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

Sandstone Water Reserve

Drinking water source protection plan

Sandstone town water supply

Looking after all our water needs

Water resource protection series
Report WRP 124
June 2011

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Cover photograph: Photo of Sandstone's welcome sign on main road entrance, Sandstone, WA (Kellie Clark).

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Preface

How do we protect public drinking water source areas?

The *Australian drinking water guidelines* (ADWG) (NHMRC & NRMMC 2004a) outline how we should protect drinking water in Australia. The ADWG recommends a 'catchment to consumer' framework that uses a preventive risk-based and multiple-barrier approach. 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 your tap. It ensures a holistic assessment of water quality risks and solutions to ensure the delivery of a reliable and safe drinking water to your home.

A preventive risk-based approach means that we look at all the different risks to water quality, to determine what risks can reasonably be avoided and what risks need to be minimised or managed. 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 catchment. 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, maintenance of pipes and testing of water quality. Another community benefit of catchment protection is its complementary nature to conservation initiatives.

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, and about protecting the catchment's water quality now and for the future.

In Western Australia, the Department of Water protects public drinking water source areas (PDWSAs) by putting the ADWG into practice, writing plans, policies and guidelines, and providing input into land-use planning.

The *Metropolitan Water Supply Sewerage and Drainage Act 1909* (WA) and the *Country Areas Water Supply Act 1947* (WA) 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. We work cooperatively with other agencies in the implementation of this legislation.

This drinking water protection plan has been developed to achieve elements two and three of the 12 elements recommended for the protection of drinking water in the ADWG. It shows where the PDWSA is located, its characteristics, existing and potential water quality contamination risks, and includes recommendations to deal

with water quality risks. The department then works with the community, other government agencies and landowners to put these recommendations into practice.

An important step in maximising the protection of water quality in PDWSAs is to define priority areas and protection zones to help guide land use planning and to identify where legislation applies. There are three different priority areas. Priority 1 (P1) areas are defined and managed to ensure there is no degradation of the quality of the drinking water source using the principle of risk avoidance. Priority 2 (P2) areas are defined and managed to maintain or improve the quality of the drinking water source using the principle of risk minimisation. Priority 3 (P3) areas are defined and managed to maintain the quality of the drinking water source for as long as possible using the principle of risk management. Protection zones surround drinking water extraction points, so that the most vulnerable areas may be protected from contamination.

If you would like more information about the ADWG and how we protect drinking water in Western Australia, go to <http://drinkingwater.water.wa.gov.au.>

The following table outlines the stages involved in the preparation of this drinking water source protection plan:

Stages in development of a plan		**Comment**
1	Prepare drinking water source protection assessment document. (2004)	Prepared after initial catchment survey and preliminary information gathering.
2	Conduct stakeholder consultation. (February 2011)	Advice sought from key stakeholders using the assessment document as a tool for information and discussion. Draft protection plan is prepared.
3	Consult draft drinking water source protection plan. (May 2011)	Draft protection plan released for a public consultation period.
4	**Publish approved drinking water source protection plan.** **(June 2011)**	**Final protection plan published after considering submissions. Includes recommendations on how to protect water quality. Proclamation of this public drinking water source area can now be progressed.**

Summary

Sandstone is located approximately 540 km north-east of Perth, Western Australia; it is a small settlement of approximately 119 people (ABS 2006). The closest town is Leinster, which is 135 km east of Sandstone. The local government authority for Sandstone is the Shire of Sandstone.

The Water Corporation abstracts groundwater from four bores (named 15/87, 16/87, 2/99 and 10/99), located approximately 3.4 km north-east of Sandstone, to supply the town.

The Sandstone Water Reserve was gazetted in 1990. This plan recommends the water reserve boundary be increased by 1.33 km^2, over crown land, to include bore 16/87.

The Department of Water has prepared this drinking water source protection plan to help protect the quality of water in the Sandstone Water Reserve to ensure it is safe for drinking. This plan:

- shows the location and boundary of the proposed water reserve
- outlines a priority area and protection zone (special areas that need protecting)
- identifies the risks to water quality from surrounding land uses and activities
- recommends strategies to address the risks to water quality
- guides future development in the Sandstone Water Reserve.

This plan is consistent with the Australian drinking water guidelines (ADWG) (NHMRC & NRMMC 2004a) and State planning policy no. 2.7: *Public drinking water source policy.*

We prepared this document in consultation with key stakeholders, including the pastoral lessee, the Water Corporation and the Shire of Sandstone. It replaces the *Sandstone Water Reserve drinking water source protection assessment* produced in 2004 by the Water Corporation on behalf of the Department of Water.

The following strategies are recommended to protect water quality within the proposed Sandstone Water Reserve:

- establish a wellhead protection zone (WHPZ) around all four bores
- all crown land, crown reserve and Water Corporation land should be managed for Priority 1 source protection
- the boundary of the proposed Sandstone Water Reserve should be amended under the *Country Areas Water Supply Act 1947* (WA)
- best management practices and guidelines need to be made available to the community to help them protect their drinking water source.

The following shows useful information about the Sandstone Water Reserve.

Key information

Local government authority	Shire of Sandstone
Locations supplied	Sandstone
Aquifer type	semi confined
Volume of water abstracted	54 963 kL/year in 2010
Number of bores	4
Bore name and GPS coordinates	15/87 (E 727 455, N 6 905 076) 16/87 (E 727 675, N 6 904 907) 2/99 (E 727 568, N 6 906 349) 10/99 (E 727 536, N 6 905 723)
Date of bore completion	15/87, 16/87 – 1987 2/99, 10/99 – 1999
Date of drinking water source protection assessment	2004
Proclamation status	Existing boundary was proclaimed on the 23 March 1990 under the *Country Areas Water Supply Act 1947* (WA).

1 Overview of Sandstone's drinking water source

Sandstone is a small regional centre located approximately 540 km north-east of Perth and 160 km east of Mt Magnet (see Figure 1). The Sandstone Water Reserve services the town of Sandstone as well as surrounding mining and pastoral industries.

The Sandstone wellfield is located approximately 3.4km north of the town. The gazetted water reserve includes three of the four bores, however, this plan proposes to incorporate the fourth bore as part of the water reserve.

1.1 The drinking water supply system

The Sandstone wellfield is operated by the Water Corporation and currently consists of four bores (see Figure 2). There are two production bores (15/87 and 2/99) and two standby bores (10/99 and16/87). The static water levels range between 15 and 20 m below ground level and the bores used for production are screened from 27 to 101 m below ground level.

The raw water is treated with chlorine to oxidise the manganese and is followed by removal of the manganese via filtration. The filtered water is then dosed with Calgon^{TM} to alleviate hardness levels. The chlorinated water is maintained throughout the treatment process for disinfection purposes.

The water is then stored in two high level tanks (combined volume of 160 kL) which are located 1.7 km south-west of the town, which are located 1.7 km south-west of the town, then supplied to the town reticulation. These elevated tanks act as a header tank to supply the town during increased demand periods when the usage exceeds the bores' pumping capacity.

It should be recognised that although treatment and disinfection are essential barriers against contamination, catchment 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,* 2004 (ADWG) (NHMRC & NRMMC 2004a) and reflects a risk-based, multiple-barrier approach 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 the preface at the front of this plan.

1.2 Water management

1.2.1 Licence to take water

Water resource use and conservation in Western Australia is administered by the Department of Water in accordance with the *Rights in Water and Irrigation Act 1914* (WA). Under this Act, the right to use and control water is vested with the Crown. This means that a licence is required for drilling bores and abstracting groundwater (pumping water from a bore, spring or soak) within proclaimed groundwater areas throughout the state. Some exemptions may apply such as abstracting water for domestic purposes only.

The Sandstone Water Reserve is located within the East Murchison Groundwater Area and the Meekatharra subarea which are proclaimed under the *Rights in Water and Irrigation Act 1914* (WA).

The Water Corporation is licensed to draw 50 000 kL a year (groundwater well licence 64109(4)) from the Sandstone wellfield for public supply purposes. The current number of services is 75. Abstraction in 2010 was 54 963 kL which was over the licensed limit; however approval was sought for the extra abstraction.

1.2.2 Future water needs

The water source is considered adequate to meet demand for the area in which the Water Corporation is currently licensed to provide water supply, including the predicted growth of services to 95 in the next 15 years.

1.3 Characteristics of the catchment

1.3.1 Physical environment

The area around Sandstone has low to moderate relief with elevations ranging from around 540 m AHD in the townsite, 520 m AHD within the entire water reserve, to 560 m AHD to the north-east and north-west of the water reserve providing a basin effect where the water reserve is located. The wellfield is in the Spring Park Drainage system which runs in a north-easterly direction with Sandstone located on the catchment divide (Dames and Moore 1999).

The main physiographic features are low relief surficial deposits, bedrock outcrops and breakaways, with saline or playa lakes, lake deposits and calcretes further away from the town (Water Corporation 2004a).

1.3.2 Climate

Sandstone experiences a semi-arid climate with high summer temperatures; the long-term average maximum temperature is 27.4^{O}C while the long-term average minimum temperature is 13.2 ^{O}C (BOM 2011a). The average rainfall in the last 30 years is 277.6 mm per annum (BOM 2011b). Around 80 per cent of the rain falls during the winter months usually between April and September. The remainder of the

rain occurs in the summer months and is associated with local thunderstorms or the southward movement of a tropical cyclone from the north of the state.

1.3.3 Hydrogeology

The Sandstone wellfield draws groundwater from what is believed to be a semi-confined aquifer. Recharge to the aquifer is believed to result from direct runoff and infiltration into the superficial formations to the south near Sandstone and to the west of the wellfield, and from indirect infiltration within the Spring Park Drainage system during periods of extensive rainfall (Dames & Moore 1999, Sinclair Knight Mertz 1997).

The production bores are screened from 27 to 101 m below ground level, in weathered basalt, and therefore are considered to have low to moderate vulnerability to contamination (Water Corporation 2004a).

1.4 How is the drinking water protected?

The Sandstone Water Reserve was proclaimed in 1990 under the *Country Areas Water Supply Act 1947* (WA). Proclamation identifies the location of the water reserve and ensures that its drinking water value is considered in land-use planning decisions. It also allows by-laws to be applied for the protection of water quality.

The Water Corporation regularly patrols the water reserve to identify risks to water quality and provides advice to the Advisory Committee for the Purity of Water (ACPOW). This plan recommends formally delegating catchment management powers to the Water Corporation. To find out more about by-laws, please see section 4.7: *Enforcing by-laws and surveying the area*.

In 2004 the Water Corporation prepared the *Sandstone Water Reserve drinking water source protection assessment.* It has information about the water reserve, identifies risks to water quality and recommends strategies to manage the risks. This document replaces it, as it provides more up-to-date information.

There is one pastoral lessee on crown lease 3114-1031 who will be stocking sheep within the water reserve; however, the lessee is using best management practices (e.g. keeping the watering points for the sheep out of the water reserve to discourage congregation and subsequent defecation in the water reserve).

1.5 Other useful information

1.5.1 Other groundwater bores in the area

The Water Corporation operates drinking water bores in the Sandstone Water Reserve. If bores for other purposes (e.g. irrigation, private household use) are constructed near a public drinking-water supply bore, they can cause contamination of the drinking-water source. For example, a poorly constructed private 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 the Department of Water's water licensing process where applicable under the *Rights in Water and Irrigation Act 1914* (WA). All bores should be constructed in accordance with *Minimum construction requirements for water bores in Australia* (National Minimum Bore Specifications Committee 2003).

1.5.2 Mining

There are two granted Exploration Licences E57/640 held by Troy Resources NL and E57/666 held by Wirraminna Gold NL and one granted Prospecting Licence P57/1111 held by Wirraminna Gold NL that occur over the Sandstone Water Reserve. However, Troy Resources have no past or current mining operations within the water reserve, nor do they have any plans to commence a mining operation within the reserve in the future.

As the mining tenement is for exploratory purposes, any exploratory drilling should comply with our Water quality protection guidelines no. 1: *Water quality management in mining and mineral processing: an overview* and all exploration drilling holes should be rehabilitated in accordance with the Department of Mines and Petroleum's *Mineral Exploration / Rehabilitation Activities Guidelines* (2007).

2 Common contamination risks

Land uses and activities within a water reserve can directly affect the quality of the drinking water and its treatment. Contaminants can reach drinking-water sources through run-off 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 safe, good quality drinking water to consumers.

Some contaminants in drinking water can affect human health. 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, undetectable microorganisms (NHMRC & NRMMC 2004b). Contaminants can also interfere with water treatment processes, and destroy water supply infrastructure (such as pipes).

The *Australian drinking water guidelines* (ADWG) outline criteria for acceptable drinking water quality to protect human health, aesthetics and water supply infrastructure.

For more information about water quality in this drinking water source, see section 3.

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

2.1 Microbiological risks

Pathogens are types of microorganisms that are capable of causing illness. These include bacteria, protozoa and viruses. In drinking-water supplies, pathogens that can cause illness are commonly found in the faeces of humans and domestic animals (such as dogs and cattle).

Pathogens can enter drinking water supplies from faecal contamination in the water reserve. 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 (e.g. salmonella, *Escherichia coli* and cholera), protozoa (e.g. *Cryptosporidium*, *Giardia*) and viruses. *E. coli* counts provide an indication of the level of faecal contamination.

Pathogen contamination of a drinking water source is influenced by many factors including the existence of pathogen carriers (e.g. 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 the length of time it normally takes to decay) and the groundwater properties (including flow rate, porosity, amount of carbon in the soil, temperature, 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, maximum 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).

Therefore it is important to understand the groundwater system to be able to protect the drinking water source from pathogens.

When people consume drinking water contaminated with pathogens the effects vary considerably, ranging from mild illness (such as stomach upset or diarrhoea) to hospitalisation and sometimes even death. During 2000, seven people died in Walkerton, Canada, because the town's water supply was contaminated by a pathogenic strain of *E. coli* and campylobacter (NHMRC & NRMMC 2004b). Where possible, avoiding the introduction of pathogens into a water source is the most effective way to protect public health.

2.2 Physical risks

Turbidity is the result of soil or organic particles becoming suspended in water (cloudiness). Increased turbidity can result in cloudy or muddy-looking water, which is not very appealing to consumers. Turbidity can also reduce the effectiveness of treatment processes (such as disinfection). This is because pathogens can adsorb onto soil particles and may be shielded from the effects of disinfection. Chemicals can also attach to suspended soil particles.

Some physical properties of water such as pH (a measure of acidity or alkalinity) can contribute to the corrosion and encrustation of pipes. Other properties such as iron and dissolved organic matter can affect the colour and smell of water. Although not necessarily harmful to human health, coloured or 'hard' water will not be as appealing to consumers. Salinity can affect the taste of drinking water.

2.3 Chemical risks

Chemicals can occur in drinking water as a result of natural leaching from mineral deposits or from different land uses (NHMRC & NRMMC 2004a). A number of these chemicals (organic and inorganic) are potentially toxic to humans.

Pesticides include agricultural chemicals such as insecticides, herbicides, nematicides (used to control worms), rodenticides and miticides (used to control 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 (e.g. fuels, oils) are potentially toxic to humans, and harmful chemical by-products may be formed when they are combined with chlorine during the water-treatment process. Hydrocarbons can occur in water supplies as a result of spills and leakage from vehicles.

Drinking-water sources can also be contaminated by nutrients (such as nitrogen) from fertiliser applications, faulty septic systems, leach drains and from domestic and feral animal faecal matter that washes through or over soil and into a water source. Nitrate and nitrite (forms of nitrogen) can be toxic to humans at high levels, with infants younger than three months being most susceptible (NHMRC & NRMMC 2004a).

Other chemicals and heavy metals can be associated with land uses such as industry and landfill. These may enter drinking water sources and could potentially be harmful to human health.

3 Contamination risks in this drinking water source

3.1 Water quality

The Water Corporation regularly monitors the quality of raw water from the Sandstone Water Reserve for microbiological, health-related and aesthetic (non-health-related) characteristics. This data shows the quality of water in the water reserve. An assessment of the drinking water quality once treated is also made against the ADWG. This assessment is made by an intergovernmental committee called the Advisory Committee for the Purity of Water that is chaired by the Department of Health.

A water quality summary for the Sandstone Water Reserve from March 2006 to February 2011 is presented in Appendix B. For more information on water quality, see the Water Corporation's most recent drinking water quality annual report at <www.watercorporation.com.au> What we do > Water quality > Water quality publications > Click on the most recent *Water quality annual report*.

3.2 Land uses and activities

The Sandstone Water Reserve is located over crown land and crown lease. The current zoning is pastoral and mining. Current land uses and activities and their risks to the drinking water source are described below. Table 1, at the end of this section, summarises this information in an easy-to-read format.

3.2.1 Crown reserve

There are four crown reserves in the Sandstone Water Reserve (see Figure 3). Crown reserve 44826 is vested in the Water Corporation (Lot 85) and contains bore 15/87.

Crown reserve 10330 contains the drinking-water treatment plant and is also vested in the Water Corporation. Potential risks to water quality associated with the treatment plant include chemical contamination from the storage of chlorine and Calgon™ on-site. However, they are housed in a locked shed with a concrete base, which significantly reduces the risks. The Water Corporation also has a spill kit on the premises in case of a spill or leak.

A landing ground used by the Royal Flying Doctor Service (RFDS) is located on part of crown reserve 10898, which is vested in the Shire of Sandstone. Part of the crown reserve is located in the water reserve, however, the landing ground, which is located 2 km upgradient of the wellfield, is outside the water reserve. There is no fuel stored on-site so this reduces the risk from chemical spills. If there are any fuel or oil spills, the Shire of Sandstone is to report to the Water Corporation immediately.

There are no land uses located on crown reserve 11714 which is vested in the Department of Planning, the reserve still contains native vegetation with no clearing within the water reserve.

There is occasional evidence that illegal recreation does occur within the water reserve, however, due to the infrequent and low intensity nature of these events and the semi-confined nature of the aquifer, it is considered a minimal risk to water quality. Recreation is an unauthorised activity within the water reserve.

3.2.2 Crown lease

The majority of the water reserve is located over crown lease 3114-1031, Black Hill Station. This land will eventually be used for low intensity sheep grazing. For the past five years there has been no stock-grazing on the land. The new lessee is planning to stock sheep from 2012. The lessee stocking limit is 8 800 sheep, however the lessee does not plan to reach this limit and will gradually increase the number of sheep each year until they reach 5 000 sheep.

The water quality risks of grazing animals are reduced by locating the watering points for sheep outside of the water reserve and ensuring the bore compounds remain fenced and locked.

3.2.3 Aboriginal sites of significance

Aboriginal sites of significance are those areas that Aboriginal people value as important and significant to their cultural heritage. The sites are significant because they link Aboriginal culture and tradition to place, land and people over time. These areas form an integral part of Aboriginal identity and the heritage of Western Australia. The *Aboriginal Heritage Act 1972* (WA) protects all Aboriginal sites in the state.

There is one Aboriginal site of significance within the Sandstone Water Reserve, called Sandstone Site 1 (10/99). This is located around bore 10/99.

3.3 Possible future contamination risks

The recharge area for the Sandstone wellfield may extend further to the south-east. This may include other land uses and their contamination risks which are not considered in this plan. We will update the risk assessment if required when adequate data becomes available.

Table 1 Land use, potential water quality risks and recommended protection strategies

Land use/activity	**Potential water quality risks**		**Consideration for management**	**Current preventive measures**	**Recommended protection strategies**
	Hazard	**Management priority**			
Crown reserve					
Landing ground	Hydrocarbons from fuel and oil spills	Low	The landing ground, although outside the water reserve, is used infrequently by the RFDS with no fuel storage or refuelling to occur within the water reserve.	· water quality monitoring · sealed bores · no fuel storage or refuelling on landing ground.	Ensure HAZMAT procedures are in place in the event of a fuel or chemical spill.
Unauthorised recreation · hunting · camping · off-road vehicles	Pathogens from human and domestic animal activity Hydrocarbons from fuel or oil leaks from vehicles	Low	Little recreational activity is reported to occur.	· water quality monitoring · sealed bores · fenced and locked bore compounds and treatment plant · Water Corporation surveillance.	Water Corporation to: · install signage to identify water reserve location · continue water quality monitoring · continue surveillance.

Land use/activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	**Management priority**			
Crown lease					
Sheep grazing	Pathogens from animal excrement	Moderate	There is currently no stocking of sheep occurring in the water reserve. When stocking does occur, it will be low intensity.	· water quality monitoring · sealed bores · fenced bore compounds and treatment plant · Water Corporation surveillance.	Prevent the overflow of the sand filter backwash from the treatment plant out of fenced compound. Water Corporation to continue water quality monitoring and surveillance. Adhere to WQPN no. 35: *Pastoral activities within rangelands* and WQPN no. 28: *Mechanical servicing and workshops.*
	Nutrients from animal excrement	Low			
Pastoral lease infrastructure maintenance	Pathogens from human activity	Low	The pastoral lease owner has recently moved onto the premises and infrastructure maintenance is occurring outside the water reserve.	· water quality monitoring · sealed bores · fenced bore compounds and treatment plant · Water Corporation surveillance.	Water Corporation to continue water quality monitoring and surveillance. Adhere to WQPN no. 35: *Pastoral activities within rangelands* & WQPN no. 28: *Mechanical servicing and workshops.*
	Hydrocarbons from fuel or oil leaks from vehicles and machinery				

Land use/activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	**Management priority**			
Water treatment plant	Chemicals from storage of chlorine and Calgon™	Low	The chemicals are housed in a locked shed with a concrete base, which significantly reduces the risks. The Water Corporation also has a spill kit on the premises in case of a spill or leak.	· water quality monitoring · spill kit on-site · fenced and locked treatment plant.	Adhere to WQPN no. 65: *Toxic and hazardous substance: storage and use.*

4 Protecting your drinking water source

The objective of this plan is to ensure that safe drinking water is available to consumers in Sandstone now and in the future.

4.1 Proclaiming the public drinking water source area

The existing Sandstone Water Reserve was proclaimed under the *Country Areas Water Supply Act 1947* (WA) in 1990.

This plan recommends proclamation of the amended Sandstone Water Reserve under the *Country Areas Water Supply Act 1947* (WA) (see Figure 2). The amended boundary will protect water abstracted from bore 16/87. This slight increase (an additional 1.33 km^2 of land) occurs on crown land and no impacts on existing land uses are foreseen.

The proclamation process begins with public consultation as part of the development of this drinking water source protection plan.

Once the water reserve is amended the local government authority is expected to incorporate the public drinking water source area (PDWSA) into their planning schemes consistent with State planning policy no. 2.7: *Public drinking water source policy*. PDWSAs are commonly shown in planning schemes as special control areas. This provides guidance for state and local government planning decision makers and developers.

Proclamation of a PDWSA will not change the zoning of the land. All existing, approved land uses and activities in the proclaimed area can continue. However, we recommend that best management practices are employed in PDWSAs to protect the quality of the drinking water source. New developments or expansion of existing land uses or activities need to consider the recommendations in this plan.

For more guidance on appropriate land uses and activities in PDWSAs please refer to our WQPN no. 25: *Land use compatibility in public drinking water source areas*.

4.2 Defining priority areas

The protection of PDWSAs relies on statutory and non-statutory measures for water resource management and land-use planning. The Department of Water's policy for the protection of PDWSAs includes a system that defines three specific priority areas:

- Priority 1 (P1) areas have the fundamental water quality objective of risk avoidance (e.g. state forest and other crown land).
- Priority 2 (P2) areas have the fundamental water quality objective of risk minimisation (e.g. land that is zoned rural).
- Priority 3 (P3) areas have the fundamental water quality objective of risk management (e.g. areas zoned urban or light/general industrial).

The determination of priority areas is based on the strategic importance of the land or water source including risks to water quality and quantity, the local planning-scheme zoning, the form of land tenure and existing approved land uses or activities. For further detail, please refer to our WQPN no. 25: *Land use compatibility in public drinking water source areas*.

The proposed priority area for the Sandstone Water Reserve has been determined in accordance with current Department of Water policy. This area is described below and displayed in Figure 5. Our WQPN no.25: *Land use compatibility in public drinking water source areas* outlines activities that are 'acceptable', 'compatible with conditions' or 'incompatible' within the different priority areas. For an explanation of the background and support for protection of PDWSAs, please refer to WQPN no. 36: *Protecting public drinking water source areas*.

We propose to assign a P1 area to the entire Sandstone Water Reserve for the following reasons:

- Water from this source is the only supply to Sandstone so it should be afforded the highest feasible level of protection.
- Existing land uses on the crown reserves and crown lease are considered compatible with P1 source protection objectives.

4.3 Defining protection zones

In addition to priority areas, protection zones are defined to protect drinking-water sources from contamination in the immediate vicinity of water extraction facilities. Specific conditions may apply within these zones such as restrictions on the storage of chemicals or public access.

Wellhead protection zones (WHPZs) are generally circular (unless information is available to determine a different shape or size), with a 500 m radius around each production bore in a P1 area and a 300 m radius around each production bore in P2 and P3 areas. WHPZs do not extend outside the boundary of the water reserve.

WHPZs of a 500 m radius have been established around each bore in the Sandstone Water Reserve (see Figure 5).

4.4 Planning for future land uses

It is recognised under the Western Australian Planning Commission's (WAPC) *State planning strategy* (1997) that appropriate protection mechanisms in statutory land-use planning processes are necessary to secure the long-term protection of drinking water sources. As outlined in the WAPC's Statement of planning policy no.2.7: *Public drinking water source policy* (2003) it is appropriate that the Sandstone Water Reserve, its priority area and protection zone be recognised in the Shire of Sandstone's local planning scheme. Any development proposals within the Sandstone Water Reserve that are inconsistent with advice in our WQPN no.25: *Land use compatibility in public drinking water source areas* or recommendations in this plan, need to be referred to the Department of Water for advice.

For further information on the integration of land-use planning and water source protection, please refer to our WQPN no.36: *Protecting public drinking water source areas*. This protection note describes the findings of Parliamentary Committee reviews instrumental in the integration of water quality protection and land use planning in WA.

The department's protection strategy for PDWSAs provides for approved developments to continue even if those facilities would not be supported under current water quality protection criteria. In these instances, the department can provide advice to landowners or operators on measures they can use to improve their facilities and reduce water quality contamination risks (see section *4.5: Using best management practices*).

4.5 Using best management practices

There are opportunities to reduce water contamination risks by carefully considering design and management practices. To help protect water sources, the Department of Water will continue to encourage the adoption of best management practices.

Guidelines on best management practices for many land uses are available in the form of industry codes of practice, environmental guidelines and water quality protection notes. They outline the recommended practices to ensure the protection of water quality and can thus help managers reduce any detrimental effects of their operations. These guidelines have been developed in consultation with stakeholders such as industry groups, agricultural producers, state government agencies and technical advisers for example, see our WQPN no. 35: *Pastoral activities within rangelands* listed in this plan's *References* section.

Education and awareness-raising (such as through providing information on signs and publications) are key mechanisms for protecting water quality, especially for people visiting the area. We will produce a brochure once this plan is finalised, describing the Sandstone Water Reserve, its location and the main threats to its water quality. The brochure will inform people in simple terms about the drinking water source and why it is important to protect it. We will make it available to the community and other stakeholders.

4.6 Enforcing by-laws and surveying the area

The quality of water in PDWSAs within country areas of the state is protected under the *Country Areas Water Supply Act 1947* (WA). Proclamation of PDWSAs allows by-laws to be applied to protect water quality.

The Department of Water considers by-law enforcement, through surveillance of land-use activities in PDWSAs, to be an important mechanism to protect water quality.

Signs will be erected on the boundaries of this water reserve to educate and advise the public about activities that are prohibited or regulated. This plan recommends that

surveillance and by-law enforcement for the Sandstone Water Reserve be formally delegated to the Water Corporation.

4.7 Responding to emergencies

The escape of contaminants during unforeseen incidents and the use of chemicals during emergency responses can result in water contamination. The Shire of Sandstone local emergency management committee (LEMC), through the Mid-West Gascoyne emergency management district, should be familiar with the location and purpose of the Sandstone Water Reserve.

A locality plan will be provided to the fire and rescue services headquarters for the hazardous materials (HAZMAT) emergency advisory team. Department of Water and the Water Corporation should have an advisory role to the HAZMAT team for incidents in the Sandstone Water Reserve.

Personnel who deal with WESTPLAN–HAZMAT (Western Australian plan for hazardous materials) incidents within the area should have access to a map of the Sandstone Water Reserve. These personnel should have an adequate understanding of the potential impacts of spills on this drinking water source.

4.8 Putting this plan into action

Table 1 (found at the end of Section 3) identifies the potential water quality risks and recommended protection strategies to deal with those risks associated with existing land uses in the Sandstone Water Reserve.

When the final *Sandstone Water Reserve drinking water source protection plan* is complete, an implementation strategy will be drawn up based on the recommendations in Section 5 and Table 1.

5 Recommendations

The following recommendations apply to the entire Sandstone Water Reserve. The bracketed stakeholders are those expected to have a responsibility for, or an interest in the relevant recommendation being implemented.

1. Amend the boundary of the Sandstone Water Reserve under the *Country Areas Water Supply Act 1947* (WA). (Department of Water)
2. Develop an implementation strategy for this plan's recommendations (including the recommended protection strategies as detailed in Table 1) showing responsible stakeholders and planned timeframes. (Department of Water, applicable stakeholders)
3. Incorporate this plan and reflect the Sandstone Water Reserve boundary, P1 area and protection zone in the Shire of Sandstone's local planning scheme in accordance with the WAPC's Statement of planning policy no.2.7: *Public drinking water source policy*. (Shire of Sandstone)
4. All development proposals within the Sandstone Water Reserve that are inconsistent with the Department of Water's WQPN no.25: *Land use compatibility in public drinking water source areas* or recommendations in this plan should be referred to the Department of Water for advice and recommendations. (Department of Planning, Shire of Sandstone, proponents of proposals)
5. Incidents covered by WESTPLAN–HAZMAT in the Sandstone Water Reserve should be addressed by ensuring that:
   - the Shire of Sandstone's LEMC is aware of the location and purpose of the Sandstone Water Reserve
   - the locality plan for the Sandstone Water Reserve is provided to the fire and emergency services headquarters for the HAZMAT emergency advisory team
   - the Department of Water and/or the Water Corporation acts in an advisory role during incidents in the Sandstone Water Reserve
   - personnel dealing with WESTPLAN–HAZMAT incidents in the area have ready access to a locality map of the Sandstone Water Reserve and information to help them recognise the potential impacts of spills on drinking water quality. (Department of Water and/or Water Corporation)
6. Formally delegate by-law enforcement and surveillance to the Water Corporation. (Department of Water)
7. Erect signs along the boundary of the Sandstone Water Reserve including an emergency contact telephone number. (Water Corporation and Department of Water)
8. Review this plan after five years. (Department of Water)

Appendices

Appendix A — Figures

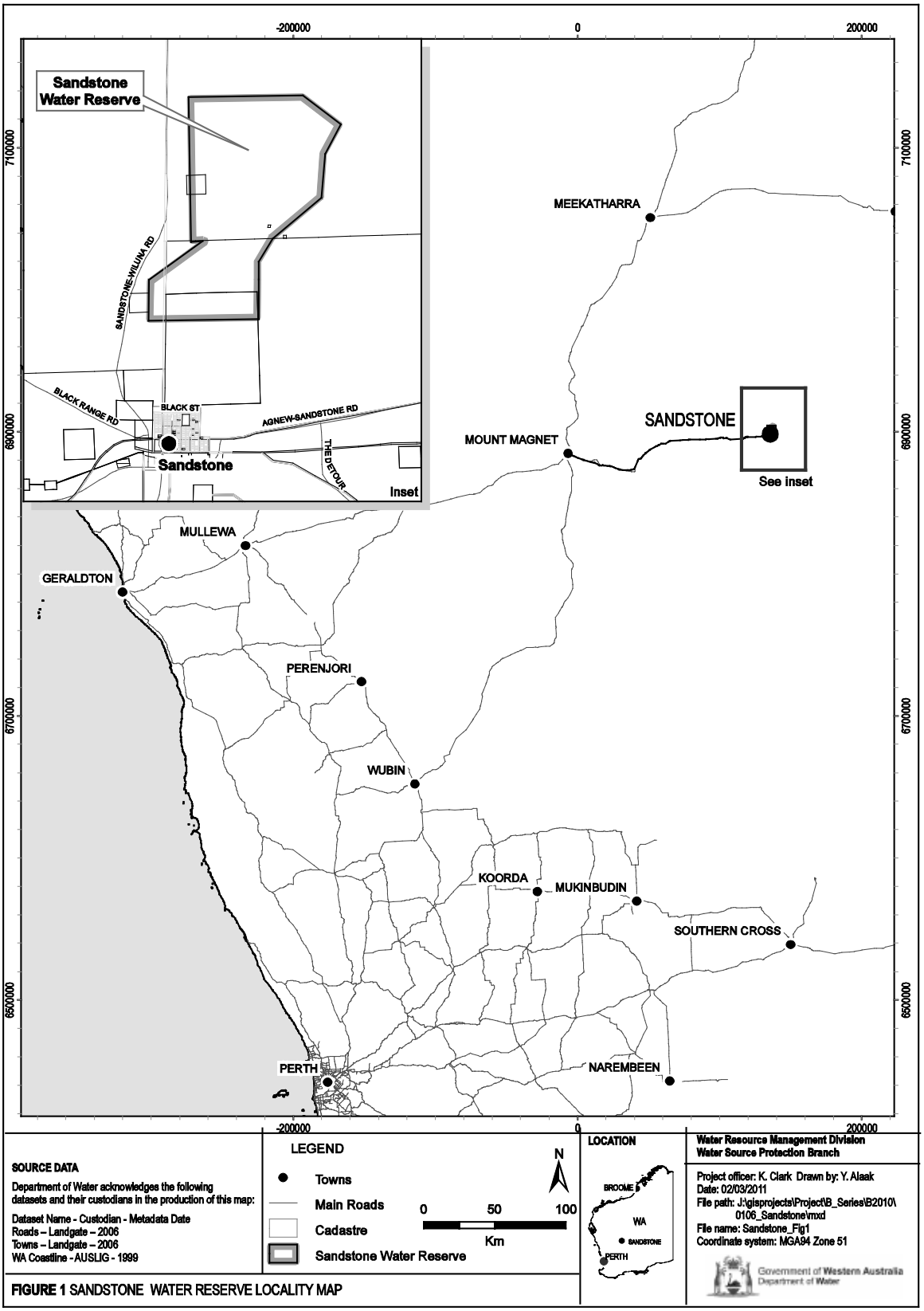

FIGURE 1 SANDSTONE WATER RESERVE LOCALITY MAP

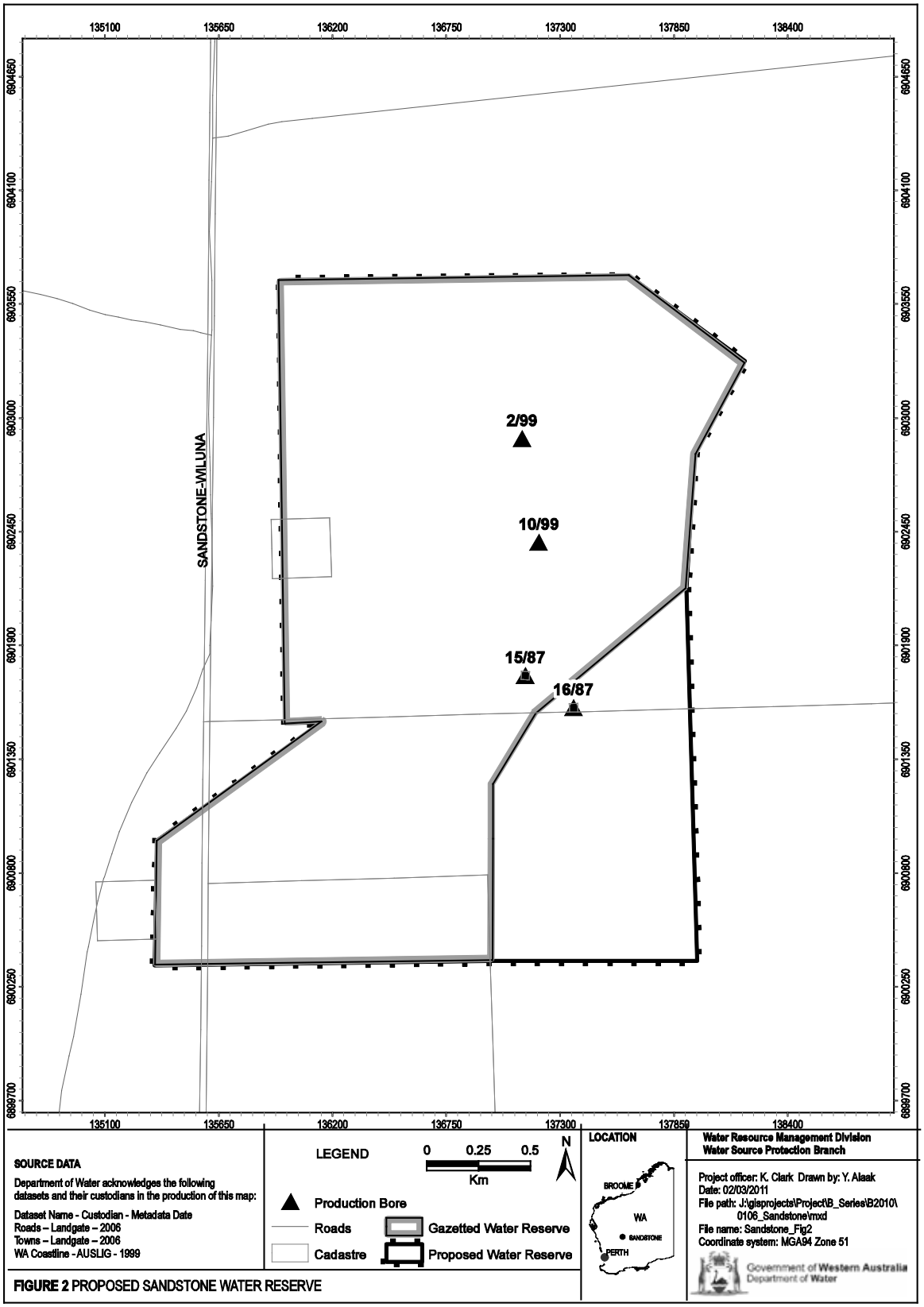

FIGURE 2 PROPOSED SANDSTONE WATER RESERVE

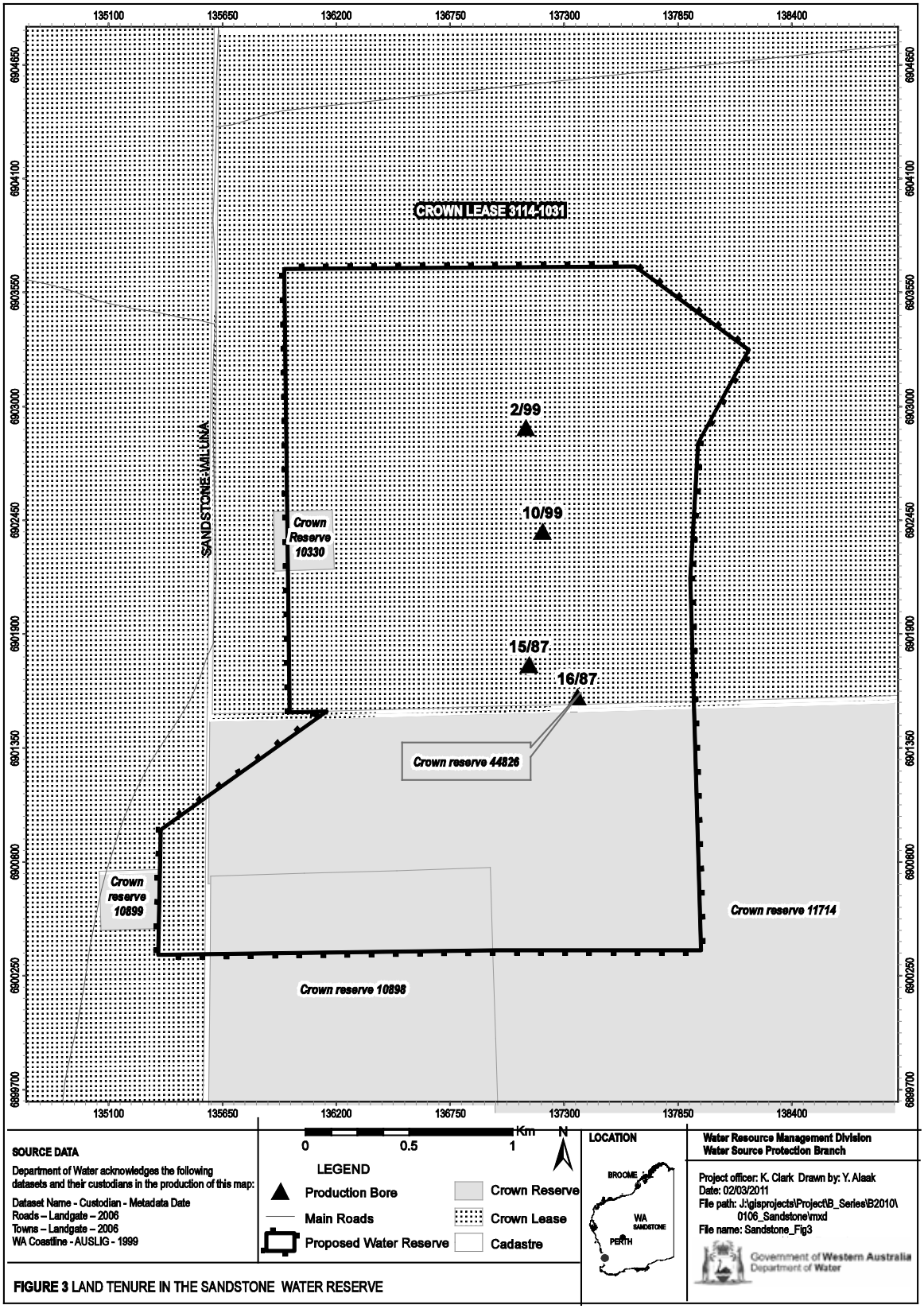

FIGURE 3 LAND TENURE IN THE SANDSTONE WATER RESERVE

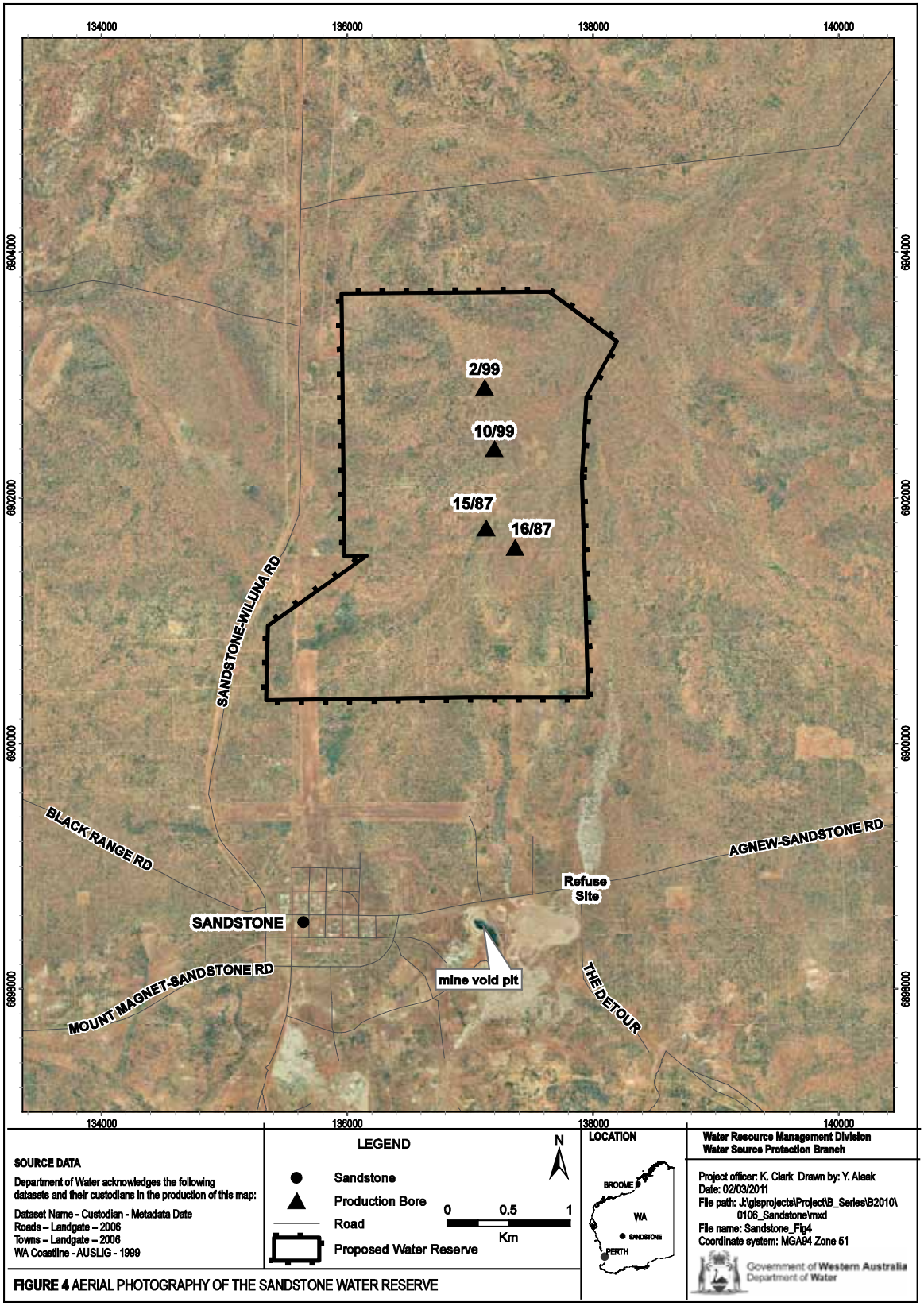

FIGURE 4 AERIAL PHOTOGRAPHY OF THE SANDSTONE WATER RESERVE

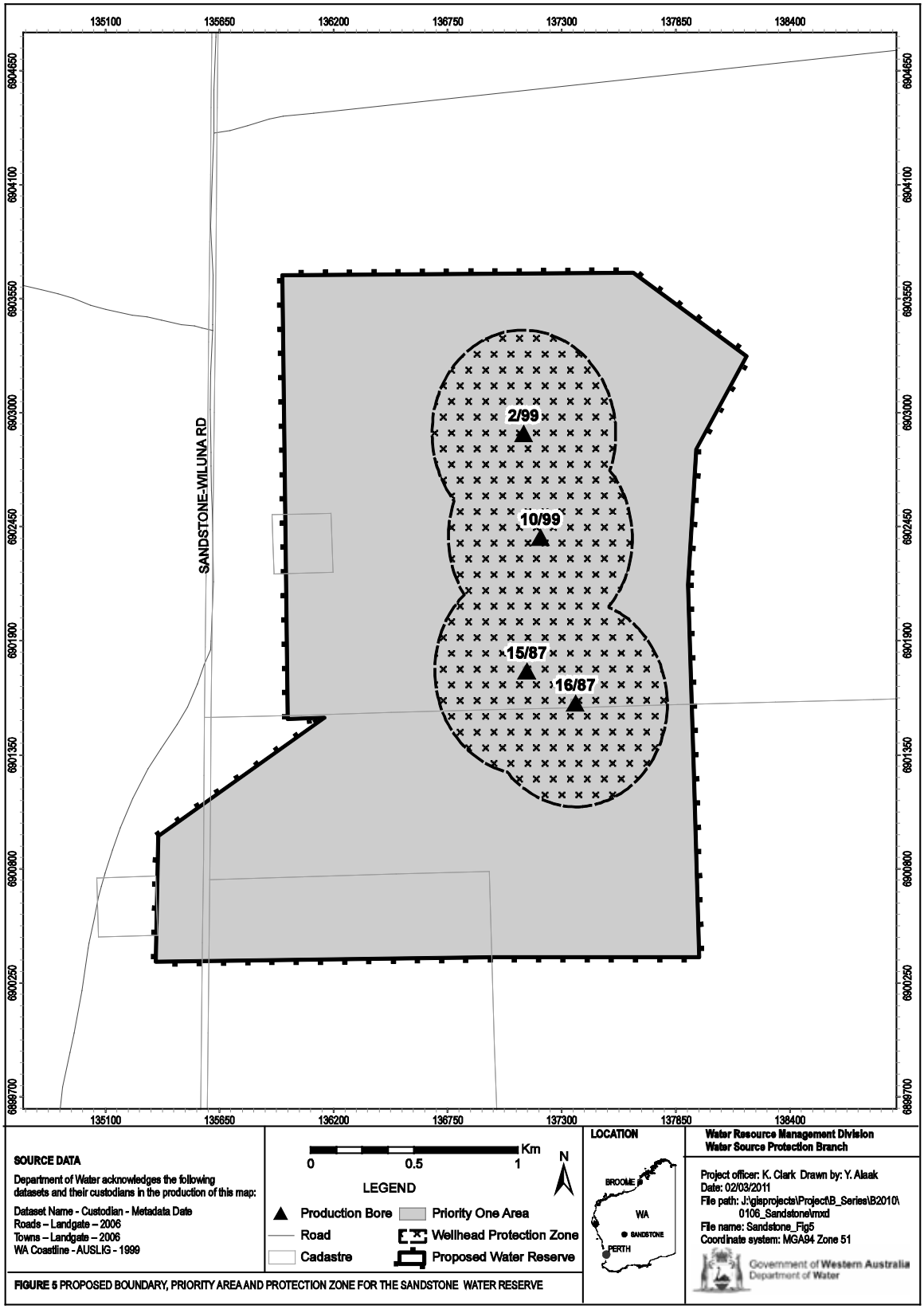

FIGURE 5 PROPOSED BOUNDARY, PRIORITY AREA AND PROTECTION ZONE FOR THE SANDSTONE WATER RESERVE

Appendix B — Water quality data

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

The Water Corporation has monitored the raw (source) water quality from the Sandstone borefield. This data shows the quality of water in the catchment. An assessment of the drinking water quality is also made in accordance with the *Australian drinking water guidelines*, 2004 (ADWG) (NHMRC & NRMMC 2004a) and interpretations agreed to with the Department of Health. The raw water is monitored regularly 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 Sandstone borefield. 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. Results that exceed the ADWG have been shaded to give an indication of potential raw-water quality issues associated with this source.

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. The values are taken from ongoing monitoring for the period March 2006 to February 2011.

Any water quality parameters that have been detected are reported; those that on occasion have exceeded the ADWG are shaded.

For more information on the quality of drinking water supplied to Sandstone 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 *Water quality annual report*.

Aesthetic

The aesthetic quality analyses for raw water from the Sandstone borefield are summarised in the following table.

Aesthetic detections for the Sandstone borefield

Parameter	Units	ADWG aesthetic guideline value*	Sandstone borefield	
			Range	Median
Chloride	mg/L	250	330–365	345
Colour (true)	TCU	15	<1–2	<1
Hardness as $CaCO_3$	mg/L	200	338–370	340
Iron unfiltered	mg/L	0.3	<0.003–0.006	<0.003
pH measured in laboratory	no units	6.5–8.5	7.02–7.42	7.2
Sodium	mg/L	180	190–195	195
Total filterable solids by summation	mg/L	500	981–1003	999
Turbidity	NTU	5	<0.1–0.8	<0.1

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

Raw water is chlorinated to oxidise manganese and to provide a disinfection barrier against possible microbiological contamination. It is then passed through a sand filter to remove the manganese and dosed with Calgon^{TM} to mitigate hardness levels.

Health related

Health-related chemicals

Raw water from the Sandstone borefield is analysed for chemicals that are harmful to human health, including categories of chemicals such as inorganics, heavy metals, industrial hydrocarbons and pesticides. Health-related parameters that impact on water quality are summarised in the following table.

Health-related detections for the Sandstone borefield

Parameter	Units	ADWG health guideline value*	Sandstone borefield	
			Range	Median
Barium	mg/L	0.7	0.017–0.02	0.019
Boron	mg/L	4	0.9–1	0.95
Chromium	mg/L	0.05	0.009–0.013	0.009
Copper	mg/L	1	0.004–0.012	0.005
Fluoride laboratory measurement	mg/L	1.5	0.35–0.5	0.4
Manganese unfiltered	mg/L	0.5	<0.002–0.006	<0.002
Nitrate as nitrogen	mg/L	11.29**	11.5–13	12
Nitrite plus nitrogen as N	mg/L	11.29**	10.7–15	12
Radon-222	Bq/L	100	1.15***	1.15***
Selenium	mg/L	0.01	<0.003–0.007	0.0045

* 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 (NHMRC & ARMCANZ 2004a).

** 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.

*** Only one sampling occasion.

Microbiological contaminants

Microbiological testing of raw water samples from Sandstone Borefield 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.

A detection of *Escherichia 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 of March 2006 to February 2011, positive *Escherichia coli* counts were recorded on one sampling occasion in the raw water. No detections have been recorded in the reticulated water.

Appendix C — Photographs

Figure C1 Bore 16/87 (photo by Kellie Clark)

Figure C2 Sandstone treatment plant (photo by Vivien Claughton)

List of shortened forms

ADWG	*Australian drinking water guidelines*
AHD	Australian height datum
ANZECC	Australian and New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
Bq/L	becquerel per litre
GL	gigalitre
ha	hectare
HAZMAT	hazardous materials
kL	kilolitre
km	kilometre
km^2	square kilometre
LEMC	local emergency management committee
m	metres
mg/L	milligram per litre
mL	millilitre
mm	millimetre
MPN	most probable number
NHMRC	National Health and Medical Research Council
NRMMC	Natural Resource Management Ministerial Council
NTU	nephelometric turbidity units
PDWSA	public drinking water source area
TCU	true colour units
WHPZ	wellhead protection zone
WESTPLAN–HAZMAT	Western Australian plan for hazardous materials

Glossary

Abstraction The pumping of groundwater from an aquifer, or the removal of water from a waterway or water body.

Adsorb Adsorb means to accumulate on the surface of something.

Aesthetic guideline value 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 2004a).

Allocation The quantity of water that a licensee is permitted to abstract is their allocation, usually specified in kilolitres per annum (kL/a).

Australian drinking water guidelines The *National water quality management strategy: Australian drinking water guidelines 6*, 2004 (NHMRC & NRMMC 2004a) (ADWG) outlines acceptable criteria for the quality of drinking water in Australia (see this plan's References).

Australian height datum Australian height datum is the height of land in metres above mean sea level. For example, the AHD is +0.026 m at Fremantle.

Becquerel A measure of radioactivity.

Catchment The physical area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.

Department of Environment and Conservation The Department of Environment and Conservation was established on 1 July 2006, bringing together the Department of Environment and the Department of Conservation and Land Management.

Gigalitre A gigalitre is equivalent to 1 000 000 000 litres or one million kilolitres.

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 2004a).

Hectare A measurement of area, equivalent to 10 000 square metres.

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 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.
mg/L	A milligram per litre (0.001 grams per litre) is a measurement of a total dissolved solid in a solution.
Most probable number	Most probable number is a measure of microbiological contamination.
Nephelometric turbidity units	Nephelometric turbidity units are 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	Includes all underground water pollution control areas, catchment areas and water reserves constituted under the *Metropolitan Water Supply Sewerage and Drainage Act 1909* (WA) and the *Country Areas Water Supply Act 1947* (WA).
Recharge	Recharge is 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.
Runoff	Water that flows over the surface from a catchment area, including streams.

Semi-confined aquifer	A semi-confined 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.
Total dissolved solids	Total dissolved solids consist of inorganic salts and small amounts of organic matter that are dissolved in water. Clay particles, colloidal iron and manganese oxides, and silica fine enough to pass through a 0.45 micrometer filter membrane can also contribute to total dissolved solids. Total dissolved solids comprise sodium, potassium, calcium, magnesium, chloride, sulfate, bicarbonate, carbonate, silica, organic matter, fluoride, iron, manganese, nitrate (and nitrite) and phosphate (NHMRC & NRMMC 2004a).
Total filterable solids by summation	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_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	True colour units are a measure of degree of colour in water.
Turbidity	The cloudiness or haziness of water caused by the presence of fine suspended matter.
Water quality	Water quality is the collective term for the physical, aesthetic, chemical and biological properties of water.
Wellfield	A wellfield is a group of bores located in the same area used to monitor or withdraw groundwater.

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