



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

Looking after all our water needs

Jurien groundwater area subarea reference sheets

Plan companion for the Jurien groundwater area
allocation plan

Department of Water

September 2009

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1 Introduction

1.1 Purpose of the plan

The *Jurien groundwater area allocation plan* provides the Department of Water's direction on how Jurien groundwater resources will be allocated and managed, now and in the future, under the current *Rights in Water Irrigation Act 1914*.

The department prepared the plan to provide clear direction to organisations, industry, individuals and licensing officers about the current groundwater availability and management responsibilities in a fast developing area. The plan replaces *Managing the water resources of the Jurien groundwater area WA – Interim sub-regional allocation strategy* (WRC 2002). We used the most up-to-date information that we had available to develop the plan.

1.2 Purpose of the subarea reference sheets

The subarea reference sheets provide local subarea based information and guidance on the groundwater licensing process in the plan area (Figure 1). The reference sheets will help to inform prospective licence applicants of their local area requirements for water use in a specific subarea and provide general information to assist them with the application process.

1.3 Licensing information and the plan

The *Jurien groundwater area allocation plan* contains the specific licensing policies and rules that apply to all subareas and must be used any licence assessment process or new application in the Jurien groundwater area.

The Department of Water assesses individual licence applications to construct a bore (26D) and to take water (5C licence) under Schedule 1, Division 2, clause 7 (2) of the *Rights in Water and Irrigation Act, 1914*. The level of assessment against the 7 (2) criteria is determined by the policies and objectives in the plan.

The plan and this document cover many aspects of the 7 (2) assessment process on a subarea and groundwater area basis. However, local scale licence assessment is still required. See Appendix A for more information.

Applicants should be aware of the licensing policies and local area rules that may apply to them before submitting their groundwater licence application to the department.

The licensing information detailed in this document follows standard statewide protocols and processes used for all plans. For further information please visit the department's website.

Licensing forms for licence applications can be found on the Department of Water's website: <www.water.wa.gov.au> Doing business with us > Water licensing > Licensing publications and forms > or by contacting our Mid West Regional office in Geraldton on 08 9965 7400.

1.4 How to use the subarea reference sheets

The reference sheets provide background information on a particular groundwater subarea (Figure 2). Each subarea has different issues associated with licensing and water management. The reference sheets summarise information on the subarea including:

- proclamation, water use and water management issues
- allocation limits and water availability
- hydrogeology
- ecological, social, cultural and recreational sites of significance that we consider in the assessment process for groundwater licensing.

Please see the *Jurien groundwater area allocation plan* for further detail and a complete reference and recommended reading list, or visit our website <www.water.wa.gov.au>.

Licence applications must be consistent with, and meet the requirements of, the *Jurien groundwater area allocation plan* and the *Rights in Water and Irrigation Act, 1914*. These reference sheets provide basic information that we use in a clause 7 (2) licence assessment process under the Act (see Appendix A). The information contained in the reference sheets must also be used in conjunction with the following information:

- the objectives for water management described in the *Jurien groundwater area allocation plan* (Chapter 2 of the plan)
- the policies and rules listed in the *Jurien groundwater area allocation plan* (sections 4.1 and 4.2 of the plan)
- state and Commonwealth legislation relating to water and its use (Appendix B)
- licensing process (Appendix A), unless otherwise stated in the plan
- statewide policies (Appendix A)
- *Allocation limit review for the Arrowsmith and Jurien groundwater areas* (DoW 2009).

There are also numerous documents produced by the department and other government agencies that provide information on a range of water management

issues that can be used as reference material for licence applications and in the assessment process. The most relevant of these are listed in Appendix B.

Appendix C provides a list of useful departmental websites to access for additional information linked to components of the water management process and used in the licence assessment process. Any licence application should be consistent with other departmental plans and other government agencies plans or strategies where applicable.

Please note that all data presented have specified dates of collection and interpretation. Contact our regional office in Geraldton for up-to-date information.

All technical and supporting documents are available on the department's website <www.water.wa.gov.au/allocationplanning>.

1.5 Water information data requests

The Department of Water monitors water levels and water quality in its monitoring bore network, and stores the data on our water information network. This information is available upon request using the data request form found here:

<www.water.wa.gov.au> Tools >Monitoring and data> or by contacting the department's regional office in Geraldton. You can email or post the completed form to us.

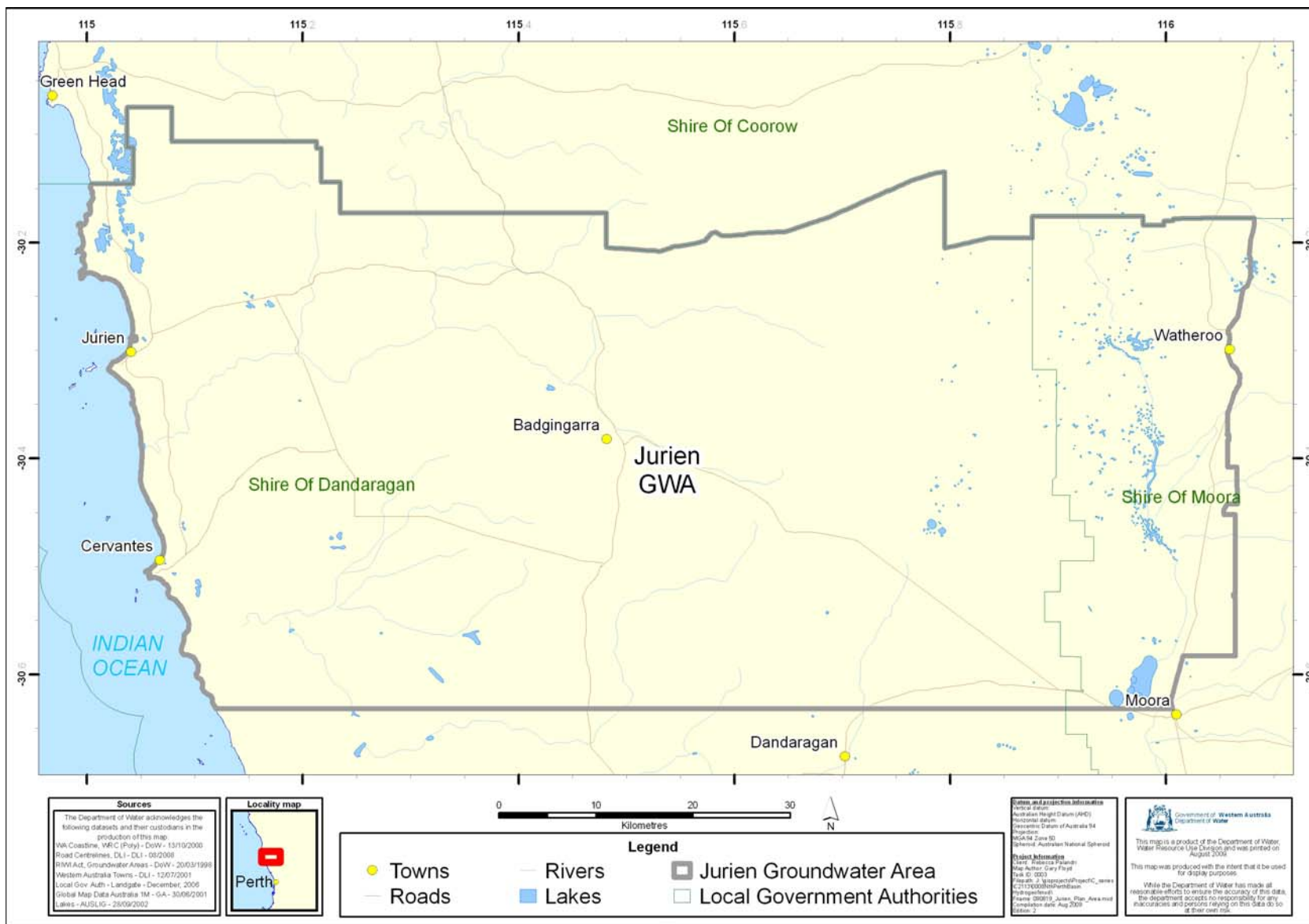


Figure 1 The plan area

2 Subarea reference sheets

We assess licence applications under clause 7 (2) of the *Rights in Water and Irrigation Act 1914*. In conducting this assessment we consider the impacts from the abstraction of the water and its use on ecological, cultural, social and economic factors.

Important sites and values that we consider for all groundwater licence applications are listed in the subarea reference sheets. These are not the full list of values or sites, but the most relevant to water management. The main sections of the subarea reference sheets are discussed below.

Ecological

When we assess a licence application, we consider nearby groundwater-dependent ecosystems (GDE). A map of potential groundwater-dependent ecosystems in the Northern Perth Basin is in Rutherford, Roy and Johnson (2005) which is available on our website. Alternatively, you can view the map by clicking on the following link.

http://portal.water.wa.gov.au/portal/page/portal/WaterManagement/Publications/HydrogeologicalRecordsSeries/Content/HG11_MAP.pdf

Many groundwater-dependent ecosystems contain or are linked to:

- declared rare flora
- declared rare fauna
- threatened ecological communities
- environmental protection policy wetlands
- Australian national conservation areas
- Ramsar wetlands
- watercourses and their associated pools, bed and banks.

These sites are listed in the subarea reference sheets to highlight their presence. The level of knowledge on these sites may be limited and as such, we may require licensees to undertake investigation work, if it has not previously been carried out, in order to prove that the proposed abstraction will not adversely affect these sites.

Cultural

The claimant groups listed and any reference to Aboriginal sites of significance (listed heritage sites) have been extracted from the Department of Indigenous Affairs database. The information only refers to those claims that have been determined and the sites that are listed on the permanent register.

The sites listed in the subarea reference sheets are known to be linked to water and licensing officers will need to undertake a full search during a licence assessment to ensure that the proposed impacts are acceptable. However, applicants may need to

undertake work associated with an Aboriginal heritage site if it is likely to be disturbed. During the licence assessment process we consult with the Department of Indigenous Affairs and we will advise applicants when further work is required.

Social

The major social water use values we consider are public and private drinking water (including domestic, stock and garden use) and recreational sites where water is used. The localities in each subarea are listed to help licensees find out which subarea they are located in. Although there are many different types of recreational sites related to water, only those which are known to be groundwater-dependent are listed.

2.1 Badgingarra

| Badgingarra | | | | | | | | | | | | | | | | | | | | |
|--|------------------------------|--|------------|---------------------|--------|--------------|--------|---------------------|-------|----------------------------|-------|-------------------|-------|----------------|-------|---------------------|-------|-------------|--|---|
| Subarea description | | | | | | | | | | | | | | | | | | | | |
| Area | 1317 km ² | | | | | | | | | | | | | | | | | | | |
| Proclamation | Jurien groundwater area 1990 | | | | | | | | | | | | | | | | | | | |
| Shire | Dandaragan | | | | | | | | | | | | | | | | | | | |
| Rainfall | 548 mm ¹ | | | | | | | | | | | | | | | | | | | |
| Licensed water use (as at December 2008) | | | | | | | | | | | | | | | | | | | | |
| <table><thead><tr><th>Sector</th><th>Percentage</th></tr></thead><tbody><tr><td>General agriculture</td><td>73.58%</td></tr><tr><td>Horticulture</td><td>14.71%</td></tr><tr><td>Mining and industry</td><td>6.27%</td></tr><tr><td>Domestic, stock and garden</td><td>3.19%</td></tr><tr><td>Irrigated pasture</td><td>1.28%</td></tr><tr><td>Service sector</td><td>0.78%</td></tr><tr><td>Public water supply</td><td>0.19%</td></tr><tr><td>Viticulture</td><td></td></tr></tbody></table> | | Sector | Percentage | General agriculture | 73.58% | Horticulture | 14.71% | Mining and industry | 6.27% | Domestic, stock and garden | 3.19% | Irrigated pasture | 1.28% | Service sector | 0.78% | Public water supply | 0.19% | Viticulture | | <p><i>Total licensed entitlements:</i> 1 568 113 kL/yr</p> <p><i>Aquifer sourced:</i> Cattamarra: 154 800 kL/yr Yarragadee: 1 413 333 kL/yr</p> |
| Sector | Percentage | | | | | | | | | | | | | | | | | | | |
| General agriculture | 73.58% | | | | | | | | | | | | | | | | | | | |
| Horticulture | 14.71% | | | | | | | | | | | | | | | | | | | |
| Mining and industry | 6.27% | | | | | | | | | | | | | | | | | | | |
| Domestic, stock and garden | 3.19% | | | | | | | | | | | | | | | | | | | |
| Irrigated pasture | 1.28% | | | | | | | | | | | | | | | | | | | |
| Service sector | 0.78% | | | | | | | | | | | | | | | | | | | |
| Public water supply | 0.19% | | | | | | | | | | | | | | | | | | | |
| Viticulture | | | | | | | | | | | | | | | | | | | | |
| Issues for water management | | | | | | | | | | | | | | | | | | | | |
| <p>The nature and location of the aquifers in this subarea may restrict accessibility and availability. There is limited monitoring of the groundwater resources and comprehensive hydrogeological investigations have not been undertaken in this area.</p> | | | | | | | | | | | | | | | | | | | | |
| Allocation and water availability | | | | | | | | | | | | | | | | | | | | |
| Aquifer | Allocation limit kL/yr | Available water | | | | | | | | | | | | | | | | | | |
| Surficial | N/A | Limited to thin sediments and localised areas of saturation. Investigations may be required before accessing this aquifer ² . | | | | | | | | | | | | | | | | | | |
| Cattamarra | 400 000 | Restricted by the location of the aquifer. Investigations may be required before accessing these aquifers ² . | | | | | | | | | | | | | | | | | | |
| Leederville–Parmelia | N/A | | | | | | | | | | | | | | | | | | | |
| Otorowiri | N/A | | | | | | | | | | | | | | | | | | | |
| Yarragadee | 27 500 000 | Contact the Geraldton office for up-to-date availability. | | | | | | | | | | | | | | | | | | |

| Badgingarra | |
|--|--|
| Hydrogeology | |
| Aquifer | Description |
| Surficial | <p>Throughout the Arrowsmith region, east of the Gingin Scarp to the Dandaragan Scarp, the surficial formation a layer of colluvial and alluvial sandy sediments over the underlying formations. These sediments are likely to be localised, with perched groundwater in elevated areas due to local confinement zones of low permeability in the laterite profile. Aquifer ranges from saturated to unsaturated across the subarea.</p> <p>Composed of sand, silt and clay. Water quality ranges from fresh to brackish.</p> |
| Cattamarra | <p>The Cattamarra is present in the north-west portion of the Arrowsmith region in a small area bounded by the Warradarge and Lesueur faults. It is composed of a discrete system of unconfined to semi-confined aquifers within the saturated sandstones bounded by thick mudstones.</p> <p>The aquifer consists predominantly of sandstone with interbedded siltstone, claystone, shale and coal. The Cattamarra is a minor aquifer with the ability to produce moderate to large bore yields. However, water quality is generally brackish.</p> |
| Leederville– Parmelia | <p>The Leederville–Parmelia aquifer is a significant multi-layered aquifer system capable of supplying bore yields of up to 5000 kL/day. It occurs where the Parmelia Formation is unconfined and outcrops in the northern portion of the Dandaragan plateau where it is connected to the overlying Leederville Formation. The Leederville–Parmelia aquifer is confined, in the most part, by the overlying Kardinya Shale (Osborne Formation) and the underlying Otorowiri Siltstone.</p> <p>It is present within the Cretaceous sediments of the Parmelia and Leederville formations. The aquifer is composed of interbedded sandstone, siltstone and shale. Saturated units within the Leederville–Parmelia aquifer commonly appear as a well sorted fine to coarse grained, sometimes pebbly sand, with groundwater salinity ranging from 500–2000 mg/L TDS.</p> |
| Otorowiri | <p>Thin localised, perched aquifers occur along the Dandaragan Scarp slope in the outcrop of the Otorowiri Siltstone (Otorowiri aquifer). The Otorowiri aquifer is a localised confining aquifer overlain by the sandier upper member of the Parmelia Formation. Composed of shale, siltstone and clay, it acts as an aquiclude between the Parmelia and Yarragadee aquifers. Limited ability to provide groundwater through abstraction. Water quality ranges from fresh to brackish.</p> |
| Yarragadee | <p>The Yarragadee aquifer is a major freshwater resource in this subarea which is capable of supplying bore yields of >5000 kL/day. The aquifer is composed of interbedded sand, sandstone, siltstone and shale. Sand content in the formation decreases with depth and varies in thickness across the aquifer. It is generally confined in the Arrowsmith Region, east of the Gingin Scarp, overlain by thin surficial deposits. East of the Eneabba fault it is in a fault block of the Badgingarra aquifer system.</p> |
| Considerations for water use include, but are not limited to, the following | |
| Ecology | |
| <p><i>Wetlands and waterways:</i> Hill River and its tributaries of Coomallo, Boothendarra and Warradarge creeks; Mullering Brook and Bibby Creek.</p> <p><i>Threatened ecological communities and declared rare flora sites:</i> Numerous sites are registered, with the majority associated with the national parks and nature and road reserves in the subarea.</p> | |

| Badgingarra |
|---|
| Culture |
| <p><i>Native Title Claimant:</i> Yued group are registered claimants over this subarea but claims have yet to be determined. Contact the South West Aboriginal Land and Sea council for more information.</p> <p><i>Aboriginal heritage sites:</i> Mullering Brook.</p> |
| Social |
| <p><i>Towns and localities:</i> Badgingarra, Boothendarra, Cooljarloo, Dandaragan, and Hill River localities obtain their water supply for domestic purposes from rainwater tanks and exempt groundwater abstraction.</p> <p>The town of Badgingarra is supplied with scheme water from the Yarragadee aquifer by the Water Corporation. There is a water source protection plan³ and protection zone around the area of abstraction.</p> <p><i>National parks, reserves and state forest:</i> Coomallo, Hill River and Twyata nature reserves, Badgingarra National Park</p> <p><i>Recreational sites:</i> Hill River</p> |

¹ Bureau of Meteorology long term average – Badgingarra research station 1962–2009. See <www.bom.gov.au> for more information.

² Investigations may include, but are not limited to, exploratory drilling, geophysical logs, pump tests, hydrogeological reporting and/or local groundwater modelling depending upon the volume and type of aquifer being accessed. See Section 4.1 of the plan for more information.

³ Badgingarra water reserve water source protection plan – Badgingarra town water supply, (WRC 1999a).

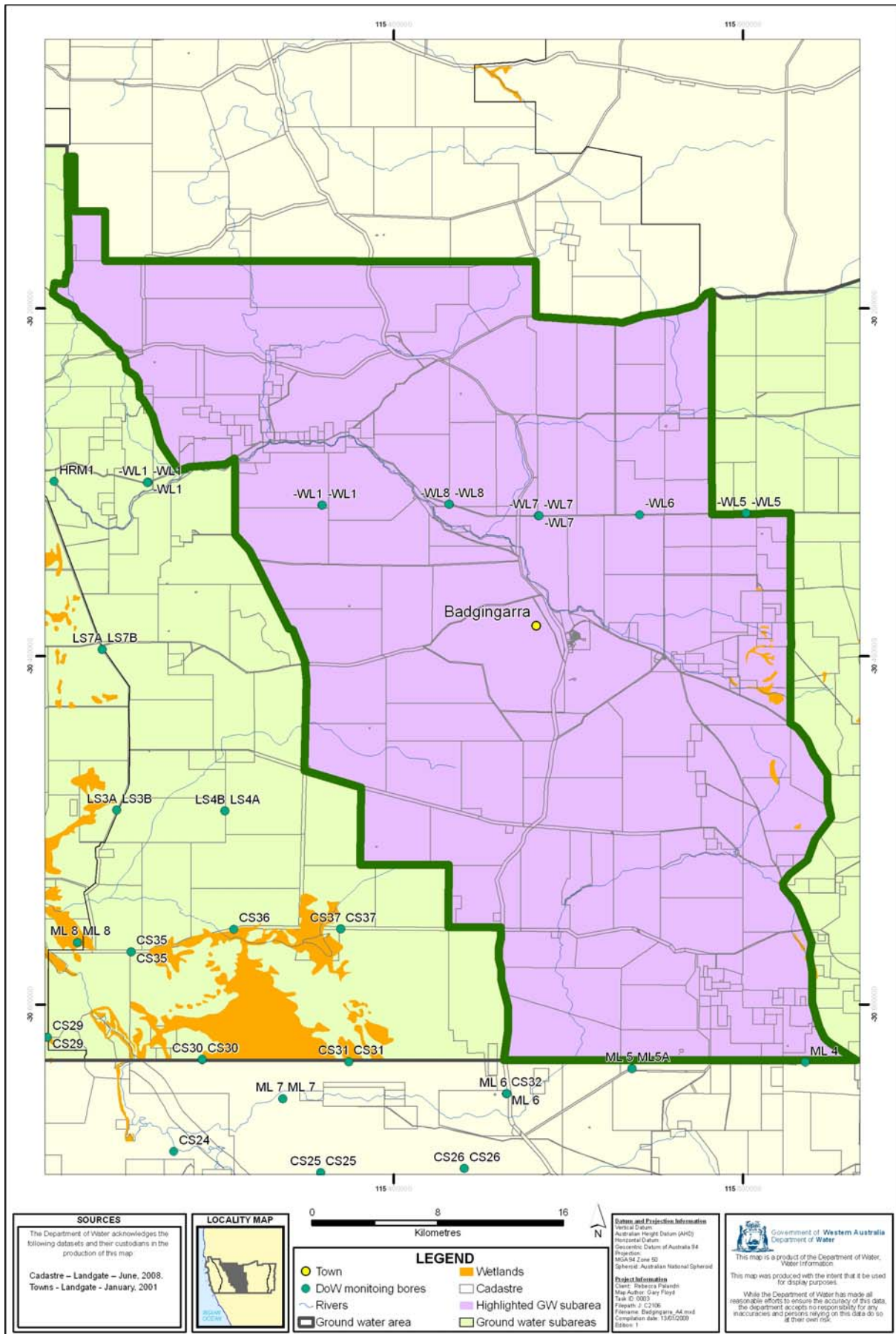
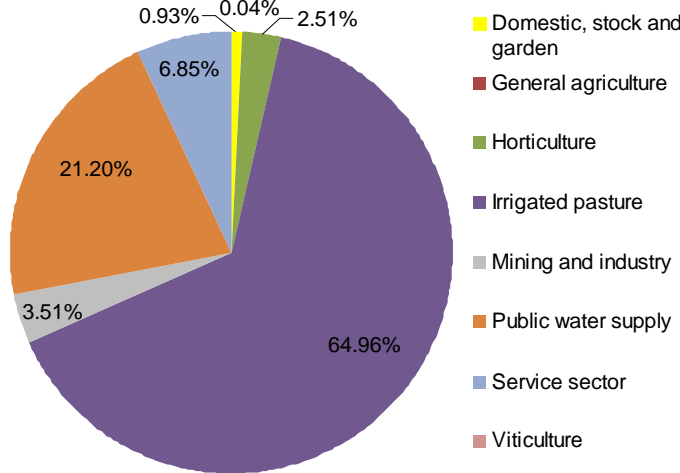


Figure 3 Badgingarra subarea

2.2 Cervantes

| Cervantes | | | | | | | | | | | | | | | | | | | | | | |
|---|------------------------------|--|------------|----------------------------|-------|---------------------|-------|--------------|-------|-------------------|--------|---------------------|-------|---------------------|--------|----------------|-------|-------------|-------|------------|-------|--|
| Subarea description | | | | | | | | | | | | | | | | | | | | | | |
| Area | 830 km ² | | | | | | | | | | | | | | | | | | | | | |
| Proclamation | Jurien groundwater area 1990 | | | | | | | | | | | | | | | | | | | | | |
| Shire | Dandaragan | | | | | | | | | | | | | | | | | | | | | |
| Rainfall | 543 mm ¹ | | | | | | | | | | | | | | | | | | | | | |
| Licensed water use (as at December 2008) | | | | | | | | | | | | | | | | | | | | | | |
|  <table><thead><tr><th>Sector</th><th>Percentage</th></tr></thead><tbody><tr><td>Domestic, stock and garden</td><td>0.93%</td></tr><tr><td>General agriculture</td><td>0.04%</td></tr><tr><td>Horticulture</td><td>2.51%</td></tr><tr><td>Irrigated pasture</td><td>64.96%</td></tr><tr><td>Mining and industry</td><td>3.51%</td></tr><tr><td>Public water supply</td><td>21.20%</td></tr><tr><td>Service sector</td><td>6.85%</td></tr><tr><td>Viticulture</td><td>0.04%</td></tr><tr><td>Unlicensed</td><td>0.04%</td></tr></tbody></table> | | Sector | Percentage | Domestic, stock and garden | 0.93% | General agriculture | 0.04% | Horticulture | 2.51% | Irrigated pasture | 64.96% | Mining and industry | 3.51% | Public water supply | 21.20% | Service sector | 6.85% | Viticulture | 0.04% | Unlicensed | 0.04% | <p><i>Total licensed entitlements:</i> 3 396 090 kL/yr</p> <p><i>Aquifer sourced:</i> Superficial: 3 396 090 kL/yr</p> |
| Sector | Percentage | | | | | | | | | | | | | | | | | | | | | |
| Domestic, stock and garden | 0.93% | | | | | | | | | | | | | | | | | | | | | |
| General agriculture | 0.04% | | | | | | | | | | | | | | | | | | | | | |
| Horticulture | 2.51% | | | | | | | | | | | | | | | | | | | | | |
| Irrigated pasture | 64.96% | | | | | | | | | | | | | | | | | | | | | |
| Mining and industry | 3.51% | | | | | | | | | | | | | | | | | | | | | |
| Public water supply | 21.20% | | | | | | | | | | | | | | | | | | | | | |
| Service sector | 6.85% | | | | | | | | | | | | | | | | | | | | | |
| Viticulture | 0.04% | | | | | | | | | | | | | | | | | | | | | |
| Unlicensed | 0.04% | | | | | | | | | | | | | | | | | | | | | |
| Issues for water management | | | | | | | | | | | | | | | | | | | | | | |
| <p>The nature and location of the aquifers in this subarea may restrict their accessibility and availability.</p> <p>There is only limited monitoring of the groundwater resources and comprehensive hydrogeological investigations have not been undertaken in this area.</p> <p>Cave systems exist extensively throughout the Tamala limestone formation (part of the Superficial aquifer).</p> <p>Within the water source protection zone for the Jurien townsite³ additional water should not be allocated from the Lesueur aquifer, as it is connected to the Tamala limestone (Superficial aquifer) which supplies the town with drinking water.</p> | | | | | | | | | | | | | | | | | | | | | | |
| Allocation and water availability | | | | | | | | | | | | | | | | | | | | | | |
| Aquifer | Allocation limit kL/yr | Available water | | | | | | | | | | | | | | | | | | | | |
| Superficial | 30 000 000 | Contact the Geraldton office for up-to-date availability | | | | | | | | | | | | | | | | | | | | |
| Cattamarra | N/A | Restricted by the location of the aquifer. Investigations may be required before accessing these aquifers ² | | | | | | | | | | | | | | | | | | | | |
| Eneabba | N/A | | | | | | | | | | | | | | | | | | | | | |
| Lesueur | 3 000 000 | No available water as at June 2009. Contact the Geraldton office for up-to-date availability. | | | | | | | | | | | | | | | | | | | | |

| Cervantes | |
|---|---|
| Hydrogeology | |
| Aquifer | Description |
| Superficial | The Superficial formations occur along the coast west of the Gingin Scarp. Composed of sand, silt, clay and limestone. The average thickness of the aquifer is 20 m, though it increases up to 40 m near the scarp. Depth to the water table ranges from 2–15 m below ground and is recharged by rainfall and surface recharge through flood plains. Upward leakage from underlying formations is known to occur. The aquifer discharges to the ocean where a seawater interface exists (ranging from the coastline to 5 km inland). Water quality is generally brackish to saline close to the coast, with some areas fresh towards the scarp. |
| Cattamarra | The Cattamarra is present in the north-west portion of the Arrowsmith Region in a small area bounded by the Warradarge and Lesueur faults. It is composed of a discrete system of unconfined to semi-confined aquifers within the saturated sandstones bounded by thick mudstones. Consists predominantly of sandstone with interbedded siltstone, claystone, shale and coal. The Cattamarra is a minor aquifer with the ability to produce moderate to large bore yields but water quality is generally brackish. |
| Eneabba | The Eneabba Formation forms a multi-layered confined aquifer across the eastern portion of the Swan coastal plain. The Eneabba aquifer consists of an interbedded sequence of saturated sandstone with semi-permeable to impermeable siltstone and shale that is in hydraulic continuity with the Lesueur Sandstone. The thicker sandstone in the outcrop areas of the formation may contain fresh to brackish groundwater. Bore yields are moderate, ranging between 500–1000 kL/day with a groundwater salinity ranging between 500–2000 mg/L TDS. |
| Lesueur | Major aquifer containing large volumes of fresh groundwater. The aquifer ranges from unconfined to confined depending upon the overlying formation (Superficial formations on the coastal plain and the Eneabba formation inland) and where it crops out. The Lesueur aquifer is a confined aquifer system in saturated sandstone. Bore yields are relatively high at 2000 kL/day, with salinity ranging from 500–1500 mg/L TDS. Groundwater recharge is considered to be from the infiltration of rainfall east of the Tamala Limestone. |
| Considerations for water use include, but are not limited to, the following | |
| Ecology | |
| <p><i>Wetlands and waterways:</i> Hill River and estuary, Cockleshell Gully, Frederick Smith Creek, Nambung River, Lake Thetis.</p> <p><i>Threatened ecological communities and declared rare flora sites:</i> Numerous sites are registered with the majority associated with the national parks, nature and road reserves in the subarea.</p> | |
| Culture | |
| <p><i>Native Title Claimant:</i> Yued group are registered claimants over this subarea but claims have yet to be determined. Contact the South West Aboriginal Land and Sea council for more information.</p> <p><i>Aboriginal heritage sites:</i> Hastings Cave</p> | |

Cervantes

Social

Towns and localities: Cervantes, Jurien Bay and Nambung localities are within this subarea, with water supply for domestic purposes being from rainwater tanks and exempt groundwater abstraction. The towns of Jurien and Cervantes are supplied with scheme water from the Superficial aquifer by the Water Corporation. There are water source protection plans³, 4 and protection zones around the areas of abstraction.

National parks, reserves and state forest: Beekeeper's, Southern Beekeeper's and Hill River nature reserves, Drover's Cave, Lesueur and Nambung National Parks

Recreational sites: nature reserves, national parks and caves

¹ Bureau of Meteorology long term average – Jurien Bay 1968–2009. See <www.bom.gov.au> for more information.

² Investigations may include, but are not limited to, exploratory drilling, geophysical logs, pump tests, hydrogeological reporting and/or local groundwater modelling depending upon the volume and type of aquifer being accessed. See section 4.1 of the plan for more information.

³ Jurien water reserve water source protection plan –Jurien town water supply, (DoW 2008a).

⁴ Cervantes water reserve water source protection plan – Cervantes town water supply, (WRC 1999b).

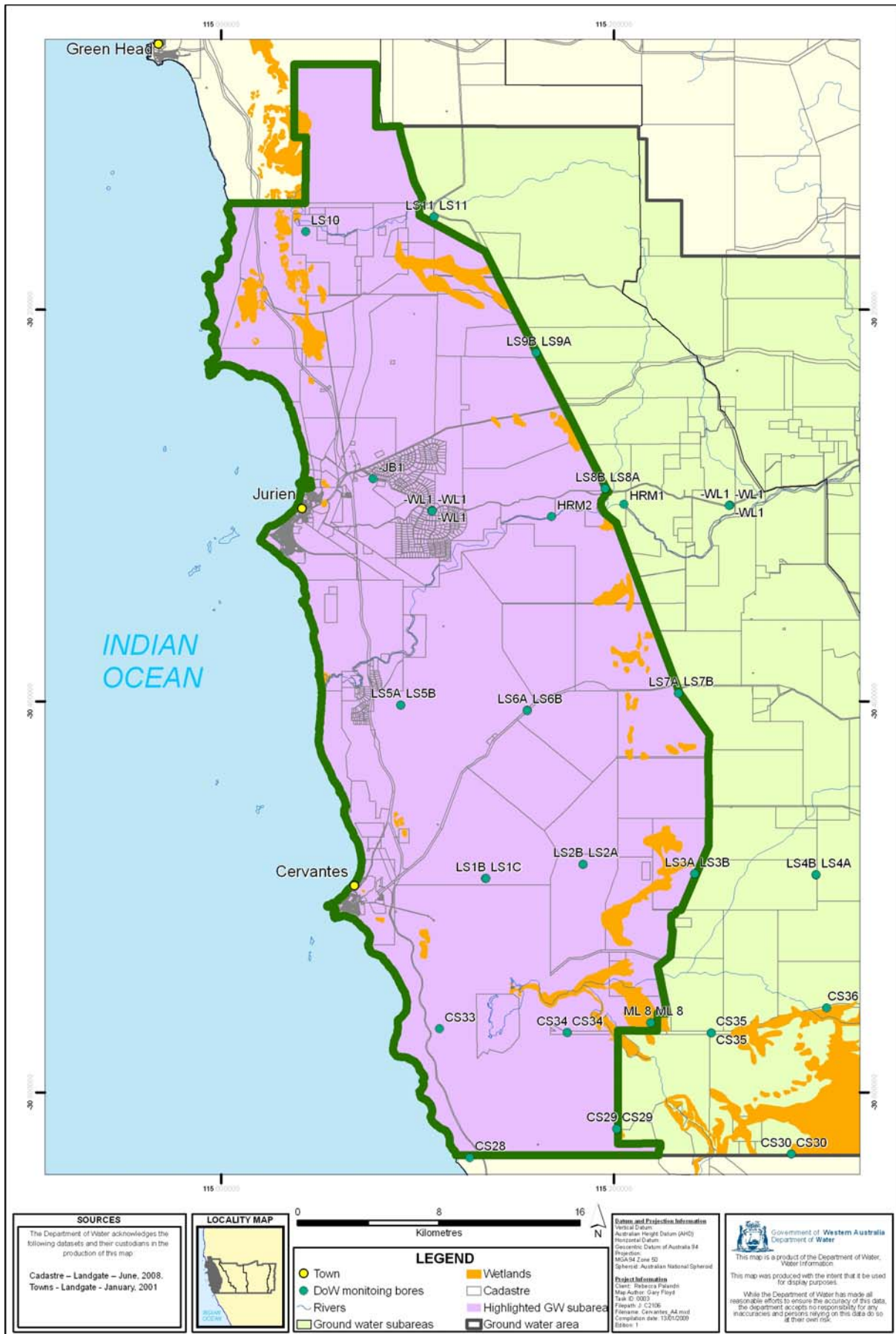


Figure 4 Cervantes subarea

2.3 Dinner Hill

| Dinner Hill | | | | | | | | | | | | | | | | | | | | |
|---|------------------------------|--|------------|--------------|--------|---------------------|--------|---------------------|-------|-------------------|-------|----------------------------|-------|---------------------|-------|----------------|-------|-------------|-------|--|
| Subarea description | | | | | | | | | | | | | | | | | | | | |
| Area | 1700 km ² | | | | | | | | | | | | | | | | | | | |
| Proclamation | Jurien groundwater area 1990 | | | | | | | | | | | | | | | | | | | |
| Shires | Dandaragan and Moora | | | | | | | | | | | | | | | | | | | |
| Rainfall | 105 mm ¹ | | | | | | | | | | | | | | | | | | | |
| Licensed water use (as at December 2008) | | | | | | | | | | | | | | | | | | | | |
| <table><tr><th>Sector</th><th>Percentage</th></tr><tr><td>Horticulture</td><td>64.14%</td></tr><tr><td>General agriculture</td><td>21.52%</td></tr><tr><td>Public water supply</td><td>6.96%</td></tr><tr><td>Irrigated pasture</td><td>6.31%</td></tr><tr><td>Domestic, stock and garden</td><td>0.99%</td></tr><tr><td>Mining and industry</td><td>0.07%</td></tr><tr><td>Service sector</td><td>0.02%</td></tr><tr><td>Viticulture</td><td>0.02%</td></tr></table> | | Sector | Percentage | Horticulture | 64.14% | General agriculture | 21.52% | Public water supply | 6.96% | Irrigated pasture | 6.31% | Domestic, stock and garden | 0.99% | Mining and industry | 0.07% | Service sector | 0.02% | Viticulture | 0.02% | <p><i>Total licensed entitlements:</i> 9 336 500 kL/yr</p> <p><i>Aquifer sourced:</i> Leederville –Parmelia: 9 316 500 kL/yr Surficial: 20 000 kL/yr</p> |
| Sector | Percentage | | | | | | | | | | | | | | | | | | | |
| Horticulture | 64.14% | | | | | | | | | | | | | | | | | | | |
| General agriculture | 21.52% | | | | | | | | | | | | | | | | | | | |
| Public water supply | 6.96% | | | | | | | | | | | | | | | | | | | |
| Irrigated pasture | 6.31% | | | | | | | | | | | | | | | | | | | |
| Domestic, stock and garden | 0.99% | | | | | | | | | | | | | | | | | | | |
| Mining and industry | 0.07% | | | | | | | | | | | | | | | | | | | |
| Service sector | 0.02% | | | | | | | | | | | | | | | | | | | |
| Viticulture | 0.02% | | | | | | | | | | | | | | | | | | | |
| Issues for water management | | | | | | | | | | | | | | | | | | | | |
| <p>The nature and location of the remaining aquifers in this subarea may restrict their accessibility and availability.</p> <p>There is only limited monitoring of the groundwater resources and comprehensive hydrogeological investigations have not been undertaken in this area.</p> | | | | | | | | | | | | | | | | | | | | |
| Allocation and water availability | | | | | | | | | | | | | | | | | | | | |
| Aquifer | Allocation limit kL/yr | Available water | | | | | | | | | | | | | | | | | | |
| Surficial | 3 200 000 | Contact the Geraldton office for up-to-date availability. | | | | | | | | | | | | | | | | | | |
| Leederville– Parmelia | 12 600 000 | Limited. Contact the Geraldton office for up-to-date availability. | | | | | | | | | | | | | | | | | | |
| Mirraboooka | N/A | Restricted by the location of the aquifer. Investigations may be required before accessing these aquifers ² . | | | | | | | | | | | | | | | | | | |
| Otorowiri | N/A | | | | | | | | | | | | | | | | | | | |

| Dinner Hill | |
|---|---|
| Hydrogeology | |
| Aquifer | Description |
| Surficial | Throughout the Dandaragan Plateau, east of the Dandaragan Scarp, the surficial formation a layer of colluvial and alluvial sandy sediments over the underlying formations. These sediments are likely to be localised, with perched groundwater in elevated areas due to local confinement zones of low permeability in the laterite profile. Aquifer ranges from saturated to unsaturated across the subarea. Composed of sand, silt and clay. Water quality ranges from fresh to brackish. |
| Leederville– Parmelia | The Leederville–Parmelia aquifer is a significant multi-layered aquifer system capable of supplying bore yields of up to 5000 kL/day. It occurs where the Parmelia Formation is unconfined and outcrops in the northern portion of the Dandaragan plateau where it is connected to the overlying Leederville Formation. |
| Leederville– Parmelia | The Leederville–Parmelia aquifer is confined, in the most part, by the overlying Kardinya Shale (Osborne Formation) and the underlying Otorowiri Siltstone. It is present within the Cretaceous sediments of the Parmelia and Leederville formations. The aquifer is composed of interbedded sandstone, siltstone and shale. Saturated units within the Leederville–Parmelia aquifer commonly appear as a well sorted fine to coarse grained, sometimes pebbly sand, with groundwater salinity ranging from 500–2000 mg/L TDS. |
| Otorowiri | Thin localised, perched aquifers occur along the Dandaragan Scarp slope in the outcrop of the Otorowiri Siltstone (Otorowiri aquifer). The Otorowiri aquifer is a localised confining aquifer overlain by the sandier, upper member of the Parmelia formation. Composed of shale, siltstone and clay, it acts as an aquiclude between the Parmelia and Yarragadee aquifers. Limited ability to provide groundwater through abstraction. Water quality ranges from fresh to brackish. |
| Mirrabooka | Location of this formation is poorly understood but it is likely to only occur in the south of the subarea. It is only located on the Dandaragan Plateau and is part of the Osborne Formation. Small quantities of groundwater may be available from the sandier sections of the Coolyena Group (Mirrabooka aquifer), especially in the saturated Poison Hill Greensand and Mirrabooka Member of the Osborne Formation. It is an unconfined to semi-confined aquifer generally less than 10 m from the ground surface. The aquifer expresses on the surface and is often waterlogged. It is likely to support groundwater-dependent ecosystems such as the Wannamal Lake system, Bunyanocca and Dandaragan springs. It is known to discharge into surface water systems in the Gingin groundwater area. |
| Considerations for water use include, but are not limited to, the following | |
| Ecology | |
| <p><i>Wetlands and waterways:</i> Dewar Creek, Coonderoo River and Minyulo Brook.</p> <p><i>Threatened ecological communities and declared rare flora sites:</i> Numerous sites are registered with most associated with the Watheroo National Park, nature and road reserves in the subarea.</p> | |
| Culture | |
| <p><i>Native Title Claimant:</i> Yued group are registered claimants over this subarea but claims have yet to be determined. Contact the South West Aboriginal Land and Sea council for more information.</p> <p><i>Aboriginal heritage sites:</i> Mungedar well, Agaton well, Yallalie well and Ellis cave</p> | |

Dinner Hill

Social

Towns and localities: Badgingarra, Boothendarra, Coomberdale, Dandaragan, Moora, Namban and Watheroo localities lie within this subarea, with water supply for domestic purposes being from rainwater tanks and exempt groundwater abstraction. Water Corporation supplies Moora potable drinking water from Dinner Hill Yarragadee aquifer.

National parks, reserves and state forest: Watheroo National Park, Boothendarra and Karamarra nature reserve

¹ Bureau of Meteorology long term average – Moora 1897–2009. See <www.bom.gov.au> for more information.

² Investigations may include, but are not limited to, exploratory drilling, geophysical logs, pump tests, hydrogeological reporting and/or local groundwater modelling depending upon the volume and type of aquifer being accessed. See section 4.1 of the plan for more information.

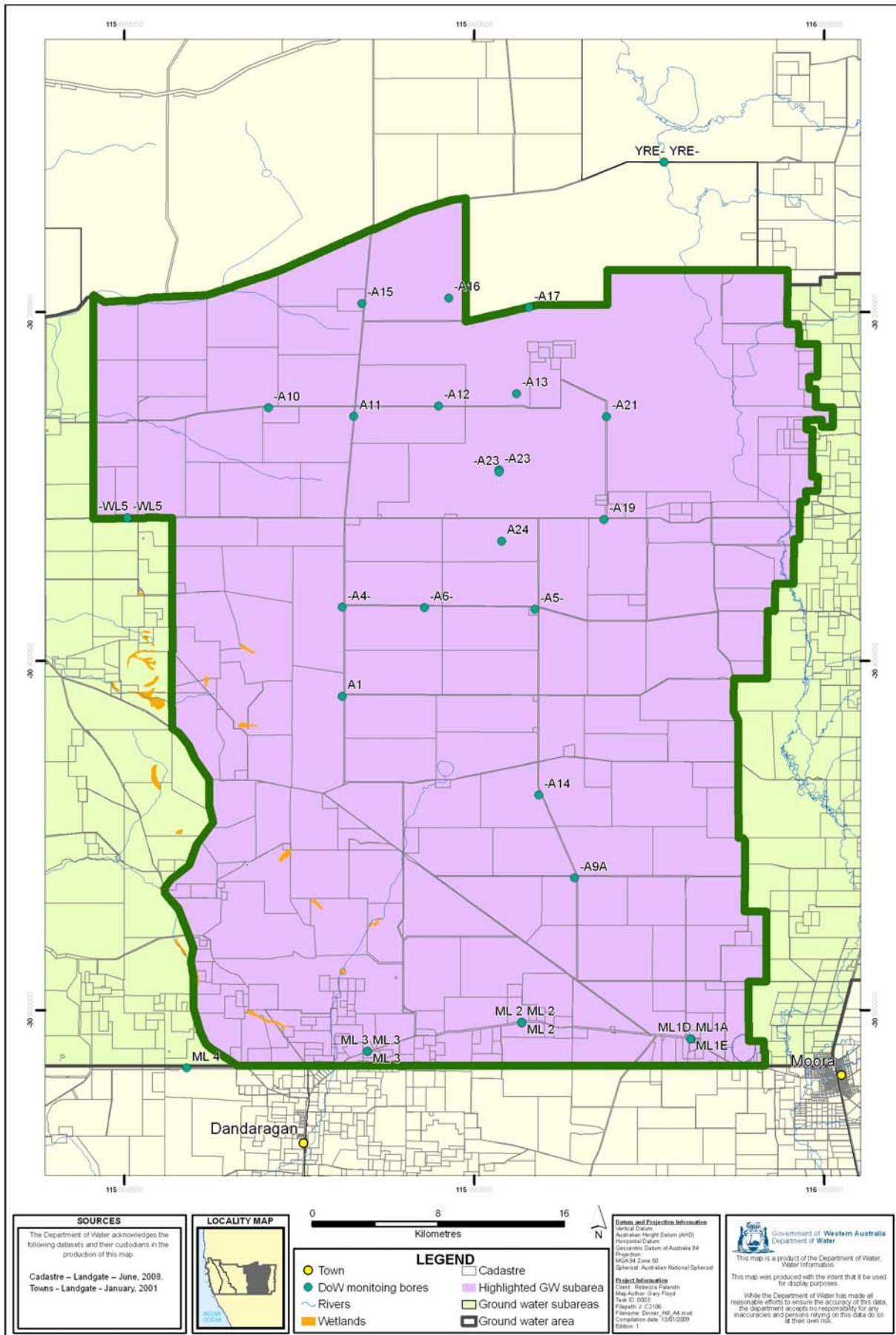
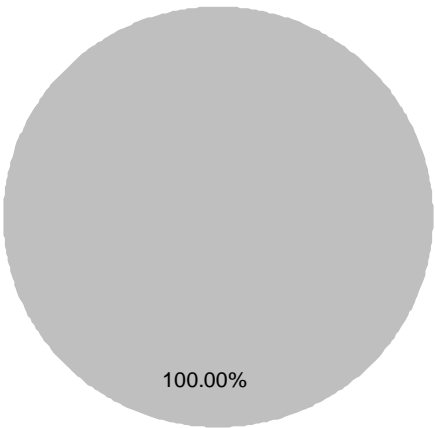


Figure 5 Dinner Hill subarea

2.4 Nambung

| Nambung | | |
|---|------------------------------|--|
| Subarea description | | |
| Area | 735 km ² | |
| Proclamation | Jurien groundwater area 1990 | |
| Shire | Dandaragan | |
| Rainfall | 543 mm ¹ | |
| Licensed water use (as at December 2008) | | |
|  | | <div><div><div></div>Domestic, stock and garden</div><div><div></div>General agriculture</div><div><div></div>Horticulture</div><div><div></div>Irrigated pasture</div><div><div></div>Mining and industry</div><div><div></div>Public water supply</div><div><div></div>Service sector</div><div><div></div>Viticulture</div></div> <div><div>Total licensed entitlements: 5 200 000 kL/yr</div><div>Aquifer sourced: Superficial: 2 700 000 kL/yr, Yarragadee: 2 500 000 kL/yr</div></div> |
| Issues for water management | | |
| <p>The nature and location of the aquifers in this subarea may restrict their accessibility and availability.</p> <p>There is limited monitoring of the groundwater resources and comprehensive hydrogeological investigations have not been undertaken in this area.</p> | | |
| Allocation and water availability | | |
| Aquifer | Allocation limit kL/yr | Available water |
| Superficial | 4 000 000 | Contact the Geraldton office for up-to-date availability |
| Cattamarra | N/A | Restricted by the location of the aquifer. Investigations may be required before accessing these aquifers ² . |
| Eneabba | N/A | |
| Lesueur | N/A | |
| Yarragadee | 8 800 000 | Contact the Geraldton office for up-to-date availability. |

| Nambung | |
|---|---|
| Hydrogeology | |
| Aquifer | Description |
| Superficial | <p>The Superficial formations occur along the coast west of the Gingin Scarp. Composed of sand, silt, clay and limestone. The average thickness of the aquifer is 20 m, though it increases up to 40 m near the scarp. Depth to the water table ranges from 2–15 m below ground and is recharged by rainfall and surface recharge through flood plains. Upward leakage from underlying formations is known to occur.</p> <p>The aquifer discharges to the ocean where a seawater interface exists (ranging from the coastline to 5 km inland). Water quality is generally brackish to saline close to the coast, with some areas fresh towards the scarp.</p> |
| Cattamarra | <p>The Cattamarra is present in the north-west portion of the Arrowsmith Region in a small area bounded by the Warradarge and Lesueur faults. It is composed of a discrete system of unconfined to semi-confined aquifers within the saturated sandstones bounded by thick mudstones. Consisting predominantly of sandstone with interbedded siltstone, claystone, shale and coal. The Cattamarra is a minor aquifer with the ability to produce moderate to large bore yields. However water quality is generally brackish.</p> |
| Eneabba | <p>The Eneabba Formation forms a multi-layered confined aquifer across the eastern portion of the Swan coastal plain. The Eneabba aquifer is composed of an interbedded sequence of saturated sandstone with semi-permeable to impermeable siltstone and shale that is in hydraulic continuity with the Lesueur Sandstone. The thicker sandstone in the outcrop areas of the formation may contain fresh to brackish groundwater. Bore yields are moderate (500–1000 kL/day) with a groundwater salinity ranging between 500–2000 mg/L TDS.</p> |
| Lesueur | <p>Major aquifer containing large volumes of fresh groundwater. The aquifer ranges from unconfined to confined depending upon the overlying formation (Superficial formations on the coastal plain and the Eneabba formation inland) and where it crops out. The Lesueur aquifer is a confined aquifer system in saturated sandstone. Bore yields are relatively high (2000 kL/day) with salinity ranging from 500–1500 mg/L TDS. Groundwater recharge is considered to be from the infiltration of rainfall east of the Tamala Limestone.</p> |
| Yarragadee | <p>The Yarragadee aquifer is a major freshwater resource in this subarea which is capable of supplying bore yields of > 5000 kL/day. It is generally confined in the Arrowsmith region and on the Swan Coastal Plain, east of the Beagle fault system and Gingin Scarp. The aquifer is composed of interbedded sand, sandstone, siltstone and shale. Sand content in the formation decreases with depth and varies in thickness across the aquifer.</p> |
| Considerations for water use include, but are not limited to, the following | |
| Ecology | |
| <p><i>Wetlands and waterways:</i> Bibby and Mount Jetty creeks, Hill River and its tributary Munbinea creek, Cockleshell Gully</p> <p><i>Threatened ecological communities and declared rare flora sites:</i> Numerous sites are registered with the majority associated with the Lesueur National Park, nature and road reserves in the subarea.</p> | |

| Nambung |
|--|
| Culture |
| <i>Native Title Claimant:</i> Yued group are registered claimants over this subarea but claims have yet to be determined. Contact the South West Aboriginal Land and Sea council for more information. |
| Social |
| <p><i>Towns and localities:</i> Badgingarra, Cooljarloo, Jurien Bay and Nambung localities lie within this subarea, with water supply for domestic purposes being from rainwater tanks and exempt groundwater abstraction.</p> <p><i>National parks, reserves and state forest:</i> Lesueur National Park, Wongonderrah and Hill River nature reserves</p> <p><i>Recreational sites:</i> Lesueur National Park and nature reserves</p> |

¹ Bureau of Meteorology long term average – Jurien Bay 1968–2009. See <www.bom.gov.au> for more information.

² Investigations may include, but are not limited to, exploratory drilling, geophysical logs, pump tests, hydrogeological reporting and/or local groundwater modelling depending upon the volume and type of aquifer being accessed. See section 4.1 of the plan for more information.

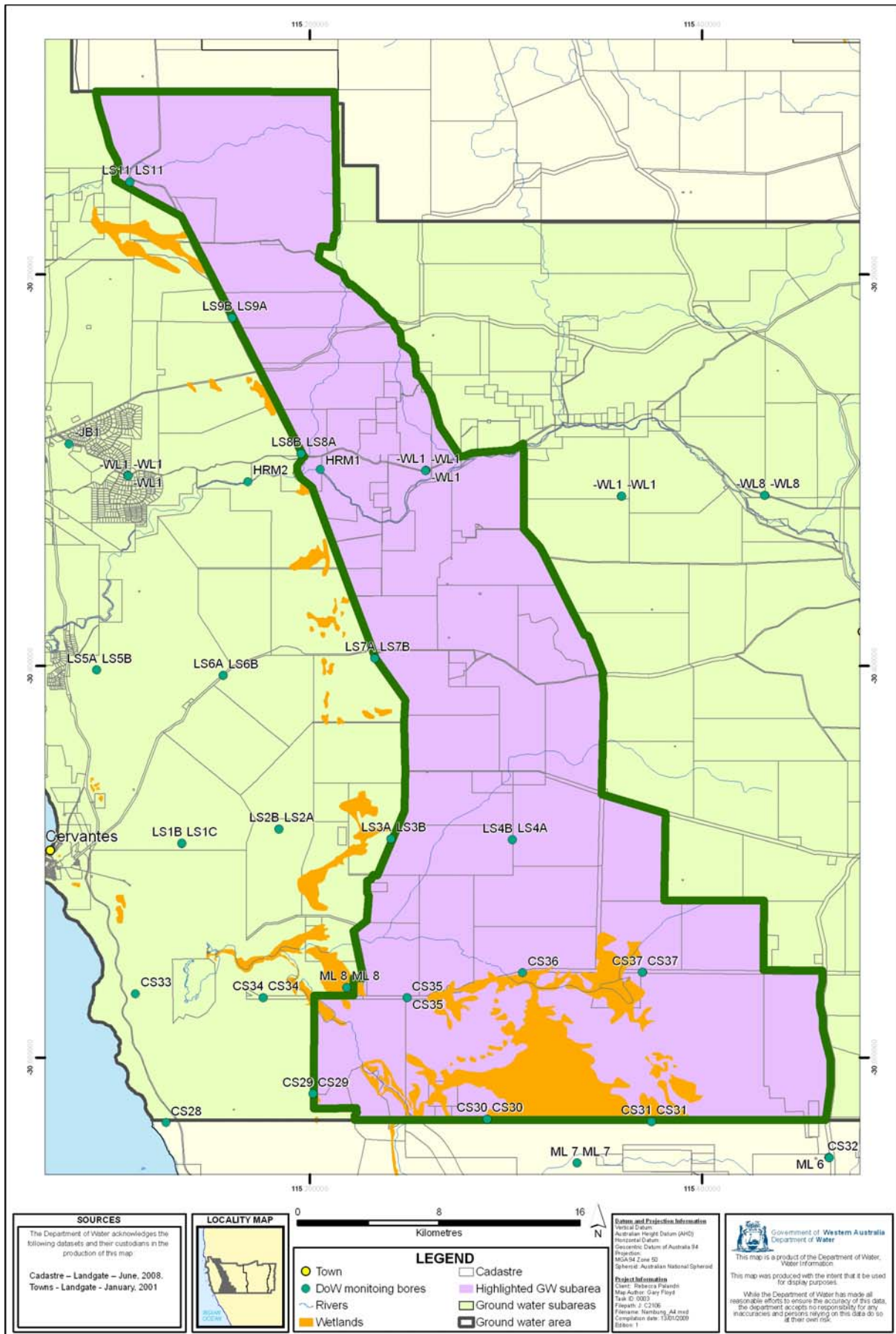
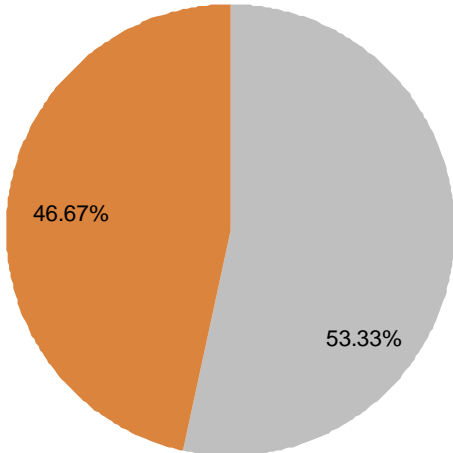


Figure 6 Nambung subarea

2.5 Watheroo

| Watheroo | | | | | | | | | | |
|---|------------------------------|--|---------------------|--------------|-------------------|---------------------|---------------------|----------------|-------------|--|
| Subarea description | | | | | | | | | | |
| Area | 430 km ² | | | | | | | | | |
| Proclamation | Jurien groundwater area 1990 | | | | | | | | | |
| Shire | Moora | | | | | | | | | |
| Rainfall | 105 mm ¹ | | | | | | | | | |
| Licensed water use (as at December 2008) | | | | | | | | | | |
|  <table><tr><td>Domestic, stock and garden</td></tr><tr><td>General agriculture</td></tr><tr><td>Horticulture</td></tr><tr><td>Irrigated pasture</td></tr><tr><td>Mining and industry</td></tr><tr><td>Public water supply</td></tr><tr><td>Service sector</td></tr><tr><td>Viticulture</td></tr></table> | | Domestic, stock and garden | General agriculture | Horticulture | Irrigated pasture | Mining and industry | Public water supply | Service sector | Viticulture | <p>Total licensed entitlements: 150 000 kL/yr</p> <p>Aquifer sourced: surficial: 150 000 kL/yr</p> |
| Domestic, stock and garden | | | | | | | | | | |
| General agriculture | | | | | | | | | | |
| Horticulture | | | | | | | | | | |
| Irrigated pasture | | | | | | | | | | |
| Mining and industry | | | | | | | | | | |
| Public water supply | | | | | | | | | | |
| Service sector | | | | | | | | | | |
| Viticulture | | | | | | | | | | |
| Issues for water management | | | | | | | | | | |
| <p>The nature and location of the aquifers in this subarea may restrict their accessibility and availability.</p> <p>There is only limited monitoring of the groundwater resources and comprehensive hydrogeological investigations have not been undertaken in this area.</p> | | | | | | | | | | |
| Allocation and water availability | | | | | | | | | | |
| Aquifer | Allocation limit kL/yr | Available water | | | | | | | | |
| Surficial | 900 000 | Contact the Geraldton office for up-to-date availability. | | | | | | | | |
| Leederville | N/A | Restricted by location of aquifer. Investigations may be required before accessing this aquifer ² . | | | | | | | | |
| Fractured rock | N/A | | | | | | | | | |

| Watheroo | |
|--|--|
| Hydrogeology | |
| Aquifer | Description |
| Surficial | Surficial formation forms a shallow localised colluvial and alluvial lens over the underlying formations. The aquifer is composed of sand, silt and clay. Aquifer ranges from saturated to unsaturated across the subarea. Water quality ranges from fresh to brackish. |
| Leederville | The formation is only found along the western edge of the subarea, south-west of the Darling fault. It is underlain by the Parmelia formation and overlain by the Dandaragan sandstone (hydraulically connected). The water quality is generally fresh, but high in iron. The aquifer is composed of interbedded sandstone, siltstone and shale. |
| Fractured rock | Unconfined aquifers are present within open saturated fractures of the Capalcarra Sandstone (Billeranga subgroup) and Noondine Chert and Winemaya Quartzite (Coomberdale subgroup). These aquifers are collectively known as fractured rock and have highly variable hydrogeology. The fractured rock aquifer systems are discrete and generally have a limited aerial extent. Groundwater quality is generally brackish to saline, although quite large supplies of low salinity groundwater have been obtained from the Noondine Chert. Aquifer recharge is restricted with minor infiltration of rainwater into connected fracture systems near the land surface. The groundwater quantity and quality of fractured rock aquifers are highly variable. Generally bore yields from these aquifers are low, commonly less than 100 kL/day. |
| Considerations for water use include, but are not limited to, the following | |
| Ecology | |
| <i>Wetlands and waterways:</i> Coonderoo River and its tributaries Kyaka, Prye and McLeans brooks and Nergaminon Creek. <i>Threatened ecological communities and declared rare flora sites:</i> Numerous sites are registered with the majority associated with the Watheroo National Park, nature and road reserves in the subarea. | |
| Culture | |
| <i>Native Title Claimant:</i> Yued group are registered claimants over this subarea but claims have yet to be determined. Contact the South West Aboriginal Land and Sea council for more information. <i>Aboriginal heritage sites:</i> Koolera well, Kyaka Brook and Cardarie well | |
| Social | |
| <i>Towns and localities:</i> Coomberdale, Moora, Namban and Watheroo localities lie within this subarea, with water supply for domestic purposes being from rainwater tanks and exempt groundwater abstraction. The town of Watheroo and Coomberdale are supplied with scheme water from the surficial aquifer by the Water Corporation. There are water source protection plans ^{3, 4} and protection zones around the areas of abstraction. <i>National parks, reserves and state forest:</i> Watheroo National Park, Namban and Gunyidi nature reserves | |

¹ Bureau of Meteorology long term average – Moora 1897–2009. See <www.bom.gov.au> for more information.

² Investigations may include, but are not limited to, exploratory drilling, geophysical logs, pump tests, hydrogeological reporting and/or local groundwater modelling depending upon the volume and type of aquifer being accessed. See section 4.1 of the plan for more information.

³ Coomberdale water reserve water source protection plan – Coomberdale town water supply, (WRC 1999c).

⁴ Watheroo water reserve water source protection plan – Watheroo town water supply, (WRC 1999d).

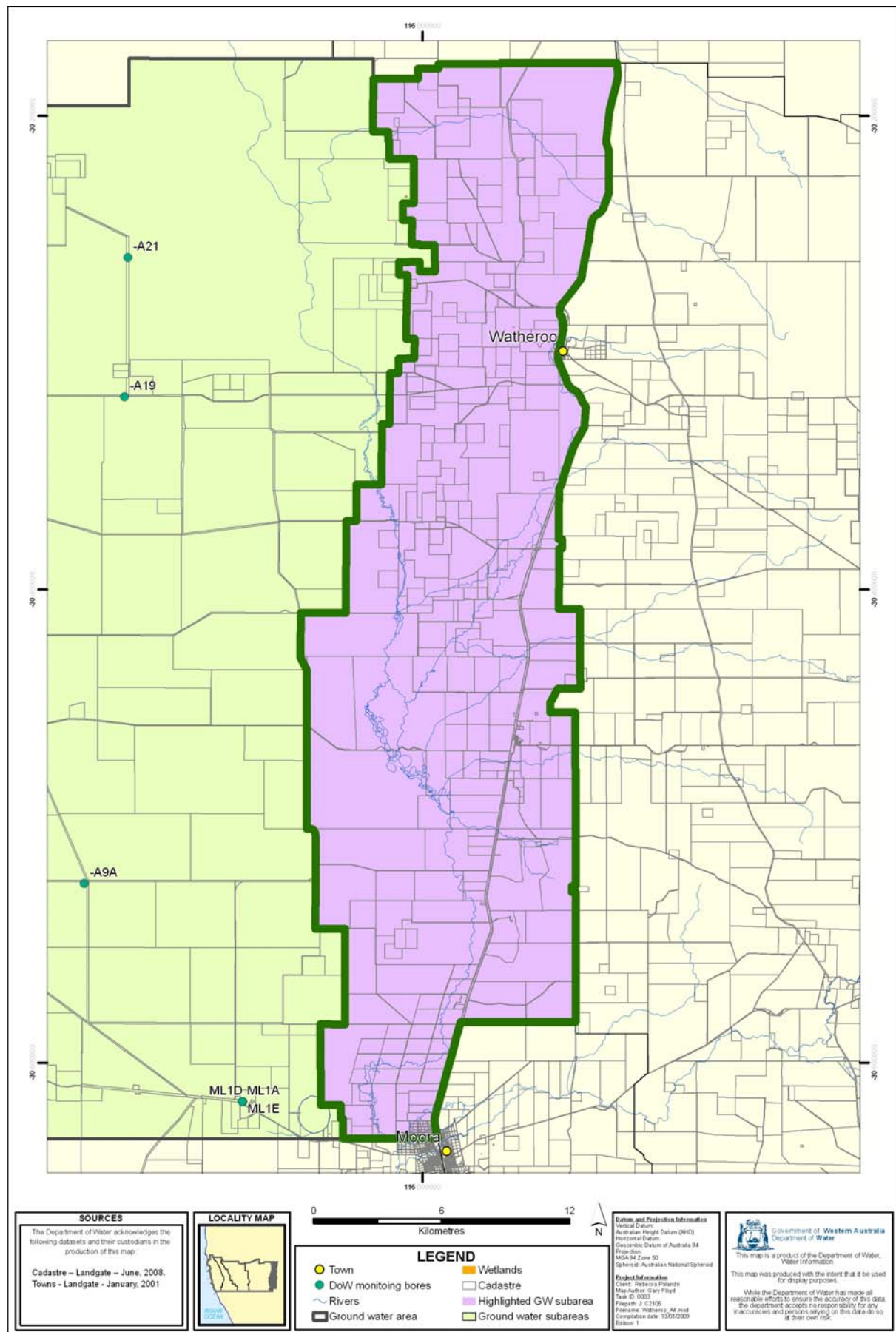


Figure 7 Watheroo subarea

Appendices

Appendix A Statewide licensing policies and process

| Policy name | Brief description |
|--|--|
| <i>Statewide policy no. 2 – Pesticide use in public drinking water source area</i> | Provides the department's position on the use of pesticides within proclaimed public drinking water source areas. |
| <i>Statewide policy no. 3 – Policy statement on water sharing</i> | Provides guidance on the overall policy approach to sharing water between competing users. |
| <i>Statewide policy no. 5 – Environmental water provisions policy for Western Australia</i> | Outlines the department's approach on ensuring that the water needs of the environment are addressed in water allocation decision-making. |
| <i>Statewide policy no. 6 – Transferable (tradeable) water entitlements for Western Australia</i> | Provides guidance on the transfer and trade of water licences. |
| <i>Statewide policy no. 8 – Giving an undertaking to grant a licence or a permit under the Rights In Water and Irrigation Act 1914</i> | Defines the circumstances under which the department will give undertakings for the granting of licences to take water, the approval of agreements with respect to water entitlements, permits to interfere with a water course or licences to construct a well. |
| <i>Statewide policy no. 9 – Water licensing – staged developments</i> | Describes the licensing policy and process used for developments and land uses with a prolonged establishment phase, where water requirements will alter significantly during the life of the project. |
| <i>Statewide policy no. 10 – Use of operating strategies in the water licensing process</i> | Provides guidance on the structure of operating strategies and on the circumstances and purposes under which they are requested. |
| <i>Statewide policy no. 11 – Management of unused licensed water entitlements</i> | Outlines how to manage licence allocations to ensure that reducing unused allocations to a minimum effectively uses the water resources. |
| <i>Draft statewide policy no. 14 – Managing unlicensed groundwater use</i> | Provides the department's position on managing groundwater taken by unlicensed users. |
| <i>Statewide policy no. 16 – Water conservation and efficiency plans</i> | Provides direction on preparing water conservation and efficiency plans required by water users as part of the water licensing process. |
| <i>Statewide policy no. 17 – Timely submissions of required further information</i> | Describes the department's policy on the timeframes for submission of further information that is required in the licence assessment process. |
| <i>Statewide policy no. 19 – Hydrogeological reporting associated with a groundwater well licence.</i> | Provides guidance on when hydrogeological assessments and groundwater monitoring reports are required and the information that they should contain. |
| <i>Strategic policy 5.03 – Metering the take of water</i> | Provides metering of groundwater and surface water guidelines and policy for the state. |

Note: All statewide policies are available on the department's website <www.water.wa.gov.au> Managing our water > Statewide policies>.

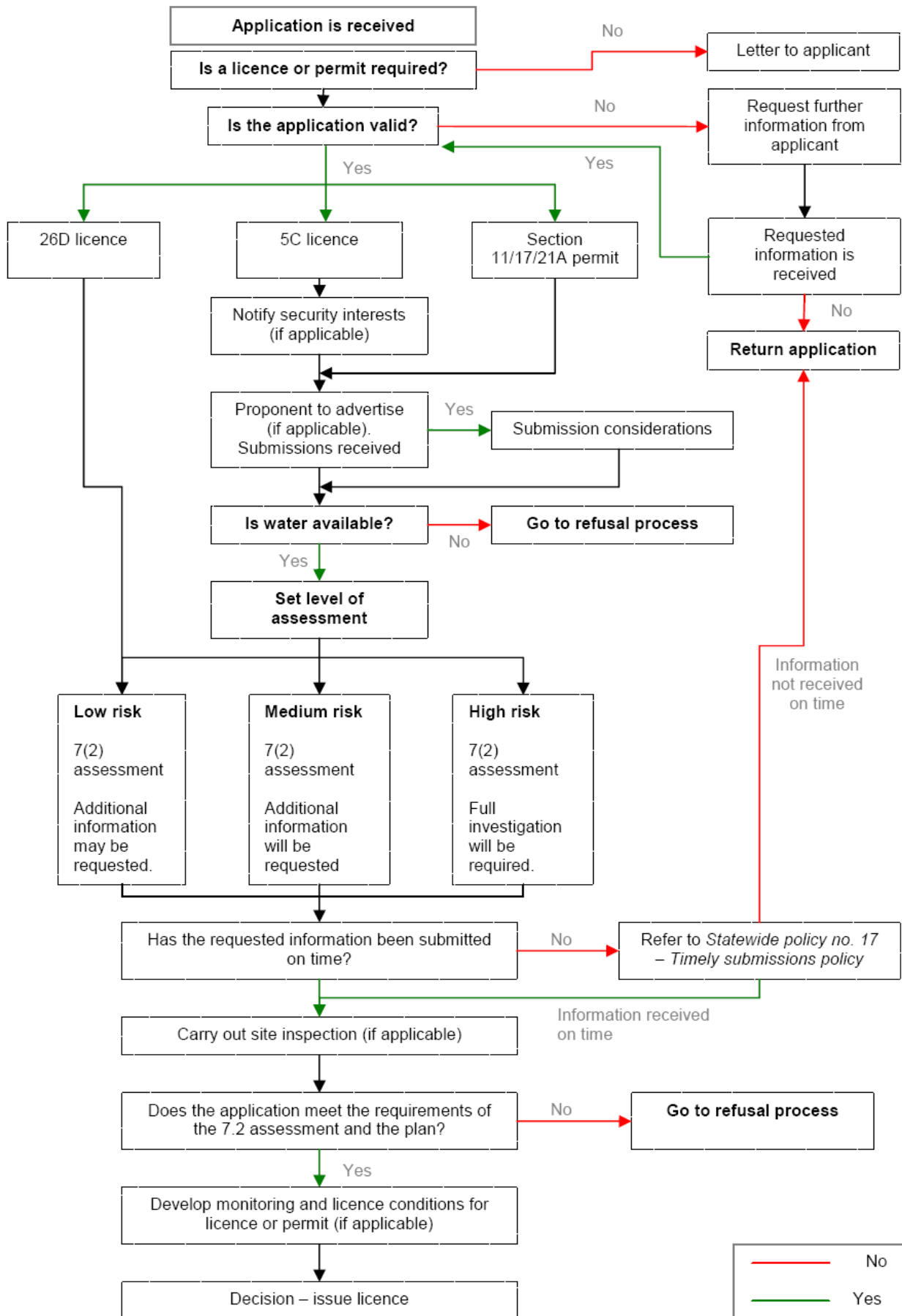


Figure A1 Standard licensing process flowchart

7(2) assessments and groundwater licensing

The Department of Water assesses individual licence applications to construct a bore (26D) and to take water (5C licence) under Schedule 1, Division 2, clause 7 (2) of the *Rights in Water and Irrigation Act, 1914*. The level of assessment against the 7 (2) criteria is determined by the policies and objectives in the plan.

However, each licence application requires local scale assessment to minimise impacts on the local environment and existing users. Table 1 provides a brief summary of the clause 7 (2) assessment process with regard to a groundwater licence application (5C and 26D) and what the department may consider against each of the requirements under clause 7 (2).

Table A1 Clause 7(2) assessment process for groundwater licensing

| Relevant consideration under clause 7(2) | What the department considers |
|--|---|
| 7(2)(a) Public interest Does the proposal have any economic, social or recreational benefits to the public? This is assessed from a regional or statewide point of view. | <ul style="list-style-type: none"> • social benefit (including water for community parks and gardens) • recreational benefit (including aesthetics of a natural system, camping, fishing) • economic benefit (including regional development, prospective employment) • advertising of proposals under <i>Rights in Water and Irrigation Act, 1914</i> which provides information to assess public interest |
| Sustainability assessment A sustainability assessment considers economic, social and ecological factors together and attempts to satisfy as many factors as possible, with minimal trade-offs, applying the principles below: <ul style="list-style-type: none"> • long-term economic health • equity and human rights • biodiversity and ecological integrity. | |
| 7(2)(b) Ecologically sustainable | <ul style="list-style-type: none"> • water availability • requirements of relevant allocation plan • hydrogeological assessment • impact on any ecologically significant sites • an assessment is made on the requirements to protect the ecology: <ul style="list-style-type: none"> – monitoring as part of the licensing conditions – an operating strategy – a water conservation or efficiency plan – a water quality assessment • clearing approval requirements • land capability assessment |

| Relevant consideration under clause 7(2) | What the department considers |
|---|---|
| <p>7(2)(c) Environmentally acceptable Can the economic, social and ecological considerations be satisfied? If not, are the impacts acceptable?</p> <p>Economic Long-term economic health Recognise needs of current and future demand</p> <p>Social Equity and human rights</p> <p>Ecological Biodiversity and ecological integrity</p> | <ul style="list-style-type: none"> any economic values identified through allocation planning categorisation of economic status: public-commercial or non-commercial, or private-commercial or non-commercial economic benefit to local, regional or state market any social and recreational values identified through allocation planning: <ul style="list-style-type: none"> cultural and heritage considerations: <ul style="list-style-type: none"> Aboriginal sites of significance Native Title claims Australian heritage listings social and recreational benefits or liabilities (including fishing) findings of the 7(2) (b) assessments |
| <p>7(2)(d) May prejudice other current and future needs for water The regional view</p> | <ul style="list-style-type: none"> hydrogeological assessment – effects on current and future needs for water and possible environmental impacts on surrounding areas |
| <p>7(2)(e) Detrimental effect on another person The local view</p> | <ul style="list-style-type: none"> need for advertising process need for an operating strategy hydrogeological assessment (impact on existing use) |
| <p>7(2)(f) Could be provided for by another source Assessment considers alternative options and sources</p> | <ul style="list-style-type: none"> most appropriate resource – hydrogeological assessment and water availability availability of other sources such as surface water, recycled water, scheme water most economically viable source |

| Relevant consideration under clause 7(2) | What the department considers |
|---|--|
| 7(2)(g) Are in keeping with: (i) Local practices Local practices and planning requirements | <ul style="list-style-type: none"> • local government authority approval and/or compatible with current land use zoning • application has other relevant government approvals including: <ul style="list-style-type: none"> – Department of Agriculture and Food – Department of Mines and Petroleum – Department of State Development – Department of Planning – Western Australian Planning Commission – Department of Environment and Conservation. • common practice within the local area |
| 7(2)(g) (ii) Relevant local by-law cont. | <ul style="list-style-type: none"> • by-laws under <i>Rights in Water and Irrigation Act, 1914</i> or <i>Environmental Protection Act 1986</i> – there are none at present in the Jurien groundwater area |
| (iii) Plan approved under Part III Division 3d Subdivision 2 | <ul style="list-style-type: none"> • meets the requirements of the plan approved under Part III Division 3d Subdivision 2 (statutory) |
| (iv) Relevant previous decisions of the department | <ul style="list-style-type: none"> • departmental policies and plans • previous licensing decisions where relevant |
| 7(2)(h) Are consistent with: (i) Land use planning Instruments | <ul style="list-style-type: none"> • application is consistent with Environmental Protection (Clearing of Native Vegetation) Regulations 2004 • local government approval • Western Australian Planning Commission approval • other relevant planning and scheme text |
| (ii) The requirements and policies of other government agencies Issue of a licence cannot pre-empt approvals under the <i>Native Title Act 1993</i> and Part V of the <i>Environmental Protection Act, 1986</i> . | <ul style="list-style-type: none"> • department refers proposal to other government departments, where appropriate |
| (iii) Any inter-governmental agreement or arrangement | <ul style="list-style-type: none"> • related inter-governmental agreements or arrangements (such as State Development Acts) |

Appendix B Other plans and strategies to be considered

| Plan | Consideration | Agency |
|--|---|--------|
| <i>State water plan</i> | Strategic direction | DoW |
| <i>Better managing the urban water cycle – the urban drainage initiative</i> | Urban water drainage and management for better urban design. | DoW |
| <i>Badgingarra water reserve water source protection plan – Badgingarra town water supply</i> | Manages land and water use activities in this area to ensure safe drinking water quality | DoW |
| <i>Cervantes water reserve water source protection plan – Cervantes town water supply</i> | Manages land and water use activities in this area to ensure safe drinking water quality | DoW |
| <i>Coomberdale water reserve water source protection plan – Coomberdale town water supply</i> | Manages land and water use activities in this area to ensure safe drinking water quality | DoW |
| <i>Watheroo water reserve water source protection plan – Watheroo town water supply</i> | Manages land and water use activities in this area to ensure safe drinking water quality | DoW |
| <i>Moora water reserve water source protection plan – Moora town water supply</i> | Manages land and water use activities in this area to ensure safe drinking water quality | DoW |
| <i>Jurien water reserve drinking water source protection plan 2008</i> | Manages land and water use activities in this area to ensure safe drinking water quality | DoW |
| <i>Nambung National Park, Wanagarra Nature Reserve, Nilgen Nature Reserve and Southern Beekeepers Nature Reserve management plan 1998–2008</i> | Nature reserve and national park management plans which deal with plant, animal, fire and other conservation issues for certain areas | DEC |
| <i>Turquoise coast island nature reserves management plan 2004</i> | Nature reserve and national park management plans which deal with plant, animal, fire and other conservation issues for certain areas | DEC |

DEC = Department of Environment and Conservation DoW = Department of Water

Major legislation relating to water resource management in the South West

Commonwealth legislation:

- *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*
- *National Water Commission Act 2004*
- *Natural Heritage Trust Act of Australia 1997*
- *National Environmental Protection Council Act 1994*
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
- *World Heritage Properties Conservation Act 1995.*

State legislation:

- *Conservation and Land Management Act 1984*
- *Native Title (State Provisions) Act 1999*
- *Aboriginal Heritage Act 1972*
- *Country Areas Water Supply Act 1947*
- *Environmental Protection Act 1986, amendment 1998*
- *Environmental Protection Regulations 1987*
- *Heritage of Western Australia Act 1990*
- *Metropolitan Water Supply, Sewerage and Drainage Act 1909 (including by-laws)*
- *National Trust of Australia (WA) Act 1964*
- *Rights in Water and Irrigation Act 1914, Regulations 2000*
- *Water Agencies (Powers) Act 1984*
- *Soil and Land Conservation Act 1945, Regulations 1992*
- *Town Planning and Development Act 1928*
- *Planning and Development Act 2005*
- *Water and Rivers Commission Act 1995*
- *Waterways Conservation Act 1976*
- *Western Australian Planning Commission Act 1985*
- *Wildlife Conservation Act 1950, Regulations 1970*
- *Pollution of Waters by Oil and Noxious Substances Act 1987*
- *Contaminated Sites Act 2003.*

Appendix C Useful information and websites for other government departments

| Government department | Website | Contact for more information on |
|---|-----------------------------|---|
| Department of Environment and Conservation | <www.dec.wa.gov.au> | Acid sulfate soils and contaminated sites Vegetation clearing and declared rare flora, fauna and threatened ecological sites Environmental protection policy wetlands National Park management |
| Environmental Protection Authority | <www.epa.wa.gov.au> | EPA approvals and processes |
| Department of Environment, Water, Heritage and the Arts | <www.environment.gov.au> | Information and approvals under the <i>Environmental Protection and Biodiversity Conservation Act 1999</i> |
| Department of Agriculture and Food | <www.dafwa.wa.gov.au> | Best management practices and information on agriculture and food |
| Bureau of Meteorology | <www.bom.wa.gov.au> | Rainfall, evaporation and climate related information |
| Department of Mines and Petroleum | <www.dmp.wa.gov.au> | Mining tenements, best-management practices and approvals |
| Geological Survey of Western Australia | | Geological survey maps and reports |
| Department of State Development | <www.dsd.wa.gov.au> | State agreement Acts and state developments |
| Department for Planning and Western Australian Planning Commission | <www.planning.wa.gov.au> | Cadastral information, land planning and land use development approvals. |
| Department of Fisheries | <www.fish.wa.gov.au> | Aquaculture |
| Forest Products Commission | <www.fpc.wa.gov.au> | Plantations |
| Department of Indigenous Affairs | <www.dia.wa.gov.au> | Aboriginal heritage sites |
| Office of Native Title | <www.nativetitle.wa.gov.au> | Native title determination |
| Heritage Council of Western Australia | <www.heritage.wa.gov.au> | Heritage sites |
| Landgate | <www.landgate.wa.gov.au> | Public mapping information for government agencies |

Glossary

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| Abstraction | The permanent or temporary withdrawal of water from any source of supply, so that it is no longer part of the resources of the locality. |
| AHD | Australian height datum – mean sea level at Fremantle + 0.026 m. |
| Allocation limit | Annual volume of water set aside for use from a water resource. |
| Aquifer | A geological formation or group of formations capable of receiving, storing and transmitting water. |
| Artesian aquifer | A confined aquifer in which the hydraulic pressure will cause water to rise in a bore or spring above the land surface. If the pressure is insufficient to cause the well to flow at the surface, it is called a sub-artesian aquifer. |
| Artesian bore | A bore, including all associated works, from which water flows, or has flowed, naturally to the surface. |
| Base flow | The component of streamflow supplied by groundwater discharge. |
| Bore | An opening in the ground, normally vertical hole drilled in soil or rock, made or used to obtain access to underground water. This is equivalent to the description of a 'well' in the <i>Rights In Water and Irrigation Act 1914</i> . |
| Confined aquifer | An aquifer lying between confining layers of low permeability strata (such as clay, coal or rock) so that the water in the aquifer cannot easily flow vertically. |
| Consumptive use | The use of water for private benefit consumptive purposes including irrigation, industry, urban and stock and domestic use. |
| Dewatering | Removing underground water to facilitate construction or other activity. It is often used as a safety measure in mining below the watertable or as a preliminary step to development in an area. |
| Discharge | The water that moves from the groundwater to the ground surface or above, such as a spring. This includes water that seeps to the ground surface, evaporation from soil, and water extracted from groundwater by plants (evapotranspiration) or engineering works (groundwater pumping). |
| Domestic bore | A bore used for providing the household and household garden watering requirements. |
| Drawdown | The lowering of a watertable resulting from the removal of water from an aquifer or reduction in hydraulic pressure. |
| Ecological water requirements | The water regime required to maintain ecological values of water-dependent ecosystems at a low level of risk. |
| Environmental water provisions | The water regimes that are provided as a result of the water allocation decision-making process taking into account ecological, social, cultural and economic impacts. They may meet in part or in full the ecological water requirements. |
| First-in first-served | A process by which groundwater entitlements are allocated consistent with the order in which licence applications are received by the Department of Water. |
| Groundwater | The water that occurs in pore spaces and fractures in rocks beneath the ground surface. Also see aquifer, confined and unconfined aquifer. |
| 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. |

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| Groundwater-dependent ecosystem | An ecosystem that is dependent on groundwater for its existence and health. |
| Hydrogeology | The hydrological and geological science concerned with the occurrence, distribution, quality and movement of groundwater, especially relating to the distribution of aquifers, groundwater flow and groundwater quality. |
| Licence | A formal authorisation which entitles the licence holder to 'take' water from a watercourse, wetland or underground source for a specified quantity and period of time. |
| Non-artesian well | A well, including all associated works, from which water does not flow, or has not flowed, naturally to the surface but has to be raised, or has been raised, by pumping or other artificial means. |
| Precautionary principle | Taking a cautious approach to development and environmental management decisions when information is uncertain, unreliable or inadequate. |
| Public water supply reserve | Reservation of a volume of water, from the allocation limit, to supply drinking water for human consumption. |
| Purchaser | A person receiving a trade is referred to as the purchaser. Any person permitted by the <i>Rights in Water and Irrigation Act 1914</i> to hold a water licence is potentially able to purchase a licensed entitlement. |
| Recharge | Water that infiltrates into the soil to replenish an aquifer. |
| Resource | In the Jurien groundwater area a resource is a given aquifer within a particular groundwater subarea. |
| Salinity | The measure of total soluble salt or mineral constituents in water. Water resources are classified based on salinity in terms of total dissolved solids (TDS) or total soluble salts (TSS). Measurements are usually in milligrams per litre (mg/L) or parts per thousand (ppt). |
| Social value | A particular in situ quality, attribute or use that is important for public benefit, welfare, physical and spiritual state or health. |
| Stock bore | A bore that provides drinking water for stock. |
| Subarea | A smaller area determined by the Department of Water within a proclaimed area used for water allocation planning and management purposes, the boundaries of which are primarily defined by the location of the water resource. |
| Surface water | Water flowing over or held in streams, rivers and wetlands on the surface of the land. |
| Sustainability | Meeting the needs of current and future generations through integration of environmental protection, social advancement and economic prosperity. |
| Sustainable groundwater yield | The amount of water that can be abstracted/extracted over time from a water resource while maintaining the ecological values (including assets, functions and processes). |
| Throughflow | The flow of water within an aquifer. |
| Trade | Sale of part or all of a licensed entitlement, by a licensee (vendor) to a second party (purchaser). This involves moving the point of abstraction from one property to another. |
| Transfer | A transfer is a change in ownership of the water licence associated with the sale of the property to which the licence applies. There is no change in the location of the abstraction. Licences can be transferred without recompense. |

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| Transpiration | The water taken up by plants, normally measured in millimetres. |
| Unconfined aquifer | Is the aquifer nearest the surface, having no overlying confining layer. The upper surface of the groundwater within the aquifer is called the watertable. An aquifer containing water with no upper non-porous material to limit its volume or to exert pressure. |
| Unconformity | A discontinuity in rock sequence indicating interruption of sedimentation, commonly accompanied by erosion of rocks below the break or the interface between such strata. |
| Vendor | A licence holder wishing to trade a water entitlement is referred to as the vendor. Any person permitted by the <i>Rights in Water and Irrigation Act 1914</i> to hold a water licence is potentially able to sell a licensed entitlement. |
| Water use efficiency | Increasing water supply efficiency and water demand efficiency to minimise the taking and use of water. |
| Water entitlement | The quantity of water that a person is entitled to take on an annual basis in accordance with the <i>Rights in Water and Irrigation Act 1914</i> and a licence. |
| 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 allow the protection and use of water on or under the land for public water supplies. |
| Watertable | The saturated level of the unconfined groundwater. Wetlands in low-lying areas are often seasonal or permanent surface expressions of the watertable. |
| Well | An opening in the ground made or used to obtain access to underground water. This includes soaks, wells, bores and excavations. |
| Wetland | An area that is permanently, seasonally or intermittently waterlogged or inundated with water that may be fresh, saline, flowing or static. (Taken from Ramsar Convention definition) |
| Yield | The volume of water that may be drawn from a well or water supply system. |

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) |

Shortened forms

| | |
|------|--|
| AHD | Australian height datum |
| ASS | Acid sulfate soils |
| DEC | Department of Environment and Conservation |
| DIA | Department of Indigenous Affairs |
| DoW | Department of Water |
| DPC | Department of the Premier and Cabinet |
| EPA | Environmental Protection Authority |
| EWR | Ecological water requirements |
| GDE | Groundwater-dependent ecosystems |
| NACC | Northern Agricultural Catchments Council |
| PASS | Potential acid sulfate soils |
| PWS | Public water supply |
| TDS | Total dissolved solids |
| WAPC | Western Australian Planning Commission |
| WC | Water Corporation |
| WRC | Water and Rivers Commission |

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