



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

Cockburn

groundwater allocation plan
for public comment



Water resource allocation
and planning report series
Report no. 60
May 2018

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Summary

The Department of Water and Environmental Regulation (DWER) is responsible for regulating and managing the state's water resources for sustainable and productive use. The *Cockburn groundwater allocation plan* sets out how we will regulate and allocate groundwater in the cities of Cockburn, Kwinana and surrounding areas.

Groundwater resources and its dependent values are better protected under this plan from the impacts of taking groundwater as the climate changes. The plan encourages groundwater users to become more climate resilient.

This plan replaces the *Cockburn groundwater area water management plan* (DoW 2007) with updates to how groundwater is managed by:

- refining the allocation limits in the Superficial aquifer to:
 - account for climate change and the impact of reduced rainfall on groundwater availability
 - improve our accounting of all groundwater use
 - minimise the risks of taking groundwater on dependent ecosystems such as lakes and wetlands
 - maintain the natural movement of the seawater interface.
- considering changes in land use over time
- designing local licensing policies to protect current use, each resource, and important lake and wetland values
- updating the groundwater monitoring program
- providing a framework for adapting and improving how we manage groundwater.

Water availability in the Cockburn plan area

Water levels in the Superficial aquifer show a general declining trend of between 0.5–1 m at the coast and around wetlands. This has occurred over the last 30 years in response to less rainfall recharge and ongoing water use at a local and regional scale. The last decade showed a slowing down of the declines experienced from 1980–2000. Since 2000 water levels have stabilised, with some seasonal variation, showing that the current level of groundwater use is likely at its limit.

Approximately 30 Gigalitres (GL) of groundwater from the Superficial aquifer is currently licensed across the Cockburn plan area, with an estimated 23 GL used each year. There is also an estimated 2 GL of unlicensed stock and domestic use in the Superficial aquifer.

Our review of allocation limits in the Superficial aquifer showed that the limits set in the 2007 plan are not sustainable to 2030 under modelled future climate trends. Taking more water from the Superficial aquifer would reduce:

- the ongoing productivity of the resource
- water quality, for example by drawing the seawater interface further inland
- the security of supply for existing and future users
- groundwater levels near important groundwater-dependent ecosystems.

The refined allocation limits set in this plan are presented in Table 1. The method for improving the limits in the Superficial aquifer is detailed in *Cockburn groundwater allocation plan: methods report* (DWER 2018). The new allocation limits closely match what is currently used in the Superficial aquifer across the plan area.

Improving water use efficiency, changes in land use over time, and localised recouping of long-term unused water entitlements will ensure that water use remains climate resilient.

Table 1 Allocation limits for the Cockburn groundwater area (GL/yr)

Groundwater resource		Allocation limit	Resource status
Subarea	Aquifer		
Kogalup	Superficial	9.0	Over-allocated
Thompsons	Superficial	4.5	Over-allocated
Valley	Superficial	5.5	Over-allocated
Wellard	Superficial	6.0	Over-allocated
Cockburn confined	Leederville	1.35	Fully allocated
	Yarragadee	5.15	Fully allocated
Total		31.50	

Water may become available from time to time if part, or all, of a licence is relinquished or returned. For more information on groundwater availability, please contact our regional office in Mandurah or visit the Water Register <<http://www.water.wa.gov.au/maps-and-data/maps/water-register>>

Allocation limits were not reviewed for the Leederville and Yarragadee aquifers in the plan area. The limits for these regional-scale aquifers will remain the same until further hydrogeological investigations are completed in the adjacent Jandakot and Serpentine groundwater areas.

Local communities and industry will need to use groundwater efficiently and look for alternative water supplies to meet future demand and remain climate resilient. Alternative water sources are already an important component of the total water supply in the plan area, particularly in the Western Trade Coast industrial precinct. This includes direct reuse of treated wastewater and managed aquifer recharge schemes. We are working with licensees to pursue the most viable options to support future growth.

Managing water resources in a drying climate

The south-west of Western Australia is being impacted by reduced rainfall as a result of climate change, particularly over the last ten years. This reduced rainfall trend is affecting groundwater recharge, resulting in less water available for use.

To make the best use of available groundwater we will:

- work with licensees to match the volume of water licensed to the new allocation limits
- encourage improvements in efficiency of use
- work with local governments, land developers and industry to identify viable alternative water supply options to meet future demand
- do compliance checks to see if licensees are monitoring and using their water responsibly and in line with licence conditions
- apply the local licensing policies in this plan to minimise any adverse effects on water quality and important groundwater-dependent ecosystems.

Groundwater resources are monitored to assess the effects of climate change and the impacts of groundwater use. The resource's response to these changes show us where we need to focus our efforts to meet the outcomes and objectives of this plan.

Have your say

This plan is available for public comment. We will review and consider each comment received to help finalise this plan. We will release a statement of response with the final plan that summarises the comments received and how we considered them in the final plan.

We will not identify individuals, but we may quote directly from your comments, so please state clearly if you do not wish us to do so.

Please send your comments by 5.00 pm Monday 3 September 2018 to: allocation.planning@dwer.wa.gov.au or to the address below:

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Water Allocation Planning Branch
Department of Water and Environmental Regulation
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Perth Western Australia 6842

1 Plan context and scope

1.1 Purpose of the plan

The cities of Cockburn, Kwinana and surrounding areas have experienced rapid growth over the last decade and since the release of the 2007 *Cockburn groundwater area water management plan*. The Western Trade Coast industrial areas (including Kwinana Industrial Area), and expanding urban land uses, have increased the demand for water.

There are also unique and significant lakes and wetlands with national and international protection status, such as the Ramsar-listed Thomsons Lake, located in the plan area. Balancing how groundwater is abstracted will minimise impacts on these sensitive environments and maintain the current reliability of supply for groundwater users as the climate changes.

The *Cockburn groundwater allocation plan* updates the way in which the Department of Water and Environmental Regulation (DWER) will regulate and manage the abstraction of groundwater through allocation limits, licensing, monitoring and evaluation. This is particularly important given the challenge of adapting to climate change.

This plan:

- defines the outcomes, objectives and strategies for allocating groundwater
- sets new allocation limits in the Superficial aquifer
- updates local licensing policies to improve how we manage groundwater licences
- accounts for current use that is exempt from licensing
- considers the water needs of current and future land use planning
- encourages water use efficiency and sourcing alternative supplies in response to reduced groundwater availability
- puts an updated monitoring program in place across the plan area to evaluate how the resource is responding
- provides a framework to adapt and improve how we manage groundwater.

This *Cockburn groundwater allocation plan* is a non-statutory plan prepared to guide licensing under the *Rights in Water and Irrigation Act 1914* (WA). It replaces the *Cockburn groundwater area water management plan*, (DoW 2007).

The plan does not address access to, or use of, public potable (drinking water) and non-potable (wastewater) supply in the cities of Cockburn, Kwinana and surrounding areas. This water is obtained from the Water Corporation's Integrated Water Supply Scheme (IWSS), water reclamation¹ or wastewater treatment plants.

¹ Kwinana Water Reclamation Plant supplies highly treated wastewater to industry for reuse.

1.2 Plan area

Location

The plan covers the Cockburn groundwater area, which extends along the Swan Coastal Plain from Kwinana Beach northward to South Beach covering a coastal strip of 22 km, and extending roughly seven kilometres inland. The plan area covers 157 km² (Figure 1) located 30 km south of Perth, in the local government areas of Cockburn, Kwinana and Rockingham.

The Cockburn groundwater area is bounded by the Perth groundwater area to the north, Jandakot groundwater area to the east and Rockingham groundwater area to the south. The plan area also borders the areas covered by the *Rockingham–Stakehill groundwater management plan* (DoW 2007) to the south (Figure 1).

Proclamation

The Cockburn groundwater area was proclaimed on 29 July 1988 under the provisions of the *Rights in Water and Irrigation Act 1914* to regulate how groundwater is taken and to protect the long-term availability of groundwater. Abstracting and using groundwater requires a licence in the plan area (see Chapter 4 for more details on licensing).

Land use

Almost half of the plan area is covered by industrial land uses, with most industry located along the coast, south of Beeliar Drive. This includes the Kwinana Industrial Area, Australian Marine Complex, Rockingham Industry Zone and the Latitude 32 industry zone², collectively known as the Western Trade Coast industrial precinct (Figure 2).

Within the Latitude 32 industry zone there are small-scale irrigated market gardens and turf production, which will transition into light industrial land use in the future.

The remaining land is covered by urban areas, interspersed with natural bushland and wetlands. Groundwater is used to irrigate public open space, sporting grounds, and suburban domestic gardens in the cities of Kwinana and Cockburn.

Most of the natural bushland and wetlands are collectively managed as the Beeliar Regional Park or Leda Nature Reserve. These areas contain high value groundwater-dependent wetlands and lakes, such as the Ramsar-listed Thomsons Lake. They are important for the community as recreational, cultural and tourism sites.

² The area covered by the *Hope Valley Wattleup Redevelopment Act 2000* and *Hope Valley Wattleup redevelopment project master plan* (LandCorp, 2017).

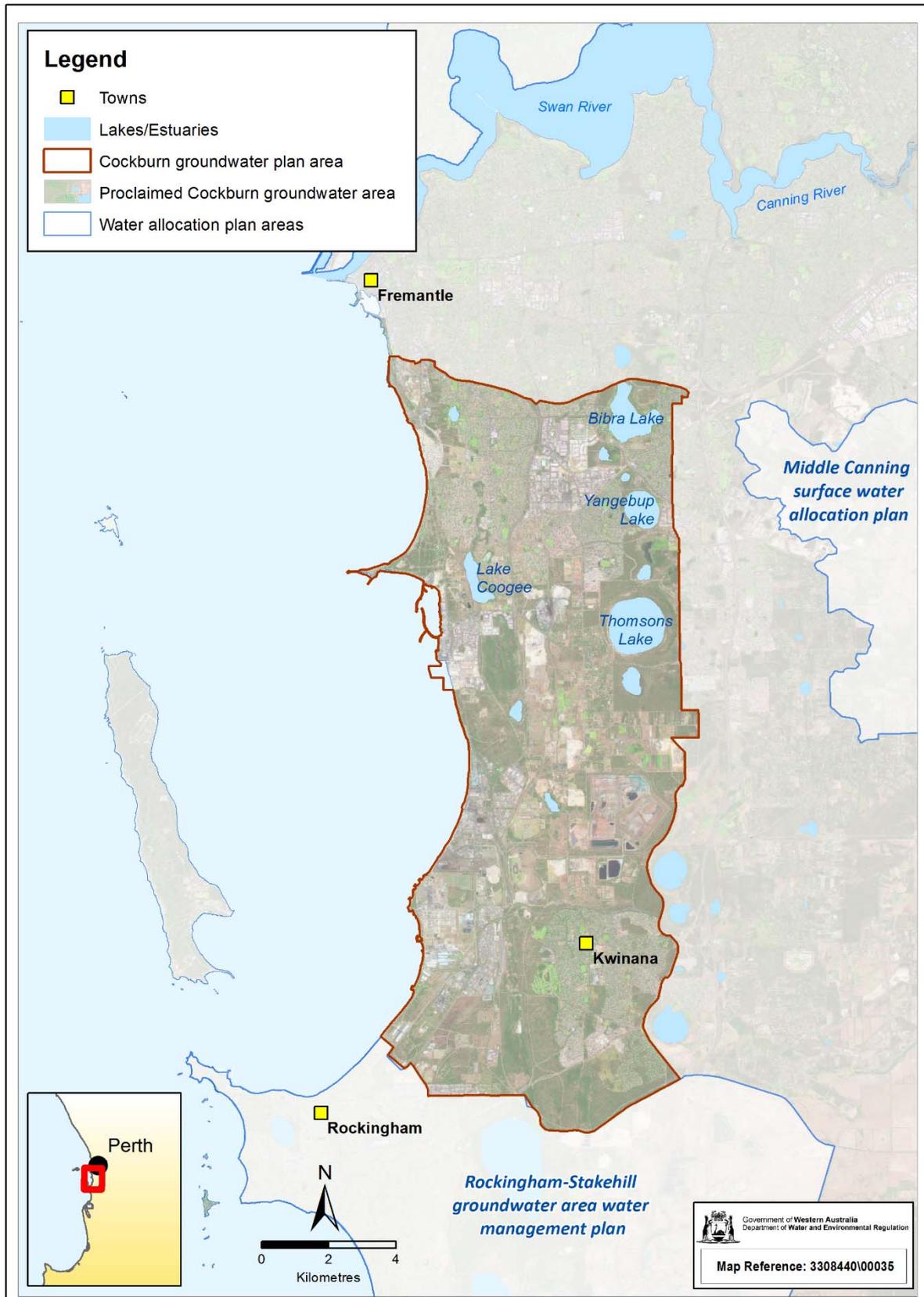


Figure 1 Cockburn groundwater allocation plan area

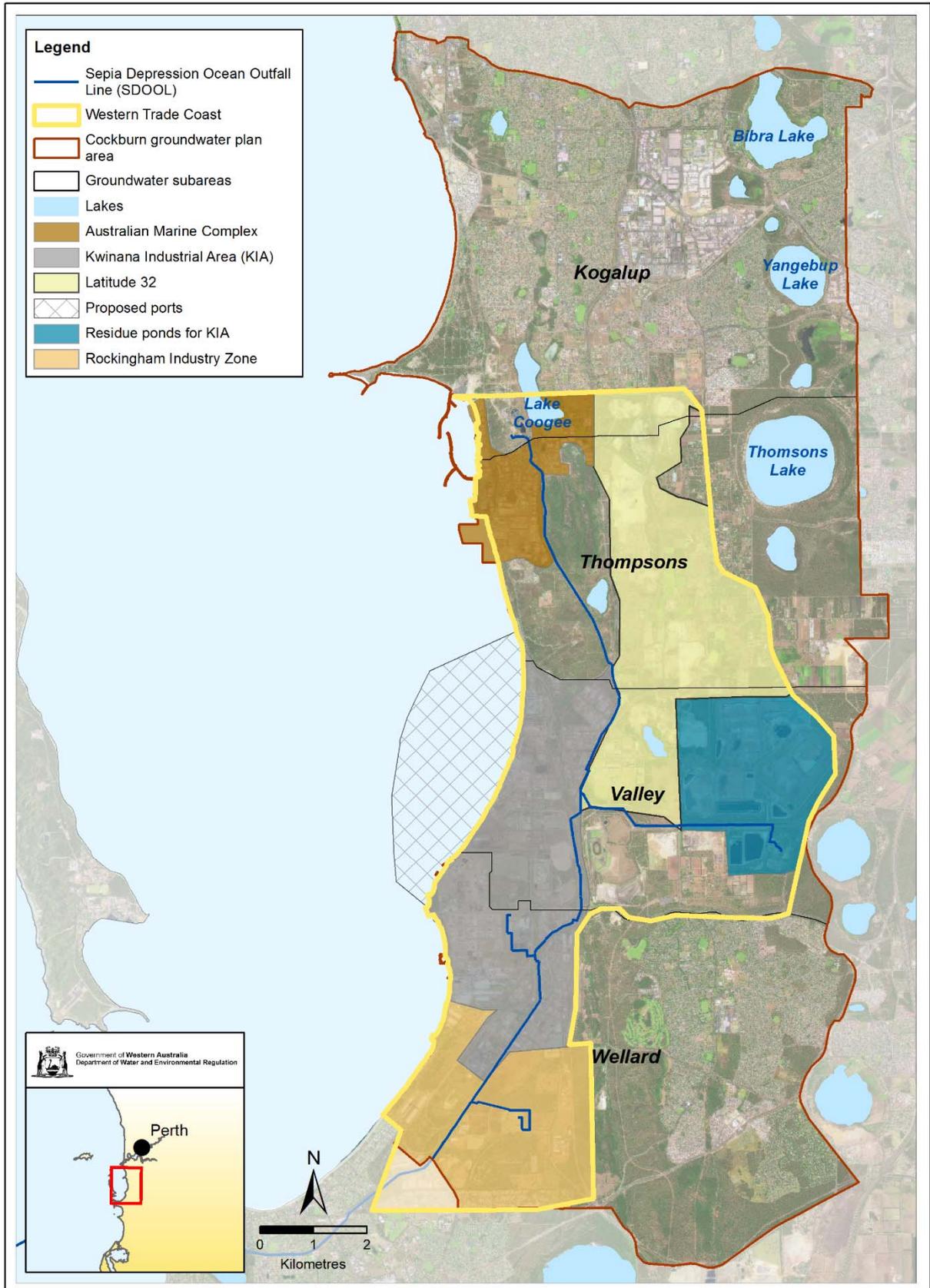


Figure 2 Western Trade Coast industrial precinct

1.3 Water resources covered

A 'groundwater resource' is defined as an aquifer that is accessible in a particular subarea. We set allocation limits for each of the six groundwater resources in the plan area (Figure 3).

The hydrogeology of the Cockburn groundwater area is well understood (see DoW 2007 and DWER 2018). Aquifers present in the groundwater area (in order of increasing depth) are:

- Superficial (including a minor localised area of Rockingham Sand)
- Leederville
- Yarragadee.

The Cockburn plan area is divided into four subareas to manage how water is allocated and licensed from the Superficial aquifer (Figure 3):

- Kogalup
- Thompsons
- Valley
- Wellard.

The Leederville and Yarragadee aquifers are managed in two subareas that cover the whole plan area – Cockburn confined Leederville aquifer and Cockburn confined Yarragadee aquifer.

Superficial aquifer

The superficial formations are an unconfined aquifer system consisting of Quaternary-tertiary sediments with a thickness of between 30 m and 65 m. These sediments consist of moderately to highly transmissive calcareous marine sands and coastal limestone formations near the coast. Inland, east of the linear chain of lakes, the superficial formations transition to variable sequences of fine and medium-grained sand with minor silt and limestone.

The Superficial aquifer has an average saturated thickness of 30 m. Recharge occurs mainly by direct infiltration of rainfall. Groundwater flows from the east, associated with the Jandakot Mound flow system, to the west, and then discharges to the ocean. Locally, flow direction may change in areas associated with wetlands.

For more information on the Superficial aquifer in Cockburn see *Cockburn groundwater allocation plan: Methods report* (DWER 2018) and *Cockburn groundwater area water management plan* (DoW 2007).

Seawater interface

A naturally occurring seawater interface exists along the coast in the Superficial aquifer. The position of the seawater interface changes over time and is influenced by climatic and seasonal variability in groundwater recharge, through-flow, sea levels and rainfall.

Seawater intruding into the Superficial aquifer, not water level decline, poses the greatest risk to water users along the coast. Where seawater is intruding into the Superficial aquifer it replaces the freshwater, maintaining water levels, but reducing water quality. The changes in water quality increase the costs of use and can adversely affect groundwater-dependent ecosystems.

For more information on the seawater interface in Cockburn see *Cockburn groundwater allocation plan: Methods report* (DWER 2018).

Confined aquifers

Leederville aquifers

The regionally extensive Leederville aquifer is composed of Osborne formation (Henley Sandstone) and Leederville formation. It is a discontinuous, multi-layered system consisting of interbedded sandstones, siltstones and shale (Davidson 1995). The Kardinya Shale formation overlies the Leederville aquifer except in southern portion of the groundwater area (Wellard Subarea).

Where the Leederville aquifer directly underlies the superficial formations it is recharged by water leaking down from the overlying aquifer. This mainly occurs where there are downward hydraulic gradients along the eastern edge of the groundwater area (Davison & Yu 2008). Over short distances and with depth, the Leederville aquifer becomes confined by layers of siltstone and shale.

Yarragadee aquifer

The confined Yarragadee aquifer is a multi-layered aquifer, consisting of interbedded sandstones, siltstones and shales. In the Cockburn groundwater area it is made up of the Gage formation, Yarragadee formation and the Cattamarra Coal Measures. It is greater than 2000 m thick. The Yarragadee aquifer is confined by both the South Perth Shale and clay beds of the Leederville formation.

For more information on the Leederville and Yarragadee aquifers in Cockburn see *Cockburn groundwater area water management plan* (DoW 2007).

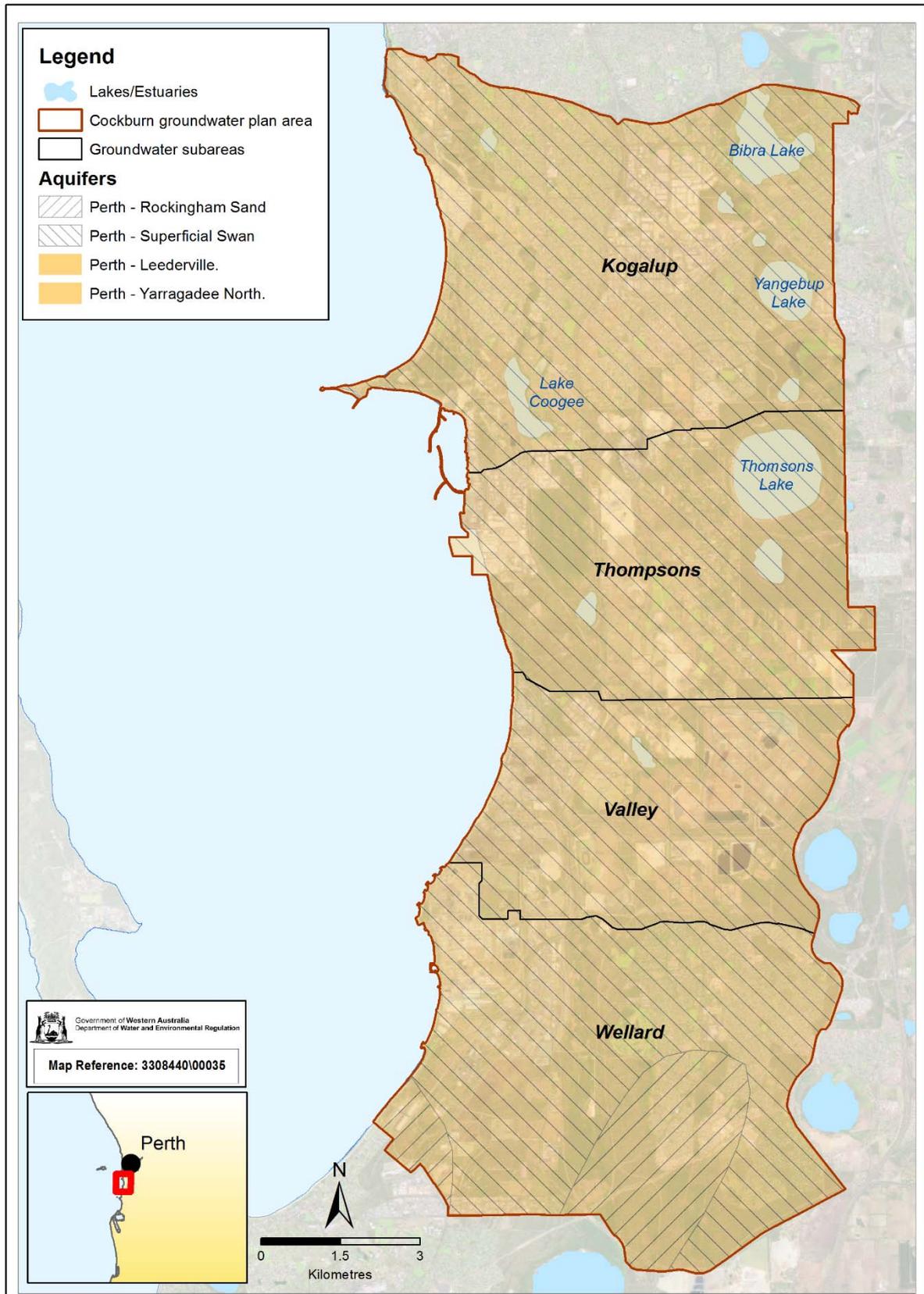


Figure 3 Subareas and groundwater resources in the Cockburn groundwater allocation plan area

1.4 How we developed the plan

The *Cockburn groundwater area water management plan: Evaluation statement 2007–2011* (DoW 2012) identified, through monitoring data that groundwater levels continued to stabilise since 2007 with a ± 1 m seasonal variation. The 2007–2011 statement suggested that groundwater abstraction was sustainable under the original allocation limits.

The *Cockburn groundwater area water management plan: Evaluation statement 2012–2015* (DoW 2016b), used groundwater monitoring, metering and modelling data, to evaluate the performance of the resource. This work showed that groundwater abstraction (estimated at 23 GL/yr out of 29.9 GL licensed in the Superficial aquifer) was likely at its limit.

Alongside this evaluation work the department assessed and reviewed the water supply and demand for the Western Trade Coast industrial precinct, as part of the *Western Trade Coast heavy industry water supply strategy* (DoW 2016a). Industry groups wanted certainty on groundwater availability to identify how much water may need to be sourced from alternative supplies, like managed aquifer recharge, to support the future growth of the industrial precinct.

The results of the 2012–2015 evaluation and the work undertaken as part of the water supply strategy triggered the review of the allocation limits and the replacement of the 2007 plan.

In November 2016, the department notified the public through the 2012–2015 evaluation statement, that we intended to replace the 2007 plan and invited feedback from stakeholders. During development of the plan we consulted directly with stakeholders (see Section 1.5 below).

To develop the *Cockburn groundwater allocation plan* we used the best-available hydrogeological, environmental and groundwater use information to:

- align our water planning with current and future land use planning
- improve our accounting of all groundwater use
- account for climate change and the impact of reduced rainfall on groundwater availability
- refine the allocation limits
- update and modernise our local licensing policies.

The plan is accompanied by the *Cockburn groundwater allocation plan: methods report* (DWER 2018). This report shows how we revised the allocation limits to determine how much fresh groundwater is available for use due to climate change (see Chapter 3).

1.5 Stakeholder interests

The following stakeholders were regularly contacted, informed or consulted throughout the planning process:

- City of Cockburn, Kwinana and Rockingham local government authorities
- Water Corporation
- Department of State Development
- Kwinana Industries Council³
- Jandakot Community Consultative Committee (JCCC)
- Beeliar Regional Park Community Advisory Committee (BRPCAC)
- LandCorp and other members of the Western Trade Coast group.⁴

Between 2014 and early 2017 we consulted with these stakeholders on the proposed changes to the allocation limits. This included seeking feedback on identifying the needs of the environment, understanding future demand and discussing the use of alternative sources. After completing the review of the allocation limits we presented the new volumes and discussed how water would be managed through the process to replace the 2007 plan.

Stakeholders were generally supportive of the need for this plan and the updated allocation limits. Discussing important issues with stakeholders shaped how we set the outcomes and objectives of this plan. The most important issues to address in this plan were that we:

- align long-term water planning with existing and future land use planning to identify gaps and work together to meet demand
- identify and address where abstracting groundwater may adversely affect groundwater-dependent ecosystems due to climate change
- match what is licensed with what licensees are using, and to stage this work over time to allow licensees to adapt
- minimise artificially moving the seawater interface further inland and adverse changes to water quality that may affect people's ability to use groundwater or impact on lake and wetland health
- assist with access to and use of alternative sources to meet future demand.

For more information about how we develop allocation plans, see *Water allocation planning in Western Australia: a guide to our process* (DoW 2011).

³ The members of the Kwinana Industries Council are Alcoa World Alumina, BHP Billiton (Nickel West), BP, Cockburn Cement, Coogee Chemicals, CSBP Limited, Fremantle Ports, Tronox, CBH, Verve Energy and the Water Corporation.

⁴ The Western Trade Coast group covers the Latitude 32 Industry zone (LandCorp), the Australian Marine Complex at Henderson, the Rockingham Industry Zone, and the Kwinana Industrial Area (represented by the Kwinana Industries Council).

1.6 Related plans and strategies

Understanding future land use and the likely demand for water is an important part of the planning process. Groundwater is typically the most accessible and cheapest source of water for consumptive use. Where there are risks to the sustainability of the resource it's essential that we signal where water is not available so that potential and planned future land uses can be identified and appropriate alternative water sources activated.

Western Trade Coast heavy industry local water supply strategy

The *Western Trade Coast heavy industry local water supply strategy* (DoW 2016a) was developed to assess the water supply options available to meet projected water demand for heavy industry over the next 15 years in the Western Trade Coast industrial precinct (Figure 2). The strategy was developed in consultation with the Kwinana Industries Council, Western Trade Coast Industries Committee, Department of State Development, Water Corporation and targeted stakeholders.

There is a gap between the amount of groundwater available and future projected demand, so alternative water sources are needed. The water supply strategy identifies fit-for-purpose options that are 'feasible, cost-effective and affordable'. The water supply strategy also identifies the regulatory controls and approval processes associated with each option to support accessing these alternative water sources.

Local land use planning

Land use is subject to the planning schemes and strategies that are set down by the Western Australian Planning Commission and local government authorities. The department used following strategies and planning-related documents to provide the strategic land planning context for this area into the future:

- Cockburn Coast district structure plan (WAPC 2009) and appendices
- Directions 2031 and beyond (WAPC 2010a)
- Draft South Metropolitan Peel sub-regional planning framework (DoP & WAPC 2015a)
- Hope Valley Wattleup redevelopment project master plan (LandCorp 2017).

We also considered the results of the assessed environmental values and projected land use change set out in the draft *Perth and Peel Green Growth Plan for 3.5 million to 2050* (DoP & WAPC 2015b).⁵

For the Latitude 32 industry zone we also considered the intent, objectives and technical data collected as part of the *Hope Valley Wattleup redevelopment project*

⁵ This is the strategic conservation plan, which sets out the outcomes and objectives for conserving the environment as land use changes over its 30 year lifespan. It provides the strategic assessment of the Perth and Peel regions under section 146 of the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*.

biodiversity strategy (LandCorp 2007) and the associated *Hope Valley Wattleup redevelopment project water management strategy* (LandCorp 2013).

In areas where rural and irrigated horticulture is changing to light industry or urban we are expecting the demand for groundwater to reduce. As this demand for water lessens it can be reallocated for other purposes or returned to the system to reduce over-allocation of the resource. Where groundwater is not available to meet future demand it can be supplemented or replaced by alternative water sources to achieve sustainable growth.

Environmental management

The plan incorporates the water level criteria set by the Minister for Environment in the *Jandakot Mound groundwater resources [including Jandakot groundwater scheme, stage 2] Ministerial statement no. 688* (EPA 2005). The water level criteria are applied to Bibra Lake, Yangebup Lake, Kogalup Lake, Thomsons Lake and Lake Banganup.

The plan also considers and aligns with the direction and outcomes presented in the *Beeliar Regional Park management plan* (CCWA & CALM 2006), *Environmental Management Plan for Cockburn Sound and its Catchment* (DoE 2005) and other local environmental management plans.

1.7 Plan timeframe

The *Cockburn groundwater allocation plan* will remain in effect until it is replaced, amended (an update version of this plan) or revoked by the Minister for Water. We will consider the need to replace this plan in 2022 unless it is identified earlier through a plan evaluation process (Chapter 6).

2 What the plan will achieve

The Department of Water and Environmental Regulation (DWER) is responsible for managing the water resources of Western Australia, consistent with the objectives of the *Rights in Water and Irrigation Act 1914*; specifically:

- a *To provide for the management of water resources, and in particular –*
 - *for their sustainable use and development to meet the needs of current and future users*
 - *for the protection of their ecosystems and the environment in which water resources are situated, including by the regulation of activities detrimental to them*
- b *To promote the orderly, equitable and efficient use of water resources.*

In administering the Act, the department makes provision for the sustainable use and development of water resources as well as the protection of ecosystems associated with water resources. Water licences are issued under the *Rights in Water and Irrigation Act 1914* to manage and regulate the individual take of groundwater.

We accounted for all groundwater use, including exempt stock and domestic use. We set out to minimise risks to groundwater-dependent ecosystems, the resource's long-term viability and from changes in water quality and seawater intrusion. This plan considers future land use changes and the effects of climate change.

The outcomes and resource objectives described below were used to develop the allocation limits, local licensing policies and our monitoring and evaluation program. These inform how we manage the water resource and make allocation decisions in the plan area.

2.1 Outcomes

The outcomes of the plan are achieved by managing the water resource in the way described in this plan. The outcomes are to:

- provide water security for users and the environment as the climate changes
- protect important lakes and wetlands from any adverse effects of taking or reinjecting groundwater
- minimise the impacts of abstracting groundwater on water quality and the long-term productivity of the resource
- encourage improved water use efficiency and investment in alternative water sources.

We will assess and report against how well the plan contributes to achieving these outcomes by evaluating the performance of the water resource against the objectives.

2.2 Resource objectives

To meet the plan's outcomes, our management is directed towards meeting specific water resource objectives. These objectives must be measurable and relate to maintaining, increasing, improving, restoring, reducing or decreasing groundwater levels or water quality.

The water resource objectives of this plan are:

1. Water levels are sufficient to meet water level criteria set under *Ministerial Statement no. 688*⁶ each year.
2. Water levels in the Superficial aquifer are sufficient to protect the current values of groundwater-dependent ecosystems each year.
3. Abstracting groundwater does not cause the seawater interface to move further inland nor increase in thickness.
4. Abstracting or reinjecting groundwater does not cause adverse changes in water quality.

The measurable performance indicators for each resource objective are described in Chapter 5, Table 4.

2.3 Strategies

To meet the plan's water resource objectives, our strategies are to:

- license the six groundwater resources in accordance with the allocation limits (Chapter 3) and local licensing policies in this plan (Chapter 4)
- reduce over-allocation through recouping unused entitlements (Chapter 4) and when land use changes
- encourage use of trading and water efficiency to meet gaps in water demand (Chapter 4)
- partner with stakeholders where there are significant gaps in water demand to access alternative water supply options (Chapter 4)
- investigate non-compliance with licence conditions and take appropriate enforcement action (Chapter 4)
- monitor groundwater resources using the department's monitoring network (Chapter 5)
- regularly evaluate whether the plan's outcomes and resource objectives are being met and adjust our management accordingly (Chapter 6).

⁶ *Jandakot Mound groundwater resources [including Jandakot groundwater scheme, stage 2] Ministerial statement no. 688*, Environmental Protection Authority, 2005.

2.4 Measuring the plan's success

We will evaluate the plan regularly to see if the outcomes and resource objectives are being met. We will evaluate the state of the water resources using monitoring data and applying the performance indicators (Chapter 5 and 6). This includes using data submitted by licensees and rainfall data collected by other agencies.

Our approach is adaptive and work will be ongoing in the plan area to refine how we monitor, report and license groundwater over time. At least every three years, we will publish how successful we were in meeting the outcomes and resource objectives of this plan in an evaluation statement.

3 Water allocation limits

3.1 Allocation limits

Allocation limits are the main tool we use to make sure that the take of water is sustainable and to maintain a reliable supply at the resource scale. Allocation limits are the annual volume of water set aside from a water resource for consumptive use such as household, urban, irrigation, stock, mining or industrial.

The allocation limits for each groundwater resource and subarea are shown in Table 2. The allocation limit includes water that is available for licensing (the general component) and water that is exempt from licensing (exempt component). See Section 3.3 for a description of allocation limit components.

Water that is left in an aquifer to support *in situ* values, such as wetlands, is accounted for before the allocation limits are set.

All groundwater resources in the plan area are now fully or over-allocated.

The department manages groundwater licensing up to the allocation limit for each resource in accordance with the licensing and allocation approach described in Chapter 4. Where a resource is fully or over-allocated we are likely to refuse applications for more water, including increases to existing licences.

We encourage people seeking more water to improve water use efficiency, trade, or use alternative water sources to meet their needs. The department will be recouping long-term unused water entitlements where necessary.

Table 2 Allocation limits for the water resources of the Cockburn groundwater area (kL/yr)

Water resource		Allocation limit	Allocation limit component	
Subarea	Aquifer		General	Exempt
Kogalup	Superficial	9 000 000	7 940 000	1 060 000
Thompsons	Superficial	4 500 000	4 280 000	220 000
Valley	Superficial	5 500 000	5 500 000	-
Wellard	Superficial	6 000 000	5 380 000	620 000
<i>Total</i>	<i>Superficial</i>	<i>25 000 000</i>	<i>23 100 000</i>	<i>1 900 000</i>
Cockburn confined	Leederville	1 350 000	1 350 000	-
	Yarragadee	5 150 000	5 150 000	-
Total		31 500 000	29 600 000	1 900 000

Please phone our Kwinana Peel regional office on 08 9550 4222 for up-to-date water availability statistics, to discuss opportunities for obtaining water by trading or from alternative sources. Water availability can also be viewed on our online Water Register at <http://www.water.wa.gov.au/maps-and-data/maps/water-register>.

3.2 Components of the allocation limits

For administrative and water accounting purposes, the allocation limit is divided into the following components:

- water that is available for licensing (general and public water supply licensing)
- water that is exempt from licensing (unlicensed)
- water that is reserved for future public water supply licensing.

General licensing

The general licensing component of the allocation limit is the total volume of water that can be issued as an annual licensed entitlement for all uses other than public water supply. The 29.6 GL/year in this component, across all aquifers at the time of publishing, is fully allocated.

Public water supply and reserved water

No groundwater is licensed or reserved for public water supply in the Cockburn groundwater area. Potable water (drinking water) supply is met through the Water Corporation's Integrated Water Supply Scheme sourced from outside the plan area.

Unlicensed use

The unlicensed use component is the volume of water for uses that are exempt from licensing under the Rights in Water and Irrigation Exemption (Section 26C) Order 2011. This includes water for rural households, gardens (<0.2 ha), minor stock and domestic uses and emergency fire-fighting purposes only. They are commonly referred to as domestic garden bores in urban areas.

We calculated that there is 1.9 GL/year of water from the Superficial aquifer exempt from licensing. This is less than eight percent of the groundwater abstracted in the plan area. This estimate is a snapshot in time calculated using the current land uses.

We are expecting that new urban areas will have a lower incidence of domestic garden bores. This is because the majority of the plan area is considered unsuitable (water quality) for drilling new domestic garden bores. Estimates of exempt use will be evaluated every three to five years, depending on urban growth.

Accounting for managed aquifer recharge

Managed aquifer recharge provides additional water to what is naturally occurring in the aquifer. Approved managed aquifer recharge activities are assigned to a separate component, which sits outside the allocation limit components.

Water abstracted from a managed aquifer recharge zone is licensed from this separate 'managed aquifer recharge component'. At present there is no water assigned to this component in the Cockburn groundwater area.

3.3 How were the allocation limits set?

Since release of the 2007 plan, regular evaluations of monitoring data showed that water levels in the Superficial aquifer generally declined at the coast and around wetlands (0.5–1 m over the last 30 years). The last decade showed a slowing down of the declines experienced from 1980–2000. Since 2000 water levels stabilised, with some seasonal variation.

The last three years of metered use data showed that there is long-term under use across the plan area. There are localised areas of high use on the coast where water quality monitoring data showed that the seawater interface moved further inland over the last five years.

These results, coupled with our understanding of how the climate is projected to change, mean that the volume of groundwater currently being abstracted is likely at its limit in the Superficial aquifer.

The methodology for refining the Superficial allocation limits under this plan is presented in *Cockburn groundwater allocation plan: methods report* (DWER 2018). The new allocation limits are based on the best-available hydrogeological, climate, environmental, water use and modelling information.

The modelling undertaken as part of refining the groundwater allocation limits in the Cockburn groundwater area used PRAMS version 3.5 (Perth Regional Aquifer Modelling System).

Superficial aquifer allocation limits

Setting allocation limits represents a balance between current and future groundwater use, and the amount of water that needs to be retained in the aquifer for environmental and resource-protection purposes.

To revise the Superficial aquifer allocation limits we tested four allocation options (Box 1) under a projected worst-case climate scenario (Figure 4). These options represented a range between current use (estimated at 21.5 GL) and licensed entitlements (30 GL). They were designed to identify the maximum volume of groundwater available for consumptive use while still achieving the plan's outcomes and objectives.

Box 1: Allocation options under a projected worst-case climate scenario

Base case (30 GL/yr): abstracting the full licence entitlements for November 2015 plus exempt use.

Option 1 (21.5 GL/yr): abstracting average metered use for 2013-2015 plus exempt use.

Option 2 (25.5 GL): mid-point between the Base case and Option 1.

Option 3 (28.5 GL/yr): mid-point between Base case and Option 2.

The Perth Regional Aquifer Modelling System (PRAMS) was run for each allocation option. The modelling results included drawdown maps, predicted water levels at criteria sites and the water balance which was used to calculate the location of the seawater interface.

We used these results to categorise the level of risk to the resource associated with each allocation option. The risk category showed whether each allocation option was acceptable and could meet the objectives set.

The allocation limit for each subarea was set when the decision provided the most acceptable level of risk to the water resource (groundwater-dependent ecosystems and seawater interface) and maintained security of supply under the objectives. The acceptable level of risk to groundwater-dependent ecosystems and the seawater interface are presented in DWER (2018) and summarised in Section 3.5 below.

Allocation option 2 was chosen to set the new allocation limits for Kogalup (9 GL/yr), Thompsons (4.5 GL/yr) and Wellard (6 GL/yr) subareas. In Valley subarea option 1 (5.5 GL/yr) was chosen to minimise further local on-ground water quality issues. These decisions secure a reliable supply of water for users and maintains sufficient water in the Superficial aquifer to support important wetlands as the climate changes.

With these changes to allocation limits all groundwater resources are fully or over-allocated. Improving water use efficiency, changes in land use over time, and localised recouping of long-term unused water entitlements will ensure that over-allocated resources are brought back into balance as well as allow for some growth in use, in some areas, over the next decade.

Confined aquifer allocation limits

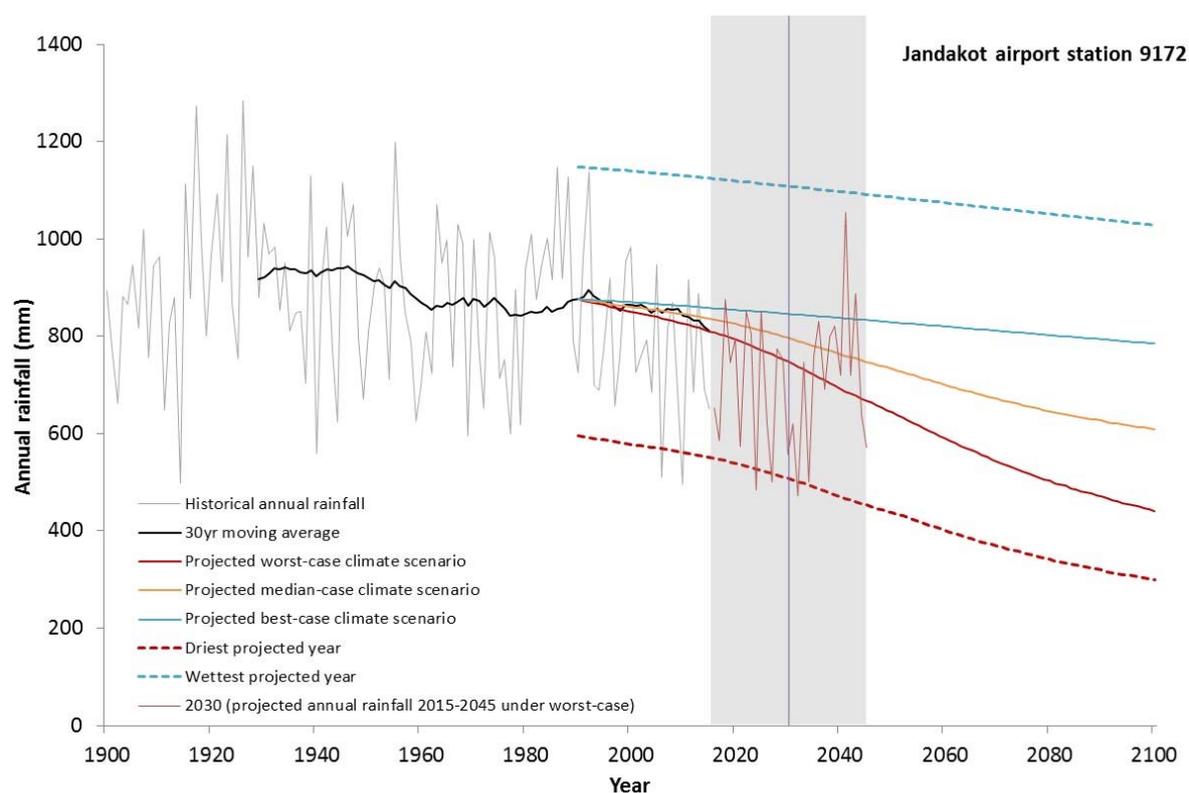
The allocation limits set in 2007 for the Leederville and Yarragadee aquifers remain unchanged in this plan. The limits for these regional-scale aquifers will remain the same until further hydrogeological investigations are completed outside of the plan area in the adjacent Jandakot and Serpentine groundwater areas.

We will also use the results of the recently completed Perth Region Confined Aquifer Capacity (PRCAC) study to inform how we manage seawater intrusion, through-flow and managed aquifer recharge in the deeper aquifers.

3.4 How we considered climate change

The south-west of Western Australia is one of the places in the world most impacted by reduced rainfall as a result of climate change. This matters for our water resources.

Since the 1980s rainfall, streamflow and recharge to groundwater has declined across south-west WA. In the plan area the 30-year long-term average was 847 mm in 1980. In 2015 it was 812 mm. The last 10 to 15 years were much drier (Figure 4), particularly the two very dry years of 2006 (510 mm) and 2010 (496 mm).



Note: The future scenarios are calculated relative to a 1961-1990 baseline, so the climate trends are plotted using 1990 as the starting year.

Figure 4 Historical and projected rainfall for best, median and worst-case climate scenarios in Cockburn groundwater area

To understand how recharge and runoff will change in response to less rainfall the department uses global climate model results generated by CSIRO and the Bureau of Meteorology. Our standard approach to climate projecting is detailed in *Selection of future climate projections for Western Australia* (DoW 2015).

Figure 4 shows the historical annual rainfall at the Bureau of Meteorology site in Jandakot (rainfall station no. 9172) and the projected patterns 2015–2045, under a best, median or worst-case climate scenario. The projected driest (worst-case) climate scenario was used to set allocation limits.⁷

In all projected climate scenarios, annual rainfall will decline over time. Rainfall is expected to decrease by 15 per cent by 2030 under the projected worst-case climate scenario when compared to the 1961–1990 baseline period. Current rainfall is tracking in line with this climate scenario.

⁷ The 'worst- case' scenario refers to a drier-hotter scenario which is close to the 10th percentile change in rainfall and has a relatively large increase in temperature. The 'median' is a mid-range scenario which is close to the 50th percentile change in rainfall and has a moderate increase in temperature. The 'best-case' scenario refers to a wetter-cooler scenario which is close to the 90th percentile change in rainfall with a relatively smaller increase in temperature (DoW 2015).

The 'worst' and 'best' case scenario therefore do not represent the driest or wettest projection of annual rainfall for an area. They are the terms we use to describe the relative dryness of a projection compared to other projections.

Allocation limits were reduced to reflect the effects of less rainfall recharge. While the worst-case climate scenario was applied to the allocation options it is possible that some years may be drier or wetter than projected.

3.5 Water that is left in the aquifer

Water that is left in the aquifer maintains the environment, water quality and resource integrity. By leaving water in the aquifer we protect the long-term viability of the aquifer for use, groundwater-dependent ecosystems and other water-dependent values.

Groundwater-dependent ecosystems

There are many groundwater-dependent ecosystems, including high conservation value wetlands, in the Cockburn groundwater area. Most wetlands are managed collectively in the Beeliar Regional Park or Leda Nature Reserve. The department is responsible for minimising the impacts to these ecosystems in areas where groundwater is abstracted.

There were two types of water level criteria used to assess risk to groundwater-dependent ecosystems across the plan area. The first type of criteria are defined under *Ministerial statement no. 688* for the highest value wetland sites. These sites are Bibra Lake, Yangebup Lake, Kogalup Lake, Thompsons Lake (Ramsar-listed) and Lake Banganup. Water level criteria include preferred and absolute minimum water levels, rate of decline and timing of drying. These sites are protected under state and federal legislation or international agreements.

The second type of water level criteria were set at representative wetland sites (protected under state and federal legislation) using minimum groundwater levels observed in 2015.⁸

The two sets of water level criteria were used to model and assess the risks to the water resource associated with revising the allocation limits. Risk categories were assigned to each allocation option based on the water level change at 2030 against the water level criteria set.

A low level of risk to groundwater-dependant ecosystems with Ministerial criteria and/or Ramsar sites was considered acceptable in Kogalup and Thompsons subareas (Option 2). At these sites the Superficial aquifer water levels should be maintained above the absolute minimum water level criteria by >0.1 m by 2030.

A low to medium level of risk was considered acceptable for other wetlands in the Valley (Option 1) and Wellard subareas (Option 2). At these sites < 0.2 m minimum water level decline was accepted by 2030, and where we are recovering water levels, no change or a rise <0.3 m in water levels was accepted by 2030.

⁸ The minimum groundwater levels were set to achieve acceptable risk to each site at the lowest on record over the last ten years.

Abstracting groundwater near groundwater-dependent ecosystems will be more precisely managed through licensing and compliance to minimise local impacts to these sites (see Chapter 4 for more details).

The water level criterion provide a measurable target to evaluate the response of the resource over time. This response will be regularly evaluated to check if we met the objectives (see Chapter 5 for more details).

The seawater interface

Groundwater through-flow and discharge to the ocean needs to be maintained to minimise moving the seawater interface further onshore and retain good water quality for use. Over time the position of the seawater interface is influenced by climatic and seasonal variability in rainfall, groundwater recharge and sea levels. This causes the natural ebb and flow movement of the interface along the coastline. Maintaining sufficient through-flow of groundwater to the coast will maintain the location of natural seawater interface.

Groundwater users and groundwater-dependent ecosystems within 3 km of the coast (coastal zone) are at risk if the seawater interface moves further inland. To understand this risk we calculated where the seawater interface stabilised, at varying distances (between 0–3 km inland) from the coast (see DWER 2018) with less rainfall recharge (worst-case climate scenario). This information was used to assess the risks to the resource under each allocation option.

When deciding on the allocation limits the lowest level of risk to moving the seawater interface was chosen to meet Objective 3. For Kogalup, Thompsons and Wellard subareas this was Option 2. For the Valley subarea it was Option 1, as we are already seeing the seawater interface moving onshore in this subarea.

Low risk to freshwater supply for use and groundwater-dependent ecosystems occurs when groundwater throughflow to the ocean is >1 GL/year/subarea and the seawater interface is less than 3 km inland.

Abstracting groundwater in the seawater interface zone (coastal zone 0–2 km inland) will be more rigorously managed through licensing and compliance to minimise the risk of artificially moving the interface (see Chapter 4 for more details).

Data from licensee and departmental monitoring bores will be used to evaluate the response of the resource over time. This response will be regularly evaluated to check if we met the objectives (see Chapter 5 for more details).

4 Water licensing

Water licences are issued under the *Rights in Water and Irrigation Act 1914* to manage and regulate the individual take of surface water and groundwater. The department uses policies and process for assessing licence applications and applying licence conditions. Allocation plans specify the local policies and water resource management outcomes that apply to a particular plan area.

The local licensing policies for managing water allocation and licensing in the Cockburn plan area are applied together with the department's state-wide policies and guidelines.

4.1 Legislative requirements

Rights in Water and Irrigation Act 1914

The *Rights in Water and Irrigation Act 1914* (the Act) establishes the legislative framework for managing and allocating water in Western Australia. The Cockburn groundwater area, was proclaimed under the Act in 1988 (see Section 1.2; Figure 1).

Water licences

Groundwater users in the *Cockburn groundwater allocation plan* area require a licence under section 5C of the Act to lawfully take groundwater, unless otherwise exempt (see below).

A licence issued under section 26D of the Act is also required to construct or alter a well (bore) unless exempt. This includes replacing collapsed bores or decommissioning abandoned bores.

When assessing any application to take water, the department does so in accordance with clause 7 (2) Schedule 1 of the Act, any relevant allocation plan and operational policies and guidelines. In granting a new licence, reissuing or renewing a licence, the department may apply terms, conditions and restrictions to the licence under clause 15 of Schedule 1 of the Act.

The department's powers to alter any licence condition are specified under clause 24 (1) of Schedule 1 of the Act. The rights of licensees are covered under clause 26. A person who is aggrieved by a decision made on a licence application may be able to apply for a review of the decision by the State Administrative Tribunal.

Exemptions

Domestic bores

Under the *Rights in Water and Irrigation Act Exemption (Section 26C) Order 2011*, some uses of water do not require licensing in proclaimed areas.

This applies to water taken from non-artesian wells in the water table aquifer for:

- fire-fighting purposes
- watering of stock, other than those raised under intensive conditions
- garden and lawn irrigation <0.2 ha
- other ordinary domestic uses.

The department does not generally consider this plan area suitable for the drilling of new bores for domestic purposes as water quality may not be suitable in some areas. There is also a risk to the groundwater resource and potential for adverse effects on other users from abstracting more water.

Dewatering

The Rights in Water and Irrigation Exemption (Dewatering) (section 26C) Order 2010 applies in the Cockburn groundwater area. Under this exemption order sections 5C and 26B (3) to (6) of the Act do not apply in relation to a non-artesian (Superficial aquifer) well for dewatering purposes, when:

- water is taken from the well or excavation solely for the purpose of removing groundwater to facilitate construction or other activity (that is, dewatering)
- the water is taken at a pump rate not exceeding 10 L/second over a period of less than 30 consecutive days
- the volume of water taken over the period does not exceed 25 000 kL.

Other exemptions

Certain activities on Commonwealth land are exempt from licensing under the *Rights in Water and Irrigation Act 1914*. This applies to any water accessed by the Department of Defence on Garden Island.

Under the Rights in Water and Irrigation Exemption (section 26C) Order 2012, a licence is not required to take water from (for sampling), or construct/alter, a non-artesian well that is used solely to monitor water levels and/or water quality.

Compliance and enforcement

Under the *Rights in Water and Irrigation Act 1914*, water users in proclaimed areas must be licensed to take surface water or groundwater, unless otherwise exempt. The department carries out regular compliance activities to make sure that the take and use of water is authorised and carried out in accordance with the annual water entitlement and licence terms, conditions or restrictions.

Water resources located in the Cockburn plan area are categorised according to risk for compliance purposes. Water resources that are categorised as high risk are subjected to a high level of on-ground compliance activities.

We regularly review all monitoring and metering data submitted by licensees when assessing any local and regional effects of groundwater use.

Other legislation

In administering the *Rights in Water and Irrigation Act 1914*, the department complies with other state and federal legislation. The department works with other government agencies to streamline the regulatory approvals process.

Environmental Protection Act 1986

Significant developments and projects generally require an environmental impact assessment under Part IV of the *Environmental Protection Act 1986*. This assessment is the responsibility of the Environmental Protection Authority (EPA). A licence application may be referred to the EPA, which will decide whether an environmental impact assessment is required and, if so, at what level.

The department is responsible for managing and approving the clearing of native vegetation, pollution and industry licensing, which falls under Part V of the Environmental Protection Act 1986 and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (WA). Additional permits and licences may be required if a water licence is associated with these actions.⁹

Contaminated Sites Act 2003

The department is responsible for regulating contaminated sites and acid sulfate soils under the *Contaminated Sites Act 2003*. Planning related activities associated with these sites or soils are also managed by the Western Australian Planning Commission (see *Acid sulfate soils planning guidelines*, WAPC 2008a). Additional approvals may be required if a water licence is associated with a contaminated site or acid sulfate soils. See *Assessment and management of contaminated sites, Contaminated Sites Guidelines*, DER (2014) and *Identification and investigation of acid sulfate soils and acidic landscapes*, DER (2015b) for more information.

⁹ See the following short-list for more details:

- *Environmental Protection Authority Guidance Statement 33 – Environmental guidance for planning and development* (EPA 2008)
- *Matters of National Environmental Significance – Significant impacts guideline 1.1 under the Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia 2013)
- *State Environmental (Cockburn Sound) Policy* (EPA 2015a)
- *Environmental Quality Criteria Reference Document for Cockburn Sound* (EPA 2015b)
- *Native vegetation clearing legislation in Western Australia – clearing regulation fact sheet* (DER 2015a)
- *Environmental Impact Assessment Procedures Manual (and Instructions)* (Part IV Divisions 1 and 2) (EPA 2016a)
- *Statement of Environmental Principles, Factors and Objectives* (EPA 2016b).

We consider the classification of contaminated sites and the location of acid sulfate soils in our water licence assessment process to make sure that any groundwater abstracted or reinjected does not expose acid sulfate soils nor adversely affect water quality.

State Agreement Acts

When assessing and approving licence applications, we consider the water related requirements of State Agreements. There are licences in the plan area that have commitments and approvals set in a State Agreements for alumina refinery, oil refinery, industrial lands and cement works in the Kwinana Industrial Area.

4.2 Aligning regulatory approvals

It is critical that all proponents consult with the department to make sure their water licence application complies with other regulatory processes documented in other legislation, including policy or guidance. This is particularly important for projects being assessed under the *Environmental Protection Act 1986* or the *Contaminated Sites Act 2003*.

Existing groundwater licences

There are existing groundwater licences in the Cockburn plan area where the taking of water is associated with activities that were assessed and approved under other legislation. Where relevant, the department uses the environmental objectives and commitments established under these approvals or conditions to inform monitoring, restrictions and reporting requirements for water licences (such as an operating strategy).

New groundwater licences

We encourage applicants for a groundwater licence to consider the likely impacts of their proposal and identify if any other approvals are required. This is to identify any measures that can be taken to avoid or reduce groundwater level drawdown or water quality risks to environmental sites or existing users. Applicants need to be aware that other regulatory approvals may be required before a groundwater licence can be assessed.

4.3 Water licensing approach

A groundwater licence provides legal access to water. Groundwater allocation plans enable us to manage groundwater licences on a collective scale by guiding how we assess and approve groundwater licences in the plan area.

The department's state-wide operational policies and guidelines apply in the plan area. Water licences are assessed and issued consistently across the state using these policies. They are available on our website <www.dwer.wa.gov.au> or alternatively you can contact the Kwinana Peel regional office.

This section outlines our licensing approach across the plan area, focusing on specific local licensing policies that are intended to manage how groundwater is abstracted in line with the objectives of the plan.

It is important to consult with us if you are seeking water or have any issues with an existing licence. Please contact the department's Kwinana Peel regional office to discuss water licensing in the Cockburn plan area.

To make sure that planning authorities, local governments and land developers are given sufficient time to identify and source long-term water supply they should contact the department, so that advice can be given in accordance with *Better urban water management* (WAPC 2008b).

Managing water in over-allocated and fully allocated resources

Groundwater resources in the plan area are now either fully or over-allocated. It is unlikely that the department will grant more water from a fully or over-allocated resource.

In accordance with our operational policies and guidelines the department will recoup long-term unused water entitlements where necessary. This will align what is currently used with the allocation limits and show us where we could reissue water.

We may reallocate water if it becomes available, when an entire licence is relinquished or a portion of an entitlement is returned. This water will only be reallocated after we assess the risks and consider the results of each resource evaluation. This will help to make sure that the use of the resource remains sustainable into the future.

The department will recoup unused groundwater entitlements in line with the land use changes for Latitude 32 in the *Hope Valley Wattleup redevelopment Act 2000* and *Hope Valley Wattleup redevelopment master plan* (LandCorp 2017).

Water use efficiency

The department encourages water licensees to use their water entitlement in an efficient manner and make the best use of the water. This includes using water that is fit-for-purpose.

In accordance with the department's operational policy and guidance we may require certain licensees to develop and implement an operating strategy. An operating strategy may contain water conservation and efficiency measures, particularly if there are multiple water licences across an area assigned to a single licensee. To maximise water use efficiency the department will negotiate with the licensee to set baseline and target levels to achieve these efficiency savings, as set out in the commitments of the operating strategy.

Water trading

Where water availability is limited groundwater users wishing to obtain a new licence, or to increase an existing licence, should consider seeking a trading partner to source water to meet their needs. We encourage the redistribution of water through both permanent and temporary transfers of water licence entitlements. Additional conditions may be required on a licence which is subject to a permanent or temporary transfer. Unused entitlements cannot be traded.

The department's operational policy on water licensing transactions can be found on our website. Applicants seeking to trade water can identify all current licensees using our Water Register <http://www.water.wa.gov.au/maps-and-data/maps/water-register>.

Monitoring and reporting in the coastal zone

To reduce the risk of the seawater interface moving further inland we established a zone extending from the coastline to 2 km inland (coastal zone). This zone was developed to closely manage where groundwater-dependent ecosystems or existing licences may be affected by changes to the interface (Figure 5 and Figure 6).

In this zone the department may impose restrictions on how groundwater is abstracted or where managed aquifer recharge schemes are located. Of particular concern are proposed activities likely to move the interface further inland or change its thickness. Licence conditions for monitoring water quality may be applied in this zone (see Table 3 for more detail).

Alternative water source options and fit for purpose water sources

When groundwater availability is limited applicants seeking more water should consider other sources, where appropriate and practical, to meet their needs. This includes using lower-quality water (e.g. saline, high nutrient) or alternative water sources. Examples include:

- reusing or treating (recycling) wastewater, drainage water or stormwater
- using desalinated water
- using reinjected water (managed aquifer recharge).

Contact the department as early as possible to discuss any licensing requirements if other sources of water are part of a proposal.

Accessing or implementing a managed aquifer recharge option as an alternative water source is guided by this plan and through the department's operational policies and guidelines.

Direct access and use of treated wastewater, drainage water or stormwater are not addressed in this plan. More information on use of these direct sources are noted in *Western Trade Coast heavy industry local water supply strategy* (DoW 2016a).

4.4 Local licensing policies

The local licensing policies in Table 3 provide specific considerations for assessing and managing a licence in the Cockburn plan area. The policies apply where the local issues are not addressed in operational policy, or because an alternative, more specific approach is required for managing a local issue. Where local policy in the allocation plan differs from an operational policy, the plan prevails.

The local licensing policies given in Table 3 are considered as part of a clause 7(2) licence assessment under the *Rights in Water and Irrigation Act 1914*. The department may refuse to grant a licence or require a proposal to be modified, if local effects are considered unacceptable, even if water is available.

Table 3 Local licensing policies specific to the Cockburn plan area

No.	Policy detail
1. General licence assessment	
1.1	<i>Bore construction and groundwater licensing</i>
1.1.1	Licensees are required to submit bore log information to the department on the prescribed form within 30 days of constructing or decommissioning a bore (s.26E, <i>Rights in Water and Irrigation Act 1914</i>).
	Note: <i>National guidelines on minimum construction requirements for water bores in Australia edition 3</i> (National Uniform Drillers Licensing Committee 2012) provides guidance regarding the construction and decommissioning of bores.
1.1.2	Bores screened in a confined aquifer, must be pressure cement or tremie cement grouted to prevent movement of water between aquifers, in accordance with <i>National guidelines on minimum construction requirements for water bores in Australia edition 3</i> (National Uniform Drillers Licensing Committee 2012).
1.1.3	All new or replacement production bores should be spaced as far away as practical from existing production bores to minimise interference and maintain productivity.
1.2	<i>Licences requiring operating strategies</i>
1.2.1	The department will request an operating strategy for a new or renewed licensed entitlement that is less than 500 000 kL/yr where impacts on other users, existing water quality or groundwater-dependent ecosystems are likely. All licences greater than 500 000 kL/yr require an operating strategy. In the Cockburn groundwater area an operating strategy will be requested when an applicant is abstracting groundwater: <ul style="list-style-type: none"> from more than one aquifer from multiple bores located across multiple locations as part of a managed aquifer recharge scheme (also see local licensing policy group 2.1) in areas where the take or use of the water is likely to draw down the water level in the Superficial aquifer to below the criteria set in Table 5 (also see local licensing policy group 3.1 – 3.3) for irrigating golf courses, public open space, cemeteries, or for the maintenance of artificial wetlands or lakes where they are abstracting more than 100 000 kL/yr

No.	Policy detail
	<ul style="list-style-type: none"> • from bores that are in the coastal zone (Figure 6) and taking more than 100 000 kL/yr from the Superficial aquifer (also see local licensing policy group 3.1 – 3.3) • for the purposes of providing a water service to others. <p>The department will negotiate the monitoring and reporting required for local water levels or quality triggers and the appropriate response for any breach, with the applicants as part of developing the operating strategy.</p>
2. Managed aquifer recharge	
2.1	<i>Locating and developing a managed aquifer recharge and recovery scheme</i>
2.1.1	Long-term banking of groundwater through a managed aquifer recharge scheme that injects or infiltrates water into the Tamala Limestone formation, is unlikely to be supported as this formation is highly transmissive. Short-term use of recharged water may be possible if modelling confirms that it is available for recovery when required.
2.1.2	<p>The department is unlikely to approve a managed aquifer recharge scheme directly adjacent to, or extending into, an area classified as contaminated and restricted for use under <i>Contaminated Sites Act 2003</i>. Exceptions may apply if the applicant can prove that the scheme will not further mobilise an existing contaminant plume or adversely alter groundwater chemistry.</p> <p>Where an application for a managed aquifer recharge scheme is located in a site classified as ‘possibly contaminated’ the applicant will need to confirm the site is uncontaminated before the application will be processed.</p>
3. Managing the impacts of groundwater abstraction and/or managed aquifer recharge on groundwater-dependent ecosystems and water quality	
3.1	<i>Assessing the impacts of a proposal to take water (including a managed aquifer recharge scheme) on groundwater-dependent ecosystems and water quality</i>
3.1.1	<p>Where water is available applicants may need to assess and demonstrate how they will prevent, or manage, the impacts of their proposal on significant groundwater-dependent ecosystems. These include:</p> <ul style="list-style-type: none"> • Groundwater-dependent ecosystems protected under national and international law, such as Ramsar-listed sites (<i>Ramsar Convention on Wetlands 1971</i>) – see requirements under the <i>Environmental Protection and Biodiversity Conservation Act 1999</i> (Commonwealth). • Groundwater-dependent ecosystems with water level criteria set by the Minister for Environment in the <i>Jandakot Mound groundwater resources [including Jandakot groundwater scheme, stage 2] Ministerial Statement no. 688</i> (EPA 2005a). • Wetlands listed in <i>A Directory of Important Wetlands in Australia: third edition</i> (Environment Australia 2001) • Wetlands classified as a conservation category or resource enhancement in geomorphic wetlands mapping (Hill et. al 1996). • Groundwater-dependent ecosystems that contain or support declared rare flora or threatened ecological communities – see requirements under the <i>Biodiversity Conservation Act 2016</i>.
<i>Note: Approvals from other agencies may be required</i>	
3.1.2	Applicants for a water licence will need to demonstrate how they will prevent, or manage, the effect of their proposal on contaminated sites, any areas at high risk of acid sulfate soils, and/or the seawater interface when applying for a licence to take groundwater.

No.	Policy detail
	Applications to take groundwater in areas at high risk of acid sulfate soils or from an identified contaminated site will not be finalised until all relevant approvals from other agencies are granted (including the Department of Health).
3.1.3	If significant impacts are likely, then the applicant will need to provide an assessment of the water regime required to maintain groundwater-dependent ecosystems at a low level of risk, including how abstraction will be managed to protect the environmental values.
	<p>Note: an impact is considered significant if it:</p> <ul style="list-style-type: none"> • lowers the water table to below the trigger levels set in Table 5, this includes accounting for cumulative impacts from existing use • raises the water table above historic maximums and sub-surface drainage • adversely affects the water quality necessary to sustain the ecosystem • may contribute to the future non-compliance of a Ministerial criteria site • adversely affects an existing user's ability to take water.
3.1.4	<p>The department may require an applicant to do site-specific work to inform the licence assessment process if the proposed take is likely to have significant impacts on groundwater-dependent ecosystem/s. This may include:</p> <ul style="list-style-type: none"> • submitting a values and condition assessment • investigating and recommending local ecological water requirements • refining water-level criteria at representative sites and associated monitoring bores. <p>If a licence is granted then the following may be applied in an operating strategy (see local licensing policy group 1.2):</p> <ul style="list-style-type: none"> • monthly monitoring of water levels and/or water quality (the collection of baseline data may be required before a licence is granted) • annual monitoring of ecological condition • reporting on water level or ecological trends, compliance with water-level criteria, and any management actions implemented.
3.2	<i>Construction of bores in areas at risk of groundwater impacts</i>
3.2.1	Licensees may be required to install new, or use existing, monitoring bores to measure the impacts of abstracting groundwater on water quality across the aquifer. This may include confirming the position of the seawater interface if water is abstracted in the coastal management zone (Figure 6). This will be assessed on a case by case basis.
3.2.2	All newly constructed bores should be drilled at least 200 m away from the defined boundary of a significant groundwater-dependent ecosystem (see 3.1.1; Figure 5). If an application to take groundwater in this area is submitted and assessed by the department then a maximum entitlement of 5000 kL/yr may be issued within 500 m of the defined wetland boundary.
3.3	<i>Amending licences if impacts on groundwater-dependent ecosystems or water quality are observed and reported</i>
3.3.1	<p>The department may amend a licence where impacts on water level associated with a groundwater-dependent ecosystem or water quality are observed through monitoring and reported.</p> <p>An amended licence may include an altered volume or rate of abstraction and it may also require the licensee to relocate production bores, install monitoring bores and/or measure and report on water levels or water quality.</p>

4.5 Factors that may affect future licensing

How we license the taking of water in the plan area in the future may include:

- changes to current land use, particularly in the Latitude 32 area (Figure 2)
- how we license the injection and abstraction of managed aquifer recharge
- movement of the seawater interface further inland
- new information on hydrogeology and ecology from departmental and / or private sources
- the extent to which the climate continues to dry, and any other climate change related factors, such as sea level rise.

In the future, alternative water sources may need to gradually replace some groundwater use in Kwinana. This will depend on how the groundwater resources, particularly water quality, are responding to climate change and continued abstraction.

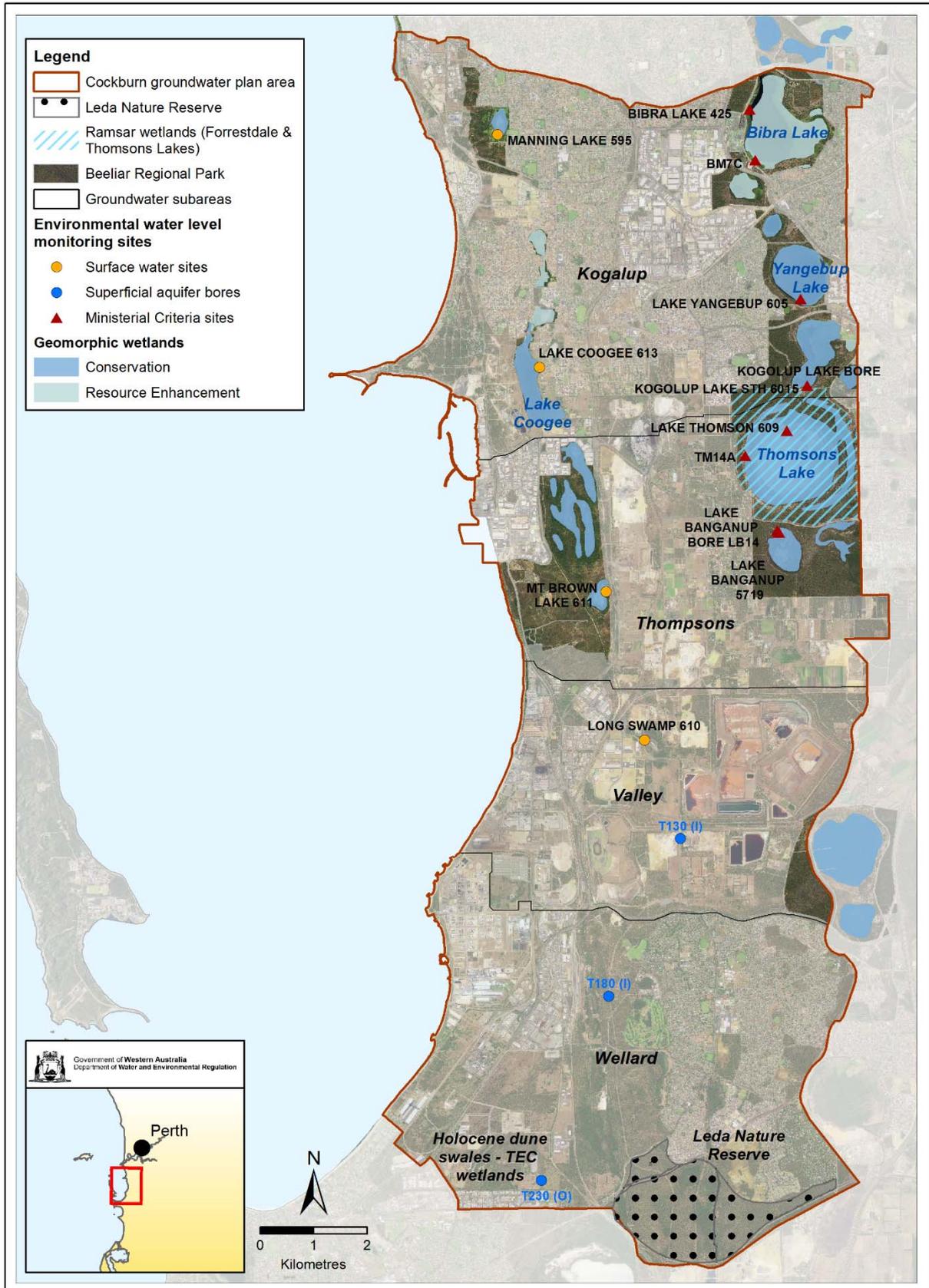


Figure 5 Groundwater-dependent ecosystems in the Cockburn groundwater allocation plan area

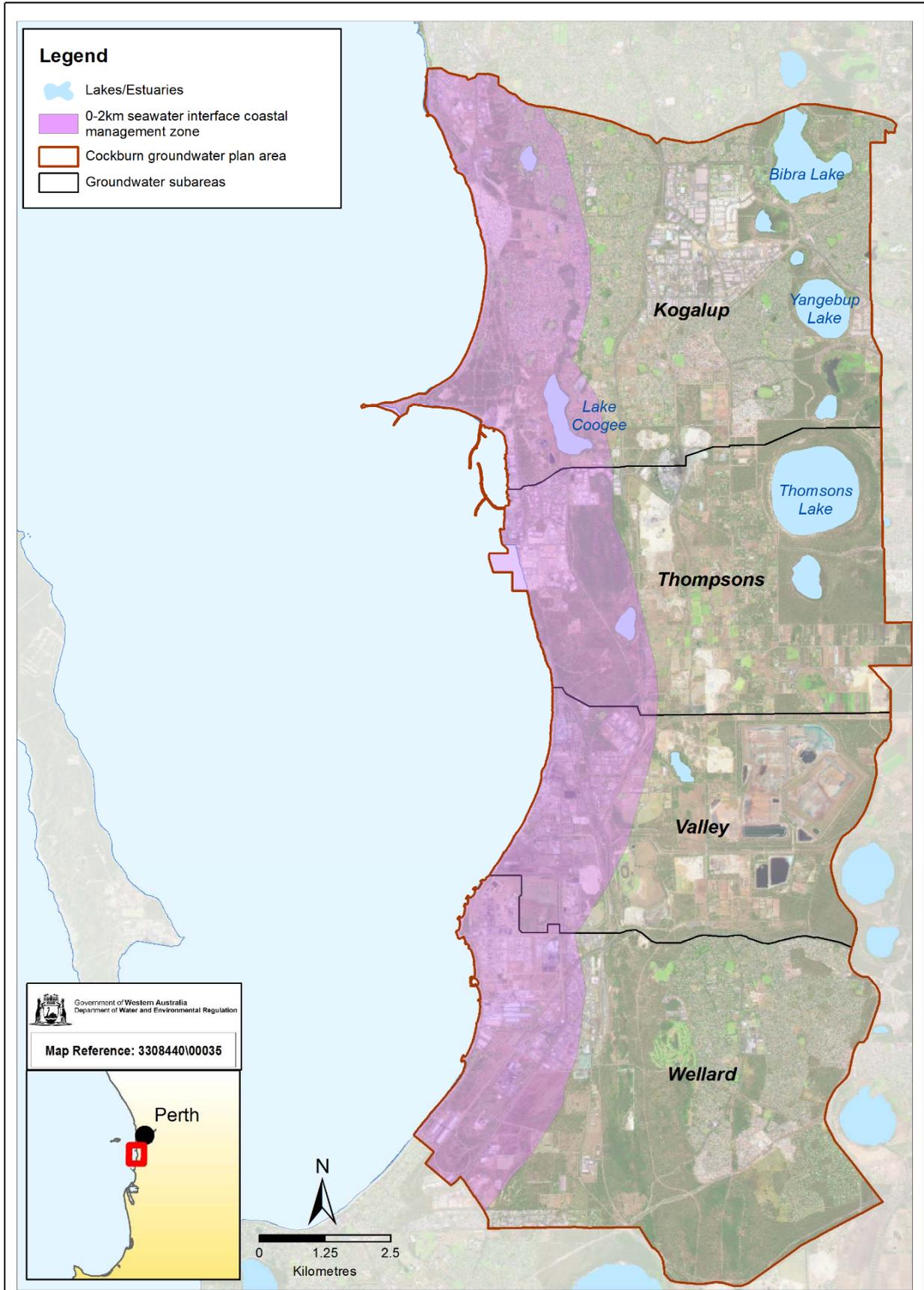


Figure 6 Seawater interface coastal management zone

5 Monitoring program

5.1 Current monitoring program

The department monitors all three water resources in the plan area. Monitoring allows us to understand how water resources are responding to abstraction and changes in climate over time. We use this information to evaluate if the plan's outcomes and objectives are being met and whether we need to adapt how we regulate and manage the take of groundwater.

We have a network of 58 monitoring bores and staff gauges in the plan area that are regularly measured for groundwater levels and water quality, and lake levels (see Figure 7 and Appendix A, Table A1). In line with the objectives of the plan our primary focus for monitoring is to understand the effects of abstracting groundwater on the Superficial aquifer.

This suite of monitoring bores and staff gauges are sufficient to provide water level data to evaluate how the resource is performing against the objectives. Groundwater salinity monitoring is currently limited along the coast to evaluate where the seawater interface is moving or changing. We will be improving monitoring in this area as part of implementing the plan (see Chapter 6, Table 6).

See Appendix A for a full list of departmental monitoring sites used in the Cockburn plan area at present and why they are monitored.

Regional water level monitoring

Regional water level monitoring is used to identify patterns in water level changes over time. This information is used to evaluate all objectives of the plan (Table 4). We review and use monitoring and reporting submitted by licensees, other water users, and other agencies, to supplement our own monitoring data as part of this process.

Most monitoring bores are measuring water levels in the Superficial aquifer (43 bores; Figure 7), as this aquifer:

- sustains groundwater-dependent ecosystems
- supplies the majority of groundwater for use
- contains the seawater interface closer to the coast compared to the deeper aquifers.

Water levels and water use (metered) are also monitored and measured by licensees in areas of high use.

There are three monitoring bores measuring hydraulic pressure levels in the regionally confined Leederville and Yarragadee aquifers (Figure 7). They are located in the subareas where use is highest. Licensees also collect hydraulic pressure levels and water use (metered) monitoring data in these areas.

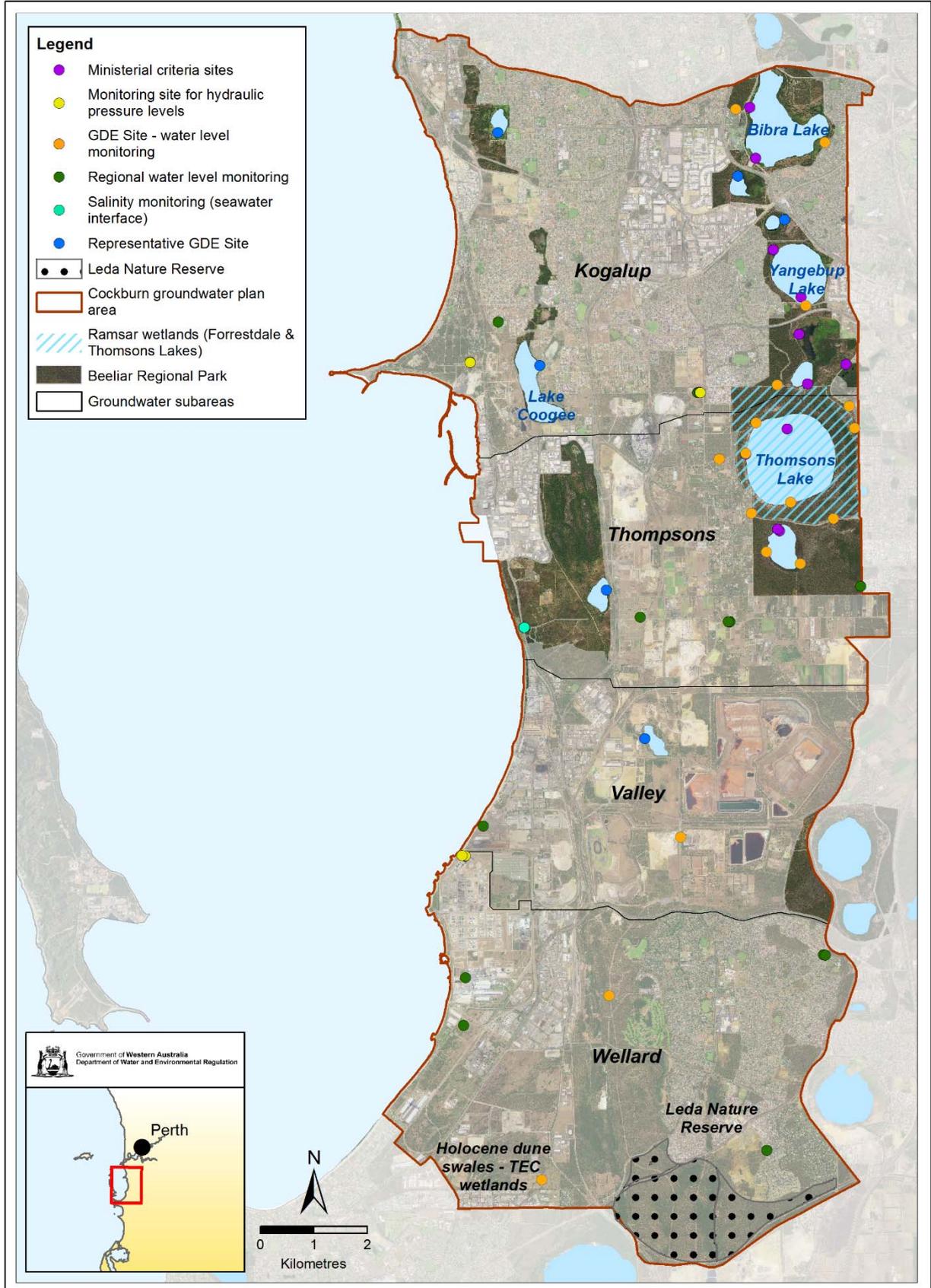


Figure 7 Groundwater monitoring sites in the Cockburn plan area

Ecological water level monitoring

To evaluate if we are meeting Objective 1, we set water level criteria (Table 5) using *Ministerial Statement no. 688* for Thomsons Lake, Bibra Lake, Kogalup Lake and Banganup Lake. These wetlands are located along the eastern margin of the northern subareas of Kogalup and Thomsons subareas (Figure 5).

In line with *Ministerial Statement no. 688*, the department monitors water levels, wetland vegetation, macro-invertebrates and water quality at Thomsons Lake, Bibra Lake, Kogalup Lake and Banganup Lake. The department prepares an annual report to the Office of the Environmental Protection Authority on compliance with *Ministerial statement 688* criteria using this information. This information is also used to identify if the performance indicators were met (Table 4).

To evaluate if we are meeting Objective 2, we set water level criteria (Table 5) using the minimum groundwater levels recorded in the last ten years, where historic water levels were relatively stable. The department monitors water levels at these sites (Appendix A) to identify if the performance indicators were met (Table 4).

Monitoring the seawater interface

There are two specifically designed seawater interface monitoring bores in Thomsons subarea. The department will be investigating, drilling and constructing a series of new regional seawater interface monitoring bores over the next two years to address gaps in our monitoring network. Monitoring data collected from existing and new seawater interface bores will be used to evaluate Objective 3 against the performance indicators in Table 4.

Licensees also monitor the seawater interface in high risk coastal areas in Valley and Wellard subareas. Monitoring and reporting carried out by licensees is likely to increase as use changes. This data will be used together with regional monitoring data to evaluate the resource against Objective 3. This information will be used to determine whether we need to respond to any identified adverse effects.

More detail on the seawater interface and how it was considered in setting the allocation limits is presented in *Cockburn groundwater allocation plan: methods report* (DWER 2018).

5.2 Evaluating against resource objectives

To achieve the objectives of the plan we need to assess and evaluate how the resource is performing against measurable indicators (Table 4). To do this we collect and analyse data from our monitoring, groundwater modelling, other government monitoring (e.g. rainfall, ecological) and reports submitted by licensees.

Our management response to each evaluation will change and adapt over time. Performance indicators may not be met if the climate dries faster than we predicted or use of the water is not managed in line with allocation limits.

5.3 Future monitoring

To complement our current suite of monitoring bores (Appendix A) we may need to add more water quality, groundwater or surface water monitoring to measure:

- salinity at Manning Lake, Lake Coogee and Long Swamp
- shallow Superficial aquifer levels at Lake Mount Brown
- surface water levels at one or more wetlands associated with the Holocene dune swales threatened ecological community in the Wellard subarea.

The need for more monitoring will be assessed each year as part of implementing and evaluating the plan.

Table 4 Performance indicators to assess the plan objectives

Performance indicators for each objective	Monitor	Evaluate
<p>1 <i>Water levels are sufficient to meet water level criteria set under Ministerial statement no. 688.</i></p> <p>Superficial aquifer water levels are at or above the absolute water level criteria set.</p>	<p>Regional groundwater levels (Appendix A).</p> <p>Water levels at Ministerial criteria sites (monitoring bores and staff gauges) identified in Table 5.</p>	<ul style="list-style-type: none"> • Changes in groundwater metered use each year. • Changes in regional groundwater levels every three years. • Annual rainfall trends every five years. <p>• Changes in water levels against criteria every three years.</p> <p>Note: This is reported annually by the department to the Minister for Environment as part of our compliance for Ministerial statement no 688.</p>
<p>2 <i>Water levels in the Superficial aquifer are sufficient to protect the current values of groundwater-dependent ecosystems.</i></p> <p>a. Water levels are at or above the criteria set in Table 5.</p> <p>b. Water levels at Sedgeland in Holocene dune swales threatened ecological community are recovered to the criteria set in Table 5.</p>	<p>Regional groundwater levels (Appendix A).</p> <p>Water levels at sites associated with representative groundwater-dependent ecosystems (Table 5 and Appendix A).</p>	<ul style="list-style-type: none"> • Changes in groundwater metered use each year. • Changes in regional groundwater levels every three years. • Annual rainfall trends every five years. <p>• Changes in water levels against criteria every three years.</p>
<p>3 <i>Abstracting groundwater does not cause the seawater interface to move further inland (0-2 km from the coastline; Figure 6) nor increase in thickness.</i></p> <p>Salinity at seawater interface monitoring sites (departmental and private monitoring bores) remain below target levels set.</p> <p>Salinity mapping shows that the seawater interface toe remains within the coastal zone (0–2 km inland).</p> <p>The seawater interface toe remains west of groundwater-dependent ecosystems.</p>	<p>Regional groundwater levels (Appendix A).</p> <p>Salinity and groundwater levels in the coastal zone:</p> <ul style="list-style-type: none"> • departmental seawater interface monitoring bores. • licensees in private production or monitoring bores. 	<ul style="list-style-type: none"> • Changes in regional groundwater levels every three years. • Changes in salinity and water levels in coastal zone every three years. • Changes in groundwater use each year. <p><i>Note: target levels will be set once the new monitoring bores are activated.</i></p> <ul style="list-style-type: none"> • Model (PRAMS) or calculate the distance inland of the seawater interface toe and verify using measured data. Compare modelled or calculated toe results with baseline set in the <i>Methods report</i> (DWER 2018) every three years. • Map the seawater interface contours. Identify where high risk water quality and groundwater-dependent ecosystem sites are located on the map every three years. <p><i>Note: if the toe comes within 500 m of groundwater-dependent ecosystems it triggers a review of licensing and the allocation limits for that subarea.</i></p>
<p>4 <i>Abstracting or injecting groundwater does not cause adverse changes in water quality.</i></p> <p>Water quality at designated monitoring sites (departmental and private monitoring bores) remains at or below the baseline set in licence conditions.</p> <p>Water reinjected into the Superficial aquifer is of higher quality than the baseline set through the licensing process.</p>	<p>Regional groundwater levels (Appendix A).</p> <p>Groundwater quality – licensees in private production or monitoring bores.</p>	<ul style="list-style-type: none"> • Changes in regional groundwater levels every three years. • Changes in water quality at high risk sites every three years. • Collect and evaluate technical data shared between agencies on changes to groundwater quality.

Table 5 Ecological monitoring and water level criteria sites in the Cockburn plan area

Subarea	Site name	Type of site (Ministerial criteria site or representative GDE)	Bore or staff gauge to measure criteria	Water level criteria (mAHD)	Objective applied	Notes:
Kogalup	Bibra Lake	Ministerial criteria site	Staff gauge (6142520) Bore BM7C (61410177)	13.6	1	Measure criteria through monthly staff gauge and bore readings. Bibra Lake and Yangebup Lake are used to represent other wetlands in this area including South Lake and Little Rush lake.
	Yangebup Lake	Ministerial criteria site	Staff gauge (6142523) Bore JE21C (61419707)	13.8	1	Measure criteria through monthly staff gauge and bore readings. As part of the Jandakot Drainage Scheme, the Water Corporation monitors water levels at this site and lowers water levels if the peak is exceeded.
	Kogalup Lake (South)	Ministerial criteria site	Staff gauge (6142522) Kogalup Lake Bore (61410727)	13.1	1	Measure criteria through monthly staff gauge and bore readings.
	Manning Lake	Representative GDE – conservation category wetland	Staff gauge 595 (6142515)	0.1	2	Measure criteria through monthly staff gauge readings. No nearby Superficial aquifer monitoring bore.
	Lake Coogee	Representative GDE – conservation category wetland	Staff gauge 613 (6142514)	0.1	2	Measure criteria through monthly staff gauge readings. No nearby Superficial aquifer monitoring bore. This representative site will be used to cover Market Garden Swamp.
Thompsons	Thomsons Lake (Ramsar wetland)	Ministerial criteria site	Staff gauge (6142517) Bore TM14A (61410367)	10.8	1	Measure criteria through monthly staff gauge and bore readings. As part of the Jandakot Drainage Scheme, the Water Corporation monitors water surface levels at this site. The Department of Parks and Wildlife implements a supplementation and sampling analysis plan that it developed in 2004–05.
	Lake Banganup	Ministerial criteria site	Staff gauge (6142516) Bore LB14 (61419614)	11.5	1	Measure criteria through monthly staff gauge and bore readings.
	Mount Brown Lake	Representative GDE – conservation category wetland	Staff gauge 611 (6142505)	0.2	2	Measure criteria through monthly staff gauge readings. No nearby Superficial aquifer monitoring bore. This site will be used to represent Brownman Swamp and Anderson Road Swamp.
Valley	Long Swamp	Representative GDE – conservation category wetland	Staff gauge 610 SG (6142509) Bore T130 (I) (61410068)	0.6	2	Measure criteria through monthly bore readings.
Wellard	Group of wetlands associated with the 'Sedgeland in Holocene dune swales of the Southern Swan Coastal Plain TEC' (DEC 2011).	Representative GDE – conservation category wetland with TEC	Bore T230 (O) (61410033)	1.2	2	Recover groundwater levels at this site. Measure criteria through monthly bore readings. Bore T230 (O) is located approx. 300 m south east of nearest wetland, no surface water level monitoring.
	Group of wetlands located to the north of the Leda Nature Reserve.	Representative GDE – conservation category wetland	Bore T180 (I) (61410053)	0.8	2	Measure criteria through monthly bore readings. Bore T180 (I) is located approx. 1 km north east of nearest wetland, no surface water level monitoring. This site will be used to represent Sloan's Reserve, Chalk Hill Lookout Swamp, Leda Nature Reserve and Bollard Bullrush Swamp.

GDE = groundwater dependent ecosystem

TEC = Threatened ecological community

6 Implementing and evaluating the plan

The Department of Water and Environmental Regulation will implement this plan by following the strategies listed in Section 2.3. Once the plan is in place, we will regularly evaluate whether the outcomes and objectives are being met. This chapter sets out actions that are necessary to implement and evaluate this plan.

6.1 Implementing the plan

The key action for implementing this plan is to reduce the volume of water over-allocated in each subarea by minimising the amount of long-term under use. To achieve this the department will be working with licensees to match what is licensed to what they are using.

In 2017 the department began recouping unused entitlements from the Superficial aquifer. In 2018–2019 the recouping of unused entitlements will be focused on large licences (>500 000 kL/yr) and licences in high risk areas (around key features in Figure 5 and Figure 6). The department will continue this work until each resource returns to full allocation.

To implement this plan successfully we are committed to working in partnership with stakeholders, local governments and other regulatory agencies. Part of this work is to:

- provide technical guidance on managed aquifer recharge activities
- investigate what existing and alternative sources will best meet their needs
- provide advice on how to efficiently use available groundwater to meet irrigation needs of existing and future public open space.

Summaries of changes in water availability and use can be provided to assist stakeholders with planning for future water sources.

To adapt and refine how we manage groundwater under this plan we have identified several projects to be carried out over the next few years (see Table 6). This work will be used to improve how we meet the outcomes and objectives of this plan.

Table 6 *Projects to improve how we manage groundwater under the Cockburn groundwater allocation plan*

	Project	Timeline
1	<p>Complete the feasibility study for the <i>Western Trade Coast managed aquifer recharge of treated wastewater for industrial water supply</i> project funded by the National Water Infrastructure Development Fund.</p> <p>This work will provide guidance on what is required to meet the technical and regulatory approvals for establishing a managed aquifer recharge scheme in the Cockburn groundwater area.</p>	2018
2	<p>Provide advice and assistance to the City of Cockburn on the project to pipe and treat water from Yangebup Lake to Bibra Lake.</p> <p>This work will design and install a system that will pipe the right quality water from Yangebup to Bibra Lake. This will only occur during periods of very low rainfall to protect the ecological values when they are under stress or threat.</p>	2018–2020
3	<p>Complete the Cockburn seawater interface monitoring project under the State groundwater investigation program.</p> <ul style="list-style-type: none"> • Investigate and construct seawater interface monitoring bores along the coast in the Cockburn groundwater area. • Define the target levels set for monitoring the seawater interface once the new monitoring bores are activated. • Incorporate these changes into the monitoring program. 	<p>June 2018</p> <p>Dec 2018</p>
4	<p>Investigate the regional and local effects of abstracting groundwater from the Leederville and Yarragadee aquifer across the Jandakot, Serpentine and Cockburn groundwater areas.</p> <p>This work will be done through planning processes for the Jandakot and Serpentine groundwater areas.</p>	Not set

6.2 Evaluating the plan

Each year we assess the resources against performance indicators to check we are meeting the objectives of the plan. We also check whether the strategies and actions in place are delivering the desired outcomes. We aim to publish the results in an evaluation statement at least every three years. The evaluation statement will include:

- the allocation status for each resource, including any changes in licensed entitlements since the previous evaluation
- the status of any plan actions due within the evaluation period
- how the resource is being managed using the performance indicators to meet the objectives of the plan
- how we will adapt our water resource management (if necessary).

The statement will be available on the department's website or by contacting our Kwinana Peel regional office.

Appendices

Appendix A – Monitoring sites in the plan area

Table A1 Monitoring sites for water levels and water quality in the Superficial aquifer

Subarea	Bore name	ID number	Purpose	Easting	Northing
Kogalup	JE21C	61419707	Ministerial criteria site – water level monitoring	389203	6446239
	JE17C	61419707	Ministerial criteria site – water level monitoring	390557	6444079
	Kogalup Lake Bore	61410727	Ministerial criteria site – water level monitoring	389839	6443716
	SCC 18/08	61407113	Regional water level monitoring	384056	6444877
	TD29	61410411	Groundwater-dependent ecosystem site – water level monitoring	389806	6445189
	BM7C	61410177	Ministerial criteria site – water level monitoring	388867	6447963
	BM2A	61410189	Groundwater-dependent ecosystem site – water level monitoring	388492	6448887
	BM5A	61410203	Groundwater-dependent ecosystem site – water level monitoring	390173	6448261
	BM5C	61419623	Groundwater-dependent ecosystem site – water level monitoring	390165	6448261
	TM2C	61611112	Groundwater-dependent ecosystem site – water level monitoring	389271	6443694
	T65 (O)	61410168	Regional water level monitoring	387786	6443555
	T65 (I)	61410169	Regional water level monitoring	387818	6443556
	WPSIM01	61407122	Regional water level monitoring	383534	6444126

Subarea	Bore name	ID number	Purpose	Easting	Northing
Thompsons	CSI-1-97	61414100	Salinity monitoring (seawater interface)	384574	6439152
	CSI-2-97	61414101	Salinity monitoring (seawater interface)	384574	6439152
	T95 (I)	61410078	Regional water level monitoring	388355	6439238
	T95 (O)	61410077	Regional water level monitoring	388387	6439238
	JM37	61410087	Regional water level monitoring	390835	6439903
	TM14A	61410367	Ministerial criteria site – water level monitoring	388683	6442392
	TM14C	61611110	Groundwater-dependent ecosystem site – water level monitoring	388683	6442403
	TM4C	61611111	Groundwater-dependent ecosystem site – water level monitoring	388874	6442978
	TM7A	61410365	Groundwater-dependent ecosystem site – water level monitoring	388198	6442303
	TM16A	61410369	Groundwater-dependent ecosystem site – water level monitoring	390720	6442883
	TM6C	61611122	Groundwater-dependent ecosystem site – water level monitoring	390616	6443296
	TM12C	61611106	Groundwater-dependent ecosystem site – water level monitoring	388790	6441276
	TM14C	61611110	Groundwater-dependent ecosystem site – water level monitoring	388683	6442403
	TM10C	61611108	Groundwater-dependent ecosystem site – water level monitoring	389521	6441484
	TM13C	61611117	Groundwater-dependent ecosystem site – water level monitoring	390322	6441183
	TM16C	61410371	Groundwater-dependent ecosystem site – water level monitoring	390719	6442881
	TM7C	61611109	Groundwater-dependent ecosystem site – water level monitoring	388185	6442303
	LB14	61419614	Ministerial criteria site – water level monitoring	389276	6440981
	LB5	61419605	Groundwater-dependent ecosystem site – water level monitoring	389703	6440329
	LB2	61419602	Groundwater-dependent ecosystem site – water level monitoring	389067	6440552
SCC16/08	61407112	Regional water level monitoring	386711	6439321	

Subarea	Bore name	ID number	Purpose	Easting	Northing
Valley	T130(I)	61410068	Groundwater-dependent ecosystem site – water level monitoring	387464	6435175
	CSG3	61410046	Regional water level monitoring	383778	6435382
Wellard	CSG5	61410039	Regional water level monitoring	383449	6432526
	T190 (O)	61410082	Regional water level monitoring	390137	6432961
	T190 (I)	61410083	Regional water level monitoring	390168	6432952
	T180 (I)	61410053	Groundwater-dependent ecosystem site – water level monitoring	386126	6432194
	T240 (I)	61410076	Regional water level monitoring	389076	6429275
	CSG6 (DR1A)	61410035	Regional water level monitoring	383407	6431626
	T230 (O)	61410033	Groundwater-dependent ecosystem site – water level monitoring	384879	6428755

Table A2 Monitoring sites for hydraulic pressure levels in the Leederville and Yarragadee aquifers

Bore name	ID number	Aquifer	Slotted interval (meters below ground level)	Frequency
<i>Note: Assess groundwater trends with Jandakot and Serpentine groundwater area monitoring bores to consider regional aquifer response.</i>				
AM45A	61411004	Leederville	225–234	Monthly
AM52C	61415075	Leederville	101–107	Monthly
AM71	61415082	Yarragadee	551–557	Data logger – continuous

Table A3 Surface water monitoring sites (staff gauge)

Subarea	Site name	ID number	Purpose	Frequency	Easting	Northing
Kogalup	Bibra Lake 425 SG	6142520	Ministerial criteria site	Monthly	388764	6448918
	Lake Coogee 613 SG	6142514	Representative GDE site	Max/Min	384837	6444057
	Lake Yangebup 605	6142532	Ministerial criteria site (monitored by Water Corporation)	Monthly	389717	6445346
	Kogalup Lake 6015 SG	6142522	Ministerial criteria site	Monthly	389679	6444649
	Kogalup Lake North	6142575	Ministerial criteria site (monitored by Water Corporation)	Monthly	389679	6444649
	Manning Lake 595 SG	6142525	Representative GDE site	Max/Min	384052	6448448
	Parkes Swamp 606 SG	6142518	Representative GDE site	Monthly	389409	6446804
	Hatch Place Swamp 4457 SG	6142519	Representative GDE site	Monthly	388539	6447628
Thompsons	Lake Banganup 5719 SG	6142516	Ministerial criteria site	Monthly	389318	6440942
	Thomson Lake 609	6142517	Ministerial criteria site (monitored by Water Corporation)	Monthly	389458	6442868
	MT Brown Lake 611 SG	6142505	Representative GDE site	Max/Min	386078	6439830
Valley	Long Swamp 610 SG	6142509	Representative GDE site	Max/Min	386799	6437029

GDE = groundwater-dependent ecosystem

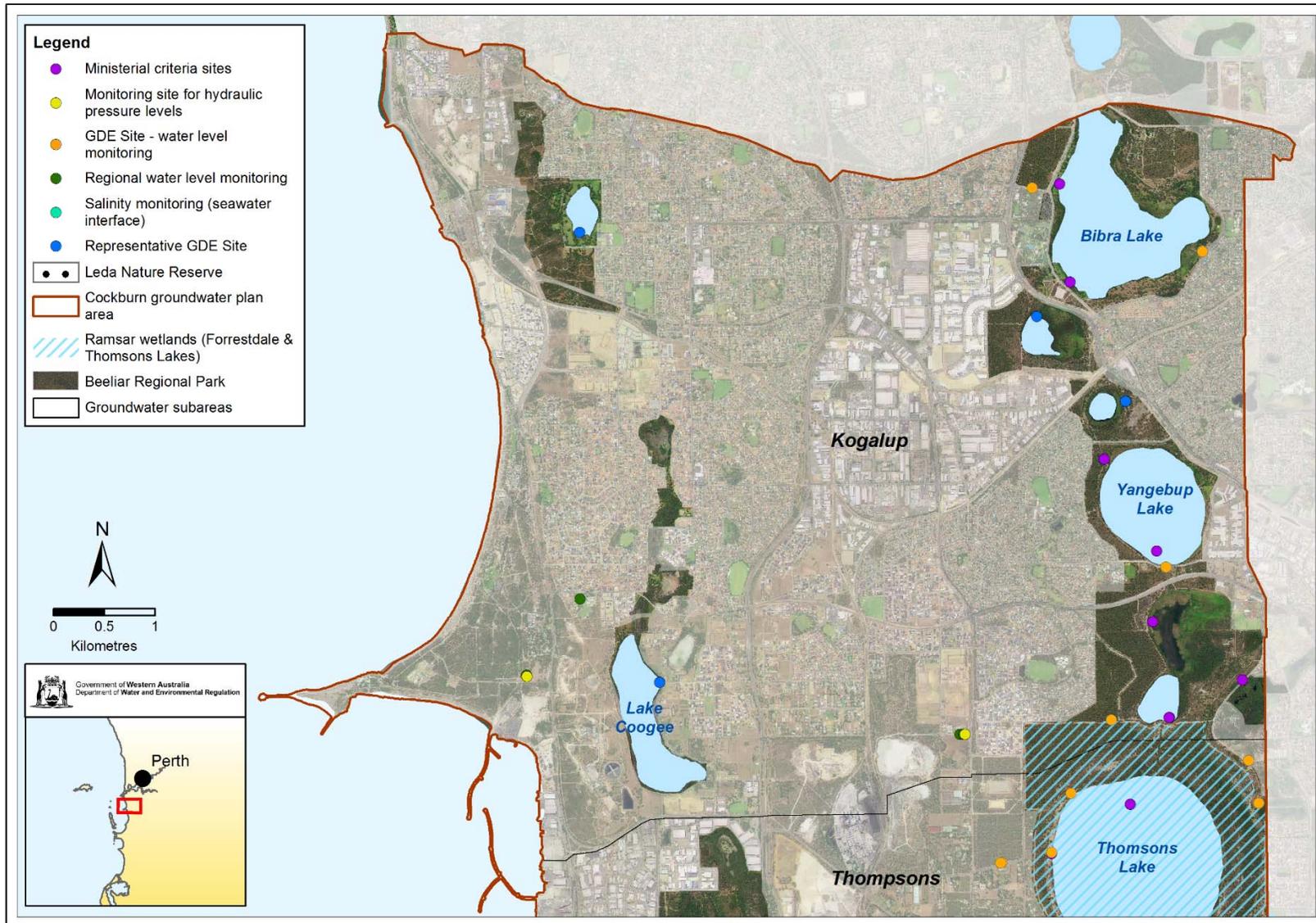


Figure A1 Kogalup subarea monitoring bores

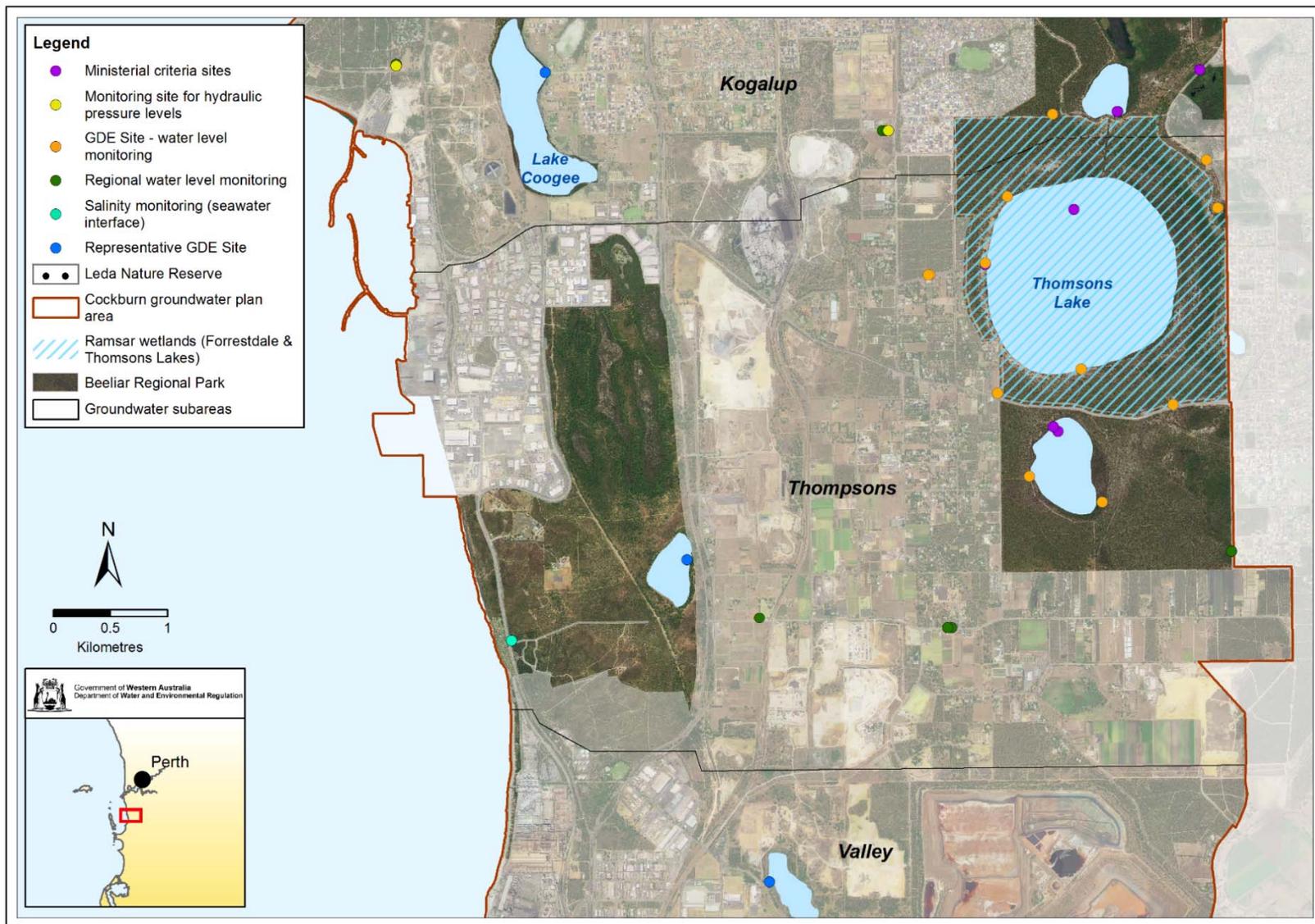


Figure A2 Thompsons subarea monitoring bores

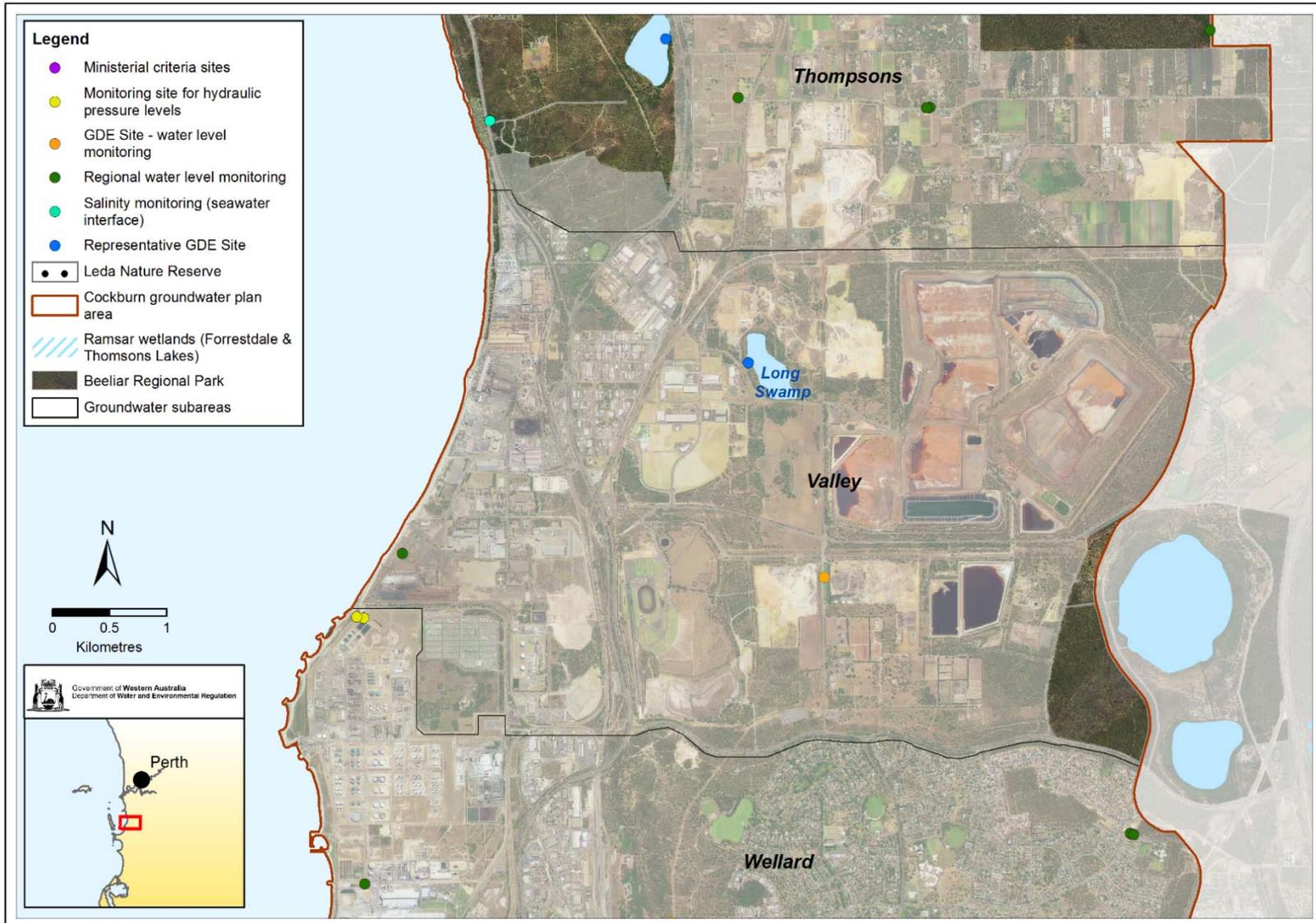


Figure A3 Valley subarea monitoring bores

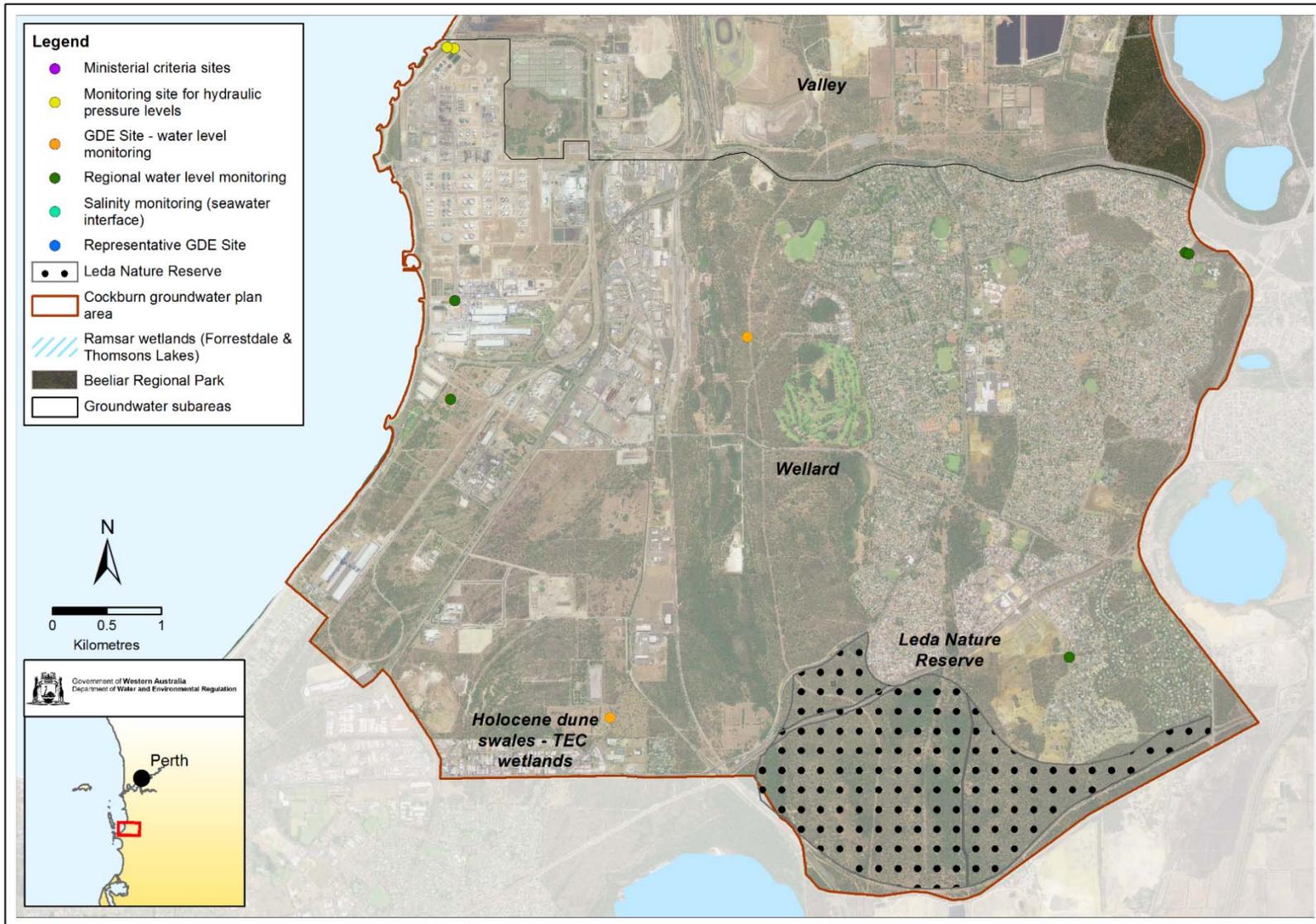


Figure A4 Wellard subarea monitoring bores

Appendix B – Map information

Datum and projection information

Vertical datum: Australian Height Datum (AHD)

Horizontal datum: Geocentric Datum of Australia 94

Projection: MGA 94 Zone 50

Spheroid: Australian National Spheroid

Project information

Client: Rebecca Palandri and Melissa Newton-Brown

Map author: Hisayo Thornton

File path:
gisprojects\Project\330\80000_89999\3308440_WAP\00035_Cockburn_GW_Alloc_Plan\

Compilation date: February 2018

Disclaimer

These maps are a product of the Department of Water and Environmental Regulation, Water Assessment and Allocation Division. These maps were produced with the intent that they be used for information purposes at the scale as shown when printed.

While the Department of Water and Environmental Regulation has made all reasonable efforts to ensure the accuracy of this data, the department accepts no responsibility for any inaccuracies and persons relying on this data do so at their own risk.

Sources

The Department of Water and Environmental Regulation acknowledges the following datasets and their custodians in the production of these maps:

- Allocation plan areas – DWER 2016
- WA Coastline – DWER 2000
- Perth Basin, Superficial aquifer, groundwater salinity – DWER 2009
- Towns – Western Australia – DWER 2013
- Imagery – Landgate 2015
- Cadastre – DLI 2017
- Groundwater subareas – DWER 2013
- Aquifers – DWER 2017
- WIN Sites – Ministerial Criteria – DWER 2017
- Road Centrelines – DWER 2016
- Lakes (Linear hydrography water poly) – AUSLIG 2013
- Geomorphic Wetlands, Swan Coastal Plain – DPAW 2013
- WRL Draw points – DWER 2017
- WIN Sites – DWER 2017
- Nature reserves/regional parks – DPAW managed Lands & Water – DPAW 2013
- Regional Parks (Beeliam) – CALM 2002
- Local Government Authority and Locality Boundaries – Landgate 2013
- Geology – Geological Survey of WA 1986
- Ramsar Wetlands – DPAW 2013

Shortened forms

AHD	Australian height datum
CALM	Conservation and Land Management
CCWA	Conservation Commission of Western Australia
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEC	Department of Environment and Conservation (now Department of Biodiversity, Conservation and Attractions)
DER	Department of Environmental Regulation (now DWER)
DPaW	Department of Parks and Wildlife (now Department of Biodiversity, Conservation and Attractions)
DoP	Department of Planning
DoW	Department of Water (now DWER)
DWER	Department of Water and Environmental Regulation
DWAID	Divertible water allocation information database
GDE	Groundwater-dependent ecosystem
IWSS	Integrated Water Supply Scheme
PRAMS	Perth Regional Aquifer Modelling System
TEC	Threatened ecological community
WAPC	Western Australian Planning Commission
WIN	Water Information Network
WRC	Water and Rivers Commission

Volumes of water

One litre	1 litre	1 litre	(L)
One thousand litres	1000 litres	1 kilolitre	(kL)
One million litres	1 000 000 litres	1 Megalitre	(ML)

One thousand million 1 000 000 000 litres 1 Gigalitre (GL)
litres

Glossary

Commonly used terms in relation to water resource management in the Cockburn plan area are listed below.

Abstraction	Withdrawal of water from any surface water or groundwater source of supply.
Allocation limit	Annual volume of water set aside for use from a water resource.
Conservation category wetland	Wetlands identified in geomorphic wetlands mapping (Hill <i>et. al</i> 1996) which are considered to be of high conservation significance.
Consumptive use	Water used for consumptive purposes considered as a private benefit including irrigation, industry, urban and stock and domestic uses.
Ecological values	The natural ecological processes occurring within water-dependent ecosystems and the biodiversity of these systems.
Ecological water requirement	The water regime needed to maintain the current ecological values (including assets, functions and processes) of water-dependent ecosystems consistent with the objectives of an ecological water requirements study.
Fit-for-purpose water	Water that is of suitable quality for the intended end purpose. It implies that the quality is not higher than needed.
Groundwater area	The boundaries proclaimed under the Rights in Water and Irrigation Act 1914 (WA) and used for water allocation planning and management.
Groundwater-dependent ecosystem	An ecosystem that is at least partially dependent on groundwater for its existence and health.
Groundwater-dependent community value	An in situ quality, attribute or use associated with a groundwater resource (or dependent on a groundwater resource) that is important for public benefit, welfare, state or health.

Licence (or licensed entitlement)	A formal permit which entitles the licence holder to take water from a watercourse, wetland or underground source under the Rights in Water and Irrigation Act 1914.
Non-artesian well or bore	A well, including all associated works, from which water does not flow, or has not flowed, naturally to the surface but has to be raised, or was raised, by pumping or other artificial means.
Over-allocation	A situation where licensed water entitlements, together with exempt uses and public water supply reserves, exceed the allocation limit set for a water resource.
Over-abstraction	A situation where the total volume of water actually abstracted by licensed and exempt water users exceeds the allocation limit set for a water resource.
Ramsar-listed wetland	Wetlands recognised as internationally significant and listed under the Convention on Wetlands of International Importance (Ramsar 1971).
Reference groundwater level	A groundwater level that triggers management actions or responses to be implemented that will reduce the impacts associated with abstraction on the water resource and dependent values.
Reliability	The number of years over time that a water licence holder can obtain their full licensed volume.
Seawater interface	The interface is a zone where dense salty water from the ocean meets the fresh groundwater flowing out to sea below the surface of the land along our coastlines.
Seawater interface 'toe'	The point at the bottom of the aquifer furthest from the coast where the seawater wedge intrudes from the ocean.
State Agreement	A State Agreement is a legal contract between the Western Australian Government and an applicant of a major project within the boundaries of Western Australia. State Agreements detail the rights, obligations, terms and conditions for the development of the specific project. In some circumstances the agreement contains clauses regarding water supply and this can affect what is required under the Rights in Water and Irrigation Act 1914.

Subarea	A subdivision, within a surface or groundwater area, defined to better manage water allocation. Subarea boundaries are not proclaimed and can therefore be amended without being gazetted.
Sustainable groundwater use	Abstracting groundwater in a way that does not result in unacceptable depletion of aquifer storage. Abstraction that causes significant long-term declines in groundwater levels is not acceptable and could ultimately have effects that cannot be reversed.
Water reserve	An area proclaimed under the Metropolitan Water Supply, Sewerage and Drainage Act 1909 (WA) or Country Areas Water Supply Act 1947 (WA) to protect and use water for public water supply.

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