbeds of fine-grained sandstone	Aquitard		
		Coorikiana Sandstone	Fine-grained, silty, glauconitic, feldspathic and lithic sandstone, minor conglomerate with dark grey siltstone and mudstone interbeds at the base	Aquifer		
		Bulldog Shale	Dark grey, bioturbated and fossiliferous mudstone with minor interbeds of micaceous siltstone and very fine-grained sandstone	Aquitard		
		Cadna-owie Formation	Pale grey siltstone with very fine to fine-grained sandstone interbeds and minor carbonaceous claystone	Unconfined, confined and artesian aquifer Leaky aquitard in some places		
		Murta Formation	Grey siltstone, shale, very fine to fine-grained sandstone, minor medium and coarse-grained sandstone. Basal siltstone in Cooper region	Aquitard		
		Namur Sandstone	White to pale grey fine to coarse-grained sandstone with minor interbedded siltstone and mudstone	Confined and artesian aquifer		
		Westbourne Formation	Interbedded dark grey shale and siltstone with minor sandstone interbeds	Aquitard		
		Adori Sandstone	Well-sorted, sub-rounded, cross-bedded, fine to coarse-grained sandstone	Confined and artesian aquifer		
		Birkhead Formation	Interbedded dark grey and brown siltstone, mudstone and buff, fine to medium-grained sandstone with thin coal seams (<0.3 m)	Aquitard		
		Hutton Sandstone	Fine to coarse-grained quartzose sandstone with minor siltstone interbeds	Confined aquifer		
		Algebuckina Sandstone	White, fine to coarse-grained quartzose sandstone with granule and pebble layers and shale intraclasts common in coarser beds	Unconfined to confined aquitard		
		Poolowanna Formation	Interbedded grey to brown carbonaceous siltstone, pale grey to buff sandstone and rare coal seams	Aquifer/aquitard		
		Palaeozoic	Cooper Basin	Cuddapan Formation	Basal sandstone with upwards increasing siltstone and coal interbeds; interbedded grey siltstone and off-white sandstone with minor mudstone	Aquifer
				Tinchoo Formation	Medium-grained quartzose sandstone. Light olive grey to brown and medium grey siltstone interbeds contain layers of coarse sand grains	Aquifer
Arrabury Formation	Mudstone and siltstone with thin fine to medium-grained quartzose sandstone interbeds overlain by sandstone with minor siltstone interbeds			Major aquitard between Cooper and Eromanga Basins		
Toolachee Formation	Interbedded buff to white, fine to coarse-grained sandstone, dark grey siltstone and dark grey to black carbonaceous shale, sometimes with thin coal seams (<3 m) and conglomerates			Aquifer		
Daralingie Formation	Carbonaceous and micaceous siltstone and mudstone, interbedded grey to brown sandstone			Both aquifer and aquitard		
Roseneath Shale	Brown-grey or olive-grey siltstone, mudstone and minor sandstone. Siltstones are micaceous with minor fine-grained pyrite. Sandstone interbeds are pale brown and fine grained			Aquitard		
Epsilon Formation	Fine to medium-grained quartzose sandstone with dark grey-brown carbonaceous siltstone and shale, and thin to occasionally thick (<2.20 m) coal seams			Aquifer		
Murteree Shale	Black to dark grey-brown siltstone and fine-grained sandstone which is more sandy in the southern Cooper Basin. Fine-grained pyrite and muscovite are characteristic and carbonaceous siltstone occurs			Aquitard		
Patchawarra Formation	Interbedded grey, buff or brown, fine to medium-grained, locally coarse-grained and pebbly sandstone, grey to black siltstone, shale and coal			Aquifer		
Tirrawarra Sandstone	Composed chiefly of brown and white, fine to coarse-grained sandstone with minor shale interbeds and rare, thin coal seams			Aquifer		
Merrimelia Formation	Conglomerate, diamictite, sandstone, conglomeratic mudstone, siltstone and shale			Aquifer		

TABLE A.2

Stratigraphy and hydrostratigraphy of the units of the Arckaringa Basin
(developed from DFW 2011)

AGE			BASIN	UNIT	LITHOLOGY	HYDROGEOLOGY
Palaeozoic	Permian	Early	Arckaringa Basin	Mount Toondina Formation	Siltstone and sandstone interbedded with shale and coal. Coal generally restricted to upper part	Confined aquifer and aquitard
				Stuart Range Formation	Grey to dark grey, sometimes brown mudstone with minor white to grey, fine to medium-grained sandstone and mid to dark grey, carbonaceous siltstone	Aquitard
	Carboniferous	Late		Boorthanna Formation	Thick sandy to bouldery, pale grey or greenish grey, often calcareous claystone overlain by medium to coarse-grained sandstone grading into siltstone or silty shale	Basal unit is a confined aquifer, upper unit is an aquitard

TABLE A.3

Stratigraphy and hydrostratigraphy of the units of the South Australian portion of the Pedirka Basin

AGE			BASIN	UNIT	LITHOLOGY	HYDROGEOLOGY
Palaeozoic	Permian	Early	Pedirka Basin	Purni Formation	Fluvial and paludal (swamp) interbedded sandstone, siltstone and claystone, as well as coal beds within the paludal sequences.	Aquifer/Aquitard
				Carboniferous	Late	Crown Point Formation

APPENDIX B

Assessment of the Water Needs of Groundwater Dependent Ecosystems: Environmental Water Requirements and Provisions

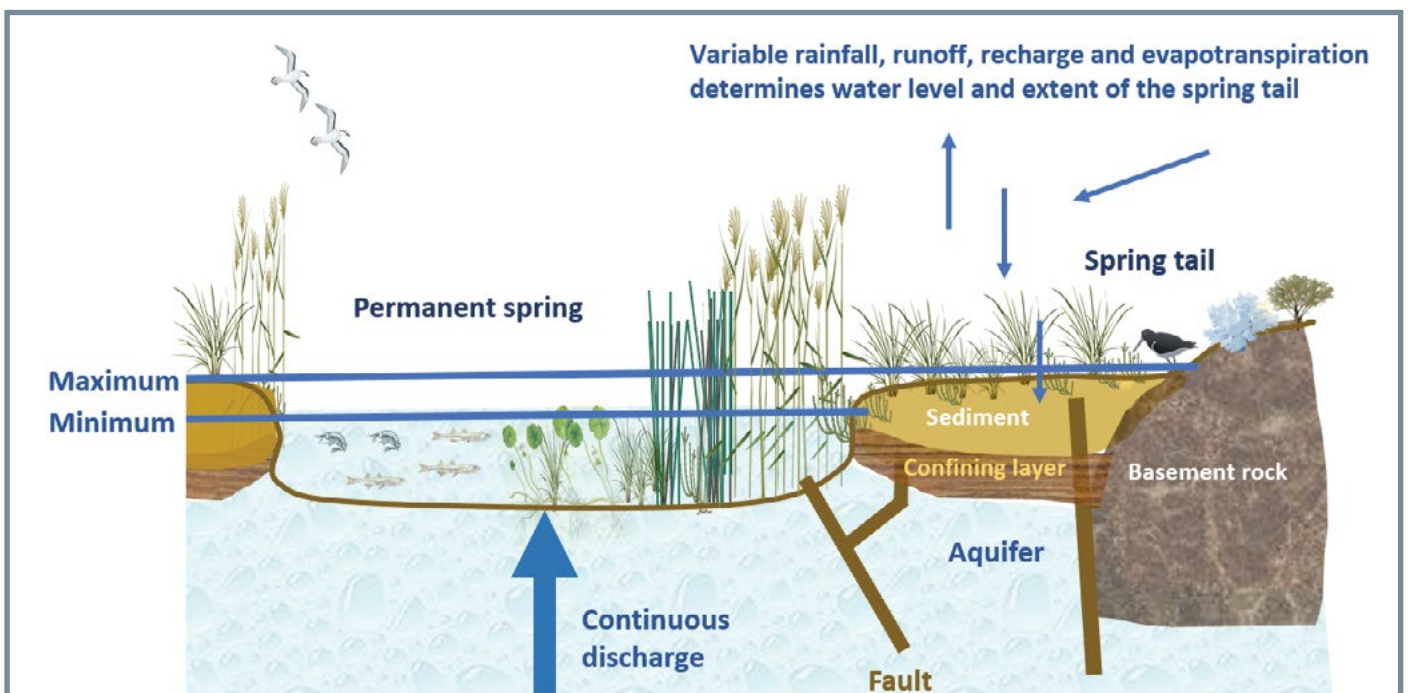
The following section provides more detail on the environmental water provisions and requirements for springs and non-spring GDEs discussed in section 2 of this Plan.

Springs

Typically, springs occur where faults in the earth’s crust provide a pathway for artesian groundwater to discharge to the soil surface, through the confining beds. This may occur where the aquifer abuts bedrock or where the pressurised water breaks through thin confining beds near the margins of the aquifer (Figure B.1; SAALNRMB 2009). This continuous discharge supports permanent spring areas within which aquatic biota such as small crustaceans, fish, snails, reeds and rushes can live. For more detailed ecohydrological conceptual modelling see Gotch *et al.* (2016) and Keppel *et al.* (2016).

FIGURE B.1

Generalised conceptual diagram of groundwater dependence of the springs in the Far North PWA



Springs in the Far North PWA typically consist of a number of vents discharging water to a surface pool, pools surrounded by a wetland, or soaks with little free surface water. The diversity and distribution of springs are determined by the flow rates, water chemistry, landscape processes and structures that characterise individual springs. These characteristics vary greatly between spring complexes and therefore springs are highly variable in size, ranging from small individual soaks to large, established spring complexes that attain a total wetland area of almost 1300 ha (Lewis *et al.* 2013). Many springs have a distinct mound associated with them and the wetland that is created from the discharge is known as the tail, which changes in spatial extent due to the combined effects of local rainfall, recharge and evapotranspiration (evaporation from the water surface plus water use by plants known as transpiration).

Spring vegetation, such as reeds and rushes, is almost entirely dependent on groundwater (Gotch 2013). Patterns of plant growth around the spring reflect the patterns of water availability, whilst the geographic position of the spring is important in determining overall plant community composition. The number of plant species (diversity) at a given spring tends to decrease from east to west across the PWA as the habitat surrounding the springs becomes increasingly arid (Gotch 2013). Several endemic and relict (were more widespread in the past) plant species have also been identified in the springs (Gotch 2005; Fensham *et al.* 2010) that have evolved independently due to their isolation (Fatchen and Fatchen 1993). Plant species will opportunistically colonise available habitat created by the formation of any new springs, the seasonal shifts in spring tails or removal of other (more palatable) plants by grazing (Gotch 2013) provided that their dispersal, colonisation and growth requirements are met. As such they are indicators of short- and long-term changes in spring water quantity, water quality and the spatial extent of the tail.

Environmental Water Requirements (EWRs) of Springs

EWRs adopted for springs in the PWA: For the entire year, sufficient groundwater pressure and volume is required to maintain an open spring vent and over the long term needs to maintain the spatial extent of the associated spring tail wetland, allowing for seasonal and multi-year fluctuations.

In determining the above EWRs for springs in the Far North PWA, water regime components such as the magnitude, frequency, duration and timing of inundation have not been detailed because the springs themselves are reliant on continuous flow of groundwater to the surface, which is not subject to defined seasonal variations. Short-term or seasonal variations in climatic factors such as evaporation, local rainfall and recharge, lead to short term changes in the extent of inundation of the tail area (**Figure B.1**). It is likely that vegetation on the outer edge of the tail would receive water less frequently (e.g. 1 in 10 years) than vegetation closer to the spring source (e.g. continuously) and this will be reflected in species composition, distribution and changes in plant health over time.

Factors such as groundwater salinity, groundwater flow rates and other environmental factors differ between springs and help determine a given spring's water requirement. The salinity and presence of other minerals in the water flowing to the springs are locally influenced by geological factors and mixing with shallow saline aquifers, surface conditions and, on a broader scale, by the different water sources within the Far North PWA (Gotch 2013). A narrow salinity range is important to maintain species diversity based on observations that the higher the groundwater salinity, the lower the species diversity in a spring. Gotch (2013) found that springs with a higher flow rate and a greater number of vents had a higher number of species, indicating that both the quantity and quality of water are important for springs. Disturbances by stock and other animals that use springs as a water source or other activities that change the surface conditions often lead to changes in surface water chemistry as well as surface structures, flow quantity and patterns. These changes can threaten the diversity and function of individual springs (SAALNRMB 2009). The strong linkages between the number of active vents in a group and the abundance of species, suggests that the springs in the Far North PWA can be treated in this Plan as a management unit rather than identifying EWRs for individual springs (Gotch 2013).

Non-spring GDEs

The presence of diverse GDEs across a landscape is driven by variations in groundwater flows across time and area that are related to geology, climate and land use (Doody *et al.* 2019).

For some of these non-spring GDEs groundwater inflows and local recharge are known to be essential for sustaining ecological populations between floods and maintaining the health of mature adult species. This allows for successful recruitment, dispersal and recolonisation when river flows or floods do occur. The significance of groundwater discharge for other GDEs, such as salt lakes is not as well understood with respect to direct effects on the lake's water and salinity levels or indirect effects through changes to base flow in creeks feeding the lakes (SAALNRMB 2009).

While it is known that some contain populations of unique, endemic and threatened fauna and flora there are also many that have not been studied. It is widely recognised that many GDEs have immense cultural importance, to both Aboriginal and non-Aboriginal people.

Non-spring GDEs across the Far North PWA can be categorised into 6 key GDE types:

1. Channel floodplain - example: Kallakoopah Creek
2. Permanent waterhole - example: Algebuckina waterhole
3. Semi-permanent waterhole - example: Hookies Waterhole
4. Ramsar - example: Coongie lakes.
5. Isolated local aquifers - example: Small valleys identified in vicinity of Hookies Waterhole
6. Terminal lakes - example: Lake Hope

A risk assessment was undertaken by the Department for Environment and Water (2020b) in preparation of this Plan, for the purposes of identifying the non-spring GDE types listed above which are likely to be at risk due to the taking of shallow groundwater and therefore may require a management response in this Plan.

The risk assessment considered what the likelihood and consequence of taking groundwater from the shallow aquifers at a rate of 10 ML/year (the likely extraction rate per well intercepting the shallow aquifers) for an ongoing period of 30 years, would have on the non-spring GDE type.

Of the non-spring GDE types listed above, only the isolated local aquifers GDE type was identified as being at a moderate risk due to the taking of shallow groundwater, whilst the remaining GDE types were assigned a low level of risk ([Figure B.3](#)). It should be noted that the uncertainty surrounding the impact of taking water in proximity to these sites is higher than other GDE types given the uncertainty around the extent of the aquifer providing water to these sites. A higher uncertainty results in a higher risk assignment. As more information is acquired in relation to this GDE type, the uncertainty may be reduced and the risk evaluation may change.

The environmental values at risk for the isolated local aquifers GDE type are primarily associated with terrestrial vegetation that is dependent on groundwater. These terrestrial systems can be considered as refugia for vertebrates such as woodland birds. The loss of assets could impact threatened vertebrates, particularly where the asset is isolated. In general, the importance of these refugia is correlated with isolation, with increasing isolation leading to greater ecological importance and thus potential consequence.

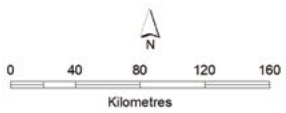
Refugia sites were identified as locations in the landscape where within a 5 km radius of a particular site, there were less than 50 hectares of other isolated local aquifers identified, i.e. approximately 0.6% of the area within the 5 km radius is an isolated local aquifer GDE type. It is these features which represent the Far North PWA Refuge Non-Spring GDEs and are afforded protection measures under this Plan. The Refuge Non-Spring GDEs may not be visible at the PWA scale in [Figure B.2](#) and as such a close up of the Innamincka region is provided in [Figure B.3](#) for visualisation purposes. The spatial layer containing this information is available on NatureMaps through the link provided in [section 1.10](#) of this Plan.

FIGURE B.2

Location of known non-spring GDEs in the Far North PWA
(100m buffer included for all sites to enable visualisation of locations)



- Locations
- Road
- Refuge non-spring GDEs
- Refuge non-spring GDEs buffer
- Low Risk GDEs
- Low Risk GDEs buffer
- Far North Prescribed Wells Area
- SAAL Landscape Region

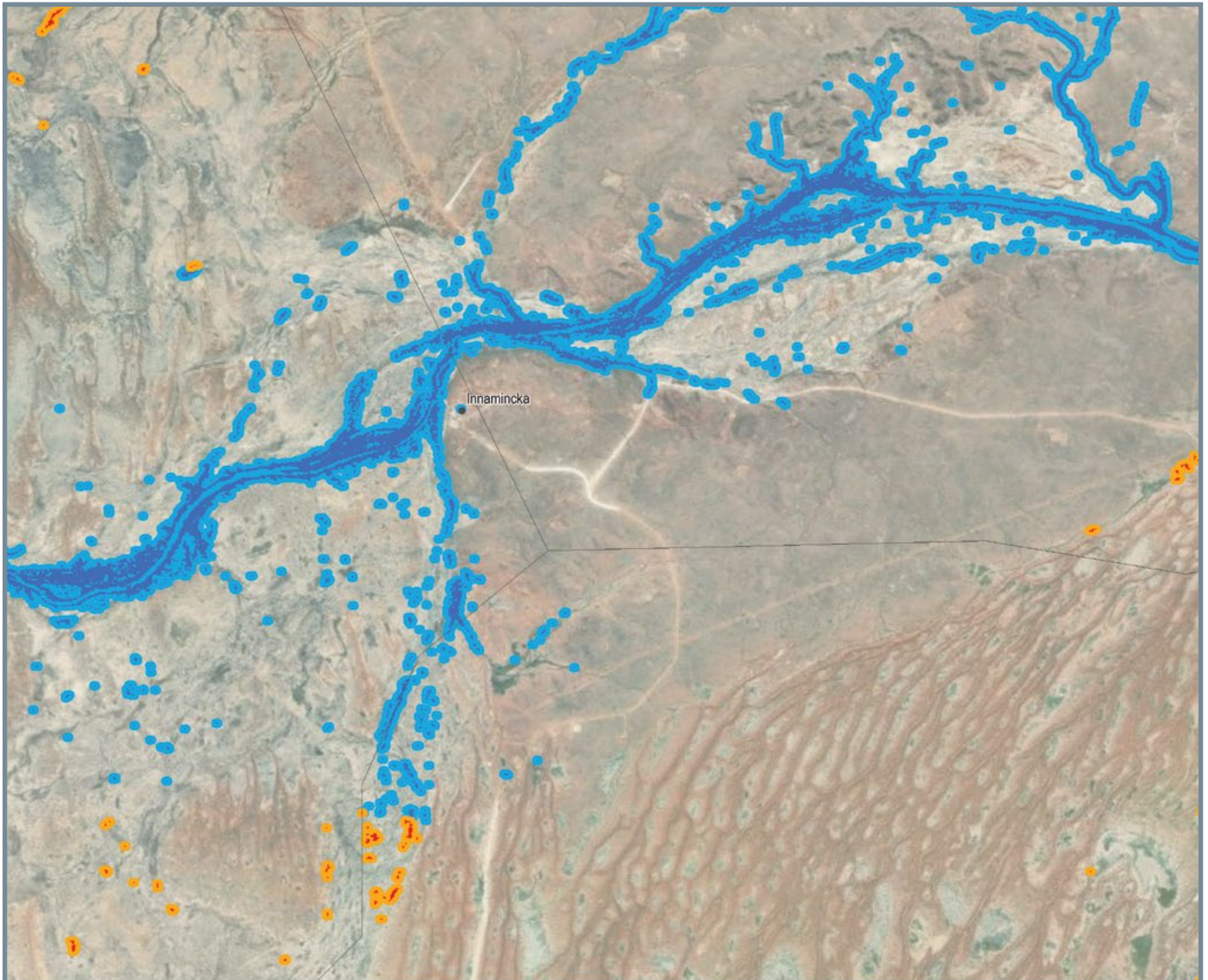


Produced by: Water Group
 Department for Environment and Water
 Map Datum: Geocentric Datum of Australia 1994
 Date: May 2020

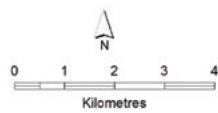
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FIGURE B.3

Innamincka region of locations of known non-spring GDEs in the Far North PWA
(100m buffer included for all sites to enable visualisation of locations)



- Locations
- Road
- Refuge non-spring GDEs
- Refuge non-spring GDEs buffer
- Low Risk GDEs
- Low Risk GDEs buffer
- Far North Prescribed Wells Area
- SAAL Landscape Region



Produced by: Water Group
Department for Environment and Water
Map Datum: Geocentric Datum of Australia 1994
Date: May 2020

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Environmental Water Requirements of non-spring GDEs

EWRs adopted for non-spring GDEs: To maintain the groundwater components of the overall water and salinity regime within the range that the GDEs' ecological communities and species need or can successfully adapt to.

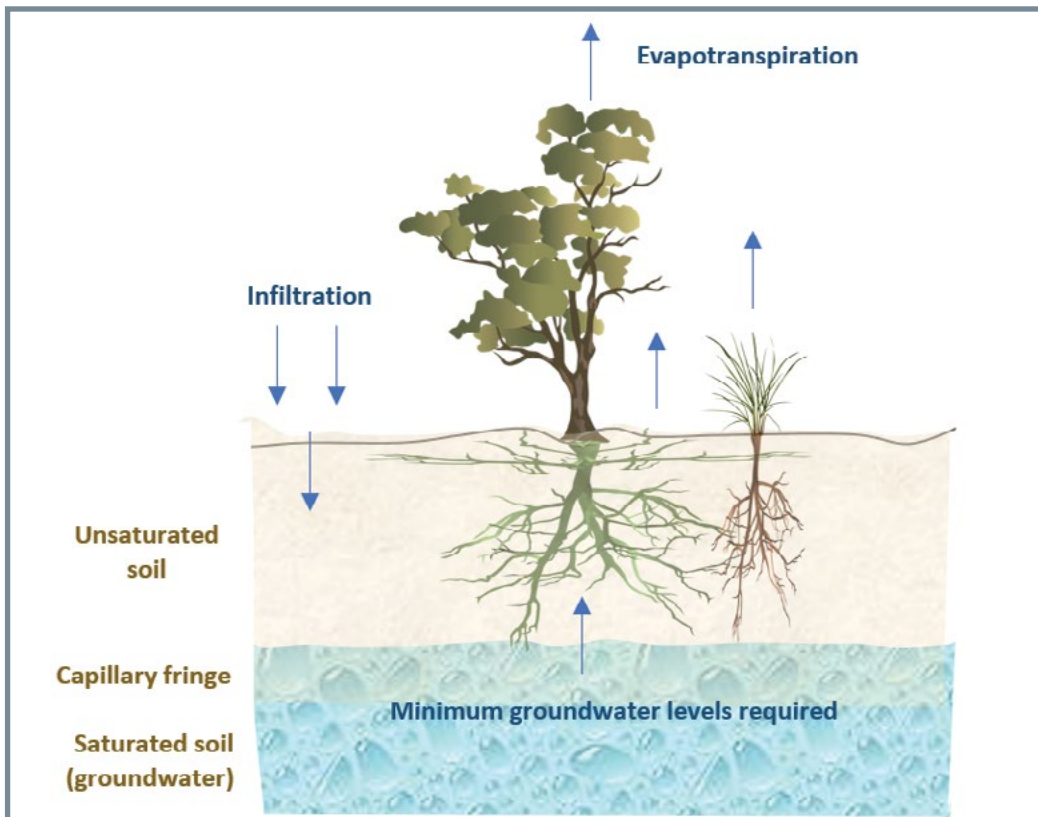
In determining the above EWRs for non-spring GDEs, it is acknowledged that there are a large number of diverse, relatively poorly-understood GDEs and it is not currently possible to document their specific water requirements in terms of the magnitude, frequency, duration and timing of inundation, as well as water quality considerations, to maintain them at a low level of risk (Doody *et al.* 2019). The adopted EWR for these sites focusses instead on the requirement for the groundwater component of the GDE's water regime that is the quantity and quality of groundwater discharging to the GDE or feeding the capillary fringe (**Figure B.4**). This needs to be maintained within the range that the ecological communities and species that inhabit the GDE need, can tolerate or can successfully adapt to without losing population resilience. Such an EWR allows for the risk posed by proposed groundwater extraction to be assessed in terms of the likelihood and consequences of significant, adverse impacts on the groundwater component of the GDE's water requirements occurring.

The extent of groundwater-surface water interactions for GDEs other than the GAB springs are relatively poorly understood. It is thought that much of the Cooper Creek in South Australia is likely to be associated with shallow aquifers but monitoring data is scarce. It has been hypothesized that the distribution of red gums along the Cooper Creek is driven by groundwater salinity as much as surface water availability and that the dynamics of groundwater levels in response to recharge may contribute to mass die-off of riparian trees (Agnew *et al.* 2014). Cullyamurra Waterhole is the principal refuge of Cooper Creek and the entire Lake Eyre Basin/*Kati Thanda*. It is therefore a vital ecological asset and its groundwater inflows need to be maintained in order for it to continue to provide these vital ecosystem services.

Non-spring GDEs, especially those that are scattered in the landscape, are often defined by their capacity to support wetland plants. This is because plants will opportunistically colonise available habitat created by groundwater discharge (Gotch 2013) provided that their dispersal, colonisation and growth requirements are met. As such wetland plants and physical habitats can be used as indicators of short and long-term changes in groundwater quantity and/or quality. EWRs of specific wetland habitats or wetland species that are supported at the non-spring GDEs can be stated as required to underpin robust risk assessments. For example, it is known that *Phragmites australis* (common reed) requires permanent water and thus groundwater levels need to be maintain those needs. Similarly, it is important that groundwater discharge maintains soil moisture within the unsaturated soil below long-lived, deep-rooted, riparian species such as red gums (*Eucalyptus camaldulensis*) and coolibah (*E. coolabah*) in between river flows or floods (**Figure B.4**).

FIGURE B.4

Groundwater feeding the capillary fringe underneath deep-rooted vegetation (Phreatophyte)



Environmental Water Provisions for GAB Springs and Refuge Non-Spring GDEs

Groundwater extraction can adversely impact on GDEs through processes such as altering the hydrological connection between a GDE and the aquifer it depends on and reducing groundwater quality (see Doody *et al.* 2019 for more detailed analysis of causal pathways). Environmental water provisions are those portions of the EWRs (presented above) that can be met at any given time by controlling the levels and/or locations of groundwater extraction through water allocation policies and principles ([sections 6 and 7](#)).

It is difficult to quantify the minimum spring flow necessary to sustain the extent and biodiversity of spring ecosystems due to the general inability to measure spring flow accurately, the large number of diverse spring types and the differences in aquifer responses to extraction rates in different parts of the Far North PWA.

Modelling of the aquifers and evaluation of spatial data has been done to estimate the impacts on springs from reductions in pressure due to extractions of various magnitudes at specific locations (e.g. Doody *et al.* 2019, Peat and Yan 2015, SA Resources Information Gateway (SARIG 2019) and the Department's GABFLOW model). The capacity of a given spring to recover from any associated changes in water chemistry or surface conditions, however, is not well researched.

Non-spring GDEs could be placed at unacceptable levels of risk if groundwater extraction leads to a significant reduction in the groundwater level, surface expression of groundwater or patterns of inundation that, in turn, adversely affects wetland biota or changes the ecological character of a GDE ([Figure B.5](#)). Soil processes may also be affected by a drop in groundwater. For example, wetting and drying of acid sulfate soils may change the pH of the water or mobilise heavy metals that harm the ecosystem.

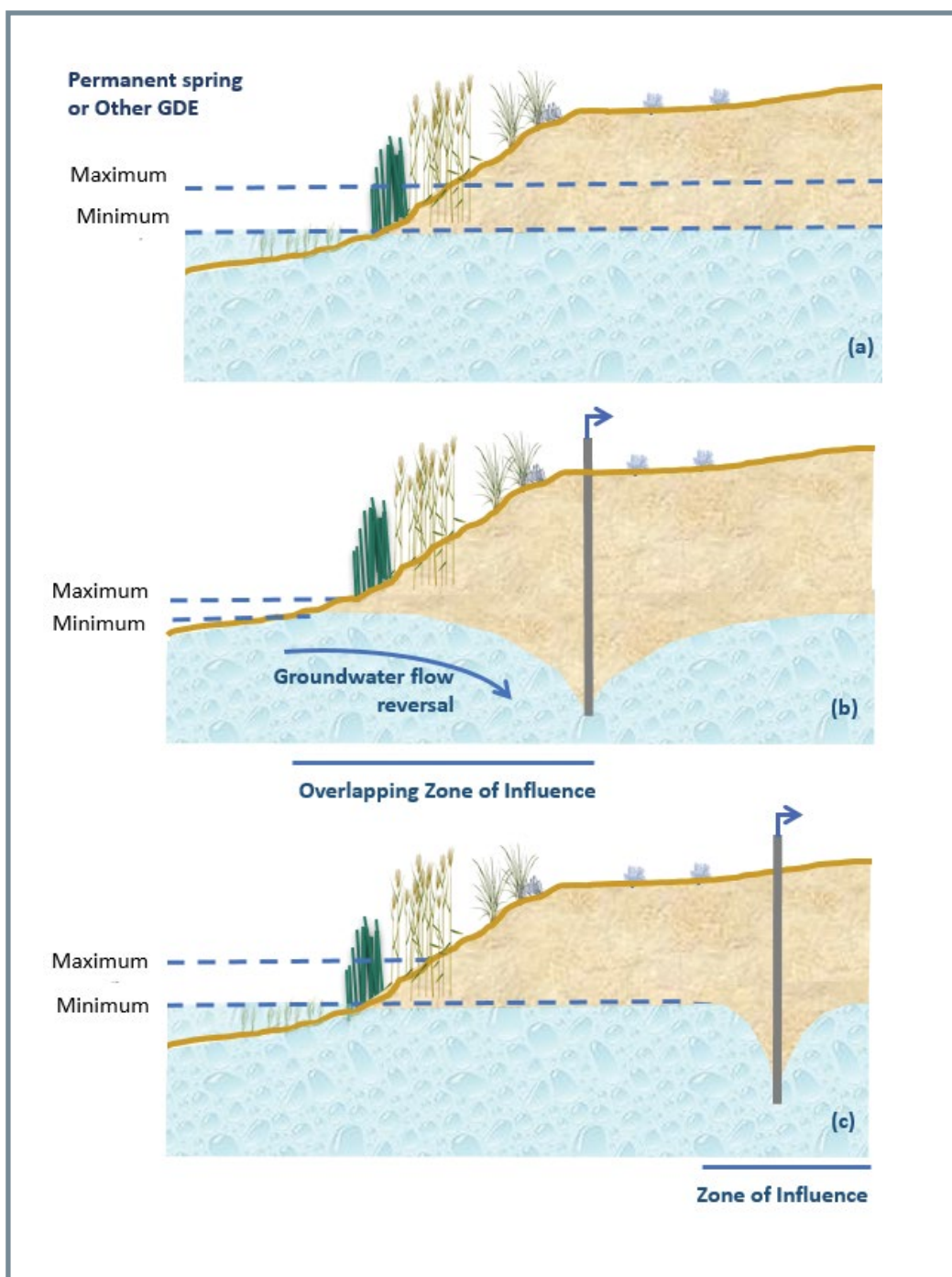
The principles in [section 7](#) of this Plan reflect the importance of managing the take of water from the resource in a manner which does not result in a decline in groundwater pressures or levels that would adversely impact on groundwater discharge to the GDEs identified above.

As discussed in [section 2](#), this Plan employs the use of buffer zones around GAB springs and utilises environmental buffers around refuge non-spring GDEs within which specific principles apply to the taking of water in order to ensure suitable provision of water for the GDEs dependent on the groundwater resource.

FIGURE B.5

Potential impacts of zones of influence from points of extraction.

(a) = natural landscape showing water level maximum and minimum, (b) = unmanaged pumping with a zone of influence that overlaps the GDE leading to a cone of depression and drying of the GDE and (c) = managed pumping where zone of influence does not overlap the GDE's water source





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