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

Environmental management of groundwater from the Jandakot Mound groundwater resources

Triennial compliance assessment report July 2017–June 2020

February 2021

Department of Water and Environmental Regulation
Prime House, 8 Davidson Terrace
Joondalup Western Australia 6027
Locked Bag 10 Joondalup DC WA 6919

Phone: 08 6364 7000
Fax: 08 6364 7001
National Relay Service 13 36 77

dwer.wa.gov.au

February 2021 (Published July 2023)

ISSN 1033-8950

WT6512

Acknowledgements

This document was prepared by the Water Allocation Planning Branch with assistance from the Regulation, Water Resource Assessment and Water Information and Modelling branches and regional operations officers of the Swan–Avon Region (Welshpool office).

For more information about this report, contact: allocation.planning@dwer.wa.gov.au

Disclaimer

This document has been published by the Department of Water and Environmental Regulation. Any representation, statement, opinion or advice expressed or implied in this publication is made in good faith and on the basis that the Department of Water and Environmental Regulation and its employees are not liable for any damage or loss whatsoever which may occur as a result of action taken or not taken, as the case may be in respect of any representation, statement, opinion or advice referred to herein. Professional advice should be obtained before applying the information contained in this document to particular circumstances.

This publication is available at our website www.dwer.wa.gov.au or for those with special needs it can be made available in alternative formats such as audio, large print, or Braille.

Contents

Figures

Tables

Summary

This report describes the Department of Water and Environmental Regulation's (the department) compliance with environmental conditions and commitments in *Ministerial statement no. 688 – Jandakot Mound groundwater resources [including Jandakot Groundwater Scheme Stage 2]* for the period 1 July 2017 to 30 June 2020, under Part IV of the *Environmental Protection Act 1986* (Government of Western Australia 2005a). The report also outlines the environmental monitoring, management, research and consultation undertaken by the department to improve sustainable management of the Jandakot groundwater system.

Rainfall at Jandakot Airport Bureau of Meteorology (BoM) station (no. 9172) over the reporting period continued on a declining trend with figures of 892.4 mm in 2017–18, 765.5 mm in 2018–19 and 634.2 mm in 2019–20 (Table 1).

Under Statement no. 688, the department must manage the groundwater system to comply with water level criteria set at 23 groundwater-dependent wetland and terrestrial vegetation sites across the Jandakot Mound. The number of sites where water levels were non-compliant with absolute minimum water level criteria increased from three sites in 2017–18 to four sites in 2018–19 and 2019–20. This change is likely because of differences in rainfall patterns, as abstraction changes were small.

Public water supply entitlements for the Integrated Water Supply Scheme (IWSS) from the Superficial aquifer were between 3.90 and 4.15 gigalitres (G)L over the triennial reporting period (Table 1). The department continued to work with Water Corporation to distribute abstraction in response to groundwater level trends and to reduce the volume of groundwater pumped from production bores nearest to non-compliant sites.

Private licensed entitlements increased across the Jandakot Mound by 0.64 GL over the triennial reporting period (Table 1). However, most of the increase in volume was taken in subareas that do not impact on non-compliant sites.

Table 1 Rainfall, licensing totals from the superficial aquifer and compliance summary

	2017–18	2018–19	2019–20
Rainfall[1]	892.4 mm	765.5 mm	634.2 mm
Public water supply entitlements	4.00 GL	3.90 GL	4.15 GL
Public water supply entitlements (IWSS groundwater replenishment – all aquifers)[2]	1.00 GL	1.00 GL	1.00 GL
Abstracted (actual)	*0.14 GL*	*0 GL*	*0.57 GL*
Private licensed entitlements	38.17 GL	38.46 GL	38.81 GL
Estimated stock and domestic garden bore use[3]	24.00 GL	24.00 GL	24.00 GL
No. of non-compliant sites[4]	3 out of 23	4 out of 23	4 out of 23

1 Rainfall figures are for July–June and taken from Jandakot Airport (BoM station no. 9172).

2 Groundwater replenishment data is for all aquifers. For full details of groundwater replenishment entitlements and abstraction see section 3.1 and Table 2.

3 Stock and domestic garden bore use is from the Superficial aquifer only and is estimated using data collected through surveys, data from the Australian Bureau of Statistics, and records of household use from Water Corporation.

4 For full details of compliance see Table 4 and Appendix A.

1 Background

1.1 Ministerial statement no. 688

Ministerial statement no. 688 – Jandakot Mound groundwater resources (Government of Western Australia 2005a) established the environmental conditions and commitments associated with the allocation of groundwater for public and private use that the department must comply with and report on each year to the Environmental Protection Authority (EPA).

Key conditions in *Statement no. 688* include environmental water provisions in the form of water level criteria at 23 representative sites across the Jandakot Mound. These comprise 10 wetland, nine terrestrial phreatophytic vegetation and four rare flora sites across the Jandakot, Perth and Cockburn groundwater areas (Figure 1). Phreatophytic vegetation uses groundwater to meet at least part of its water needs. On the Swan Coastal Plain, native vegetation that occurs within 10.5 m depth to groundwater is considered to be phreatophytic.

The conditions and commitments under Part IV of the *Environmental Protection Act 1986* were first established in 1992 to ensure that the important environmental values of the Jandakot Mound were protected from significant impacts from groundwater abstraction for public water supply scheme and private licensed use. In 2005, the conditions and commitments were revised to remove sites where environmental values were lost because of causes other than abstraction (see Appendix A). These included sites that had been affected by land clearing for development and other land use changes.

The 2005 revision resulted in the removal of 15 sites and the amendment of water level criteria at a further five sites. The water level criteria at the 23 current sites have been established to ensure wetland surface water levels and groundwater levels in areas of phreatophytic vegetation stay within a range necessary to protect the stated environmental values of that site.

The department was formed with the merging of the Department of Water, Department of Environment Regulation and the Office of the Environmental Protection Authority in July 2017, and became the proponent of *Ministerial statement no. 688*. To ensure there is no possible apprehension of bias, the Director General of the department will not be involved in monitoring compliance with the Statement. The Executive Director, Compliance and Enforcement has been formally delegated to exercise the duties under the Act.

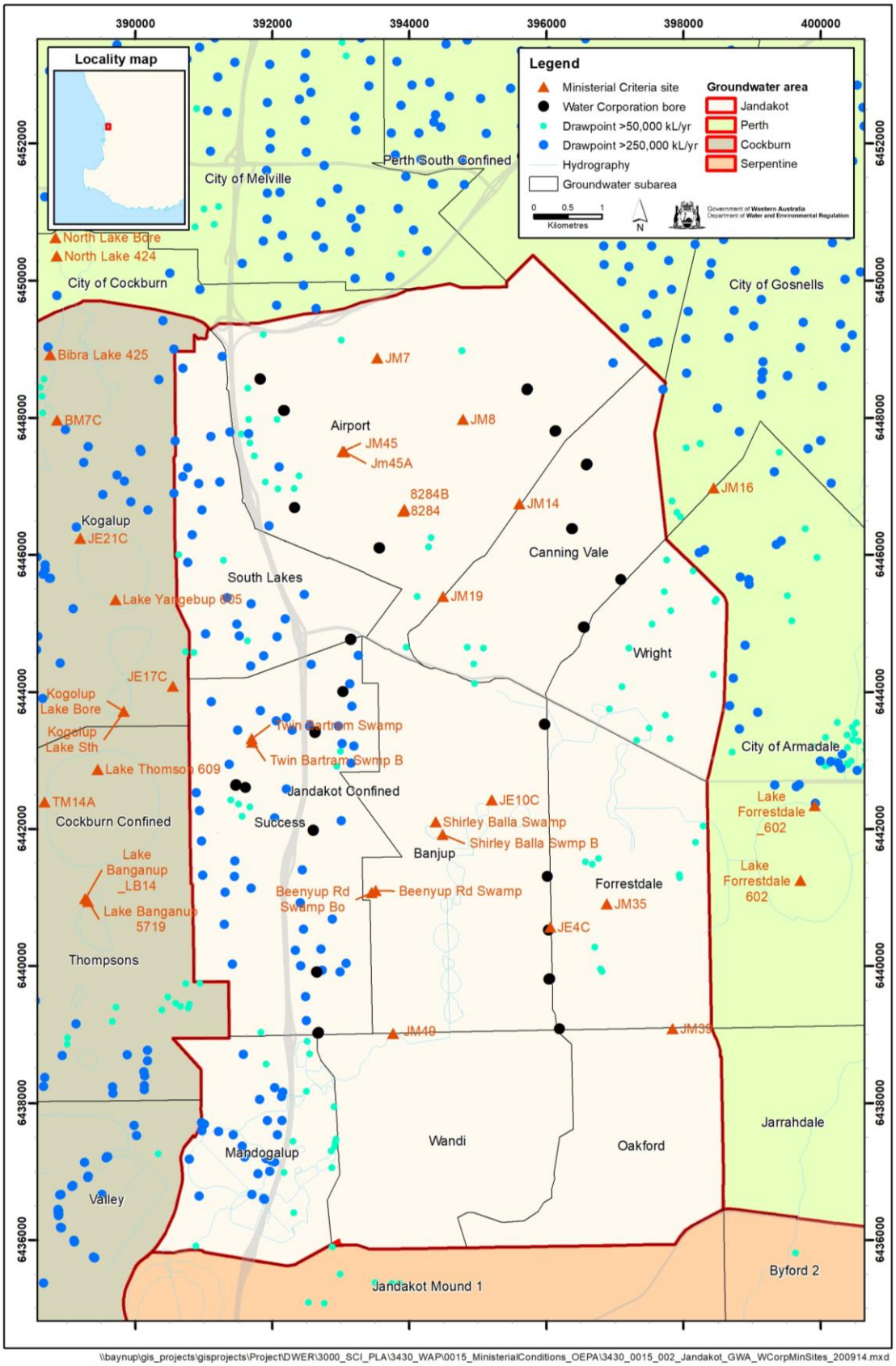

Figure 1 Location of Jandakot Ministerial sites, public water supply production bores (Water Corporation) and private licensed drawpoints with entitlements ≥50,000 kL/yr

1.2 The Jandakot groundwater system

The Jandakot groundwater system is located south of Perth. It extends from Rockingham in the south to the Swan–Canning River in the north, and from the coast to close to the Darling Scarp in the east. The system comprises three main aquifers:

- the shallow, unconfined Superficial (water table) aquifer, also referred to as the Jandakot Mound
- the deep, partially confined Leederville Aquifer
- the deep, mostly confined Yarragadee Aquifer.

Most of the Jandakot Mound is separated from the deeper Leederville Aquifer by a confining layer of Kardinya shale that extends under all of the sites with Ministerial water level criteria except Lake Forrestdale. This separation means that abstraction from the Superficial aquifer has a greater impact on Jandakot Mound wetlands and phreatophytic vegetation than abstraction from the deep aquifers.

Groundwater levels across the Jandakot Mound have generally declined over the past 40 years, but at a slower rate than that seen across the Gnangara Mound, north of the Swan River. In some areas of the Jandakot Mound water levels improved from 2016 to 2019 because of:

- annual rainfall being greater than the extreme dry years of 2006, 2010 and 2015
- unusual summer rainfall events in 2017 and 2018
- increased recharge rates from clearing and urbanisation
- localised management of abstraction.

1.3 Allocation limits and licensing

The department uses allocation limits, groundwater licensing rules and conditions, and monitoring of water levels and the environment as the main mechanisms to manage groundwater resources.

An allocation limit is the annual volume of water set aside for consumptive use from a water resource. This usually includes:

- water that is available for licensing
- water we account for that is exempt from licensing, including water used by domestic garden bores
- water set aside for future public water supply.

Water for the environment is not included as part of an allocation limit because it is left in the groundwater system to support environmental, cultural and community values. The water level criteria set at high-value wetland and terrestrial vegetation sites on the Jandakot groundwater system (see Section 5.1) essentially restrict the

amount of water that is made available for allocation (the allocation limit) so that the water left in the system is sufficient to meet environmental needs.

Allocation limits are set following comprehensive assessments of the state of the groundwater resource, hydrogeological capacity of the system and risks of abstraction to the resource, existing users and the environment. The department applies climate science, hydrogeological modelling and environmental assessments when setting and reviewing allocation limits. The department also uses science and monitoring along with licencing policy to manage licences.

Although domestic garden bores are exempt from licensing, they are still accounted for in setting allocation limits. They are managed through constraints on their use (such as the winter sprinkler ban and three-day-per-week restrictions) by identifying areas unsuitable for their installation, and through groundwater awareness and water use efficiency messaging targeted at domestic garden bore owners.

2 Rainfall

Groundwater in the Superficial aquifer is recharged by rainfall. How much groundwater levels rise and fall each year is affected by the volume of rain that falls in the catchment, but also by how it falls (timing, pattern and intensity). Recharge is also affected by temperature – warmer weather increases evaporation so that less rainfall reaches the aquifer.

The climate across south-western Western Australia is changing. There has been a general trend of declining annual rainfall since the mid-1970s. Average temperatures have also risen. CSIRO's climate change research (Bates et al. 2010), as well as relevant global climate change models, project continued rainfall reduction in this region. This trend was confirmed most recently through the World Climate Research Program Coupled Model Inter-comparison Project phase 6 (CMIP6) multi-model ensemble.

Over the triennial reporting period rainfall at the Bureau of Meteorology's (BoM) Jandakot Airport station was 892.4 mm in 2017–18, 765.5 mm in 2018–19 and 634.2 mm in 2019–20 (Figure 2).

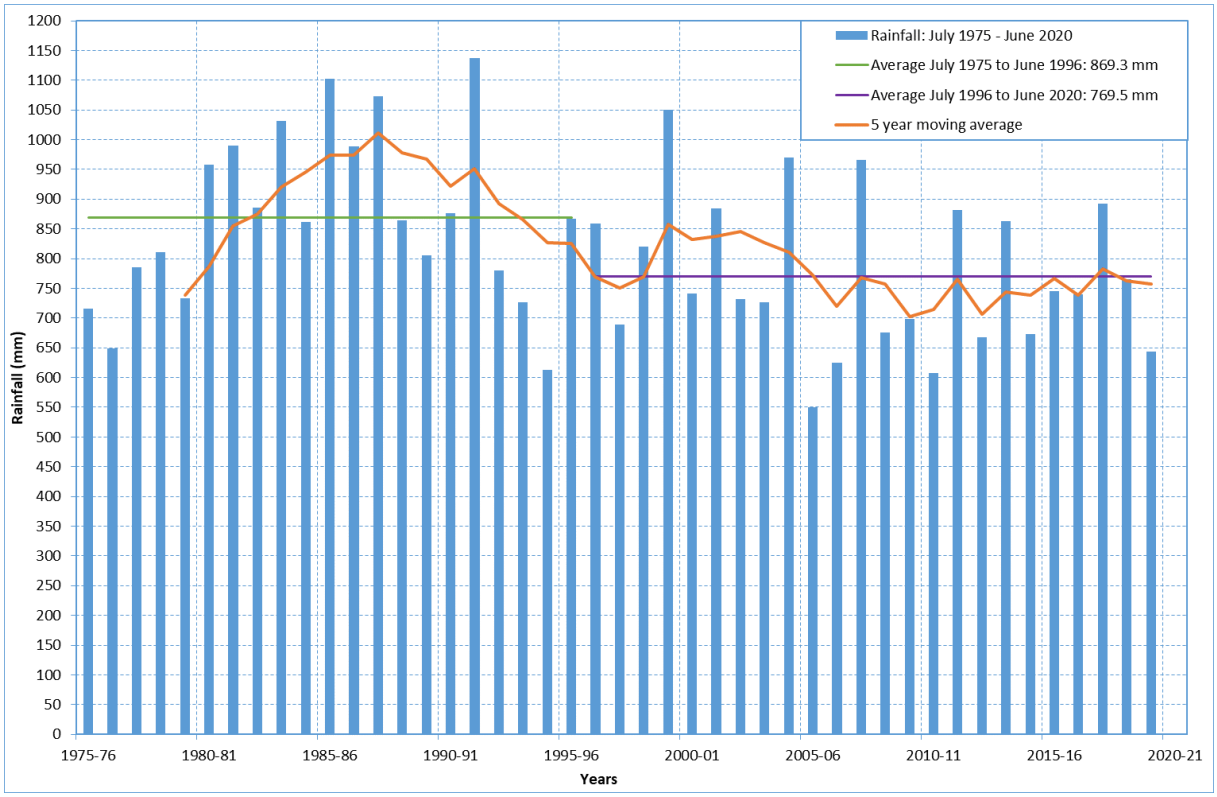

Figure 2 Annual and average water-year (July-June) rainfall at Jandakot Airport (BoM site no. 9172)

3 Groundwater use

The Jandakot groundwater system is a source of easily accessible, low-cost, good-quality water. It provides water for public open space, irrigated agriculture and industry, contributes to Perth's public water supply and supplies water for domestic garden bores.

This report summarises allocation limits, licensed entitlements and estimates of use exempt from licensing on the Jandakot Mound, in water management subareas where groundwater abstraction has an effect on sites with water level criteria in *Ministerial statement no. 688.*

Most of the sites with water level criteria are in the Jandakot groundwater area, with the remainder found in the Cockburn and the Perth South groundwater areas (Figure 1). Sites within the three areas are most impacted by local abstraction from within the groundwater area. However, sites in the Cockburn and Perth South groundwater areas, to the west and east respectively, are also impacted by abstraction from the Jandakot groundwater area. This is because groundwater flows from the Jandakot groundwater area outwards into the Cockburn and Perth South groundwater areas.

3.1 Public water supply

The department licenses Water Corporation to take groundwater from the Gnangara and Jandakot groundwater systems for Perth's public water supply. Groundwater abstracted from these systems forms an important part of supply to Perth's IWSS.

The volume of water licensed for public supply from all aquifers of the Jandakot system (Table 2) was 17.30 GL in 2017–18, 17.20 GL in 2018–19 and 17.06 GL in 2019–20. The volume licensed from the Superficial aquifer in each of these years included an additional 1.00 GL allocated as part of a trial in 2021–22 to assess the sustainability of the additional volume. The total licensed volume from the deeper aquifers remained similar across the reporting period.

In all years of the reporting period, 1.00 GL was also licensed from the Jandakot system as part of Water Corporation's groundwater replenishment (GWR) scheme. GWR is a form of managed aquifer recharge. At Beenyup Wastewater Treatment Plant in Craigie, water is treated to drinking-water standard and recharged/injected into the Leederville and Yarragadee aquifers onsite. An equivalent amount is then abstracted from aquifers across the Jandakot and Gnangara groundwater systems. This is subject to a groundwater licence.

Stage 1 of the Beenyup GWR scheme enables Water Corporation to inject and recover 14.00 GL of groundwater. Almost all of this is licensed to be abstracted from the Gnangara groundwater resources, but 1.00 GL was licensed to be abstracted from the Jandakot groundwater system (0.70 GL from the Leederville Aquifer and 0.30 GL from the Yarragadee Aquifer). The distribution of GWR licensing considers IWSS operating constraints while aiming to limit overall impacts to groundwater-

dependent ecosystems supported by the Gnangara and Jandakot systems. During the triennial reporting period, 0.14 GL was abstracted in the Jandakot Leederville aquifer in 2017–18, and 0.50 GL was abstracted in 2019–20. In 2019–20, 0.07 GL was abstracted from bore MR17 in the Yarragadee aquifer. Stage 2 of the GWR scheme has been commissioned which will enable Water Corporation to inject and recover up to 28.00 GL of groundwater each year; however, no additional water will be from the Jandakot borefield.

We continue to work with Water Corporation to distribute public water supply abstraction in response to groundwater level trends, and to move abstraction away from sites that are non-compliant with environmental criteria.

Licensed entitlements for public water supply from the Superficial aquifer are further broken down into groundwater subareas in Table 3 (Section 3.2).

Table 2 Public water supply entitlements from all aquifers of the Jandakot groundwater system

Aquifer	Baseline licence entitlement (GL)			Groundwater replenishment (GWR) (GL)					
				Entitlements			Abstracted[2]		
	2017–18	2018–19	2019–20	2017–18	2018–19	2019–20	2017–18	2018–19	2019–20
Superficial	4.00	3.90	4.15	-	-	-	-	-	-
Leederville	6.60	6.45	6.45	0.70	0.70	0.70	0.14	-	0.50
Yarragadee[1]	6.70	6.85	6.46	0.30	0.30	0.30	-	-	0.07
Total	**17.30**	**17.20**	**17.06**	**1.00**	**1.00**	**1.00**	**0.14**	**0.00**	**0.57**

1 Includes groundwater licensed from the new Yarragadee bore in the Jandakot groundwater area (5.85 GL in 2017–18, 6.00 GL in 2018–19 and 5.63 GL in 2019–20) and volumes licensed to bore MR17 in the Perth South groundwater area (0.85 GL in both 2017–18 and 2018–19 and 0.83 GL in 2019–20).

2 Of the 1.00 GL licensed for groundwater replenishment. 0.14 GL in 2017–18 and 0.57 GL in 2019–20 was abstracted by Water Corporation. 2019–20 includes water abstracted from bore MR17 in the Yarragadee aquifer.

3.2 Private licensed use

Groundwater licensed for private use from the Jandakot system mostly comes from the Superficial aquifer and is used for the irrigation of parks, public open spaces, agriculture, industry and commercial uses.

Over the triennial reporting period, there was an increase of 0.64 GL in private licensed entitlements from the Superficial aquifer (Table 3) in the Jandakot, Perth South and Cockburn groundwater areas. Table 3 shows private licensed entitlements for the groundwater subareas related to the sites with water level criteria set in *Ministerial statement no. 688*.

Table 3 Licensed entitlements for public water supply and private use from the Superficial aquifer in the subareas that impact on Ministerial sites

Groundwater area	Subarea	Ministerial criteria site present?	Allocation limit GL/year	Public water supply entitlements[4] GL			Private licensed entitlements[5] GL		
				2017–18	2018–19	2019–20	2017–18	2018–19	2019–20
Jandakot[1]	Airport	Yes	2.64	1.33	1.46	1.64	0.99	1.03	1.04
	Banjup	Yes	2.00	0.30	0.28	0.20	0.46	0.45	0.50
	Canning Vale	No	1.10	0.92	0.94	1.02	0.07	0.07	0.24
	Forrestdale	Yes	1.30	0.15	0.15	0.15	0.97	1.07	0.81
	Mandogalup	No	2.05				1.87	2.27	2.27
	Oakford	Yes	0.55				0.08	0.08	0.08
	South Lakes	No	0.82				0.53	0.57	0.87
	Success	Yes	3.91	1.30	1.08	1.15	1.08	1.13	1.13
	Wandi	No	0.88				0.31	0.30	0.31
	Wright	No	0.96				0.99	0.86	0.77
Total for Jandakot groundwater area			**16.21**	**4.00**	**3.90**	**4.15**	**7.34**	**7.83**	**8.02**
Perth[2]	City of Armadale	Yes	4.00				4.34	4.32	4.59
	City of Canning	No	3.50				2.75	2.62	2.55
	City of Cockburn	Yes	1.00				0.54	0.64	0.64
	City of Gosnells	No	5.50				3.43	3.22	3.43
	City of Melville	No	5.50				4.28	4.58	4.28
Total for Perth South groundwater area			**19.50**	**0.00**	**0.00**	**0.00**	**15.34**	**15.39**	**15.50**
Cockburn[3]	Kogolup	Yes	7.94				9.88	9.87	9.84
	Thompsons	Yes	4.28				5.62	5.38	5.44
Total for Cockburn groundwater area			**13.50**	**0.00**	**0.00**	**0.00**	**15.50**	**15.24**	**15.29**
Total for Jandakot subareas that affect Ministerial criteria sites			**47.93**	**4.00**	**3.90**	**4.15**	**38.17**	**38.46**	**38.81**

1 Allocation limits for the Jandakot groundwater area were updated in October 2014.

2 Allocation limits for subareas in the Perth South groundwater area, to the south of the Swan River, were reviewed in 2007.

3 Allocation limits for the Cockburn groundwater area are from the new Cockburn groundwater allocation plan released in January 2021 (DWER 2021).

4 Public water supply information is from the department's COMPASS system and annual reports submitted to the department as a condition of Water Corporation licences. The figures shown are what was allocated to Water Corporation for public water supply as at 30 June in each of the reporting years.

5 The 2017–18 allocation report was run on 1 July 2018, the 2018–19 report on 30 September 2019 and the 2019–20 report on 1 July 2020, all using COMPASS.

Up-to-date information about water availability can be found on the department's website or through Swan–Avon or Kwinana Peel regional offices.

Figures are rounded to two decimal places. 1 GL = 1 000 000 kL.

3.3 Use that is exempt from licensing

The department estimates and accounts for groundwater that is exempt from licensing. The main types of exempt water use from Jandakot are garden bores used in urban areas and stock and domestic bores used in rural areas where there is no scheme water connection. In 2014 we estimated a total of 2.39 GL was abstracted from garden bores and stock and domestic bores across the Jandakot Groundwater area. This is about 10 per cent of the total estimated 24 GL/year used across the Jandakot Mound.

Information on the number of garden bores that are installed in urban areas across Perth is currently based on data from on-the-ground surveys by Water Corporation, surveys by the Australian Bureau of Statistics in 2003, 2006 and 2009, and independent phone surveys conducted in 2012, 2016 and 2018.

Average water use per bore was estimated from the department's domestic bore metering project, which operated from 2009–2012 and was updated in 2016. Department estimates on exempt use are updated over time as we get new data on rates of instalment and average water use per bore in urban and rural areas, or as new assessment methods become available.

Under the *Waterwise Perth Action Plan* the department is working with Water Corporation to investigate ways of measuring and estimating garden bore usage.

4 Compliance

The conditions and commitments that the department is required to comply with from *Ministerial statement no. 688: Jandakot Mound groundwater resources* under Part IV of the *Environmental Protection Act 1986* (Government of Western Australia 2005a) are detailed in Appendices A and B (the 'audit tables'). The compliance results are summarised below.

4.1 Compliance with water level criteria

Ministerial statement no. 688 sets water level criteria at 23 sites across the Jandakot Mound (Figure 1). There are 10 wetland sites, nine terrestrial (phreatophytic) vegetation monitoring sites, and four rare flora sites. Some criteria sites have more than one water level criterion and can be non-compliant with multiple criteria. Water level criteria include:

- absolute minimum levels – these are used as the main indicator for compliance from year to year
- levels allowed to fall between a preferred minimum and the absolute minimum in two out of six years to replicate natural drying cycles – these are referred to as 'other' water level criteria in this report and provide information on water level trends
- rate of decline and time of drying – these are also referred to as 'other' water level criteria in this report.

In 2018–19 and 2019–20 four of the 23 sites were non-compliant with absolute minimum water level criteria (Table 4), one more than the previous year. Three sites were non-compliant with 'other' criteria across the triennial reporting period (Table 4). This change is likely because of the ongoing declining rainfall patterns and rainfall over the reporting period (refer to Section 2). Changes to abstraction were small over the same period. The new site to be non-compliant with absolute minimum water levels was Lake Forrestdale. It was previously non-compliant between 2010 and 2016.

The management and mitigation actions we implement in response to non-compliance are described in Section 6. Details for individual sites can be found in Appendix A.

Table 4 Summary of non-compliance with water level criteria for Jandakot groundwater resources for the reporting period

Non-compliant sites[1]					
Absolute minimum water level criteria			**Other water level criterion**		
Wetlands	**Terrestrial vegetation and rare flora**	**Total non-compliant**	**Wetlands**	**Terrestrial vegetation and rare flora**	**Total non-compliant**
2017–18					
North Lake Bibra Lake Shirley Balla Swamp	None	3 out of 23	Bibra Lake Lake Forrestdale Shirley Balla Swamp	None	3 out of 12
2018–19					
North Lake Bibra Lake Lake Forrestdale Shirley Balla Swamp	None	4 out of 23	Bibra Lake Lake Forrestdale Shirley Balla Swamp	None	3 out of 12
2019–20					
North Lake Bibra Lake Lake Forrestdale Shirley Balla Swamp	None	4 out of 23	Bibra Lake Lake Forrestdale Shirley Balla Swamp	JM7 JM45A JE17C	6 out of 12

1 In the event that a site is non-compliant with both absolute summer minimum and peak water level criteria within the same year, it is only counted as a single incidence of non-compliance; i.e. the site is not double counted. See also Appendix A.

5 Environmental monitoring, management, research and consultation

5.1 Environmental monitoring

Expert environmental consultants undertake environmental monitoring for the department in line with the commitments in *Ministerial statement no. 688: Jandakot Mound groundwater resources* (Government of Western Australia 2005a).

The department reviewed the environmental monitoring program in 2009 and 2013 (see Appendix D) to improve cost-effectiveness and efficiency. Over the triennial reporting period the program included monitoring of:

- wetland vegetation
- terrestrial vegetation
- wetland macroinvertebrates
- wetland water quality.

The ecological condition of groundwater-dependent ecosystems is affected by a number of factors, of which the water regime is just one. Other factors include fire, insect attack, disease, weed invasion, pollution and disturbance from changing land use. Similarly, groundwater abstraction is just one of the factors that can affect the water regime of an ecosystem. Others include changes in rainfall patterns, fire and land use changes such as urbanisation.

The department uses the results of environmental monitoring, carried out each spring in the reporting period, to continually improve its understanding of the relationship between water levels and ecological condition. The information is also used to manage abstraction at priority locations, reducing abstraction where it is likely to improve ecological condition.

Wetland vegetation

Over the triennial reporting period the condition of wetland vegetation was monitored in spring by Edith Cowan University at the sites listed in Table 5.

Table 5 Sites where wetland vegetation monitoring occurred over the 2017–20 triennial reporting period

	2017–18	2018–19	2019–20
Ministerial criteria sites	North Lake Bibra Lake Beenyup Road Swamp Shirley Balla Swamp Lake Forrestdale	North Lake Thomsons Lake Banganup Lake Beenyup Road Swamp Shirley Balla Swamp Lake Forrestdale	North Lake Thomsons Lake Banganup Lake Kogolup Lake South Beenyup Road Swamp Shirley Balla Swamp Lake Forrestdale
Other sites	-	The Spectacles	-
Reference	Buller et al. 2020	Buller et al. 2020	Buller et al. 2020

Improved mean canopy condition was recorded at all sites except Bibra Lake in 2017–18. In 2018–19 only minor changes in mean canopy condition were recorded across all the sites monitored. Canopy condition at Shirley Balla Swamp and Banganup Lake continued to be influenced by post-fire regeneration – fires experienced in 2014 and 2015 respectively.

The vegetation at Banganup Lake remains a potential risk of a threshold response in ecohydrological state despite increased groundwater levels. A threshold response is where particular ‘groups’ of species that prefer wetter conditions may be lost from the ecosystem because of excessive drying. The native sedges, *Baumea articulata* and *Baumea juncea*, which were present in moderate to high abundance before 2008 are now absent from the transect.

Spread of exotic species continues to be a significant driver of floristic change at Jandakot wetlands, with all sites monitored across the reporting period recording moderate to large increases in exotic cover-abundance since baseline monitoring. Some of these can be attributed to inundation and post-fire regeneration. At Thomsons Lake and Lake Forrestdale it is having a negative impact on species richness and cover-abundance.

Wetland macroinvertebrates and water quality

Over the reporting period macroinvertebrates and water quality were monitored in spring at the sites listed in Table 6.

Table 6 Sites where wetland macroinvertebrate and water quality monitoring occurred over the 2017–20 triennial reporting period

	2017–18	2018–19	2019–20
Ministerial criteria sites	Bibra Lake Kogolup Lake South (water quality only) Thomsons Lake Shirley Balla Swamp Lake Forestdale	Bibra Lake Kogolup Lake South Thomsons Lake Shirley Balla Swamp Lake Forrestdale	North Lake Thomsons Lake Shirley Balla Swamp Lake Forrestdale
Reference	Bennelongia Environmental Consultants 2018	Bennelongia Environmental Consultants 2019	Bennelongia Environmental Consultants 2020

The monitoring found that:

- water quality parameters at Lake Forrestdale were similar to previous years and within historical ranges. All parameters measured, except nitrogen, were within limits of acceptable change set for Ramsar sites (Maher & Davis 2009)
- tested parameters at Thomsons Lake were within historical ranges and limits of acceptable change for Ramsar sites (Maher & Davis 2009), with conductivity and turbidity the lowest recorded in the past nine years. pH at the lake increased from 6.86 in 2016, to 8.29 and 8.05 in 2017 and 2018 respectively, and other acidity parameters have improved in recent years
- water quality parameters at Shirley Balla Swamp were within historical ranges, with pH remaining relatively unchanged since 2016
- there was little variation in water quality at Kogolup Lake South, with all tested parameters within historical ranges
- high nutrient concentrations and low dissolved oxygen levels at North Lake compared with the other wetlands monitored
- oxygenation improved at Bibra Lake but nutrient concentrations (total nitrogen and total phosphorus) remained high.

The monitoring found that wetland conditions are able to support healthy macroinvertebrate assemblages. Species richness declined slightly at all sites from 2017–18 to 2018–19 but improved at Thomsons Lake and Shirley Balla Swamp in 2019–20. Abundance decreased at all sites over the same time.

Terrestrial vegetation

In 2019–20 the health of phreatophytic vegetation was monitored at five sites on the Jandakot Mound.

At all of the five monitoring transects there has been a general long-term declining trend in groundwater levels, vegetation condition/health and abundance of both overstorey and understorey species since the baseline monitoring in 1988 (Syrinx Environmental PL 2020). Higher-than-average rainfall received in the first two years of the triennial reporting period may have slowed or prevented the decline of many species.

5.2 Management actions

Managing public water supply

Before the start of each new water year (July to June), the department works with Water Corporation to optimise the distribution of abstraction for the IWSS, including from the Jandakot borefield, by considering groundwater level trends. This work uses a bore sensitivity classification system so that abstraction can be moved away from more sensitive bores, such as those closer to sites that are non-compliant with water level criteria set in *Ministerial statement no. 688*.

Managing local government and private licensed use

The department monitors local government and private licensed use through on-ground compliance inspections, meter audits, water use surveys and standard checks as part of the licence renewal process. Through this work the department verifies that groundwater use is within licensed entitlements and that site activities are authorised.

We also work with local governments, urban developers and other licensees that use large volumes, to improve water use efficiency, reduce demand for groundwater, assess water needs for future public open space and evaluate alternative water supply options.

The *Rights in Water and Irrigation Amendment Regulations*, which came in to effect in 2018, requires meters be fitted to all bores with a licensed entitlement greater than 10,000 kL by the end of 2020. Licence holders are required to adhere to their licence conditions and provide metered information to the department. This is a significant shift from previous requirements, where the threshold for metering was an entitlement of 500,000 kL/yr or greater, and supports improved water resource management.

Managing groundwater use exempt from licensing

Responsible and efficient use of domestic garden bores can provide a fit-for-purpose source of water for irrigating of lawns and gardens. Responsible and efficient use of garden bores can reduce demand on the scheme supply as well as spread the impacts of water abstraction through localised pumping of small volumes across many thousands of drawpoints. However, because of the large number of garden bores, if they are not used sparingly they may impact on groundwater levels which support with public open space, verge trees, neighbours gardens and local environments.

The use of urban garden bores and so-called 'stock and domestic' bores is managed under the provisions of the *Water Agencies (Water Use) By-Laws 2010*. These specify permanent sprinkler restrictions that apply to Area 3 Perth/Mandurah, which covers the majority of the Jandakot groundwater allocation plan area.

The following permanent sprinkler restrictions have applied to garden bores since 2010:

- A total winter sprinkler ban between 1 June and 31 August each year (unless extended by the Minister because of low rainfall).
- Sprinkler use is limited to once a day on three rostered days a week between 1 September and 31 May each year.
- Daytime sprinkler bans between the hours of 9am and 6pm.

These sprinkler restrictions are generally supported by the community, helping to preserve groundwater resources and encouraging water use efficiency in garden irrigation. Failure to adhere to restrictions can result in an infringement being issued.

The department guides where new bores can be installed without increasing the risk of impacting the quality of the water resource or environmentally sensitive areas, such as wetlands. The department's garden bore suitability map was updated in 2011 and can be found as a layer in the Perth Groundwater Map on the department's website.

The department also undertook a digital education campaign in 2019 to increase garden bore owners' awareness of groundwater as a limited and shared resource and to encourage waterwise use of garden bores. This is part of the department and Water Corporation's Be groundwater wise campaigns and contributes to implementation of the *Waterwise Perth Action Plan*. The expanded Be Groundwater Wise website provides one location for garden bore and waterwise advice: begroundwaterwise.wa.gov.au

Waterwise Perth Action Plan

The *Waterwise Perth Action Plan* was released in October 2019 to help transition Perth to a leading waterwise city. The strategy advocates responsible and sustainable use of water from all sources, including groundwater, and well-designed private and public green spaces to make the most of Perth's limited water resources. To deliver the plan the department will work with local government, industry and the broader community to fulfil (among others) the following commitments:

- manage groundwater levels to sustain wetlands and urban trees, and reduce irrigation of green spaces
- extend and enhance the Waterwise Council and Waterwise Golf Course programs
- assist schools, universities and other institutions to reduce groundwater use through the Waterwise grounds programs.

The *Cockburn groundwater areas allocation plan* was released in January 2021 (DWER 2021). The plan is the first Action 14 deliverable under *Waterwise Perth Action Plan 2019.*

5.3 Research initiatives

The department continues to undertake research to better understand and manage water resources on the Jandakot Mound. Before the reporting period, this has included updating the Perth Regional Aquifer Modelling System, developing a tool that generates local climate projections for planning. The Perth Regional Confined Aquifer Capacity study has enabled a much better understanding of the Leederville and Yarragadee aquifers, and their connection with the Superficial aquifer. This information is used in licensing decisions and for planning purposes.

5.4 Consultation

The department regularly engages with the community through public seminars, conferences, workshops and community meetings, presenting annually to the Jandakot Community Consultative Committee (JCCC). This is in line with the commitment in *Ministerial statement no. 688: Jandakot Mound groundwater resources*. Over the triennial reporting period it met with the JCCC annually.

The department provides advice to local and State Government agencies to ensure that water availability and supply options for irrigation of public open space, or for development proposals, are considered as early as possible in the planning phase, and that environmental and resource restrictions are properly considered.

Through the framework described in *Better urban water management* (WAPC 2008), the department provides advice to local governments and land planning agencies on water management in urban areas to minimise the effects of drainage and stormwater on shallow groundwater in the Jandakot area. The framework sets out

how water resources should be considered at each planning stage by identifying the actions and investigations required to support decisions.

Appendices

Appendix A — Water level monitoring results for Ministerial sites on the Jandakot Mound for 2009–2020

Bold text refers to compliance with water level criteria and other criteria. **Black bold text** indicates sites compliant with water level and other criteria. **Red bold text** indicates sites non-compliant with water level criteria. **Blue bold text** indicates sites non-compliant with other criteria.

Table A1 Wetland sites

Wetland	AWRC reference number	Water level criteria (mAHD)		Other criteria	Water level (mAHD)											Status and comments on compliance during the 2017–2020 triennial reporting period
		Preferred	Absolute			2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	
North Lake	Staff 424 6142521	13.29	12.68	<0.1 m decline per year	Max	12.93	12.68	12.93	12.71	13.01	13.11	12.79	12.95	13.03	13.38	12.98	Compliance and trends: **Non-compliant with absolute minimum criterion.** The lake has been non-compliant with the absolute minimum criteria at both the staff gauge and the bore since 2006–07. **Compliant with other criterion.** Ecological condition: Long-term monitoring has shown declines in canopy condition, changes in species composition to more terrestrial species, increases in abundance of exotic species and insect damage. Management and mitigation: A shallow groundwater investigation finalised in 2014–15 improved understanding of the lake's hydrogeology in relation to its ecological health. In 2014–15, the department updated the allocation limits in the Jandakot groundwater area based on a review that considered compliance, water level trends and ecological health at the lake. The lower allocation limits reduce the risk of future increases in abstraction impacting on lake levels.
					Min	**12.38**	**12.38**	**12.27**	**12.30**	**12.30**	**12.30**	**12.00**	**12.30**	**12.30**	**12.30**	**12.43**	
	Bore 61410726				Min	**11.59**	**11.48**	**11.60**	**11.45**	**11.52**	**11.61**	**11.87**	**11.66**	**11.81**	**11.80**	**11.60**	
Bibra Lake	Staff 425 6142520	13.6–14.2 <15.0 peak	13.6	Dry no more than 2 in 3 years, and preferably less than 1 in 3 years	Max	14.2	13.7	14.0	13.9	14.3	14.3	14.0	14.1	14.3	14.5	14.3	Compliance and trends: **Non-compliant with absolute minimum criterion.** **Non-compliant with other criterion.** The lake is non-compliant with the absolute minimum criterion. The lake did not dry in 2018–19 but was still non-compliant with the other criterion as it had dried more than two times in three years. Ecological condition: Long-term monitoring has shown declines in canopy condition, changes in species composition to more terrestrial species and increases in abundance of exotic species. Management and mitigation: In 2014–15, the department updated the allocation limits in the Jandakot groundwater area based on a review that considered compliance, water level trends and ecological health at the lake. The revised allocation limits reduce the risk of future increases in abstraction impacting on lake levels.
					Min	**13.5 dry 19/02**	**13.5 dry 07/12**	**13.5 dry 01/02**	**13.5 dry 05/03**	**13.5 dry 01/04**	**13.5 dry 04/05**	**13.5 dry 01/03**	**13.5 dry 03/04**	**13.5 dry 04/04**	**13.5**	**13.5 dry 04/02**	
	Bore BM7C 61410177	<15.0 peak			Min							**13.0**	**13.2**	**13.2**	**13.2**	**12.8**	
Kogolup Lake (South)	Staff 6142522	13.1–14.0 <14.8 peak	13.1	N/A	Max	15.2	14.5	14.8	14.6	15.1	15.2	14.6	14.9	15.1	15.3	16.1	Compliance: **Compliant with absolute minimum criterion.** Maximum and minimum groundwater levels in 2017–18 and 2018–19 were the highest recorded since 2014–15. Additional information: Water Corporation monitors surface water levels at this site.
					Min	14.0	14.0	14.0	13.8	14.1	14.4	13.8	13.9	14.1	13.8	13.8	
	Bore 6015 61410727				Max	14.5	14.5	14.8	14.6	15.1	15.2	14.6	14.7	15.0	15.3	15.2	
					Min	14.0	13.6	13.9	13.6	14.0	14.0	13.6	13.8	14.0	14.0	13.5	

Wetland	AWRC reference number	Water level criteria (mAHD)		Other criteria	Water level (mAHD)											Status and comments on compliance during the 2017–2020 triennial reporting period
		Preferred	Absolute			2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	
Thomsons Lake	Staff 609 6142517	11.3–11.8	10.8	For 30% of time water levels > 11.8 mAHD (wet year – 10 %) 11.3-11.8 mAHD (medium year – 80 %) 10.8-11.3 mAHD (dry year – 10 %)	Max	12.7	12.1	12.3	12.2	12.5	12.4	12.2	12.6	12.6	12.8	12.6	Compliance and trends: **Compliant with absolute minimum and other criteria.** Maximum water levels in 2018–19 and 2019–20 were the highest recorded since 2009–10. 2017–18 was classed as a 'medium year' with 894.4 mm of rainfall received at Jandakot Airport (BoM station no. 9172) and 765.6 mm at Perth Airport (BoM station no. 9021). Levels were above 11.3-11.8 mAHD set for 'medium years'. 2018–19 and 2019–20 were both classed as dry years with 765.6 mm and 644.2 mm of rainfall received respectively at Jandakot Airport (BoM station no. 9172). In both years, levels were above the water levels of 10.8-11.3 mAHD set for dry years. The lake dries at 11.5 mAHD. Absolute minimum water levels are measured at the bore. Additional information: As part of the Jandakot Drainage Scheme, Water Corporation monitors surface water levels at this site. The maximum depth recorded was 0.75 m. The ecological character description for the site recommends that the lake achieves a maximum water depth of >1.6 m every 10 years. This cannot be met under the current supplementation program as this water level would inundate Water Corporation pump station infrastructure. The Department of Biodiversity, Conservation and Attractions (DBCA) (formerly the Department of Parks and Wildlife) implements an annual supplementation and sampling analysis plan that it developed in 2004–05. The lake is supplemented over the winter months to ensure it contains sufficient water in late spring and early summer to support migratory and resident bird populations. It also allows cygnets time to mature enough to fly over the vermin-proof fence surrounding the lake.
					Min	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	11.5 dry	
	Bore TM14A 61410367				Max	12.2	11.8	12.1	11.8	12.1	12.1	11.8	12.0	12.2	12.4	12.3	
					Min	11.3	11.0	11.2	11.4	11.2	11.2	11.1	11.3	11.4	11.5	11.3	

Wetland	AWRC reference number	Water level criteria (mAHD)		Other criteria		Water level (mAHD)											Status and comments on compliance during the 2017–2020 triennial reporting period
		Preferred	Absolute			2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	
Lake Forrestdale	Staff 6162557	21.2–21.6	21.1	Preferred earliest drying by April (wet year), February to March (medium year) or January (dry year) Lake levels must be at least 0.9 m deep (22.6 mAHD)	Max	**22.0**	**21.7**	**21.9**	**21.7**	**22.0**	**21.9**	**21.8**	**22.0**	**22.0**	**22.1**	**21.9**	Compliance and trends: **Non-compliant with absolute minimum criterion.** The lake was compliant with minimum water level criteria levels in 2017–18 but was non-compliant in 2018–19 and 2019–20. **Non-compliant with other criterion.** The lake did not achieve a minimum depth of 0.9 m (22.6 mAHD) over the triennial reporting period. 2017–18 was classed as a 'medium year' with 894.4 mm of rainfall received at Jandakot Airport (BoM station no. 9172) and 765.6 mm at Perth Airport (BoM station no. 9021). Levels were above 11.3-11.8 mAHD set for 'medium years'. 2018–19 and 2019–20 were both classed as dry years with 765.6 mm and 644.2 mm of rainfall received respectively at Jandakot Airport (BoM station no. 9172). In 2017–18 the lake dried before the 'medium' year preferred months of February or March. In 2019–20 the lake dried before the 'dry' year preferred month of January. Ecological condition: Long-term monitoring has shown declines in canopy condition, changes in species composition to more terrestrial species and increases in abundance of exotic species. Management and mitigation: In 2014–15, the department updated the allocation limits in the Jandakot groundwater area based on a review that considered compliance, water level trends and ecological health at the lake.
					Min	**dry 09/12**	**dry 07/12**	dry 11/01	dry 04/02	dry 04/01	dry 13/01	dry 11/01	dry 21/02	**dry 04/12**	dry 08/01	**dry 02/12**	
	Bore 602 61410714				Max	23.2	23.0	23.2	22.9	23.2	23.1	23.0	23.1	23.1	23.1	23.1	
					Min	21.2	**20.6**	**21.0**	**20.9**	**20.8**	**20.8**	**20.6**	21.4	21.1	**20.9**	**20.7**	
Yangebup Lake	Staff 605 6142523	13.9–15.5 <16.5 peak	13.8	Either Bibra or Yangebup Lake must contain 0.3 m water, preferably 0.5 m	Max	16.6	15.9	15.9	15.9	17.1	16.9	16.4	16.8	16.4	16.7	16.6	Compliance: **Compliant with absolute minimum and other criteria.** Additional information: As part of the Jandakot Drainage Scheme, Water Corporation monitors surface water levels at this site and lowers water levels if the peak is exceeded. The peak was last exceeded in 2014–15.
					Min	15.4	14.5	15.1	15.2	15.6	15.5	14.9	15.2	15.3	15.4	15.0	
	Bore JE21C 61419707				Max	16.1	15.3	15.3	15.3	16.2	16.2	15.8	16.0	15.8	16.1	16.0	
					Min	15.0	14.1	14.6	14.6	15.0	15.0	14.9	15.1	15.4	14.8	14.7	
Banganup Lake	Staff 5719 6142516	N/A	11.5	N/A	Max	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.6	12.6	12.9	Compliance and trends: **Compliant with absolute minimum criterion** 2017–18 was the first year in which groundwater levels were compliant with the absolute minimum criteria since 2014–15. Levels remained compliant in 2018–19 and 2019–20.
					Min	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.6	12.6	12.6	
	Bore LB14 61419614				Max	12.5	12.0	12.3	12.1	12.4	12.2	12.3	12.3	12.4	12.7	12.8	
					Min	11.6	**11.2**	**11.4**	**11.4**	**11.4**	11.6	**11.3**	**11.4**	11.5	11.8	11.6	
Twin Bartram Swamp	Staff JE7C 6142544	22.8	22.5	No drying before end of January. Must be above preferred minimum 4 in every 6 years.	Max	24.4	23.7	23.8	24.3	24.7	24.6	24.3	24.4	24.6	24.3	24.7	Compliance and trends: **Compliant with absolute minimum and other criteria.** Maximum and minimum water levels have remained relatively stable over the past few years. The lake has not dried before the end January since 2010–11. Water levels have been above the preferred minimum level in all years.
					Min	23.2	23.0 **dry 04/01**	23.1	23.2	23.4	23.5	23.3	23.7	23.8	23.6	23.5	
	Bore JE6C 61410715				Max	24.5	23.8	23.9	24.3	24.7	24.6	24.3	24.4	24.6	24.8	24.6	
					Min	23.4	22.7	23.1	23.3	23.4	23.6	23.3	23.7	23.9	23.7	23.5	

Wetland	AWRC reference number	Water level criteria (mAHD)		Other criteria	Water level (mAHD)											Status and comments on compliance during the 2017–2020 triennial reporting period
		Preferred	Absolute			2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	
Shirley Balla Swamp	Staff 6142576	N/A	23.1 mAHD or 0.5 m below lake base, whichever is higher 24.5	No drying before end of January. Must be above preferred minimum 4 in every 6 years. Water levels should not decline at rate greater than 0.1 m/year. Monitor staff gauge.	Max	25.0	25.1	25.1	25.0	25.2	25.5	25.3	25.2	25.2	25.4	25.1	Compliance and trends: **Non-compliant with absolute minimum criterion.** Minimum water levels have been below the absolute minimum except for the 2014–15 reporting period. **Non-compliant with other criterion.** The wetland has dried before the end of January every year. Ecological condition: Long-term monitoring has shown declines in canopy condition, changes in species composition to more terrestrial species and increases in abundance of exotic species. Management and mitigation: In 2014–15, the department updated the allocation limits in the Jandakot groundwater area based on a review that considered compliance, water level trends and ecological health at the lake. The revised allocation limits reduce the risk of future increases in abstraction impacting on lake levels. Additional information: A preferred minimum has not been established so the four-in-six-years criteria cannot be applied. Further review of criteria is required.
					Min	**dry**	**dry 01/09**	**dry 01/12**	**dry 05/11**	**dry 02/12**	**dry 02/02**	**dry 01/12**	**dry 01/12**	**dry 04/12**	**dry 03/12**	**dry 08/01**	
	Bore 61410713				Max	25.3	24.6	24.6	25.1	25.3	25.6	25.4	25.2	25.2	25.5	25.2	
					Min	**24.2**	**23.8**	**24.3**	**24.1**	**24.4**	24.7	**24.2**	**24.2**	**24.3**	**24.2**	**23.9**	
Beenyup Road Swamp	Staff 6142547	24.0	23.6	Bore must be above preferred minimum 4 in every 6 years.	Max	25.1	24.7	25.1	25.1	25.3	25.3	24.9	25.1	25.3	25.5	25.3	Compliance: **Compliant with absolute minimum and other criteria.**
					Min	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	24.6 dry	
	Bore 61410711				Max	25.2	24.7	25.2	25.1	25.4	25.3	24.9	25.2	25.3	25.6	25.4	
					Min	24.2	23.9	24.3	24.3	24.4	24.4	24.1	24.5	24.6	24.4	24.2	

Table A2 Phreatophytic vegetation or rare flora sites

Monitoring bore	AWRC reference number	Water level criteria (mAHD)		Other criteria		Water level (mAHD)											Status and comments on compliance during the 2017–2020 triennial reporting period
		Preferred	Absolute			2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	
Vegetation sites																	
JM14	61610247	24.39	23.89		Max	25.64	25.08	25.30	25.16	25.67	25.91	25.26	25.58	25.67	26.13	25.48	Compliance: **Compliant with absolute minimum criterion.**
					Min	24.64	**23.82**	24.59	24.34	24.61	24.78	24.35	24.68	24.75	24.75	24.47	
JM16	61610445	23.90	23.40		Max	25.50	24.95	25.27	24.94	25.53	25.56	25.13	25.30	25.51	25.71	25.36	Compliance: **Compliant with absolute minimum criterion.**
					Min	24.38	23.98	24.31	24.17	24.31	24.39	24.19	24.49	24.57	24.40	24.22	
JM19	61610177	25.26	24.76		Max	26.27	25.59	25.90	25.65	26.06	26.18	25.72	26.41	26.82	27.27	27.05	Compliance: **Compliant with absolute minimum criterion.**
					Min	25.26	**24.29**	25.12	24.86	24.90	25.26	24.84	25.28	25.90	26.22	26.10	
JM35	61610333	21.25	20.75		Max	25.82	24.33	25.68	25.44	25.76	26.06	25.02	23.39	24.13	25.18	24.75	Compliance: **Compliant with absolute minimum criterion.**
					Min	23.11	21.22	21.74	23.42	24.08	21.76	20.91	21.45	21.86	22.56	22.15	
JM39	61410142	21.20	20.70		Max	24.27	22.66	23.86	23.46	23.80	23.71	22.46	22.76	23.56	24.39	23.61	Compliance: **Compliant with absolute minimum criterion.**
					Min	21.62	21.16	21.86	21.88	21.52	21.37	20.76	21.08	21.59	21.85	21.42	
JM49	61410111	22.34	21.84		Max	23.81	23.49	23.86	23.73	23.89	23.98	23.67	23.86	24.02	24.23	24.11	Compliance: **Compliant with absolute minimum criterion.**
					Min	23.19	22.75	23.25	22.98	23.04	23.01	22.93	23.08	23.19	23.20	22.92	
8284 8284B	61610178/ 61611864	24.82	24.32		Max	25.70	25.35	25.62	25.38	25.79	25.99	25.68	25.78	26.16	26.56	26.26	Compliance: **Compliant with absolute minimum criterion.** Additional information: 8284 has been decommissioned because the bore collapsed while it was being airlifted. The department now uses 8284B (AWRC ref. 61611864), next to 8284, to measure water level criteria.
					Min	25.00	25.00	25.03	25.00	25.07	25.29	24.99	25.11	25.38	25.52	24.34	
JE4C	61610234	24.00	23.50		Max	25.70	24.83	25.63	23.85	25.81	25.95	25.45	25.72	26.07	26.46	26.08	Compliance: **Compliant with absolute minimum criterion.**
					Min	24.43	24.00	24.78	23.30	24.59	24.71	24.43	24.79	25.06	25.13	24.79	
JE10C	61410250	21.80	21.30		Max	25.98	24.86	25.28	25.06	25.72	25.98	26.04	25.48	25.96	26.44	26.19	Compliance: **Compliant with absolute minimum criterion.**
					Min	23.25	22.46	23.81	23.26	23.31	23.94	23.01	23.62	23.98	24.19	23.66	
Rare flora sites																	
JM7	61610180		22.06	< 0.1 m decline per year	Max	23.84	23.27	23.84	23.85	24.48	24.61	24.35	24.41	24.74	25.17	24.87	Compliance: **Compliant with absolute minimum criterion.** **Non-compliant with other criterion.** Absolute summer minimum water levels declined by >0.1 m over the 2019–20 reporting period.
					Min	22.97	22.30	23.13	23.06	23.59	23.77	23.56	23.81	24.00	24.05	**23.63**	
JM8	61610248		23.38	< 0.1 m decline per year	Max	25.12	24.49	24.88	24.66	25.29	25.58						Unavailable. Monitoring of water levels stopped in September 2014 because of access issues. The department is unable to determine compliance with absolute summer minimum water level criteria.
					Min	24.19	23.67	24.15	23.96	24.42							
JM45 JM45A	61610179/ 61618756		22.71	< 0.1 m decline per year	Max	24.12	23.62	23.91	23.85	24.45	24.76	24.39	24.59	24.85	25.16	24.96	Compliance: **Compliant with absolute minimum criterion.** **Non-compliant with other criterion.** Absolute summer minimum water levels declined by >0.1 m over the 2019–20 reporting period. Additional information: JM45 has been decommissioned because of urban development in the area. The department now uses JM45A (AWRC ref. 61618756) to measure water level criteria.
					Min	23.38	22.71	23.45	23.30	23.72	23.97	23.69	23.82	24.09	24.09	**23.93**	

Monitoring bore	AWRC reference number	Water level criteria (mAHD)		Other criteria	Water level (mAHD)											Status and comments on compliance during the 2017–2020 triennial reporting period
		Preferred	Absolute			2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2019–20	
JE17C	61419703		16.35	< 0.1 m decline per year	Max	18.13	18.06	18.05	18.06	18.16	18.27	18.13	18.18	18.18	18.24	18.20	Compliance: **Compliant with absolute minimum criterion.** **Non-compliant with other criterion.** Absolute summer minimum water levels declined by >0.1 m over the 2019–20 reporting period.
					Min	17.68	16.97	17.48	17.36	17.55	17.39	17.45	17.76	17.76	17.69	**17.58**	

Appendix B — Audit tables: Environmental conditions, procedures and commitments for the Jandakot Mound

Proponent: Department of Water and Environmental Regulation

Period: 1 July 2017 to 30 June 2020

Note: *Ministerial statement no. 688* refers to Department of Water and Environmental Regulation (formerly Water and Rivers Commission and Department of Water) responsibilities to the EPA. In some cases, although referred to below as EPA, some responsibilities now lie with DBCA.

Table B1 Ministerial conditions and procedures

Audit code	Subject	Action	How	Evidence	Require-ment of:	On advice from	Phase	When/Where	Status and further information for the 2017–20 triennial reporting period
688: M 1-1	Implementation	The proponent shall implement the proposals as documented in *Section 46 Review of Environmental Conditions on Management of the Gnangara and Jandakot Mounds – Stage 1 Proposal for Changes to Conditions* (August 2004), as modified and documented in *Environmental Protection Authority Bulletin 1155*.	Implement proposals (conditions, procedures) given in EPA Bulletin 1155 and *Ministerial statement no. 688*.	Compliance report.	Minister for the Environment		Overall		**Non-compliant.** Strategies have been implemented to reduce impacts on environmentally important sites. These include: • significantly reducing abstraction for public water supply • increasing licence compliance and enforcement activities • capping abstraction for private licensed water supply. In October 2019, the State Government released the *Waterwise Perth Action Plan*, committing to a target of a 10 per cent reduction in groundwater use across the greater Perth area by 2030. Refer to the status column of this table.
688: M 2-1	Proponent commitments	The proponent shall implement the environmental management commitments, as revised in December 2004, and documented in schedule 1 of *Ministerial statement 688*, to the requirements of the Minister for the Environment on advice of the EPA.	Implement environmental management commitments given in EPA Bulletin 1155 and *Ministerial statement no. 688*.	Compliance report	Minister for the Environment	EPA	Overall		**Non-compliant.** Some sites were non-compliant with the absolute minimum water level criteria identified in Schedule 1 of *Ministerial Statement no. 688*. Three sites were non-compliant in 2017–18 and four sites were non-compliant in 2018–19 and 2019–20.
688: M 3-1	Proponent nomination & contact details	The proponent nominated by the Minister for the Environment under section 38 (6) or (7) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal, until such time as the Minister for the Environment has exercised the Minister's power under section 38 (7) of the Act to revoke the nomination of that proponent and nominate another person as the proponent for the proposal.	Adhere to conditions, procedures and commitments given in EPA Bulletin 1155 and *Ministerial statement no. 688*.	Letter notifying the Chief Executive Officer of any change in proponent details.	Minister for the Environment	EPA	Overall		**Compliant.** The department was established by the Government of Western Australia on 1 July 2017. It is a result of the amalgamation of the Department of Environment Regulation, Department of Water and the Office of the Environmental Protection Authority.
688: M 3-2	Proponent nomination & contact details	If the proponent wishes to relinquish the nomination, the proponent shall apply for the transfer of proponent and provide a letter with a copy of this statement endorsed by the proposed replacement proponent that the proposal will be carried out in accordance with this statement. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall also be provided.	Follow procedure given in 'action'.	Letter notifying the Chief Executive Officer of any change in proponent details.	Minister for the Environment		Overall		**Not required at this time.** No change to proponent was made in the 2017–20 reporting period.

Audit code	Subject	Action	How	Evidence	Require-ment of:	On advice from	Phase	When/Where	Status and further information for the 2017–20 triennial reporting period
688: M 3-3	Proponent nomination & contact details	The nominated proponent shall notify the EPA of any change of contact name and address within 60 days of such change.	Follow procedure given in 'action'.	Letter notifying the Chief Executive Officer of the EPA of any change in proponent details.	CEO of DWER or their delegate		Overall	60 days of change	**Not required at this time.** No change to proponent was made in the 2017–20 reporting period.
688: M 4-1	Commencement and time limit of approval	The proponent shall provide evidence to the Minister for the Environment within five years of the date of this statement that the proposals have been substantially commenced or the approvals granted in the statements of 8 March 1988 and 17 February 1999 shall lapse and be void.	Provide evidence in annual/triennial reports.	Compliance report.			Overall	Condition complete	**Completed.** The 'status of implementation of the proposals' is 'completed' because the Water Corporation's Jandakot scheme stages 1 and 2 are fully commissioned.
688: M 5-1 1	Compliance audit and performance review	The proponent shall prepare an audit program and submit compliance reports to the EPA which address: 1. the status of implementation of the proposals	Detail in annual/triennial reports. Compliance report will include: 1. the status of implementation of the proposals	Compliance report.	CEO		Overall	Condition complete	**Completed.** An audit program (see 688: P 14) was submitted to the EPA on 25 November 2005. The 'status of implementation of the proposals' is 'completed' as Jandakot scheme stage 1 and 2 are fully commissioned.
688: M 5-1 2	Compliance audit and performance review	The proponent shall prepare an audit program and submit compliance reports to the EPA which address: 2. evidence of compliance with the conditions and commitments	Detail in annual/triennial reports. Compliance report will include: 2. evidence of compliance with the conditions and commitments	Compliance report.	CEO			Annually	**Compliant.** Detailed in section 6 of this report and status column of this Appendix.
688: M 5-1 3	Compliance audit and performance review	The proponent shall prepare an audit program and submit compliance reports to the EPA which address: 3. the performance of the environmental management plans and programs. Note: Under delegation No. 54 issued on 18 June 2004 and section 48 (1) of the *Environmental Protection Act 1986*, the EPA is empowered to monitor the compliance of the proponent with the statement and should directly receive the compliance documentation, including environmental management plans, related to the conditions, procedures and commitments contained in this statement.	Detail in annual/triennial reports. Compliance report will include: 3. the performance of the environmental management plans and programs.	Compliance report.	CEO			Annually	**Compliant.** Detailed in section 5 of this report and status column of this Appendix. Also refer to the results in Appendix A and Table 4 (Section 4).
688: M 5-2 1	Compliance audit and performance review	The proponent shall submit a performance review report by 1 December each year and more detailed reports by 1 February every three years, to the requirements of the EPA, which address: 1. compliance with the conditions	The performance review will address: 1. compliance with the conditions	Compliance report.	CEO		Overall	By 1 December each year and more detailed reports by 1 February every three years.	**Compliant.** Detailed in section 5 of this report and status column of this Appendix. Also refer to the results in Appendix A and Table 4 (Section 4).
688: M 5-2 2	Compliance audit and performance review	The proponent shall submit a performance review report by 1 December each year and more detailed reports by 1 February every three years, to the requirements of the EPA, which address: 2. the achievement of environmental objectives set for the proposal	The performance review will address: 2. the achievement of environmental objectives set for the proposal	Compliance report.	CEO		Overall	By 1 December each year and more detailed reports by 1 February every three years.	**Compliant.** This report provides the required performance review and evidence of whether the environmental objectives (refer to Table 2 in the Appendix B for objectives) are being met.

Audit code	Subject	Action	How	Evidence	Require-ment of:	On advice from	Phase	When/Where	Status and further information for the 2017–20 triennial reporting period
688: M 5-2 3	Compliance audit and performance review	The proponent shall submit a performance review report by 1 December each year and more detailed reports by 1 February every three years, to the requirements of the EPA, which address: 3. stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed	The performance review will address: 3. stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed. Comply with commitments in Ministerial statement 688: P 7, 9, 10, 11, 16, and 17.	Compliance report.	CEO		Overall	By 1 December each year and more detailed reports by 1 February every three years.	**Compliant.** Detailed in this report. Over the triennial reporting period, the Jandakot Community Consultative Committee (JCCC) met on: • 12 October 2017 • 11 October 2018 • 24 October 2019 and discussed the environmental management of abstraction from the Jandakot groundwater system.
688: M 5-2 4	Compliance audit and performance review	The proponent shall submit a performance review report by 1 December each year and more detailed reports by 1 February every three years, to the requirements of the EPA, which address: 4. proposed environmental management over the next three years to comply with conditions and environmental objectives set for the proposal.	The performance review will address: 4. proposed environmental management over the next three years to comply with conditions and environmental objectives set for the proposal.	Compliance report.	CEO		Overall	By 1 December each year and more detailed reports by 1 February every three years.	**Compliant.** The department is continuing to review and refine its environmental management of Jandakot groundwater resources using results from environmental monitoring and hydrogeological investigations (see section 6).
688: M 5-3	Compliance audit and performance review	The proponent shall make the reports required by condition 5-2 publicly available, to the requirements of the EPA.	Available on Department of Water and Environmental Regulation's website:	Reports made available on the Department of Water and Environmental Regulation website: <www.dwer.wa.gov.au>	CEO		Overall	After OEPA acknowledge-ment letter being received. Department of Water and Environmental Regulation's website.	**Compliant.** Jandakot annual and triennial compliance reports are available.
688: M 5-4	Compliance audit and performance review	The proponent shall report any breach or anticipated breach of the environmental criteria set out in tables 1 and 2 (attached to *Ministerial statement 688*) or environmental objectives to the OEPA immediately it becomes evident to the proponent.	Report in regular summaries sent to the Chief Executive Officer of the EPA.	Letter to the Chief Executive Officer of the EPA reporting non compliances with water level and other criteria as required. Compliance report.	CEO		Overall	Immediately as it becomes evident.	**Compliant.** The department informs the EPA of non-compliance with criteria water levels and other criteria in annual and triennial compliance reports.

Audit code	Subject	Action	How	Evidence	Require-ment of:	On advice from	Phase	When/Where	Status and further information for the 2017–20 triennial reporting period
688: M 6-1	Management plan	The proponent shall implement the Environmental Management Plan prepared by the Water Authority of Western Australia (1992) to the requirements of the EPA.	Comply with environmental objectives and criteria listed in WAWA EMP (1992).	Compliance report	EPA		Overall		**Completed.** The condition to implement the requirements set out in the Environmental Management Plan is met by following and meeting the commitments in *Ministerial statement no. 688*. The Environmental Management Plan was submitted to the former Department of Environment and Conservation (now DBCA) in 1992 and since then there have been a number of amendments to Ministerial conditions relating to the plan. The department considers the implementation of the Environmental Management Plan an ongoing commitment. From 2005 onwards the former Department of Environment and Department of Water, now the department, is demonstrating its implementation through the annual/triennial compliance reports to the EPA. Implementation is reported as: • compliance with water level and other criteria • predictions of non-compliance with water level criteria • reporting on proponent and Ministerial conditions/commitments (audit tables) • implementation of the environmental monitoring program (required under other conditions).
688: M 7-1	Groundwater allocations	The proponent shall inform the EPA immediately of any proposed changes to allocations, abstraction limits and licence or allocation periods.	Detail limits on availability on the Department of Water and Environmental Regulation's website. Detailed in annual/triennial reports.	Reports made available on the Department of Water and Environmental Regulation's website: <www.dwer.wa.gov.au>	Minister for the Environment		Overall		**Compliant.** Changes to allocations, abstraction limits and licensing is documented in annual and triennial compliance reports. There has been limited change (mostly reductions in abstraction) over the past five years. The department's recent management focus has been an allocation limit review for the Jandakot groundwater area. The EPA will be consulted regarding changes that have resulted from the review.
688: M 8-1	Water conservation	The proponent shall actively encourage further reduction in public and private water demand in accordance with the State Water Strategy (2003) and other water conservation initiatives.	Engage in activity that supports water conservation.	Compliance reports	Minister for the Environment		Overall		**Compliant.** Section 5 outlines the management actions the department is taking to encourage further reduction in public and private water demand. Following extensive consultation with the irrigation industry as well as local government, the Department of Water developed and implements *Operational policy no. 1.2 – Policy on water conservation/efficiency plans* (DoW 2009a). The department's Water Recycling and Efficiency staff undertake projects to reduce water demand and achieve water conservation initiatives. This includes implementing the above policy and the permanent winter sprinkler ban.
688: M Procedure 1		Where a condition states 'to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority', the EPA will prepare the written notice to the proponent.	The EPA to provide written notice to the proponent (Department of Water) and Environmental Regulation.		Minister for the Environment		Overall		**Not required at this stage.**
688: M Procedure 2		The EPA may seek advice from other agencies or organisations, as required, in order to provide its advice.	The EPA to seek advice as required.		EPA	Other agencies as required	Overall		**Not required at this stage.**
688: M Procedure 3		Where a condition lists advisory bodies, it is expected that the proponent will obtain the advice of those listed as part of its compliance reporting to the EPA.	Department of Water liaises with advisory body as required.	Liaison with advisory body in compliance report	EPA	Agencies listed as part of compliance reporting	Overall		**Compliant.**

Table B2 The proponent's (Department of Water and Environmental Regulation's) environmental management conditions

Audit code	Subject	Objective	Action	How	Evidence	Require-ment of	On advice from	When/ Where	Status and further information for the 2017–20 triennial reporting period
688: P 1	Groundwater-dependent ecosystems	To protect significant environmental values.	Ensure that groundwater abstraction satisfies the environmental criteria presented in tables 1 and 2 (*Ministerial statement no. 688*).	Meet objectives and Environmental Water Provisions criteria presented in Tables 1 and 2 (*Ministerial statement no. 688*).	Compliance report	Minister for the Environment		Overall	**Non-compliant.** Groundwater abstraction has not satisfied the environmental criteria presented in Appendix A. Three sites were non-compliant with water level criteria in 2017–18 and four in 2018–19 and 2019–20. These include North Lake, Bibra Lake, Lake Forrestdale and Shirley Balla Swamp that have been consistently non-compliant with water level and other criteria. The department considered non-compliance and ecological condition at these sites in its review of allocation limits for the Jandakot (2014) and Cockburn (2021) groundwater areas. The department also considers non-compliance at these sites in distributing public supply abstraction and in licensing decisions for private use. Under the *Waterwise Perth Action Plan 2019* we are reviewing allocation limits in the Jandakot and Perth South groundwater areas.
688: P 2 1	Environmental management and monitoring	To minimise environmental and/or significant impact.	In the event that monitoring indicates that there will be significant impacts of a nature not predicted or indicates that a breach of the specified criteria has occurred or is likely to occur, then one or more of the following actions will be undertaken: 1. demonstrate to the satisfaction of the EPA that the breach of criteria is not a result of groundwater abstraction; or	Review of monitoring results, advice from expert hydrogeologists, groundwater modelling.	Compliance report See Condition 688: M 5-4	EPA		Overall	**Compliant.** The department annually predicts whether sites are likely to be non-compliant with water level criteria during the coming summer and reviews public water supply abstraction to limit impacts at potentially non-compliant sites.
688: P 2 2	Environmental management and monitoring	To minimise environmental and/or significant impact.	2. satisfy the EPA that the breach of a criterion is transient and not of permanent significance; or	Review of similar occurrence in the past and consequences from environmental monitoring results Advice from expert hydrogeologists.	Compliance report	EPA		Overall	**Non-compliant.** Water levels at a number of Ministerial sites (including North Lake, Bibra Lake, Lake Forestdale and Shirley Balla Swamp) are consistently non-compliant with water level and other criteria. The department considered non-compliance and ecological condition at these sites in its review of allocation limits for the Jandakot and Cockburn groundwater areas. The department also considers non-compliance at these sites in distributing public supply abstraction and in licensing decisions for private use. The department continues to review and update allocation limits in line with trends in climate. Under the *Waterwise Perth Action Plan 2019* we are reviewing allocation limits in the Jandakot and Perth South groundwater areas.

Audit code	Subject	Objective	Action	How	Evidence	Require-ment of	On advice from	When/ Where	Status and further information for the 2017–20 triennial reporting period
688: P 2 3	Environmental management and monitoring	To minimise environmental and/or significant impact.	3. take the following actions: a. modify pumping from any bore where such changes can have a measurable effect (say raise water levels 1 centimetre or more), except in extenuating circumstances such as where significant economic hardship would occur, or DBCA (formerly CALM) declare that the low water levels would be beneficial b. in the case of a wetland, artificially maintain the 'action minima' water level c. implement a short-term detailed monitoring program to establish the condition of agreed species in the affected area.	Implement actions as outlined.	Compliance report	EPA		Overall	**Compliant.** No new actions were required in the reporting period. As described in previous compliance reports, the department restricts Water Corporation abstraction from bores that impact on Ministerial sites and other groundwater-dependent ecosystems.
688: P 3	Water allocation	To minimise environmental and/or significant impact and manage the resource sustainability.	Regularly review the bulk allocations for private abstraction, as part of the total water abstraction allocation for the Jandakot PWSA, with regard to the sustainable yield of the superficial aquifer, including consideration of the environmental impacts of that abstraction.	Make part of Department of Water and Environmental Regulation's water allocation planning program.	Compliance report	EPA		Overall	**Compliant.** The department's recent management focus was refining the allocation limits in the Jandakot (2014) and Cockburn groundwater areas (2021). This work considered licensed entitlements for both private and public abstraction. Under the *Waterwise Perth Action Plan 2019* we are reviewing allocation limits in the Jandakot and Perth South groundwater areas. The Cockburn allocation plan was released in January 2021 (DWER 2021). It is the first Action 14 deliverable under *Waterwise Perth Action Plan 2019*.
688: P 4	Water allocation	To minimise environmental and/or significant impact and manage the groundwater resource sustainability.	Restrict the issuing of licences for private abstraction to the limits set by the bulk allocations for both the Jandakot PWSA in its entirety and the licensing subareas.	Set sub-area groundwater allocation limits to values equal to or less than those set for the Jandakot PWSA.	Compliance report	EPA			**Compliant.** The department's recent management focus was refining the allocation limits in the Jandakot and Cockburn groundwater areas.
688: P 5	Water allocation	Provide up-to-date mechanisms for groundwater allocation.	Investigate and implement efficient mechanisms for groundwater allocation.	Incorporate in regular Department of Water and Environmental Regulations' allocation work program.	Compliance report	EPA			**Compliant.** The department's recent management focus was refining the allocation limits in the Jandakot and Cockburn groundwater areas. This work used contemporary methods for determining sustainable limits for use in the decision-making process for the new allocation limits.
688: P 6	Groundwater protection	To minimise environmental and/or significant impact and manage the groundwater resource sustainability.	Assist the EPA in the development of environmental protection policies to protect groundwater.	Liaise with the EPA as required	Compliance report	EPA			**Not required at this time.**

Audit code	Subject	Objective	Action	How	Evidence	Require-ment of	On advice from	When/ Where	Status and further information for the 2017–20 triennial reporting period
688: P 7	Groundwater protection	Integrated land and water resource planning to minimise environmental and/or significant impact.	Participate in the review of regional plans proposed by the Department of Planning, Lands and Heritage (formerly Department for Planning and Infrastructure), local government town planning schemes, and rezoning and development applications.	Liaise with local government, the Department for Planning, Lands and Heritage, and other relevant land-use planning agencies.	Compliance report	EPA			**Compliant.** The department assesses land use proposals with potential water resource issues referred from local and State Government agencies. In partnership with the then Department of Planning and other agencies, the department helped develop *Better urban water management* (WAPC 2008), a framework for land use planning assessments. The department also produced the *Jandakot drainage and water management plan* (DoW 2009b), which aims to assist land developers and local government to better manage groundwater quantity and quality in the area. The department recently provided advice on the *Southern Metropolitan and Peel sub-regional structure plan – Regional water management strategy,* which identifies water-related constraints and opportunities associated with proposed urban and industrial areas.
688: P 8	Groundwater protection	Integrated land and water resource planning to minimise environmental and/or significant impact.	Participate in the review of development submissions to the EPA.	Provide advice to the EPA as requested.	Compliance report See 688: P 7	EPA			**Compliant.** See the status of 688: P 7.
688: P 9	Groundwater protection	Integrated land and water resource planning to minimise environmental and/or significant impact.	Work with the Department of Planning, Lands and Heritage (formerly Department for Planning and Infrastructure), to prepare an integrated Land Use and Water Management Strategy for the Jandakot Mound.	Liaise with the Department of Planning, Lands and Heritage to prepare an integrated Land Use and Water Management Strategy for the Jandakot Mound.	Compliance report	EPA			**Compliant.** The department produced the *Jandakot drainage and water management plan* (DoW 2009c), which aims to assist land developers and local government to better manage groundwater quantity and quality in the area. With the then Department of Planning and other agencies, the department has produced the *Better urban water management* publication (WAPC 2008). The department recently provided advice on the *Southern Metropolitan and Peel sub-regional structure plan – Regional water management strategy,* which identifies water-related constraints and opportunities associated with proposed urban and industrial areas.
688: P 10	Water conservation	Water conservation.	Actively pursue programs in both supply and demand management. This includes ongoing public information programs and, where appropriate, regulation for design changes and regular reviews of pricing to conserve water. Improvements in the Water Corporation's supply system will also be pursued.	Engage in activity that supports water conservation. Development of a policy on water conservation plans.	Compliance report	EPA			**Compliant.** Section 6.2 outlines the actions the department is taking to manage supply and demand, and support water conservation.
688: P 11	Groundwater protection	Integrated land and water resource management to minimise environmental and/or significant impact.	Actively participate in integrated management of the Jandakot catchment.	Liaise with other water and land-use agencies.	Compliance report	EPA			**Compliant.** The department liaises with other water and land-use agencies to integrate management of the Jandakot catchment, including Water Corporation, the EPA and the Western Australian Planning Commission. For example, the department prepared the *Jandakot drainage and water management plan* for the WAPC Jandakot structure plan area (see 688: P 9) with some modelling assistance from Water Corporation.
688: P 12	Environmental management and monitoring	Environmental management of groundwater abstraction is based on best available scientific knowledge.	Review and revise the management criteria and strategies, with the agreement of the EPA, as knowledge of the Jandakot environment and its interaction with groundwater improves.	Stage 1 and 2 Section 46 review supported by scientific research results.	Compliance report	EPA	EPA		**Compliant.** Stage I Section 46 (DoE 2005) is complete and a number of changes were supported by the EPA (refer Bulletin 1155). Stage II Section 46 work has concentrated on the Gnangara Mound area because of priorities. The department's recent management focus was refining the allocation limits in the Jandakot and Cockburn groundwater areas.

Audit code	Subject	Objective	Action	How	Evidence	Require-ment of	On advice from	When/ Where	Status and further information for the 2017–20 triennial reporting period
688: P 13	Environmental management and monitoring	Monitor compliance with Ministerial water level criteria. Management of groundwater levels to protect environmental values of select wetlands.	Monitor water levels in groundwater monitoring bores and North, Bibra, Yangebup, Kogolup, Thomsons and Forrestdale lakes, and The Spectacles and Twin Bartram Swamp, as well as some other small wetlands.	Include in Department of Water regional groundwater monitoring program.	Compliance report Hydrographs available on the Department of Water and Environmental Regulation's website: <www.dwer.wa.gov.au> See 688: P 14	EPA			**Compliant.** Detailed in this report, refer to the results given in Appendix A. Wetlands were included in the department's Jandakot Environmental Monitoring Program referred to the EPA in December 2005 (see 688: P 14). Hydrographs of Ministerial wetland and terrestrial vegetation sites are available on the department's website.
688: P 14 1	Environmental management and monitoring	Provide a means for the assessment of compliance with Ministerial environmental criteria for the Jandakot Mound.	1. Prepare an environmental monitoring program for submission to the EPA for review and subsequent finalisation of the program to the satisfaction of the EPA. The monitoring program will include: • monitoring of groundwater levels in all relevant aquifer systems • relevant wetland water levels and water quality • condition of vegetation and fauna associated with groundwater-dependent ecosystems.	Prepare an environmental monitoring program.	Submit monitoring program to the EPA for approval Compliance report	EPA	DBCA (formerly DEC)	Within four months of a revised statement being issued following the 2004 Stage 1 section 46 review	**Compliant.** The department's monitoring program includes: • groundwater levels in all relevant aquifer systems • relevant wetland water levels and water quality • condition of vegetation and fauna associated with groundwater-dependent ecosystems. The previous environmental monitoring program was submitted to the EPA on 21 December 2005. It was detailed in Appendix 7 of the Gnangara triennial report for 2003–06 (DoW 2007). The EPA's audit of the 2006–07 compliance report agreed that the commitment could be 'cleared' upon confirmation from the then DEC. The department reviewed the environmental monitoring program in June 2009 with the monitoring ecologists (see Appendix D). A number of amendments were made. A letter was sent to the Director General of the then DEC in December 2009, seeking advice and input on the amendments.
688: P 14 2	Environmental management and monitoring	To enable assessment of compliance with Ministerial environmental criteria for the Jandakot Mound.	2. Implement the approved environmental monitoring plan	Make part of annual departmental work program	Compliance report	EPA	DBCA (formerly DEC)		**Compliant.** A summary of the results of the environmental monitoring over the reporting period (2017–20) is reported in Section 5.1. The department used these results to distribute public supply abstraction to limit environmental impacts and inform licensing decisions for private use. The department has also considered the results in its review of allocation limits in the Jandakot and Cockburn groundwater areas.
688: P 14 3	Environmental management and monitoring	Monitoring program is a reflection of the best available knowledge of groundwater/environment interaction.	3. Review and revise the program every six years (coinciding with triennial reports), to the satisfaction of the EPA.	Incorporate review in triennial reporting in 6 year intervals.	Triennial compliance report	EPA	DBCA (formerly DEC)	Every six years (coincides with triennial report)	**Compliant.** The department reviewed the environmental monitoring program in June 2009 with the monitoring ecologists (see Appendix D). A number of amendments were made. A letter was sent to the Director General of the then DEC in December 2009, seeking advice and input on the amendments.
688: P 15	Environmental management and monitoring	Monitor habitat shifts in conjunction with the assessment of potential impacts on environmental values from groundwater abstraction on the Jandakot Mound.	Use aerial photographs or equivalent on a triennial basis to detect habitat shifts in North Lake, Yangebup, Kogolup, Thomsons and Forrestdale lakes.	Aerial photographs not an effective method. Instead the department focuses on field surveys of vegetation transects.	Triennial compliance report	EPA		Every three years (coincides with triennial report)	**Non-compliant.** The department has not used aerial photographs over the triennial reporting period to detect habitat shifts at North Lake, Yangebup, Kogolup, Thomsons and Forrestdale lakes. However, there may be limited value using aerial photos solely as a diagnostic tool. This was recognised and the commitment was modified in Bulletin 1155. The department does monitoring at established transects annually at each of these wetland sites. This monitoring identifies shifts in habitat. The department also commissioned Edith Cowan University to develop a model for determining ecological risk to groundwater-dependent vegetation in a drying climate. The model is based on 30 years of ecological and hydrological monitoring data. It will be an important management tool for assessing risk to groundwater-dependent vegetation (including likely habitat shifts) under different climate and abstraction regimes.

Audit code	Subject	Objective	Action	How	Evidence	Require-ment of	On advice from	When/ Where	Status and further information for the 2017–20 triennial reporting period
688: P 16	Community consultation	Inform major stakeholders of Department of Water and the Water Corporation activities on the Jandakot Mound. Provide mechanism for feed-back.	Hold meetings at least annually with the Jandakot Community Consultative Committee (JCCC) established in consultation with the EPA. This committee will be informed on the groundwater scheme's operation and will provide feed-back to the proponent.	Department of Water to organise JCCC meetings.	Compliance report	EPA			**Compliant.** Detailed in this report. Over the triennial reporting period, the Jandakot Community Consultative Committee (JCCC) met on: • 12 October 2017 • 11 October 2018 • 24 October 2019 and discussed the environmental management of abstraction from the Jandakot groundwater system.
688: P 17	Community information	Maintain good public image and up-to-date knowledge of community concerns of water resource issues.	Continue to monitor community response to relevant water resource issues as reported by the media and maintain the current practice of public accessibility of WRC staff. Upon request and adequate notice, staff will address community groups on issues associated with groundwater management.	Monitor media for relevant issues. Address community groups as requested.	Compliance report	EPA			**Compliant.** The department subscribes to the 'Media Portal' which forwards water-related newspaper articles to department employees so they are kept informed. The department's staff are involved in conferences, meetings and workshops that include community group representation (e.g. JCCC meetings).
688: P 18	Environmental management and monitoring	Improved environmental monitoring facility at this significant wetland.	Install monitoring wells and improved wetland water level monitoring facilities for Forrestdale Lake, and evaluate monitoring data to determine groundwater/wetland water level relationship. Subject to DBCA/DWER (formerly CALM/WRC) installing permanent vegetation monitoring transect and undertaking flora and fauna studies to establish environmental values, the proponent will review available information to propose revised management criteria, if appropriate.	Addressed as part of the Department of Water and Environmental Regulation's completed project – 'Perth shallow groundwater systems investigation'.	Compliance report	EPA			**Compliant.** The department installed groundwater monitoring bores at Lake Forrestdale (Bourke 2008) and North Lake (Searle 2009) as part of the Perth shallow groundwater systems investigation. The Spectacles and Thomsons Lake were also included (Searle 2009) with sampling done at existing bores. The department is evaluating monitoring data at these wetlands to determine the groundwater–wetland water level relationship.
688: P 19	Environmental management and monitoring	Enable good water resource management including environmental protection on the Jandakot Mound.	1. Prepare a Management and Monitoring Program. 2. Implement the Management and Monitoring Program.	Prepare Management and Monitoring Program and submit to EPA.		EPA		Completed	**Completed.** This commitment was required before commissioning the Stage 2 scheme. Stage 2 was in operation for more than 10 years and the implementation of the management and monitoring program is described in numerous annual and triennial compliance reports. In addition, following publication of *Ministerial statement no. 688*, a revised monitoring program was developed and submitted to EPA (refer Commitment 688: P 14) in December 2005.
688: P 20	Environmental management and monitoring	Improve understanding of groundwater/wetland ecology relationships	Continue to fund the research projects 10.6.3 listed in Appendix 2 of the EPA Bulletin 587 for the duration of the studies.	Include research projects in annual business planning.		EPA		Completed	**Completed.** Auditor's comments in the 2003–04 annual report state that the commitment can be 'cleared'. Research projects given in Appendix C (Table A12.2) of EPA *Bulletin 587* refer to commitments given in numbers 21, 22, and 23 below.
688: P 21	Environmental management and monitoring	Improve understanding of aquatic fauna of the select Jandakot wetlands.	Develop a fauna monitoring program which will focus on: 1. waterbird species diversity and breeding success 2. the number of families of aquatic invertebrate and, at infrequent intervals, species richness.	Develop a fauna monitoring program.		EPA	DBCA (formerly CALM)	Completed	**Completed.** Auditor's comments in the 2003–04 annual report agreed such a program had been developed and implemented before commissioning the Stage 2 scheme and that the commitment can be 'cleared'. A fauna monitoring program was developed and implemented. The results are presented in numerous annual and triennial reports to date.
688: P 22	Environmental management and monitoring	Improve understanding of the environmental significance of this wetland and means of protecting values.	Undertake study of Banganup Lake, in conjunction with DBCA (formerly CALM) and The University of WA to establish management criteria and consider effectiveness of artificial maintenance of water levels.	Undertake a study of Banganup Lake as described.		EPA	CALM	Completed	**Completed.** The study was completed and Auditor comments in 2003–04 annual report states that the commitment can be 'cleared'.

Audit code	Subject	Objective	Action	How	Evidence	Require-ment of	On advice from	When/ Where	Status and further information for the 2017–20 triennial reporting period
688: P 23	Environmental management and monitoring	Improve understanding of the environmental significance of this wetland and means of protecting values.	Undertake a study of Twin Bartram Swamp to consider the feasibility and effectiveness of artificial maintenance of water levels.	Undertake a study of Twin Bartram Swamp as described.		EPA	CALM	Completed	**Completed.** The study was completed and Auditor's comments in 2003–04 annual report state that the commitment can be 'cleared'.

Appendix C — History of Ministerial statements for the Jandakot Mound

In 1988, the former Water Authority of Western Australia (WAWA) referred plans for the construction of Stage 2 of the Jandakot groundwater scheme to the Environmental Protection Agency (EPA). The EPA completed a Public Environmental Review level of assessment of the proposal. In 1992, the Minister for the Environment issued a statement (EPA Bulletin 587, *Ministerial statement no. 253 – Assessment 196)* advising that the proposal could be implemented subject to conditions and commitments imposed on the WAWA. Most of the conditions and commitments related to ensuring that groundwater and surface water levels across the Jandakot Mound are maintained at acceptable levels.

A key element of *Ministerial statement no. 253* was that it confirmed environmental water provisions to maintain environmental values on the Jandakot Mound. These were set in the form of water level criteria to be achieved in key wetlands and other groundwater-dependent ecosystems, such as areas of phreatophytic vegetation.

In 2001, as a consequence of changes in land use and lower rainfall, the EPA endorsed a two-stage approach to review the Ministerial conditions and commitments for the Gnangara and Jandakot mounds under section 46 of the *Environmental Protection Act 1986*. The first stage of the section 46 review was for the department (then the Department of Environment) to review Ministerial conditions and commitments on Gnangara and Jandakot based on existing knowledge (DoE 2005). This review led to *Ministerial statement no. 687* for Gnangara (Government of Western Australia 2005b) and *Ministerial statement no. 688* for Jandakot (Government of Western Australia 2005a).

The department further reviewed Ministerial conditions and commitments on Gnangara in 2007 (DoW 2008). The purpose of this review was to refine Ministerial criteria sites to those with significant ecological value and those where abstraction is the main factor influencing groundwater levels. This review led to the *EPA Bulletin 1324* in May 2009, which recommended changes to the Minister for Environment. *Ministerial statement no. 819* for Gnangara (Government of Western Australia 2009) was released later that year including the consolidated and refined conditions and commitments.

The second stage of the section 46 review was proposed as a more comprehensive review to improve how the department manages public and private abstraction and to incorporate ecological information using the results of work underway at the time. This stage was later improved by more recent investigations into the shallow groundwater systems and ecological responses to climate.

For Gnangara, the second stage review will occur as part of the work associated with the next Gnangara groundwater allocation plan, due for release as a draft for public comment in late 2018. For Jandakot, the department will use the analysis of recent

work to focus management efforts in the areas that will most benefit from changes to abstraction.

Appendix D – Review of the environmental monitoring program (688: P 14 1)

In mid-2009, the department started a series of workshops to review the current environmental monitoring with the ecologists contracted to do the work. The workshops aimed to improve both the effectiveness and efficiency of the environmental monitoring program.

The initial review of the environmental monitoring program:

- refocused the program on the relationships between groundwater levels, ecological condition and abstraction
- improved efficiency by reducing the monitoring frequency from annually to every three years, unless annual monitoring is warranted on a management or information-needs basis
- improved the presentation and communication of monitoring data.

The second review workshop, held in late April 2010, considered two key issues:

- how monitoring results could be presented spatially so that it represents short-term and long-term trends across an entire groundwater management area
- how modelling results could be used to ensure the monitoring effort is focused on the correct areas in the long-term.

The three main outcomes and recommendations from this second workshop were that:

- future monitoring programs should include sites where ecological health and compliance can be improved through managing abstraction (based on modelling)
- the department can make a difference to important areas on the Jandakot Mound by managing abstraction – even minor benefits to groundwater levels can be significant for certain groundwater-dependent ecosystems
- where possible, abstraction should be reduced in areas where it would benefit wetlands that still retain some of their key environmental values.

Another review workshop was held in 2013 to further refine the frequency of the monitoring program.

References

Bates BC, Chandler RE, Charles SP & Campbell EP 2010, 'Assessment of apparent nonstationary in time series of annual inflow, daily precipitation, and atmospheric circulation indices: A case study from southwest Western Australia', *Water Resources Research, vol. 46*, W00H02, doi:10.1029/2010WR009509.

Bennelongia Environmental Consultants 2018, *Jandakot Wetland Monitoring, annual report 2017*, Prepared for the Department of Water and Environmental Regulation, Perth.

Bennelongia Environmental Consultants 2019, *Jandakot Wetland Monitoring, annual report 2018*, Prepared for the Department of Water and Environmental Regulation, Perth.

Bennelongia Environmental Consultants 2020, *Jandakot Wetland Monitoring, annual report 2019*, Prepared for the Department of Water and Environmental Regulation, Perth.

Bourke SA 2008, *Bore completion report for Perth shallow groundwater systems: investigation – stage 1*, Hydrogeology Report no. HR 266, Department of Water, Government of Western Australia, Perth.

Buller G, Kavazos C & Froend R 2018, *Wetland Vegetation Monitoring 2017 Survey of Jandakot Wetlands*, Prepared for the Department of Water and Environmental Regulation, May 2018.

Buller G, Kavazos C & Froend R 2019, *Wetland Vegetation Monitoring 2018 Survey of Jandakot Wetlands*, Prepared for the Department of Water and Environmental Regulation, May 2018.

Buller G, Kavazos C & Froend R 2020, *Wetland Vegetation Monitoring 2019 Survey of Jandakot Wetlands*, Prepared for the Department of Water and Environmental Regulation, March 2020.

Department of Environment 2005, *Section 46 review of environmental conditions on management of the Gnangara and Jandakot Mounds: Section 46 progress report – State of the Gnangara Mound*, Department of Environment, Government of Western Australia, Perth.

DoE – see Department of Environment

Department of Water 2007, *Environmental management of groundwater allocation from Gnangara groundwater mound – triennial compliance report to the Environmental Protection Authority, July 2003–June 2006*, Department of Water, Government of Western Australia, Perth.

——2008, *Review of Ministerial conditions on the groundwater resources of the Gnangara Mound*, Department of Water, Government of Western Australia, Perth.

——2009a, Operational policy no. 1.2 – Policy on water conservation and efficiency *plans: Achieving water use efficiency gains through water licensing*, Department of Water, Government of Western Australia, Perth.

——2009b, *Jandakot drainage and water management plan,* Department of Water, Government of Western Australia, Perth.

DoW – see Department of Water

Department of Water and Environmental Regulation 2021*, Cockburn groundwater areas allocation plan*, Department of Water and Environmental Regulation, Government of Western Australia, Perth.

DWER – see Department of Water and Environmental Regulation

Government of Western Australia 2005a, *Ministerial statement no. 688: Jandakot Mound groundwater resources*, Government of Western Australia, Perth.

Government of Western Australia 2005b, *Statement to amend conditions applying to proposals – Gnangara Mound groundwater resources, Ministerial Statement 687*, Minister for Environment, Government of Western Australia, Perth.

Maher K & Davis J 2009, *Ecological Character Description for the Forrestdale and Thomsons Lakes Ramsar Site*, A report to the Department of Environment and Conservation, Murdoch University, Perth.

Syrinx Environmental PL 2020, *Jandakot triennial terrestrial vegetation monitoring 2019*. Report no. RPT-1329-003 V3 for the Department of Water and Environmental Regulation, Syrinx Environmental PL, Perth.

Western Australian Planning Commission 2008, *Better urban water management*, Government of Western Australia, Perth.

WAPC – see Western Australian Planning Commission

Department of Water and Environmental Regulation
Prime House 8 Davidson Terrace
Joondalup WA 6027

Phone: 08 6364 7000
Fax: 08 6364 7001
National Relay Service 13 36 77
dwer.wa.gov.au

22230610-2