



Government of Western Australia  
Department of Water

# Perth Coastal and Gwelup Underground Water Pollution Control Area

Drinking water source protection review

*Integrated water supply scheme*



*Looking after all our water needs*

Water resource protection series  
Report WRP 136  
November 2012



# Perth Coastal and Gwelup Underground Water Pollution Control Area drinking water source protection review

Providing water to the Integrated Water Supply Scheme – supplying the Perth metropolitan and Mandurah areas and the Goldfields and Agricultural Water Supply Scheme

*Looking after all our water needs*

Department of Water

Water resource protection series

Report no. 136

November 2012

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](http://www.water.wa.gov.au)

© Government of Western Australia

November 2012

This work is copyright. You may download, display, print and reproduce this material in unaltered form only (retaining this notice) for your personal, non-commercial use or use within your organisation. Apart from any use as permitted under the *Copyright Act 1968*, all other rights are reserved. Requests and inquiries concerning reproduction and rights should be addressed to the Department of Water.

ISSN 1835-3924 (online)

ISBN 978-1-921992-91-9 (online)

### **Acknowledgements**

The Department of Water would like to thank the following for their contribution to this publication: Jon Kaub, James Mackintosh, Matt Viskovich, Chris Qiu, Stephen Watson and Nigel Mantle (Department of Water), Hew Merrett and Brian Duke (Water Corporation).

For more information about this report, contact

Water Source Protection Planning on +61 8 6364 7600 or [drinkingwater@water.wa.gov.au](mailto:drinkingwater@water.wa.gov.au).

This publication updates a June 2012 internal report.

Cover photograph: Aerial photograph of Perth Coastal Underground Water Pollution Control Area boundary, GIS image by Chris Qiu, using Landgate data.

### **Disclaimer**

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

*This publication is available at our website <[www.water.wa.gov.au](http://www.water.wa.gov.au)> or for those with special needs it can be made available in alternative formats such as audio, large print, or Braille.*

# Contents

Contents .....	iii
Summary .....	iv
<b>1 Review of Perth Coastal and Gwelup UWPCAs drinking water source protection assessment .....</b>	<b>1</b>
1.1 Boundary, priority areas and protection zones .....	1
1.2 Update on water supply scheme and water licensing.....	1
1.3 Potential future land uses .....	2
1.4 Water quality risks .....	2
1.5 Water quality information .....	3
<b>2 Implementation of Perth Coastal and Gwelup UWPCA assessment recommendations .....</b>	<b>4</b>
2.1 Status of previous recommendations .....	4
2.2 Consolidated recommendations .....	6
<b>Appendices .....</b>	<b>7</b>
Appendix A — Figures .....	7
Appendix B — Water quality data .....	11
Appendix C — Photographs .....	15
<b>List of shortened forms .....</b>	<b>17</b>
<b>Glossary.....</b>	<b>18</b>
<b>References .....</b>	<b>22</b>

## Summary

In 2007, the Water Corporation prepared a drinking water source protection assessment for the Perth Coastal and Gwelup Underground Water Pollution Control Areas (UWPCAs, or ‘control areas’). This document was endorsed by the Department of Water. Refer to Figure 1 for the location of these control areas.

This 2012 review considers advice in the 2007 assessment and possible changes to the boundaries and arrangements of these control areas. Any proposed boundary amendments will need to be proclaimed under the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909*.

This review also presents the status of recommendations made in the 2007 assessment to protect water quality and public health. Where appropriate, new recommendations have been made.

Both the 2007 assessment and this document are available on our website or by contacting us (see details on the inside cover of this report).

The Perth Coastal UWPCA stretches 15 to 60 km north of Perth, including portions of many of the city’s northern suburbs. It extends from Warwick at its southern end to Two Rocks at its northern limit. The area is within the local governments of the Cities of Joondalup and Wanneroo.

The Gwelup UWPCA is approximately 7 to 15 km north of Perth, within the City of Stirling, and includes parts of the suburbs of Stirling, Gwelup, Balcatta and Hamersley.

The primary purpose of this review is to examine combining the Perth Coastal and Gwelup control areas, as well as realigning the western edge of the Perth Coastal area. This report recommends that these boundary changes are to be implemented by proclamation under the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909*.

Both control areas lie at the western edge of the Gnangara Mound groundwater system. The Water Corporation draws water from the control areas as part of the Integrated Water Supply Scheme. Water is drawn from a variety of depths—from the superficial and deeper aquifers (see Tables 1 and 2). In general terms, the deeper aquifers tend to be semi-confined or confined, and as such have a greater degree of protection than the superficial unconfined aquifer.

The Integrated Water Supply Scheme supplies drinking water to much of the population of Western Australia. This includes metropolitan Perth, Mandurah, a number of south-west and Wheatbelt towns and the Goldfields. The land within both UWPCAs is predominantly urban—largely residential with some city centres. Additionally, there are some industrial areas and various forms of Crown land—including public open space and conservation areas.

It is not within the scope of this review to change the priority 3 (P3) classification that currently applies throughout both UWPCAs. During the preparation of a drinking

water source protection plan (building on this review and the 2007 assessment) consideration will be given to some of the Crown land such as conservation areas becoming Priority 2 (P2) or Priority 1 (P1). This is consistent with the standard approach used for public drinking water source area management in Western Australia.

Key strategies to protect water quality in these control areas include:

- combining the adjacent Perth Coastal and Gwelup control areas to streamline administration of this drinking water source
- moving the western boundary approximately 1 km west away from the coast (close to the alignment of Marmion Avenue) to remove any constraints for land development along the coast
- ongoing best practice management consistent with the existing P3 area to protect water quality
- preparation of a drinking water source protection plan within five years to ensure up to date advice is available to guide land use planning decisions.

These strategies are consistent with those used for public drinking water source areas throughout Western Australia and are based on the recognition that existing land uses will continue. Their purpose is to protect the supply of good quality drinking water to the Integrated Water Supply Scheme.

The following tables show important information about the Perth Coastal UWPCA and the Gwelup UWPCA.

*Key information about the Perth Coastal UWPCA*

Local government authority	Wanneroo and Joondalup
Locations supplied	Integrated Water Supply Scheme
Aquifer types	Unconfined (Superficial aquifer); semi-confined (Mirrabooka formation); semi-confined/confined (Leederville formation); and confined (Yarragadee formation).
Licensed water entitlement	The Water Corporation is licensed to abstract a total of 24 600 000 kL/year subject to annual review.
Production bore information <i>Please note this UWPCA is comprised of two borefields.</i>	Refer to Figure 4 for locations.  There are 39 production bores in the UWPCA, all drawing water from the Gnangara groundwater system.  Neerabup borefield (including Quinns Rock and Whitfords bores) draws from the following aquifers: <ul style="list-style-type: none"> <li>• Superficial (25)</li> </ul>

	<ul style="list-style-type: none"> <li>• Leederville (7)</li> <li>• Yarragadee (1).</li> </ul> <p>Yanchep borefield (including Yanchep and Two Rocks bores) draws from the following aquifer:</p> <p>Superficial (6).</p>
Dates of drinking water source protection reports	<p>2007 – Drinking water source protection assessment</p> <p>2012 – Drinking water source protection review (this document)</p>
Proclamation status	<p>Perth Coastal UWPCA was proclaimed in 1973 under the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909</i> and amended in 1989 and 1990. This review proposes to further amend and proclaim the boundary, to combine it with Gwelup UWPCA.</p>

### Key information about the Gwelup UWPCA

Local government authority	Stirling
Locations supplied	Integrated Water Supply Scheme
Aquifer types	<p>Unconfined (Superficial aquifer); semi-confined (Mirrabooka formation); semi-confined/confined (Leederville formation; &amp; confined (Yarragadee formation). The bores drawing from the Yarragadee aquifer are artesian.</p>
Licensed water entitlement	The Water Corporation is licensed to abstract a total of 20 550 000 kL/year subject to annual review.
Production bore information <i>Please note, this UWPCA is comprised of two borefields.</i>	<p>Refer to Figure 4 for locations.</p> <p>There are 22 production bores drawing water from the following aquifers:</p> <ul style="list-style-type: none"> <li>• Superficial (10)</li> <li>• Mirrabooka (3)</li> <li>• Leederville (5)</li> <li>• Yarragadee (4).</li> </ul>



Dates of drinking water source protection reports	2007 – Drinking water source protection assessment 2012 – Drinking water source protection review (this document)
Proclamation status	Proclaimed in 1973 under the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909</i> . This 2012 review proposes to combine Gwelup control area with Perth Coastal control area and proclaim it.



# 1 Review of Perth Coastal and Gwelup UWPCAs drinking water source protection assessment

## 1.1 Boundary, priority areas and protection zones

An underground water pollution control area (UWPCA) is a specific type of public drinking water source area (PDWSA). For more information on the background to and support for the protection of PDWSAs, please refer to our Water quality protection note (WQPN) no. 36: *Protecting public drinking water source areas*.

The current boundaries of the Perth Coastal and Gwelup UWPCAs were established in 1990 through proclamation under the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909*.

A priority 3 (P3) area was assigned over both control areas. This included a 300 m radius wellhead protection zone (WHPZ) around each production bore (see Figure 4).

In accordance with current departmental policy it is proposed to:

- amalgamate these control areas into one Perth Coastal and Gwelup UWPCA
- move the western boundary of Perth Coastal UWPCA away from the coast by approximately 1 km, close to the alignment of Marmion Avenue
- Prepare a drinking water source protection plan, including stakeholder consultation as part of this process—building on the 2007 assessment and this 2012 review— within five years. This plan should consider if some of the Crown land within the UWPCA, such as conservation areas, should become priority 2 (P2) or priority 1 (P1).

## 1.2 Update on water supply scheme and water licensing

Water drawn from production bores within Perth Coastal and Gwelup UWPCAs provides part of the drinking water sources of the Water Corporation's Integrated Water Supply Scheme (IWSS). This scheme provides drinking water to Perth, Mandurah, the Goldfields and agricultural towns along the route of the Goldfields pipeline. A combination of water sources supply the IWSS and consist of water pumped from surface water storage reservoirs, desalination and groundwater. Groundwater is drawn from both the Jandakot and Gnangara groundwater systems.

Perth Coastal UWPCA's water is drawn from the Gnangara groundwater system, then treated at nearby water treatment plants prior to distribution. These plants are located at Gwelup, Neerabup, Yanchep and Two Rocks.

Water Corporation's groundwater allocation licences are issued under section 5C of the *Rights in Water Irrigation Act 1914*. The licences apply to several sub-areas within both control areas. See Tables 1 and 2.

### 1.3 Potential future land uses

Urban-zoned land covers approximately 50 per cent of both control areas (Water Corporation 2007). Considerable residential development is currently taking place, and based on strategic land-use planning for the region, this trend will continue into the foreseeable future.

Land reserved for parks and recreation covers approximately 25 per cent of both control areas (Water Corporation 2007).

This review will guide the protection of groundwater that is abstracted to supply drinking water to much of the public of Western Australia. Given that groundwater reserves are fully allocated in this part of Perth, water is not readily available to irrigate parks and gardens, or for new residential development within and close to the control areas (e.g. Alkimos and Eglinton). As such, the possibility of using recycled water for these purposes has been identified.

From a land-use planning and development viewpoint, the ideal location for water recycling and associated infrastructure is within the Perth Coastal UWPCA. However, the Departments of Water and Health's policies are that recycled water and its infrastructure should not be located within PDWSAs in order to protect the water from contamination.

If it is determined in the future, by the Water Corporation, that it is not feasible to draw drinking water from specific parts of these control areas, then arrangements could be made for this land to be used for water recycling purposes (the Department would need to arrange for this land to be excised from the UWPCA).

### 1.4 Water quality risks

Please refer to *Table 1: Drinking water quality risk assessment* in the 2007 Perth Coastal UWPCA for detailed information on risks to water quality, and management measures proposed to protect the source. (Available on our website or by contacting us—see details on the inside cover of this report).

As shown in Tables 1 and 2 of this review, water is drawn from unconfined, semi-confined and confined aquifers. Generally, a high degree of protection is in place for confined groundwater sources, given the confining layers of rock preventing water infiltration from the surface. In comparison, semi-confined and unconfined sources are much more vulnerable to possible surface contamination.

The public drinking water supply bores in the Perth Coastal and Gwelup UWPCAs are maintained and secured by the Water Corporation. As such, the risk of contamination is reduced through regular surveillance, maintenance as required and safeguarding against unauthorised access.

Bores that are drilled close to a public drinking water supply bore (e.g. for irrigation or private purposes) can cause contamination of the drinking water source. For example, a poorly constructed bore may introduce contaminants from surface leakage down the outside of the bore casing into an otherwise uncontaminated aquifer.

It is therefore important to ensure that any bores are appropriately located and constructed to prevent contamination of the public drinking water source. This issue can be assessed as part of the Department of Water's water licensing process where applicable under the *Rights in Water and Irrigation Act 1914*. All bores should be constructed in accordance with *Minimum construction requirements for water bores in Australia* (National Minimum Bore Specifications Committee 2003).

## 1.5 Water quality information

The Water Corporation have provided water quality information for the Perth Coastal and Gwelup UWPCAs. This is shown in Appendix B.

## 2 Implementation of Perth Coastal and Gwelup UWPCA assessment recommendations

### 2.1 Status of previous recommendations

Table 1 Recommendations from the 2007 assessment and their current status

Page no.	Description	Status	Comments and further actions
56	(It is essential that) water managers continue with and improve upon best practice catchment management strategies, and implement protection policies/guidelines to ensure the ongoing availability of good quality drinking water.	Ongoing	An underlying aim of this 2012 review is to improve preventive and management strategies, and their implementation, in order to protect drinking water quality into the future.  A recommendation in this 2012 review is development proposals that are not consistent with P3 management objectives are to be referred to the Department of Water for advice.
1	The proposed UWPCA incorporates most of the existing Perth Coastal and Gwelup UWPCAs.	To be implemented during 2012/13	A recommendation in this 2012 review is to combine the Perth Coastal and Gwelup UWPCAs.
5 and Figure 1	It is proposed to amend the UWPCA boundaries to align with the revised boundary as defined in the <i>Review of Groundwater Protection Priority Area Boundaries Gnangara Mound</i> (Dames & Moore 1996).  In general this means: <ul style="list-style-type: none"> <li>• amalgamating Perth Coastal and Gwelup UWPCAs</li> <li>• the western boundary being moved approximately 1 km from the coast.</li> </ul>	To be implemented during 2012/13	A recommendation of this review is to move the western boundary.

Page no.	Description	Status	Comments and further actions
10	(It is planned to) improve information (flow) (provided by) regular surveillance carried out by the Water Corporation as part of its routine operational procedures.	Complete	The Water Corporation reports to the Department of Water each month on water quality issues in public drinking water source areas through the Advisory Committee for the Purity of Water.
10	The information collected (during surveillance) will be put into a land use database for use by the Department of Water and Water Corporation.	Ongoing	
Table 1A and Table 1B	Land planning controls, applicable to various land uses and activities e.g. industry.	Ongoing	A recommendation in this 2012 review is to assess proposals in P3 areas to ensure that they are consistent with the department's Water quality protection note no. 25: <i>Land use compatibility in public drinking water source areas.</i>
	HAZMAT emergency response (to be used for incidents) e.g. for major transport routes.	Ongoing	Emergency response management in this area is subject to the same processes as the rest of metropolitan Perth. The location of the UWPCAs is readily identifiable in GIS mapping used by emergency response agencies.

## 2.2 Consolidated recommendations

Based on the finding of this 2012 review, the following recommendations will now be applied to the Perth Coastal and Gwelup UWPCAs. The bracketed stakeholders are those expected to have a responsibility for, or an interest in, the relevant recommendation being implemented.

1. Combine and amend the boundary of the Perth Coastal UWPCA and Gwelup UWPCA under the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909*. The new area is to be called the Perth Coastal and Gwelup UWPCA. (Department of Water)
2. Update the Perth Coastal and Gwelup UWPCA boundary in relevant *local planning schemes*. (City of Joondalup, City of Wanneroo and City of Stirling)
3. Ensure the ongoing compatibility of land uses with the P3 status of the Perth Coastal and Gwelup UWPCAs, as per the Western Australian Planning Commission's State planning policy no.2.7: *Public drinking water source policy*. This includes a 300 m radius protection zone around each production bore. (City of Joondalup, City of Wanneroo and City of Stirling)
4. Incidents covered by Westplan–HAZMAT in the Perth Coastal and Gwelup UWPCA are addressed by ensuring that:
  - the Wanneroo/Joondalup and Stirling local emergency management committees are aware of the location and purpose of the UWPCA
  - the locality plan for the Perth Coastal and Gwelup UWPCA is provided to the Fire and Emergency Services Authority headquarters for the HAZMAT emergency advisory team
  - the Water Corporation acts in an advisory role during incidents in the Perth Coastal and Gwelup UWPCA
  - personnel dealing with Westplan–HAZMAT incidents in the area have ready access to a locality map of the Perth Coastal and Gwelup UWPCA and information to help them recognise the potential impacts of spills on drinking water quality. (Water Corporation)
5. Refer development proposals that are inconsistent with the management objectives of P3 areas to the Department of Water for advice. (Department of Planning, City of Joondalup, City of Wanneroo, City of Stirling and development proponents)
6. Prepare a drinking water source protection plan within five years, building on the 2007 assessment and this 2012 review. (Department of Water)



# Appendices

## Appendix A. – Figures

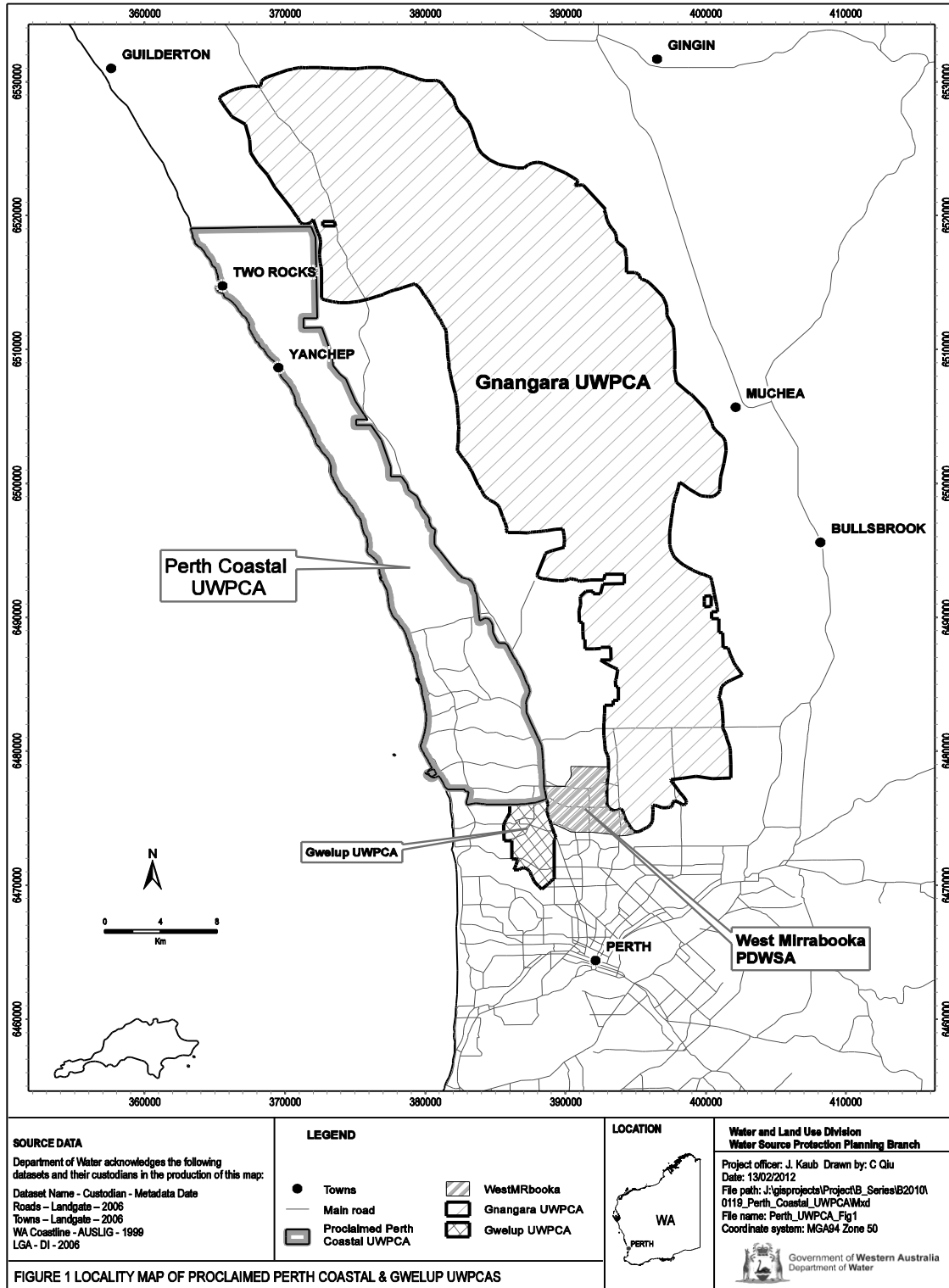


Figure A1 Locality map of proclaimed Perth Coastal and Gwelup UWPCAs

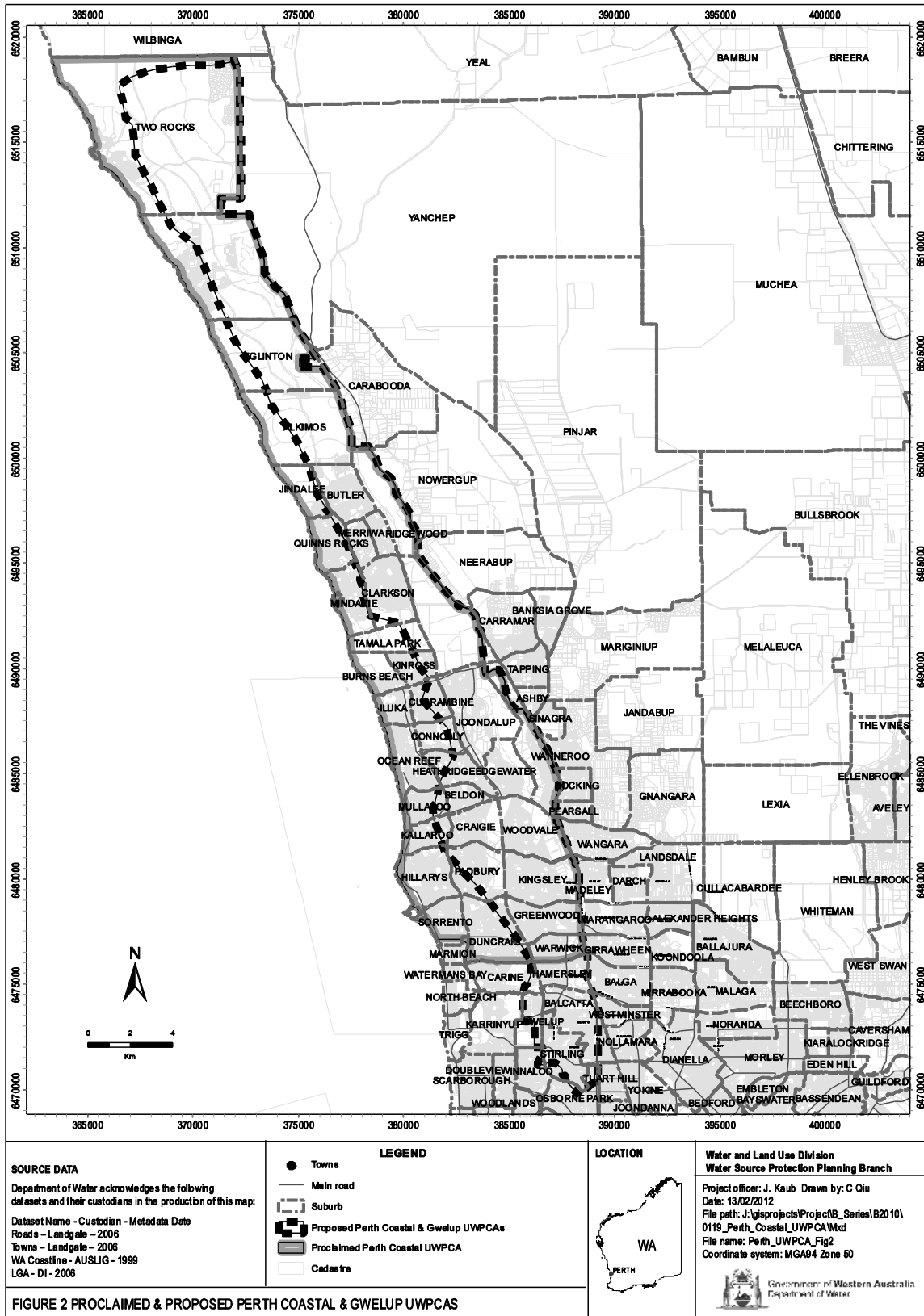


Figure A2 Proclaimed and proposed Perth Coastal and Gwelup UWPCAs

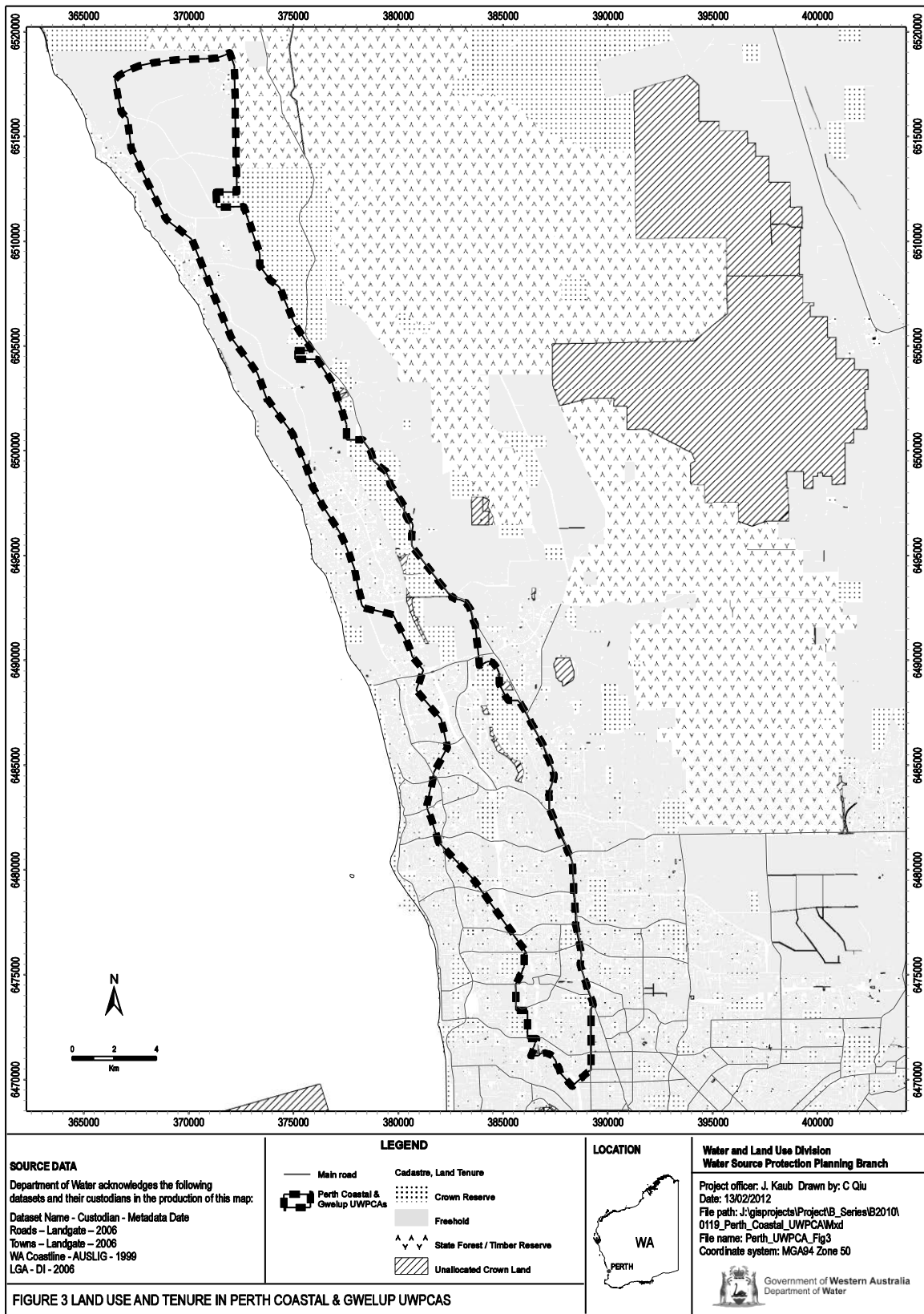


Figure A3 Land use and tenure in Perth Coastal and Gwelup UWPCA

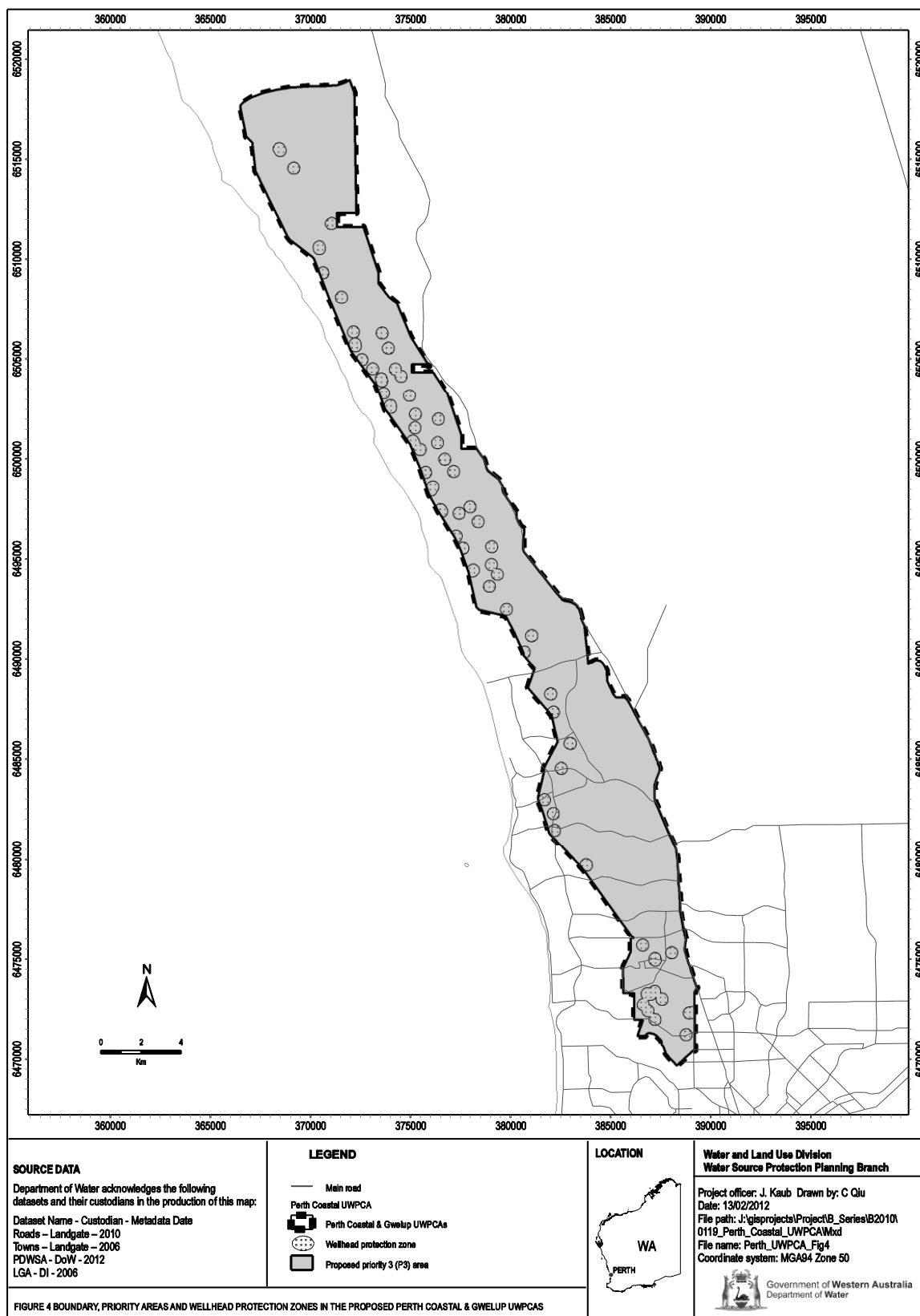


Figure A4 Boundary, priority areas and wellhead protection zones in the proposed Perth Coastal and Gwelup UWPCA

## Appendix B.— Water quality data

**The information provided in this appendix has been provided by the Water Corporation.**

The Water Corporation has monitored the raw (source) water quality from Perth Coastal UWPCA in accordance with the *Australian drinking water guidelines, 2011* (ADWG) and interpretations agreed to with the Department of Health. This data shows the quality of water in the catchment. The raw water is regularly monitored for:

- aesthetic characteristics (non-health-related)
- health-related characteristics, including
  - health-related chemicals
  - microbiological contaminants.

The following data represents the quality of raw water from Perth Coastal UWPCA and Gwelup UWPCA. In the absence of specific guidelines for raw water quality, the results have been compared with the ADWG values set for drinking water, which defines the quality requirements at the customer's tap. Any water quality parameters that have been detected are reported; those that on occasion have exceeded the ADWG are presented in ***bold and italics*** to give an indication of potential raw water quality issues associated with this source. The values are taken from ongoing monitoring for the period March 2007 to March 2012.

It is important to appreciate that the raw water data presented does not represent the quality of drinking water distributed to the public. Barriers such as storage and water treatment exist downstream of the raw water to ensure it meets the requirements of the ADWG. For more information on the quality of drinking water supplied to Perth Integrated Water Supply Scheme refer to the most recent Water Corporation drinking water quality annual report at <watercorporation.com.au> What we do > Water quality > Water quality publications > Most recent *Drinking water quality annual report*.

### *Aesthetic characteristics*

Aesthetic water quality analyses for raw water from Perth Coastal UWPCA and Gwelup UWPCA are summarised in the following tables.

*Aesthetic detections for Perth Coastal UWPCA*

Parameter	Units	ADWG aesthetic guideline value*	Range of monitored values			
			Min-max Med			
			Yanchep raw water	Gwelup raw water	Neerabup raw water	Two rocks raw water
Chloride	mg/L	250	85–120 100	115–170 140	105–150 125	55–115 100
Colour - true	TCU	15	N/A	<1–7 3	<1–3 2	N/A
Hardness as CaCO <sub>3</sub>	mg/L	200	N/A	120– <b>220</b> 169.5	150– <b>260</b> <b>230</b>	<b>210–234</b> <b>220</b>
Iron unfiltered	mg/L	0.3	<0.003–0.06 <0.003	0.22– <b>110</b> <b>8.75</b>	<0.003– <b>3.2</b> <b>1</b>	<0.003–0.189 <0.003
Sodium	mg/L	180	47–60 52	<0.05–2.1 0.53	<0.1–80 73	55–65 58
Total filterable solids by summation	mg/L	500	411–497 460	430– <b>578</b> <b>578</b>	459– <b>735</b> <b>576.5</b>	482– <b>558</b> <b>504</b>
Turbidity	NTU	5	<0.1–0.4 <0.1	<b>8–&gt;400</b> <b>551</b>	0.2– <b>15</b> 4.8	<0.1–0.3 <0.1
pH measured in laboratory	No unit	8.5	7.43–8.17 7.64	6.53–7.33 6.90	6.93–7.61 7.2	7.37–7.96 7.56
Zinc	mg/L	3	N/A	<0.02–0.12 <0.02	<0.02–0.02 <0.02	N/A

\* An aesthetic guideline value is the concentration or measure of a water quality characteristic that is associated with good quality water.

*Aesthetic detections for Gwelup UWPCA*

Parameter	Units	ADWG aesthetic guideline value*	Range of monitored values		
			Min-max Med		
			Independent artesian G7	Independent artesian G27	Independent artesian G17
Aluminium acid soluble	mg/L	0.2	0.01–0.01 0.01 <sup>^</sup>	N/A	N/A
Chloride	mg/L	250		230– <b>255</b> 240	120–165 140
Colour - true	TCU	15	<1–4 2	2–4 3	<1–3 2
Hardness as CaCO <sub>3</sub>	mg/L	200	39–41 40	42–50 44	60–65 61
Iron unfiltered	mg/L	0.3	0.006–0.009 0.008	0.1–0.14 0.113	0.025–0.035 0.03
Sodium	mg/L	180	<b>235–250</b> <b>255</b>	<b>205–240</b> <b>220</b>	120–140 125
Total filterable solids by summation	mg/L	500	<b>810–833</b> <b>818</b>	<b>701–743</b> <b>718</b>	497– <b>521</b> <b>510.5</b>

Parameter	Units	ADWG aesthetic guideline value*	Range of monitored values		
			Min-max Med		
			Independent artesian G7	Independent artesian G27	Independent artesian G17
Turbidity	NTU	5	<0.1–0.2 <0.1	0.1 –0.3 0.2	<0.1–0.3 <0.1
pH measured in laboratory	No unit	8.5	7.63–8.06 7.81	7.59–8.13 7.81	7.4–8.03 7.7

\* An aesthetic guideline value is the concentration or measure of a water quality characteristic that is associated with good quality water.

### Health-related chemicals

Raw water from Perth Coastal UWPCA and Gwelup UWPCA is analysed for chemicals that are harmful to human health including inorganics, heavy metals, industrial hydrocarbons and pesticides. Health-related water quality parameters that have been detected in the source are summarised in the following table.

### Health-related detections for Perth Coastal UWPCA

Parameter	Units	ADWG health guideline value*	Range of Monitored Values			
			Min-max Med			
			Yanchep raw water	Gwelup raw water	Neerabup raw water	Two rocks raw water
Arsenic	mg/L	0.007	N/A	<0.02–0.009 <0.02	<0.02–0.02 <0.02	N/A
Barium	mg/L	0.7	0.07–0.07 0.07	0.09–0.14 0.11	0.085–0.18 0.14	N/A
Boron	mg/L	4	N/A	N/A	<0.02–0.05 0.04	N/A
Chromium	mg/L	0.05	N/A	<0.0005– 0.00105 0.014	<0.0005– 0.00105 0.00105	0.0008– 0.0008 0.0008
Copper	mg/L	2	N/A	<0.002–0.012 <0.002	0.035–0.085 0.055	<0.002– 0.002 <0.002
Fluoride	mg/L	1.5	N/A	N/A	<0.10–0.15 0.125	0.1–0.2
Lead	mg/L	0.01	N/A	N/A	<0.002– 0.008 <0.002	N/A
Manganese unfiltered	mg/L	0.5	N/A	0.034–0.055 0.08	<0.002–0.03 0.016	N/A
Nitrite plus nitrate as N †	mg/L	11.29	0.52–1.1 0.89	<0.05–0.53 2.1	<0.05–3.2 2	0.5–2.6 2.3
Radon-222	Bq/L	100	0.46–0.46 0.46	N/A	5.4–5.4 5.4	0.99–2.29 1.64
Sulphate	mg/L	500	N/A	4.6–98 46	<0.1–14 11	12–20 13

### Health-related detections for Gwelup UWPCA

Parameter	Units	ADWG health guideline value*	Range of monitored values		
			Independent artesian G7	Independent artesian G27	Independent artesian G17
Annual Radiation Dose	mSv	1	N/A	0.68–0.68 0.68*	N/A
Barium	mg/L	250	0.26–0.26 0.26 <sup>^</sup>	0.46–0.46 0.46 <sup>^</sup>	0.8–0.8 0.8 <sup>^</sup>
Boron	mg/L	15	0.26–0.26 0.26	0.2–0.22 0.21	0.16–0.16 0.16
Fluoride	mg/L	180	0.8–0.9 0.85	0.5–0.5 0.5 <sup>^</sup>	0.4–0.5 0.45
Manganese unfiltered	mg/L	0.5	0.008–0.009 0.008	0.006–0.008 0.008	0.012–0.014 0.014
Molybdenum	mg/L	0.05	0.001–0.001 0.001 <sup>^</sup>	N/A	N/A
Radon-222	Bq/L	100	3.05–3.05 3.05 <sup>^</sup>	1.82–1.82 1.82 <sup>^</sup>	3.14–3.14 3.14 <sup>^</sup>
Sulphate	mg/L	500	14–17 16	12–14 13	6.5–7.5 7

\* A health guideline value is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption (NHRMC & ARMCANZ, 2011).

† The guideline value of 11.29 mg/L (as nitrogen) has been set to protect bottle-fed infants under three months of age. Up to 22.58 mg/L (as nitrogen) can be safely consumed by adults and children over three months of age.

<sup>^</sup> Single sample taken during the reporting period.

#### Microbiological contaminants

Microbiological testing of raw water samples from Perth Coastal UWPCA and Gwelup UWPCA is currently conducted on a monthly basis. *Escherichia coli* counts are used as an indicator of the degree of recent faecal contamination of the raw water from warm-blooded animals.

A detection of *E. coli* in raw water abstracted from any bore may indicate contamination of faecal material through ingress into the bore, or recharge through to the aquifer (depending on aquifer type).

During the review period, positive *E. coli* counts were not recorded in any of the Yanchep or Neerabup raw water samples. Less than 1 per cent of Gwelup, Two Rocks and independent artesian raw water samples recorded positive *E. coli* counts.



## Appendix C.— Photographs



*Figure C1 Water Corporation compound at Kalbarri Avenue, Yanchep*



*Figure C2 Yanchep drinking water storage tanks*



*Figure C3 Entrance to Neerabup groundwater treatment plant*

## List of shortened forms

<b>ADWG</b>	<i>Australian drinking water guidelines</i>
<b>ARMCANZ</b>	Agriculture and Resource Management Council of Australia and New Zealand
<b>DWSPA</b>	drinking water source protection assessment
<b>DWSPP</b>	drinking water source protection plan
<b>HAZMAT</b>	hazardous materials
<b>IWSS</b>	Integrated Water Supply Scheme
<b>kL</b>	kilolitre
<b>km</b>	kilometre
<b>mg/L</b>	milligram per litre
<b>NHMRC</b>	National Health and Medical Research Council
<b>NRMMC</b>	Natural Resource Management Ministerial Council
<b>P1</b>	priority 1
<b>P2</b>	priority 2
<b>P3</b>	priority 3
<b>PDWSA</b>	public drinking water source area
<b>TCU</b>	true colour units
<b>UWPCA</b>	underground water pollution control area
<b>WESTPLAN- HAZMAT</b>	Western Australian plan for hazardous materials
<b>WHPZ</b>	wellhead protection zone
<b>WQPN</b>	water quality protection note

# Glossary

<b>Abstraction</b>	The pumping of groundwater from an aquifer, or the removal of water from a waterway or water body.
<b>Aesthetic guideline value</b>	The concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer, e.g. appearance, taste and odour (NHMRC & NRMMC 2011).
<b>Allocation</b>	The quantity of water that a licensee is permitted to abstract is their allocation, usually specified in kilolitres per annum (kL/a).
<b>Aquifer</b>	An aquifer is a geological formation or group or formations able to receive, store and transmit significant quantities of water.
<b>Australian drinking water guidelines</b>	The <i>National water quality management strategy: Australian drinking water guidelines 6, 2011</i> (NHMRC & NRMMC 2011) (ADWG) outlines acceptable criteria for the quality of drinking water in Australia (see this plan's Bibliography).
<b>Bore</b>	A bore is a narrow, lined hole drilled into the ground to monitor or draw groundwater (also called a well).
<b>Borefield</b>	A group of bores to monitor or withdraw groundwater is referred to as a bore field (also see <i>wellfield</i> ).
<b>Catchment</b>	The physical area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
<b>Confined aquifer</b>	An aquifer that is confined between non-porous rock formations (such as shale and siltstone) and therefore contains water under pressure.
<b>Drinking water source protection plan</b>	This is a report on water quality hazards and risk levels within a public drinking water source area that includes recommendations to avoid, minimise, or manage those risks for the protection of the water supply in the provision of safe drinking water supply.
<b>Health guideline value</b>	The concentration or measure of a water quality characteristic that, based on current knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption (NHMRC & NRMMC 2011).

<b>Hydrocarbons</b>	A class of compounds containing only hydrogen and carbon, such as methane, ethylene, acetylene and benzene. Fossil fuels (oil, petroleum and natural gas all contain hydrocarbons.
<b>Hydrogeology</b>	The study of groundwater, especially relating to the distribution of aquifers, groundwater flow and groundwater quality.
<b>Integrated Water Supply Scheme</b>	A scheme for the supply of drinking water to much of the population of Western Australia – including metropolitan Perth, Mandurah, a number of south-west and Wheatbelt towns and the Goldfields.
<b>mg/L</b>	A milligram per litre (0.001 grams per litre) is a measurement of a total dissolved solid in a solution.
<b>Nutrients</b>	Minerals, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorous (phosphate) dissolved in water which provide nutrition (food) for plant growth.
<b>Pathogen</b>	A disease-producing organism that can cause sickness and sometimes death through the consumption of water, including bacteria (such as <i>Escherichia coli</i> ), protozoa (such as <i>Cryptosporidium</i> and <i>Giardia</i> ) and viruses.
<b>Pesticides</b>	Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms.
<b>pH</b>	A logarithmic scale for expressing the acidity or alkalinity of a solution. A pH below seven indicates an acidic solution and above seven indicates an alkaline solution.
<b>Public drinking water source area</b>	Includes all underground water pollution control areas, catchment areas and water reserves constituted under the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909</i> and the <i>Country Areas Water Supply Act 1947</i> .
<b>Recharge</b>	Recharge is the action of water infiltrating through the soil/ground to replenish an aquifer.
<b>Scheme supply</b>	Water diverted from a source or sources by a water authority or private company and supplied via a distribution network to customers for urban and industrial use or for irrigation.

<b>Semi-confined aquifer</b>	A semi-confined aquifer or leaky aquifer is saturated and bounded above by a semi-permeable layer and below by a layer that is either impermeable or semi-permeable.
<b>Total filterable solids by summation</b>	Total filterable solids by summation is a water quality test which is a total of the following ions: Na (sodium), K (potassium), Ca (calcium), Mg (magnesium), Cl equivalent (chloride), alkalinity equivalent, SO <sub>4</sub> equivalent (sulfate) or S (sulfur) in grams, Fe (iron), Mn (manganese), and SiO <sub>2</sub> (silicon oxide). It is used as a more accurate measure than total dissolved solids (TDS). The higher the value, the more solids that are present and generally the saltier the taste.
<b>Treatment</b>	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes, including drinking and discharge to the environment.
<b>Turbidity</b>	The cloudiness or haziness of water caused by the presence of fine suspended matter.
<b>Unconfined aquifer</b>	An aquifer in which the upper surface of water is lower than the top of the aquifer itself. The upper surface of the groundwater within the aquifer is called the watertable. This is also known as a superficial aquifer.
<b>Underground water pollution control area</b>	A form of public drinking water source area under the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909</i> and the <i>Country Areas Water Supply Act 1947</i> .
<b>Water quality</b>	Water quality is the collective term for the physical, aesthetic, chemical and biological properties of water.
<b>Water reserve</b>	A water reserve is an area proclaimed under the <i>Country Areas Water Supply Act 1947</i> or the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909</i> for the purposes of protecting a drinking water supply.
<b>Wellfield</b>	A wellfield is a group of bores located in the same area used to monitor or withdraw groundwater.
<b>Wellhead</b>	The top of a well (or bore) used to draw groundwater is referred to as a wellhead.
<b>Wellhead protection zone</b>	A wellhead protection zone is usually declared around wellheads in public drinking water source areas to protect the groundwater from immediate contamination threats in the nearby area.

**Western Australian  
hazardous materials  
emergency  
management scheme**

This is now known as Westplan–HAZMAT.

## References

- Dames & Moore 1996, *Review of Groundwater Protection Priority Area Boundaries Gnangara Mound*, Waters and Rivers Commission, Perth.
- Department of Water various dates, Water quality protection note – *various titles*, Department of Water, Perth, available <<http://drinkingwater.water.wa.gov.au>> and scroll down to the link for water quality protection notes.
- Government of Western Australia 1909, *Metropolitan Water Supply, Sewerage, and Drainage Act*, reprinted under the *Reprints Act 1984* as at 27 April 2008, available <[www.slp.wa.gov.au/legislation/statutes.nsf/main\\_mrtitle\\_588\\_homepage.html](http://www.slp.wa.gov.au/legislation/statutes.nsf/main_mrtitle_588_homepage.html)>.
- 1914, *Rights in Water and Irrigation Act*, Reprinted under the *Reprints Act 1984* as at 1 February 2008, available <[www.slp.wa.gov.au/legislation/statutes.nsf/main\\_mrtitle\\_844\\_homepage.html](http://www.slp.wa.gov.au/legislation/statutes.nsf/main_mrtitle_844_homepage.html)>.
- National Health and Medical Research Council (NHMRC) and Natural Resource Management Ministerial Council (NRMMC) 2004a, National Water Quality Management Strategy: *Australian drinking water guidelines*, Australian Government, Canberra, available <[www7.health.gov.au/nhmrc/publications/synopses/eh19syn.htm](http://www7.health.gov.au/nhmrc/publications/synopses/eh19syn.htm)>.
- 2004b, *Water made clear – A consumer guide to accompany the Australian drinking water guidelines 2004*, Australian Government, Canberra, available <[www.nhmrc.gov.au/publications/synopses/eh19syn.htm](http://www.nhmrc.gov.au/publications/synopses/eh19syn.htm)>.
- 2011, National Water Quality Management Strategy: *Australian drinking water guidelines*, Australian Government, Canberra, available <[www.nhmrc.gov.au/guidelines/publications/eh52](http://www.nhmrc.gov.au/guidelines/publications/eh52)>.
- National Minimum Bore Specifications Committee 2003, *Minimum construction requirements for water bores in Australia*, 2<sup>nd</sup> edn, Land and Water Biodiversity Committee, Queensland, available <[www.water.wa.gov.au](http://www.water.wa.gov.au)> Publications > Find a publication > A-Z browse.
- Water Corporation 2007, *Perth Coastal Underground Water Pollution Control Area – Drinking Water Source Protection Assessment – Integrated Water Supply Scheme*, Water Corporation, Perth.
- Western Australian Planning Commission 2003, State planning policy no.2.7: *Public drinking water source policy*, Government Gazette Western Australia, 10 June 2003, pp. 2077-82, Government of Western Australia, Perth, available <<http://www.planning.wa.gov.au/5132.asp>>.







## 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](http://www.water.wa.gov.au)