Government of Western Australia
Department of Water and Environmental Regulation

Condingup Water Reserve

drinking water source protection review

Condingup town water supply

Water resource protection series
Report WRP 164
October 2017

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Report no. 164

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Cover photograph: Aerial photo of Condingup Water Reserve.

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

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Summary

This report was prepared by the former Department of Water. On 1 July 2017, the Government of Western Australia established the Department of Water and Environmental Regulation, resulting from the amalgamation of the Department of Water, the Department of Environment Regulation and the Office of the Environmental Protection Authority. As such, this publication contains references to previous government departments and programs. Please email drinkingwater@dwer.wa.gov.au to clarify any specific information.

This drinking water source protection review considers changes that have occurred in and around the Condingup Water Reserve since completion of the *Condingup Water Reserve drinking water source protection plan* in 2008. It also considers a 2015 hydrogeological assessment. The plan still contains relevant information, so it is important that these documents are read in conjunction. Both are available on our website or by contacting us.

Condingup is a small town and service centre located around 20 kilometres (km) inland from the southern Western Australian coast. There are 438 people living in the suburb of Condingup (Australian Bureau of Statistics 2011).

Condingup is in the Shire of Esperance, approximately 65 km east of Esperance. The Water Corporation supplies water to the town from one production bore which draws water from a semi-confined aquifer. The bore is located within a secure Water Corporation compound which abuts the Condingup Primary School.

The main findings of this review are:

- The water reserve boundary is proposed to be significantly reduced to the south.
- Priority areas need to be amended to reflect the zoning in the current local planning scheme and the existing land uses (see Figure A4).
- Potential expansion of the Condingup Water Reserve to the north and north-west needs to be discussed with stakeholders before it is further considered. These discussions will take place during the next report update for this water reserve.

This review is consistent with the *Australian drinking water guidelines* (ADWG; NHMRC & NRMMC 2011), State planning policy no. 2.7: *Public drinking water source policy* (Western Australian Planning Commission 2003) and Strategic policy: *Protecting public drinking water source areas in Western Australia* (Department of Water 2016a).

Important information about the Condingup Water Reserve is shown in Table 1.

Table 1 Key information about the Condingup Water Reserve

Condingup Water Reserve	
Local government authority	Shire of Esperance
Location supplied	Condingup
Water service provider	Water Corporation
Aquifer type	semi-confined
Licensed abstraction	20 000 kL per year expiring on 31 December 2025
Number of bores	1
Bore names and GPS coordinates	6/83 (E 456 316, N 6 264 837, zone 50)
Date of bore completion	1983
Dates of drinking water source protection reports	2004 – *Condingup Water Reserve water source protection assessment* (Water Corporation) 2008 – *Condingup Water Reserve drinking water source protection plan* (Department of Water) 2017 – *Condingup Water Reserve drinking water source protection review* (this document)
Consultation	2008 – public consultation as part of the water source protection plan 2016 – consultation with the Shire of Esperance, Water Corporation and other key stakeholders
Proclamation history	Proclaimed on 4 April 1995 under the *Country Areas Water Supply Act 1947*. Proclamation of the proposed amended boundary will need to be progressed under the *Country Areas Water Supply Act 1947*.
Reference documents	*Australian drinking water guidelines* (NHMRC & NRMMC 2011) State planning policy no. 2.7: *Public drinking water source policy* (Western Australian Planning Commission 2003) *Esperance region water resources review and development plan* (Water and Rivers Commission 1997) *Shire of Esperance town planning scheme no. 23* (Department of Planning 2010) *Esperance local planning strategy* (Shire of Esperance 2006)

Condingup Water Reserve	
	Strategic policy: *Protecting public drinking water source areas in Western Australia* (Department of Water 2016a) Water quality protection note no. 25: *Land use compatibility tables for public drinking water source areas* (Department of Water 2016b)

1 Review of Condingup's drinking water source protection plan

1.1 Boundary, priority areas and protection zones

The Condingup Water Reserve was proclaimed in 1995 under the *Country Areas Water Supply Act 1947*. The water reserve was assigned with a combination of priority 1 (P1), priority 2 (P2) and priority 3 (P3) areas, based on the zoning of the land (Figure A1). The water reserve included a wellhead protection zone for the single production bore (6/83), with a radius that was half 300 m and half 500 m. This shape resulted from the varying priority areas surrounding the production bore. There is also one monitoring bore (2/03). Refer to Figure A3 for bore locations.

Since the former Department of Water published the *Condingup Water Reserve drinking water source protection plan* in 2008, there have been no significant changes to the water supply scheme. There are no plans to establish the monitoring bore as a production bore because it is brackish and would require desalination (Water Corporation 2009).

As part of this review, the department used new and existing data to conduct a hydrogeological assessment into the recharge area for the production bore. The assessment determined that the aquifer is semi-confined and therefore potentially vulnerable to contamination from land uses in and near the Condingup townsite, although the clay and siltstone provides some protection.

The assessment found that the existing Condingup Water Reserve covers a significant proportion of the recharge area for the production bore but recommended that its boundary could be extended to the north and north-west to better protect the potential recharge area. However extending the boundary would require us to conduct public consultation because it affects privately-owned properties. In addition a drinking water source protection plan which covers the new landuses within this area is required. Therefore consultation on a larger boundary will occur as part of the next Condingup Water Reserve drinking water source protection plan.

The assessment also concluded that there is a significant proportion of the Condingup Water Reserve to the south that could be removed, because it does not contribute to the recharge for the production bore (Figure A4). Removing this portion of the water reserve required limited consultation, which we have completed. The department will arrange proclamation of the new Condingup Water Reserve boundary under the *Country Areas Water Supply Act 1947* (see section 2.2, recommendation no. 1).

Priority areas have been updated to reflect the zoning in the current local planning scheme and the existing land uses (see Figure A4). This includes changing a section of the Shire of Condingup sporting grounds north of the school and a road reserve adjacent to the Condingup Primary School from P1 to P3; and changing some P3 areas south of the Condingup Primary School to P1.

There are some P2 areas within the water reserve that were zoned ‘country town’ after the 2008 *Condingup Water Reserve drinking water source protection plan*. Under Department of Water and Environmental Regulation policy, this type of zoning is only consistent with the objectives for P3 areas.

The Shire of Esperance has dealt with this issue by amending the *Town planning scheme no. 23* to limit subdivision in these areas:

> *‘2015 Minimum lot sizes for Rural Residential and Country Town zones – AMD 14 GG 5/12/14*
>
> *(i) Where subdivision of land zoned Rural Residential or Country Town is proposed within Special Control Area 4, the minimum lot sizes shall be as follows:*
>
> *Priority Area 1 – No permitted subdivision*
>
> *Priority Area 2 – 2 Hectares*
>
> *Priority Area 3 – 1 Hectare*
>
> *(ii) Irrespective of Clause 6.8.4(c)(i) subdivision will not be supported unless the proposal complies with the provisions of Water quality protection note 25 Land use compatibility in public drinking water source areas or is located in an endorsed Outline Development Plan area.’*

This will ensure that lot sizes are maintained at the minimum preferred for P2 areas, instead of P3 areas. Therefore, these areas will remain P2.

All other proposed priority area changes reflect the current local planning scheme zoning and existing land uses.

The boundary, priority areas and protection zones above have been determined in accordance with current departmental policy. If you require more information about how we protect drinking water sources, please read Appendix D.

1.2 Update on water supply scheme

The former Department of Water renewed Water Corporation’s groundwater allocation licence on 8 May 2015. This licence allows the Water Corporation to draw 20 000 kL of water from the Bremer East – Sedimentary aquifer (semi-confined) to supply Condingup’s drinking water from one production bore. This licence expires on 31 December 2025.

Groundwater from this source undergoes chlorination at the headworks to disinfect the water to ensure microbiological quality for consumers. It is then pumped into the adjacent elevated service tank (please see Figure C2) and distributed via gravity to the town scheme.

The Water Corporation supplies drinking water to 54 services in Condingup. There are 438 people in the suburb of Condingup however many of these people reside outside of the water supply scheme (Australian Bureau of Statistics 2011).

It should be recognised that although treatment and disinfection are essential barriers against contamination, public drinking water source area (PDWSA) management is the first step in protecting water quality and ensuring a safe drinking water supply. This approach is endorsed by the *Australian drinking water guidelines* (ADWG; NHMRC & NRMMC 2011) and reflects an approach based on preventive risk and multiple barriers for providing safe drinking water to consumers. This combination of catchment protection and water treatment will deliver a more reliable, safer and lower cost drinking water to consumers than either approach could achieve individually.

For more information on why it is so important to protect our catchments, please read Appendix E.

1.3 Aboriginal sites of significance and native title claims

Aboriginal sites of significance are important places with special cultural connections to Aboriginal people. They are important because they link Aboriginal cultural tradition to place, land and people over time. These sites are integral to the lives of Aboriginal people, and are found in urban, rural and remote areas. They are most common near rivers, lakes, swamps, hills and the coast. The *Aboriginal Heritage Act 1972* protects all Aboriginal places and objects that are culturally important to Aboriginal people. It is against the law to disturb a site or to remove artefacts.

There is one Aboriginal site of significance within the Condingup Water Reserve. This is the Condingup School site (W01437).

Native title is the recognition in Australian law that some Aboriginal people continue to hold native title rights to lands and water arising from their traditional laws and customs.

There is one native title claim within the Condingup Water Reserve. This is the Esperance Nyungars (WAD6097/1998).

The Department of Water and Environmental Regulation is committed to working with Aboriginal people in its planning and management activities. The department recognises that native title is an important framework for water management.

1.4 Enforcing by-laws, surveying the area and maintenance

This review recommends that the Water Corporation continue by-law enforcement under the existing delegation arrangement (see section 2.2, recommendation no. 6). This also includes:

- erecting and maintaining signs in accordance with *S111 Source protection signage* (Water Corporation 2013)
- maintaining security and fencing surrounding the production bore compound (please see figure C1)

- ongoing regular surveillance and inspections from two to three monthly with a minimum of quarterly inspections.

1.5 Other departmental work

In 1997, the former Water and Rivers Commission released the *Esperance region water resources review and development plan*. This report outlines the water availability in the Esperance region including Condingup. It covers water resource management and development issues, existing water sources and supplies, town population and water supply projections and water resource development plans.

1.6 Update on water quality risks

As part of this review, the former Department of Water conducted a new assessment of water quality contamination risks to the Condingup drinking water source, in accordance with the ADWG. Table 2 shows the risks that are new or changed since the 2008 plan, and also includes risks that are still considered high.

Refer to Appendix D for information about typical contamination risks in PDWSAs. Refer to Appendix F to gain a greater understanding about the risk assessment process we use.

1.6.1 Production bore compound

The public drinking water supply bore is within a secure compound that is owned by the Water Corporation (see Figure C1). There has been no evidence of problems with vandalism.

1.6.2 Condingup townsite

Various land uses within the Condingup town centre pose a water quality risk to the water reserve, including: residential areas, light industry, the school, community facilities and sporting facilities. The highest risk, ongoing since the development of the 2008 plan, is pathogens and nutrients from septic tanks and leach drain systems. All private residences and public facilities in Condingup have septic systems.

The main area of the Condingup townsite is located a few hundred metres to the east of the bores and is mostly residential with some light industrial areas (see Figure C3). The land within the Condingup townsite is zoned a combination of Country Town, Parks, Recreation and Conservation - Local Parks and Public Purpose in the Shire of Esperance's *Town planning scheme no. 23*.

The production bore is bordered to the west and north by a public primary school. The school grounds include land uses such as hobby gardens, irrigated grassed areas, playgrounds and septic toilet blocks (see Figure C2). These facilities pose a number of water quality risks including pathogens, nutrients and chemicals.

There are several undeveloped lots to the east of the production bore that are zoned Country Town, and are earmarked for development. We have not amended these

lots to P3 because they were zoned as Country Town after the 2008 plan (see section 1.1).

1.6.3 Surrounding the Condingup townsite

Outside of the townsite, there is a mixture of other land uses within the Condingup Water Reserve. In the Shire of Esperance's scheme, this land is predominantly zoned as Agriculture-General and Recreation and Conservation – Local Parks, but there are some small sections zoned as Public Purpose, such as the old landfill disposal site and telecommunications site (see Figure A3).

Historically, there were two landfill sites within the Condingup Water Reserve. The 2008 plan mentions that only one of these was still active. That landfill site has now also been closed, including the removal of a bunded and covered oil wastes disposal area (see Figure C4). This closure was part of a program to centralise all waste disposal in the Shire of Esperance. This change has resulted in a reduced risk to the water reserve.

1.6.4 Possible boundary extension in the north and north-west

As part of this review, the former Department of Water conducted a hydrogeological assessment (see section 1.1) which indicates that the current boundary should be extended to the north and north-west to better protect the potential recharge area of the production bore.

If this boundary extension occurs in the future, it will introduce a number of new land uses into the Condingup Water Reserve. These land uses include a tourist waste transfer station, a tavern (including a general store, café/restaurant, service station and LPG depot facilities), vineyards, an olive plantation, light industry, residential areas and the northern half of the shire's sporting grounds (Figure C6). Therefore, the potential expansion of this water reserve will require extensive consultation with the landowners of these areas and the Shire of Esperance to ensure that proposed priority areas are consistent with relevant planning decisions.

The *Esperance local planning strategy* (Shire of Esperance and Department of Planning 2006) proposes a number of developments that may occur within the proposed future expanded area of the water reserve. These developments could include a caravan park, residential and rural-residential areas.

All existing land uses and activities that have been legally established in a PDWSA prior to it being proclaimed are able to continue to operate, and we recommend they employ best management practices to help protect drinking water quality. However, we do not support expansion or intensification of incompatible land uses (Department of Water 2016b).

1.6.5 Boundary reduction in the south

The hydrogeological assessment (see section 1.1) recommended that the southern portion of the water reserve should be significantly reduced, because this area does not contribute recharge to the production bore and therefore the land uses in this

area do not pose a water quality risk. We propose to remove a large section of the southern P2 area, which is rural land, from the water reserve by proclaiming an amended boundary under the *Country Areas Water Supply Act 1947* (see section 2.2, recommendation no. 1).

1.6.6 Residential development

Since the *Condingup Water Reserve drinking water source protection plan* was released in 2008, there continues to be a small but consistent demand for residential development in the town of Condingup. This has been reflected in the *Shire of Esperance town planning scheme no. 23* which includes several areas identified for residential subdivision.

The *Esperance local planning strategy* (Shire of Esperance and Department of Planning 2006) states that population growth within the town of Condingup is dependent on employment opportunities and the availability of land and infrastructure (particularly water). The strategy supports the further development of Gibson and Condingup as the two main population centres outside of Esperance.

The strategy anticipated that demand for housing in Condingup would be two to three lots per year. This demand is particularly due to people looking to retire in Condingup or from those who are employed on surrounding farms.

The strategy supports the long-term expansion of Condingup to the south and south-east towards Condingup Peak, and there are several areas allocated for future residential and rural-residential development.

Any development in these areas should be consistent with the priority area of the land and the minimum lot sizes in *Shire of Esperance town planning scheme no. 23* (Department of Planning 2010).

The strategy supports an additional production bore near the school in the short-term, because ‘further expansion of the Condingup and Wharton townsites will be constrained until an alternative or supplementary water supply has been identified and limited power supplies have been resolved’.

There are also two unnamed existing roads within the Condingup Water Reserve that are proposed to be gazetted in the *Esperance local planning strategy* (Shire of Esperance and Department of Planning 2006).

1.6.7 Commercial development

In addition to demand for residential development, there continues to be scope for growth in tourism, light industry and other commercial activities within Condingup.

The *Esperance local planning strategy* (Shire of Esperance and Department of Planning 2006) supports the establishment of a shooting range. Land was initially allocated for this use to the east of the townsite. However, the strategy states that ‘the association and the Condingup community feel that it would be preferable to find a site further away from the town’. It should be noted that while incompatible in P1 areas, shooting ranges are compatible with conditions in P2 areas.

1.6.8 Other groundwater bores

Bores drilled near a public drinking water supply bore (such as 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 will be assessed through Department of Water and Environmental Regulation'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 Uniform Drillers Licensing Committee 2012).

There is a licensed production bore less than 500 m north-north-east of the public drinking water production bore (6/83). The Shire of Esperance has a licence to take 22 500 kL of groundwater per year from this bore, expiring in 2023.

There is also a production bore located on the school grounds, less than 150 m north-north-east of the public drinking water production bore (6/83). The Department of Education has a licence to take 6375 kL of groundwater per year from this bore, expiring in 2026.

Please refer to Figure A3 for the location of these bores.

Table 2 Summary of potential water quality risks, land use compatibility and best management practices

Land use/activity	Hazard	Management priority	Comments	Best management practice guidance[1]
Urban - residential - rural - commercial - school - light industry	Pathogens	High	The drinking water bore is close to these developed areas because it was originally established to supply the school with water.	WQPN no. 70: *Wastewater treatment and disposal: domestic systems* WQPN no. 54*: Rezoning and subdivision of land in public drinking water source areas* WQPN no. 93: *Light industry near sensitive waters* WQPN no. 10: *Contaminant spills – emergency response*
	Chemicals and hydrocarbons	Medium		
	Nutrients	Medium		
Sporting grounds	Nutrients and pesticides	Medium	Only half of the sporting grounds are currently within the Condingup Water Reserve.	Public sector circular number 88: *Use of herbicides in water catchment areas* WQPN no. 33: *Nutrient and irrigation management plans*
Old landfill	Heavy metals, hydrocarbons and nutrients	Medium	The landfill site has been closed and will be monitored on an ongoing basis.	WQPN no. 84: *Rehabilitation of disturbed land in public drinking water source areas*
Roads and tracks	Hydrocarbons	Low	The roads have low levels of traffic, typically travelling at low speeds.	WQPN no. 44: *Roads near sensitive water resources* WQPN no. 10: *Contaminant spills – emergency response*

[1] Water quality protection notes (WQPNs) are available at www.dwer.wa.gov.au.

1.7 Water quality information

The Water Corporation has provided updated water quality information for raw water from the Condingup Water Reserve. This is shown in Appendix B.

Total filterable solids, chloride and sodium levels exceeded the aesthetic guideline values of the ADWG (NHMRC & NRMMC 2011). These are naturally occurring characteristics of the groundwater in the area.

There were no health-related detections that exceeded the guideline values of the ADWG (NHMRC & NRMMC 2011) during the monitoring period.

1.8 Water supply planning

There is an allocation limit of 10 ML/year in the Condingup Groundwater Area for the Bremer East Superficial aquifer (Department of Water 2014). The entire 10 ML/year is still available for allocation. The Water Corporation's allocation has not been included in this limit, because Condingup's drinking water comes from the Bremer East Sedimentary aquifer. The sedimentary aquifer is separated from the superficial aquifer and therefore, allocation for one does not impact on the other.

2 Implementation of Condingup's drinking water source protection plan

2.1 Status of previous recommendations

Table 3 outlines recommendations from the 2008 plan and their current status.

Table 3 Implementation status for Condingup Water Reserve

No.	Recommendation	Comments
1	Prepare implementation plan.	Implementation of this review will be undertaken by the Department of Water and Environmental Regulation and other relevant agencies.
2	Incorporation into land planning strategies.	The water reserve was incorporated into the *Shire of Esperance town planning scheme no. 23,* however it did not incorporate the priority areas (see section 1.1). This has been continued as a recommendation of this review (section 2.2, recommendation no. 2).
3	Referral of development proposals to Department of Water and Environmental Regulation (formerly Department of Water) for advice.	Development proposals within all PDWSAs in the region are referred to the department's South Coast Regional office. This has been continued as a recommendation of this review (section 2.2, recommendation no. 3).
4	Emergency response: Shire of Esperance local emergency management committee should be aware of the Condingup Water Reserve. Locality plan should be provided to the HAZMAT Emergency advisory team and they should be aware of the PDWSA. The Water Corporation should provide an advisory role during incidents.	Emergency response protocols have since changed to Westplan–HAZMAT and the local emergency management committee. This has been continued as a recommendation of this review (section 2.2, recommendation no. 4).

No.	Recommendation	Comments
5	Management delegated formally to the Water Corporation.	Completed.
6	Surveillance program should be maintained.	Water Corporation undertakes surveillance within the water reserve. This has been continued as a recommendation of this review (section 2.2, recommendation no. 6).
7	Signs should be erected along the boundary and include an emergency contact number.	Signs should be installed and maintained in accordance with the Water Corporation's *S111 Source protection signage* (2013). Signs advising on the location of the Condingup Water Reserve have not been erected. This has been continued as a recommendation of this review (section 2.2, recommendation no. 5).
8	Hydrogeological study should be undertaken to review the boundary.	This was undertaken by the former Department of Water in 2014 and its findings have been incorporated into this review.
9	Planning for any future production bores should be aimed to be located within Priority 1 areas of the PDWSA.	Currently there are no plans for additional production bores. This has been continued as a recommendation of this review (section 2.2, recommendation no. 7).
10	Review of the plan and recommendations after seven years.	Undertaken through the preparation of this review document. This has been continued as a recommendation of this review (section 2.2, recommendation no. 8).

2.2 Consolidated recommendations

Based on the findings of this review, the following recommendations will now be applied to the Condingup Water Reserve. The bracketed stakeholders are those expected to have a responsibility for, or an interest in, the implementation of that recommendation.

1. Amend the boundary of the Condingup Water Reserve under the *Country Areas Water Supply Act 1947* to remove the southern parcel of land within the existing water reserve that is no longer required. (Department of Water and Environmental Regulation)
2. Incorporate the findings of this review and the amended boundary of the Condingup Water Reserve (including its priority areas and protection zone) into the Shire of Esperance town planning scheme in accordance with the Western Australian Planning Commission's State planning policy no. 2.7: *Public drinking water source policy*. (Shire of Esperance)
3. Refer development proposals within the Condingup Water Reserve that are inconsistent with the department's WQPN no. 25: *Land use compatibility tables for public drinking water source areas* or recommendations in this review to the Department of Water regional office for advice. (Department of Planning, Lands and Heritage, Shire of Esperance, proponents of proposals)
4. Ensure incidents covered by Westplan–HAZMAT in the Condingup Water Reserve are addressed by ensuring that:
    - the Esperance local emergency management committee is aware of the location and purpose of the Condingup Water Reserve
    - the locality plan for the Condingup Water Reserve is provided to the Department of Fire and Emergency Services headquarters for the HAZMAT emergency advisory team
    - the Water Corporation acts in an advisory role during incidents in the Condingup Water Reserve
    - personnel dealing with Westplan–HAZMAT incidents in the area have ready access to a locality map of the Condingup Water Reserve and information to help them recognise the potential impacts of spills on drinking water quality. (Water Corporation)
5. Erect and maintain signs along the boundary of the Condingup Water Reserve including an emergency contact telephone number, in accordance with the Water Corporation's *S111 Source protection signage* (2013). (Water Corporation)
6. Water Corporation should continue the current regime of water quality monitoring, maintenance of fencing, inspections and by-law enforcement. (Water Corporation)
7. Any future production bores be located in the priority 1 area of the Condingup Water Reserve. (Water Corporation)

8. Consult with the community about the proposed expansion of the water reserve to the north and north-east as part of the next drinking water source protection report for Condingup. (Department of Water and Environmental Regulation)
9. Update this review within seven years or in response to changes in water quality contamination risks. (Department of Water and Environmental Regulation)

Appendices

Appendix A — Figures

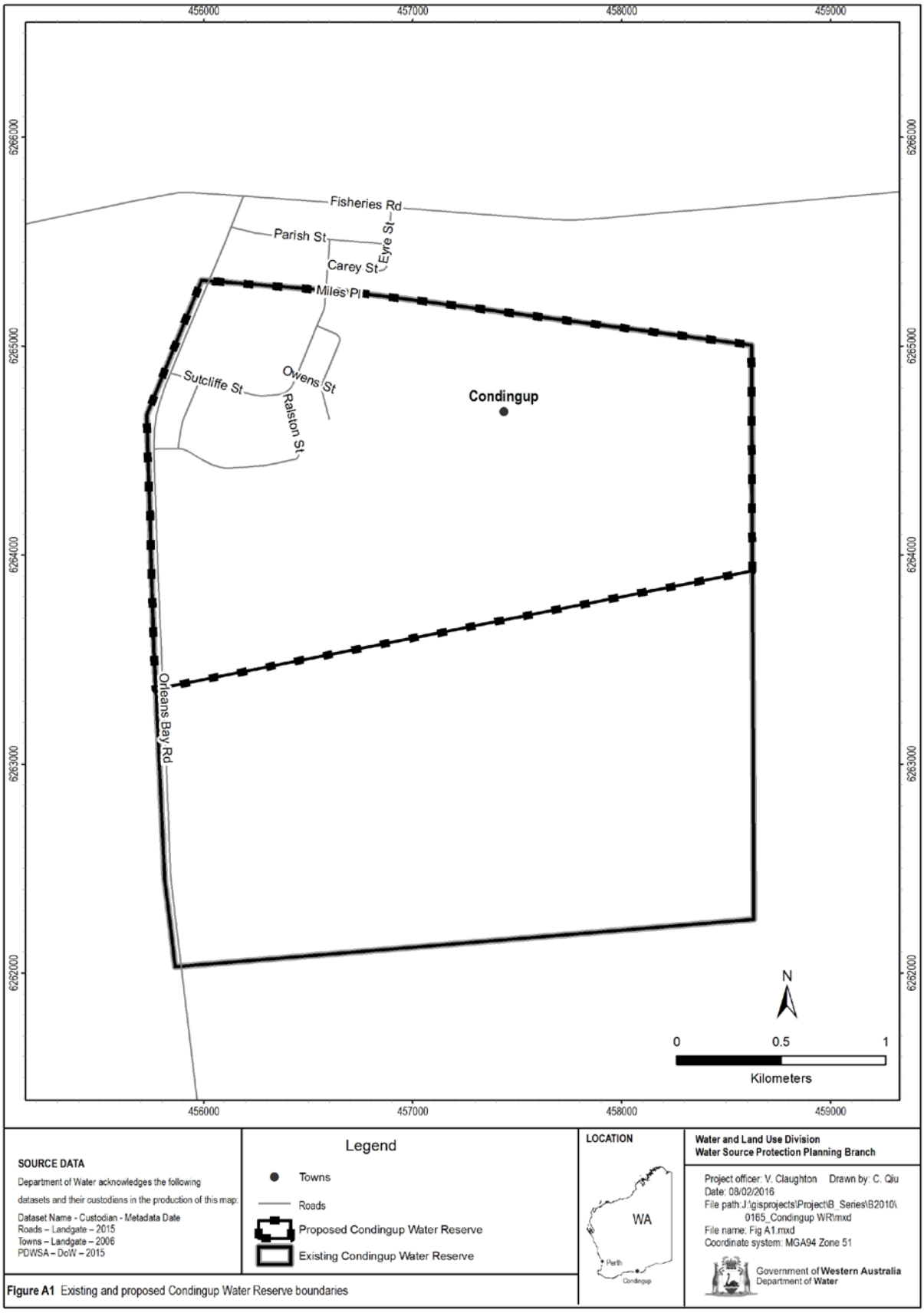
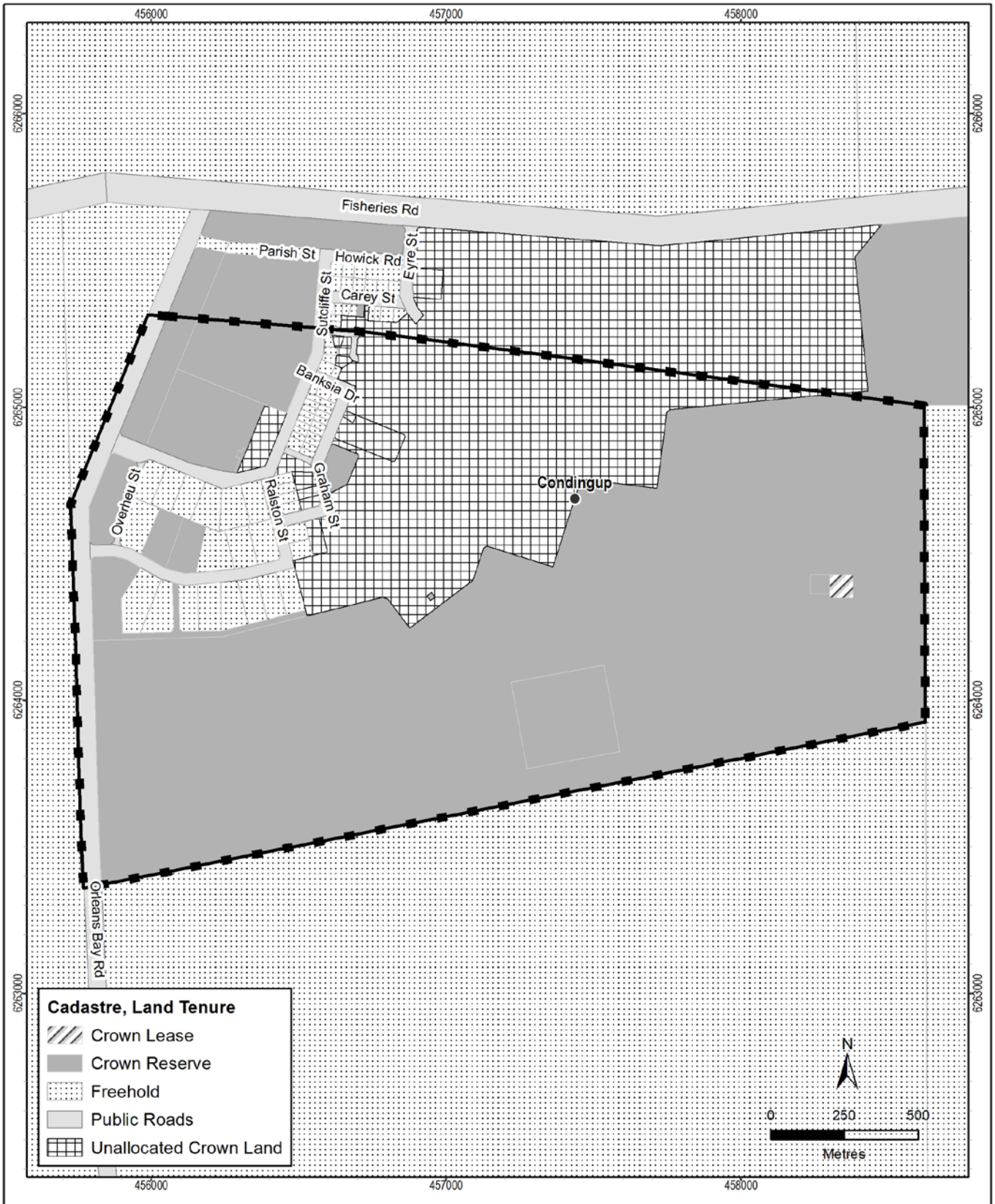


Figure A1 Existing and proposed Condingup Water Reserve boundaries



SOURCE DATA

Department of Water acknowledges the following datasets and their custodians in the production of this map:

Dataset Name - Custodian - Metadata Date
Roads – Landgate – 2015
Towns – Landgate – 2006
PDWSA – DoW – 2015

Legend

- Towns
- Proposed Condingup Water Reserve

LOCATION

Water and Land Use Division
Water Source Protection Planning Branch

Project officer: V. Claughton Drawn by: C. Qiu
Date: 08/02/2016
File path:J:\gisprojects\Project\B_Series\B2010\0165_Condingup WR\mxd
File name: Fig A2.mxd
Coordinate system: MGA94 Zone 51

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

Figure A2 Land use, activities and tenure in and around the Condingup Water Reserve

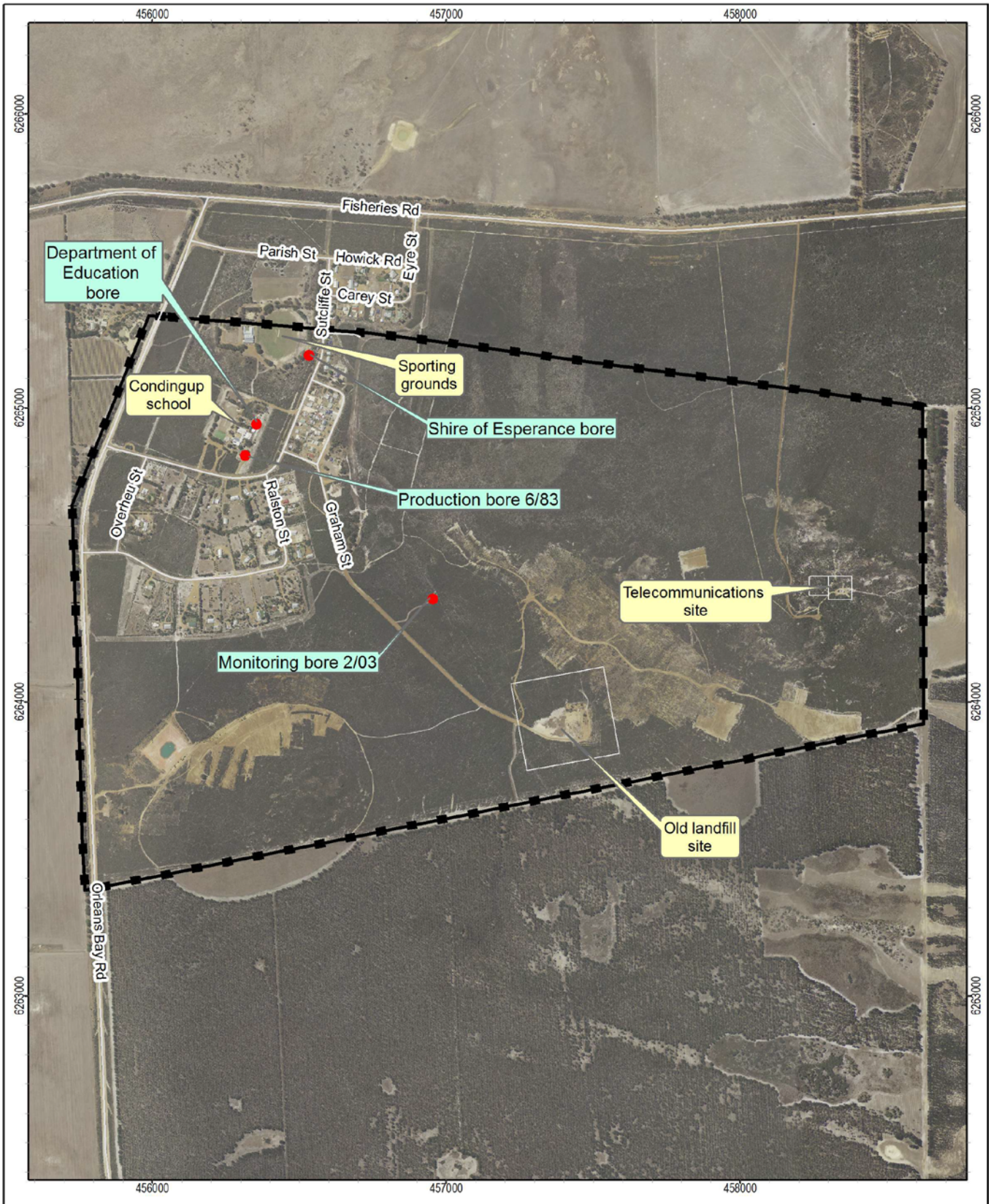


Figure A3 Aerial photography and land uses in Condingup Water Reserve

Figure A4 Proposed boundary, priority areas and wellhead protection zone in the Condingup Water Reserve

Appendix B — Water quality data

The Water Corporation has monitored the raw (source) water quality from the Condingup bore in accordance with the requirements of the *Australian drinking water guidelines*, (ADWG; NHMRC & NRMMC 2011) 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 the Condingup bore. 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 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 five year period from December 2009 to November 2014.

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 health guideline levels of the ADWG.

For more information on the quality of drinking water supplied to Condingup refer to the most recent Water Corporation drinking water quality annual report at watercorporation.com.au.

Aesthetic

The aesthetic water quality analyses for raw water from the Condingup bore are summarised in the following table.

Aesthetic detections for Condingup bore

Parameter	**Units**	**ADWG aesthetic guideline value***	**Condingup bore (6/83)**	
			Range	**Median**
Chloride	mg/L	250	***350–415***	***375***
Colour – true	TCU	15	<1–1	<1
Hardness as $CaCO_3$	mg/L	200	65–80	75
Iron unfiltered	mg/L	0.3	0.004–0.025	0.015
Manganese unfiltered	mg/L	0.1	<0.002–0.002	<0.002
Silicon as SiO_2	mg/L	80	47–65	60
Sodium	mg/L	180	***255–330***	***300***
Sulfate	mg/L	250	57–66	62
Total filterable solids by summation	mg/L	600	***869–1080***	***996***
Turbidity	NTU	5	<0.1–0.5	<0.1
pH measured in laboratory	-	8.5	6.19–7.21	6.68
Copper	mg/L	1	0.02–0.02^	0.02^
Zinc	mg/L	3	0.02–0.02^	0.02^

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

^ data derived from a single sample.

Health-related chemicals

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

Health-related detections for the Condingup bore

Parameter	Units	ADWG health guideline value*	Condingup bore (6/83)	
			Range	Median
Manganese unfiltered	mg/L	0.5	<0.002–0.002	<0.002
Nitrite plus nitrate as N	mg/L	11.29†	0.17–0.57	0.27
Sulfate	mg/L	500	57–66	62
Arsenic	mg/L	0.01	<0.002–0.003	0.002
Barium	mg/L	2	0.0012–0.0012	0.0012
Boron	mg/L	4	0.22–0.25	0.235
Uranium	mg/L	0.017	0.001–0.001	0.001
Copper	mg/L	2	0.02–0.02^	0.02^
Fluoride (lab measured)	mg/L	1.5	0.3–0.3	0.3
Nitrate as nitrogen	mg/L	11.29†	0.17–0.48	0.275
Annual radiation dose	mSv	1	0.074–0.074^	0.074^
Radon-222	Bq/L	100	12.1–26.3	19.2

* 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 less than 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.

^ data derived from a single sample.

Microbiological contaminants

Microbiological testing of raw water samples from the Condingup bore 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, no positive *E. coli* counts were recorded.

Appendix C — Photographs

Figure C1 Production bore 6/83 surrounded by fencing and signs, photograph by V. Claughton, Department of Water and Environmental Regulation

Figure C2 Condingup school garden and Water Corporation storage tank, photograph by V. Claughton, Department of Water and Environmental Regulation

Figure C3 Light industry within the Condingup Water Reserve, photograph by V. Claughton, Department of Water and Environmental Regulation

Figure C4 Rehabilitated landfill site within the Condingup Water Reserve, photograph by V. Claughton, Department of Water and Environmental Regulation

Figure C5 View of the Condingup Water Reserve and Condingup town from the south-west, photograph by V. Claughton, Department of Water and Environmental Regulation

Figure C6 Shire of Condingup sporting grounds partly within the Condingup Water Reserve, photograph by N. Sykora, Department of Water and Environmental Regulation

Appendix D — Typical contamination risks in groundwater sources

Land development and land- or water-based activities within a water reserve can directly affect the quality of drinking water and its treatment. Contaminants can reach drinking water sources through runoff over the ground and infiltration through soil. A wide range of microbiological, chemical and physical contamination risks can impact on water quality and therefore affect the provision of a reliable, safe, good quality drinking water to consumers.

Some contaminants in drinking water can affect human health, resulting in illness, hospitalisation or even death. Other impurities can affect the water's aesthetic qualities, including its appearance, taste, smell and 'feel' but are not necessarily hazardous to human health. For example, cloudy water with a distinctive odour or strong taste may not be harmful to health, but clear, pleasant-tasting water may contain harmful microorganisms that are undetectable by sight, taste or smell. (NHMRC & NRMMC 2011). Contaminants can also interfere with water treatment processes, and damage water supply infrastructure (such as iron corroding pipes).

The *Australian drinking water guidelines* (ADWG; NHMRC & NRMMC 2011) outline criteria for acceptable drinking water quality to protect human health, manage aesthetics and maintain water supply infrastructure.

Some commonly seen contamination risks relevant to groundwater drinking water sources are described below.

Microbiological risks

Pathogens are types of microorganisms that are capable of causing illness and include bacteria, protozoa and viruses. When people consume drinking water that is contaminated with pathogens, the consequences vary considerably, ranging from mild illness (such as stomach upset or diarrhoea) to hospitalisation and in some cases even death. For example, seven people died and about 2500 became ill in Walkerton, Canada, during 2000, because the town's water supply was contaminated by a pathogenic strain of *E. coli* and *Campylobacter* (NHMRC & NRMMC 2011).

The types of pathogens that are likely to cause harm to people are commonly found in the faeces of humans and domestic animals (such as dogs and cattle). These pathogens can enter drinking water supplies from faecal contamination in the catchment area, either directly or indirectly.

In groundwater sources, this occurs indirectly. Faecal material can infiltrate through the soil and into the groundwater. For example, contamination can occur from septic tanks or grazing animals.

A number of pathogens are commonly known to contaminate water supplies worldwide. These include bacteria (for example *Salmonella*, *Escherichia coli* and cholera), protozoa (such as *Cryptosporidium* and *Giardia*) and viruses. Monitoring for

the presence of *E. coli* in water supplies provides an indication of the level of recent faecal contamination.

Pathogen contamination of a drinking water source is influenced by many factors including the existence of pathogen carriers (humans and domestic animals), the transfer to and movement of the pathogen in the water source and its ability to survive in the water.

The percentage of humans in the world that carry pathogens varies. For example, it is estimated that between 0.6 to 4.3 per cent of people are infected with *Cryptosporidium* worldwide, and 7.4 per cent with *Giardia* (Geldreich 1996).

The survival and movement of pathogens in groundwater is influenced by the characteristics of the pathogen (such as its size and inactivation rate) and the groundwater properties (including flow rate, porosity, amount of carbon in the soil, temperature and pH). Inactivation rate (the time it normally takes a pathogen to decay) is one of the most important factors governing how far pathogens may migrate. Typical half-lives of pathogens range from a few hours to a few weeks. For example, some reported migration distances of bacteria in groundwater are:

- 600 m in a sandy aquifer
- 1000–1600 m in channelled limestone
- 250–408 m in glacial silt-sand aquifers (Robertson & Edbery 1997).

Unlike chemicals, which dissipate and dilute when they enter a water source, pathogens can multiply under the right conditions, increasing the likelihood of contamination. Therefore it is important to understand both the surface water and groundwater systems to be able to protect the drinking water source from pathogens.

Given the wide variety of pathogens, their behaviour in the environment and the potential consequences of consuming contaminated water, the most effective way to protect public health and reduce water treatment costs is to avoid the introduction of pathogens into a water source.

Physical risks

Turbidity is the result of soil or organic particles becoming suspended in water. Increased turbidity can result in cloudy or muddy-looking water, which is not aesthetically appealing to consumers. Turbidity can also reduce the effectiveness of treatment processes (such as disinfection). This is because pathogens and chemicals can attach onto soil particles, make them more difficult to remove during disinfection and treatment processes.

Other physical properties of water can affect water supply infrastructure, or the aesthetics of the drinking water. For example, pH can contribute to the corrosion and encrustation of pipes; iron and dissolved organic matter can affect the colour and smell of water; and salinity levels can affect its taste. Although not necessarily harmful to human health, water with properties like this will be less appealing to customers.

Chemical risks

Chemicals can occur in drinking water as a result of natural leaching from mineral deposits or from different land uses (NHMRC & NRMMC 2011). A number of these chemicals (organic and inorganic) are potentially toxic to humans.

Pesticides include agricultural chemicals used to control weeds (herbicides) and pests (insecticides, rodenticides, nematicides (for worms) and miticides (for mites)). Contamination of a drinking water source by pesticides (and other chemicals) may occur as a result of accidental spills, incorrect use or leakage from storage areas. In these cases, the relevant authorities should be notified promptly and the spill cleaned up to prevent contamination of the drinking water source.

Hydrocarbons such as fuels and oils are potentially toxic to humans. Harmful chemical by-products may be formed when hydrocarbons are combined with chlorine during the water treatment process. Hydrocarbons can occur in water supplies as a result of spills and leaks from vehicles and machinery.

Drinking water sources can also be contaminated by nutrients such as nitrogen and phosphorus. Nutrients can be introduced into a catchment via the application of fertiliser, from septic systems, and from animal faecal matter that washes through soil and into the groundwater. Nitrate and nitrite are two forms of nitrogen that can be toxic to humans at high levels, with infants younger than three months being most susceptible (NHMRC & NRMMC 2011).

Other chemicals and heavy metals can be associated with land uses such as industry and landfill. These may enter groundwater and could be harmful to human health if consumed.

Appendix E — How do we protect public drinking water source areas?

The *Australian drinking water guidelines* (ADWG; NHMRC & NRMMC 2011) outline how we should protect drinking water in Australia. The ADWG recommends a 'catchment to consumer' framework that uses an approach based on preventive risk and multiple barriers. A similar approach is recommended by the World Health Organization.

The catchment to consumer framework applies across the entire drinking water supply system – from the water source to the taps in your home. It ensures a holistic assessment of water quality risks and solutions to ensure the delivery of a reliable and safe drinking water to supply your home.

An approach based on preventive risk means that we look at all the different risks to water quality. We determine what risks can reasonably be avoided and what risks need to be minimised or managed to protect public health. This approach means that the inherent risks to water quality are as low as possible.

A multiple-barrier approach means that we use different barriers against contamination at different stages of a drinking water supply system. The first and most important barrier is protecting the public drinking water source area (PDWSA) (the area from which water is captured to supply drinking water). If we get this barrier right, it has a flow-on effect that can result in a lower cost, safer drinking water supply. Other barriers against contamination include storage of water to help reduce contaminant levels, disinfecting the water (for example chlorination to inactivate pathogens), maintenance of pipes and testing of water quality.

Research and experience shows that a combination of catchment protection and water treatment is safer than relying on either barrier on its own. That's why this drinking water source protection plan is important. We should not forget that ultimately it's about protecting your health by protecting water quality now and for the future.

An additional benefit from PDWSA protection is that it complements the state's conservation initiatives.

In Western Australia, the Department of Water and Environmental Regulation protects PDWSAs by implementing the ADWG, writing reports, policies and guidelines, and providing input into land use planning.

This drinking water protection report achieves elements 2 and 3 of the 12 elements in the ADWG recommended for protecting drinking water. It shows the PDWSA's location, its characteristics, existing and potential water quality contamination risks, and makes recommendations to deal with those risks.

The *Metropolitan Water Supply, Sewerage, and Drainage Act 1909* and the *Country Areas Water Supply Act 1947* provide us with important tools to protect water quality in proclaimed PDWSAs. These Acts allow us to assess and manage the water quality contamination risks from different land uses and activities. The department works

cooperatively with other agencies and the community to implement this legislation and develop drinking water source protection reports. For example, the Western Australian Planning Commission has developed a number of state planning policies to help guide development in PDWSAs.

An important step in maximising the protection of water quality in PDWSAs is to define their boundaries, priority areas and protection zones to help guide land use planning and to identify where legislation applies. Our Strategic policy: *Protecting public drinking water source areas in Western Australia* (Department of Water 2016a) describes how we do this. It is available at www.dwer.wa.gov.au.

There are three different priority areas. The objective of priority 1 (P1) areas is risk avoidance – ensuring there is no degradation of the water quality (for example over Crown land). The objective of priority 2 (P2) areas is risk minimisation – maintaining or improving water quality (for example over rural-zoned land). The objective of priority 3 (P3) areas is risk management – maintaining the water quality for as long as possible (for example, urban- or commercial-zoned land). Protection zones surround drinking water abstraction bores and surface water reservoirs so that the most vulnerable areas are protected from contamination.

The department's Water quality protection note (WQPN) no. 25: *Land use compatibility tables for public drinking water source areas* (Department of Water 2016b) outlines appropriate development and activities within each of the priority areas (P1, P2 and P3).

With 129 proclaimed PDWSAs across Western Australia, the department prioritises the update of drinking water source protection reports (such as this document). Our aim is to update each report every seven years. In some locations, more frequent updates may be required to address changing water quality risks and land uses. These updates allow us to make changes to the PDWSA boundary, priority areas and protection zones if required. They also allow solutions to new water quality risks to be considered.

There are three different types of drinking water source protection report – each providing for different needs. The following table shows the differences between the types of reports.

There is a fourth type of report – Land use and water management strategy – that performs the same functions as a drinking water source protection report. However, these strategies are prepared by the Western Australian Planning Commission (with input from the Department of Water and Environmental Regulation) and are strategic documents that integrate land use planning with water management. There are currently land use and water management strategies for Gnangara, Jandakot and Middle Helena.

If you would like more information about the ADWG and how we protect drinking water in Western Australia, visit www.water.wa.gov.au or refer to our WQPN no. 36: *Protecting public drinking water source areas*. You can also contact the Department

of Water and Environmental Regulation's Water source protection planning branch on +61 8 6364 7600 or email drinkingwater@dwer.wa.gov.au.

Drinking water source protection reports

Drinking water source protection report	Scope and outcome	Consultation	Time to prepare	Implementation table	Proclamation
Drinking water source protection assessment (DWSPA)	Desktop assessment of readily available information.	Preliminary	Up to 3 months	No	Proclamation to protect water quality and guide land use planning can occur as a result of any type of drinking water source protection report.
Drinking water source protection plan (DWSPP)	Full investigation of risks to water quality building on information in the DWSPA.	Public	6–12 months	Prepared from recommendations in the DWSPA and/or information from public consultation.	
Drinking water source protection review (DWSPR)	Review changes in land and water factors and implementation of previous recommendations. Sometimes prepared to consider specific issues in a PDWSA.	Key stakeholders	3–6 months	Prepared from recommendations in the DWSPA or DWSPP.	

Appendix F — Understanding risks to drinking water quality

The existing integrated land use planning and public drinking water source area (PDWSA) protection program is based on the findings of three parliamentary committee reports in 1994, 2000 and 2010 (see *Further reading*). Since 1995, this integrated program has resulted in the development of four Western Australian Planning Commission state planning policies (SPPs), recognising the importance of PDWSAs for the protection of water quality and public health:

- SPP no. 2.2: *Gnangara groundwater protection*
- SPP no. 2.3: *Jandakot groundwater protection*
- SPP no. 2.7: *Public drinking water source policy*
- SPP no. 2.9: *Water resources*.

This integrated program relies upon a risk assessment process based on preventing risk in each PDWSA through the development of drinking water source protection reports. It is important to understand how risks are assessed to appreciate the impact of development within PDWSAs.

Risk-based assessments normally focus on the acceptability of risks after mitigation (residual risks). For drinking water sources, an assessment based on preventing risk that considers both the maximum and residual risks is required. This means that in some cases, the maximum risks from land uses will still be considered unacceptable, even after mitigation has reduced the risk. This is a more conservative approach needed to protect the health of consumers.

Water quality risks are evaluated by considering the type and scale of a potential contamination event (consequence), together with the probability/frequency of that event occurring (likelihood). An understanding of this relationship will prevent the common misunderstanding that probability equals risk (see risk matrix below).

Risk matrix: Level of risk (from the Australian drinking water guidelines *2011)*

Likelihood	**Consequences**				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	Moderate	High	Very high	Very high	Very high
Likely	Moderate	High	High	Very high	Very high
Possible	Low	Moderate	High	Very high	Very high
Unlikely	Low	Low	Moderate	High	Very high
Rare	Low	Low	Moderate	High	High

For example, just because a drinking water contamination incident has not occurred for many years (low likelihood) does not mean that the risk is low, because we also need to consider the consequence of that contamination when determining risk. Furthermore, no previous detection of contamination is not proof that the risk is acceptable.

Shortened forms

List of shortened forms

ADWG	*Australian drinking water guidelines*
HAZMAT	hazardous materials
NHMRC	National Health and Medical Research Council
NRMMC	Natural Resource Management Ministerial Council
P1, P2, P3	priority 1, priority 2, priority 3
PSC 88	Public sector circular number 88
PDWSA	public drinking water source area
Westplan–HAZMAT	Western Australian plan for hazardous materials
WQPN	water quality protection note

Units of measurement

Bq/L	becquerels per litre
km	kilometres
mSv	millisieverts
m	metres
mg/L	milligrams per litre
NTU	nephelometric turbidity units
TCU	true colour units

Volumes of water

One millilitre	0.001 litre	1 millilitre	(mL)
One litre	1 litre	1 litre	(L)
One thousand litres	1000 litres	1 kilolitre	(kL)
One million litres	1 000 000 litres	1 megalitre	(ML)
One thousand million litres	1 000 000 000 litres	1 gigalitre	(GL)

Glossary

Abstraction	The pumping of groundwater from an aquifer, or the removal of water from a waterway or water body.
Aesthetic guideline value	The concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer, for example appearance, taste and odour (NHMRC & NRMMC 2011).
Allocation	The volume of water that a licensee is permitted to abstract, usually specified in kilolitres per annum (kL/a).
Aquifer	A geological formation or group or formations able to receive, store and transmit significant quantities of water.
Australian drinking water guidelines	The *National water quality management strategy: Australian drinking water guidelines 6*, 2011 (NHMRC & NRMMC 2011) (ADWG) outlines acceptable criteria for the quality of drinking water in Australia (see *References*).
Becquerel	A measure of radioactivity, as per the International System of Units.
Bore	A narrow, lined hole drilled into the ground to monitor or draw groundwater (also called a well).
Catchment	The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
Contamination	A substance present at concentrations exceeding background levels that presents – or has the potential to present – a risk of harm to human health, the environment, water resources or any environmental value.
Drinking water source protection report	A report on water quality hazards and risk levels within a public drinking water source area; includes recommendations to avoid, minimise, or manage those risks for the protection of the water supply in the provision of safe drinking water supply.
Health guideline value	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).
Hydrocarbons	A class of compounds containing only hydrogen and carbon, such as methane, ethylene, acetylene and benzene. Fossil fuels such as oil, petroleum and natural gas all contain hydrocarbons.

Hydrogeology	The branch of geology that deals with the occurrence, distribution and effects of groundwater. It is the study of groundwater, especially relating to the distribution of aquifers, groundwater flow and groundwater quality.
Leaching/ leachate	The process by which materials such as organic matter and mineral salts are washed out of a layer of soil or dumped material by being dissolved or suspended in percolating rainwater. The material washed out is known as leachate. Leachate can pollute groundwater and waterways.
Millisievert	A measure of annual radiological dose, with a natural dose equivalent to 2 mSv/yr.
Nephelometric turbidity units	A measure of turbidity in water.
Nutrients	Minerals, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorous (phosphate) dissolved in water which provide nutrition (food) for plant growth.
Pathogen	A disease-producing organism that can cause sickness and sometimes death through the consumption of water, including bacteria (such as *Escherichia coli*), protozoa (such as *Cryptosporidium* and *Giardia*) and viruses.
Pesticides	Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms.
pH	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.
Public drinking water source area	The area from which water is captured to supply drinking water. It includes all underground water pollution control areas, catchment areas and water reserves constituted under the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909* or the *Country Areas Water Supply Act 1947*.
Recharge	The action of water infiltrating through the soil/ground to replenish an aquifer.
Recharge area	An area through which water from a groundwater catchment percolates to replenish (recharge) an aquifer. An unconfined aquifer is recharged by rainfall throughout its distribution. Confined aquifers are recharged in specific areas where water leaks from overlying aquifers, or where the aquifer rises to meet the surface.

Sedimentary rocks	Rocks that have been formed by the deposition of materials. Examples are limestone, sandstone and siltstone.
Sedimentary aquifer	Aquifers occurring in sedimentary rocks.
Semi-confined aquifer	A leaky aquifer, saturated and bounded above by a semi-permeable layer and below by a layer that is either impermeable or semi-permeable.
Superficial aquifer	Shallow (near to the surface) aquifers which are easily recharged and can be readily accessed by bores.
Total filterable solids by summation	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_4 equivalent (sulfate) or S (sulfur) in grams, Fe (iron), Mn (manganese), and SiO_2 (silicon oxide). It is used as a more accurate measure than total dissolved solids. The higher the value, the more solids that are present and generally the saltier the taste.
Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes, including drinking and discharge to the environment.
True colour units	A measure of degree of colour in water.
Turbidity	The cloudiness or haziness of water caused by the presence of fine suspended matter.
Wastewater	Water that has been used for some purpose and would normally be treated and discarded. Wastewater usually contains significant quantities of pollutant.
Water quality	Collective term for the physical, aesthetic, chemical and biological properties of water.
Water reserve	An area proclaimed under the *Country Areas Water Supply Act 1947* or the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909* for the purposes of protecting a drinking water supply.
Wellhead	The top of a well (or bore) used to draw groundwater.
Wellhead protection zone	Usually declared around wellheads in public drinking water source areas to protect the groundwater from immediate contamination risks.

Westplan–HAZMAT	State emergency management plan for hazardous materials emergencies.

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