



Government of **Western Australia**
Department of **Water**

Gingin

groundwater allocation plan



Securing Western Australia's water future

Water resource allocation
and planning report series
Report no 53
March 2015



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Department of Water

168 St Georges Terrace

Perth Western Australia 6000

Telephone +61 8 6364 7600

Facsimile +61 8 6364 7601

National Relay Service 13 36 77

www.water.wa.gov.au

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For more information about this report, contact:
Regional Manager at the Swan–Avon regional office
Department of Water
7 Ellam Street, Victoria Park, Western Australia 6100
Telephone: (08) 6250 8000
Facsimile: (08) 6250 8050

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Message from the Minister



Groundwater use in the Gingin area is continuing to grow with high demand, particularly from irrigated agriculture and for mining and urban growth.

New horticulture, tree crop, stock fodder and bio-energy industries are also looking to coastal wheatbelt locations in the Gingin plan area for expansion opportunities.

This water allocation plan has been developed to meet the current and future needs of the region by ensuring allocated volumes are within margins that will support long-term sustainability of supply.

The plan takes into account the lower than average rainfall pattern in the region, increased understanding of groundwater resources, as well as data from surface and groundwater monitoring networks. Applying this information to management is the best way to maintain the resource for reliable use.

There are significant fresh groundwater resources across the five shires in the Gingin groundwater allocation plan area. The plan shows how these valuable resources will be allocated and licensed by the Department of Water to provide water security for a range of users.

The plan has been developed with extensive stakeholder consultation to incorporate the needs and aspirations of the community for a diverse and productive region, as well as the establishment of new water trading zones which will provide additional flexibility to local businesses. It also recognises and appreciates the relationship between groundwater and many of the region's wonderful natural features like Gingin Brook and Moore River.

The Department of Water is committed to finding new opportunities for water to support growth. An 18 month, \$4.5 million groundwater investigation in the north Gingin area is underway to help us continue to make the best use of the region's water resources into the future.

I want the communities that rely on the area's groundwater to continue to flourish and I thank everyone who has helped shape this plan to achieve that goal.

A handwritten signature in black ink, reading 'M Davies', with a stylized flourish at the end.

Hon Mia Davies, MLA
Minister for Water

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Summary

Gingin groundwater allocation plan

Purpose of the plan

The Department of Water is responsible for regulating and managing the state's water resources for sustainable productive use. This plan sets out how we will manage groundwater in the Gingin plan area through allocation limits, water licensing and ongoing monitoring and evaluation until at least 2020.

The *Gingin groundwater allocation plan* replaces *Managing the water resources of the Gingin groundwater area, WA-interim sub-regional allocation strategy* (WRC 2002). The effects of drying climate on the plan area have become apparent since the release of the 2002 strategy. Reduced rainfall and lower groundwater recharge has resulted in declining groundwater levels in many aquifers and is also contributing to declining baseflow in the Gingin Brook and Moore River.

This plan has been developed to manage groundwater resources in the Gingin plan area in the context of the drying climate as well as the high levels of demand. The updated allocation limits and the licensing rules in the plan will maintain the reliability of groundwater for productive use and reduce the risks to the groundwater-dependent environment. The plan further supports development in the area by indicating the amount of water that can reliably be abstracted and by establishing new water trading zones.

This plan complements the department's management of both surface water resources in Gingin and the Gnangara groundwater system. Management of these highly connected systems is described in the *Gingin surface water allocation plan* (DoW 2011a) and *Gnangara groundwater areas allocation plan* (DoW 2009).

Summary

Water availability in the Gingin plan area

Water is still available for new or increased entitlements in 29 out of the 35 resources in the Gingin plan area.

Subarea	Aquifer	Allocation limit (ML/yr)	Water available*
Beermullah Plain North	Superficial	6500	Yes
Bindoon	Surficial	2400	Yes
Eclipse Hill	Superficial	1050	No
	Surficial	3000	Yes
Gingin Townsite	Superficial	920	Yes
	Surficial	5000	Yes
Guilderton North	Superficial	6500	No
Karakin Lakes	Superficial	17 000	Yes
Lancelin	Superficial	21 000	Yes
Moora	Surficial	800	Yes
Namming Lake	Superficial	10 500	Yes
	Surficial	300	Yes
North Moore River Park	Superficial	12 900	Yes
Red Gully	Superficial	750	No
	Surficial	5600	Yes
Seabird	Superficial	17 000	Yes
South Moore River Park	Superficial	7500	Yes
Victoria Plains	Surficial	4400	Yes
Wedge Island	Superficial	58 500	Yes
	Surficial	3000	Yes
Central Coastal	Leederville	2800	No
Northern Coastal	Cattamarra Coal Measures	250	Yes
	Lesueur Sandstone	1700	Yes
	Leederville	4100	Yes
Southern Coastal	Leederville	1000	Yes
Central Scarp	Mirrabooka	1500	Yes
	Fractured Rock	50	Yes
Northern Scarp	Mirrabooka	3700	Yes
	Fractured Rock	50	Yes
Southern Scarp	Mirrabooka	800	No
	Fractured Rock	50	Yes
Cowalla	Leederville-Parmelia	19 000	No
Cataby	Yarragadee	13 000	Yes
Wannamal	Yarragadee	1300	Yes
Chandala	Yarragadee	1050	Yes
Total		234 970	

* Water availability for licensing changes from time to time. Please check the Department of Water's Water Register www.water.wa.gov.au or contact our Swan-Avon regional office for up-to-date information on the volume of water available for licensing.

Allocation and licensing approach for the Gingin plan area

The department will issue groundwater licences up to the allocation limits using the licensing rules set out in Chapter 4. Once allocation limits are reached, water users may be able to access supplementary groundwater through trading. The plan establishes three trading zones in the Leederville–Parmelia subarea. To prevent further groundwater declines, trades within the Leederville–Parmelia that reduce abstraction from the southern zone are preferred.

The department has also reserved water for future regional water supply needs, and as a future supply option for Perth. These reserves may be accessed for other purposes on a temporary basis.

The department may require applicants seeking to take groundwater from the Mirrabooka aquifer to submit additional hydrogeological information, including lithology and bore logs. This information will be used to assess whether the proposed abstraction is likely to reduce the baseflow in the Gingin Brook and Moore River.

Where resources are over-allocated, the department will recoup unused water entitlements. We will not re-allocate recouped entitlements in over-allocated subareas.



Chapter One

Plan purpose and scope

1.1 Purpose of the plan

The *Gingin groundwater allocation plan* (plan) is the Department of Water's response to the drying climate and high abstraction of the water resources in the Gingin groundwater area. The plan has been developed to reduce the likelihood of:

- decreasing reliability of current licensed entitlements
- further declines in groundwater levels and pressure heads
- decreasing groundwater contribution (baseflow) to Gingin Brook and Moore River
- damage to, and loss of, important groundwater-dependent ecosystems
- the seawater interface moving inland, making groundwater saline.

The department will manage these risks by using the allocation limits, licensing rules and the monitoring program established in this plan. The allocation limits in this plan replace those established in 2002 in the interim sub-regional allocation strategy - *Managing the water resources of the Gingin groundwater area, WA-interim sub-regional allocation strategy* (WRC 2002).

This new plan also helps current and future licensees in the area by defining the volume of water that can be abstracted reliably, updating the amount of water reserved for public supply and introducing new water trading zones where water availability is currently limited.

The plan is accompanied by the *Gingin groundwater allocation plan methods report* (DoW 2015a), which describes the data and approach we used when making allocation decisions for this plan.

Changes and new information since the 2002 interim strategy

Similar to other parts of the state's south-west, the plan area is being affected by a drying climate trend. In the southern portion of the plan area, mean annual rainfall has dropped by 15 per cent, to 618 mm/yr, from the long-term mean of 727 mm/yr.

Data from the department's monitoring bores have shown that the aquifers in the plan area are responding differently depending on the amount of recharge they are receiving and the amount of groundwater that is being abstracted. Groundwater levels in the superficial aquifer in the Wedge Island subarea have declined by up to 4 m since 1997. In other subareas, the groundwater levels in the superficial aquifer are relatively stable. In parts of the north east of the plan area, levels have increased by up to 2 m. Pressure heads in the southern portion of the deeper Yarragadee and Leederville–Parmelia aquifers have declined more than 4 m since 1997.

Currently, agricultural and horticultural industries are the main groundwater users in the plan area, accounting for about 85 per cent of licensed entitlements. Since the 2002 interim strategy was released, licensed water entitlements have increased by 34 GL/yr (from 106 to 140 GL/yr).

The department's recent investigations have confirmed that groundwater discharge provides baseflow to the Gingin Brook from the Superficial, Mirrabooka, Leederville and Leederville–Parmelia aquifers (Tufts 2011). Groundwater declines in these aquifers are likely to have contributed to reduced flows in the Gingin Brook.

The department is currently installing bores to investigate the potential for the coastal aquifers (particularly the Leederville and Yarragadee aquifers) to become saline from the inland movement of the seawater interface.

In response to falling groundwater levels, resources in the Gingin groundwater area south of Gingin Brook were incorporated in the *Gnangara groundwater areas allocation plan* (DoW 2009). The department reduced allocation limits and capped use in these resources as a priority because of their hydrogeological connection to the Gnangara groundwater system and their influence on Gingin Brook and Moore River.

For further information on the department's approach for managing Gingin Brook's surface water resources and groundwater resources south of the Gingin Brook, refer to *Gingin surface water allocation plan* (DoW 2011a) and *Gnangara groundwater areas allocation plan* (DoW 2009).

1.2 Plan area

This plan area covers the proclaimed Gingin groundwater area north of Gingin Brook (Figure 1). The Gingin groundwater area was proclaimed on 26 September 1975 under section 26B of the *Rights in Water and Irrigation Act 1914*. This means that water users require a water licence to lawfully abstract groundwater under section 5C of the Act, unless exemptions apply.

The town of Gingin is close to the southern boundary of the plan area and is about 90 km north of Perth. The plan area covers about 6000 km² and extends between Guilderton and Bindoon in the south, to Grey and Moora in the north. The southern boundary of the plan area generally follows the Gingin Brook and Moore River.

1.3 Land use

The majority of the land use in the Gingin plan area is associated with irrigated agriculture and horticulture. Both industries have grown and diversified over the last decade. This trend is likely to continue with agricultural and horticultural ventures moving northwards from the Gnangara area due to increasing pressure from urban development. Accordingly, we expect the volume of water used for agricultural and horticultural production to increase over the next decade.

Moora has also been identified as a Specialist Food Centre in the government's Agricultural Policy. The department is currently working with Department of Agriculture and Food (DAFWA) to identify areas of high-value arable land and accessibility to water in these areas.

Water use from other industries (including mining) and urban/residential developments are also expected to increase during the life of the plan.

The Gingin plan area contains groundwater-dependent ecosystems that are at risk from declining groundwater levels. These include swamps, wetlands, areas of native vegetation and ecological systems that depend on river baseflow (refer to Section 3.4). There are large areas of nature reserve and national park, particularly west of the Brand Highway and along Indian Ocean Drive (Figure 1). These range from 2 km² in the Moora subarea (less than five per cent of subarea) to 175 km² in the South Moore River Park subarea (70 per cent of subarea).

For further information on land use and other factors considered in making allocation limit decisions, refer to the *Gingin groundwater allocation plan methods report* (DoW 2015a).

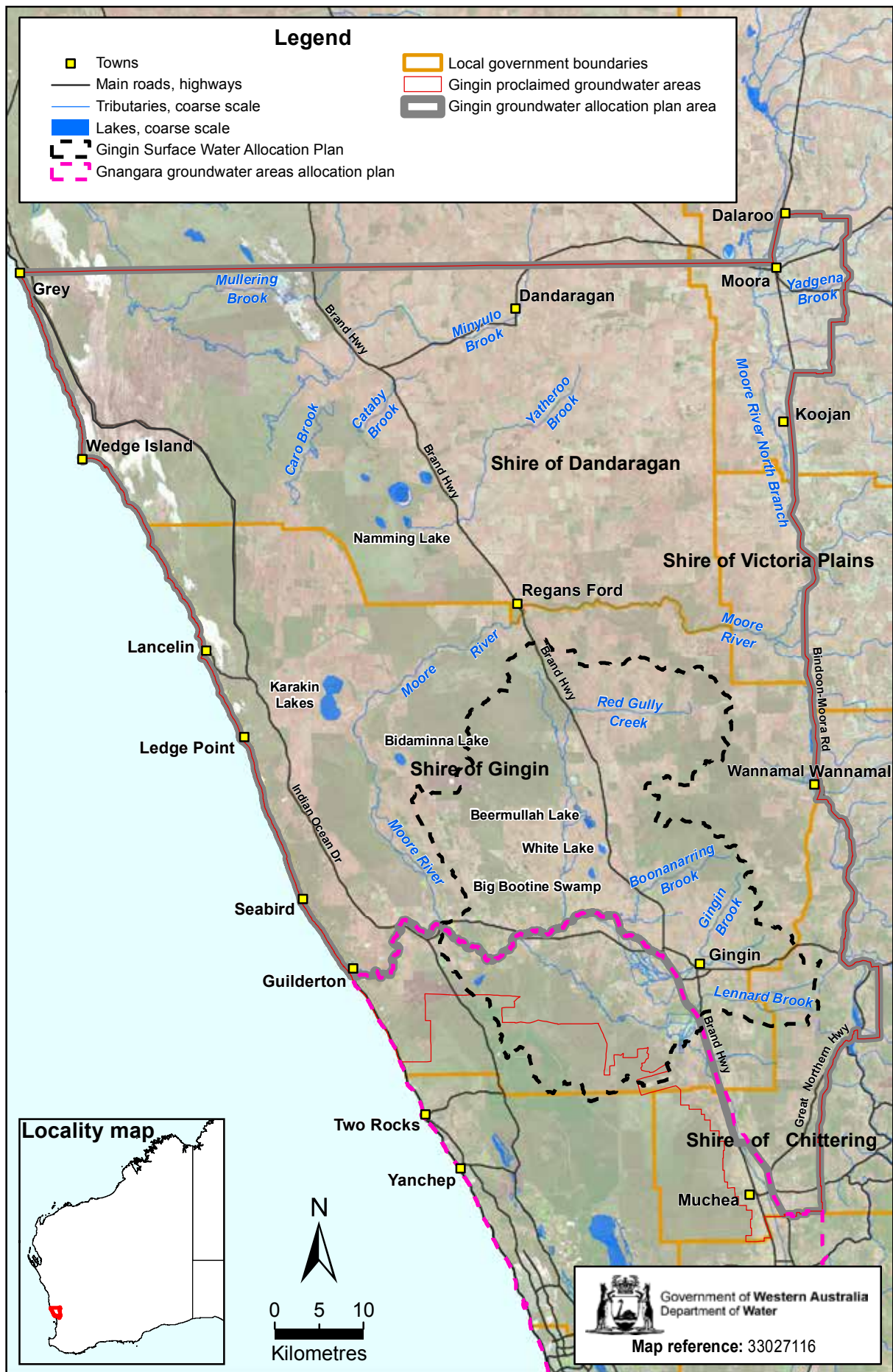


Figure 1
Gingin groundwater allocation plan area

Gingin groundwater allocation plan

1.4 Water resources covered

This plan applies to nine aquifers. The characteristics and location of these aquifers are listed in Table 1.

Table 1
Aquifers within the Gingin groundwater plan area

Aquifer	Description and notes	Location
Surficial	<ul style="list-style-type: none"> Extensive, patchy aquifer (sand, clay) Unconfined, thin and often unsaturated Generally fresh groundwater (<1000 mg/L TDS) Generally small bore yields (<100 kL/day) Supports groundwater-dependent ecosystems 	East of the Brand Highway–Figure 2
Superficial	<ul style="list-style-type: none"> Extensive and shallow aquifer (sand, gravel, clay) Unconfined with saturated thickness of up to 50 m Generally fresh groundwater (<1000 mg/L TDS) Moderate-to-good bore yields (up to 2000 kL/day) Groundwater levels tend to be deeper and more stable in coastal areas Inland, water tables are shallower, supporting groundwater-dependent ecosystems such as wetlands and remnant vegetation 	West of the Brand Highway–Figure 2
Mirrabooka	<ul style="list-style-type: none"> Partially unsaturated and highly variable thickness (sandstone, shale) Semi-confined aquifer Generally fresh groundwater (<1000 mg/L TDS) Highly variable yields Contributes to most of the summer flow in the headwaters of Gingin Brook including downstream of the Gingin town site to the confluence with Mungala Brook Important for maintaining summer flows in the Moore River 	Eastern parts of plan area–Figure 3
Fractured rock	<ul style="list-style-type: none"> Fractured and weathered crystalline bedrock Very variable water quality Low bore yields (<500 kL/day) Small groundwater storage capacity 	Eastern margins of the plan area, east of the Darling Scarp–Figure 3
Cattamarra	<ul style="list-style-type: none"> Sandstone and shale Groundwater is brackish-to-saline 	Small area in the northwest of the plan area–Figure 4

Table 1 (continued)
Aquifers within the Gingin groundwater plan area

Aquifer	Description and notes	Location
Lesueur	<ul style="list-style-type: none"> Mainly sandstone Groundwater is fresh-to-brackish 	Small area in the northwest of the plan area-Figure 4
Leederville	<ul style="list-style-type: none"> Deep aquifer (sandstone, shale), up to 550 m thick Semi-confined to confined aquifer Variable water quality, generally fresh groundwater (<1000 mg/L TDS) Good bore yields (up to 3000 kL/day) Provides baseflow to Gingin Brook downstream of Mungala Brook confluence Seawater interface is likely to be offshore 	South of Wedge Island and west of the Brand Highway-Figure 4
Leederville-Parmelia	<ul style="list-style-type: none"> Interconnected Leederville Formation and Parmelia Group (sandstone, shale) Semi-confined to the north becoming confined to the south Generally fresh groundwater (<1000 mg/L TDS) Good bore yields (up to 3000 kL/day) Recharged in north-eastern part of the Gingin groundwater area as well as in the Jurien and Arrowsmith groundwater areas Contributes to baseflow in headwaters of the Gingin Brook and downstream sections Important for maintaining summer flows in the Moore River 	East of the Brand Highway-Figure 4
Yarragadee	<ul style="list-style-type: none"> Deep aquifer (sandstone, shale), up to 2000 m thick Unconfined to confined aquifer Generally fresh groundwater (<1000 mg/L TDS) however, high groundwater salinity along the Darling Fault (Scarp) Very good bore yields (up to 5000 kL/day) Seawater interface is likely to be offshore 	Present in most of the plan area-Figure 5

The department has divided the plan area into 25 subareas for administrative purposes (figures 2, 3, 4 and 5). A 'water resource' is a portion of a particular aquifer present in a particular subarea. In total, there are 35 'water resources' covered by the plan. We have set an allocation limit for each of these water resources.

For this plan, we have made the following changes to the subarea boundaries from the 2002 interim strategy:

- The Deepwater Lagoon North subarea has now been amalgamated into the Gingin Townsite subarea to manage the superficial aquifer as a single resource in this part of the plan area (Figure 2).
- The Leederville–Parmelia aquifer was managed as three separate subareas (SA4, SA5 and SA6). We have now amalgamated these three subareas into a single subarea called the Cowalla subarea, and the aquifer is now managed as a single resource in the Gingin plan area (Figure 4).

- The Yarragadee aquifer was managed in six separate subareas (SA1, SA2, SA3, SA4, SA5 and SA6). These have now been amalgamated into three new subareas to facilitate trading: Cataby (SA1 and SA4), Wannamal (SA2 and SA5) and Chandala (SA3 North and SA6) (Figure 5).

When the *Gnangara groundwater areas allocation plan* (DoW 2009) was developed, the original SA3 subarea was divided along Gingin Brook resulting in the formation of SA3 North (within Gingin plan area) and SA3 South (within the Gnangara plan area). Further information can be found in the *Gnangara groundwater areas allocation plan* (DoW 2009).

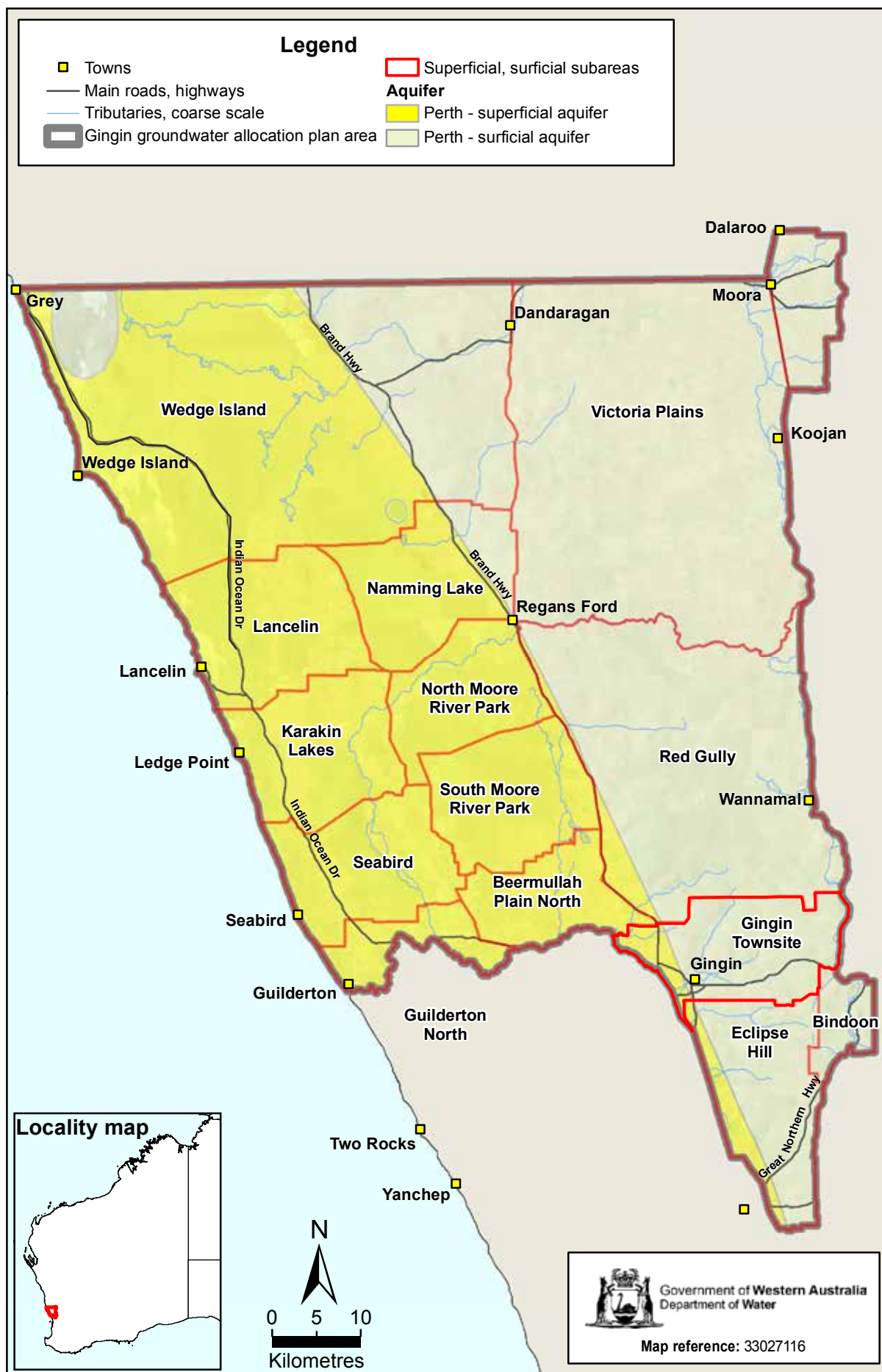


Figure 2
Subareas covering the superficial and surficial aquifers
Gingin groundwater allocation plan

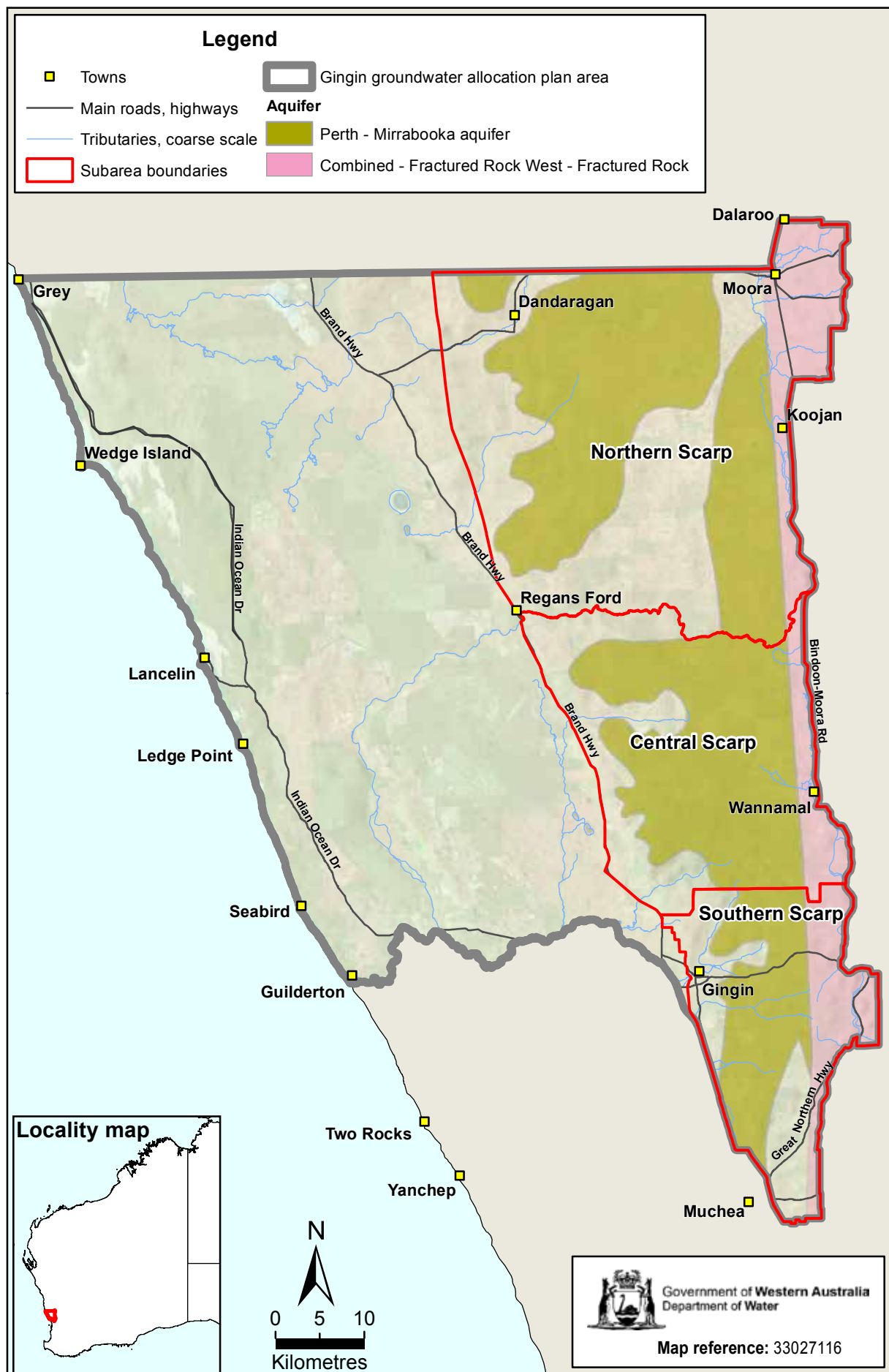


Figure 3
Subareas covering the Mirrabooka and fractured rock aquifers
Gingin groundwater allocation plan

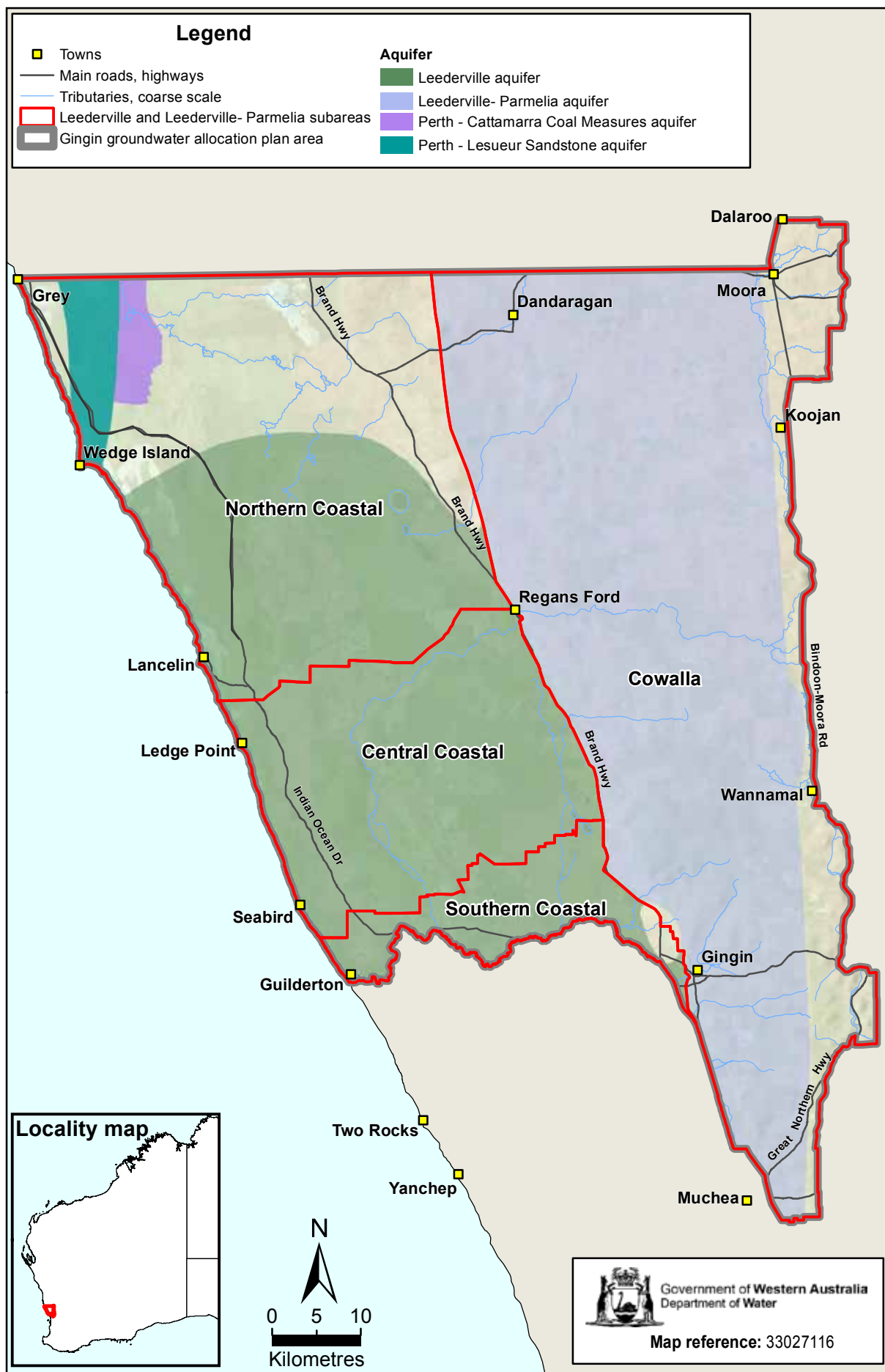


Figure 4
 Leederville, Leederville–Parmelia, Lesueur and Cattamarra aquifer subarea boundaries
 Gingin groundwater allocation plan

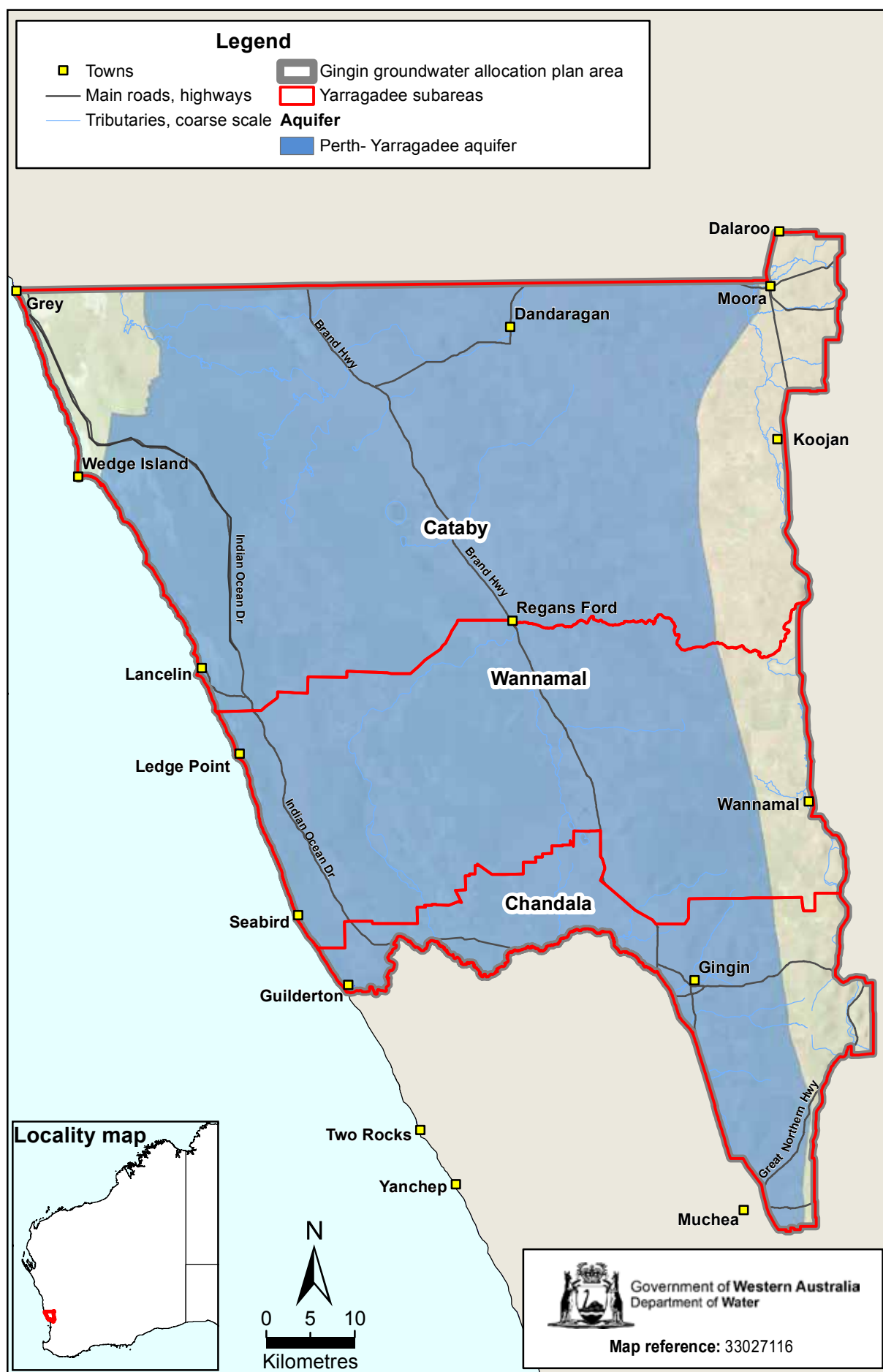


Figure 5
Yarragadee aquifer subarea boundaries
Gingin groundwater allocation plan

1.5 How we developed the plan

The department began work on this plan in 2009. A number of questions needed to be answered during planning:

- How has reduced rainfall affected recharge?
- How can the effects of a drying climate be managed?
- Where are groundwater levels declining and by how much?
- What do stakeholders value and what are their concerns?
- How can the groundwater-dependent environment be supported?
- Can current and future demand for groundwater be met?

To answer these questions, the department used updated rainfall data, examined climate trends, analysed trends in groundwater levels, consulted stakeholders, explored recent findings on the surface water-groundwater interaction along Gingin Brook, investigated projected growth in demand for water and reviewed licensing data.

As the basis of our allocation limit decisions, we calculated the amount of aquifer recharge (the amount of rainfall that becomes groundwater stored in the aquifers) for each of the 35 resources in the plan area. This included an adjustment for the expected continuation of the drying trend being experienced in the south-west of Western Australia.

More information on our recharge calculations and how the allocation limits were set is summarised in sections 3.3 and 3.4 and described in detail in the *Gingin groundwater allocation plan methods report* (DoW 2015a). Other work that informed this plan includes:

- *Gingin aquifer trend review* (MWH 2010)
- *Gingin surface water allocation plan* (DoW 2011a)
- *Groundwater-surface water interaction along Gingin Brook Western Australia* (Tuffs 2011).

For more information about the allocation planning process, please refer to *Water allocation planning in Western Australia: a guide to our process* (DoW 2011b).

1.6 Stakeholder interests

In preparing the plan, we consulted with a variety of stakeholders to assess the importance of groundwater to the community. We consulted with:

- Licensees
- Water service providers – Water Corporation and Aquasol
- Local government – Shire of Chittering, Shire of Dandaragan and Shire of Gingin
- Other government agencies
- Interest groups – Gingin Water Group, West Koojan-Gillingara Land Care District Committee.

Our stakeholders were kept informed of the plan's progress via periodic newsletters and updates on the department's website. In addition to the newsletters, we also held community information sessions. The water-related issues raised by stakeholders and the community at these sessions were:

- concern that the reliability of their licence entitlement will be affected by other nearby abstractions, or by development of the Gingin groundwater resources reserved for Perth's Integrated Water Supply Scheme (IWSS)
- concern that the high social and environmental values of the Gingin Brook and Moore River are being unacceptably impacted by surface water and groundwater abstraction
- the need to improve opportunities to trade in areas that are fully-allocated.

The department released the plan for public comment on 16 August 2013. We received 13 submissions during the comment period which closed on 6 December 2013. The submissions were generally supportive of the plan and our consultative approach.

Stakeholders raised a number of additional issues during the comment period. The two key issues raised were:

- ensuring that towns in the plan area have adequate water supplies into the future
- that after reserving water for Perth's IWSS, there is still adequate water to meet growth in agricultural demand in the plan area.

We have ensured that all of the issues raised by stakeholders during the comment period are addressed in this plan to the extent possible. Where appropriate, we met with respondents to clarify and address specific issues raised in their submission. These issues and our specific responses are documented in the *Gingin groundwater allocation plan: Statement of response* (DoW 2015b).

1.7 Plan timeframe

The *Gingin groundwater allocation plan* will be in effect until it is replaced by a new water allocation plan or it is amended or revoked by the Minister for Water. The Department of Water will consider the need to replace this plan in 2020, unless the need is identified earlier, during a plan evaluation process (see Chapter 6).

Chapter Two

What the plan will achieve

The Department of Water is responsible for managing water resources in Western Australia consistent with the objects of the *Rights in Water and Irrigation Act 1914*, specifically:

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

Through allocation planning, the department determines the amount of water that can be taken from a water resource consistent with the objects of the Act.

This plan establishes the total volume of water that can be reliably taken every year from each of the 35 water resources in the Gingin plan area while managing risks to groundwater-dependent values.

The outcomes and water resource objectives described below guided how we set the key elements of this plan – allocation limits, licensing policies, and our monitoring and evaluation program. These outcomes and water resource objectives will continue to inform our water resource management as we implement the plan.

2.1 Outcomes

Outcomes are what we aim to achieve by implementing the water resource management described in an allocation plan. The outcomes for this plan are that:

- licensed entitlements can be met reliably in most years
- water source options to support growth in agricultural and horticultural industries are clear
- sufficient water is available to support population growth in local towns, as well as to provide a future groundwater source option for Perth's Integrated Water Supply Scheme (IWSS)
- groundwater-dependent ecosystems and watercourses are protected from over-abstraction
- groundwater quality in the coastal aquifers is protected from seawater intrusion.

2.2 Water resource objectives

Water resource objectives must be specific and measurable and relate to maintaining, increasing, improving, restoring, reducing or decreasing surface water flow, groundwater levels or water quality.

The water resource objectives for this plan are as follows:

- a. groundwater levels or pressure heads are consistent with rainfall trends
- b. maintain groundwater levels or pressure heads within a target range to avoid impacts to groundwater-dependent ecosystems and/or baseflow in the Gingin Brook and Moore River
- c. there is sufficient groundwater throughflow in coastal aquifers to reduce the risk of seawater intrusion.

Measurable performance indicators for these objectives are outlined in Section 5.1.

2.3 Strategies

The department's strategies for meeting the water resources objectives are to:

- manage to the allocation limits for each of the 35 groundwater resources in the plan area (Chapter 3)
- reserve water for future local and regional public water supply (Chapter 3)
- issue licences according to the licensing policies outlined in this plan (Chapter 4)

- recover unused licensed allocations in over-allocated resources (Chapter 4)
- focus compliance and enforcement activities in water resources that are over-allocated, or close to being fully-allocated, to recover allocations and manage associated risks in these resources (Chapter 4)
- issue licences according to the trading policy for the Leederville-Parmelia resource to manage impacts from over-allocation (Chapter 4)
- monitor groundwater resources regularly using selected bores from the department's regional monitoring network (Chapter 5)
- evaluate whether the plan objectives are being met and adjust our management accordingly (Chapter 6).

2.4 Measuring the success of the plan

We will evaluate the plan regularly to see if the outcomes and resource objectives are being met. To evaluate the plan we will assess:

- licensing and water use data
- the condition of the water resource using monitoring information and performance indicators (Section 5.1).

We will publish the results in evaluation statements at least every three years. Chapters 5 and 6 provide more information about how the department will monitor and evaluate the performance of the plan.

Chapter Three

Water allocation limits

This chapter sets out:

- the allocation limits for consumptive use in each groundwater resource
- the water to be left in aquifers to maintain water quality, aquifer productivity, groundwater-dependent values and other non-consumptive uses.

3.1 Allocation limit

An allocation limit is the annual volume of water set aside for consumptive use from a water resource. In the Gingin plan area, the allocation limit represents the total volume of water that can reliably be taken annually from each resource. The allocation limit does not include the volume of water to be left in aquifers.

The allocation limits for the 35 resources in the Gingin plan area are shown in Table 3. The total allocation limit is about 235 GL/yr across all resources. The department will allocate water up to the allocation limit for each resource in accordance with the licensing approach and policies described in Chapter 4. Once a resource is fully-allocated, the department will refuse applications for new licences (including increases to existing ones). However, other options such as trading may be available.

Licence applicants are encouraged to contact our Swan–Avon regional office in Victoria Park on (08) 6250 8000 for up-to-date water availability information and to discuss opportunities for obtaining water by trading or from alternative sources. Water availability information is also accessible from the department's online Water Register at www.water.wa.gov.au Business with water> Water trading and register>.

3.2 Components of the allocation limit

Where appropriate, the allocation limit is divided into components for accounting purposes including:

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

General licensing

The general licensing component of the allocation limit includes the total volume of water which can be issued as annual licence entitlements for all uses except public water supply. The total available for general licensing is approximately 187 GL/yr. As at 30 January 2015, there was approximately 140 GL/yr licensed and 30 GL/yr in licence applications which the department is assessing.

Public water supply

The public water supply component of the allocation limit is the volume of water that is licensed to water service providers. Currently, water service providers in the plan area have licences totalling about 4 GL/yr in six resources. These service the ten towns in Table 2. Depending on growth of these towns, these volumes will be adequate to 2020.

Table 2

Volumes licensed to water service providers servicing towns within the Gingin plan area*

Town(s)	Subarea	Aquifer	Total licence volume (ML/yr)	Volume abstracted 2012/13 (ML/yr)
Lancelin and Seaview Park	Lancelin	Superficial	1409.5	360.0
Ledge Point	Karakin Lakes	Superficial	120	93.6
Lancelin South	Northern Coastal	Leederville	470	0.2
Seabird	Central Coastal	Leederville	100	24.3
Sovereign Hill and Guilderton	Guilderton North	Superficial	370	208.9
Dandaragan, Gingin, Bindoon and Chittering	Cowalla	Leederville-Parmelia	1382.7	197.6
Total			3852.2	884.6

* Although Moora is located within the Gingin plan area, local supply is sourced from the Jurien groundwater area and managed under the *Jurien groundwater allocation plan* (DoW 2010).

Public water supply reserve

The public water supply reserve component is water set aside to meet future public water supply needs. The department has adjusted the public water supply reserves as part of revising the allocation limits for this plan. As at January 2015, about 41 GL/yr is reserved across nine resources in the plan area (Table 3). The reserved volume is a 31 GL/yr reduction from the 2002 interim strategy which listed 72 GL/yr for future public water supply.

This volume has been reserved for the provision of future water supply to towns located in the plan area and as a future option for Perth's IWSS.

Aquifers in the Gingin and Jurien groundwater areas have long been identified as a potential future water supply option for Perth (WAWA 1993; WRC 2002; Water Corporation 2009). However, to date, other source options for Perth have been more feasible or economically viable. With increasing demand, the Gingin/Jurien option is likely to become more cost-effective over time. Water service providers wishing to access these reserves will need to comply with department policy (DoW 2011c and licensing policy 1.5 – Table 5).

Water is still available for general licensing (new or increased entitlements) in most areas where public water supply reserves exist. We have reserved water where there are significant areas of either state- or Commonwealth-managed land (Figure 6). By doing this, we have maximised water availability where it can be accessed for general licensing purposes.

Towns in the south eastern part of the plan area are not located near the reserves. To meet long-term water supplies needs for these towns, water service providers may have to access Surficial or Mirrabooka resources (which have variable yields) or trade/transfer with existing licensees in-line with the local licensing policy on trades (local licensing policy 1.4 - Table 5).

Unlicensed use – water exempt from licensing

The unlicensed use component of the allocation limit is the volume of water set aside for uses that are exempt from licensing under the Act (refer to Section 4.1 for further information). Exempt water use was not included in the 2002 allocation limits. There is about 3 GL/yr of groundwater for stock and domestic use accounted for in this plan.

The amount of exempt stock and domestic use in the plan area was calculated using information provided by the Department of Agriculture and Food. This included the number of properties within each subarea, land-use mapping, stocking patterns and average stock water requirements.

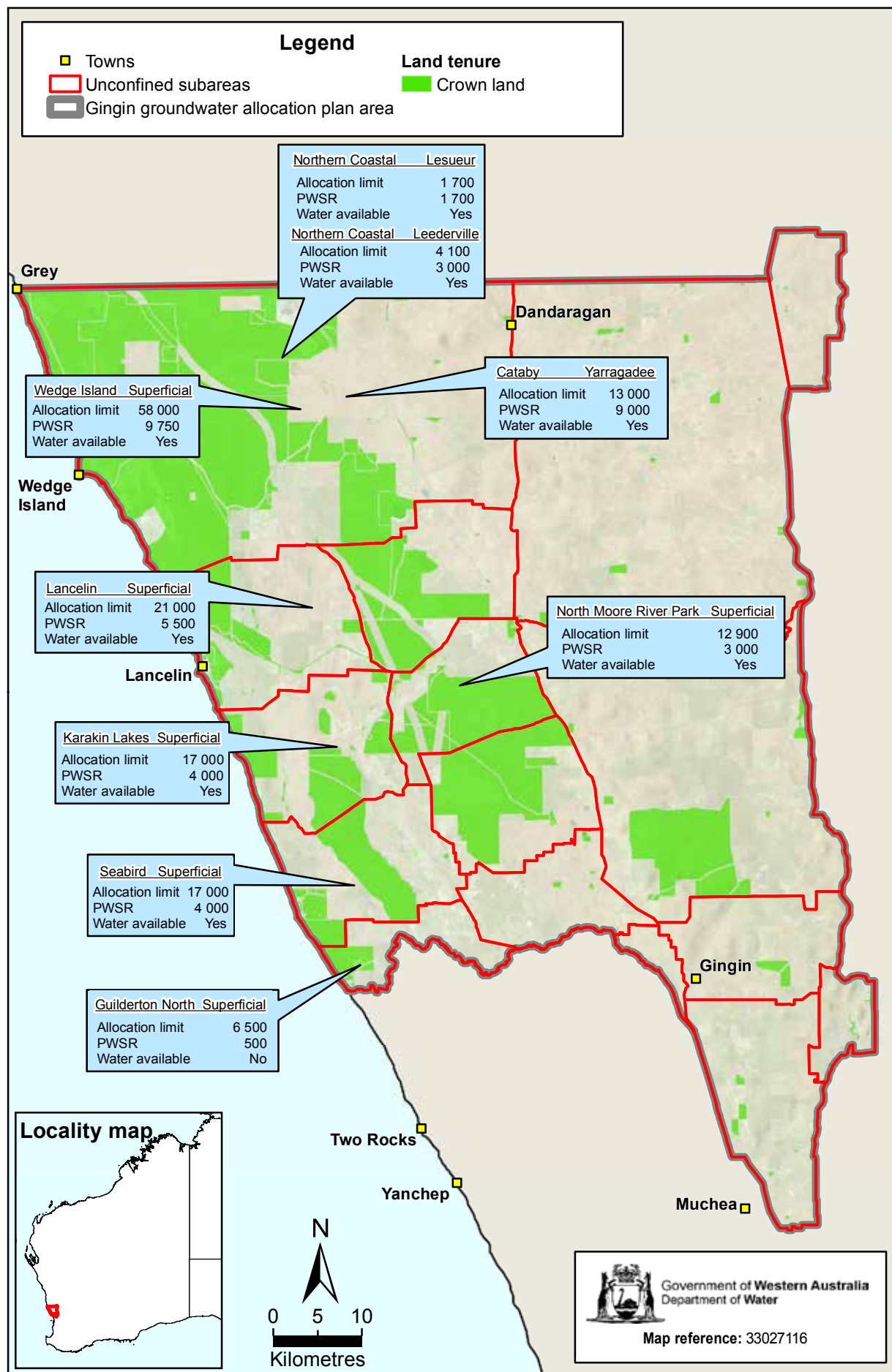


Figure 6
Location of public water supply reserves and state- and Commonwealth-
managed lands
Gingin groundwater allocation plan

Table 3

Allocation limits for the Gingin plan area

Groundwater resource (subarea and aquifer)		Allocation limit components (ML/yr)				
		Allocation limit	Licensable		Unlicensable	Reserved water
			General	Public water supply	Exempt	Public water supply
Superficial and surficial aquifers						
Beermullah Plain North	Superficial	6500	6370	0	130	0
Bindoon	Surficial	2400	1925	0	475	0
Eclipse Hill	Superficial	1050	980	0	70	0
	Surficial	3000	3000	0	0	0
Gingin Townsite	Superficial	920	865	0	55	0
	Surficial	5000	5000	0	0	0
Guilderton North	Superficial	6500	5510	370	120	500
Karakin Lakes	Superficial	17 000	12 240	120	140	4500
Lancelin	Superficial	21 000	13 875.5	1409.5	215	5500
Moora	Surficial	800	730	0	70	0
Namming Lake	Superficial	10 500	10 465	0	35	0
	Surficial	300	300	0	0	0
North Moore River Park	Superficial	12 900	9840	0	60	3000
Red Gully	Superficial	750	710	0	40	0
	Surficial	5600	5600	0	0	0
Seabird	Superficial	17 000	12 790	0	210	4000
South Moore River Park	Superficial	7500	7425	0	75	0
Victoria Plains	Surficial	4400	4400	0	0	0
Wedge Island	Superficial	58 500	48 565	0	185	9750
	Surficial	3000	3000	0	0	0

Table 3 (continued)
Allocation limits for the Gingin plan area

Groundwater resource (subarea and aquifer)		Allocation limit components (ML/yr)				
		Allocation limit	Licensable		Unlicensable	Reserved water
			General	Public water supply	Exempt	Public water supply
Leederville, Cattamarra, Lesueur, Mirrabooka and fractured rock aquifers						
Central Coastal	Leederville	2800	2700	100	0	0
Northern Coastal	Cattamarra Coal Measures	250	250	0	0	0
	Lesueur Sandstone	1700	0	0	0	1700
	Leederville	4100	630	470	0	3000
Southern Coastal	Leederville	1000	1000	0	0	0
Central Scarp	Mirrabooka	1500	1135	0	365	0
	Fractured Rock	50	50	0	0	0
Northern Scarp	Mirrabooka	3700	3070	0	630	0
	Fractured Rock	50	50	0	0	0
Southern Scarp	Mirrabooka	800	285	0	515	0
	Fractured Rock	50	50	0	0	0
Leederville–Parmelia aquifer						
Cowalla	Leederville–Parmelia	19 000	17 617.3	1382.7	0	0
Yarragadee aquifer						
Cataby	Yarragadee	13 000	4000	0	0	9000
Wannamal	Yarragadee	1300	1300	0	0	0
Chandala	Yarragadee	1050	1050	0	0	0
Total		234 970	186 777.8	3852.2	3390	40 950

Water allocation limits

3.3 How the allocation limits were set

The department set the allocation limits for each resource after balancing the need to make water available for use and retaining water in the aquifers to support groundwater levels and aquifer throughflow. To set allocation limits, we also assumed a 15 per cent reduction in average annual recharge by 2020. This is consistent with dry climate projections for the south-west of Western Australia. In our recharge calculations, we accounted for aquifer outcrop area, current vegetation cover, soil type and aquifer characteristics.

We first considered the proportion of recharge to be retained in each resource depending on the presence of groundwater-dependent systems, contribution to river baseflow and potential landward movement of the seawater interface (see Section 3.4 for more detail). We then compared the remaining amount of water available for use from each resource to the total amount needed to meet current use and future demand.

Where total demand was less than water available, the allocation limit was set above this level, allowing abstraction to increase.

Where total demand was greater than the available water, we considered the risks from further declines in groundwater levels and throughflow, and also examined whether we could use allocation limits, licensing and

monitoring in a complementary way to manage these risks. In some cases, where the risks can be managed, allocation limits have been set to meet the total demand. In other cases, allocation limits are set below the level of total demand.

The effectiveness of the allocation limits will be assessed annually through our plan evaluation process.

Over-allocated resources

After reducing allocation limits across the plan area, six resources in the plan area are now classified as over-allocated:

- Eclipse Hill-superficial
- Guilderton North-superficial
- Red Gully-superficial
- Central Coastal-Leederville
- Cowalla-Leederville-Parmelia
- Southern Scarp-Mirrabooka.

By setting allocation limits below the level of licensed entitlements in these resources, we trigger recovery of these resources through recouping of unused entitlements and focused compliance activity. These actions will reduce the risk of further groundwater declines while the need for additional recovery actions is assessed through plan evaluations.

The approach to managing over-allocated resources is described in Chapter 4.

3.4 Water that is left in aquifers

As a result of our allocation limit decisions for each resource, a proportion of aquifer recharge is left to support environmental features (Table 4). Water that is not abstracted:

- supports environmental and social values dependent on groundwater
- supports baseflow in the Gingin Brook and Moore River
- protects water quality by preventing seawater intrusion.

Table 4
Percentage of recharge retained in aquifers

Aquifer	Percentage of recharge that is left in aquifers
Surficial	20
Superficial	25, 30, 40
Mirrabooka	80
Southern Coastal Leederville	40
Northern and Central Coastal Leederville	10
Leederville–Parmelia	10
Yarragadee	10

Environmental and social values dependent on groundwater

In the Gingin plan area, groundwater-dependent ecosystems are common in areas where the superficial aquifer exists because the aquifer is close to the surface across large areas (Figure 7). Throughout the coastal plain, there are a number of swamps and wetlands in topographic and inter-dunal depressions and also at the base of the Gingin Scarp (approximately the position of the Brand Highway in Figure 7).

Guraga Lake, Karakin Lakes, Wannamal Lake system, Chandala Swamp and Chittering–Needonga Lakes are recognised wetlands listed in the *Directory of important wetlands in Australia* (ANCA 1996). There are also other ecosystems recognised under the Environmental Protection Authority’s Environmental Protection Policy.

Up to 40 per cent of recharge is left in surficial and superficial resources to support groundwater-dependent ecosystems. The highest proportions of recharge (30 and 40 per cent) are left in subareas with the largest areas of remnant vegetation and groundwater-dependent ecosystems.

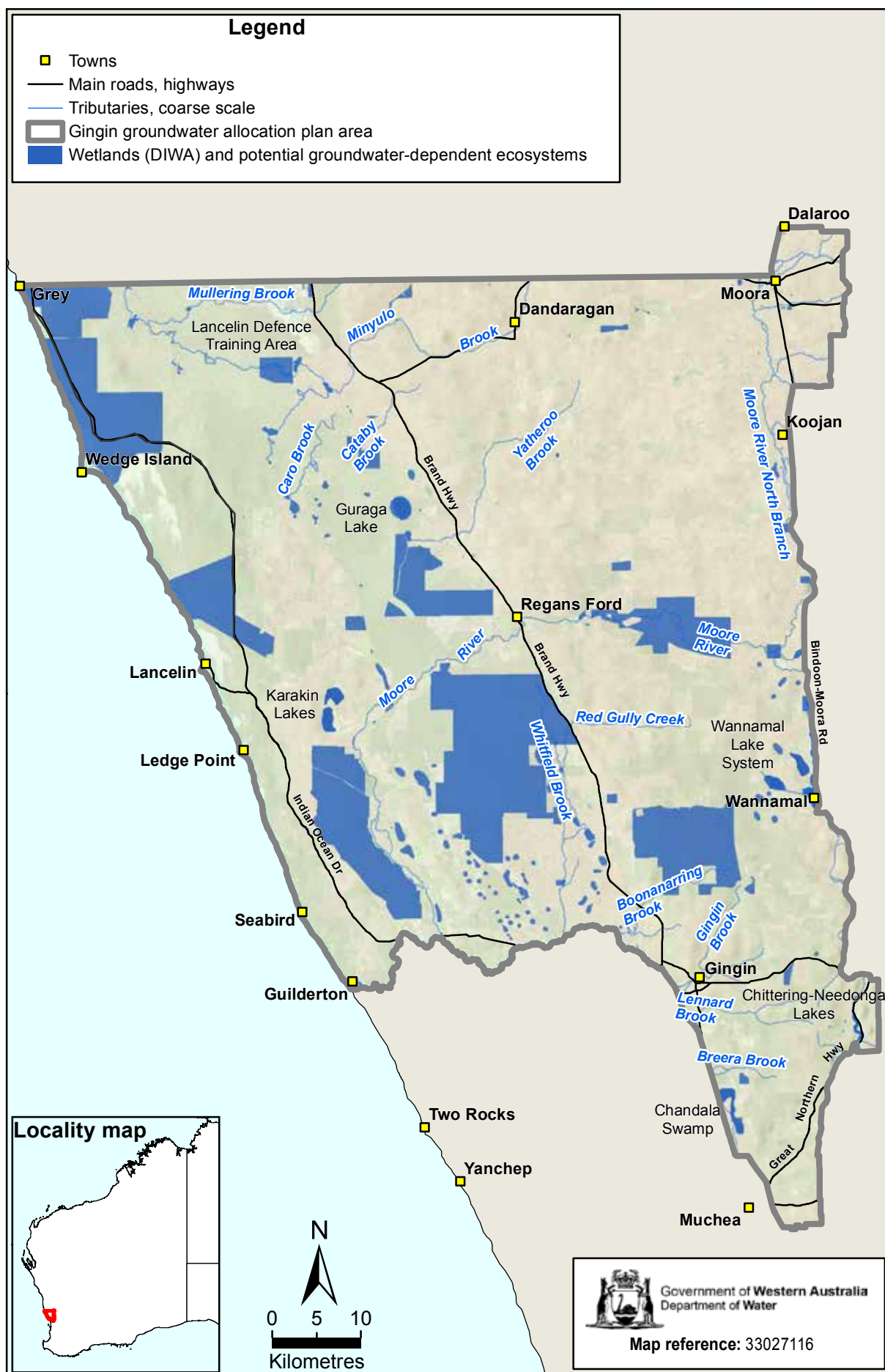


Figure 7

Groundwater-dependent values in the plan area derived by combining remnant vegetation and wetlands with depth-to-groundwater data

Gingin groundwater allocation plan

Baseflow in the Gingin Brook and Moore River

Parts of Gingin Brook are now dry in summer. This is partly due to a drying climate and depending on location, groundwater and surface water abstraction. Declining groundwater levels and discharge to Gingin Brook and Moore River could make flows more ephemeral in some river reaches.

Groundwater is discharged from the Leederville–Parmelia and Mirrabooka aquifers and is the source of baseflow in the headwaters of Gingin Brook.

The plan supports baseflow in Gingin Brook and Moore River by leaving a percentage of recharge in the Leederville–Parmelia (10 per cent), Southern Coastal Leederville (40 per cent) and Mirrabooka aquifers (80 per cent). A higher proportion of recharge is left in the Mirrabooka aquifer because it is the source of all summer flow in Moore River and in the downstream sections of Gingin Brook between Gingin townsite and the confluence with Mungala Brook.

The department manages the impacts of licensed abstraction from Gingin Brook and Moore River using the allocation limits, local licensing rules and baseflow monitoring described in the *Gingin surface water allocation plan* (DoW 2011a).

Streamflow at Gingin Brook gauging station is one of our performance indicators for both this plan (Table 8 in Section 5.1) and the surface water plan. Should baseflow reach the low-flow threshold, we will investigate options for reducing the impacts of both groundwater and surface water abstraction.

The department has undertaken an extensive investigation of the surface water–groundwater interaction along Gingin Brook. As part of future management for the plan area, the department is considering undertaking a study of similar scale for the Moore River (Action 8 in Table 11).

3

Water allocation limits

Protecting water quality by preventing seawater intrusion

Groundwater in the Leederville and Yarragadee aquifers generally flows westward and eventually discharges offshore into the ocean. This prevents seawater from entering into the onshore, freshwater aquifers.

As a result of our allocation limit decisions, 10 per cent of the aquifer recharge to the coastal Leederville and Yarragadee aquifers will be left to reduce the risk of seawater intrusion.

The presence of the Lancelin Formation confining bed and the significant groundwater pressure head (14 to 18 m AHD) in the Leederville and Yarragadee aquifers at the coast is likely to provide an effective barrier against seawater intrusion during the life of this plan.

The department will review the status of the groundwater pressure heads in the confined aquifers at the coast annually. Any significant reduction outside the normal historical range (14 to 18 m AHD) for groundwater pressure head in the Leederville and Yarragadee aquifers will trigger a review of the risk of seawater intrusion.

The department is installing additional monitoring bores in these aquifers to help us better understand and manage the seawater interface in the plan area. Refer to Section 5.2 for additional information on this project.

For further information on how we set allocation limits and water to be left in the aquifers, refer to the *Gingin groundwater allocation plan methods report* (DoW 2015a).

Chapter Four

Water licensing

Water licences are issued under the *Rights in Water and Irrigation Act 1914* (the Act) to manage and regulate the individual take of surface water and groundwater.

The department uses policies to guide how we assess licence applications and apply licence conditions. Allocation plans specify the specific policies that apply in a particular plan area.

This chapter details policies that will apply to licensing in the Gingin plan area.

4.1 Legislative requirements

Rights in Water and Irrigation Act 1914

The department manages water on behalf of the state under the Act, which establishes the legislative framework for managing and allocating water in Western Australia. In administering the Act, we also abide by other state and federal legislation.

Water licences

Water users in the plan area require a water licence to lawfully take groundwater under section 5C of the Act. Water users also require a licence issued under section 26D of the Act to construct or alter wells, unless specified in an exemption order.

When assessing a water licence application, the department considers the allocation plan, as well as clause 7(2) of Schedule 1 of the Act.

In granting a licence, the department may apply terms, conditions and restrictions to licences under clause 15 of Schedule 1 of the Act. This may also include the requirement for an operating strategy.

The department's requirements for altering any licence condition are specified under clause 24(1) of Schedule 1 of the Act.

The rights of licensees are covered under clause 26 of the Act. Any decision made on a licence application can be reviewed through the State Administrative Tribunal.

Exemptions

Private, domestic water supply from the superficial aquifer is managed through the Rights in Water and Irrigation Act Exemption and Repeal (section 26C) Order 2011.

The Order identifies that taking groundwater from the watertable aquifer in the plan area is exempt from licensing where it is used solely for:

- fire fighting purposes
- watering of stock, other than those raised under intensive conditions

- household purposes and domestic garden and lawn irrigation (not exceeding 0.2 ha).

The Rights in Water and Irrigation Exemption (Dewatering) (section 26C) Order 2010 applies in the Gingin groundwater area. This Order exempts small short-term dewatering projects.

The Rights in Water and Irrigation Exemption (section 26C) Order 2012 also applies in the Gingin plan area. This Order exempts licensing under section 5C (take of water) and 26D (construction of wells) of non-artesian monitoring wells where the sole purpose of the well is for monitoring water levels or water quality. For further information, please contact the department's Swan-Avon regional office in Victoria Park.

Compliance and enforcement

The department carries out regular compliance monitoring events across the state to ensure that the take and use of water is authorised, and is in accordance with licence terms, conditions and restrictions, such as annual water entitlement. These monitoring events include on-ground water licence compliance inspections and water meter audits, as well as off-site activities such as remote water use surveying which utilise aerial imagery and the review of licensee submissions such as water use cards and annual reports. Where non-compliance is detected, an investigation is conducted and compliance and enforcement action taken where appropriate.

The department has a *Statewide compliance monitoring plan 2013–16*. As per the requirements of this plan, water resources located within the Gingin plan area will be categorised according to risk for compliance monitoring purposes. Those water

resources that are categorised as high risk will be subjected to a greater level of on-ground compliance monitoring activity. The department will also review monitoring and metering data for the Gingin plan area and assess any local impacts, to ensure that the licence conditions applied within the plan area are appropriate.

Compliance and enforcement in the plan area will be focussed on water resources that are over-allocated, or close to being fully-allocated. This mechanism is part of the strategy for the department to prevent further risks to these resources.

Public drinking water source protection areas

Parts of the Gingin plan area are proclaimed for the protection of public drinking water supplies under the *Country Areas Water Supply Act 1947*. These are the:

- Dandaragan Water Reserve
- Moora Water Reserve
- Lancelin Water Reserve
- Seaview Water Reserve
- Ledge Point Water Reserve
- Sovereign Hill Water Reserve
- Guilderton Water Reserve
- Gingin Water Reserve
- Bindoon/Chittering Water Reserve.

The department has water source protection plans for these areas. Water source protection plans, assessments, policies and water quality protection notes are available on our website: www.water.wa.gov.au.

Applications to access water in a public drinking water supply reserve must be consistent with the department's drinking water source protection plans or any relevant land use and water management strategy.

If groundwater is to be used for private drinking water supplies, the department recommends that it be filtered, treated and tested according to public health advice from the Department of Health. For more information, also see the department's water quality protection notes, *Australian drinking water guidelines* (Australian Government 2004) and the *Australian fresh and marine water quality guidelines* (ARMCANZ & ANZECC 2000).

Other legislation

In administering the Act, we abide by other state and federal legislation.

Environmental Protection Act 1986

Significant development projects may require an environmental impact assessment under Part IV of the *Environmental Protection Act 1986*. This assessment is the responsibility of the Office of the Environmental Protection Authority (OEPA). The department may refer a licence application to the OEPA if there are potentially significant impacts.

4.2 Water licensing approach

The department's approach to licensing water in the Gingin area aims to achieve the outcomes and objectives set out in Chapter 2. The department uses the licensing process to allocate the available water for new or increased entitlements up to the allocation limits set in Chapter 3.

First-in first-served

The department will generally apply a first-in-first-served approach as well as applying other local and statewide policies when assessing applications for water licences. For further information on the first-in-first-served approach, please visit www.water.wa.gov.au Future Water > Water Reform.

Managing water in over-allocated resources

Six resources in the plan area are now classified as being over-allocated (Section 3.3). The department now aims to recover licensed entitlements in these resources to match the new allocation limits. This will ensure that the resource remains a viable water source into the future and continues to support groundwater-dependent ecosystems.

We will recoup unused water entitlements (or unused portions of entitlements) in accordance with the Statewide Policy no. 11 – *Management of unused licensed water entitlements* (WRC 2003b).

Where water is recouped and reduces the total amount of licensed entitlements to below the allocation limit, the department will review the resource's performance and either:

- make the portion of recouped water below the allocation limit available for licensing, or
- reduce the allocation limit and not make the portion of recouped water below the allocation limit available for licensing.

4

Water licensing approach

Any amendment of the allocation limit will be supported by an assessment of the monitoring data from the resource. Recouped water will not be made available for licensing if the monitoring data indicates a declining trend in groundwater levels (Action 1 in Table 11).

The department will also focus compliance and enforcement activities in these high risk resources to ensure there are no further water levels declines due to abstraction.

Trading water in the Leederville-Parmelia resource

The department has put in place trading arrangements for the Leederville-Parmelia resource to address its over-allocation, in particular in its southern extent. Groundwater monitoring indicates that there are rising pressure heads in northern parts of the resource (up to 7 m between 1991 and 2007) and declines in the south (up to 10 m since 1980 and 4 m since 2002).

Recharge to the Leederville-Parmelia aquifer does not occur in the southern portion of the subarea and this is the area of highest abstraction. In order to alleviate this stress on the aquifer, we have encouraged a redistribution of abstraction to the northern part of the aquifer. To do this, we amalgamated the SA4, SA5 and SA6 subareas into a single subarea (Cwalla subarea) and established three trading zones. This enables us to manage the Leederville-Parmelia as a single resource and manage trading across the whole resource, but only in a northerly direction. This will reduce the risk to the reliability of supply to current licensees abstracting from this aquifer.

To make decisions for water trades, we will use the rules outlined in local licensing policy 1.4 (Table 5) and Table 6. The department will only allow northward trades to occur.

Accessing public water supply reserves

There is currently 41 GL/yr reserved for future public supply to both local towns and Perth's IWSS.

Accessing reserves for local towns' water supply

Development of these reserves for local town supplies will be through a standard licensing process established by the department with the water service provider(s). The applicant would be required to undertake local hydrogeological investigations and assessment to confirm groundwater yields and identify issues to support a water licence application in-line with the department's policy (DoW 2011c). The Department of Water would then assess the licence application and determine appropriate licence conditions.

The Department of Water will manage the gazetting of new or amended Public Drinking Water Source Protection Areas where necessary.

Accessing reserves for Perth's Integrated Water Supply Scheme

A Gingin/Jurien groundwater scheme has been identified as a potential future water supply option for Perth since the mid-1980s (WAWA 1993 and WRC 2002). This scheme was also listed by the Water Corporation in their 50-year water supply strategy for Perth - *Water Forever: Towards climate resilience* (Water Corporation 2009). The scheme is a long-term option that will become more cost-effective over time.

Prior to accessing the reserve, the Water Corporation (or other water service provider) will need to notify the department of the intent to access the reserve and provide a detailed source development plan. The source development plan should provide the department with information of when future demand will require access to the reserve and what other options have been considered. It should also outline the investigations that will be carried out to support a future 5C licence application. Further details on source development plans are outlined in Table 5.

It should be noted that due to the effects of the drying climate, the department does not guarantee that the total volume of water will be available in future years.

Temporary access of public water supply reserves for private use

Where there are no current source development plans to develop the reserves in the Gingin area, the water is available temporarily for new or increased entitlements to applicants that can demonstrate a need to access those resources for a clearly specified period, not exceeding 10 years. Refer to Operational policy no. 5.01 – *Managing water reserved for use by drinking water service providers* (DoW 2011c).

Similarly, if Water Corporation (or other water service provider) chooses not to use the reserved water, it may be reallocated back into the system for general use.

Taking water from the Mirrabooka aquifer

The Mirrabooka aquifer is present in the eastern portion of the plan area. The aquifer is partially saturated, variable in thickness and is connected with the shallow watertable in certain areas. As the aquifer's thickness is variable, yields from it vary from location to location.

Due to the variability in yields and connection to the shallow watertable, applicants will be required to conduct aquifer tests to confirm bore yields and submit this information to the department. In this case, applicants may also be asked to provide additional information such as lithology and geophysical logs (Table 5). This will allow the department to assess the potential of the proposed abstraction to affect groundwater users and the environment.

We encourage applicants who are applying to take water from the Mirrabooka aquifer to contact the department's Swan-Avon regional office in Victoria Park for more information.

Taking water from fractured rock aquifers

Compared to sedimentary aquifers such as the superficial aquifer that can hold large volumes of water and yield up to 20 L/s, fractured rock aquifers east of the Darling Scarp have a small storage capacity and provide variable bore yields (up to 6 L/s) from highly fractured and weathered zones. The fractured rock aquifers in the plan area vary in their distribution and hydrogeological properties. This means that the yield of these aquifers cannot be calculated accurately and the allocation limit for these resources is only indicative of water availability.

4

Water licensing approach

Applicants for licences to abstract from fractured rock aquifers may be required to conduct aquifer tests to confirm bore yields to allow the department to assess the potential for effects on other groundwater users and the environment. In cases where the allocation limit has been reached in the fractured rock aquifers, aquifer test evidence may be sufficient for the department to consider increasing the allocation limit.

We encourage applicants who are applying to take water from the fractured rock aquifers to contact the department's Swan-Avon regional office in Victoria Park for more information.

4.3 Licensing policies

Local licensing policies for the Gingin plan area

Clause 7(2) of Schedule 1 of the Act is used when assessing water licence applications. The local licensing policies in Table 5 better define specific considerations for licence assessments in the Gingin plan area. The policies apply either because the local issues are not addressed in statewide policy, or because an alternative, more specific approach is better for managing local issues. Where local policy within the allocation plan differs from a statewide policy, the policy in the allocation plan is applied.

Table 5
Local licensing policies specific to the Gingin plan area

Policy group		Policy detail
1.1	Information required from new bores drilled into the Mirrabooka aquifer	New applications for a licence in the Mirrabooka aquifer will be requested to support their application with: <ul style="list-style-type: none"> • a detailed description of the lithology, with retention of lithology drill samples • geophysical log – gamma and resistivity (long- and short-normals) • aquifer tests and results from these tests • survey level of bore • palynology analysis of lithology drill samples may also be required.
1.2	Managing applications in resources that contribute to baseflow in Gingin Brook and Moore River	Applicants proposing to have production bores close to Gingin Brook or Moore River must demonstrate that pumping from their bores will not significantly reduce baseflow in these watercourses. A hydrogeological assessment may be required to demonstrate this. Production bores should be located at least 400 m from these watercourses to minimise impacts on baseflow. Monitoring bores may need to be installed as part of any licence conditions to monitor impacts of abstraction on baseflow.
1.3	Managing applications in coastal resources	For licence applications in coastal resources, the department may require applicants to install bores to monitor water quality as part of any licence conditions.
1.4	Trading within the Cowalla Leederville–Parmelia resource	When assessing trades in the Cowalla Leederville–Parmelia resource, the department will be guided by the Trading Zones defined in Figure 8 and rules in Table 6. The department will support trades in a northerly direction that alleviate abstraction pressure in the southern portion of the Leederville–Parmelia resource and decrease the risk to groundwater-dependent ecosystems and baseflow in the Gingin Brook.
1.5	Requirements of a source development plan	A source development plan should at least provide the department with the following information: <ul style="list-style-type: none"> • supply and demand projections • next source needs (size, timing, triggers, buffers) • water use efficiency plan (targets, actions) • source options & evaluation • proposed next source (yield, timing, impacts) • implementation plan (future work) • drought contingency plan • risk management. Licence applications from water service providers wishing to access a public water supply reserve should be consistent with a source development plan that has been worked through with the Department of Water.



Figure 8
Trading zones for the Leederville–Parmelia resource
Gingin groundwater allocation plan

Table 6

Trading rules between and within zones in the Cowalla Leederville–Parmelia resource

		Trading to		
		Zone 1	Zone 2	Zone 3
Trading from	Zone 1	Trading is permitted.	Trading is not permitted.	Trading is not permitted.
	Zone 2	Trading is permitted.	Trading is permitted.	Trading is not permitted.
	Zone 3	Trading is permitted.	Trading is permitted.	Trading is permitted.

Statewide licensing policies

The department's statewide policies guide our licensing processes and decisions. They ensure that licences are assessed and issued consistently and equitably across the state. These policies can be accessed on our website at www.water.wa.gov.au or by contacting our Swan–Avon regional office on 08 6250 8000.

The relevant policies in the Gingin plan area relate to:

- timely submission of information
- hydrogeological reporting
- use of operating strategies
- metering
- water conservation and water use efficiency plans
- water trading/transactions
- recouping of unused entitlements
- managing temporary access water reserved for public water supply
- extenuating circumstances for temporarily over-allocating a resource.

4

Water licensing approach

4.4 Factors that may affect future water allocation and licensing

The main factors that may affect how we license groundwater abstraction in the plan area into the future include (but are not limited to):

- how growth in town populations, agriculture and industrial activities progresses
- the extent to which the climate continues to dry
- how groundwater resources respond to the drying climate and changes to land use
- evaluations of the *Gingin surface water allocation plan* (DoW 2011a)
- new hydrogeological information from departmental or private investigations.

Chapter Five

Monitoring program for the Gingin groundwater plan area

The monitoring program sets out how the department will monitor water resources in the plan area. It will tell us how the resources are performing over time and in particular, how they are responding to abstraction and climate change. Using that information, we will evaluate whether the plan's resource objectives are being met and whether we need to adapt our management of abstraction.

The department has a regional monitoring network of bores that covers the plan area. It has been recording changes in groundwater levels since the 1970s (Table 7 and Figure 9).

The regional monitoring network is used for calibrating the Perth regional aquifer modelling system (PRAMS). The department will use the PRAMS groundwater model to assess monitoring information at a regional scale and evaluate the performance of the Gingin plan.

The department obtains most of its water quality information and information about local impacts on groundwater-dependent ecosystems from licensees.

Table 7

Number of monitoring bores in the Gingin plan area (regional monitoring network)

Aquifer	Bore Series	Number of monitoring bores	Total
Superficial	Cataby Shallow	28	73
	Gillingarra Line	3	
	Gingin Brook Series	21	
	Gingin Monitoring	10	
	Salvado Line	11	
Mirrabooka	Gillingarra Line	1	10
	Gingin Brook Series	8	
	Red Gully Series	1	
Leederville and Leederville-Parmelia	Artesian Monitoring	2	22
	Cataby Shallow	1	
	Gillingarra Line	12	
	Gingin Brook Series	4	
	Red Gully Series	3	
Yarragadee	Cataby Shallow	4	16
	Gillingarra Line	8	
	Moora Line	4	
Total			121

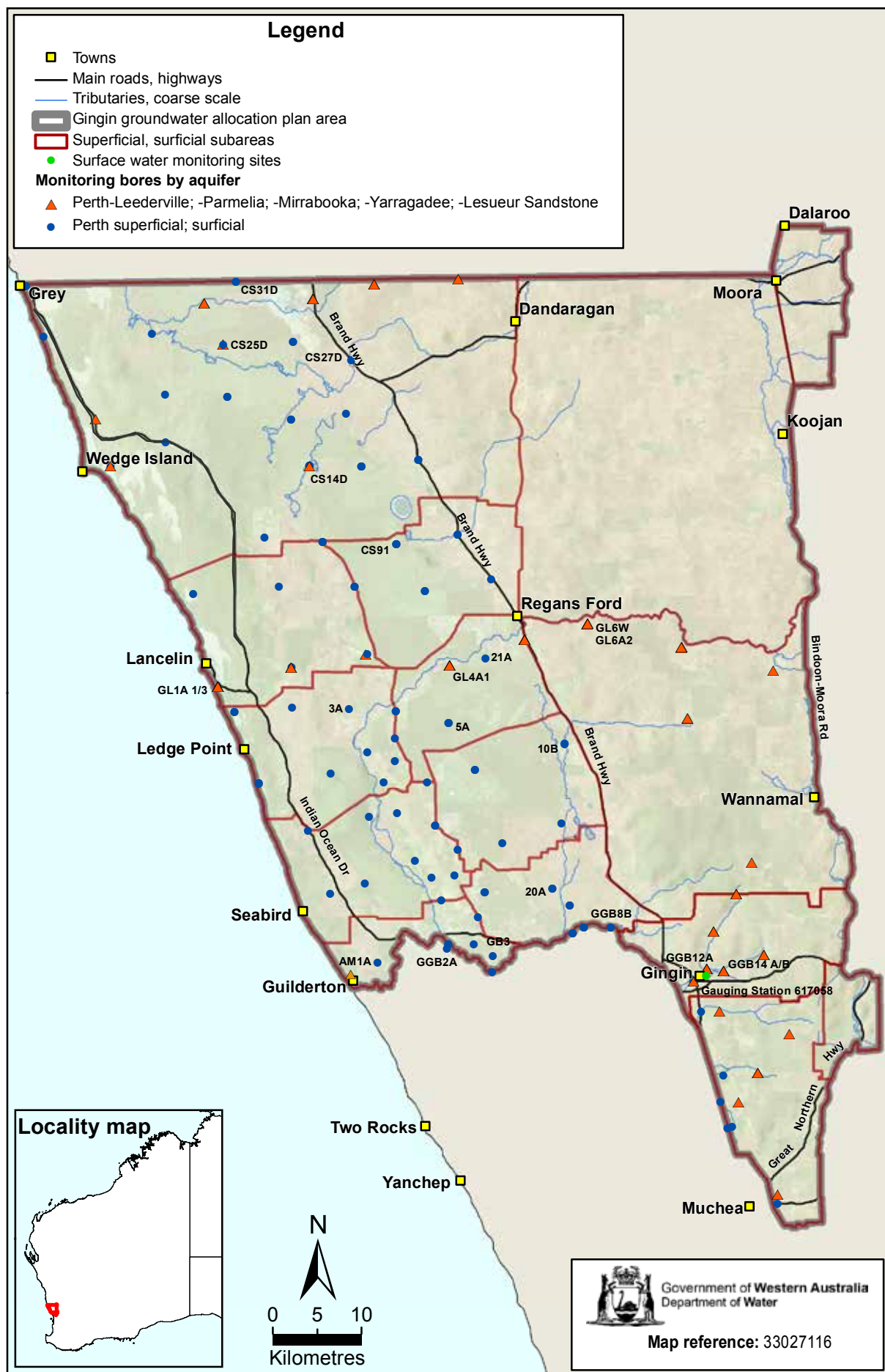


Figure 9

Location of Department of Water monitoring bores in the plan area

Gingin groundwater allocation plan

5.1 Evaluating resource objectives

The department will regularly review information from individual bores to determine whether the plan's resource objectives are being met. We will use the performance indicators and the sites specified in Table 8 to monitor our progress. When the department evaluates the plan, we may change monitoring bores to assess the aquifer's performance.

Table 8
Monitoring and performance indicators in the plan area to assess resource objectives for each aquifer

Resource objective	Sites	Performance indicator	Frequency
Superficial aquifer			
a. Groundwater levels are consistent with rainfall trends.	Bore 3A Bore 5A Bore 10B Bore 20A Bore 21A Bore CS28D Bore CS31D Bore CS27D Bore CS9I Bore GB3 Bore GGB2A Bore GGB8B	Subarea inflows are greater than the best estimate abstraction data (using water balance calculations).	Annually
		Monitoring bore data shows that the rate of change in groundwater level over the last five years is similar to the rate of change in recharge over the same period (hydrographs will be used for verification).	Annually
b. Maintain groundwater levels within a target range to avoid impacts to groundwater-dependent ecosystems and/or baseflow in the Gingin Brook and Moore River.	Bore GGB2A Bore GGB8B	Groundwater levels at GGB2A and GGB8B will remain above the base of Gingin Brook for a majority of the year (hydrographs will be used for verification).	Annually
c. There is sufficient groundwater throughflow in coastal aquifers to reduce the risk of seawater intrusion.	Bore 3A Bore 5A Bore 10B Bore 20A Bore 21A Bore CS28D Bore CS31D Bore CS27D Bore CS9I Bore GB3	Groundwater modelling (PRAMS) indicates that groundwater flow is in a westerly direction.	Annually

Monitoring program for the Gingin groundwater plan area

Table 8 (continued)

Monitoring and performance indicators in the plan area to assess resource objectives for each aquifer

Resource objective		Sites	Performance indicator	Frequency
Mirrabooka aquifer				
a.	Groundwater levels are consistent with rainfall trends.	Bore GL7W	Monitoring bore data show the rate of change in pressure head over the last five years is similar to the rate of change in recharge over the same period (hydrographs will be used for verification).	Annually
b.	Maintain groundwater levels within a target range to avoid impacts to groundwater-dependent ecosystems and/or baseflow in the Gingin Brook and Moore River.	Bore GGB14B	Pressure head at GGB14B will remain above the base of Moondah Brook for a majority of the year (hydrographs will be used for verification).	Annually
		Gingin Brook gauging station 617058	Streamflow does not drop below 5 ML/day at Gingin Brook gauging station for more than two consecutive days in a year.	Annually
Leederville and Leederville–Parmelia aquifers				
a.	Groundwater levels are consistent with rainfall trends.	Bore AM1 Bore CS14D Bore GGB14A Bore GL1A1 Bore GL6W	Subarea inflows are greater than best estimate abstraction data (using water balance calculations).	Annually
			Monitoring bore data show the rate of change in pressure head over the last five years is similar to the rate of change in recharge over the same period (hydrographs will be used for verification).	Annually
b.	Maintain groundwater levels within a target range to avoid impacts to groundwater-dependent ecosystems and/or baseflow in the Gingin Brook and Moore River.	Bore GGB14A	Pressure head at GGB14A will remain above the base of Moondah Brook for a majority of the year.	Annually
		Gingin Brook gauging station 617058	Streamflow does not drop below 5 ML/day at Gingin Brook gauging station for more than two consecutive days in a year.	Annually

Table 8 (continued)

Monitoring and performance indicators in the plan area to assess resource objectives for each aquifer

Resource objective	Sites	Performance indicator	Frequency
Yarragadee			
a. Groundwater levels are consistent with rainfall trends.	Bore CS25D Bore GL1A3 Bore GL4A1 Bore GL6A2	Subarea inflows are greater than best estimate abstraction data (using water balance calculations).	Annually
		Monitoring bore data show the rate of change in pressure head over the last five years is similar to the rate of change in recharge over the same period (hydrographs will be used for verification).	Annually
c. There is sufficient groundwater throughflow in coastal aquifers to reduce the risk of seawater intrusion.	Bore AM1A Bore GL1A3	No significant reduction outside of the normal historical range (13 to 18 m AHD) for groundwater pressure heads in the Yarragadee aquifers at the coast (hydrographs will be used for verification).	Annually

Responding to assessment of performance indicators

Where our assessment of performance indicators identifies a resource objective is not met, we will take appropriate actions to rectify the situation.

The first step will be to investigate what caused the performance indicator to not be met. We will then take the most appropriate actions. This may impact on licensees' ability to abstract.

In the case that performance indicators for Gingin Brook or Moore River are not met, we may also take action with surface water licensees.

Monitoring program for the Gingin groundwater plan area

5.2 Monitoring for future planning needs

The Gingin plan area has few deep monitoring bores for evaluating the seawater interface in the confined Leederville and Yarragadee aquifers at the coast. The department's North Gingin Groundwater Investigation Project, funded through the State Groundwater Investigation Program, will install four lines of deep Leederville and Yarragadee aquifer monitoring bores on the Swan Coastal Plain. There will be a total of 24 deep monitoring bores installed (Table 9). The four lines of monitoring bores will be positioned within the Gingin plan area between the coastal settlements of Seabird in the south and Wedge Island in the north and move inland to the Brand Highway near Gingin Scarp in the east.

Construction of the new monitoring bores started in 2012 and will be completed in 2014. Prior to the completion of the North Gingin Groundwater Investigation, existing deep monitoring bores at Guilderton (AM1A, just outside the southern boundary of the plan area) and Lancelin (GL1A3, GL1A1 and GL1B) were used to estimate the distance of the seawater interface offshore. The new bores will enable us to better understand and manage the confined groundwater resources in the Gingin groundwater area. The bore construction program also ensures that we are well placed to manage growth in the demand for water, which is occurring as a result of horticultural ventures moving northwards from the Gnangara area. The new data collected will also improve our conceptual geology model and be used to update the PRAMS model.

Following the installation of the monitoring bores on the coastal plain, the project will extend eastward to fill the monitoring gap on the Dandaragan Plateau. It is anticipated that this work will begin in 2015–16.

Table 9

New monitoring bores from the North Gingin groundwater investigation

New monitoring bores	Purpose	Frequency of data collection
North Gingin 1 – 12B	Monitor the Leederville aquifer. Provide data for input to PRAMS.	Yet to be determined
North Gingin 1 – 12A	Monitor the Yarragadee aquifer. Provide data for input to PRAMS.	Yet to be determined

Chapter Six

Implementing and evaluating the plan

The department will implement this plan by following the strategies listed in Section 2.3. Once the plan is in place, we will regularly evaluate whether the plan's objectives are being met.

This chapter sets out some actions necessary to implement and evaluate the plan.

6.1 Implementing the plan

To successfully implement the plan and ensure we are able to effectively manage groundwater abstraction into the future, we identified a number of actions that we will need to carry out (Table 10).

Table 10

Actions to implement the Gingin groundwater allocation plan

Action	Responsibility ¹	Timeline
Allocation planning		
1 Review allocation limit if water is recouped to below the allocation limit in over-allocated resources.	Water Allocation Planning Swan-Avon Region	As required
Licence compliance		
2 Undertake compliance inspections on high risk resources in the plan area.	Swan-Avon Region	Annually as per the <i>Statewide compliance monitoring plan 2013-2016</i>
Resource assessment and plan evaluation		
3 Assess performance indicators and resource objectives.	Swan-Avon Region Water Resource Assessment Water Allocation Planning	Annually
4 Communicate results of plan evaluation to interested stakeholders.	Swan-Avon Region	Annually as required
5 Publish evaluation statement.	Water Allocation Planning	At least every three years

¹ Departmental branch responsible for the action

Implementing and evaluating the plan

Table 10 (continued)

Actions to implement the Gingin groundwater allocation plan

Action	Responsibility ¹	Timeline
Monitoring		
6 Review, and amend where appropriate, the current groundwater monitoring program.	Water Resource Assessment	Annually during plan evaluation
Communication		
7 Develop a communication and education program with groundwater users within resources that contribute to baseflow to raise awareness of the effect of abstraction on baseflow.	Water Allocation Planning Swan-Avon Region	2014-15

¹ Departmental branch responsible for the action

The department improves its management of water resources over time to ensure that we are able to maximise the amount of water available while still protecting the resource. Table 11 identifies some actions that we will need to complete as groundwater use increase in the plan area.

Table 11

Actions to support future planning

Action	Responsibility	Timeline
8 Confirm areas and aquifers that contribute to Moore River baseflow.	Water Resource Assessment	To be determined
9 Investigate options for managing groundwater abstraction when baseflow in Gingin Brook is below a low flow threshold as outlined in the <i>Gingin surface water allocation plan</i> (DoW 2011a).	Water Allocation Planning Water Resource Assessment Swan-Avon Region	Ongoing
10 Refine understanding of water requirements of groundwater-dependent ecosystems.	Water Allocation Planning	To be determined

6.2 Evaluating the plan

The department will evaluate performance indicators and objectives on an annual basis. We will take appropriate opportunities to communicate the results to stakeholders.

We will, however, publish a comprehensive evaluation statement at least every three years to ensure all stakeholders are informed of how the resource and management framework is performing.

The evaluation statement will include:

- the allocation status for each resource, including any changes in licensed entitlements since the plan release or last evaluation
- the status of plan management and actions due in the evaluation period
- our performance against the plan outcomes and resource objectives
- whether we need to adapt our water resource management.

The statement will be available on the department's website www.water.wa.gov.au or by contacting the department's Swan-Avon regional office in Victoria Park.





Appendix

Gingin groundwater allocation plan

A

Appendix A Map information and disclaimer

Datum and projection information

Vertical datum: Australian Height Datum (AHD)
Horizontal datum: Geocentric Datum of Australia 94
Projection: MGA 94 Zone 50
Spheroid: Australian National Spheroid

Project information

Client: K. Youngs, M. Tiong and G. Chandler
Map authors: S. Edgar, G. Floyd, D. Abbott, C. Samuel, S. Shah, M. Fifield and Gerard Paul.
File path: J:\gisprojects\Project\330\20000_29999\33027116..For all maps
File name: J:\gisprojects\Project\330\20000_29999\33027116\0001_Gingin_Allocation_Plan..For all maps
Compilation date: 28 September 2012

Disclaimer

These maps are a product of the Department of Water, Water Assessment and Allocation Division and were printed as shown.

These maps were produced with the intent that they be used for information purposes at the scales as shown when printed.

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

Sources

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

Western Australia Towns – Landgate – 2012
Hydrography, Linear (Hierarchy) – DoW – 2007
Global Map Data Australia 1M – Geoscience Australia – 2001
Road Centrelines, DLI – Landgate – 2012
WA Coastline, WRC (Poly) – DoW – 2006
Local Government Authority and Locality Boundaries – Landgate – 2012
DWAID Aquifers – DoW – 2012
DWAID Groundwater Subareas – DoW – 2012
WIN Monitoring Boresites – DoW – 2012
WIN Surface Water Sites, Stream Gauging (DoW) – DoW – 2012
Groundwater Allocation Plan Area – DoW – 2012
Proclaimed Groundwater Areas – DoW – 2007
DIWA Wetlands – DoW – 2008
Mean Annual Rainfall Surface (1975–2003), Southwest Australia – DoE – 2006
Mid-West Potential GDE and Associated Values – DoW – 2012
WA Satellite Imagery – Landgate – 2005

Shortened forms

List of shortened forms	
AHD	Australian height datum
ANCA	Australian Nature Conservation Agency
ARMCANZ & ANZECC	Agriculture and Resource Management Council of Australia & New Zealand, and the Australian and New Zealand Environment and Conservation Council
DAFWA	Department of Agriculture and Food (WA)
DoW	Department of Water
IWSS	Integrated Water Supply Scheme
PRAMS	Perth regional aquifer modelling system
WRC	Water and Rivers Commission

Volumes of water			
One litre	1 litre	1 litre	(L)
One thousand litres	1000 litres	1 kilolitre	(kL)
One million litres	1 000 000 litres	1 megalitre	(ML)
One thousand million litres	1 000 000 000 litres	1 gigalitre	(GL)

Glossary

Abstraction	Withdrawal of water from any surface water or groundwater source of supply.
Allocation limit	Annual volume of water set aside for use from a water resource.
Baseflow	The component of stream flow supplied by groundwater discharge.
Consumptive use	Water used for consumptive purposes considered as a private benefit including irrigation, industry, urban and stock and domestic use.
Discharge	The water that moves from the groundwater to the ground surface or above, such as a spring or the ocean. This includes water that seeps onto the ground surface, evaporation from unsaturated soil, and water extracted from groundwater by plants (evapotranspiration) or engineering works (groundwater pumping).
Groundwater area	An area proclaimed under the <i>Rights in Water and Irrigation Act 1914</i> for the purposes of licensing and managing water use.
Licence (or licensed entitlement)	A formal permit which entitles the licence holder to take water from a watercourse, wetland or underground source under the <i>Rights in Water and Irrigation Act 1914</i> .
Over-allocation	Where the total volume of water allocated out of the resource (that could be abstracted at any time) is over the set allocation limit.
Over-use	Where the actual volume of water abstracted from the resource is over the set allocation limit.
Pressure head	Hydrostatic pressure expressed as the height of a column of water that the pressure can support at the point of measurement.
Public water supply reserve	Reservation of a volume of water to supply drinking water for human consumption.
Reliability	The frequency with which a water licence holder can take their full licensed volume.
Recharge	Water that infiltrates into the ground to replenish an aquifer.
Seawater interface	The boundary between the freshwater flowing through the aquifer and the denser, saline seawater at the coast. This interaction is present at the coastal boundary of the aquifers that extend to the coast.
Self-supply	Water users (individuals or organisations) who divert from a source for their own individual requirements.
Social value	An <i>in situ</i> quality, attribute or use that is important for public benefit, welfare, state or health.
Social water requirement	The water regime needed to maintain social and cultural values.

Glossary

Subarea	A subdivision, within a surface or groundwater area, defined to better manage water allocation. Subareas boundaries are not proclaimed and can therefore be amended without being gazetted.
Throughflow	The flow of water within an aquifer, and between, aquifers.
Water reserve	An area proclaimed under the <i>Metropolitan Water Supply, Sewerage and Drainage Act 1909</i> or <i>Country Areas Water Supply Act 1947</i> to protect and use water for public water supply.
Yield	The yield is the calculated volume of water that can be taken from a system renewably; subject to the effects of climate, variability, water quality and <i>in situ</i> water dependencies.

References

- Australian Nature Conservation Agency (ANCA) 1996, *A Directory of important wetlands in Australia*, (2nd edition), Canberra.
- Department of Water 2009, *Gnangara groundwater areas allocation plan*, Department of Water, Perth.
- 2010, *Jurien groundwater allocation plan*, Department of Water, Perth.
- 2011a, *Gingin surface water allocation plan*, Department of Water, Perth.
- 2011b, *Water allocation planning in Western Australia: a guide to our process*, Department of Water, Perth.
- 2015a, *Gingin groundwater allocation plan methods report*, Department of Water, Perth.
- 2015b, *Gingin groundwater allocation plan: Statement of response*, Department of Water, Perth.
- MWH 2010, *Final report: Gingin aquifer trend review – prepared for Department of Water*, MWH Australia Pty Ltd, Perth.
- Tuffs, AF, 2011, *Groundwater-surface water interaction along Gingin Brook Western Australia*, Department of Water, Perth.
- Water and Rivers Commission 2002, *Managing the water resources of the Gingin Groundwater Area, WA Interim Sub-Regional Allocation Strategy*, Water and Rivers Commission, Perth.
- Water Corporation 2009, *Water Forever: Towards climate resilience*, Water Corporation, Perth.
- Water Authority of Western Australia 1993, *Gingin Groundwater Area Management Plan*, Water Authority of Western Australia, Perth.

Legislation

- Government of Western Australia 1914, *Rights in Water and Irrigation Act 1914*, Perth.
- 1914, Rights in Water and Irrigation Exemption (section 26C) Order 2012, Perth.
- 1914, Rights in Water and Irrigation Exemption and Repeal (section 26C) Order 2011, Perth.
- 1914, Rights in Water and Irrigation Exemption (Dewatering) (section 26C) Order 2010, Perth.
- 1914, Rights in Water and Irrigation Act (Approved Meters) Order 2009, Perth.
- Government of Western Australia 1947, *Country Areas Water Supply Act 1947*, Perth.

Policy

Agriculture and Resource Management Council of Australia & New Zealand and the Australian and New Zealand Environment and Conservation Council 2000, *The Australian and New Zealand guidelines for fresh and marine water quality, paper no. 4.*, Commonwealth of Australia, Canberra.

ARMCANZ & ANZECC – see Agriculture and Resource Management Council of Australia & New Zealand, and the Australian and New Zealand Environment and Conservation Council

Australian Government 2004, *National water quality management strategy – Australian drinking water guidelines 6*, National Health and Medical Research Council and Natural Resource Management Ministerial Council, Government of Australia, Canberra.

Department of Water 2008, *Extenuating circumstances for granting water entitlements resulting in allocation limits being temporarily exceeded, Internal operational policy*, Department of Water, Perth.

—2009b, Operational policy no. 5.11 – *Timely submission of further required information*, Department of Water, Perth.

—2009c, Strategic policy no. 5.03 – *Metering the taking of water*, Department of Water, Perth.

—2009d, *Guidelines for water meter installation*, Department of Water, Perth.

—2009e, Operational policy no. 5.13 – *Water entitlement transactions for Western Australia*, Department of Water, Perth.

—2009f, Operational policy no. 1.02 – *Policy on water conservation/efficiency plans: Achieving water use efficiency gains through water licensing*, Department of Water, Perth.

—2009g, Operational policy no. 5.12 – *Hydrogeological reporting associated with a groundwater well licence*, Department of Water, Perth.

—2010, Operational policy no. 5.8 – *Use of operating strategies in the water licensing process*, Department of Water, Perth.

—2011c, Operational policy no. 5.01 – *Managing water reserved for use by drinking water service providers*, Department of Water, Perth.

Water and Rivers Commission 2003a, *Statewide policy no. 9 – Water licensing – staged developments*, Water and Rivers Commission, Perth.

—2003b, *Statewide policy no. 11 – Management of unused licensed water entitlements*, Water and Rivers Commission, Perth.

Notes



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Department of **Water**

168 St Georges Terrace, Perth, Western Australia
PO Box K822 Perth Western Australia 6842
Phone: 08 6364 7600
Fax: 08 6364 7601
www.water.wa.gov.au

6590 200 0315