Government of **Western Australia**
Department of **Water and Environmental Regulation**

Waangaamaap – Serpentine

groundwater allocation statement

March 2024

Waangaamaap is the name used by the Bindjareb Noongar people for the Serpentine area.

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Acknowledgement of Country

The Department of Water and Environmental Regulation acknowledges the Bindjareb people of the Noongar nation as the Traditional Owners of the lands and waters covered by the *Waangaamaap – Serpentine groundwater allocation statement*. We pay our respects to their Elders past and present, and we recognise the practice of intergenerational care for Country and its relevance to our work.

We acknowledge that the traditional lands of two language groups – the Bindjareb and Whadjuk peoples – meet towards the northern end of the statement area and we acknowledge the connection of Whadjuk people to this area. We pay our respects to Whadjuk Elders past and present, and to the rich stories, culture and traditions that they hold.

We also acknowledge and recognise Aboriginal peoples with ties to other lands that now call this place home and their continuing connection to Country.

Where Noongar language has been used in this statement it represents the cultural knowledge of Bindjareb people.

Cultural informants: George Walley, Bindjareb Cultural Knowledge Holder and Joseph Walley, Bindjareb Senior Elder and Cultural Knowledge Holder (RIP).

Kep Katitjin – Gabi Kaadadjan

Waterwise Perth Action Plan 2

The Kep Katitjin – Gabi Kaadadjan Waterwise Perth Action Plan 2 sets the direction for our transition to a waterwise region. Our ambition is for Boorloo (Perth) and Bindjareb (Peel) to be climate-resilient, liveable and sustainable places where people want to live, work and spend their time. This allocation statement supports meeting an action plan target to use 10 per cent less groundwater across the region to manage groundwater levels for wetlands, urban trees and irrigation of green spaces.

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Waangaamaap Bilya (Serpentine River) - Lower Punrak Drain

1. Context and scope

1.1 Purpose

There is no allocation plan for the Serpentine groundwater area and the previous allocation limits were set in 1995. Allocation limits for the Keysbrook subarea in the Stakehill groundwater area were set in the *Rockingham–Stakehill groundwater management plan* (DoW 2008). The previous allocation limits for these areas did not consider that rainfall was reducing due to climate change.

This allocation statement describes how the Department of Water and Environmental Regulation (the department) has decided on new allocation limits in the Serpentine groundwater area and the Keysbrook subarea in the Stakehill groundwater area (see Figure 1). We have set the new limits to address ongoing declines in groundwater levels in the context of rainfall reducing due to climate change. This statement also outlines how we will manage groundwater use and how we will continue to monitor the groundwater resources in the area.

This allocation statement helps deliver Action 20 of *Kep Katitjin – Gabi Kaadadjan Waterwise Perth Action Plan 2* – Review allocation limits across the Boorloo (Perth) and Bindjareb (Peel) regions to manage groundwater levels for sustainable use in line with the impacts of climate change (Government of Western Australia 2022).

1.2 Outcomes

The outcomes we expect to see from implementing this statement are:

1. Maintain water security for the environment and water users as the climate changes.
2. Protect high-value groundwater-dependent ecosystems and associated values from the impacts of increased abstraction.
3. Support water users to improve water use efficiency.

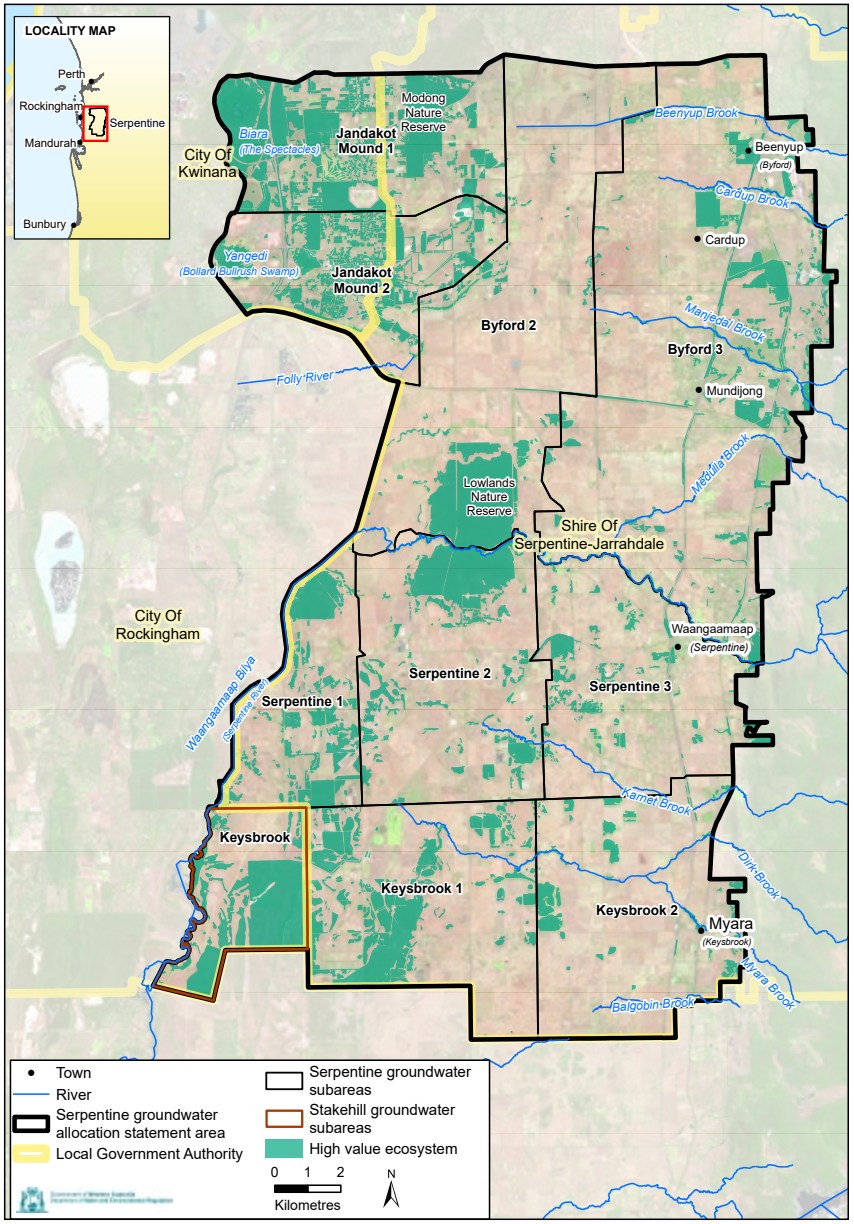

Figure 1 Location of the Serpentine groundwater area and Keysbrook subarea of the Stakehill groundwater area (the statement area) showing groundwater subareas and high-value ecosystems

1.3 Proclamation

The Serpentine and Stakehill groundwater areas are proclaimed under Section 26B of the *Rights in Water and Irrigation Act 1914* (WA) (RIWI Act), both of which were gazetted on 29 June 1988. Proclamation means that a water licence is needed before groundwater can be taken from any aquifer in these areas unless an exemption applies under the RIWI Act. A licence is also required to construct or alter wells in any aquifer unless an exemption under Section 26C of the Act applies.

1.4 Location

The Serpentine groundwater area is located about 30 km south of Boorloo (Perth). Most of the area falls within the boundary of the Shire of Serpentine Jarrahdale, but the north-easternmost portion lies in the City of Kwinana (see Figure 1).

The Keysbrook subarea is part of the Stakehill groundwater area, which is located to the west of the Serpentine groundwater area in the City of Rockingham (see Figure 1). We included the Keysbrook subarea in this statement in line with a recommendation in the *Rockingham Stakehill groundwater management plan* (DoW 2008) that it should be managed as part of the Serpentine groundwater area. Note we use the term 'statement area' to refer to the Serpentine groundwater area and Keysbrook subarea in this statement.

The statement area covers about 430 km^2 and is bordered by the Jandakot and Perth South groundwater areas to the north, the Cockburn and Stakehill groundwater areas to the west, and the Murray groundwater area to the south. East of the statement area is unproclaimed.

2. Hydrogeology and groundwater resources

2.1 Hydrogeology

Aquifers in the statement area are made up of layers of water-holding sands and gravels interspersed with clays. At present the following aquifers provide the most water for consumptive use in the statement area:

- the shallow, unconfined Superficial (watertable) aquifer
- the deep, partially confined Leederville aquifer
- the deeper, partially confined Cattamarra Coal Measures resource (a layer of the Yarragadee aquifer).

Small volumes of water are also taken from fractured rock aquifers along the statement area's eastern margin.

The Superficial aquifer is shallow, unconfined and mostly sandy, with some clay lenses present in the statement area's western part. The average saturated thickness of the Superficial aquifer is about 10 m and the watertable is generally very shallow, with surface inundation occurring in parts during winter. The aquifer provides baseflow for rivers and streams, including the Waangaamaap Bilya (Serpentine River), and supports wetlands and bushland that lie over shallow groundwater.

The Rockingham Sand aquifer underlies the Superficial aquifer in the Keysbrook subarea of the Stakehill groundwater area. It is hydraulically connected to the Superficial aquifer as well as the surrounding Leederville aquifer. A significant part of the recharge to the Superficial aquifer drains to surface water features across the statement area rather than to the deeper aquifers (Barron et al. 2020).

The investigations completed as part of the Peel Integrated Water Initiative (PIWI) have improved our understanding of the connectivity of the Superficial aquifer with the Leederville aquifer and Cattamarra Coal Measures resource in the statement area's south.

High-quality seismic imaging was used to map the key hydrogeological boundaries, including a significant fault system measuring 500 m wide and reaching depths of at least 100 m below ground level. The north–south oriented fault system broadly corresponded with the previously identified Serpentine Fault but showed vertical displacement across the Leederville Formations and older sediments. Analysis undertaken as part of PIWI (Barron et al. 2020) revealed:

- There is a high degree of connectivity between all aquifers to the Serpentine Fault's east, following the regional groundwater flow direction. Sub-vertical components of groundwater flow develop east of the fault, especially near abstraction locations and at recharge areas, connecting the Superficial and deeper aquifers, and allowing recharge into the deeper aquifers. This connectivity means abstraction from the deeper aquifers has the potential to affect water levels in the Superficial aquifer.
- There is more confinement between the Superficial and deeper aquifers to the Serpentine Fault's west, and groundwater flows are predominantly horizontal. There is little recharge through to the deeper aquifers in this area.

The **Peel Integrated Water Initiative (PIWI)**, an element of the Transform Peel 2021 project, covered several subareas in the statement area (most of the Serpentine 1, Serpentine 2 and Serpentine 3 subareas and all of the Keysbrook, Keysbrook 1 and Keysbrook 2 subareas).

The PIWI's aim was to deliver detailed knowledge of water resources to enable more informed decision-making by government, and to guide industry and the community on sustainable and innovative water supply opportunities in the area.

Work completed for the PIWI found that climate change had already affected the availability of surface and groundwater resources in the area and, therefore, it was crucial to consider the future effects of climate change with respect to groundwater allocation limits and the water needs of groundwater-dependent environmental features and values.

2.2 Groundwater resources

To enable more effective management of abstraction impacts, the statement area is divided into subareas (see Figure 1). Within each subarea there may be one or more aquifers present. When a part of an aquifer falls within a subarea, we call it a 'groundwater resource'. We set an allocation limit for each groundwater resource after considering the associated environmental requirements. This helps to prevent the over-allocation of resources and reduce environmental and user impacts at a local scale (see Table 1 in Section 4.2).

In the Serpentine groundwater area, the Superficial, Leederville and Yarragadee aquifers are present in all subareas. The Cattamarra Coal Measures resource and fractured rock aquifers only exist in the three easternmost subareas. The Keysbrook and Stakehill–Keysbrook Confined subareas in the Stakehill groundwater area include the shallow Superficial and Rockingham Sand aquifers, and the deep Leederville aquifer and Cattamarra Coal Measures resource.

In resources of the Superficial aquifer, including parts of the Byford 2 and Byford 3 subareas, the presence of clay restricts aquifer yield (Giannoulopoulos 2020).

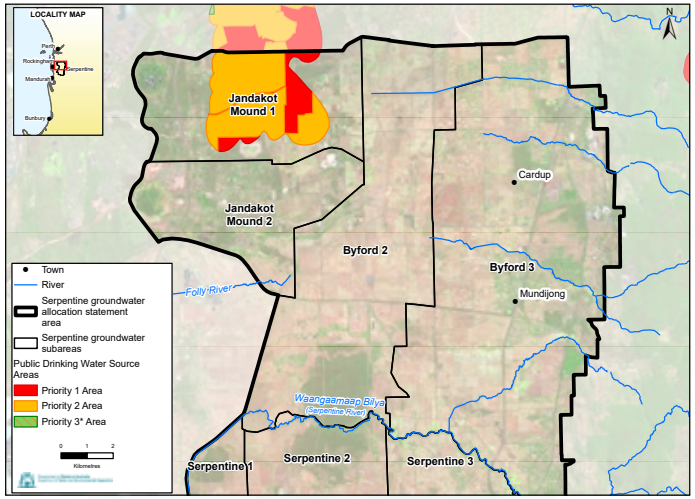

Figure 2 Public drinking water source area in the Jandakot Mound 1 subarea

Different groundwater use categories or 'components' in each allocation limit help us account for different water uses and to administer water licensing (see Table 1).

Water source protection planning

Safe drinking water is essential for all Western Australians. Drinking water for the state's cities and towns comes from surface water and groundwater sources, seawater desalination and recycled water. Surface water catchments and groundwater aquifers that supply drinking water are called 'public drinking water source areas' (PDWSAs).

In the statement area, there is one PDWSA located in the Jandakot Mound 1 subarea, which is known as the Jandakot Underground Water Pollution Control Area (see Figure 2). This PDWSA was established under the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909* and is used to supply drinking water to Perth's integrated water supply scheme (operated by Water Corporation).

Land uses and development in the Jandakot PDWSA are managed through the department's drinking water legislation, policy, and drinking water source protection reports. The principles of, and measures for protecting, the Jandakot PDWSA are outlined in the *Jandakot Underground Water Pollution Control Area drinking water source protection review* (Water Corporation 2006). For additional information on public drinking water source protection policies and best management practices, see our Drinking Water Matters webpage.

In recognition of the practice of intergenerational care for Country, customary activities for Noongar people in PDWSAs are provided for in the *Noongar (Koorah, Nitja, Boordahwan) (Past, Present, Future) Recognition Act 2016*, the South West Native Title Settlements Indigenous Land Use Agreements and in updated drinking water by-laws. For more information, see the Department of Premier and Cabinet's South West Native Title Settlement Resources and water by-laws websites.

3. Values of groundwater

3.1 Groundwater use

Groundwater in the statement area is used for licensed self-supply purposes, as well as for small-scale stock and domestic and garden bore uses that may be exempt from licensing.[1] At present there is 20.7 GL/year of licensed usage (under 924 licences) and about 1.5 GL/year of licence-exempt usage.

Most licensed groundwater use (61 per cent) is for agricultural purposes, including irrigation for pasture, vegetables and nurseries, as well as intensive stock raising. The second-largest use of groundwater (13 per cent) comes from developers and local governments establishing and then continuing to irrigate parks, ovals and other public open space areas (see Figure 3).

By aquifer:

- 60 per cent (13.3 GL/year) is abstracted from the Superficial aquifer. This includes almost all of the exempt use (1.5 GL/year).
- 39 per cent (8.7 GL/year) is abstracted from the deeper aquifers: 28 per cent (6.3 GL/year) from the Leederville aquifer and 11 per cent (2.4 GL/year) from the Cattamarra resource.
- 1 per cent (0.2 GL/year) is abstracted from fractured rock aquifers. There is also a small amount of exempt use from these aquifers.

Agricultural groundwater uses in the statement area include intensive stock raising

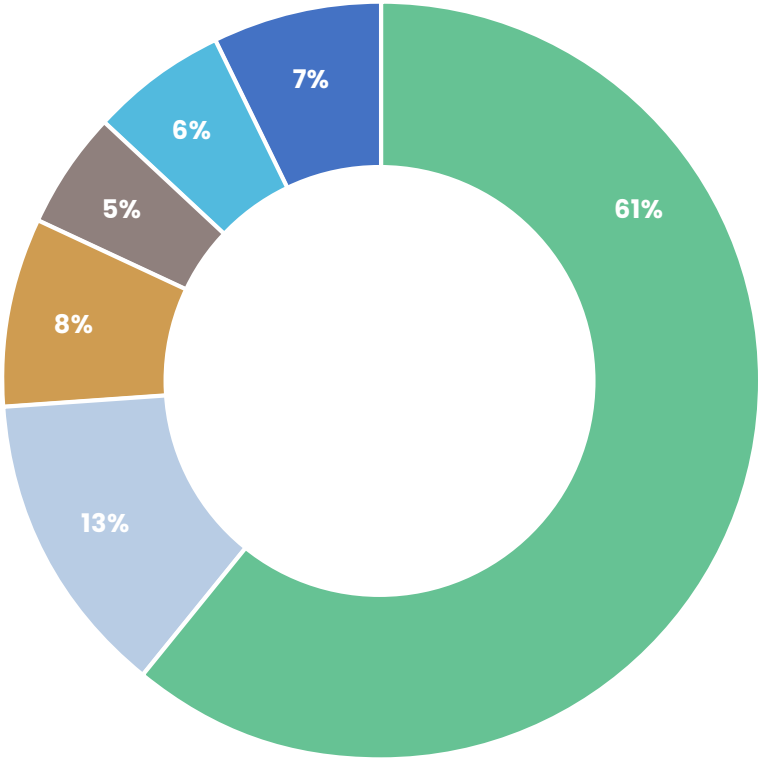

Figure 3 Use of groundwater in the statement area

[1] Stock and domestic bore use is a usage type that occurs in semi-rural and rural areas where scheme water is not always connected. Garden bores are generally used to irrigate lawns and gardens in urban areas where households also have access to scheme water. The licensing exemption only applies to these usages if abstraction is from the unconfined Superficial (watertable) aquifer.

3.2 Groundwater-dependent ecosystems

The natural areas remaining on the Kwongan (Swan coastal plain) are critically important, given most of the native bushland and more than 80 per cent of the original wetlands have been lost through clearing and draining since European settlement.

Groundwater in the statement area provides baseflow for rivers and streams (see Figure 1 in Section 1.4), including the Waangaamaap Bilya (Serpentine River), which supports a vibrant community of aquatic organisms (Beatty et al. 2021). River health assessments conducted along the Waangaamaap Bilya since 2017 under our Healthy Rivers program have recorded nine native fish and crustacean species including:

- four endemic freshwater fish (kedalak djildjit [nightfish], western minnow, western pygmy perch and nyola [freshwater cobbler])
- two native estuarine/freshwater fish (blue-spot goby and western hardyhead)
- three endemic freshwater crustaceans (smooth marron, gilgie and south-west glass shrimp).

Other species recorded include the:

- yaakan (south-western snake-necked turtle)
- rakali – a Priority 4 species under the *Biodiversity Conservation Act 2016* (WA), meaning it is a rare or near-threatened species
- Carter's freshwater mussel – listed as Vulnerable under the *Biodiversity Conservation Act 2016* (WA).

The kedalak djildjit (nightfish) is one of the four endemic freshwater fish species found in the Waangaamaap Bilya

Groundwater also sustains valuable natural areas, which include wetlands and bushland that lie over shallow groundwater including Banksia woodlands (see Figure 1 in Section 1.4).

Most of the groundwater-dependent native vegetation in the statement area is Banksia woodland. This provides vital habitat for more than 20 nationally threatened species, including the Carnaby's black cockatoo. In 2016 the Banksia woodlands of the Swan coastal plain ecological community was listed as 'endangered' under Australia's national environment law, the *Environment Protection and Biodiversity Conservation Act 1999* (Cth). Areas of Banksia woodland are highly likely to depend on groundwater for some or all of their water needs where water levels in the Superficial aquifer are within 10.5 m of the surface (Sommer & Froend 2010).

Important wetlands in the statement area include Biara (The Spectacles), Sandy Lake, Yangedi (Bollard Bulrush Swamp) and Hymus Swamp (see Figure 1 in Section 1.4).

Surface water use from the Waangaamaap Bilya (Serpentine River)

The Serpentine Pipehead Dam is located about 8.5 km upstream of the Serpentine groundwater area. It was built in the late 1950s to convey water from Serpentine Dam to the public water supply trunk main network.

Water is released during summer from two release points located in trunk mains below the Pipehead Dam to provide downstream flows to the Waangaamaap Bilya. The releases provide water to support local amenity and the riverine environment, including its aquatic ecology, and provides supply for landowners who have a riparian right or a surface water licence to abstract water from the river.

At present there are 34 surface water licences within the Serpentine groundwater area that account for 0.82 GL/per year in total. The water is used mainly for dairy farms, pasture, perennial horticulture, orchards and stock and domestic purposes (DWER 2017).

Groundwater seeps into the Waangaamaap Bilya in some sections, also helping to maintain river pools and water flow. The effective management of water releases from the Pipehead Dam, and surface water and groundwater use along the river, is important for managing river health.

For more information about water allocation and management of the Waangaamaap Bilya, Serpentine Dam and associated release regime, see *Managing releases for the Serpentine River: Serpentine River allocation statement* (DWER 2017).

3.3 Cultural values of groundwater

> "From the creation time to the present time, to the future, the Bindjareb Noongar people's water story is a very amazing and important story. The interconnectedness of spirit, land and people brings together our cosmology, our sense of place, our homeland."
>
> George Walley

Bindjareb Noongar people have been the managers of the land and waterways of the statement area for more than 50,000 years, including at the sites and places shown in Figure 4.

Bindjareb people have a life commitment and cultural responsibility to respect and preserve gabi (water) and the Noongar water cycle (Walley & Nannup 2012). The Bindjareb people value all water. Water represents life and their spiritual connection to the landscape. For Bindjareb people, all waterways, wetlands, swamps, rivers, the estuary and the ocean are special places and sites of significance because of their spiritual beliefs, connection and continued use.

The Bindjareb people believe the Woggaal Maadjit, the rainbow serpent, created the gabi (water and waterways), djilba (estuary), bilya (rivers), manang wari (swamps) and all places with water. The Woggaal Maadjit listened to the prayers of the Bindjareb Noongar Elders and came from the wardarn (ocean) and moved across the land creating the Mandja Bay area, and the salt water followed into the djilba darbal (estuary waters). The yalgoraps (lakes) and rivers from the djilba darbal to the Kaada Moornda (Darling Ranges) were also created. The Woggaal Maadjit and her children became responsible for the regeneration of the water onto and into the lands to help the people, plants and animals.

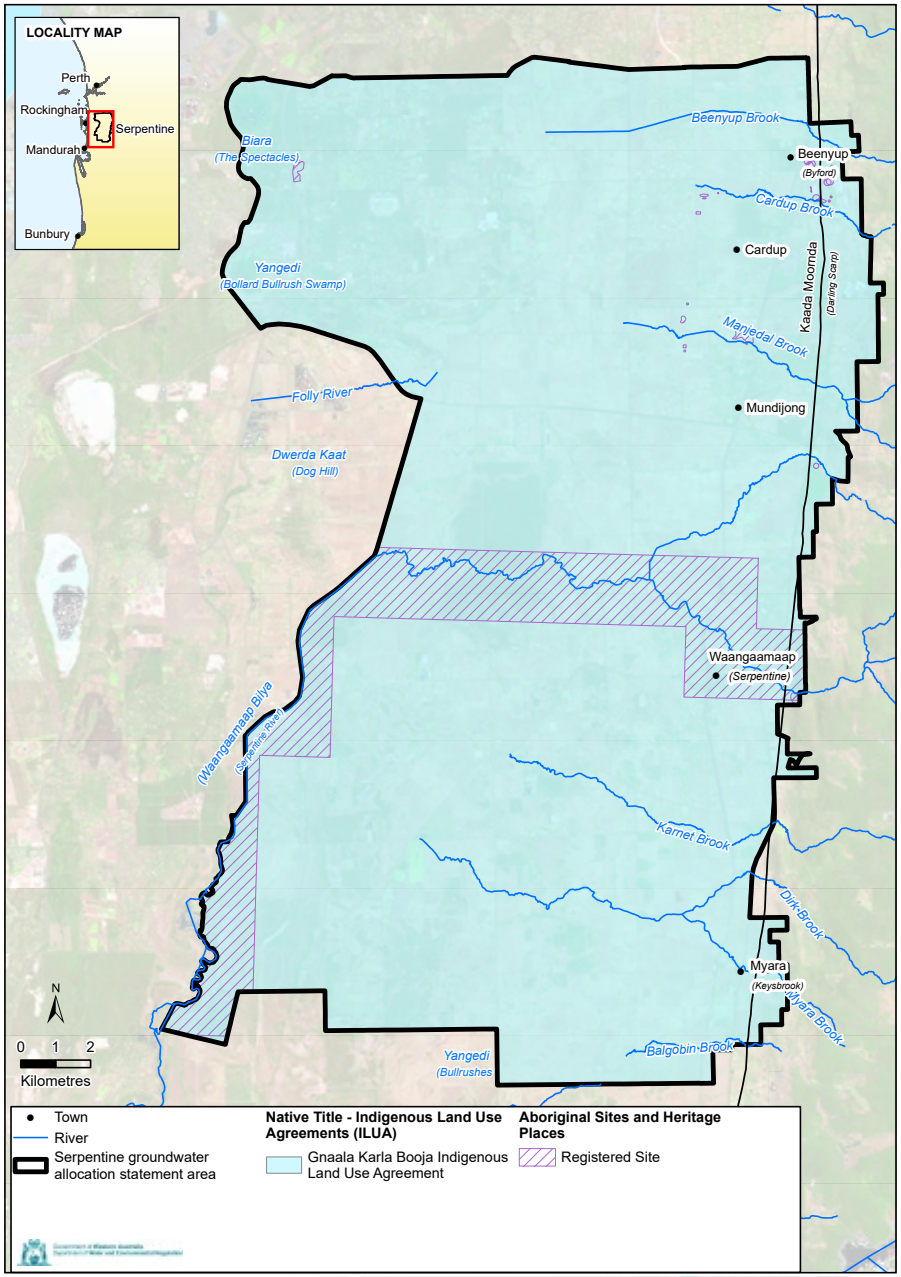

Figure 4 Registered Aboriginal sites and heritage places in the statement area

Childhood story of the Waangaamaap Bilya by George Walley

My family placed a big emphasis on the Waangaamaap Bilya. We still do. As a child growing up, we lived in places around the Waangaamaap Bilya, and visited the river quite often.

As a child I remember riding my tricycle while my Nan Julie was walking with me. We went along the gravel road onto Rapids Road and went towards the Waangaamaap Bilya. I remember seeing the river in flood and covering the bridge. That was terrifying and I can still picture that today.

When the river was much calmer, we would visit what we called Coffey's Bridge, park the cars and relax there. Sometimes we would catch marron, gilgies, yaakan (long neck tortoise) and nyola (cobbler) for a feed. The new bridge has family names under it and reflects families visiting and using that beautiful family space. It is like a family heritage and historical document.

As kids we also visited the falls and the railway bridge and had just as much fun. Wonderful memories are from that part and other parts of the Waangaamaap Bilya.

Bindjareb people are immersed in traditional beliefs and managing boodja (land) and gabi (water). In this way, Bindjareb people are looked after spiritually and with food and resources. Bindjareb people's continued hunting and gathering of bush tucker, and taking of aquatic foods such as marron, preserves their culture. It keeps spirit strong, improves health and wellbeing, and benefits families economically.

Today Bindjareb people remain actively engaged in catchment management work to improve the health of the bilya (rivers) and gabi (waterways) for future generations. A ranger program helps to engage young people and pass on cultural knowledge, while also providing care for Country, training and employment opportunities. Cultural mapping work is also taking place along the Waangaamaap Bilya (Serpentine River) to record important sites and stories, as well as ensure the ongoing protection of sacred places.

Bindjareb Traditional Owners and the department have a strong partnership, forged through meaningful engagement during development of the *Bindjareb Djilba Peel-Harvey estuary protection plan*. This partnership also led to the development of *Bring Together Walk Together*, a framework to foster, build and maintain strong partnerships for Aboriginal land and water through the sharing and threading of knowledge in a respectful way (Walley & Grant 2021). The Bindjareb Gabi Wonga (Bindjareb water story) is empowering Bindjareb people to share their visions, goals and priorities for water planning, and has informed other projects such as the *Kep Katitjin – Gabi Kaadadjan Waterwise Perth Action Plan 2* and water quality improvement plan for the Peel-Harvey estuary, to ensure Bindjareb knowledge and aspirations are represented.

We strongly value our partnership with Bindjareb people, and we hope to keep walking together long into the future.

Bindjareb people fishing in the Waangaamaap Bilya. Image from Mandurah Museum, City of Mandurah

Ngalang gabi/kep kaditj wer kaadadjaan wongi	Our water knowledge and learning story.
Nidja gabi/kep wongi, koora yey wer benang-gnat	This water story is from our past, present and into the future.
Ngalang gabi/kep wongi ngalang gabi/kep ngarniny wongi	Our water story is our water drinking story.
Ngalang wardarn, yalgorap, bilya wer darbal, ngalang mereny-baranginy wongi	Our ocean, lakes, rivers, and estuaries are our food gathering stories.
Ngalang wardarn, yalgorap, bilya wer darbal, ngalang djiba-djob-oliny wongi	Our ocean, lakes, rivers, and estuaries are our swimming stories.
Nidja yey, booroong daaranginoo daat-koorliny boodja wer boodja-ak	These times let the rain fall, let the rain come down and fall onto the lands and go into the ground.
Nidja yey, Kwanata kwanata booroong daat-koorliny ngalang boodja wer boodja-ak daat-koorling	These days less, much less, rain falls onto our lands and seeps into our lands.
Nyorn ngany wirrin winyarn-baranginy, ngany miyal mingalya	With sadness my spirit is feeling desperate that my eyes are starting to tear up.

George Walley

Djildja Mungah (fish trap) on Waangaamaap Bilya. Image from Mandurah Museum, City of Mandurah

4. Allocation limits

Under the RIWI Act, the Minister (or their delegate) has the discretion to determine licence applications. When exercising that discretion, the Minister will take into account the matters set out in clause 7(2) of Schedule 1 of that Act, this allocation statement and other relevant considerations.

The *Cockburn groundwater allocation plan* (DWER 2021a) and the *Murray groundwater area allocation statement* (DWER 2022a) updated the allocation limits in these adjacent groundwater areas in response to climate change, and we are currently reviewing allocation limits for the Jandakot and Perth South groundwater areas. These allocation limit reviews were also delivered as part of Action 20 of *Kep Katitjin – Gabi Kaadadjan Waterwise Perth Action Plan 2* (Government of Western Australia 2022).

4.1 Previous allocation limits

There is no groundwater allocation plan for the Serpentine groundwater area and the previous allocation limits were set in 1995 (except for limits for the Superficial aquifer in the Jandakot Mound 1 subarea[2]). These limits did not consider reductions in rainfall and rainfall recharge due to climate change.

Allocation limits for the Keysbrook subarea in the Stakehill groundwater area were set in the *Rockingham-Stakehill groundwater management plan* (DoW 2008). The 2008 plan's allocation limits were based on modelling of a climate scenario using rainfall from 1975–2003. The plan noted the drying climate in south-west Western Australia and recognised the allocation limits would need to be reduced if the drying climate trend were to continue.

4.2 Key outcomes of the allocation limit review

After a review of the previous allocation limits we have reduced the available groundwater in most Superficial and Leederville aquifer resources in the statement area (see Table 1).

The new allocation limits factor in the entitlements of existing licensees and those who currently access groundwater for purposes exempt from licensing. Many resources in the statement area are now fully allocated and access to more groundwater is limited. It is important to note that water availability changes daily as licences expire or are relinquished, unused entitlements are recouped, or new or amended licences are granted.

Reducing available groundwater will achieve the following outcomes:

- give security of supply to existing groundwater users over the next 10 years
- reduce the risks from the increased abstraction of groundwater on groundwater-dependent ecosystems and cultural values
- limit access to 'new' groundwater, thereby encouraging improved water use efficiency among existing users.

For the Cattamarra Coal Measures resources, while no additional groundwater has been made available as a result of the review, allocation limits in the Serpentine 3 and Keysbrook 2 subareas for these resources have been raised to reflect existing licensed use. The Cattamarra resource in the Stakehill–Keysbrook Confined subarea of the Stakehill groundwater area has been 'not set' and we will assess licence applications on a case-by-case basis due to significant constraints (depth, water quality etc.) in accessing the resource.

The Cattamarra resources in the statement area are likely being influenced by Water Corporation's abstraction from the Yarragadee aquifer in the Jandakot groundwater area to the north (see Figure 8 in Section 4.3). We will look closely at the effects of public water supply abstraction from the Leederville and Yarragadee aquifers as part of our current allocation limit review for the Jandakot and Perth South groundwater areas. When the review is complete, we may decide to re-examine the allocation limits for the Leederville and Cattamarra resources in the statement area.

Allocation limits for fractured rock resources are 'not set' and we will assess applications for groundwater licences within fractured rock aquifers on a case-by-case basis.

[2] The allocation limit for the Superficial aquifer in the Jandakot Mound 1 subarea was reviewed in 2014 as part of the review of allocation limits for Superficial aquifer resources of the Jandakot groundwater area.

Table 1 2024 allocation limit updates for the statement area (kL/year)

Groundwater area	Subarea	Aquifer[1]	Previous allocation limit	2024 allocation limit	Allocation limit components		Is water available for licensing? (as at September 2023)[2]
					Licensable	Unlicensed	
					General licensing	Garden stock and domestic bores	
Serpentine	Byford 2	Superficial	8,130,000	518,100	466,000	52,100	Yes
		Leederville.	1,350,000	1,150,000	1,150,000		No
		Cattamarra.	0	0	0		No
		Yarragadee.	0	0	0		No
	Byford 3	Superficial	13,630,000	2,198,340	1,860,000	338,340	No
		Leederville.	2,270,000	2,159,000	2,159,000		No
		Cattamarra.	1,130,000	1,130,000	1,130,000		No
		Yarragadee.	0	0	0		No
		Fractured rock[3]	Not set	Not set	Not set	Not set	Case-by-case
	Jandakot Mound 1	Superficial	4,440,000	4,440,000	3,980,000	460,000	Yes
		Leederville.	0	0	0		No
		Yarragadee.	0	0	0		No
	Jandakot Mound 2	Superficial	1,930,000	1,930,000	1,761,500	168,500	No
		Leederville.	0	0	0		No
		Yarragadee.	0	0	0		No
	Keysbrook 1	Superficial	2,000,000	2,010,000	2,000,000	10,000	No
		Leederville.	750,000	450,000	450,000		Yes
		Yarragadee.	0	0	0		No
	Keysbrook 2	Superficial	2,600,000	370,000	330,000	40,000	Yes
		Leederville.	860,000	850,000	850,000		Yes
		Cattamarra.	0	440,000	440,000		No
		Fractured rock[3]	Not set	Not set	Not set	Not set[4]	Case-by-case

Table 1 2024 allocation limit updates for the statement area (kL/year) (cont.)

Groundwater area	Subarea	Aquifer[1]	Previous allocation limit	2024 allocation limit	Allocation limit components		Is water available for licensing? (as at September 2023)[2]
					Licensable	Unlicensed	
					General licensing	Garden stock and domestic bores	
Serpentine	Serpentine 1	Superficial	1,370,000	850,000	800,000	50,000	Yes
		Leederville.	450,000	450,000	450,000		Yes
		Cattamarra.	0	0	0		No
		Yarragadee.	0	0	0		No
	Serpentine 2	Superficial	2,760,000	1,900,000	1,830,000	70,000	No
		Leederville.	920,000	900,000	900,000		No
		Yarragadee.	100,000	0	0		No
	Serpentine 3	Superficial	2,380,000	740,000	440,000	300,000	No
		Leederville.	790,000	610,000	610,000		No
		Cattamarra.	390,000	720,000	720,000		No
		Yarragadee.	0	0	0		No
		Fractured rock[3]	Not set	Not set	Not set	Not set[4]	Case-by-case
Stakehill	Keysbrook	Superficial Swan and Rockingham Sand	720,000	650,000	650,000	0	Yes
		Leederville.	150,000	60,000	60,000		Yes
		Cattamarra.	450,000	Not set	Not set	Not set	Case-by-case
		Yarragadee.	0	0	0		No

Note: Aquifers with (.) at the end of their name are confined.

1 The Cattamarra resource is constrained by depth, availability and quality.

2 Water availability changes daily. Contact our Kwinana Peel regional office to confirm groundwater availability.

3 The department may assess applications for groundwater licences within fractured rock aquifers on a case-by-case basis.

4 There is a small amount of exempt use from fractured rock resources (500 kL/year in the Keysbrook 2 subarea and 1500 kL/year in the Serpentine 3 subarea).

4.3 Considerations in reviewing the allocation limits

As part of reviewing allocation limits to meet the outcomes in Section 1.2 we considered:

- past and projected changes in rainfall due to climate change
- groundwater level trends
- impacts of declining groundwater levels
- aquifer yields.

Past and projected changes in rainfall due to climate change

Climate change is causing rainfall to decrease in the statement area (Figure 5).

Average annual rainfall has declined by about 10 per cent since 1975. During the period 1945–1974 average rainfall was 870 mm/year, while between 1975–2022 it dropped to 780 mm/year. The declining trend has been more prominent since 2000, with the average rainfall decreasing to 750 mm/year (2000–2022).[3] The effect of this has been a significant reduction in rainfall recharge to groundwater in the region.

The historical climate analysis completed as part of the PIWI (Barron et al. 2020) noted the key features of the changing climate in the region included:

- a significant decrease in winter rainfall with a shorter winter rainfall season and delayed onset of winter rainfall
- a decrease in the intensity, frequency and persistence of rain events
- a slow but steady rise in potential evaporation over the decades.

Rainfall in the area is projected to continue to decline, with recent global climate models strongly indicating that south-west Western Australia will be warmer and drier in the future (DWER 2021b).

The PIWI, and the allocation limit review for this statement, considered the range of climate change projections for Australia released in 2015 by the Australian Government, the Australian Bureau of Meteorology and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) – see www.climatechangeinaustralia.gov.au (CCIA). Average annual rainfall in the statement area at 2030 is projected to be around 680 mm/year under the CCIA's dry climate scenario (Figure 5).[4]

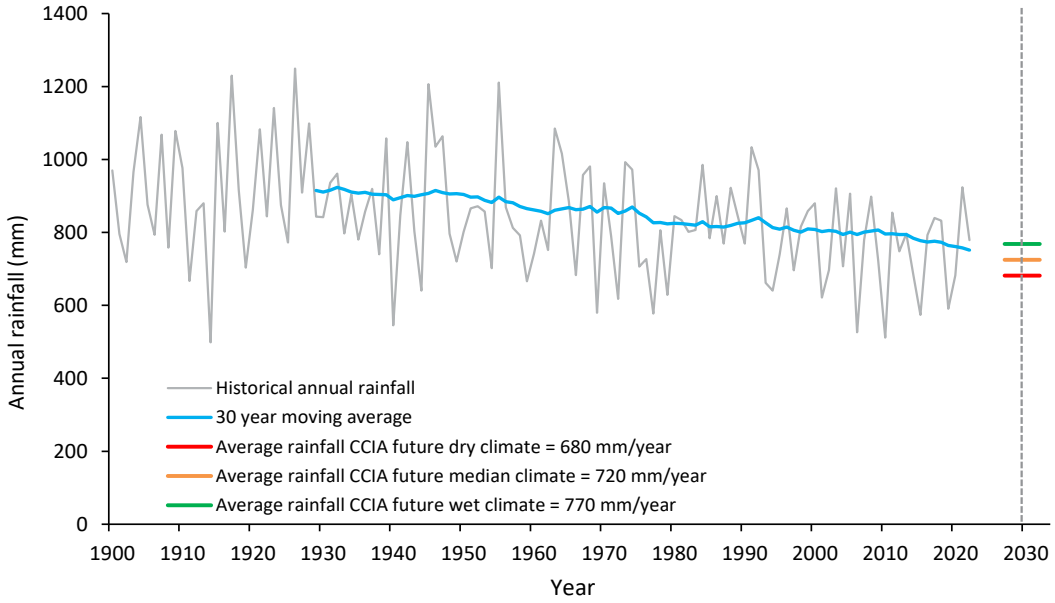

Figure 5 Historical and projected rainfall in the statement area

[3] The rainfall data referenced in the statement (and Figure 5) is based on daily SILO rainfall data at the grid 32.30 N, 115.90 E (www.longpaddock.qld.gov.au/silo/point-data/, copyright: The State of Queensland 2022).

[4] The future climate projections of rainfall use the SILO data, scaled by future climate anomalies sourced from CCIA (www.climatechangeinaustralia.gov.au)

BOOROONG YOOWAAL KOORL (Rain come here)

This is the story about encouraging the rain to come out to Boodja (land/environment), to Mandjoogoordap Boodja or to Mundap or Waraangu, all around the Bindjareb Boodja:

Booroong, booroong yoowaal koorl	Rain, rain come here
Mari warabiny yoowaal koorl	Storm clouds come here
Booroong, booroong daat koorl	Rain, rain come here
Nidja ngany Boodja, Bindjareb Boodja	Here, my country, Bindjareb country
Booroong Booroong daat koorl daat koorl	Rain, rain come here, come here
Nidja ngany Boodja Bindjareb Boodja	Here, my country, Bindjareb country
Yey yaanga yaanga	Today, thank you, thank you
Daat nyininny daat koorliny	Down sitting, down going
Moorditj moorditj booroonginy booroonginy	Great, great rain.

Groundwater level trends

Within the statement area, the department conducts groundwater level monitoring at 42 bores in the Superficial aquifer, nine bores in the Leederville aquifer and 14 bores in the Yarragadee aquifer/Cattamarra Coal Measures. Figure 11 and Table 3 in Section 7 provide more information on monitoring in the statement area.

The groundwater monitoring data collected shows declines in water levels in the Superficial and Leederville aquifers and across the Cattamarra Coal Measures resource and Yarragadee aquifer. The declines are caused by a combination of abstraction and reduced rainfall as a result of climate change.

Superficial aquifer

On the Serpentine Fault's western side (see Figure 6), confining layers reduce the connectivity between the Superficial aquifer and the deeper aquifers.

However, to the fault's east – in parts of the Byford 3, Serpentine 3 and Keysbrook 2 subareas – there is significant connectivity between the aquifers. In these areas, Superficial aquifer levels are drawn down by abstraction from the Leederville aquifer, the Cattamarra resource and the Yarragadee aquifer (see figures 6, 7 and 8).

Figure 6 shows groundwater level trends in the Superficial aquifer from 2000 to 2022. Groundwater levels in the Superficial aquifer declined by up to 4.4 m (0.2 m/year) in the Byford 3 subarea and by up to 5.5 m (0.25 m/year) in the Serpentine 3 subarea. Less rainfall due to climate change, together with local abstraction from the Superficial aquifer and abstraction from the deep aquifers, are factors contributing to the trends in these subareas. In other parts of the statement area, Superficial aquifer levels are more stable.

Leederville aquifer

Figure 7 shows trends in groundwater levels in the Leederville aquifer between 2000 and 2022. Groundwater levels in the Leederville aquifer declined by up to 8.8 m (0.4 m/year) in the Byford 3 subarea and by up to 13.2 m (0.6 m/year) in the Serpentine 3 subarea. Less rainfall due to climate change, together with local abstraction from the Leederville aquifer and abstraction from deeper resources are factors contributing to the trends in these subareas. In other parts of the statement area, Leederville aquifer levels have declined, but to a lesser extent.

Cattamarra Coal Measures resource and Yarragadee aquifer

Figure 8 shows trends in groundwater levels in the Cattamarra Coal Measures resource and Yarragadee aquifer between 2000 and 2022. Groundwater levels have declined significantly across the statement area, with declines of up to 24.2 m (1.1 m/year) in the Jandakot Mound 1 subarea. The declines in that subarea are likely influenced by Water Corporation's abstraction from the Yarragadee aquifer in the Jandakot groundwater area to the north. This abstraction occurs under licence for public drinking water that goes into Perth's integrated water supply scheme.

Impacts of declining groundwater levels

Within the statement area, groundwater levels in the Superficial aquifer sustain valuable waterways, wetlands and areas of bushland (including Banksia woodlands) that overlie shallow groundwater. Many have conservation significance and are recognised and protected under state and federal legislation. These environments are at risk of impacts from further groundwater level declines.

Work undertaken for the PIWI, which covers the statement area's southern part, found that any additional groundwater drawdown from current levels would pose an unacceptable risk to 68 per cent of the wetlands, river systems and riparian vegetation and 34 per cent of the waterways in the PIWI area (Transform Peel 2021). Continued access to groundwater is crucial for the ongoing health of groundwater-dependent ecosystems and for protecting the environmental, cultural and social values they support.

The impact of groundwater declines from climate change and abstraction on groundwater-dependent ecosystems is a concern shared by all people with a connection to the area. The health of waterways influences the spiritual, physical, emotional, social and personal wellbeing of the Bindjareb (Peel) region's communities, and the Bindjareb Noongar people who say, "If we look after the land and waterways, the land and waterways will look after us."

Declining rainfall means that less rainfall recharge enters the groundwater system and groundwater levels fall. By reducing allocation limits in response to lower recharge, less additional groundwater can be taken from the system by users, which will help to slow the rate of decline in groundwater levels and allow groundwater-dependent ecosystems more time to adapt to falling watertables. By reducing additional stress on the system, we can help maintain resilient ecosystems in the face of climate change.

Allowing more abstraction in subareas where groundwater levels are declining would threaten the resource's capacity to supply the required quantity and quality of groundwater into the future.

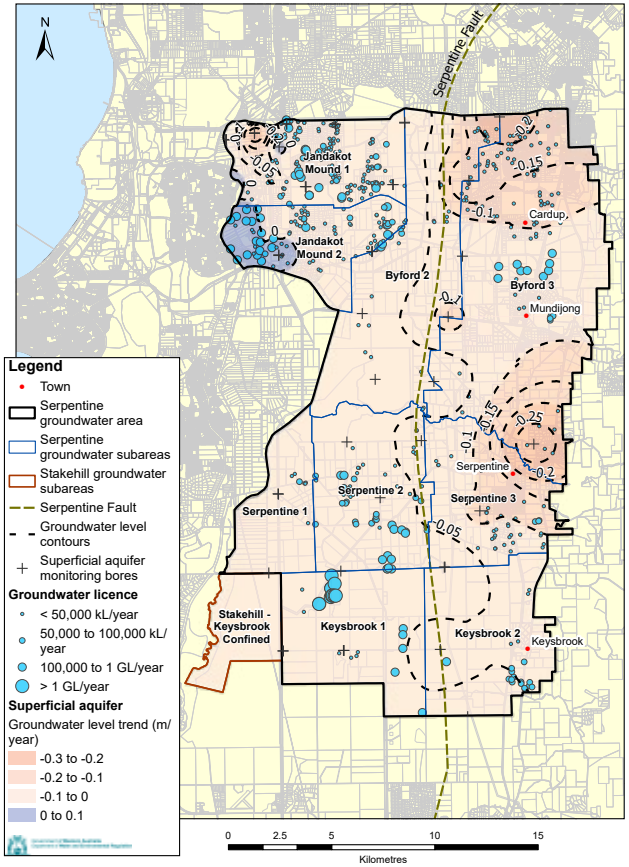

Figure 6 Superficial aquifer groundwater level trends between 2000 and 2022

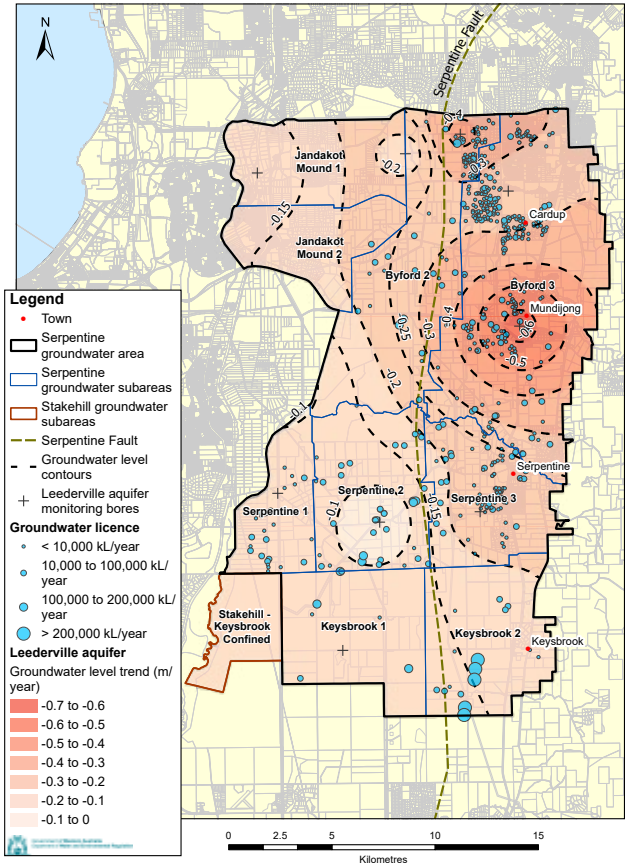

Figure 7 Leederville aquifer trends between 2000 and 2022

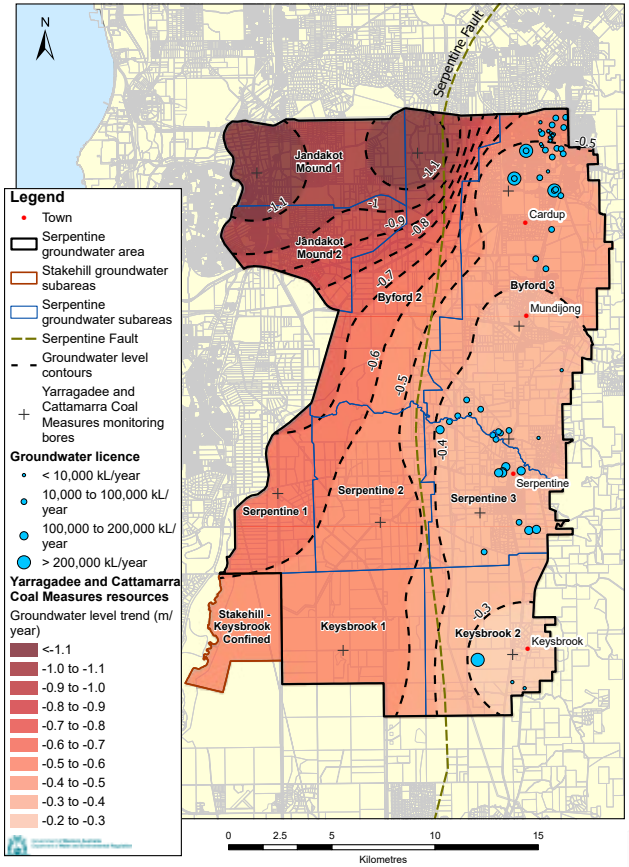

Figure 8 Cattamarra Coal Measures resource and Yarragadee aquifer trends between 2000 and 2022

Lowlands Nature Reserve

Modelling of deep abstraction impacts on the Superficial aquifer

The department conducted a modelling exercise using the Perth Regional Aquifer Modelling System (PRAMS 3.6) to assess the impacts of deep aquifer abstraction on Superficial aquifer levels in the statement area. We ran two scenarios out to 2040 to test how abstraction from the Leederville aquifer and Cattamarra Coal Measures resource in the statement area influenced groundwater levels in the Superficial aquifer, namely:

1. Remove all Leederville aquifer abstraction from the statement area (Figure 9).
2. Remove all Cattamarra Coal Measures abstraction from the statement area (Figure 10).

The outputs found that abstraction from the Leederville aquifer and Cattamarra resource contributed to modelled drawdown in the Superficial aquifer to the Serpentine Fault's east, where the Superficial aquifer is highly connected to the deeper aquifers. The modelling results highlight the importance of managing abstraction from deep resources where they are connected to the Superficial aquifer.

Initial modelling done for the upcoming Jandakot and Perth South groundwater areas allocation plan has also shown the effects of deep aquifer pumping for public water supply in the Jandakot groundwater area – from the Leederville and Yarragadee aquifers – are propagating southwards (i.e. affecting deep aquifer levels in the statement area).

We will continue to look closely at the effects of abstraction for public water supply from the Leederville and Yarragadee aquifers as part of the allocation limit review for the Jandakot and Perth South groundwater areas. Once the review is complete, we will consider whether we need to re-examine the allocation limits for the Leederville and Cattamarra resources in the statement area.

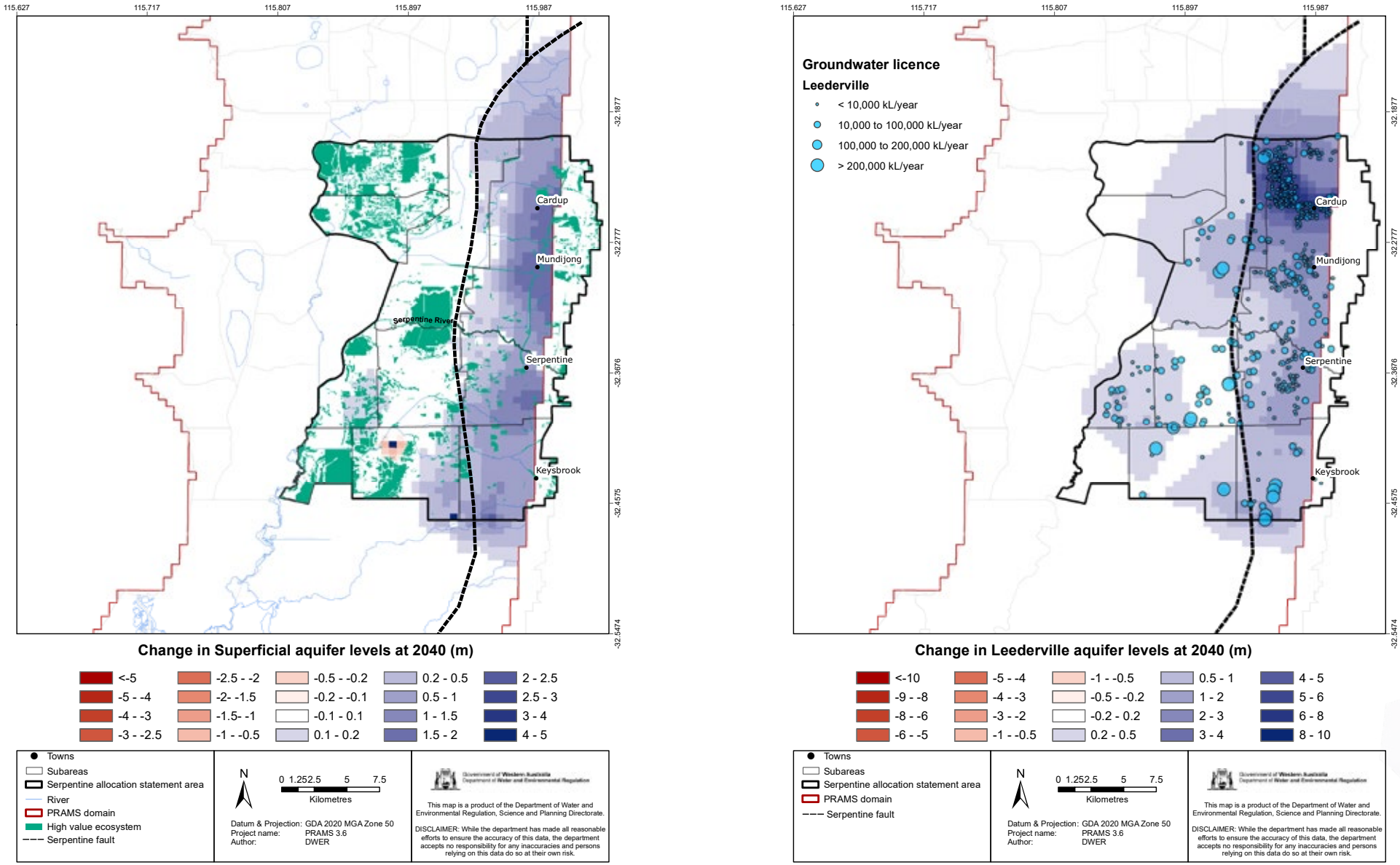

Figure 9 Maps showing changes in groundwater levels in the Superficial aquifer (left) and Leederville aquifer (right) when all licensed abstraction from the Leederville aquifer is removed from the statement area

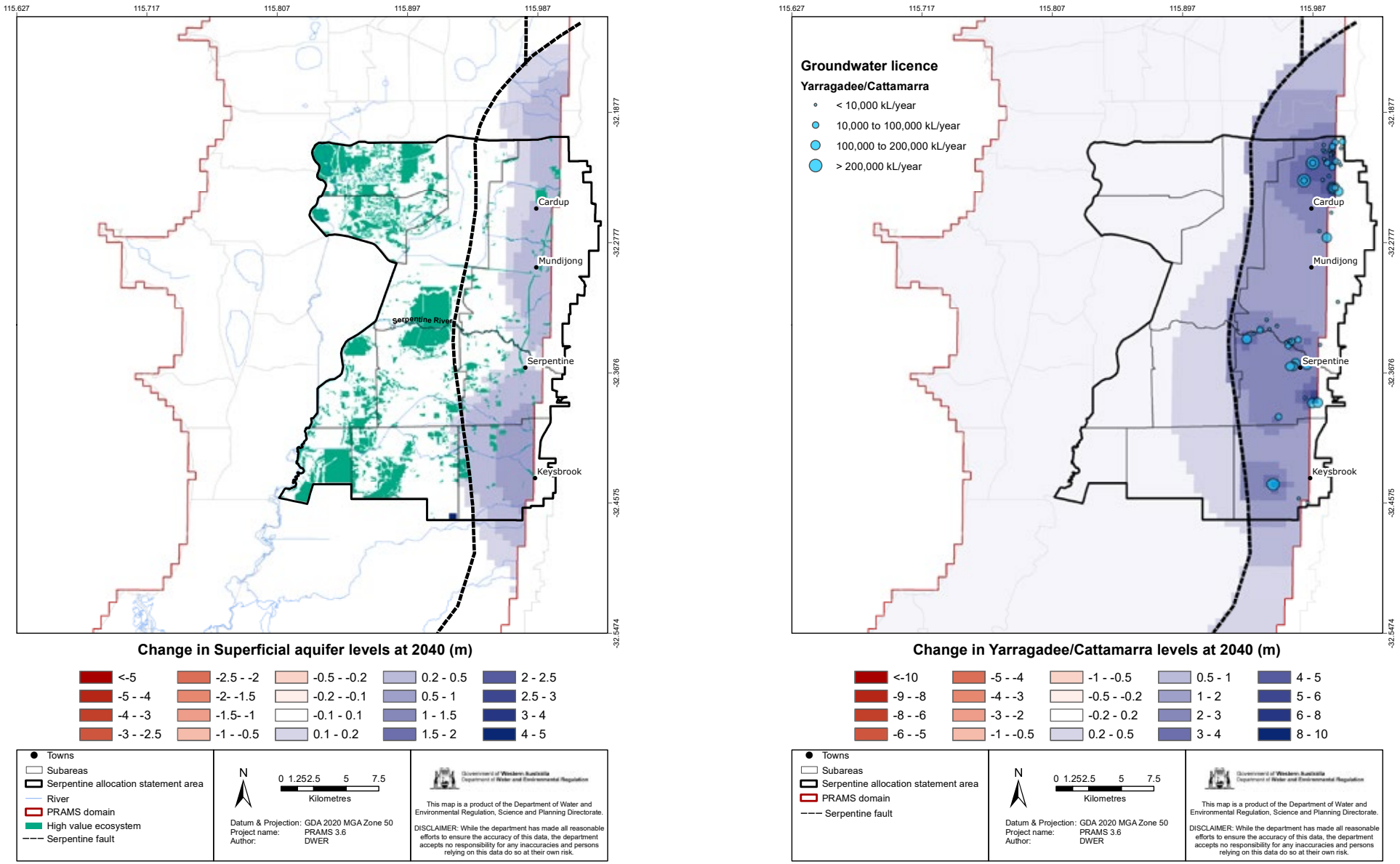

Figure 10 Maps showing changes in groundwater levels in the Superficial aquifer (left) and Cattamarra Coal Measures (right) when all licensed abstraction from the Cattamarra resource is removed from the statement area

5. Managing groundwater use

The Minister for Water, supported by the department, is responsible for managing Western Australia's water resources consistent with the RIWI Act.

Under the *Water Agencies (Powers) Act 1984* (WA) the Minister for Water also has the general functions and powers to conserve, protect and manage the state's water resources by assessing and planning for their use.

The Minister for Water, and department officers under delegation, make decisions on each licence application consistent with the provisions in our state's water legislation. When exercising that discretion, the Minister will take into account the matters set out in clause 7(2) of Schedule 1 of that Act, this allocation statement and other relevant considerations.

This statement and statewide policy are considered when making decisions on groundwater licence applications in the statement area.

A water licence is the regulatory instrument under the RIWI Act that entitles a licensee to take water (the licensed entitlement) from a water resource in accordance with the specified terms, conditions and restrictions. A licence to construct is the regulatory instrument that entitles a holder to construct or alter a well (bore), subject to the licence conditions.

Statewide policies are updated from time to time and the most recent version will apply – see DWER regulatory documents.

5.1 Managing licensed self-supply use

Metering

Under Regulation 41C of the Rights in Water and Irrigation Regulations 2000 (Metering Regulations) and in line with *Policy: Measuring the taking of water* (DWER 2019), all licensees in the statement area with an annual water entitlement equal to or greater than 10,000 kL/year must meter their water use and submit metering data to us through Water Online. The metering of abstraction and capturing this data through Water Online is building a comprehensive database of groundwater use within the statement area, which can be compared with licensed entitlements.

The Metering Regulations override any pre-existing metering licence conditions (including requirements for online data submission). Failure to comply with the regulations is an offence and prosecution can result in a fine of $2,000 and a daily penalty of $200. Incorrect installation or alteration of a meter, such that it does not accurately measure water, or damaging meters, are prosecutable offences. You can find more information including fact sheets and frequently asked questions at Water metering and measurement.

All licensees in the statement area with an annual water entitlement equal to or greater than 10,000 kL/year must meter their water use.

Water efficiency measures

The following water efficiency measures may apply to licensed use that goes toward irrigating non-commercial crops and areas of turf/lawn, gardens and pasture in the statement area:

- daytime sprinkler ban (non-use of water between 9am and 6pm)
- winter sprinkler ban (non-use of water between 1 June and 31 August).

Further information can be found at:

- Winter sprinkler switch off
- Check garden bore water restrictions

Recouping of unused water entitlements

We assess licensee water use and, where appropriate, recoup unused water as per *Policy: Management of unused licensed water entitlements* (DWER 2020a).

We consider an unused entitlement to be all or part of a licensed annual water entitlement that was not taken (productively used) for three or more consecutive years.

For licence renewal applications, we assess metered and peak water use information in the years preceding the application to identify any unused water entitlement. Metering and other information – such as the licensee's history of water use, ongoing and demonstrated demand, property surveys and aerial photography – may be used to assess, identify and recoup unused water entitlements. If we establish that this volume is consistently unused for three years, we may act to recoup it.

5.2 Water entitlement transactions

We assess water entitlement transactions as per *Policy: Water entitlement transactions for Western Australia* (DWER 2020b).[5]

Trades, transfers and agreements allow new users to obtain an entitlement in a fully allocated area and existing licensees to expand their operations as well as adapt to changing circumstances. These water entitlement transactions can only occur within the same subarea and aquifer resource. We expect that the clear picture of water scarcity and reduced groundwater availability described in this statement will drive increased interest in water transactions.

People seeking water entitlement transactions can find details about current water licences and contact details for existing licensees at our online Water Register.

Trading of water entitlements

Trading of water entitlements allows water users to access additional water entitlements, and new users to obtain an entitlement. We encourage this, as it typically results in the water going to its highest-value use.

We recognise that variable aquifer yields in some resources in parts of the statement area may restrict trades (e.g. if the part of the resource where the water entitlement trade is proposed is low-yielding).

We may request additional information from the applicant to inform the assessment of a water entitlement trade if it is near a groundwater-dependent ecosystem. We may apply conditions on the traded water licence to minimise the risk to water levels and quality of the target or connected aquifers. Trades may be refused if they increase the risk of abstraction impacts on the aquifers, identified groundwater-dependent ecosystems or other users.

Along the Waangaamaap Bilya (Serpentine River) we are developing new trading rules for groundwater licences to manage the risks to the river's flow regime posed by groundwater abstraction (see Section 8).

Transfers of licences

Licence transfers are required when the legal access to land changes. This usually occurs when a licensee sells their property to another party. Settlement on a property purchase does not automatically transfer a water licence. Both the seller and purchaser must send us a licence transfer application (Form 4T) before or within 30 days of settlement.

Agreements

A licensee can agree with another party to temporarily use part or all of their water entitlement for a period within the tenure of the parent licence.

When parties submit an agreement application, we will assess the current water use of the parent licence to determine if any portion of their water licence entitlement is unused. Any portion of the entitlement that is unused may be recouped.

[5] Formerly Operational policy 5.13, published in 2010. The policy was reformatted in 2020 to show how it is classified within the department's current policy framework but its content was not changed.

5.3 Compliance and enforcement

Licensed water users have a legal responsibility to manage their water use according to the terms and conditions of their licence. See our Compliance and enforcement policy (DWER 2021c) to find out about our approach to compliance and enforcement.

Compliance and enforcement activities

We seek to ensure compliance in various ways, from desktop investigations to site visits. We usually notify the licensee if we intend to visit a site, but this is not compulsory. Our officers or investigators may enter properties at all reasonable times, without notice, to conduct a site inspection to establish if an offence against the RIWI Act is being committed.

Water metering is becoming a critical component of compliance and enforcement. It is the most accurate way to find out how much of a water entitlement is being used and also discourages over-use.

Wasting water

Given the limited water availability in the statement area, it is important that people use their water efficiently and responsibly. A licensee who wastes water may be in breach of section 26G of the RIWI Act.

We may identify wasteful behaviour in several ways, including conducting surveys and investigations, or responding to concerns raised by members of the community.

Enforcement action for wasting water may include, but not be limited to, the issuing of directions and prosecution, which may lead to the imposition of a fine.

5.4 Managing bores exempt from licensing

Garden bores and stock and domestic bores that are abstracting water from the unconfined Superficial (watertable) aquifer, and that are exempt from licensing, are an important part of water supply in the statement area. Across Boorloo (Perth) and Mandjoogoordap (Mandurah) about one in four households has a garden bore.

During the past decade various estimates of residential water use have consistently found that on average, households with a garden bore use three to four times more water on lawns and gardens than households using scheme water. In part, this is a consequence of the extra watering day that garden bore users had under past sprinkler restrictions.

Between 19 November 2021 and 28 February 2022, the State Government sought feedback on a proposal to align the domestic garden bore sprinkler roster with the two-days-per-week scheme water roster for the Boorloo (Perth) and Mandjoogoordap (Mandurah) area. We prepared a consultation summary report (DWER 2022b) that summarises the submissions received on the proposal and our response.

The use of garden bores and stock and domestic bores is managed under the provisions of the Water Agencies (Water Use) By-Laws 2010. These by-laws have been amended and the roster change began on 1 September 2022. This means that all households in the statement area now have the same two-days-per-week sprinkler roster, whether they use scheme or bore water. Households can seek an exemption from the two-days-per-week sprinkler roster if they do not have access to scheme water and are located in a bushfire prone area (as designated by the Department of Fire and Emergency Services).

Visit the Be Groundwater Wise website for advice on waterwise gardens and how to use a garden bore efficiently to reduce water use and energy consumption.

We are aware of, and are working to reduce, unauthorised use in the statement area where groundwater use exceeds or does not meet the exemption criteria. If you are unsure whether or not your property requires a licence, go to our website for more information or contact the Kwinana Peel regional office.

6. Monitoring

The department operates an extensive network of 65 groundwater monitoring bores within the statement area, together with wetland and surface water monitoring sites, to manage groundwater use (Figure 11).

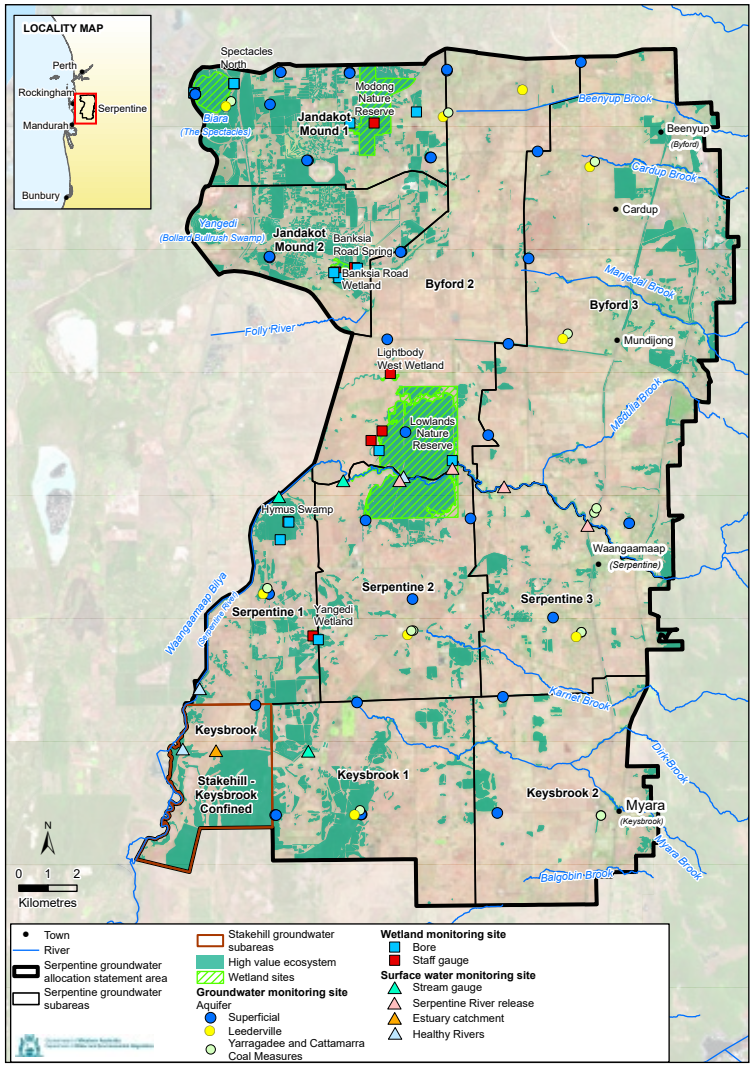

Figure 11 Monitoring sites in the statement area

6.1 Groundwater monitoring

Our network of monitoring bores enables the collection of data on the groundwater resources in the statement area (see Figure 11 and Table 3) and consists of:

- 42 bores in the Superficial aquifer
- nine bores in the Leederville aquifer
- 14 bores in the Yarragadee aquifer and the Cattamarra Coal Measures resource.

We regularly take measurements at these sites to assess changes in groundwater levels and hydraulic pressure. Many of the bores inform the Perth Regional Aquifer Modelling System version 6.

We will continue to assess the results of the monitoring program as part of our adaptive management of groundwater resources in the statement area.

Table 2 Groundwater monitoring bores in the statement area

Subarea	Aquifer	Bore name[1]	ID number[1]
Byford 2	Superficial	T160 (O)	61410139
Byford 2	Superficial	T161 (I)	61419702
Byford 2	Superficial	T170	61410153
Byford 2	Superficial	T220	61410152
Byford 2	Superficial	T310	61410130
Byford 2	Superficial	T320	61410148
Byford 2	Superficial	T360	61410129
Byford 2	Leederville	AM50B	61415077
Byford 3	Superficial	SE5	61410266
Byford 3	Superficial	T270	61410151
Byford 3	Superficial	T370	61410147
Byford 3	Leederville	AM56A, AM56C	61415042, 61470645
Byford 3	Leederville	AM50X, AM50U	61415054, 61470141

Table 2 Groundwater monitoring bores in the statement area (cont.)

Subarea	Aquifer	Bore name[1]	ID number[1]
Byford 3	Yarragadee	AM50Y, AM50V	61415038, 61470142
Byford 3	Cattamarra Coal Measures	AM61C	61415070
Byford 3	Cattamarra Coal Measures	AM61D	61415074
Byford 3	Yarragadee	AM56, AM56B	61415041, 61470644
Jandakot Mound 1	Superficial	Anketell Site 1	61410705
Jandakot Mound 1	Superficial	Anketell Site 1A	61410706
Jandakot Mound 1	Superficial	JE22C	61419711
Jandakot Mound 1	Superficial	SP1_1A	61419851
Jandakot Mound 1	Superficial	SP1_1B	61419852
Jandakot Mound 1	Superficial	SP1_1C	61419853
Jandakot Mound 1	Superficial	SP1_1D	61419854
Jandakot Mound 1	Superficial	T150 (I)	61410119
Jandakot Mound 1	Superficial	T150 (O)	61410118
Jandakot Mound 1	Superficial	T200 (I)	61410108
Jandakot Mound 1	Superficial	T200 (O)	61410107
Jandakot Mound 1	Superficial	T210 (I)	61410138
Jandakot Mound 1	Superficial	T210 (O)	61410137
Jandakot Mound 1	Leederville	AM50A, AM50C	61415057, 61470341
Jandakot Mound 1	Yarragadee	AM53A, AM53B	61415022, 61470955
Jandakot Mound 1	Leederville	AM53, AM53C	61415021, 61470956
Jandakot Mound 1	Yarragadee	AM50, AM50D	61415032, 61470342
Jandakot Mound 2	Superficial	T250 (I)	61410096
Jandakot Mound 2	Superficial	T250 (O)	61410095
Jandakot Mound 2	Superficial	T260 (I)	61410132
Jandakot Mound 2	Superficial	T260 (O)	61410131
Keysbrook 1	Superficial	T550 (I)	61410089
Keysbrook 1	Superficial	T550 (O)	61410088
Keysbrook 1	Superficial	T560 (I)	61410114
Keysbrook 1	Superficial	T560 (O)	61410113
Keysbrook 1	Yarragadee	AM63, AM63B	61415025, 61470937
Keysbrook 1	Leederville	AM63A, AM63C	61470938, 61470938
Keysbrook 1	Superficial	T560S	61410681
Keysbrook 2	Superficial	T570	61410143
Keysbrook 2	Yarragadee	AM64, AM64B	61415037, 61415073
Keysbrook 2	Yarragadee	AM64A, AM64C	61415058, 61470326
Serpentine 1	Superficial	T450 (I)	61410092
Serpentine 1	Superficial	T450 (O)	61410091
Serpentine 1	Superficial	T500	61410090
Serpentine 1	Leederville	AM59A, AM59B	61415018, 61415071
Serpentine 1	Yarragadee	AM59, AM59C	61415017, 61470380
Serpentine 2	Superficial	T410	61410116
Serpentine 2	Superficial	T420	61410146
Serpentine 2	Superficial	T460	61410128
Serpentine 2	Superficial	T510	61410115
Serpentine 2	Leederville	AM60B, AM60E	61415031, 61415069
Serpentine 2	Yarragadee	AM60, AM60C	61415029, 61470765
Serpentine 2	Yarragadee	AM60A, AM60D	61415030, 61470766
Serpentine 3	Superficial	T470	61410150
Serpentine 3	Superficial	T520 (O)	61410144
Serpentine 3	Leederville	AM61B, AM61G	61415035, 61470549
Serpentine 3	Yarragadee	AM61, AM61E	61415033, 61470546
Serpentine 3	Yarragadee	AM61A, AM61F	61415034, 61470547

[1] Where there are two bore names and ID numbers listed on one line, the first refers to the original bore and the second refers to a redrilled replacement bore.

6.2 Wetland monitoring (surface water and groundwater)

We monitor surface water levels at staff gauges at eight wetlands in the statement area (see Figure 11 and Table 3). We also monitor Superficial aquifer levels at bores at some of these sites.

We use the data collected at the staff gauges and bores to understand how groundwater levels impact on wetland levels and ecological health.

Table 3 Staff gauges and bores for monitoring wetlands in the statement area

Subarea	Site	Staff gauge name and ID	Bore name and ID
Byford 2	Lightbody West Wetland	Lightbody West, 6141493	T360, 61410129
Byford 2	Lowlands Nature Reserve	Lowlands North, 6141494 Lowlands Linear, 6141495	SSB10, 61410484 SSB11, 61410485
Jandakot Mound 1	Spectacles North	Spectacles Swamp, 6142528	SP1_1A, 61419851 SP1_1B, 61419852 SP1_1C, 61419853 SP1_1D, 61419854 SP1_2A, 61419855 SP1_2B, 61419856 SP1_2C, 61419857
Jandakot Mound 1	Modong Nature Reserve	Modong Nature Reserve [12987], 6141500	SSB20, 61410494 SSB21, 61410495
Jandakot Mound 2	Banksia Road Spring	Banksia Road Spring, 6141501	SSB23, 61410497
Jandakot Mound 2	Banksia Road Wetland	Banksia Road Wetland, 6141491	SSB17, 61410491 SSB19, 61410493
Serpentine 1	Yangedi Wetland	Yangedi North Wetland [6906], 6141492	SSB15, 61410489
Serpentine 1	Hymus Swamp	Hymus Sump [13326], 6141498	SSB12, 61410486 SSB13, 61410487

6.3 Surface water monitoring

Monitoring surface water flow

We monitor river flow data at three stream gauging sites along the Waangaamaap Bilya (Serpentine River) in the statement area (see Figure 11 and Table 4), which helps track how river flows are responding to reducing rainfall due to climate change. We will also use the data to learn more about if and where groundwater inputs are supporting river flows and therefore how groundwater abstraction along the river may affect flow volumes. Go to our River Monitoring Stations website to access data from the stream gauge sites.

Table 4 Surface water monitoring sites in the statement area

Groundwater area	Subarea	Site name	ID number
Stream gauge			
Serpentine	Keysbrook 1	Punrak Drain – Yangedi Swamp	614094
Serpentine	Serpentine 1	Dog Hill	614030
Serpentine	Serpentine 2	Lowlands	614114
Waangaamaap Bilya (Serpentine River) releases			
Serpentine	Serpentine 3	Halls Road	614117
Serpentine	Byford 3	Rapids Road	614116
Serpentine	Serpentine 2	Lowlands East	6141497
Serpentine	Serpentine 2	Powerlines North	6141496
Healthy Rivers			
Serpentine	Serpentine 1	Serpentine River – Downstream Peel Main Drain	6144122
Serpentine	Serpentine 2	Serpentine River – Lowlands	6144121
Stakehill	Keysbrook	Serpentine River – Lower Punrak Drain 2	6140264
Estuary catchment			
Stakehill	Keysbrook	Hncculv	6141444

Monitoring of water releases for the Waangaamaap Bilya (Serpentine River)

Water is released over the summer from below the Serpentine Pipehead Dam for downstream flows to support aquatic ecology and to supply holders of a riparian right or licence to abstract water.

We use staff gauges at sites at Hall Road, Rapids Road, Lowlands East and Pipeline North to measure flow in the river in relation to releases (see Figure 11 and Table 4). We also regularly monitor water quality, including dissolved oxygen, pH, temperature and salinity to assess the health of river pools during summer. Every three years Water Corporation samples fish and crayfish species and water quality in the river, as per the operating strategy associated with its water licence, to determine if species richness and abundance are being maintained.

For more information about water allocation and management of the Waangaamaap Bilya, Serpentine Dam and associated release regime, see *Managing releases for the Serpentine River: Serpentine River allocation statement* (DWER 2017).

Healthy Rivers program

Under the Healthy Rivers program, we conduct standardised assessments of river health in strategic locations across south-west Western Australia. Through the program, we collect and interpret biological, water quality and habitat data on rivers and their catchments, and use the knowledge gained to support the development of strategies to best protect the environment. In the statement area, ongoing monitoring is undertaken at three sites (see Figure 11 and Table 4).

Estuary catchment

We also monitor the Bindjareb Djilba (Peel-Harvey estuary) and its catchment. We use the data collected to determine the status of water quality in the estuary and the rivers that feed into it. A catchment model has been calibrated to catchment monitoring data to estimate the sources of nutrient loss to the estuary, as well as the impact of various scenarios (management, land use change and climate change) on nutrient loss. We have used the findings from this monitoring and modelling to inform the upcoming Gabi Warlang Bidi water quality improvement plan for the Peel-Harvey estuary system and *Bindjareb Djilba (Peel-Harvey) protection plan* (DWER 2020c). One of the monitoring sites is located in the Keysbrook subarea (Figure 11 and Table 4).

Healthy Rivers program monitoring site (6144122) on the Waangaamaap Bilya downstream of the Peel Main Drain confluence showing the river drying to isolated pools in March 2023

7. Meeting future demand

The Shire of Serpentine Jarrahdale is growing rapidly, with the population expected to reach 110,000 people by 2050 (DWER 2023). The demand for water is growing along with it, particularly around Beenyup (Byford) and Mundijong.

The revised allocation limits for resources in the statement area adjust groundwater availability in line with reductions in rainfall due to climate change. Existing and future developments should optimise groundwater use through water sensitive urban design and efficient irrigation systems and practices.

Meeting future demand will need to include consideration of water entitlement transfers and trading, greater water use efficiency and alternative sources (other than groundwater). As part of the *Kep Katitjin – Gabi Kaadadjan Waterwise Perth Action Plan 2* (Government of Western Australia 2022), we are working with state and local government agencies to plan for sufficient non-potable water sources to irrigate urban greenspaces and strengthen our advice for land and water planning.

We assessed potential water needs for the future urban developments described in the Perth and Peel @ 3.5 million land use planning and infrastructure frameworks (DPLH & WAPC 2018) and the Shire of Serpentine Jarrahdale's local planning strategy and district structure plans. The study identified potential shortfalls of groundwater to support planned urban and industry development in the shire. It recommends the use of groundwater be optimised through demand management and water entitlement transactions before investing in additional water supplies (DWER 2023).

We also note that accessing groundwater from some parts of the statement area and the Bindjareb (Peel) region more widely can be difficult due to issues with water quality and low yields associated with soils with high clay content.

Allocation limit changes do not prevent access to water for domestic use for rural residential developments, although options and/or volumes may be restricted. Water is available through a combination of scheme, groundwater and rainwater capture. Rural residential property owners who are considering taking groundwater should contact us to work out if they need a licence and if water is available for licensing.

We can provide water licensing advice and technical assistance to Aboriginal people who wish to seek groundwater for economic benefit on land they own or have legal access to.

For advice or assistance in the statement area, please contact our Kwinana Peel regional office.

8. Next steps

The department's next steps are:

1. Continue to support collaborative strategic projects with the Bindjareb people to improve and build on how we protect and understand cultural values.
2. Continue to use data collected through our monitoring program to inform our adaptive management of groundwater resources in the statement area.
3. Continue to implement actions under *Kep Katitjin – Gabi Kaadadjan Waterwise Perth Action Plan 2*.
4. After the allocation limits for the Jandakot and Perth South groundwater areas are set, possibly re-examine allocation limits in the Leederville and Cattamarra resources in the statement area. We aim to have a draft Jandakot and Perth South groundwater allocation plan ready for public comment in early 2025.
5. Evaluate the priority of a study into localised surface/groundwater interaction along the Waangaamaap Bilya (Serpentine River) to map areas where the river is supported by groundwater baseflow.
6. In consultation with stakeholders, develop local licensing policies for:
    - Water licence applications for new public open space so that licence applications are based on an average allocation rate of 6,750 kL/year/ha for the irrigated area (currently 7,500 kL/year/ha).
    - Groundwater entitlement transactions near the Waangaamaap Bilya (Serpentine River) to manage the trading of groundwater entitlements close to the river in areas where it is supported by groundwater baseflow.
    - Additional water efficiency measures for licensed non-commercial uses, which might include aligning the sprinkler roster for licensed non-commercial uses with the scheme water and domestic garden bore roster.
7. Continue to collaborate with the state and local governments and industry groups to enable regional development and growth through fit-for-purpose water servicing.
8. Refine and document the final shortfall in groundwater for meeting the needs of development and determine the additional water sources at the district scale of land use planning.

Commitment statement

Baalap, ngalak baarniny	People we walking
Ngalang gabi waalang bidi	Our water healing journey
Yoowaal – koorl, baarn dandjoo	Come here (come on) walk together
Dandjoo baarniny	Together walking
Kalyakool kalyakool	Forever and ever

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For more information about the allocation limits, please email allocation.planning@dwer.wa.gov.au