Department of Environment

Water Resource Protection Series

WRP 55 2005

South Dandalup Dam Catchment Area
South Dandalup Pipehead Dam Catchment Area

Drinking Water Source Protection Plan

Integrated Water Supply System

SOUTH DANDALUP DAM CATCHMENT AREA AND SOUTH DANDALUP PIPEHEAD DAM CATCHMENT AREA DRINKING WATER SOURCE PROTECTION PLAN

INTEGRATED WATER SUPPLY SYSTEM

Prepared by

Water Resources Division

Department of Environment

DEPARTMENT OF ENVIRONMENT
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Acknowledgments

Contribution	Personnel	Title	Organisation
Supervision	Peter Coghlan	Supervising Engineer	Water Corporation
	Stephen Watson	Program Manager, Protection Planning	Department of Environment
Report Preparation	Sarah McNish	Environmental Engineer	Water Corporation
	Alia Abid	Environmental Engineer	Water Corporation
	Trudy Evans	Environmental Officer	Department of Environment
	Fiona Routledge	Water Resource Officer	Department of Environment
Drafting	Jenny Shaw	Drafting Officer	Water Corporation
	Dianne Abbott	Drafting Officer	Department of Environment

For more information contact:

Department of Environment
Program Manager, Protection Planning
Water Source Protection Branch
3 Plain Street
EAST PERTH WA 6004
Telephone: (08) 9278 0300
Facsimile: (08) 9278 0585

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Foreword

The Department of Environment (DoE) has prepared this Drinking Water Source Protection Plan (DWSPP) to report on the activities and risks to water quality within the South Dandalup and South Dandalup Pipehead Dam Catchment Areas and to recommend management strategies to minimise the identified risks.

A safe drinking water supply is critical to the wellbeing of a community and catchment protection is necessary to help avoid, minimise or manage risks to water quality in Public Drinking Water Source Areas (PDWSA). The DoE is committed to protecting these areas to ensure the continued supply of 'safe, good quality drinking water' to consumers to protect public health now and in the future.

The Australian Drinking Water Guidelines recommend a multiple barrier 'catchment to consumer' approach to protect public drinking water. The protection and management of a PDWSA is the 'first barrier', with subsequent barriers implemented at the water storage, treatment and distribution stages of a water supply system. Catchment protection includes:

- Understanding the catchment, the hazards and hazardous events that can compromise drinking water quality; and
- developing and implementing preventive strategies and operational controls necessary to ensure the safest possible raw water supply (i.e. before treatment).

This Plan details the location and boundaries of the South Dandalup Dam and South Dandalup Pipehead Dam drinking water catchments, which provide potable water to the Integrated Water Supply System. It discusses existing use of the water source, describes the water supply system, identifies risks and recommends management approaches to maximise protection of the catchments.

The Plan should be used to guide State and local government land use planning decisions in Western Australia. This DWSPP should be recognised in the Shire of Murray and Shire of Boddington Town Planning Schemes and other local planning strategies and plans, consistent with the Western Australian Planning Commission's Statement of Planning Policy No. 2.7 *Public Drinking Water Source Policy*. Other stakeholders should use this document as a guide for protecting the quality of water in the PDWSAs.

The process involved in the preparation of a DWSPP is as follows:

Stages in development of a DWSPP	**Comment**
1 Prepare 'Drinking Water Source Protection Assessment' document	Assessment document may be prepared following catchment survey and preliminary information gathering from State and local government authority stakeholders. This stage is completed by the DoE or a Water Service Provider.
2 Undertake stakeholder consultation	Advice sought from key stakeholders. If a Stage 1 Assessment is available it will be used as a tool for background information and discussion.
3 Prepare Draft DWSPP	Draft DWSPP developed taking into account input from identified stakeholders and any additional relevant information on the catchment.
4 Release Draft DWSPP for public comment	Draft DWSPP released for a six week public consultation period.
5 Publish DWSPP	The Plan is published after considering advice received in submissions on the Draft Plan. Recommendations to protect the drinking water catchment are provided. The Plan is available from the Department's website: <http://drinkingwater.environment.wa.gov.au>.

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The South Dandalup Dam and South Dandalup Pipehead Dam are located approximately 80 km south of Perth in the Shire of Murray and the Shire of Boddington. The dams are strategic sources of public drinking water for the Integrated Water Supply System. The South Dandalup Dam was proclaimed in 1982 under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* and the South Dandalup Pipehead Dam Catchment Area was proclaimed in 1990 under the *Country Areas Water Supply Act 1947* to ensure protection of this water source from potential contamination.

This Plan has been developed to protect drinking water quality for public health. The Plan:

- Identifies potential drinking water quality contamination risks from land use activities within the catchments; and
- recommends strategies to manage these potential risks whilst recognising current approved land uses.

Most of the South Dandalup Dam and South Dandalup Pipehead Dam Catchment Areas is State Forest vested with the Conservation Commission of Western Australia and managed by the Department of Conservation and Land Management. There are small areas of freehold land under private ownership or owned by the Water and Rivers Commission or the Water Corporation.

Use of the State Forest currently includes forest and plantation management, such as timber harvesting, bauxite mining by Alcoa World Alumina Australia, fire protection, and an extensive range of recreation. Recreation includes approved activities such as bushwalking on the Bibbulmun Track and bike riding on the Munda Biddi Trail, and unauthorised activities such as fishing, marroning and off-road vehicle use, which occur as a result of open access to the catchments.

An area of privately owned land exists in the eastern portion of the South Dandalup Dam catchment. Bunnings Forest Products Pty Ltd, trading as Sotico Forest Products, have established a pine plantation, however their land within the catchment is native vegetation. A portion of Boddington Gold Mine joint venture, trading as Boddington Gold Mine, protrudes into the catchment, however it also remains as native vegetation.

There are two private properties along the western boundary of the South Dandalup Pipehead Dam catchment. This land is owned by Alcoa World Alumina Australia and Bangadang Pty Ltd, trading as B & J Catalano Pty Ltd, respectively. The portion of each property within the catchment is undeveloped.

The following strategies are recommended to protect the water quality of the South Dandalup Dam and South Dandalup Pipehead Dam:

- The existing Reservoir Protection Zone for each reservoir needs to be clearly identified within the catchments.
- All Crown land (including Water and Rivers Commission and Water Corporation land) in the catchments should be managed for Priority 1 source protection.
- The area of private property within the South Dandalup Dam catchment should be managed for Priority 2 source protection.
- The area of private property within the South Dandalup Pipehead Dam catchment should be managed for Priority 1 source protection.

- The catchment areas, including the Reservoir Protection Zones and the proposed priority classifications, should be recognised in the relevant land planning strategies and schemes; specifically, the Shire of Murray Town Planning Scheme and the Shire of Boddington Town Planning Scheme.
- Best management practices for the current land uses in the catchment should be implemented.

Priority classification areas and the Reservoir Protection Zone provide guidance on appropriate land use planning decisions and define areas where *Metropolitan Water Supply, Sewerage and Drainage Ac*t by-laws are available to protect drinking water catchments. These areas and zones recognise established approved land uses but may constrain expansion of those uses, or development of alternative future land uses. Implementation of best management practices in the design, construction and operational stages is recommended for existing or approved land uses.

1 Introduction

The South Dandalup Dam (SDD) is situated on the South Dandalup River, approximately 80 km south of Perth. The reservoir is a strategic source of public drinking water for the Integrated Water Supply System (IWSS), which provides drinking water to Perth, Mandurah, Pinjarra, Harvey, the Goldfields and Agricultural regions.

The South Dandalup Pipehead Dam (Pipehead) is situated about 7 km downstream of the SDD on the South Dandalup River. The Pipehead reservoir acts as a pumpback for SDD adding to the available water for supply to the IWSS.

The SDD Catchment Area is within the Shires of Murray and Boddington. The Pipehead is exclusively in the Shire of Murray. Figure 1 shows the location of the dams and their catchments.

The objective of this Plan is to recommend protection strategies for the catchment areas to protect the drinking water quality of these sources.

1.1 Water supply system

The South Dandalup dam was constructed between 1971 and 1974, forming the South Dandalup Dam reservoir. The dam is an earthfill embankment, 268 m long and 43 m high. The reservoir has a capacity of 208.2 GL and is the largest dam supplying water to the IWSS.

The Pipehead dam was constructed in 1971 and the wall was upgraded in 1996/97. The dam is a post-tensioned concrete gravity dam. The dam wall is 13 m high and has a capacity of 76 ML (0.076 GL).

1.2 Existing water source protection

The SDD Catchment Area was proclaimed in 1982 under the *Metropolitan Water Supply, Sewerage and Drainage (MWSSD) Act 1909* to ensure protection of the water source from potential contamination. Boundary alterations were made in 2000. Figure 2 shows the SDD Catchment Area.

The Pipehead Catchment Area was originally proclaimed as the Lower South Dandalup Pipehead Catchment Area in 1990 under the *Country Areas Water Supply Act* (CAWS) 1947 to ensure protection of the water source from potential contamination. In 2000 Lower South Dandalup Pipehead was renamed South Dandalup Pipehead Dam and re-gazetted under the *MWSSD Act*. Figure 3 shows the South Dandalup Pipehead Dam Catchment Area.

1.3 Water resource allocation

Surface water resource utilisation and conservation in Western Australia is administered by the Department of Environment (DoE) in accordance with the *Rights in Water and Irrigation (RIWI) Act 1914*. Under the *RIWI Act*, the right to use and control surface water is vested with the Crown. This Act requires licensing of surface water abstraction within proclaimed Surface Water Areas. The SDD and Pipehead Catchment Areas are within the Serpentine and Dandalup River Systems proclaimed under the *RIWI Act*.

1.3.1 Current allocation licence

The current allocation licence for the SDD, Surface Water Licence No. 56734, allows the Water Corporation (WC) to divert up to 17.9 GL per annum from the South Dandalup River. The current allocation licence for the Pipehead, Surface Water Licence No. 56733, allows the WC to divert up to 9 GL per annum from the Pipehead reservoir. These licences are issued for the purpose of providing potable water for public water supply to the IWSS.

Due to reduced rainfall and streamflow, the combined annual abstraction from the two reservoirs in 2002/03 was 10.4 GL and 4.8 GL in 2003/04.

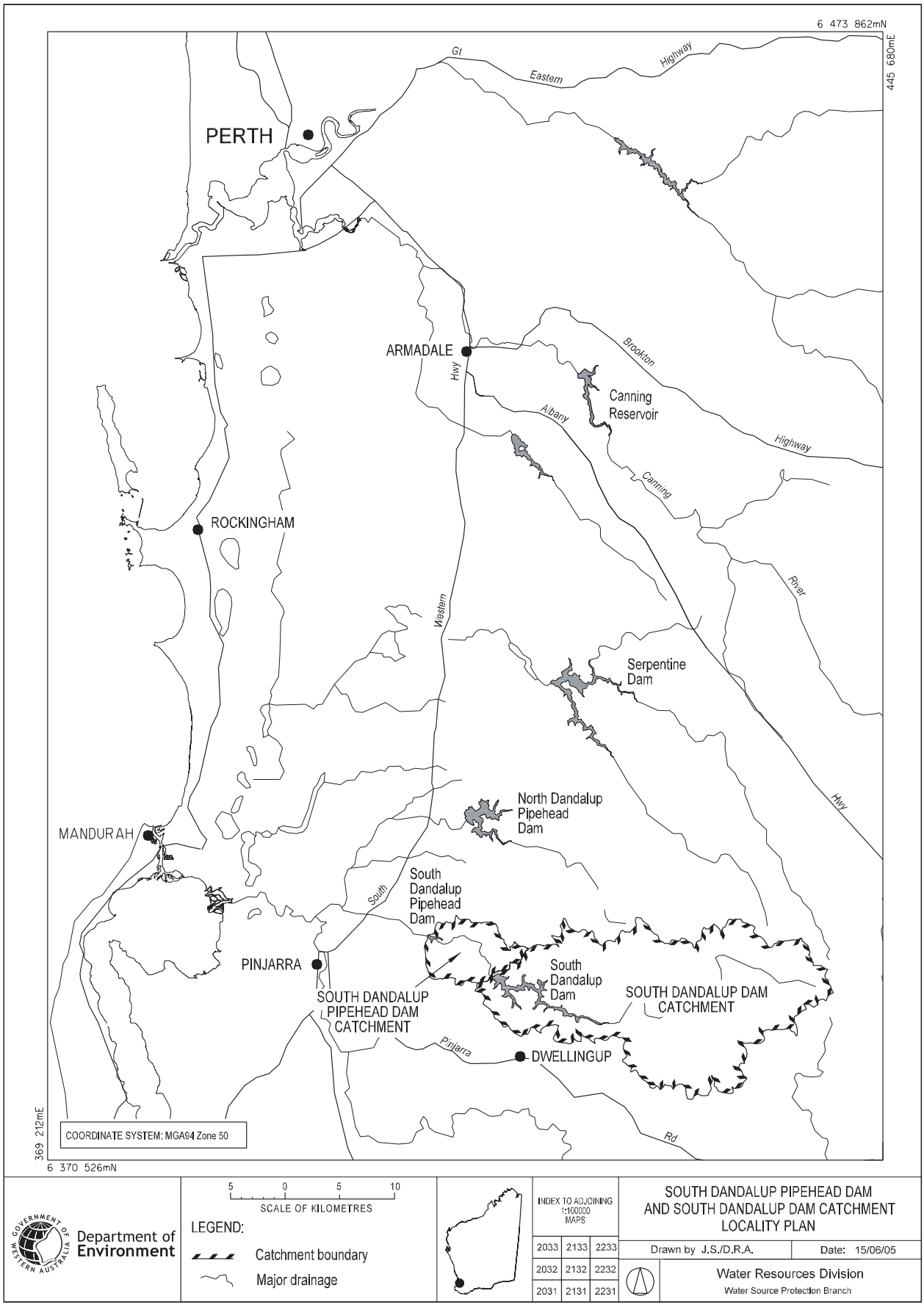

Figure 1. South Dandalup Dam and South Dandalup Pipehead Dam Catchment Areas locality plan

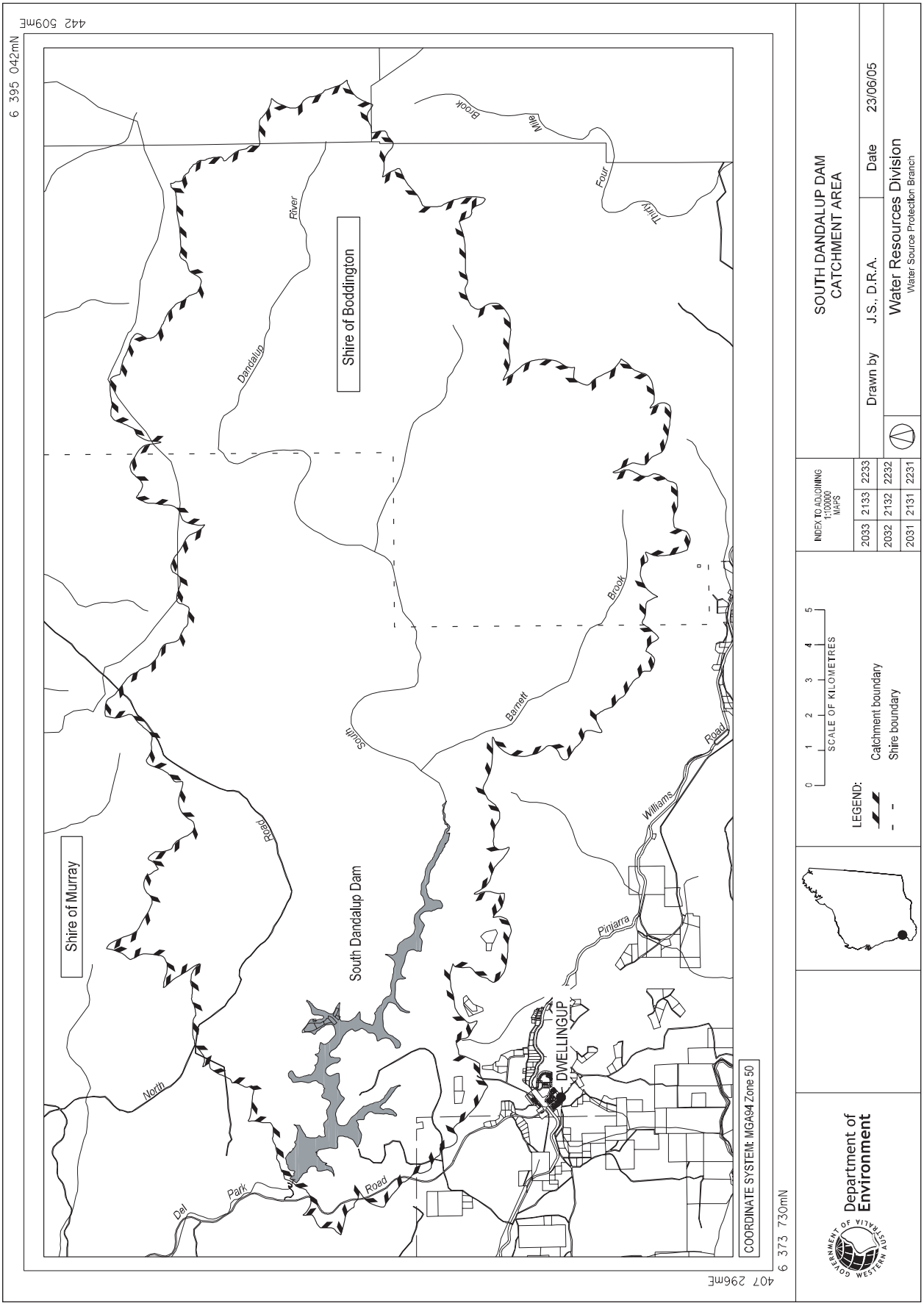

Figure 2. South Dandalup Dam Catchment Area

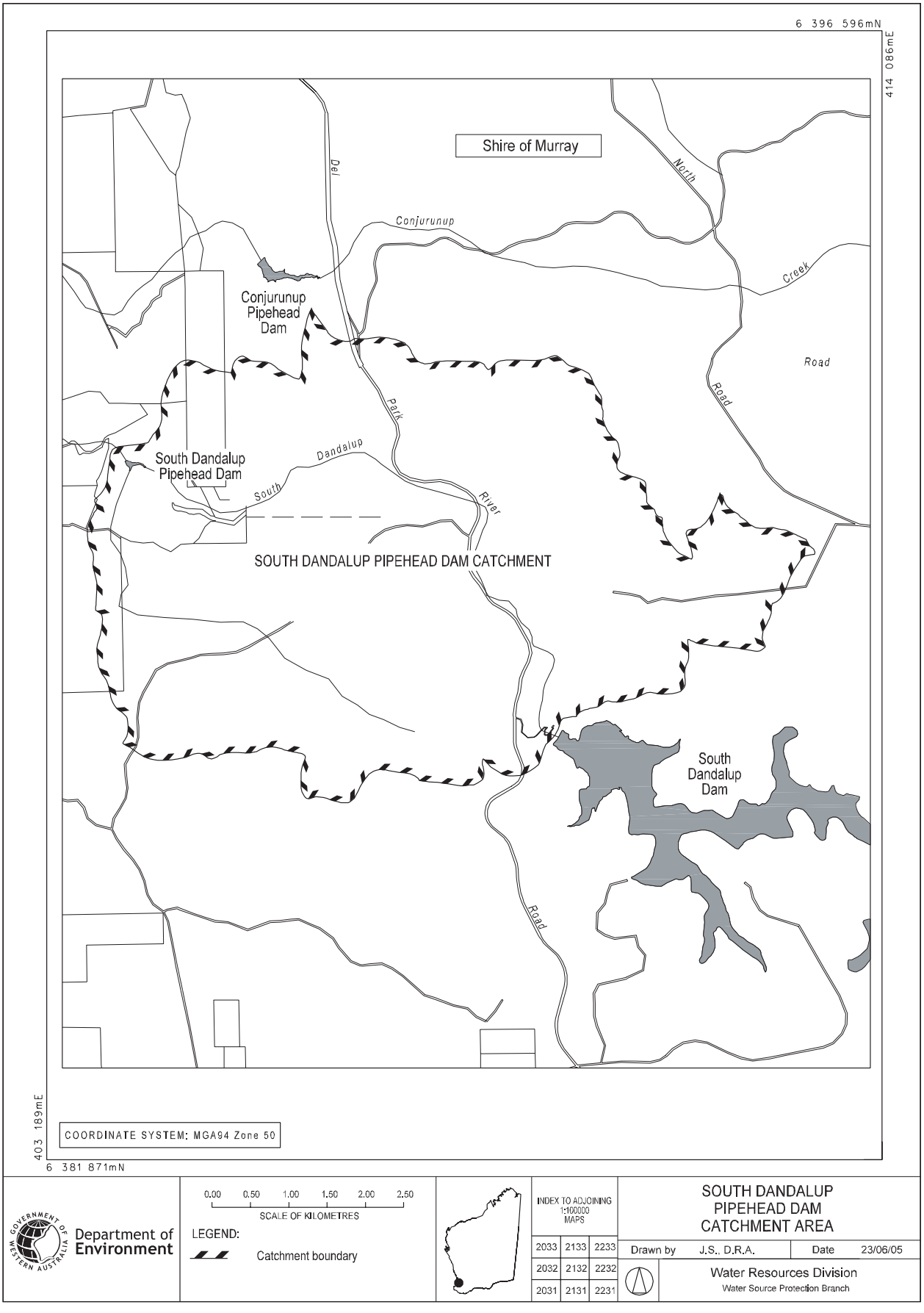

Figure 3. South Dandalup Pipehead Dam Catchment Area

2 Catchment description

2.1 Climate

The region has a Mediterranean type climate characterised by warm dry summers and cool wet winters.

Since the mid 1970s, the south west of Western Australia has experienced a 10 to 20% decline in its long-term average rainfall. Rain gauging stations in the area have shown a 60-100 mm decrease from the long-term average. The average catchment annual rainfall between 1976 to 2002 was 1230 mm. The average rainfall for the last seven years, 1998 to 2005, was 1166 mm, with most of the rainfall occurring between May and September.

2.2 Physiography and vegetation

The SDD and Pipehead catchments are located in the Murray River Basin. Steep undulating hills form part of the Darling Plateau.

The soil surrounding the Pipehead reservoir is Darling Scarp soil, which is characterised by moderate to steeply inclined, high relief slopes and moderately deep to deep sandy and loamy duplex with yellow to red subsoils, yellow, red and brown loamy earth.

The soil surrounding most of the South Dandalup River and the SDD is defined as either the Murray soil type, which is characterised by red and yellow soils, or the Yarragil soil type, which is characterised by valleys with sandy gravels on slopes, yellow-brown earths on valley floors and minor swampy elements as determined from vegetation.

The lateritic uplands are represented predominantly by the Dwellingup soil type, which forms a gently undulating landscape. This soil type consists of duricrusts on the ridges and sands and gravels in shallow depressions. There are also some smaller areas of the Hester soil type, which includes narrow plateau remnants with duricrust and gravels; and gravelly duplex soils on upper slopes (Department of Agriculture, 1999).

Vegetation is dominated by marri (*Corymbia calophylla*) and jarrah (*Eucalyptus marginata*) overstorey trees on the slopes and upland. Freshwater paperbark (*Melaleuca rhaphiophylla*) and black butt (*Eucalyptus patens*) are common in the river valley. There are some areas of swamp type vegetation in the SDD Catchment Area and these are characterised by *Melaleuca pressiana* and *Banksia littoralis* (CALM, 1998).

2.3 Hydrology

The SDD catchment has a total area of 311 km^2 and the Pipehead catchment has a total area of 37.8 km^2.

The major tributary to the SDD is the South Dandalup River. Since the 1970s streamflow has decreased by approximately 50% as a result of reduced rainfall. From 1948 to 1974 the average inflow of water was 36.5 GL, however from 1975 to 2004 the average annual streamflow into the reservoir via South Dandalup River was 18.8 GL.

The major tributaries to the Pipehead are South Dandalup River and Boomer Brook. From 1975 to 2004, the average annual streamflow into the reservoir was 7.4 GL.

3 Water quality and treatment

3.1 Water quality

A wide range of chemical, physical and microbiological properties can affect the safety and aesthetic quality of drinking water.

Water quality in the SDD and Pipehead reservoirs is monitored by WC on a quarterly basis in accordance with the Australian Drinking Water Guidelines (ADWG) (NHMRC & ARMCANZ, 1996). The ADWG are used in Western Australia by the Department of Health (DoH), DoE and WC to assess the quality of drinking water.

A summary of the results of the comprehensive water quality analyses was prepared by WC and is shown in Appendix 2.

Iron, manganese and aluminium levels in the Pipehead reservoir have exceeded the ADWG aesthetic guidelines on occasion. Iron and aluminium levels were also elevated within SDD. The pH level and turbidity in both reservoirs has periodically exceeded the lower aesthetic guideline value. Colour measurements, which generally relate to the organic content of a water body, within the Pipehead occasionally exceeded the aesthetic guideline value of the ADWG. The levels of the remaining parameters monitored in both reservoirs were within acceptable limits.

No pesticides were detected in the Pipehead or SDD during the sampling period.

The microbiological quality of the water is monitored regularly both before and after treatment. Despite the presence of thermotolerant coliforms (an indicator of the potential presence of pathogenic microbes) in raw water, treatment generally removes all traces of contamination. The microbiological quality of water in the Pipehead is significantly poorer than that of SDD (see Appendix 2). This may be due to the minimal detention time in the reservoir for pathogen breakdown; reduced microbe disbursement due to the small size of the catchment; and the elevation of land, which would decrease the time taken for surface runoff to enter the reservoir and therefore minimise the time available for microbiological decomposition.

In addition to WC monitoring, the turbidity of major tributaries into the reservoirs has been monitored intermittently by DoE and Alcoa World Alumina Australia (Alcoa) during mining operations in the catchment.

3.2 Water treatment

The water abstracted from the Pipehead is pumped back to SDD via the Trunk main. Due to the historically poor water quality, the Pipehead water is disinfected with chlorine before it is pumped to SDD. The water abstracted from SDD is disinfected by chlorination and fluoridated before supplying the IWSS. Chlorination is the final barrier used to ensure good quality public drinking water (NHMRC and ARMCANZ, 1996).

It should be recognised that although reservoir storage and disinfection by chlorination generally removes microbiological contamination, treatment processes alone cannot be relied upon. Where possible, contamination can and should be prevented or reduced through appropriate land use or activity controls in the catchment. This approach is endorsed by the ADWG and reflects a ‘catchment to consumer’ multiple barrier approach for the provision of safe drinking water to consumers.

4 Land use

Land uses in the SDD and Pipehead catchments include:

- Forest and plantation management;
- Mining and gravel extraction; and
- Recreation.

Land use and tenure in the SDD catchment is shown in Figure 4. Land use in the Pipehead catchment is shown in Figure 5.

4.1 Private land

About 400 ha, or 1.2%, of the SDD catchment is private land (see Figure 4). The two private properties are located along the eastern boundary of the catchment and are owned by Bunnings Forest Products Pty Ltd (Bunnings) and Boddington Gold Mine joint venture, operating as Boddington Gold Mine. The area of land within the catchment is primarily native vegetation.

The Boddington Gold Mine operation does not currently encroach on the gazetted catchment boundary of the SDD catchment. The mine currently has approval to expand its operations adjacent to the catchment boundary. However, its proposed expansion does not cross into the catchment.

There are two private properties along the western boundary of the Pipehead Catchment Area (see Figure 5). Only a small portion of each property lies within the catchment boundary. The property south of the reservoir is owned by Alcoa and is primarily native vegetation. The freehold land north of the reservoir is owned by Bangadang Pty Ltd; the south-east corner of the property is within the catchment and has been cleared.

4.2 Crown land

Most of the SDD and Pipehead catchments is under Crown ownership. An extensive area is State Forest (Number 14) vested in the Conservation Commission of Western Australia and managed by the Department of Conservation and Land Management (CALM).

4.2.1 Forest and plantation management

Forest Products Commission (FPC) and CALM forestry operations are governed by the *Forest Management Plan 2004-2013* (Conservation Commission, 2004). No plantation timber production currently occurs within the catchments. However, there are a number of small plantations in both catchments. Native forest timber harvesting occurs on occasion.

Land management by CALM includes fire protection, such as prescribed burning and maintenance of firebreaks. WC Rangers and licensed CALM hunters also undertake feral animal control (fox baiting, feral pig hunting and trapping) in the catchment.

Firewood collection and other private resource harvesting, including apiaries (twenty sites of which five are currently being used), wildflower picking and seed collection occur in the State Forest. The catchments and reservoirs are also used for research purposes on occasion.

In order to protect the area from Dieback, *Phytophthora cinnamoni*, a Disease Risk Area (DRA) has been declared by CALM across a significant proportion of the SDD catchment, which restricts public access to the area. The DRA is not actively policed or enforced in this catchment.

CALM Dwellingup manages the Marrinup arboretum (Figure 5), which is located on the southern extent of the Pipehead catchment. This arboretum is well established and is expected to have minimal impact on water quality.

4.2.2 Mining and gravel extraction

A Special Mining Lease, granted to Alcoa under the *Alumina Refinery Agreement Act 1961, No. 3*, covers part of the Crown land in the catchment. Under the State Agreement, Alcoa has rights to extract bauxite with associated responsibilities to protect environmental values and rehabilitate mine sites. Alcoa has a comprehensive *Environmental Management Manual* and Mining and Management Programs which are reviewed and audited by the Mining and Management Program Liaison Group (MMPLG).

As at 31st December 2004, 624.3 ha (16%) of the Pipehead Catchment Area had been mined; 566.1 ha (15%) had been rehabilitated. Alcoa is actively mining in SDD catchment on the north side of the reservoir. As at 31st December 2004, 1,683.6 ha (5%) of the SDD catchment had been mined and 1,629.1 ha had been rehabilitated with native vegetation. Mining and rehabilitation should be completed in this catchment by 2007.

There are a number of gravel pits within the SDD and Pipehead catchments. These gravel pits are often focal points for illegal recreational activities.

4.2.3 Recreation

Recreation in the catchments is generally discouraged, as there are limited designated sites for recreation. In the past a motor rally event, Rally Australia practice route, was staged, but this is no longer approved within the Pipehead catchment.

The Bibbulmun Track crosses through the eastern side of the SDD catchment. Bushwalking along this track and camping at the associated Mt Wells campsite (Figure 4) is the only approved recreation within the catchment. The route for the Munda Biddi Trail bisects the Pipehead, however there are no associated campsites for the trail within the catchment. CALM and the Munda Biddi Trail Foundation manage the Munda Biddi Trail. There are management prescriptions in place to safeguard the environment and publications, such as the *Caring for the Trail – Code to Off-road Cycling*, to educate track and trail users.

There are no other approved recreational activities in the catchments, however unauthorised activities occur as a result of open access to the catchment.

Unauthorised activities include swimming, fishing, marroning, hunting, camping, dog exercising, off-road driving and rubbish dumping. It should be noted that these activities are prohibited in the reservoir and catchments under the *MWSSD Act* by-laws.

4.2.4 Water and Rivers Commission freehold land

The Water and Rivers Commission (WRC) has freehold ownership of two properties in the SDD catchment, comprising about 0.1% of the catchment. These areas consist of small cleared or partly revegetated blocks.

WC has freehold ownership of properties surrounding the Pipehead reservoir, comprising about 7% of the Pipehead Catchment Area. These properties were previously used for agriculture and a rehabilitation program has been implemented.

WC manages both WC and WRC owned properties.

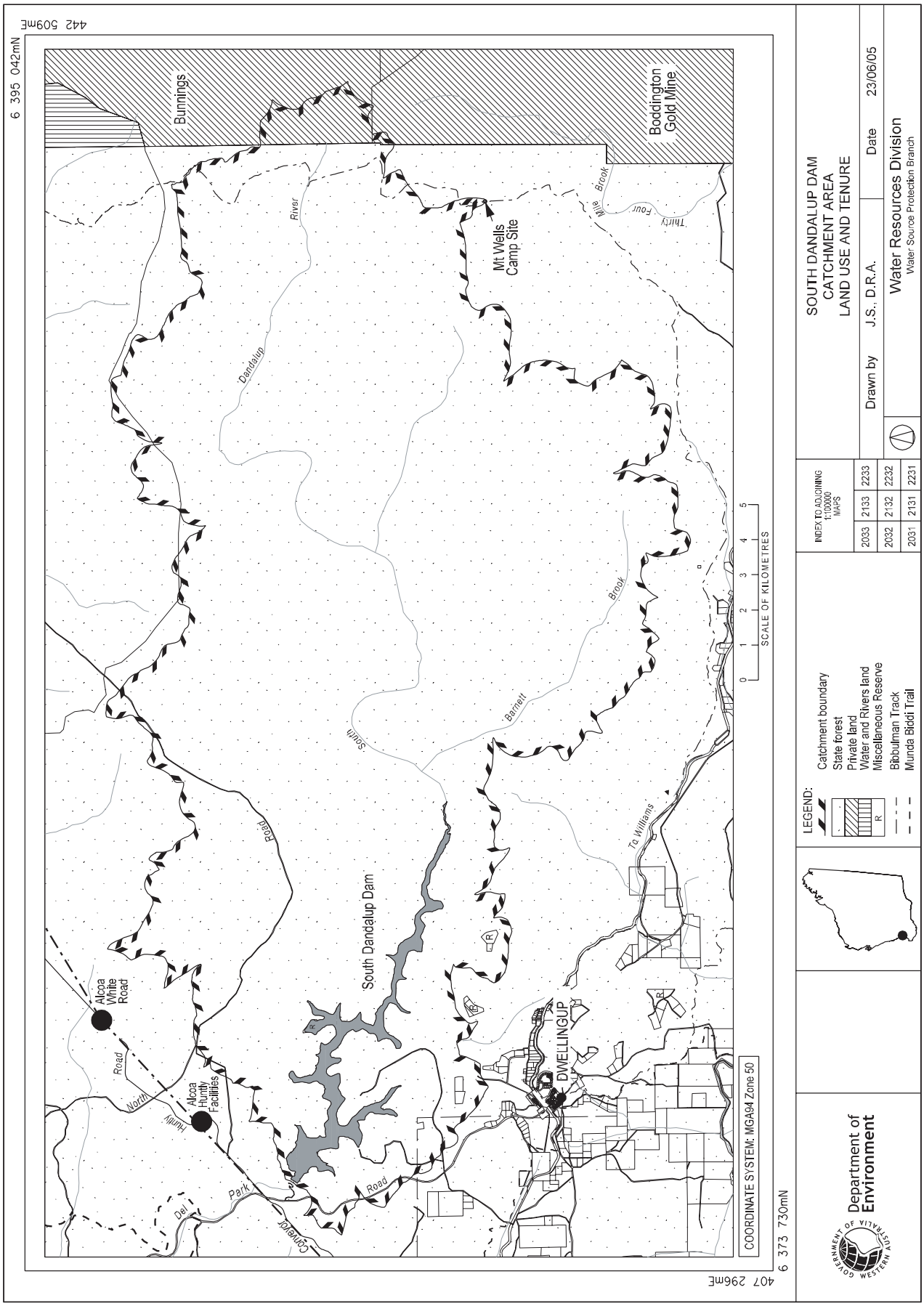

Figure 4. South Dandalup Dam catchment land use and tenure

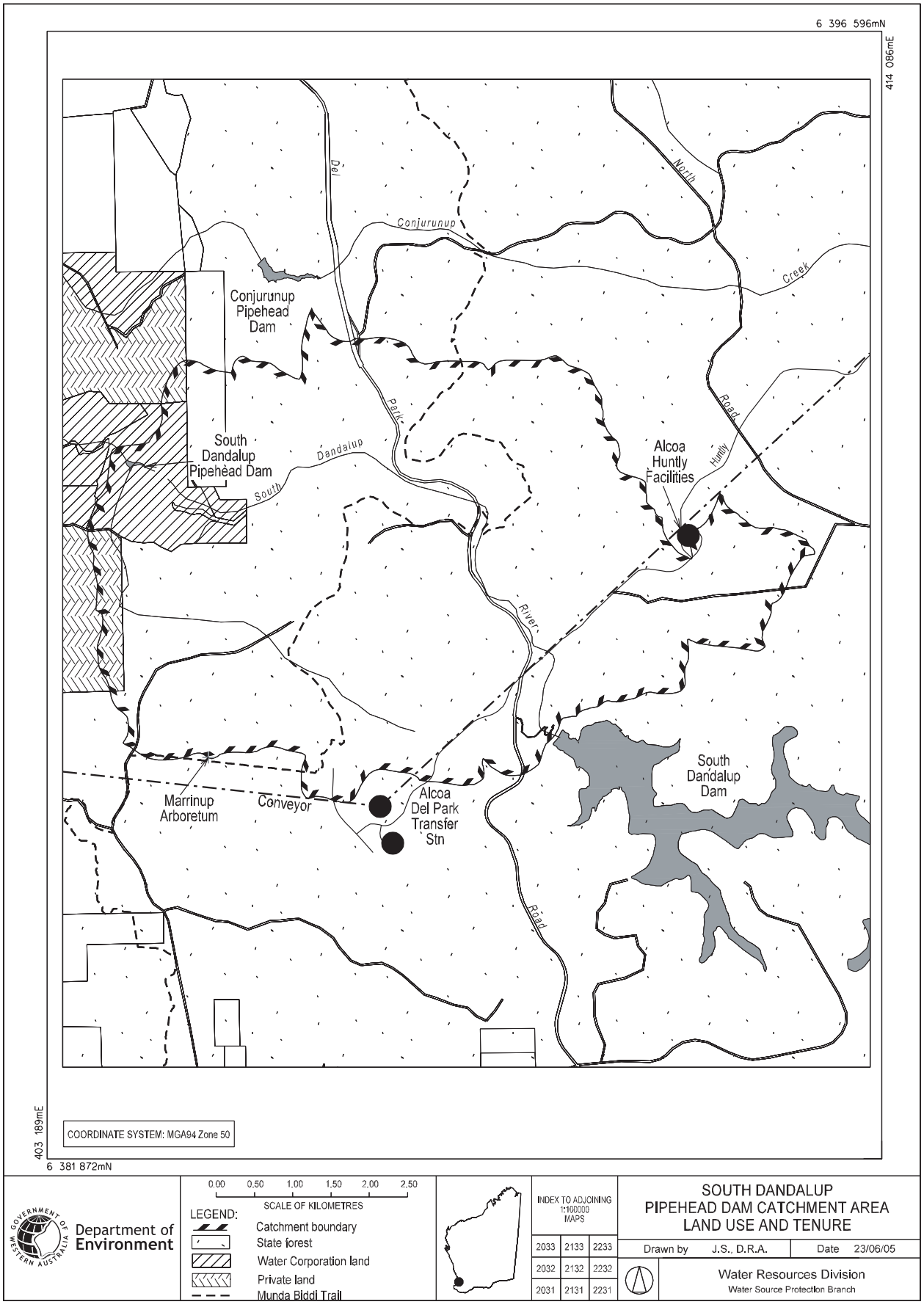

Figure 5. South Dandalup Pipehead Dam catchment land use and tenure

5 Proclaimed areas and priority classifications

5.1 Proclaimed areas

The South Dandalup Dam Catchment Area was proclaimed in 1982 under the *MWSSD Act*. Its boundary was amended in 2000. The South Dandalup Pipehead Dam Catchment Area was originally proclaimed in 1990 under the *CAWS Act* but was re-proclaimed in 2000 under the *MWSSD Act*.

5.2 Priority classifications

An explanation of the priority classifications, the protection approach and details of land use compatibility with each priority classification is provided in Appendix 3.

The Pipehead catchment predominantly comprises Crown land and freehold land owned by WC. As such it is appropriate that this land should be managed for Priority 1 (P1) source protection. Similarly, most of the SDD catchment is Crown land which should also be managed as P1. The objective of this priority classification is to protect water quality according to the principle of risk avoidance.

A P1 source protection classification is appropriate for these areas as:

- SDD and the Pipehead dam are strategic sources of public drinking water for the IWSS, and should be afforded the highest level of protection.
- Most of the land is State Forest or owned freehold by WRC and WC, where management recognises the importance of catchment protection.
- Existing land use practices are compatible with P1 source protection, or can be managed for P1 source protection with the use of best management practices.

The private land in the Pipehead catchment should also be managed for P1 source protection due to its location within the RPZ and proximity to the reservoir.

Private land in the SDD catchment should be managed for P2 source protection, as it is located approximately 20 km from the reservoir on the eastern boundary of the catchment. The objective of this priority classification is to protect water quality according to the principle of risk minimisation.

Negotiations may be required to ensure future land uses on private land within the catchments will not compromise the principles of risk avoidance and risk minimisation.

5.3 Reservoir Protection Zones

To protect the SDD and the Pipehead from immediate risks to water quality, such as human contact or chemical spills, the dams are currently managed with a Prohibited Zone (PZ), also referred to as a Reservoir Protection Zone (RPZ). The RPZ is defined as an area approximately 2 km around the top water level of the reservoir, including the reservoir itself, and not extending outside the catchment area or downstream of the dam wall. The RPZ is a key barrier in the 'catchment to consumer' multiple barrier approach for protecting the reservoir and its drinking water quality (NHMRC & ARMCANZ, 1996).

Figure 6 shows the RPZ boundary of the SDD. Figure 7 shows the boundary of the Pipehead RPZ.

Unauthorised entry to the RPZ, other than on public or private roads, is prohibited under the provisions of the *MWSSD Act* by-laws. Entry to the RPZ requires approval from WC (as the agent with delegated responsibility from DoE).

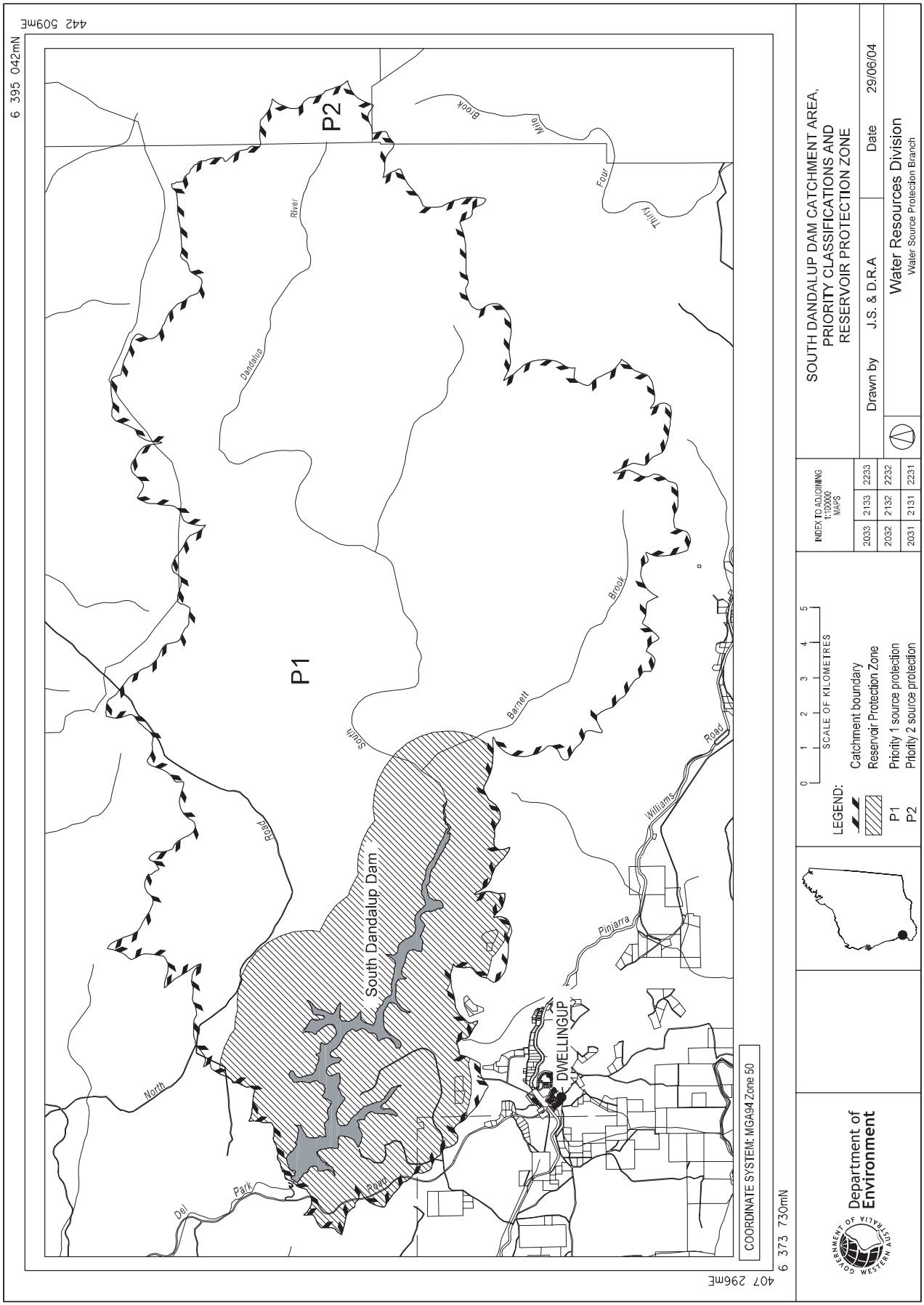

Figure 6. South Dandalup Dam Catchment Area, Reservoir Protection Zone and priority classifications

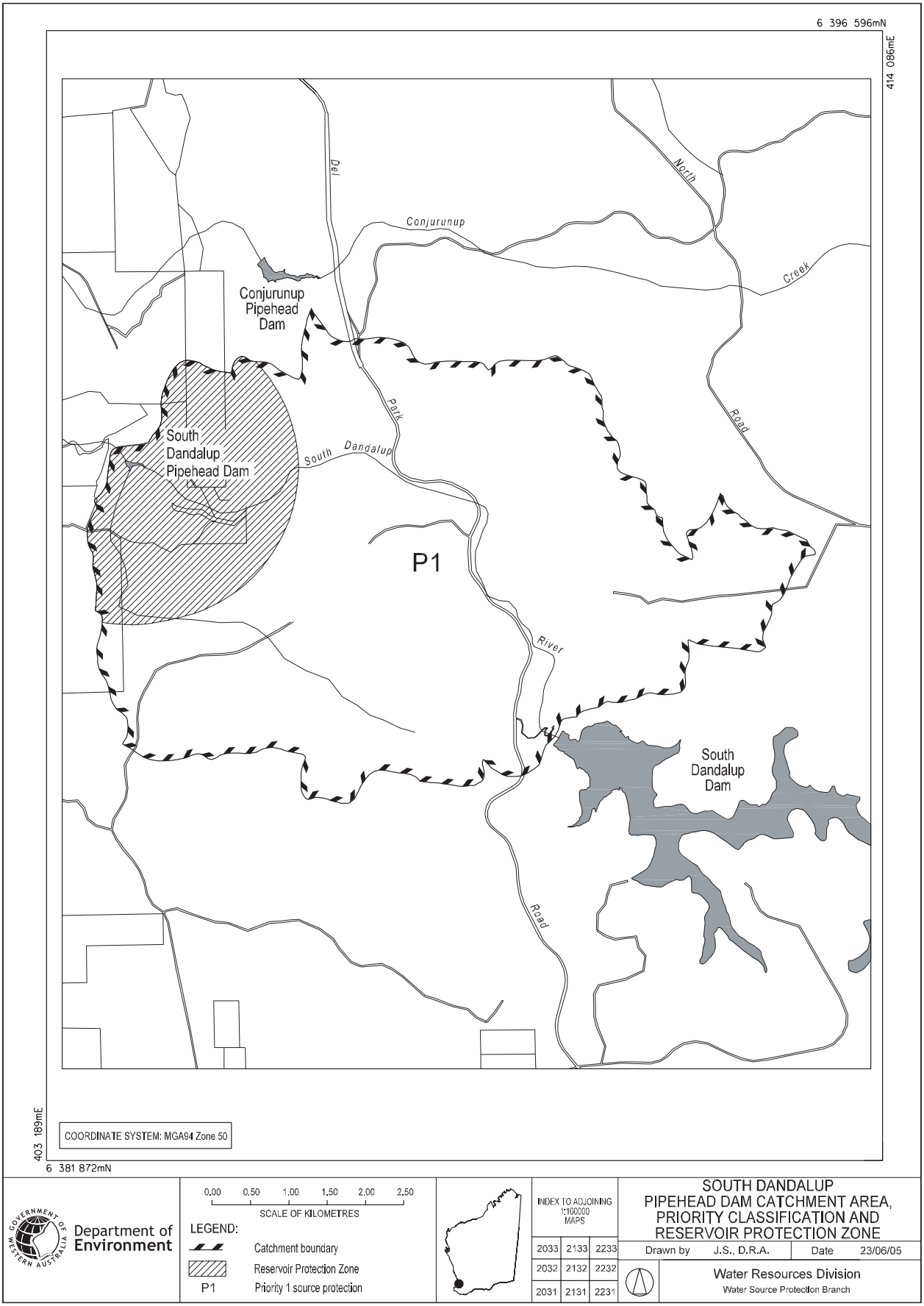

Figure 7. South Dandalup Pipehead Dam Catchment Area Reservoir Protection Zone and priority classification

6 The impact of drinking water source protection planning

General issues raised throughout the State regarding the impact of water source protection planning are addressed below.

6.1 Common areas of concern about the impact of drinking water source protection planning

6.1.1 Existing and future land uses and activities

DoE's water source protection planning recognises existing approvals and does not prohibit currently approved land use activities, even where they are considered incompatible with assigned priority classifications.

When a landowner applies to their local authority to expand an existing operation or develop the land for a particular use, DoE will provide advice on activities that may be compatible with the relevant priority classification in accordance with Water Quality Protection Note *Land Use Compatibility in Public Drinking Water Source Areas* (Appendix 3).

6.1.2 Compensation for development constraints

The issue of compensation is often raised through water source protection planning. The existing water source protection legislation, the *MWSSD Act*, does not contain any provision for compensation when a protection area is proclaimed and the *MWSSD Act* by-laws become applicable. Existing land uses can continue in accordance with planning approvals, however any new development proposals will be assessed in accordance with the given priority objectives. Properties may also change hands and existing approved land uses can continue following the transfer.

Private landowners within the catchments may approach DoE to consider the purchase of their property. Any purchase by DoE is subject to the availability of funds and other priorities for purchase. Sales are negotiated on fair market value and resumptions of property for catchment protection are not undertaken.

7 Management of potential water quality risks

SDD and the Pipehead are strategic sources of drinking water supply to the IWSS, which supplies an estimated 350,000 residences. Based on the potential risk posed by human contact with the water and the number of people that could potentially be affected, activities that require contact with the water body are not acceptable within this catchment.

7.1 Protection objectives

The objective of water source protection in the SDD and Pipehead is to protect drinking water quality for public health, while recognising current approved land uses.

7.2 Potential water quality risks

The potential risk to water quality associated with activities in the catchments includes pathogen contamination, turbidity, pesticides and nutrient contamination. Pathogens pose the most significant risk to public health. Human and domestic animal contact with water involves an immediate threat of pathogen contamination.

Many pathogens are commonly known to contaminate water supplies worldwide. These include bacteria (e.g. *Salmonella, Escherichia coli* and *Cholera*), parasites (e.g. *Cryptosporidium*, *Giardia*) and viruses. These pathogens generally arise from faecal contamination. In May 2000, bacterial pathogens from cattle manure contaminated the drinking water supply of the town of Walkerton, Canada. Approximately 2,300 individuals suffered gastrointestinal illnesses and 7 people died.

The percentage of humans in the world who carry various pathogens, and hence have the potential to contaminate, varies. For example, it is estimated between 0.6 to 4.3% of people are infected with *Cryptosporidium* worldwide and 7.4% are infected with *Giardia* (Geldreich, 1996). In 1998, Sydney's drinking water supply became contaminated with these parasites and 'boil water' notices were issued to 3 million residents.

The viability of pathogens in surface water will also affect the risk. For example, *Salmonella* is viable for two to three months, *Giardia* may still infect after one month in the natural environment (Geldreich, 1996) and *Cryptosporidium* oocysts (cells containing reproductive spores) can survive weeks to months in fresh water (NHMRC & ARMCANZ, 2004). These survival times enable pathogen contamination to occur many kilometres away from the original source.

The combination of human pathogen infection, the viable life of the pathogen and human contact with the water, or the presence of humans near the reservoir or feeder streams, creates a serious risk to public drinking water quality and public health. Preventing the presence of pathogens in the water source is the most effective barrier in avoiding a public health risk.

Table 1 summarises the water quality risks associated with existing land uses and activities within the catchment which have the potential to pose some risk to the quality of the water source. Hazards identified as high risks include turbidity associated with native timber harvesting, wildfires, roads and tracks; and pathogens associated with feral animals, decomposition of animal carcasses and people fishing or marroning within the catchment.

7.3 Land use planning

The establishment of appropriate protection mechanisms in statutory land use planning processes is necessary to secure the long-term protection of water sources.

It is recommended that the SDD and Pipehead Catchment Areas and the priority land classifications be recognised in the Town Planning Schemes of the Shire of Murray and the Shire of Boddington, consistent with the Western Australian Planning Commission's Statement of Planning Policy 2.7 *Public Drinking Water Source Policy* (June 2003).

DoE provides advice on the compatibility of land uses with the priority classification based on the Water Quality Protection Note *Land Use Compatibility in Public Drinking Water Source Areas* (Appendix 3). Development and works proposals in the SDD and Pipehead Catchment Areas that are likely to impact on water quality and are inconsistent with the *Land Use Compatibility in Public Drinking Water Source Areas* guidance document should be referred to DoE's Kwinana Peel Regional office.

7.4 Surveillance and by-law enforcement

As the SDD and Pipehead Catchment Areas have been proclaimed under the *MWSSD Act*, the by-laws of this Act can be used to control potentially contaminating activities within the catchments.

In the SDD and Pipehead catchments, DoE has delegated the responsibility for surveillance and associated by-law enforcement to WC, who report annually to DoE on the surveillance program and associated issues.

By-law enforcement, through on-ground surveillance of land uses and activities, is a critical mechanism in protecting the quality of drinking water sources. WC and CALM Ranger communication with visitors to the catchment also assists in increasing public awareness of the need to protect drinking water quality.

The use of signs and other informative material is also an important component of water quality protection for those who visit the catchment and for landowners in the catchment.

7.5 Best management practices

Best management practices for land use activities are encouraged to help protect water quality. These are often in the form of an industry code of practice or environmental guideline. They are usually developed in consultation with industry groups, producers and State government agencies. Best management practices can be developed for an individual enterprise or have a local or regional focus and must consider the full range of economic, social and environmental issues associated with land, water and vegetation use. Development of best management practices must also take into consideration the needs and concerns of users, consumers and the wider community (ARMCANZ & ANZECC, 1996).

The potential risks to water quality due to existing land uses can be significantly reduced by the implementation of best management practices. For example:

- Retention of vegetation along streamlines (refer to DoE's Water Quality Protection Note *Buffers to Sensitive Water Resources (draft)*).
- Appropriate pesticide application practices (as detailed in Statewide Policy No.2 *Pesticide Use in Public Drinking Water Source Areas* (WRC, 2000) and Public Service Circular 88 *Use of Herbicides in Water Catchment Areas* (DoH, 1993).

- Forestry activities can be managed by appropriate road construction and maintenance, the use of sumps or drains for sediment control, and appropriate retention of buffer zones along watercourses. Refer to the *Manual of Management Guidelines for Timber Harvesting in Western Australia* (CALM, 1999a) and the *Contractors' Timber Harvesting Manual – South West Native Forests* (FPC, 2003).

- Appropriate buffers should be maintained between drinking water resources and bauxite mining operations. Alcoa maintains a 100 m buffer between the top water level of drinking water reservoirs and any mining operations. In addition, Alcoa self-imposes a Water Resource Sensitive Zone, which extends 500 m from the reservoir top water level and includes a 200 m stream buffer (from the centre of the streamzone) for 1 km upstream of the top water level. Within this zone, Alcoa undertakes risk assessment to ensure that mining or infrastructure has no impact on the water resource. Strategies in place include maximising mine development work in summer, mining of pits along contours to ensure that stormwater runoff is fully contained and early rehabilitation of significant areas up-slope of the mining face.

The implementation of best management practices for land use activities in the catchments should be encouraged as it assists in protecting water quality. A reference list of best management practices for some of the activities in the SDD and Pipehead Catchment Areas is provided in Appendix 4.

7.6 Emergency response

Discharge of chemicals during unforeseen incidents and the use of chemicals during emergency response can cause contamination of water sources. The Shire of Boddington and the Shire of Murray Local Emergency Management Committees, through the Boddington and Peel Emergency Management Districts respectively, should be familiar with the location and purpose of the SDD and Pipehead Catchment Areas. A locality plan should be provided to the Fire and Rescue Services headquarters for the HAZMAT Emergency Advisory Team. WC have an advisory role to any HAZMAT incident in the catchments.

Personnel who deal with WESTPLAN - HAZMAT incidents within the area should be given ready access to a locality map of the catchments. These personnel should receive training to ensure an understanding of the potential impacts of spills on the surface water resource.

Alcoa has approved emergency response plans which address any risks associated with its operations within the catchments.

7.7 Recommended protection strategies

Table 1 identifies the potential water quality risks associated with existing land uses in the SDD and Pipehead catchments and recommends protection strategies to manage these risks.

The potential water quality risks were identified and the resulting management priorities were designated using a risk assessment process. Strategies have been developed in line with the ADWG (NHMRC & ARMCANZ, 1996).

The discussion and recommended strategies balance the need to protect water quality for the community now and in the future with the rights of land holders to continue to utilise their land for lawful purposes.

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

All activities occur in both catchments unless otherwise indicated in the activity column. Any difference in consideration of management for the two catchments is indicated in the appropriate column.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
Private Land				
Boddington Gold Mine (SDD)	The risks associated with gold mining include: • Turbidity from cleared areas and the use of unsealed roads; Low • Hydrocarbon contamination due to fuel spills from vehicles and machinery; Low • Pathogens due to human presence; Low • Chemical handling, storage and disposal associated with mineral processing. Low		Mining operations are licensed by the Department of Industry and Resources (DoIR). In general, DoIR will refer proposals that impact on water resource to the DoE. The BGM Environmental Management Liaison Group provides advice on mining operations. DoE are represented on this group. Approval to expand the operations was granted by the Environmental Protection Authority in 2002. The site is located on the eastern boundary of the catchment approximately 20 km from the reservoir.	*Existing land uses are acceptable with best management practices.* • Ensure any conditions imposed by the BGM Environmental Management Liaison group specifically pertaining to water quality protection are adhered to. • Ensure compliance with DoIR licence conditions. • Ensure the proposed expansion of the tailings facility does not cross the catchment boundary.
Bunnings – timber plantation (SDD)	The potential water quality risks associated with this land use includes: • Increased turbidity as a result of clearing, changing vegetation cover and vehicle use; Low • Nutrient and pesticide contamination from fertilisers and pesticide use. Low		Bunnings' property is located in the eastern part of the catchment. Bunnings use part of the property for softwood plantations. The area of this property within the SDD catchment is native vegetation and is managed for fire by Bunnings. The risks associated with this land use are minimal.	*Existing land uses are acceptable.* • Encourage the landowners to manage the property for Priority 2 source protection. • Ensure compliance with pesticide use guidelines as defined in PSC88 *Use of Herbicides in Water Catchment Areas* (DoH, 1993). • Ensure the managers of the property are aware of the catchment boundary location in relation to the property.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
State Forest				
Native forest timber harvesting	The risks associated with native forest timber harvesting include: • Turbidity due to log handling practices, and the use of unsealed roads and tracks; • Fuel spills from vehicles and machinery; • Pathogens due to human presence.	 High Medium Medium	The impact of hardwood harvesting on water quality can be minimised through proper management (i.e. vegetation buffers along watercourses and retaining understorey vegetation after timber harvesting). The guidelines indicate that WC should be notified if logging is planned within 500 m of the top water level of water reservoirs. Harvesting could occur within the RPZ. The potential risks to water quality of harvesting within 200 m of the reservoir and feeder streams are more acute. Increased turbidity is evident from harvesting operations. Best practice management is required. FPC and CALM forestry operations are governed by the *Forest Management Plan 2004-2013*.	*Acceptable activity with best management practices.* • Continue to review harvesting plans during the planning phase to ensure water quality protection objectives are included. • Inspect water quality protection measures on site. • Where possible, avoid logging in the RPZ and within 200 m of the reservoir. • Ensure contract specifications recognise water quality protection objectives, including the use of chemical toilets during periods of intensive activity on the site. Chemical toilets are prohibited within the RPZ or within 100 m of the reservoir or its tributaries. • Ensure timber harvesting occurs in accordance with the *Contractors' Timber Harvesting Manual – South West Native Forests* (FPC, 2003) and the *Code of Practice for Timber Harvesting* (CALM, 1999b). • Update timber codes, guidelines and manuals in accordance with FPC, CALM, WC and DoE requirements.
Plantation timber harvesting	The potential risks to water quality include: • Turbidity due to runoff from cleared areas; • Fuel spills from vehicles and machinery; • Chemical contamination from fertiliser and pesticide application during plantation establishment; • Pathogens due to human presence.	 Low Low Low Low	The impact of softwood harvesting can be minimised through proper management including maintenance of roads, retention of vegetation buffers along watercourses and appropriate pesticide and fertiliser use. Turbidity from plantation harvesting can be considerable due to the clear-felling harvesting method, but the relatively small areas and location of the plantations in the catchment reduces the associated risks.	*Acceptable activity with best management practices.* • Review harvesting and establishment plans during the planning phase to ensure water quality protection objectives are included. • Ensure protocols are in place between relevant agencies on harvesting issues such as pesticide and fertiliser use, stream monitoring, road routes and construction. • Review road network and close roads not essential for forest operations and management or transport thoroughfare. • Ensure contract specifications recognise water quality protection objectives, including the use of chemical toilets during periods of intensive activity on the site. Chemical toilets are prohibited within the RPZ or within 100 m of the reservoir or its tributaries.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
State Forest				
Plantation timber harvesting (*continued*)			The potential risks to water quality of harvesting within 200 m of the reservoir and feeder streams are more acute. Increased turbidity is evident from harvesting operations. Best practice management is required. There is no current plantation harvesting in the SDD or Pipehead catchments. However there is a small plot of pine plantation about 11 km from the SDD reservoir which may be harvested in the future. Similarly in the Pipehead catchment there is one plot of pines. If harvesting is to occur in these plots appropriate management will need to be in place to reduce the risks to water quality. Increased acidity of soil waters may affect transport of other contaminants. A greater understanding of the effects of pine plantations is required. FPC and CALM forestry operations are governed by the *Forest Management Plan 2004-2013.*	• Inspect water quality protection measures on site. • Ensure monitoring of appropriate streams before and after harvesting and chemical application, to identify any impact. • Ensure plantation harvesting does not occur in high risk areas, such as areas of steep slope or adjacent to watercourses. • Avoid new plantations within the RPZ and within 200 m of the reservoir. • Ensure timber harvesting occurs in accordance with the *Manual of Management Guidelines for Timber Harvesting* (CALM, 1999a) and the *Code of Practice for Timber Harvesting* (CALM, 1999b). • Ensure pesticides are used in accordance with Statewide Policy No. 2 *Pesticide Use in Public Drinking Water Source Areas* (WRC, 2000) and PSC88 *Use of Herbicides in Water Catchment Areas* (DoH, 1993). • Update timber plantation and harvesting codes and manuals in accordance with FPC, CALM, WC and DoE requirements.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
State Forest				
Bauxite mining (SDD)	The risks associated with bauxite mining include: • Turbidity from runoff from cleared areas; • Fuel spills from vehicles, machinery and water pump; • Pathogens due to human presence; • Contamination of water from water supply pump.	 Medium Low Medium Low	Alcoa holds a Special Mining Lease under the *Alumina Refinery Agreement Act 1961, No. 3*. The Lease is managed by DoIR and allows Alcoa to mine bauxite in the SDD and Pipehead catchments. A multi-agency group, the Mining and Management Program Liaison Group (MMPLG), oversees the implementation of the State Agreement Act. This includes reviewing Alcoa's 5-year mine plan and enforcing environmental (including water quality protection) conditions where appropriate. Membership includes the DoE, CALM, WC and DoIR. The Mining Operation Group (MOG) reviews the clearing plans, inspects areas in the field and may modify proposals that may affect water quality in the reservoir. Membership includes CALM, WC, DoIR, DoE and FPC. Alcoa has programs in place for sediment control, prevention of erosion and monitoring. Rehabilitation of cleared land soon after the completion of mining reduces the risk of turbidity once mining is completed. Areas identified as high risk to water quality are cleared, mined and rehabilitated in the shortest possible time, usually within a 6-month period over summer.	*Acceptable if operated in compliance with conditions imposed by MMPLG.* • Ensure the conditions imposed by the MMPLG specifically pertaining to water quality protection are adhered to. • Ensure Alcoa continues to manage water protection in accordance with its *Environmental Management Manual* (reviewed biannually). • Ensure Alcoa operates according to the *Working Arrangements Between Alcoa World Alumina Australia, the Department of Environment and the Water Corporation covering Alcoa's Mining Operations in the Darling Range*. • Ensure that Alcoa's monitoring program continues. • Ensure the temporary pump is moved if dam water levels rise near its location.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
State Forest				
Bauxite mining (*continued*)			Alcoa pumps between 20 to 150 ML of water from the SDD per annum. The pump is fuelled with gas and is currently located below the high water mark of the dam. The pump is temporary and will be moved if the water level in the dam rises towards its location. The pump is regarded as a low risk. As at 31st December 2004, 624.3 ha (16%) of the Pipehead and 1,683.6 ha (5%) of SDD had been mined.	
Rehabilitation of mined areas	The risks associated with rehabilitation include: • Leaching of nutrients from the use of fertilisers; • Fuel spills from vehicles and machinery.	Low Low	A rehabilitation prescription is agreed between Alcoa and CALM, and is included in the *Alcoa/CALM Working Arrangements*. Annual rehabilitation reports are submitted to CALM to certify that Alcoa has achieved the required standards for rehabilitation success. Rehabilitation is monitored at 9 months and 15 months to ensure it meets completion criteria. Long-term successional monitoring of flora and fauna is also carried out. Fertilisers are applied once, initially in August following seeding. Fertiliser is restricted to rehabilitated areas only. Fertiliser is not applied to streamzones. As at 31st December 2004, 566.1 ha (15%) of the Pipehead and 1,629.1 ha (5%) of the SDD catchments previously mined had been rehabilitated with native vegetation.	*Acceptable if undertaken in compliance with conditions imposed by the MMPLG.* • Ensure the conditions imposed by the MMPLG specifically pertaining to water quality protection are adhered to. • Ensure Alcoa continues to manage water protection in accordance with its *Environmental Management Manual.* • Ensure Alcoa operates according to the *Working Arrangements between Alcoa World Alumina Australia, the Department of Environment and the Water Corporation covering Alcoa's Mining Operations in the Darling Range.* • Ensure the *Alcoa/CALM Working Arrangements* are continued. • Ensure compliance with Policy Statement No. 10 *Rehabilitation of Disturbed Land* (CALM, 1986). • Ensure Alcoa's monitoring program continues.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
State Forest				
Fire management • Fuel reduction burning • Firebreaks • Water points	Risks from fuel reduction burning and the construction and maintenance of firebreaks include: • Increase in turbidity; • Carbon and nutrient contamination. The risks associated with the construction and access of water points for wildfires and controlled burns include: • Turbidity from the use of unsealed roads and tracks; • Fuel spills from vehicles and machinery.	 Medium Low Medium Medium	Wildfire prevention by fuel reduction burning is an established and essential land management practice in the catchments. Firebreaks are generally cut in the event of an emergency and are not cut on a routine basis. They may be constructed for pre-suppression purposes or to meet biodiversity outcomes. An increase in turbidity may be more prevalent in areas of steeper slope close to the reservoir and tributaries.	*Acceptable activity with best management practices.* • Liaise closely with CALM to ensure that specific guidelines related to water quality protection are incorporated into CALM's *Fire Operations Manual* and that protocols are put in place for effective communications between agencies managing the catchment. • Ensure that any firebreaks required on an ongoing basis are constructed and maintained to minimise the risk of soil disturbance. • Emergency firebreaks should be rehabilitated immediately. • Ensure stabilisation of soil excavated during construction of water points to prevent turbid runoff into watercourses.
Wildfires	The risks associated with wildfires include: • Increased erosion and turbidity; • Carbon and nutrient contamination.	 High Medium	Intense wildfire can cause turbidity, from the ash made airborne during the burn or through runoff when the burn is followed by rain. WC staff attend fires. The fuel reduction program run by CALM should reduce the incidence of wildfire.	*Acceptable activity with best management practices.* • Where location, extent or intensity of a fire suggests the need, inspect sites following fire to assess need for turbidity mitigation works, and conduct these works. • Ensure sites that require permanent protection from wildfire have adequate firebreaks and/or low vegetation buffer zones to prevent the need for extensive earthworks or clearing at short notice during a fire. • Reduce fuel loads with appropriate prescribed burning by CALM. • For water quality considerations to be sufficiently addressed, a WC staff member should attend all fires in catchment areas.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
State Forest				
Firewood collection	The risks associated with firewood collection include: • Pathogen contamination through the presence of people and domestic animals near watercourses; • Rubbish dumping; • Increased turbidity due to the use of unsealed roads and damage to vegetation through off-road driving.	Medium Medium Medium	The primary concern is the potential for people to be close to the reservoir or tributaries during public firewood collection. Firewood collection is not permitted in the RPZ. The collection of firewood is managed by CALM through a permit system, although there is also illegal firewood collection. Rubbish dumping is often associated with firewood collection points. Domestic animals often accompany people during firewood collection.	*Acceptable activity with conditions.* • Ensure regional plans for public firewood collection areas give consideration to water quality protection objectives. • Where public firewood areas are required within the catchment, establish designated public firewood areas away from watercourses and outside the RPZ, and restrict activity to these areas. • Ensure the public firewood areas are regularly patrolled and dumped rubbish is removed. • Use signs and brochures to promote water catchment awareness and to ensure the public are aware that dogs are not permitted within the catchment, unless on private property.
Research projects	The use of the catchments and reservoirs for research projects involves a potential risk of pathogen contamination from people remaining in the catchment, particularly if they get close to or enter the reservoir.	Low	The risk associated with this activity is minimal due to the low number of people involved, management controls and the ease of education prior to the activity occurring. WC, CALM and Alcoa staff often supervise projects.	*Acceptable activity with controls.* • Ensure education on water quality protection requirements is undertaken prior to the activity. • Apply a condition of approval for researchers that requires adherence to water quality protection objectives.
Private resource harvesting • Apiaries (16 in SDD) (4 in Pipehead) • Wildflowers • Seed collection	The potential risks to water quality from these activities include: • Pathogen contamination through the presence of people near the reservoir and tributaries; • Increased turbidity due to the use of unsealed roads.	Low Low	The primary concern from these activities is the potential for people to be close to the reservoir or its tributaries. CALM and Alcoa collect seeds for rehabilitation. CALM also licenses a number of apiarists, private seed collectors and wildflower pickers. The permit conditions imposed by CALM cater for water quality protection in public drinking water source areas.	*Acceptable activities with controls.* • Ensure if water is required at apiary sites it is not sourced from the reservoir, but trucked in as per licence conditions. • Apply a condition of approval for apiarists, wildflower picking and seed collection licences that requires adherence to water quality protection objectives, including exclusion from the RPZ and advice that no camping in the catchment area is permitted. • Inspect water quality protection measures on site.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
State Forest				
Private resource harvesting (*continued*)			The low numbers of people involved, together with CALM's management controls, reduces the risk associated with these activities. The potential risks to water quality are increased when the activity is within an RPZ, near the reservoir or its feeder streams.	
Gravel pits	The potential risks associated with gravel pits are: • Turbidity from runoff from cleared areas; • Fuel spills from vehicles and machinery; • Pathogens from human presence; • Rubbish dumping in the form of car bodies associated with illegal recreation.	 Medium Low Medium Medium	Gravel pits used for road maintenance require effective site management to reduce the risk to water quality. Gravel pits are focal points for illegal and sometimes destructive recreation activities usually involving vehicles. Recreational activities may also be responsible for a failure of rehabilitation in gravel pits. New pits established by CALM are rehabilitated after use. There are many gravel pits in the SDD catchment but few in the Pipehead catchment.	*Acceptable activity with best management practices.* • Ensure gravel extraction occurs in accordance with Policy Statement No. 2 *Local Government Authority Access to Basic Raw Materials from State Forest and Timber Reserves* (CALM, 1993), Policy Statement No. 10 *Rehabilitation of Disturbed Land* (CALM, 1986), and *Code of Practice for Timber Plantations in Western Australia* (AFG, 1997). • Pits should be rehabilitated immediately after decommissioning. • Ensure gravel pits are constructed outside the RPZ. • Inspect water quality measures on site. • Ensure contract specifications recognise water quality protection objectives. • Approval of gravel extraction proposals should include the conditions stated in the Water Quality Protection Note *Extractive Industries within Public Drinking Water Source Areas* (WRC, 2000).

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
Vehicle roads and tracks	The risks associated with the use of roads and tracks include: • Turbidity from erosion of unsealed roads and tracks; • Fuel and chemical spills from vehicles and machinery; • Pathogen contamination from public access to the water body.	 High Low High	Some roads and tracks are necessary for forest management. It is essential they are well maintained to minimise the risk of erosion. All roads and tracks in the State Forest are open to the public, which significantly increases access to the catchment. Control of access is a major issue in the catchments. The few roads in the Pipehead catchment do not provide easy access to the reservoir. Rehabilitation on roads and tracks following the harvesting process should be conducted to reduce public access and erosion problems. The main road that intersects the catchments is Del Park Road. There are numerous unsealed roads, particularly within SDD catchment. These include Scarp Road and North East Road. The risks associated with these roads are reduced by the distance from the water body. Del Park Rd passes downstream of the SDD wall, passing straight through the Pipehead catchment, but is no closer than ~3.5 km from the reservoir. All stream crossings have bridges. Unauthorised entry to the RPZ is prohibited, except on private or public roads.	*Accepted as necessary for proper forest management and requires best management practices.* • Adherence to DoE's draft Water Quality Protection Note *Roads in Sensitive Environments.* • Review the road network to identify roads not essential for forest operations and management, or transport thoroughfare. • Rehabilitate tracks that are not required for forest operations and management or transport thoroughfare. • Define 'Public Road' and educate the public on the definition and implication of by-law enforcement. • Undertake road maintenance to minimise water source contamination risks. • Ensure road upgrades follow alignments and incorporate measures to avoid or minimise water source contamination risks. • Avoid the development of new tracks and roads through the catchment, particularly within the RPZ. • Use signs along roads to inform people of their presence in a PDWSA, and display the emergency contact number for use in the event of a spill.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
State Forest				
Feral animal control • Feral pigs • Licensed pig hunters • Foxes (Rabbits and cats are also present but are not perceived to pose a significant water quality problem)	The major risk to water quality associated with feral animals in the catchment is pathogen contamination. Feral pigs increase the risk of : • Turbidity; • Pathogens through excretion of faecal material whilst wallowing. Fox control occurs through baiting and involves a risk of pathogen contamination from animal carcasses.	 Medium High Low	Under *MWSSD Act* by-laws, shooting, trapping or hunting of game is prohibited in catchment areas, as is the presence of dogs. Illegal introduction of pigs (and their associated diseases) by hunters is known to have occurred and increases all risks associated with the animals. Feral animal control reduces the risks, but may introduce additional risks to water quality if not properly managed. It is essential that feral pig control, in particular, be undertaken in a well-managed and organised manner, in order to minimise the potential impacts on water quality. Feral pig control occurs through volunteer hunters and local landowners, which involves additional risks associated with pathogen contamination from feral animal carcasses, and from people and dogs in the catchment. WC currently undertakes some feral pig control in the catchment, using the 'trap and shoot' method. This method is preferred as it reduces the risk to water quality, as animal carcasses are removed from the catchment, and addresses safety concerns.	*Acceptable activity with controls.* • Ensure feral pig control is performed by the 'trap and shoot' method only. • Ensure carcasses are removed from the catchments. • Ensure fox baiting is undertaken in accordance with CALM's current 1080 policy *CALM Fox Control Manual* (CALM, 1996) and the DoH's *Code of Practice on the Safe Use and Management of 1080* (DoH, 2000).

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
State Forest				
Feral animal control (*continued*)			The bait used for fox control contains 1080 (sodium monofluoroacetate), which is a naturally occurring chemical found in the plant genus *Gastrolobium*. It does not pose a risk to public drinking water supplies as it is rapidly broken down in the environment by microbial action. Protocol followed by CALM is to ensure that baits are not placed within 100 m of the full supply level of reservoirs.	
Recreation				
All recreational activities within the catchments are to comply with DoE's Statewide Policy No. 13 *Policy and Recreation within Public Drinking Water Source Areas on Crown Land (2003).*				
Swimming	There is a high risk of pathogen contamination associated with swimming, through direct body contact with the water body.	Medium	Swimming, bathing, bodily contact with water and washing clothes in the reservoir, tributaries and in the RPZ are prohibited under *MWSSD Act* by-laws because of the immediate risk to drinking water quality.	*Swimming is prohibited in the reservoir and tributaries in the catchment.* • Use signs and promotional material to ensure the public are aware that swimming is prohibited in the catchment. • Undertake after-hours surveillance with by-law enforcement.
Fishing and marroning	The major risks to water quality from fishing and marroning are: • Pathogen contamination from people close to watercourses and the use of bait; • Turbidity from vehicle use close to the water body.	High Low	Human or animal contact with the reservoir and its tributaries poses an immediate threat to water quality. There are additional risks associated with fishing and marroning through on-site camping, the presence of dogs close to watercourses and the use of bait. Fishing and marroning in the reservoir and tributaries are prohibited under *MWSSD Act* by-laws. By-laws are enforced by WC after-hours surveillance, but penalties are small and the activities continue. Preventing these activities is essential to protecting water quality. Fishing and marroning is less prevalent in the Pipehead reservoir as the water body is less accessible.	*Fishing and marroning are prohibited in the reservoirs and its tributaries in the catchments.* • Use signs and advertising material to ensure the public are aware that fishing and marroning are not permitted. • Liaise with and advertise through the Department of Fisheries and fishing organisations. • Undertake after-hours surveillance of the catchment and by-law enforcement with the aim of stopping activities. • Increase the penalties associated with offences under Part 4 of the *MWSSD Act* by-laws. • Consider alternative enforcement options under the *Environmental Protection Act 1986*, i.e. Environmental Protection Policy.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
Recreation				
Bird watching	The potential risk to water quality associated with bird watching is from pathogen contamination, through people close to the water body, and the spread of forest disease from people leaving the paths.	Low	There is no promoted bird watching in the Pipehead catchment. There are some bird watching locations in SDD.	*Acceptable with appropriate management.* • Bird watching should be restricted to outside the catchment or on designated pathways. • Appropriate signage for bird watchers to stay on paths should be erected.
Picnicking (Pipehead)	The potential risks to water quality from this activity include: • Pathogen contamination from people in the catchment; • Rubbish dumping.	Medium Low	The risk is minimised where picnic sites and facilities are provided away from watercourses. Two designated picnic sites occur downstream of the SDD, in the Pipehead catchment. The picnic areas are well sign-posted to prohibit swimming, fishing and marroning. Dogs and other pets are not allowed within the catchment. There may also be undesignated picnicking in both catchments.	*Acceptable activity with conditions.* • Enforce *MWSSD Act* by-laws that prohibit non-designated picnic sites within the catchment. • Ensure designated picnic areas are outside the RPZ and include appropriate facilities with no access to the water body or tributaries. • Septic tanks at the picnic sites in the Pipehead catchment should be replaced with composting toilets. • Ensure no new designated picnic sites are developed without DoE approval. • Use signs and brochures to educate visitors on the importance of protecting drinking water quality.
Camping Designated campsites • Bibbulmun Track (SDD) Undesignated camping	The potential risks associated with camping are: • Pathogen contamination; • Rubbish dumping.	Medium Low	The risks to water quality can be managed at designated campsites, such as Mt Wells along the Bibbulmun Track, as appropriate facilities are provided and there is no direct access to the water body. However, use of the Bibbulmun Track is increasing, and camping now occurs between designated campsites, where no proper facilities are available. Undesignated camping poses a significant risk to water quality, as appropriate facilities are not available and sites are generally close to the reservoir or tributaries.	Uncontrolled camping is not acceptable in the catchment. • Ensure permanent designated campsites in the catchment are only in association with the Bibbulmun Track, and are outside the RPZ. • Inspect and audit the Mt Wells permanent designated campsite regularly and ensure it is properly maintained. • Ensure designated campsites adequately cater for demand (particularly the toilet facilities). • Use signs and advertising material to ensure the public are aware that camping is prohibited at undesignated sites, and to educate on the importance of protecting drinking water quality. • Undertake surveillance of the catchment with by-law enforcement.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
Recreation				
Camping (*continued*)			Camping at undesignated sites is likely to involve additional risks associated with illegal activities, such as rubbish dumping, fishing and marroning. Currently undesignated camping is rare and the risks to water quality are minimised due to catchment surveillance by WC Rangers.	• Consider alternative enforcement options under the *Environmental Protection Act 1986*, i.e. Environmental Protection Policy.
Bush walking and cycling • Bibbulmun Track (SDD) • Munda Biddi Trail (Pipehead) • Organised groups/events • Informal activities	The risks to water quality associated with these activities include: • Pathogen contamination; • Turbidity, primarily from cyclists; • Rubbish dumping.	Medium Medium Low	Bush walking and cycling in organised groups (for example along the Bibbulmun Track in SDD catchment) can be managed through approval and education, which reduces the risk to water quality. It is essential that designated or promoted tracks be regularly inspected and maintained to minimise the risks associated with degradation and erosion of the area. CALM is responsible for the establishment of the the Munda Biddi Trail, a long distance mountain bike trail between Mundaring and Collie, which passes through the Pipehead catchment. Brochures have been produced for the Munda Biddi Trail which highlight that the trail passes through some PDWSAs, although catchment boundaries are not shown on the trail maps.	*Acceptable activities along designated tracks with conditions.* • No further events or trails to be developed in the catchment without consultation with relevant agencies (CALM, WC and DoE). • Ensure an environmental management plan which addresses water quality protection objectives is developed, implemented and audited for the Munda Biddi Trail. • Ensure that the Bibbulmun Track is managed and maintained to reduce risks to water quality. • Use signs and brochures to educate on the *MWSSD* by-laws and the importance of protecting drinking water quality. • Consider alternative enforcement options under the *Environmental Protection Act 1986*, i.e. Environmental Protection Policy.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
Recreation				
Animal (dog) exercising	The potential risk associated with this activity is pathogen contamination from people and animals in the catchment, particularly if close to the reservoir or its tributaries.	Medium	It is prohibited to bring a dog into a catchment under *MWSSD Act* by-laws, unless on private property.	*The entry of dogs is not acceptable in the catchments, unless on private property.* • Use signs and advertising material to ensure the public are aware that dogs are not permitted in the catchments, unless on private property. • Undertake surveillance with by-law enforcement.
Off-road driving (away from designated roads) • 4WDs • Motorcycles • Unlicensed vehicles	The risks associated with off-road driving include: • Turbidity from erosion of land, particularly on the steep slopes close to the reservoir, and from damage to vegetation; • Hydrocarbon contamination from fuel spills; • Contamination from vehicle dumping.	Medium Low Low	Under *MWSSD* by-law 4.7.2: No person shall drive a vehicle on any part of a catchment area other than a road or track which has a graded, gravelled, sealed, primed or other prepared surface without written approval of DoE. Off-road driving is known to occur in the SDD catchment, though low numbers reduce the associated risk. The risks associated with this activity are significant, particularly with regard to turbidity caused by the erosion of unsealed roads and tracks. Crown reserves created by the purchase of private land are often low in vegetation and are targeted for off-road vehicle use and the dumping of vehicles.	*Off-road driving (away from designated roads) is prohibited in the catchments.* • Use signs to advertise that off-road driving away from designated roads is prohibited in the catchments. • Undertake surveillance with by-law enforcement. • Rehabilitate WRC and WC owned land with local native species.
Rubbish dumping	The potential risks associated with rubbish dumping include: • Pathogen contamination; • Nutrient, chemical, heavy metal and fuel contamination from domestic or industrial waste, and the dumping of stolen cars.	Medium Low	Rubbish dumping is often associated with informal or unauthorised recreation in the catchments. As all roads and tracks in the State Forest are open to the public, control of access is a major issue in the catchments.	*Rubbish dumping is not acceptable in the catchments.* • Continue to work with local governments and relevant agencies to reduce rubbish dumping in the catchments. • Undertake surveillance with by-law enforcement. • Use signage and advertising material to ensure the public are aware that rubbish dumping is not permitted.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	**Management Priority**		
Recreation				
Rubbish dumping (*continued*)			There is little rubbish or car dumping in the Pipehead catchment. The amount of rubbish and car dumping in both catchments is low compared to catchments closer to the metropolitan area.	
Recreational hunting	The major risk to water quality associated with illegal hunting is pathogen contamination from: • Feral animal carcasses; • People and dogs in the catchment, and possibly camping.	High Medium	Under *MWSSD Act* by-law 4.3.4: No person shall shoot, trap or hunt any game or catch, or attempt to catch, any fish or marron within a catchment area, without specific permission in writing from DoE to which it may attach any conditions that it deems necessary. Approval from CALM is required to hunt in the catchments for feral animal control. WC will only approve feral animal control by the 'trap and shoot' method. Uncontrolled hunting and shooting introduces significant additional risks to water quality, particularly due to associated camping and the use of dogs. Surveillance by WC Catchment Rangers currently reduces the occurrence of illegal hunting and the associated risks, but greater surveillance would further minimise the activity.	*Recreational hunting is prohibited in the catchment.* • Use signs and advertising material to advertise that hunting and shooting is not permitted. • Continue to undertake surveillance of the catchments with by-law enforcement. • Any hunting in the catchments is undertaken by the 'trap and shoot' method only, under authorisation as part of the feral animal control program.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
Water and Rivers Commission and Water Corporation freehold land				
Unauthorised recreation • Camping • Bushwalking • Off-road vehicle use • Hunting	The potential risks associated with these activities have been discussed in detail in previous sections.		WRC owns one small property south of SDD reservoir. WC owns some land in the west of the Pipehead. This land was previously privately owned and had been cleared. The properties are used for unauthorised recreation. These activities may be controlled through the use of trespassing laws.	*Unauthorised recreation is prohibited on WRC and WC land in the catchments.* • Investigate and prioritise the rehabilitation of cleared land with local native vegetation. • Prohibit unauthorised access to WRC and WC properties under trespass laws. • Use signs to ensure the public are aware of the private ownership of the properties. • Undertake surveillance of WRC and WC properties with enforcement of trespass laws. • Repair fences and gates to restrict access.
Other land uses				
Other infrastructure • Power lines • Roads/tracks • Conveyer belt (Pipehead) • Bridges • Pipelines (Pipehead)	The major risks associated with these activities are: • Turbidity due to clearing of vegetation and the use of unsealed roads; • Herbicides from weed control; • Hydrocarbon contamination due to fuel spills from vehicles and machinery.	Medium Low Low	Maintenance is necessary for the operation of the infrastructure. However, the risks to water quality associated with maintenance need to be managed, particularly in close proximity to watercourses. WRCs Statewide Policy No. 2 *Pesticide Use in Public Drinking Water Source Areas* should be considered when dealing with this hazard. There are restrictions on the use of pesticides in catchment areas, reflected in PSC88 *Use of Herbicides in Water Catchment Areas* (DoH, 1993). PSC88 is currently being updated.	*Best management practices should be followed for all maintenance in the catchment.* • Ensure that all responsible agencies and their maintenance contractors know when they are in a PDWSA and appropriate best management practices are followed. • Ensure responsible agencies adhere to relevant policies.

Activity	Potential Water Quality Risks		Consideration for Management	Recommended Protection Strategy
	Hazard	Management Priority		
Other land uses				
Pumping of water from Pipehead reservoir to SDD.	Poor water quality in the Pipehead may contaminate the water in SDD. There is also a risk of adversely affecting water quality through improper management of the inflow and outflow system, which may result in inadequate mixing of the imported water.	Low	Due to the size of SDD reservoir, the effect of the pumpback water on the water quality in the SDD reservoir will be minimal. Also, the water will be stored in SDD for a retention time, which will allow settling out of particles which cause turbidity. Pumpback water is chlorinated before it is pumped into SDD, minimising the risk of pathogen contamination.	*Considered necessary for water supply operations.* • Continue to monitor the quality of water sourced from the Pipehead reservoir to ensure the imported water will not impair supply to the IWSS.

8 Recommendations

The following recommendations and identified key stakeholders are proposed to help protect the water quality of the South Dandalup Dam and the South Dandalup Pipehead Dam.

1. The Town Planning Schemes for the Shires of Murray and Boddington, and the Metropolitan Regional Scheme, should incorporate the management principles outlined in this Plan, including recognition of the Reservoir Protection Zones and priority classifications assigned to land in the South Dandalup Dam and South Dandalup Pipehead Dam Catchment Areas. (Shire of Murray, Shire of Boddington, Western Australian Planning Commission)

2. Development and works proposals in the South Dandalup Dam and South Dandalup Pipehead Dam Catchment Areas that are likely to impact on water quality or are inconsistent with the Department of Environment's guidelines and Water Quality Protection Notes, including *Land Use Compatibility in Public Drinking Water Source Areas* (as amended from time to time), should be forwarded to the Department of Environment. (Shire of Murray, Shire of Boddington, Department for Planning and Infrastructure)

3. Signs should be erected and maintained along the boundaries of the catchments and Reservoir Protection Zones to define the areas and to promote public awareness of the importance of protecting drinking water quality. (Water Corporation)

4. The Department of Conservation and Land Management, Forest Products Commission, Department for Planning and Infrastructure, Shire of Murray, Shire of Boddington and Alcoa World Alumina Australia should be supplied with a digital copy of the priority classifications and Reservoir Protection Zones to facilitate their planning processes. (Department of Environment)

5. The catchment surveillance program and associated by-law enforcement should continue to be implemented by the Water Corporation in the South Dandalup Dam and South Dandalup Pipehead Dam Catchment Areas. (Water Corporation)

6. Investigate the options for Water Corporation Catchment Rangers and Department of Conservation and Land Management Rangers to be trained to enforce *Metropolitan Water Supply, Sewerage and Drainage Act* by-laws. (Water Corporation, Department of Conservation and Land Management)

7. New recreational events or activities in the catchments should only be approved if in accordance with the requirements of the relevant agencies and the Department of Environment's Statewide Policy No. 13 *Recreation within Public Drinking Water Source Areas on Crown Land* (2003). The Department of Environment will not support new activities within the Reservoir Protection Zone. (Shire of Murray, Shire of Boddington, Department of Conservation and Land Management, Water Corporation, Department of Environment)

8. A risk assessment of the Munda Biddi Trail should be completed and the risks addressed. Management plans covering the roles and responsibilities of the relevant agency stakeholders should be prepared and audited. (Department of Conservation and Land Management, Munda Biddi Trail Foundation)

9. Streamzones and other areas of the catchments in Water Corporation, Water and Rivers Commission or other government ownership should be assessed for the need for rehabilitation. Areas identified should be rehabilitated with local native species. (Water Corporation, Department of Environment)

10. Personnel dealing with WESTPLAN – HAZMAT incidents in the area should be given ready access to a locality map of the catchments and training to understand the potential impacts of spills on the surface water resource. (Department of Environment, Fire and Emergency Services Authority of Western Australia)

11. The strategies detailed in Table 1. *Land use, potential water quality risks and recommended strategies* should be considered for adoption by those with responsibility for the recommended protection strategy. (Stakeholders)

12. The Department of Environment is to work with the Department of Conservation and Land Management and Forest Products Commission to update forestry manuals, codes and guidelines. (Department of Environment, Department of Conservation and Land Management, Forest Products Commission)

13. The Department of Environment should prepare an Implementation Strategy for this Plan involving all relevant stakeholders. (Department of Environment)

14. Implementation of these recommendations should be reviewed periodically after this Plan is endorsed. A full review of this Plan should be undertaken after five years. (Department of Environment)

9 Glossary

Aesthetic Guideline Level	ADWG level ascribed for acceptable aesthetic quality of drinking water.
Allocation	The quantity of surface water permitted to be abstracted by a licence, usually specified in gigalitres/year (GL/a).
Catchment	The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
Health Guideline Level	ADWG level ascribed for acceptable drinking water quality for human health.
IWSS	The Integrated Water Supply System provides water to Perth, Mandurah, Pinjarra, Harvey and the Goldfields and Agricultural regions, servicing approximately 1.5 million people. 50% of the water is from surface water catchments, 50% is from groundwater. Refer to Figure 1 in Water Corporation's *Perth's Water Balance – The Way Forward* for a diagrammatic representation.
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.
m AHD	Australian Height Datum. Height in metres above Mean Sea Level +0.026 m at Fremantle.
Nutrients	Minerals dissolved in water, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorus (phosphate) which provide nutrition (food) for plant growth. Total nutrient levels include the inorganic forms of an element plus any bound in organic molecules.
PDWSA	Public Drinking Water Source Areas are Underground Water Pollution Control Areas, Catchment Areas or Water Reserves established under the *MWSSD Act 1909* or *CAWS Act 1947*.
Pesticides	Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms.
Pipehead	In this case refers to South Dandalup Pipehead Dam.
Pollution	Water pollution occurs when waste products or other substances, e.g. effluent, litter, refuse, sewage or contaminated runoff, change the physical, chemical, biological or thermal properties of the water, adversely affecting water quality, living species and beneficial uses.
Runoff	Water that flows over the surface from a catchment area, including streams.
Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes including drinking and discharge to the environment.
Water quality	The physical, chemical and biological measures of water.

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Acronyms

Alcoa	Alcoa World Alumina Australia
ADWG	Australian Drinking Water Guidelines
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
CALM	Department of Conservation and Land Management
CAWS Act	*Country Areas Water Supply Act 1947*
DoE	Department of Environment, formerly the Water and Rivers Commission and the Department of Environmental Protection
DoH	Department of Health
DoIR	Department of Industry and Resources
DRA	Disease Risk Area
DWSPA	Drinking Water Source Protection Assessment
DWSPP	Drinking Water Source Protection Plan
FPC	Forest Products Commission
GL	Gigalitre; 1 thousand million litres
HAZMAT	Hazardous materials
IWSS	Integrated Water Supply System
ML	Megalitres; 1 million litres.
MMPLG	Mining and Management Program Liaison Group
MOG	Mining Operations Group
MWSSD Act	*Metropolitan Water Supply, Sewerage and Drainage Act 1909*
NHMRC	National Health and Medical Research Council
P1	Priority 1 - priority classification for land use
P2	Priority 2 - priority classification for land use
PDWSA	Public Drinking Water Source Area
PZ	Prohibited Zone (also known as Reservoir Protection Zone {RPZ})
RIWI Act	*Rights in Water and Irrigation Act 1914*
RPZ	Reservoir Protection Zone (also known as Prohibited Zone {PZ})
WC	Water Corporation
WHO	World Health Organisation
WRC	Water and Rivers Commission

Appendix 1 - Protecting our Public Drinking Water Source Areas

PROTECTING PUBLIC DRINKING WATER SOURCE AREAS

Introduction

This agency is the custodian of all of the State's water resources. Our role is to ensure the State's water resources are managed to support sustainable development and conservation of the environment for the long-term benefit of the community.

Next to food, water is the most essential element for life, and our aim is to protect Public Drinking Water Source Areas (PDWSA). Achieving this aim will provide consumers with reliably 'safe, good quality drinking water' to protect public health for now and into the future at a reasonable cost to consumers.

This note provides an overview of policy and processes used to protect PDWSA supplying drinking water to major population centres in Western Australia. Generally, private sources supplying drinking water to a household, business or remote aboriginal community are not subject to the same level of assessment, sampling, treatment and reporting requirements. Accordingly, they are not directly addressed in this protection note. Nonetheless, the approaches described in this note are still recommended for private sources. For example, the Water Corporation have a number of significant private drinking water source areas (eg 'roaded' catchments) that they operate consistent with PDWSA policy and processes.

The former State Government agencies the *Department of Environmental Protection* and *Water and Rivers Commission* are presently being combined to form the *Department of Environment*. This process will not be complete until enabling legislation has been passed by Parliament and proclaimed. This note aims to present a generic 'combined agency' position on the nominated topic.

Who is involved in protecting our drinking water supplies?

Responsibility for the condition (quality) and availability (quantity) of our drinking water must be shared by the community, land owners/developers, industry, agriculture, local government, water service providers and the State government. All of these groups play a significant role in the development of Drinking Water Source Protection Plans (DWSPP) for PDWSAs (also called drinking water catchments in this note). They also may be involved in the implementation of the recommendations in those plans. Their direct and ongoing involvement in the protection of our drinking water catchments is essential to achieve a successful outcome.

The Department of Environment (DOE), is primarily responsible for defining, proclaiming and protecting the catchments of Public Drinking Water Source Areas (PDWSAs). The PDWSAs are made up of any area proclaimed to protect public drinking water source catchments. These areas are proclaimed as Water Reserves, Catchment Areas or Underground Water Pollution Control Areas under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*, and Water Reserves or Catchment Areas under the *Country Areas Water Supply Act 1947*.

The DOE has responsibility to administer the State's catchment protection legislation. This administration includes:

- undertaking and facilitating effective by-law enforcement and catchment surveillance;
- the assessment and permitting of land use developments or activities;
- negotiating protection mechanisms in the land use planning process; and
- advising on the compatibility of land development and use activities.

The DOE also has responsibility for preparing policies and guidelines, drinking water source protection assessments and plans and advising other decision-making agencies on source protection requirements. The Department promotes a coordinated approach to catchment protection encompassing a variety of related measures including regional and local land use planning; health; and environmental legislation.

Where public health is concerned, the Department of Health has primary responsibility. The Department of Health's role is to minimise human exposure to environmental health hazards that pose or have the potential to pose a health risk and to reduce the incidents and impact of communicable disease. To safeguard against unhealthy drinking water, the Department of Health works closely with the DOE and individual Water Service Providers. The Department of Health also chairs an inter-agency committee, called the "*Advisory Committee for the Purity of Water*", established in 1925 and charged with the ongoing responsibility of advising the State on drinking water protection issues. The Office of Water Regulation is another government agency with a key role in regulating drinking water supply issues. It issues licences to individual Water Service Providers such as the Water Corporation, Aqwest (Bunbury) and Busselton Water Board.

The Water Corporation is the largest Water Service Provider in WA, and it was formed in the mid 1990's after the split of the former Water Authority of Western Australia as part of the COAG Water Industry Reform initiatives. The Corporation is the major licensed Water Service Provider in Western Australia, supplying the Perth metropolitan area as well as a further 230 towns across the State. It is a corporation, with the state government being the sole shareholder, and is subject to corporation law. It is managed by a board of directors including the Managing Director (its CEO). The Corporation is required to return a dividend on the Government's investment in the Corporation's assets and in return receives Customer Service Obligation (CSO) payments to subsidise uneconomic services that are required to be provided by the Government. The Corporation also pays federal tax equivalents to the State Government in accordance with the COAG reform agreement.

Source Protection Operational Agreements exist between the DOE and the Water Corporation, which assign roles in catchment protection, clarify responsibilities in catchment protection and ensure the process is carried out effectively. Under the legislation, the DOE may delegate certain catchment management functions to the Water Corporation (or other water service providers). Delegation is appropriate as the Corporation has a strong vested interest in assuring high quality drinking water from the catchments and is also prepared to resource catchment management functions. Currently, delegated functions relate to catchment surveillance, enforcing by-laws regarding transient catchment activities, entry onto land and catchment management planning. The extent of delegated responsibilities may vary between catchments.

Why should we protect our drinking water supplies?

Drinking water should be safe to drink and aesthetically pleasing. Ideally, it should be clear, colourless, pleasant tasting and contain no harmful chemicals or disease-causing microbes. To keep drinking water clean it is important to protect both our surface and underground drinking water sources (e.g. surface dams and groundwater) and the catchments in which they are located.

This advice deals with the water consumed in homes and provided by licensed Water Service Providers (often referred to as 'scheme' supplies). These WSP are responsible for water treatment (including disinfection) and distribution services to the community. Advice on alternative (potentially less safe) drinking water sources, such as private bores or rainwater tanks, is available in other documents. As a rule neither the Department of Health or DOE recommend the use of rainwater or private bore water for drinking water purposes where a scheme water source is available. This is because the catchments of these other sources are generally not protected from contamination and they are not analysed or treated to meet the relevant health guidelines for drinking water. Such sources can however be useful for non-potable uses such as in washing machines, toilets or for gardens. If a scheme supply is not available, then it is important that the consumer implements the necessary measures to ensure their drinking water source is safe to drink (i.e. arrange water analyses and treatment as required).

In the mid 1990's, the Council of Australian Government reforms process took an initiative to pursue the sustainable use of water resources by protecting and enhancing their quality, while maintaining economic and social development. This was achieved through the development of a National Water Quality Management Strategy (NWQMS) presently comprising 21 national guideline documents. Two of these focused on drinking water, the *Australian Drinking Water Guidelines-Summary and the Australian Drinking Water Guidelines*, 1996 (an update of the 1987 *Guidelines for Drinking Water Quality in Australia*). The *Australian Drinking Water Guidelines*, 1996 (ADWG) recognised water source protection through catchment management as an effective approach to preventing contamination of drinking water sources and undertook to investigate this issue further.

In May 2001, Western Australia supported the NWQMS (including the ADWG) through the launch of its own State Water Quality Management Strategy (SWQMS). In late 2002, the ADWG were updated and released for public comment. The ADWG 2003 have now been finalised and are planned to be released in late 2003. A 'consumer guide' to the ADWG 2003 called Water made clear has also been developed to raise awareness of the need to protect drinking water catchments from 'catchment to consumer'.

Roughly half of Perth's water supplies come from surface sources with the remainder harvested from groundwater. In 1994, a Parliamentary Select Committee reported on the issue of Perth's development and groundwater supplies. The Select Committee considered experience from around the world and overwhelmingly concluded, "an ounce of prevention is worth a pound of cure". In his foreword, the chairman of the Select Committee noted: "*experts around the world expressed their envy of our relatively pristine water supply and advised us to protect our groundwater supply at all costs*".

In 2000, the State Legislative Council's *Standing Committee on Ecologically Sustainable Development in relation to the Quality of Perth's Water Supply* expressed confidence in the system managing and operating Perth's water supply. The Standing Committee noted, however, that various activities posed a contamination risk to water supplies. It found as a "f*irst priority that water sources be protected through good land use planning*. **It also noted that** "*Using treatment to deal with contamination is a second-best option. The Committee found support for adopting catchment protection as the major weapon in preventing contamination of water supplie*s". In November 2001, in support of this finding, the Western Australian Planning Commission (in consultation with the Water and Rivers Commission) released a *Public Drinking Water Source Policy* for public comment. The Policy was gazetted in June 2003. This policy will guide State and Local Government land use planning decisions in public drinking water catchments.

Although the above committees were reporting on Perth's water supplies, their findings apply to all public drinking water sources in Western Australia. This is especially true when a community is reliant upon a single drinking water resource (such as the groundwater bore network in Kununurra or surface water dam in Quinninup) rather than an integrated series of sources (such as those that supply Perth). Contamination

of a single resource from inappropriate land use planning or polluting activities within the catchment can have significant health and economic impacts, which should be avoided.

In February 2003, the Western Australian Government released its State-wide water strategy. Although prepared in response to a number of forums around State focusing on drought, it did however make a significant statement about protecting our public drinking water sources. It stated unequivocally that *recognition of the primacy of water quality in the management of drinking water catchments, to protect the long term sustainability of the resource, will be used to guide catchment management decisions*.

This is interpreted to mean, when managing and protecting any public drinking water source catchment, the dominant consideration must be maintenance of water resource quality and the prevention of contamination risk. This objective in most cases may prevent or constrain further land development.

More recently in September 2003, the Western Australian Government also released its State-sustainability strategy document – "Hope for the future". Drinking water catchments are now recognised as important 'natural resources' together with the other more common natural resources (eg. agriculture, fisheries, forestry, mining, tourism, aquatic systems, coastal and marine environments and rangelands). The 'Vision' in the Strategy is that "Drinking water sources are fully protected for future generations.". The Strategy lists the following 'Actions': (number 3.48) that we "Work to ensure all present and future drinking water sources are protected."; and (number 3.51) that we "Ensure the activities in catchments are actively managed and sustainable…" through "…investigation of the impact of active catchment management strategies that enhance water quality and quantity outcomes…".

What are we protecting the drinking water supplies from?

Land use planning decisions and recreational or business activities occurring in drinking water catchments can impact on the quality and quantity of drinking water. Where catchments remain covered with native vegetation with little human activity, the risk of contamination is low. However, contamination risks increase with increased human activity.

Potential contaminants may include:

- physical contaminants e.g. colour, foaming agents and suspended solids;
- chemical contaminants e.g. salts, heavy metals and poisons; or
- microbiological contaminants e.g. bacteria, protozoa and pathogenic viruses.

Although many contaminants can be removed by treatment processes, such treatment increases the cost of the water supply, and continuous effective removal of all contaminants is not considered technically or economically feasible. If contamination does occur, the opportunity to locate and develop a replacement source is often limited, and the provision of alternatives, e.g. bottled drinking water, is costly and can only be considered a short-term solution. Stopping contamination before it occurs prevents the need for costly treatment or the development of often more costly alternative sources. It should also be appreciated that there is a substantial ongoing financial cost to be borne in sampling and testing for contaminants if they become prevalent in drinking water sources. The benefits (environmental, social and economic) of avoiding contamination through best management decisions and practices are recognised in the ADWG 2003.

Clearly drinking water quality and safety cannot be taken for granted. Appropriate State and Local Government controls are required in consultation with, and the support of the community and other stakeholders. These controls are needed to manage a number of threats to drinking water areas, including inappropriate:

- land use planning processes and decisions resulting in high risk developments in catchments;
- recreational activities where the impact of human wastes and damage to natural protective measures associated with higher intensity land use is often underestimated; and
- use and/or disposal of chemicals, animal and domestic wastes and pesticides.

We should also appreciate that beyond the actual catchment and water storage area, drinking water that is not properly treated, or which travels through an inadequately maintained distribution system, also poses a serious public health risk.

Several recent events that have occurred nationally and internationally that highlight the importance of protecting drinking water, especially at the source.

The main finding of an inquiry into the well-publicised Sydney Water Crisis in 1998 was that the catchments were seriously compromised by many possible sources of contamination, and that there was insufficient regulatory control to guarantee safe drinking water. The Sydney Water Catchment Authority was set up in response to this event which transferred responsibility for land use decisions within the catchment from the Planning Authority to the new catchment Authority.

In Walkerton (Canada), in 2000 a drinking water catchment related tragedy unfolded where a pathogenic E-coli outbreak resulted in over 2300 cases of illness amongst 4,800 residents, 70 people were hospitalised and 7 deaths were attributed to the outbreak. A judicial inquiry concluded that the likely initial cause of the outbreak was from manure application on farmland (a common practice even in WA) that resulted in bacterial contamination finding its way into the shallow underground water-body which was used to supply drinking water. Other contributing factors to the outbreak included a high rainfall event just prior to the contamination outbreak, and an inadequate disinfectant dose rate and monitoring issues related to the distribution system. It is important to appreciate that the drinking water system at Walkerton operated for more than 8 years without major incident up until the year 2000. The over-reliance on treatment to provide a safe drinking water supply was highlighted and a new approach adopted that considered both catchment protection and improved treatment (in combination) to provide a more reliably-safe supply to consumers.

How do we protect public drinking water source areas in WA?

A ‘catchment to consumer’ multiple barrier approach is used in the management of drinking water quality in Western Australia. Catchment management for protection of the water source (held in storage in surface dams or underground aquifers) is considered the first important barrier. Historically, a heavy reliance was placed on treating water to achieve the desired level of safety, but it is now recognised that treatment alone does not remove all hazards to public health. Therefore, to maximise public health safety effective catchment protection is also essential. Other barriers include:

- selection of an appropriate safe high quality source (where alternatives exist);
- controls over land uses and high risk human activities in catchments underpinned by statutory measures;
- protective undeveloped buffer zones to supply bores, reservoirs and feeder streams;
- catchment protection strategies for education, surveillance, enforcement and monitoring/reporting;
- pre-treatment of drinking water, for example use of detention and settling in reservoirs to induce microbes to die off;

- protection of water storage works, for example water tanks and reservoirs;
- disinfection of drinking water before it enters the distribution system and provision to ensure an adequate disinfectant residual throughout that system;
- maintaining the distribution system as a whole including the pipe system, vermin-proofing of water tanks and preventing back-flow; and
- Promotion of source protection measures in local government planning schemes using the WA Planning Commission's *Statement of Planning Policy– Public Drinking Water Source Policy* (June 2003).

A key process employed by this agency to protect drinking water sources involves the preparation of Drinking Water Source Protection Plans (DWSPP) for the State's PDWSAs.

Drinking Water Source Protection Plans (and Drinking Water Source Protection Assessments)

Drinking Water Source Protection Plans are a key component of the 'catchment-to-consumer' protection strategy for Western Australia's drinking water supplies. This is reflected in the Government's report "*Securing our water future - A State Water Strategy for Western Australia (2003)*" which states that **water source protection plans should be completed for all public drinking water supply catchments throughout the State**. A DWSPP aims to identify existing and potential threats to a drinking water source and to provide risk management strategies and programs for the ongoing management/protection of that source.

Plans are prepared in consultation with the community, potentially affected stakeholders (especially landowners), local government and the State government. Stakeholders are strongly encouraged to consider the risks and potential consequences of inappropriate land-use planning or human activities in the catchment (e.g contamination of the resource and costs to clean-up or establish a new drinking water source). It should be noted that decisions made following consultation may result in some land use/activity restriction in order to achieve a safe, good quality drinking water supply.

Providing a basis for establishing compatible land uses within PDWSAs, the DWSPP is only one of a suite of measures used by this agency to meet its drinking water protection responsibilities. As at June 2003, there were approximately 139 plans listed for completion. Of this number, 50 are complete and 89 are in production.

While the full suite of DWSPPs await completion, land planners and developers need to be aware of the location of and risks to existing drinking water catchments. To this end the DOE is preparing Drinking Water Source Protection Assessments (DWSPA). These Assessments will provide a broad overview of catchment risks, planning and land uses; and a basic understanding of the drinking water catchment and supply system. They are not intended to include extensive data, but to characterise the drinking water system by providing useful information for decision makers. Generally, the DWSPA will be a desktop assessment followed by a site visit and discussions with local government. In some circumstances the DWSPA may be all that is required to achieve good land planning/activity controls (e.g. through planning schemes or strategies) for the protection of drinking water source areas. Otherwise, the DWSPA will be considered base information for development of the DWSPP described above.

Priority classification system

This agency has also implemented policies to protect public drinking water source areas that includes a differential '*priority classification area*' system that includes special 'protection zones' around bores and reservoirs. Through development of a DWSPP (or possibly the DWSPA), land in a PDWSA is identified as a mix of Priority 1 (P1), Priority 2 (P2) or Priority 3 (P3) classification areas, with appropriate protection zones.

Priority 1 (P1) source protection areas are defined to ensure that there is **no degradation** of the water source. P1 areas are declared over land where the provision of high quality public drinking water is the prime beneficial land use. P1 areas would typically include land under public ownership but may in a limited number of cases include private land.

P1 areas are managed in accordance with the principle of **risk avoidance**, and hence land development is generally not permitted. Where P1 land is in private ownership this agency may make an offer to the owner to sell their land at agreed market values subject to available funding and priority order purchasing rules. There is no obligation on the owner to sell their land.

Priority 2 (P2) areas are defined to ensure that there is **no increased risk of pollution** to the water source. P2 areas are declared over land where low intensity development (such as rural) already exists. Protection of public water supply sources is a high priority relative to other land use values in these areas.

P2 areas are managed in accordance with the principle of **risk minimisation**, and as such only limited conditional development is supported. Such development must be consistent with the protection of waters within the drinking water catchment. A proposed change in land use from a relatively low to a more intensive use may result in contamination of the PDWSA, and would not be supported.

Priority 3 (P3) areas are defined where it is practical to **manage the risk of pollution** to the water source, and where water supply sources need to co-exist with other generally existing land uses such as residential, commercial and light industrial developments.

Protection of P3 areas is achieved through **management guidelines** rather than restrictions on land use. Key elements in protection of P3 areas are the provision of deep sewerage and land users using best environmental management practices for their activities. In P3 areas, compared to P1 and P2 areas, it is likely that the direct cost of providing the drinking water to consumers is greater, given the need to monitor and treat the water more comprehensively due to the variety of existing and allowable land uses/risks. If water from P3 areas becomes contaminated, then that water may need to be further treated or an alternative water source found.

In these priority areas there is a strong reliance on landowners, developers, regulators and other users to be acutely aware of the drinking water resource and risks, such that the adoption and implementation of best management practices will help protect the drinking water source . Existing lawfully established but non-conforming land uses in PDWSAs are allowed to continue, however land users will be encouraged to adopt environmentally responsible/best practice land use practices. This agency has prepared a "*Water Quality Protection Note -Land Use Compatibility table in PDWSAs*" that provides guidance on the type of land uses appropriate within P1, P2 and P3 areas.

Reservoir and wellhead protection zones

As noted above, reservoir protection zones (RPZ) are also defined to protect the surface water source from contamination in the immediate vicinity of reservoirs. Reservoir protection zones consist of up to a 2 kilometre buffer around the top water level of a reservoir and includes the reservoir itself. These zones do not extend outside the catchment area (i.e. downstream from a dam wall). This agency provides a high level of protection in these zones and does not support land uses or activities that may add to add to the risk of contamination of the water source. Generally conditions apply in these zones aimed at preventing people from entering the RPZ to avoid the risk of contamination (consistent with the P1 areas).

For underground water sources, well-head protection zones are defined around the abstraction bores and allowable activities/ land uses in these areas are also restricted and subject to approval processes. Well-head protection zones in P1 areas are set at a 500 metre radius around a bore, and in P2 or P3 areas they are set at a 300 metre radius around a bore.

How are priority classification areas and protection zones determined?

The determination of a priority classification area or protection zone over land in a PDWSA is based on the strategic importance of the land or water source, its zoning, ownership and existing approved land uses/activities. The land use tables in this protection note directly relate to the three types of priority classification areas identified in DWSPP or agreed in Land Use and Water Management Strategy documents. In the absence of a DWSPP, the DOE recommends that planning decisions within any gazetted or proposed PDWSA are guided by DWSPA documents (where they exist) and the 'potential' priority classification area or protection zone status of a proposal identified using the following process flow diagram.

Conclusion

We can improve the availability of 'safe, good quality drinking water' to protect public health if we continue to combine catchment protection and water treatment approaches. This 'catchment to consumer' approach to drinking water protection is the basis of the recently updated *Australian Drinking Water Guidelines 2003*.

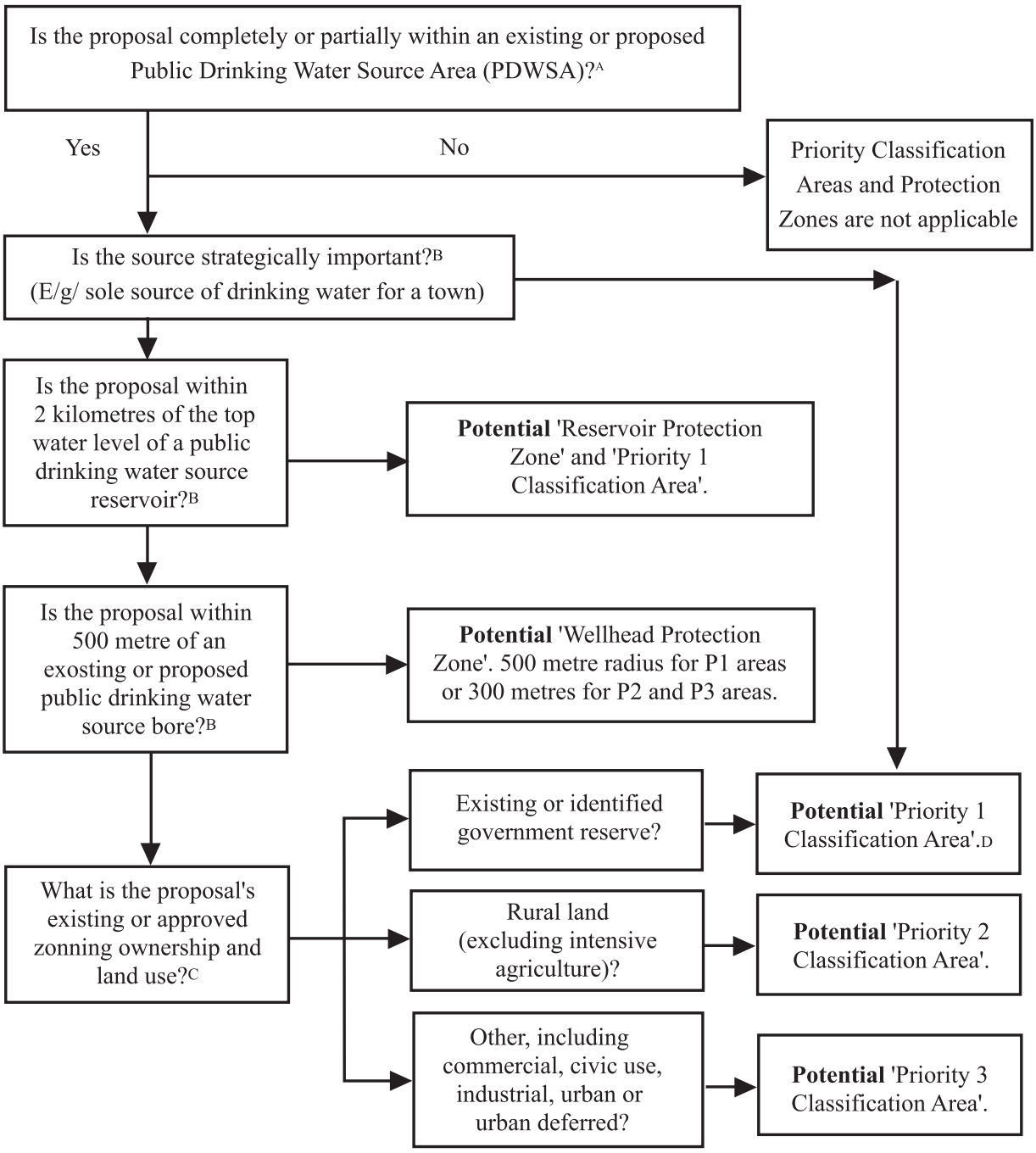
Many land uses and activities can pose a risk to water quality, so in undeveloped drinking water catchments strict management controls are proposed to 'avoid the risk' of contaminating the source. In catchments with some level of development, management controls recognise the existing development but may place restrictions on alternative land uses or expansion of existing land uses. This approach looks to 'minimise' or 'manage the risk' of contamination in the catchment. These management controls help protect public health, lower the costs of supplying drinking water to consumers and provide a long term source of safe, good quality drinking water.

More information

We welcome your thoughts on this note. The note will be updated from time to time as comments are received, or industry standards change.

If you wish to comment on the note or require more information, please contact our Program Manager, Protection Planning (Stephen Watson) at the Water Source Protection Branch in our head office in the Hyatt Centre. Phone: (08) 9278 0454 (business hours), Fax: (08) 9278 0585.

Figure 1. Determination of Priority Classification and Protection Zones



Legend

A The location of PDWSAs can be found in DOE's Drinking Water Source Protection Assessments and Plans or through your regional DOE office, Local Government office, Water Corporation or from the Department for Planning and Infrastructure.

B Strategically significant sources and potential contamination from land uses close to drinking water reservoirs or abstraction bores are considered first, due to these involving the highest risk of contamination reaching consumers.

C Current zoning or land use information is available from your Local Government office.

D Government land is protected to achieve the highest level of safety for drinking water in all parts of a catchment through a Priority 1 classification, wherever this is reasonable and practicable.

Appendix 2 - Water quality analysis

WATER QUALITY ANALYSIS RESULTS

Explanatory note

Water from the Pipehead Dam is chlorinated before pumpback to SDD where its quality is ameliorated by reservoir storage. Water supplied to the IWSS is disinfected by chlorination.

The Water Corporation is required to comply with the health related guidelines of the Australian Drinking Water Guidelines (ADWG). There have been no exceedences of the health guidelines. Compliance with aesthetic parameters of the ADWG is not required; occasional exceedences have occurred.

Health parameters

Raw water from South Dandalup Dam and South Dandalup Pipehead Dam is analysed for health related chemicals. Health related chemicals include inorganics, heavy metals, industrial hydrocarbons and pesticides. Health related water quality parameters that have been measured at detectable levels in the source between July 1999 and July 2004 are summarised in the following table.

Parameter	**Units**	**Health Guideline Value***	**South Dandalup Dam**	**South Dandalup Pipehead Dam**
			Min-Max Median	**Min-Max Median**
Barium	mg/L	0.7	0.0095 – 0.014 0.012	0.019†
Boron	mg/L	4	0.02 – 0.03 0.029	Not Detected
Fluoride	mg/L	1.5	<0.1 – 0.65 <0.1	<0.1 – 0.15 <0.1
Iodide	mg/L	0.1	0.08†	Not Detected

* 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, 1996).

† Single detection only.

Microbiological analysis

Microbiological testing of raw water samples from South Dandalup Dam is conducted on a weekly to monthly basis, particularly during summer and autumn. Microbiological testing of raw water samples from South Dandalup Pipehead Dam is conducted on a quarterly basis.

Thermotolerant coliform counts are used as an indicator of the degree of faecal contamination of the raw water from warm-blooded animals. A count of less than 20 colony forming units (cfu) per 100 mL is typically associated with low levels of contamination and is used as a microbiological contamination benchmark (WHO, 1996).

During the review period, July 1999 to July 2004, positive thermotolerant coliform counts were recorded in 34% of samples from South Dandalup Dam, with 7% of the positive samples exceeding 20 cfu/100 mL. Positive thermotolerant coliform counts were recorded in 92% of samples from South Dandalup Pipehead Dam, with 50% of the positive samples exceeding 20 cfu/100 mL.

Aesthetic water quality data

Aesthetic water quality analyses of raw water from South Dandalup Dam and South Dandalup Pipehead Dam are summarised in the following table. The values are taken from ongoing monitoring for the period July 1999 to July 2004. The values are in milligrams per litre (mg/L) unless stated otherwise. The water quality parameters that have on occasion exceeded the ADWG are shaded.

Parameter	**Units**	**Aesthetic Guideline Value**	**South Dandalup Dam**	**South Dandalup Pipehead Dam**
			Min-Max Median	**Min-Max Median**
pH		6.5 – 8.5	7.01 – 7.56 7.27	6.44 – 7.22 6.87
Turbidity	NTU	5	0 – 10 1.2	0.6 – 274 6.6
Colour	TCU	15	2 – 8 3	5 – 80 10
Conductivity	mS/m	-	23 – 42 29	18 – 38 26
Total Dissolved Solids	mg/L	500	124 – 185 143	130 – 210 158
Iron (unfiltered)	mg/L	0.3	0.04 – 0.95 0.09	0.152 – 5 0.825
Manganese (unfiltered)	mg/L	0.1	0.002 – 0.026 0.007	0.012 – 0.4 0.048
Aluminium (unfiltered)	mg/L	0.2	0.01 – 0.24 0.026	0.022 – 2.6 0.34
Sodium	mg/L	180	32 – 44 37	30 – 52 42
Potassium	mg/L	-	0.95 – 2 1.4	0.65 – 2 1.2
Calcium	mg/L	-	2.4 – 4 3.2	2 – 4.8 3
Magnesium	mg/L	-	4 – 6 4.8	4 – 7.5 5
Hardness (as $CaCO_3$)	mg/L	200	23 – 33 28	20 – 43 29
Alkalinity (as HCO_3)	mg/L	-	8.3 – 16.3 12.4	7 – 25 12
Chloride	mg/L	250	53 – 104 66	54 – 96 75
Sulphate	mg/L	250	6.5 – 15 10	6 – 14 7
Silica (as SiO_2)	mg/L	-	2.2 – 3.5 2.7	4.7 – 9 8.1
Filterable organic carbon	mg/L	-	2.2 – 5.2 3.2	1.2 – 5.6 8.1

Appendix 3 - Land use compatibility in Public Drinking Water Source Areas

LAND USE COMPATIBILITY IN PUBLIC DRINKING WATER SOURCE AREAS

Purpose

The Department of Environment (DoE) is responsible for managing and protecting the State's water resources. This note provides advice on the acceptability of land uses and activities within specific catchments that are the water source for schemes supplying cities and towns. These catchments are termed Public Drinking Water Source Areas (PDWSAs) and they require comprehensive water resource quality and land planning protection measures to ensure the ongoing availability of a 'safe, good quality drinking water' supply to protect the health of consumers for now and into the future. This note supports the DoEs Public Drinking Water Resource Policy (July 2004).

The note also forms an integral part of the Western Australian Planning Commission's *Statement of Planning Policy No. 2.7- Public Drinking Water Source Policy* 2003 (relevant to approximately 140 existing PDWSAs in Western Australia) prepared by the Department for Planning and Infrastructure under Section 5AA of the *Town Planning and Development Act 1928*. It is also intended to support the proposed Statement of Planning Policy for *Water Resources* designed to guide planning decisions in future PDWSAs. This note should be used by Local Government when developing local planning strategies, structure plans and town planning schemes. It should also be used in the assessment of subdivision and other development applications. The note will also assist the development of formal guidelines on land use activities in PDWSA prepared in liaison with key stakeholders such as the Water Corporation, Department of Health, Department of Conservation and Land Management, Department of Agriculture, Department of Industry and Resources, Department for Planning and Infrastructure and local government.

A review of this note may occur within 12 months (depending on feedback) to reflect DoE's policy position (which is influenced by public consultation undertaken for PDWSAs), advances in technology or land use activity standards, and Government decisions made concerning drinking water quality protection. This note may not consider all the circumstances that exist for planning strategies, plans and schemes across the State. Accordingly, changes to this note will only be considered if they apply broadly across the State. Other means of addressing localised special circumstances may be employed and the DoE will assist in achieving this outcome provided those changes do not place the PDWSA at a higher contamination risk.

Scope

This note provides the DoE's position on a range of land uses assessed against the Department's water quality protection strategy and management objectives within PDWSAs. Where a specific land use has not been covered in the accompanying tables, it should be referred to the Department's Water Source Protection Branch for assessment and a written response concerning its acceptability or any necessary water resource protection measures.

Public Drinking Water Source Area in Western Australia is the collective description for:

- Underground Water Pollution Control Areas,
- Water Reserves, and
- Catchment Areas,

declared under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *Country Areas Water Supply Act 1947*.

This note is intended to complement the statutory role and policy of State and local government authorities, but it does not override Government policy or the need for proponents to fulfil their legal responsibilities for land use planning, and environmental, health, building or other necessary approvals.

PDWSA protection framework

The protection of PDWSAs relies on statutory measures available in water resource management and land use planning legislation. The DoE policy for the protection of PDWSAs includes three risk management based priority classification areas and two types of protection zones. The priority classification areas and protection zones are determined via specific Drinking Water Source Protection Plans (DWSPP) that are prepared in consultation with State government agencies, landowners, local government, and key industry and community stakeholders. Where a fully consulted DWSPP does not exist for a PDWSA, the DoE initially prepares Drinking Water Source Protection Assessment (DWSPA) documents to reflect readily available information for use in land use planning assessments and decision making.

Priority classification areas

Priority 1 (P1) classification areas are managed to ensure that there is **no degradation** of the drinking water source by preventing the development of potentially harmful activities in these areas. The guiding principle is **risk avoidance**. This is the most stringent priority classification for drinking water sources. P1 areas normally encompass land owned or managed by State agencies, but may include private land that is strategically significant to the protection of the drinking water source (e.g. land immediately adjacent to a reservoir). Most land uses create some risk to water quality and are therefore defined as "**Incompatible**" in P1 areas.

Priority 2 (P2) classification areas are managed to ensure that there is **no increased risk** of water source contamination/ pollution. For P2 areas, the guiding principle is **risk minimisation**. These areas include established low-risk land development (e.g. low intensity rural activity). Some development is allowed within P2 areas for land uses that are defined as either "**Compatible with conditions**" or "**Acceptable**".

Priority 3 (P3) classification areas are defined to **manage the risk of pollution** to the water source from catchment activities. Protection of P3 areas is mainly achieved through guided or regulated environmental (risk) management for land use activities. P3 areas are declared over land where water supply sources co-exist with other land uses such as residential, commercial and light industrial development. Land uses considered to have significant pollution potential are nonetheless opposed or constrained.

Wellhead and reservoir protection zones

In addition to the three Priority Classification Areas, specific protection zones are defined to protect drinking water sources from contamination in the immediate vicinity of water extraction facilities. Within these zones by-laws may prohibit, restrict or approve defined land uses and activities to prevent water

source contamination or pollution. Special conditions, such as restrictions on storage and use of chemicals, may apply within these zones. The legislation is currently being reviewed to simplify and enhance the protection of public drinking water sources.

Wellhead protection zones (WHPZ) are used to protect underground sources of drinking water. They are circular (unless information is available to determine a different shape), with a radius of 500 metres in P1 areas, and 300 metres in P2 and P3 areas. WHPZ do not extend outside PDWSA boundaries. Reservoir protection zones (or '**prohibited zones**' as they are called in the by-laws) consist of a statutory 2 kilometre wide buffer area around the top water level of storage reservoirs in the Perth water supply area, and include the reservoir water-body. The reservoir protection zones (RPZ) apply over Crown land and prohibit public access to prevent contamination (physical, chemical and biological) of the source water. RPZ do not extend outside PDWSA boundaries. The DoE is currently considering a provision for RPZ buffer areas of less than 2 kilometres, and creation of consistent by-laws for country and Perth PDWSAs.

Special protection measures apply in WHPZ and RPZ (prohibited zones) as described in the By-laws *under the Metropolitan Water Supply, Sewerage and Drainage Act 1909* and the *Country Areas Water Supply Act 1947*.

The determination of priority classification areas or protection zones over land in a PDWSA is based on:

- the strategic importance of the land or water source,
- the local planning scheme zoning,
- form of land tenure, and
- existing approved land uses/activities.

The land use tables in this protection note directly apply to the three types of priority classification areas identified in DWSPP or agreed in specific *Land Use and Water Management Strategy* documents. Currently there are 45 DWSPPs available to guide land use planning decisions in PDWSAs, and (nearly 100) others are in development. In the absence of a DWSPP, the DoE recommends that planning decisions within any gazetted or proposed PDWSA are guided by DWSPA documents (where they exist) and the '**potential**' priority classification area or protection zone status of a proposal identified using **Diagram 1: Assessment of potential priority classification areas and protection zones** (overleaf).

Compatibility of land uses within PDWSAs

The tables in this note have been prepared for use by local governments, State planners and other agencies as a basis for regulating land use within PDWSAs. The note complements the Western Australian Planning Commission's *Statement of Planning Policy Number 2.7 (June 2003) Public Drinking Water Sources*. These tables define land uses in terms of their compatibility with the sustainable use of the drinking water source. They promote a priority for protection of the environmental value: 'drinking water' within a PDWSA over other values that may exists. The three definitions used are '**Incompatible**', '**Compatible with conditions**' and '**Acceptable**'. In previous versions of this note the definitions were 'Incompatible', 'Conditional' and 'Compatible'.

The DoE recognises that there may be special circumstances which may occasionally result in an '**Incompatible**' land use receiving approval. Where planning decisions result in this outcome it is important for project proponents to have demonstrated an overriding community benefit and that the land use will not increase the risk of contamination to the PDWSA. The DoE expects to have significant, early involvement in planning decisions of this nature to maximise the protection of the drinking water resource.

It should be noted that where a water source is the sole supply for a community, or has a particularly high strategic value for the supply of drinking water, then it would be difficult to understand how that source might be put at any risk of contamination.

Detailed information on water quality protection issues and recommended best management practices for '**Compatible with conditions**' land uses are being developed in approved environmental policy, codes of practice, management guidelines and water quality protection notes. These documents, along with the most recent version of this note, can be found on the DoE Internet site http://www.environment.wa.gov.au Information on land use and development regulation within PDWSAs can also be obtained from DoE's regional offices.

The DoE's Water Source Protection Branch, presently located in East Perth, is custodian of this water quality protection note and will provide detailed advice on its application and coordinate any suggested amendments.

Existing approved land uses

Many land uses covered in this note may have been legally established prior to establishment/ gazettal of the PDWSA or modern protection measures being required. The DoE policy is that existing approved land uses/ activities can continue at their presently approved level, provided they operate lawfully. Where necessary, negotiations may be arranged with land owners to acquire property rights in P1 source protection areas. Where practical, this agency will also negotiate with the operators of existing '*Incompatible*', or '*Compatible with conditions*' activities to implement environmental management practices that minimise risks to water sources.

Proposed land uses

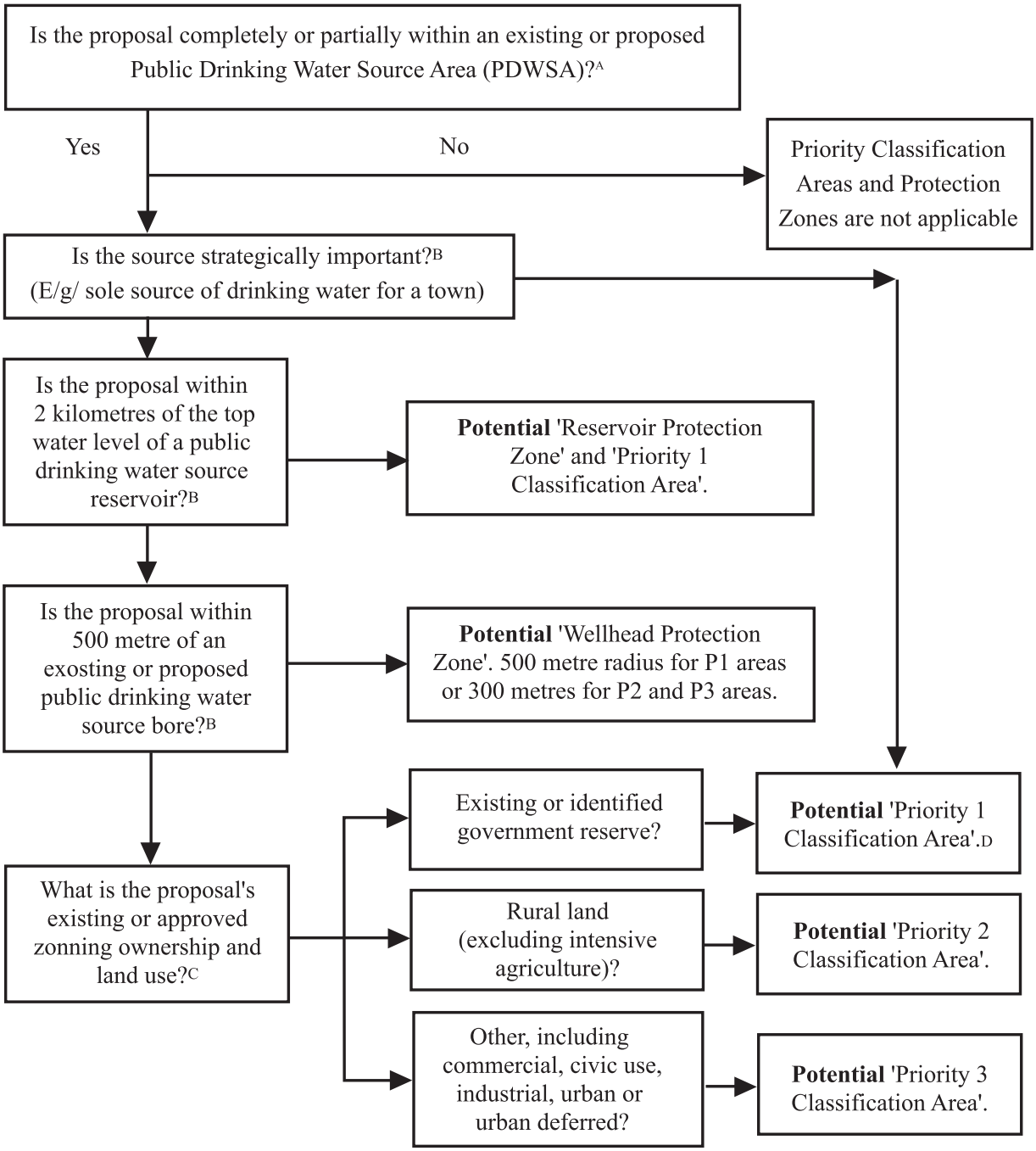
After reading this protection note, please view the DoE Internet site and/ or contact your nearest DoE Regional Office for advice on the location of PDWSAs, priority classification areas, and reservoir or wellhead protection zones. You may discuss with DoE staff any proposed land use activities that may affect water resources. The early identification of water resource protection issues in development stages of land use planning proposals is recommended in both the June 2003 *Statement of Planning Policy for Public Drinking Water Sources* and proposed *Water Resources Policy* by the Western Australian Planning Commission.

Definition of terms used in the following tables

'**Acceptable**' (equivalent to 'compatible' in previous version of this note)- means the land use is accepted by DoE as not likely to harm the drinking water source, and is consistent with the management objectives of that priority classification. The adoption of best practice environmental management methods for new proposals to protect water quality is expected. Existing land users are also encouraged to adopt best practice environmental management methods to help protect water quality. These land uses generally do not need referral to the DoE.

'**Compatible with conditions**' (equivalent to 'conditional' in previous version of this note) - means the land use is likely to be accepted by DoE as not likely to harm the drinking water source, (and is consistent with the management objectives of the priority classification) provided best environmental management practices are used. This may result in the application of 'specific conditions' (via the planning or environmental approval processes) that must be complied with to ensure the water quality objective of the priority area is maintained.

Figure 1. Assessment of potential priority classification areas and protection zones



Legend

A The location of PDWSAs can be found in DOE's Drinking Water Source Protection Assessments and Plans or through your regional DOE office, Local Government office, Water Corporation or from the Department for Planning and Infrastructure.

B Strategically significant sources and potential contamination from land uses close to drinking water reservoirs or abstraction bores are considered first, due to these involving the highest risk of contamination reaching consumers.

C Current zoning or land use information is available from your Local Government office.

D Government land is protected to achieve the highest level of safety for drinking water in all parts of a catchment through a Priority 1 classification, wherever this is reasonable and practicable.

Land uses described as 'Compatible with conditions' need ONLY to be referred to DoE for assessment and a written response if the activity does not follow recommendations endorsed by DoE such as those made in policy, environmental management guidelines, protection notes; Ministerial Conditions, Works Approvals, Licenses or agreements (e.g. a 'Memorandum of Understanding' developed between any Local Government and DoE).

'**Incompatible**'- means the land use is UNACCEPTABLE to DoE as it does not meet the management objectives of the priority classification area. DoE will normally oppose approval of these land uses through the planning decision making process and under legislation administered by DoE. If planning decisions are made to approve these land uses (e.g. as a consequence of a planning appeals process), then DoE should be advised of that decision and have been directly involved in providing advice to the planning decision makers on water quality protection issues. It should be noted that contentious proposals may be referred to the EPA for Environmental Impact Assessment under the *Environmental Protection Act 1986*.

'**Extensive**'- means limited additional inputs beyond those supplied by nature are required to support the land use, e.g. for agriculture- animal feed supplements only during seasonal dry periods, or during the final preparation of stock for the market.

'I**ntensive**'- means regular additional inputs are required to support the desired land use, e.g. for agriculture- irrigation, fertilisers, pesticides, or non-forage animal feeding dominates.

Interpretation of land use recommendations for planning schemes and development approvals

When using the following land use compatibility tables to guide planning schemes and development approval decisions, the following relationships should be used:

a) Where the table identifies a land use as '**Acceptable**', this use is permitted by DoE within that priority classification area. It may be identified as a 'P' (permitted) use in a scheme, providing the use complies with the relevant development standards and requirements of the planning scheme.

b) Where the table identifies a use as '**Compatible with conditions**', this use should be a discretionary use within the priority classification area and should be identified as either a '**D**' or '**A**' (after special notice) use in the scheme. Proposals for '**Compatible with conditions**' uses should ONLY be referred to DoE for assessment and response if they do not meet existing agency policy, guidelines or protection note measures, unless prior agreement has been made between a specific local government and DoE on alternative measures.

c) Relevant environmental management guidelines, codes of practice, water quality protection notes or agreements should be used in the first instance to define DoE's position on any land-use and limit the need to refer proposals to the DoE. Where these do not exist, site specific advice may be provided by the DoE.

d) Where the table identifies a use as '**Incompatible**', that use should not be permitted within that priority source protection area, and should be identified as an '**X**' (unacceptable use) in the scheme.

Where the table does not include a proposed land use that could affect water quality, that use should be considered to be '**Incompatible**' until the proponent can demonstrate that it meets the drinking water quality protection objective of the designated priority classification area . Specific advice on the proposed land use should be obtained from the DoE's Water Source Protection Branch.

If the land use planning approval process supports a proposal that is inconsistent with this water quality protection note, then DoE Water Source Protection Branch should be advised of this situation and the reasons for that decision. This advice will trigger DoE's assessment of the significance/ consequence of that decision to the drinking water source and the outcome will be considered in future strategies for water quality protection, and in the periodic review and update of this note. A means to ensure the DoE's effective early involvement with such cases is currently being developed.

Tables defining compatibility of various land uses within PDWSA

It is important to note that this table provides the DoE's recommended compatibility of land uses for the current zoning of land. It must not be used to support rezoning of land to provide for more intensive land uses. For example, although P3 areas provide for high density urban development when the land is already zoned Urban or Urban deferred, this Table must not be read to justify a zoning change within P3 areas to allow for high density urbanisation of rural zoned land.

Model Scheme Text (MST) land uses are shown in **bold** in the first column. Definitions covered in the MST (see note 23) can also be found in the *Town Planning Amendment Regulations 1999*.

Model Scheme Text & interpreted type of land use	P1 areas	P2 areas	P3 areas
Agriculture – extensive			
- pastoral leases	Compatible with conditions	Acceptable	Acceptable
- floriculture (non-irrigated), stock grazing (excluding pastoral leases) and broad hectare cropping	Incompatible	Compatible with conditions (see notes 11, 12)	Acceptable
Agriculture - intensive			
- aquaculture (fish, plants and crustaceans)	Incompatible	Compatible with conditions	Compatible with conditions
- orchards; production nurseries – potted plants; viticulture– wine and table grapes	Incompatible	Compatible with conditions	Acceptable
- floriculture; market gardens (see note 24); turf farms	Incompatible	Incompatible	Compatible with conditions
- hydroponic plant growing	Incompatible	Compatible with conditions	Compatible with conditions
- plant nurseries / garden centres	Incompatible	Compatible with conditions (see note 2)	Acceptable
Agro-forestry	Incompatible	Compatible with conditions	Acceptable
Amusement parlour	Incompatible	Incompatible	Acceptable (see note 1)
Animal establishment			
- animal saleyards and stockyards (see note 13)	Incompatible	Compatible with conditions (see note 2)	Compatible with conditions (see note 2)
- apiaries	Compatible with conditions	Acceptable	Acceptable
- catteries	Incompatible	Acceptable	Acceptable
- dairy sheds	Incompatible	Compatible with conditions (see notes 2, 3, 12)	Compatible with conditions (see note 3)
- dog kennels	Incompatible	Compatible with conditions	Compatible with conditions
- equestrian centres (see note 17)	Incompatible	Incompatible	Acceptable
- feedlots, intensive outdoor livestock holding	Incompatible	Incompatible	Compatible with conditions
- stables (see note 18)	Incompatible	Compatible with conditions	Acceptable
Animal husbandry - intensive			
- piggeries	Incompatible	Incompatible	Incompatible
- poultry farming - housed	Incompatible	Compatible with conditions	Compatible with conditions

Model Scheme Text & interpreted type of land use	P1 areas	P2 areas	P3 areas
Bed and breakfast (accommodating a max of 6 guests)	Compatible with conditions (see notes 6, 16)	Acceptable (see note 23)	Acceptable
- farm stay accommodation, rural chalets)	Compatible with conditions (see notes 6, 16)	Compatible with conditions (see note 4)	Acceptable
Betting agency	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Caravan park	Incompatible	Incompatible	Compatible with conditions (see note 1)
Caretakers dwelling	Compatible with conditions (see note 2)	Compatible with conditions	Acceptable
Car park	Incompatible	Compatible with conditions (see note 2)	Acceptable
Cemeteries	Incompatible	Incompatible	Compatible with conditions
Child care premises	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Cinema/theatre	Incompatible	Incompatible	Acceptable (see note 1)
Civic use	Incompatible	Compatible with conditions (see note 1)	Acceptable (see note 2)
Club premises			
- sporting or recreation clubs	Incompatible	Compatible with conditions	Acceptable (see note 1)
- health centres	Incompatible	Incompatible	Acceptable (see note 1)
Community purpose			
- community halls	Incompatible	Compatible with conditions (see note 2)	Acceptable
- irrigated golf courses or recreational parks	Incompatible	Incompatible	Compatible with conditions (see note 11)
- motor-sports (permanent racing facilities)	Incompatible	Incompatible	Compatible with conditions
- public swimming pools/ aquatic centres	Incompatible	Incompatible	Compatible with conditions

Model Scheme Text & interpreted type of land use	**P1 areas**	**P2 areas**	**P3 areas**
- rifle ranges	Incompatible	Compatible with conditions	Acceptable
Consulting rooms	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Convenience store	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Corrective institution	Incompatible	Incompatible	Compatible with conditions (see note 1)
Educational establishment			
- community education centres, scientific research institution	Compatible with conditions (see note 2)	Compatible with conditions (see note 2)	Acceptable (see note 1)
- primary / secondary schools, tertiary education facilities	Incompatible	Incompatible	Acceptable (see note 1)
Exhibition centre	Incompatible	Incompatible	Acceptable (see note 1)
Family day care	Incompatible	Acceptable (see note 19)	Acceptable (see note 1)
Fast food outlet	Incompatible	Incompatible	Acceptable (see note 1)
Forestry (native forest/ silviculture/ tree farming)	Compatible with conditions (see note 11)	Compatible with conditions (see note 11)	Acceptable
Fuel depot (storage/ transfer)	Incompatible	Incompatible	Compatible with conditions
Funeral parlour	Incompatible	Incompatible	Acceptable (see note 1)
Home business	Incompatible	Acceptable (see note 20)	Acceptable (see note 1)
Home occupation	Compatible with conditions (see note 15)	Acceptable (see note 21)	Acceptable (see note 1)
Home office	Compatible with conditions (see note 15)	Acceptable	Acceptable
Home store	Incompatible	Compatible with conditions	Acceptable (see note 1)
Hospital	Incompatible	Incompatible	Compatible with conditions (see note 1)
Hotel (includes hotels, hostels, resorts)	Incompatible	Incompatible	Acceptable (see note 1)

Model Scheme Text & interpreted type of land use	P1 areas	P2 areas	P3 areas
Industry			
- abattoirs	Incompatible	Incompatible	Incompatible
- cottage	Compatible with conditions	Compatible with conditions	Acceptable
- drinking water treatment plant	Compatible with conditions	Compatible with conditions	Compatible with conditions
- extractive, includes construction/ mining camps (see note 10)	Compatible with conditions	Compatible with conditions	Compatible with conditions
- food processing, dairy product factories, breweries	Incompatible	Incompatible	Compatible with conditions (see note 1)
- general (chemical manufacture/ formulation, dry cleaners, dye works, laboratories, photo-processors)	Incompatible	Incompatible	Compatible with conditions see note 1)
- general (metal production/ finishing, pesticide operator depots, heavy or energy industry, petroleum refineries)	Incompatible	Incompatible	Incompatible
- general (concrete batching, cement products, fertiliser manufacture/ bulk storage, wrecking)	Incompatible	Incompatible	Compatible with conditions
- general (mineral processing)	Incompatible	Incompatible	Compatible with conditions (see note 9)
- light industry	Incompatible	Incompatible	Compatible with conditions (see note 1)
- milk transfer depots	Incompatible	Incompatible	Compatible with conditions
- mining (includes mineral and energy exploration, oil or gas extraction/ decontamination for transport)	Compatible with conditions (see note 9)	Compatible with conditions (see note 9)	Compatible with conditions (see note 9)
- mining (tailings dams)	Incompatible	Incompatible	Compatible with conditions (see note 9)
- mining (includes construction/ mining camps), (see note 10)	Compatible with conditions	Compatible with conditions	Compatible with conditions
- rural (animal product rendering works, tanneries, wool scourers)	Incompatible	Incompatible	Incompatible
- rural (farm supply centres, manure stockpiling/processing facilities)	Incompatible	Compatible with conditions (see note 2)	Compatible with conditions
- rural (forestry products processing – chip mills, pulp/ paper, timber preservation, wood/ fibre works, composting/ soil blending - commercial)	Incompatible	Incompatible	Compatible with conditions
- service industry	Incompatible	Incompatible	Compatible with conditions

Model Scheme Text & interpreted type of land use	**P1 areas**	**P2 areas**	**P3 areas**
Landfill (solid waste disposal)			
- class I (refer also to 'Storage - used tyres' advice)	Incompatible	Incompatible	Compatible with conditions
- class II or III	Incompatible	Incompatible	Incompatible
- class IV or V	Incompatible	Incompatible	Incompatible
Lunch bar	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Major transport infrastructure (roads, railways)	Incompatible	Compatible (see note 14)	Acceptable with conditions
Marina (includes boat moorings and servicing)	Incompatible	Incompatible	Compatible with conditions
Marine filling station (boat fuelling)	Incompatible	Incompatible	Compatible with conditions
Market (food; general produce; second–hand goods)	Incompatible	Incompatible	Acceptable (see note 1)
Medical centre	Incompatible	Incompatible	Acceptable (see note 1)
Motel	Incompatible	Incompatible	Acceptable (see note 1)
Motor vehicle, boat or caravan sales (sales yards)	Incompatible	Incompatible	Acceptable (see note 1)
Motor vehicle repair	Incompatible	Incompatible	Compatible with conditions
Motor vehicle wash	Incompatible	Incompatible	Compatible with conditions
National and regional parks and nature reserves	Acceptable	Acceptable	Acceptable
Night club	Incompatible	Incompatible	Acceptable (see note 1)
Office	Incompatible	Compatible with conditions	Acceptable (see note 1)
Park home	Incompatible	Incompatible	Compatible with conditions (see note 1)
Place of worship	Incompatible	Incompatible	Acceptable (see note 1)
Plantation	Compatible with conditions (see note 11)	Compatible with conditions (see note 11)	Acceptable (see note 11)
Reception centre	Incompatible	Incompatible	Acceptable (see note 1)
Recreation – private (within non-designated recreation areas on Crown land)	Incompatible	Incompatible	Acceptable

Model Scheme Text & interpreted type of land use	**P1 areas**	**P2 areas**	**P3 areas**
Residential building			
- house	Compatible with conditions (see note 16)	Acceptable (see note 4)	Acceptable (see note 4)
- group dwellings (aged and dependent persons)	Incompatible	Incompatible	Acceptable (see note 1)
Restaurant	Incompatible	Incompatible	Acceptable (see note 1)
Restricted premises (adult interests)	Incompatible	Incompatible	Acceptable (see note 1)
Rural pursuit	See Agriculture, Animal establishment or husbandry		
Service station (includes aircraft, automotive repairs, boats, mechanical plant, service stations at transport and municipal works depots)	Incompatible	Incompatible	Compatible with conditions (refer to note 1)
Shop	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Showroom	Incompatible	Incompatible	Acceptable (see note 1)
Storage			
- used tyres (see note 22)	Incompatible	Incompatible	Incompatible
- chemical storage in under ground tanks	Incompatible	Incompatible	Compatible with conditions
- chemical storage in above ground tanks	Incompatible	Compatible with conditions	Compatible with conditions
Tavern	Incompatible	Incompatible	Acceptable (see note 1)
Telecommunications infrastructure	Compatible with conditions	Compatible with conditions	Compatible with conditions
Toilet blocks and change rooms	Compatible with conditions (see note 2)	Compatible with conditions	Acceptable
Trade display	Incompatible	Incompatible	Acceptable (see note 1)
Veterinary centre	Incompatible	Compatible with conditions (see note 2)	Compatible with conditions (see note 1)
Warehouse	Incompatible	Compatible with conditions (see note 2)	Compatible with conditions (see note 1)
Waste transfer station (includes recycling depots)	Incompatible	Incompatible	Compatible with conditions

Model Scheme Text & interpreted type of land use	**P1 areas**	**P2 areas**	**P3 areas**
Wastewater infrastructure			
- sewerage – gravity sewers	Incompatible	Incompatible	Acceptable
- sewerage – pressure mains	Incompatible	Compatible with conditions	Acceptable
- sewer pump stations	Incompatible	Compatible with conditions	Compatible with conditions
- treatment plants, wastewater disposal to land	Incompatible	Incompatible	Compatible with conditions
- wastewater injection into the ground (see note 25)	Incompatible	Incompatible	Incompatible
Water treatment plants (drinking)	See Industry		
Winery (includes wine tasting facilities)	Incompatible	Compatible with conditions (see notes 3 & 5)	Compatible with conditions (see note 3)

Table recommending compatibility of land subdivision within PDWSA: Note - This table reflects the recommended size of a subdivision based on the existing zoning and the priority classification area status of land. It should be noted that Town Planning Scheme provisions for specific zones and reserves will take precedence over the following recommended lot sizes.

Form of subdivision (specific to current zoning)	**P1 areas**	**P2 areas**	**P3 areas**
Rural subdivision			
- to a lot size of 4 hectares or greater	Incompatible	Acceptable	Acceptable
- to a lot size less than 4 hectares	Incompatible	Incompatible	Incompatible
Special rural subdivision			
- to a lot size of 2 hectares or greater	Incompatible	Compatible with conditions (see notes 7 & 8)	Compatible with conditions (see note 8)
- to a lot size between 1 and 2 hectares	Incompatible	Incompatible	Compatible with conditions (see notes 7 & 8)
- to a lot size less than 1 hectare	Incompatible	Incompatible	Compatible with conditions (see note 7)
Urban subdivision	Incompatible	Incompatible	Acceptable (see note 1)
Industrial subdivision	Incompatible	Incompatible	Acceptable (see note 1)

Explanatory notes related to land uses described the tables:

The following notes provide interpretive information based on the scale or type of development described in the preceding tables. They do not list all the conditions that could apply to any activity or development.

1. Must be connected to deep sewerage, except where exemptions apply under State Government Sewerage Policy. The Policy recognises that sewer connection may be impractical in some areas. Under these circumstances maximum wastewater loadings (based on people/ hectare) apply linked to the management Priority of the site.

2. The land use is normally incompatible, but may be conditionally approved where this facility is consistent with approved State and local government planning strategies or schemes.

3. The land use must incorporate best environmental management practices compatible with the management strategy for the designated priority area defined in the relevant source protection plan.

4. In Priority 2 areas: conditions may apply to density of dwellings (i.e. hectares per dwelling).

5. Size of the grape crush shall not exceed 500 tonnes per year.

6. May be approved if occupancy is of equivalent size to a single dwelling household (i.e. less than 10 people– defined by capacity of a septic tank based on-site wastewater treatment system).

7. An average, rather than minimum, lot size may be accepted if the proponent can demonstrate that the water quality objectives of the source protection area are met, and caveats/memorials are placed on titles of specified blocks stating that further subdivision shall not occur.

8. Lots should only be created where land capability assessment shows that effective on-site soakage of treated wastewater can be achieved. Conditions apply to siting of wastewater disposal systems in areas with poor land drainage and/ or a shallow depth to groundwater, animals are held or fertiliser is applied. Alternative wastewater treatment systems, where approved by the Department of Health, may be accepted with ongoing maintenance requirements.

9. Conditions are likely to be placed via a Department of Industry and Resources mineral tenement lease, and / or as a result of Minister for the Environment's approval after an Environmental Impact Assessment.

10. Conditions apply to the storage of fuels and chemicals, the depth of excavation related to the water table and rehabilitation criteria. Underground fuel or chemical storage tanks are prohibited via DoE by-laws in Priority 1 and 2 areas within Underground Water Pollution Control Areas.

11. Conditions apply to regulate fertiliser and pesticide application.

12. Can be approved if animal stocking levels (animals per hectare, guided by the Department of Agriculture's stocking rate guidelines) are consistent with the priority source protection area objectives.

13. This does not include stockyards occasionally used on farms or pastoral leases for animal husbandry.

14. Conditions may be imposed to cover design, construction of infrastructure and the types of goods.

15. May only be approved if *Home Occupation* relates to an existing residence.

16. Limited to one residential building per property.

17. Includes land or buildings dominantly used for the showing, competition or training of horses, and riding schools.

18. Includes any land, building or structure used for equine (e.g. horses, asses, mules and donkeys) housing, keeping and feeding and associated activities.

19. In accordance with *Community Services (Child Care) Regulations 1988: A child care service provided to a child in a private dwelling in a family of or domestic environment. No more than 5 children of pre-school age and no more than 7 children under 12 years old, including the children of the licensee or permit holder.*

20. No more than 2 employees, and the home business occupies an area up to 50 square metres. Compatible if only an office/ administrative business (i.e. overnight parking of only one commercial vehicle, no refuelling or repair/ maintenance of business vehicles, and no activities involving on-site use storage or disposal of chemicals or process wastewater).

21. Employees shall be members of the household, and the home business occupies an area of up to 20 square metres. No provision for refuelling, repair or maintenance of commercial/ business vehicles or on-site use or storage of chemicals.

22. Used tyre use, storage and disposal are subject to *Used Tyre Regulations 1996,* administered by the this agency.

23. As defined in the Model Scheme Text (1997) or the *Residential Design Codes of Western Australia* (2002) prepared by the Western Australian Planning Commission, and covering local government planning schemes.

24. Applies to the commercial production of horticultural crops e.g. vegetables, flowers and fruit crops grown in contact with the ground. Does not apply to cereal or oil seed crops, perennials e.g. orchards, vineyards, nuts; or any crop grown separate from contact with soils in the natural environment e.g. hydroponics.

25. The use of recycled (reclaimed) water to address the diminishing level of scheme water supply in Western Australia is currently being investigated by Government. The social, environmental, health and economic issues related to this option are significant and need to be further progressed before its applicability in PDWSA is reconsidered.

More information or feedback

More information about recommended best management practices is available in Environmental Management Guidelines and Water Quality Protection Notes for some of the listed land uses. These are available on DoE's Internet site http://drinkingwater.environment.wa.gov.au or by contacting DoE regional offices.

We welcome your comments on this note. The note will be updated from time to time as feedback is received or land-use activity standards change. For the most up to date version of this note, please refer to http://www.environment.wa.gov.au. If you wish to discuss this note, please contact DoE Water Source Protection Branch at the Hyatt Centre in East Perth. Phone: (08) 9278 0300 (business hours); Fax: (08) 9278 0585; or E-mail: use {feedback} section at DoE Internet address http://www.environment.wa.gov.au citing the topic and version.

Appendix 4 - Best management practice documents for activities in PDWSAs

BEST MANAGEMENT PRACTICE DOCUMENTS FOR ACTIVITIES IN PDWSAS

Drainage:

Overland runoff should not be channelled into streams. Infiltration into soil should be aided at every opportunity.

- Lloyd, B. and Van Delft R., 2001, *Erosion and Sediment Control Manual for the Darling Range, Perth Western Australia*. Upper Canning/Southern Wungong Catchment Team, Agriculture WA.

Buffers:

Vegetated buffers should be maintained along all streamlines, whether currently flowing or not.

- Example in Section 4.1: Department of Conservation and Land Management, 1999, *Manual of Management Guidelines for Timber Harvesting in Western Australia*, Department of Conservation and Land Management. Available from: www.naturebase.net/forest_facts/sy_review/manuals/manual_of_harvesting_specifications/index.html.
- Department of Environment, 2005, Water Quality Protection Note *Buffers to Sensitive Water Resources (draft)*, Department of Environment. Available from <http://drinkingwater.environment.wa.gov.au>.
- National Health & Medical Research Council and Agriculture & Resource Management Council of Australia and New Zealand, 2004, *Australian Drinking Water Guidelines*, NHMRC and ARMCANZ. Available from: <www.nhmrc.gov.au/publications/synopses/eh19syn.htm>.
- Water and Rivers Commission, 2001, *A Review of Stream and River Logging Buffers in Western Australia, to Ensure their Adequacy in Protecting Waterways from Salinity, Degradation and Turbidity*, Water and Rivers Commission report to the Conservation Commission of Western Australia.

Pesticide application:

Should be minimised in catchment areas. For specific needs of crops and best practice contact Department of Agriculture.

- Department of Health, 1993, Public Service Circular 88 *Use of Herbicides in Water Catchment Areas*, Government of Western Australia. Available from: <www.population.health.wa.gov.au/environmental/resources/use%20of%20herbicides%20in%20water%20catchment%20areas.pdf>.
- Department of Environment, 2004, Water Quality Protection Note *Pesticide Use in Sensitive Environments (draft)*, Department of Environment.

- Water and Rivers Commission, 2000, Statewide Policy No. 2 *Pesticide Use in Public Drinking Water Source Areas*, Water and Rivers Commission. Available from: <http://drinkingwater.environment.wa.gov.au>.

Nutrient application:

Should be minimised in catchment areas. For specific needs of crops contact Department of Agriculture.

- Water and Rivers Commission, 1998, Water Quality Protection Note *Nutrient and Irrigation Management Plan*, Water and Rivers Commission. Available from: <http//drinkingwater.environment.wa.gov.au>.

Forest management:

- Australian Forest Growers, 1997, *Code of Practice for Timber Plantations in Western Australia*, Australian Forest Growers, Department of Conservation and Land Management.
- Department of Conservation and Land Management, 1999, *Manual of Management Guidelines for Timber Harvesting in Western Australia*, Department of Conservation and Land Management. Available from: www.naturebase.net/forest_facts/sy_review/manuals/manual_of_harvesting_specifications/index.html.
- Department of Conservation and Land Management, 1999, *Code of Practice for Timber Harvesting in Western Australia*, Department of Conservation and Land Management. Available from: (www.naturebase.net/forest_facts/sy_review/manuals/index.html>).
- Forest Products Commission, 2003, *Contractors' Timber Harvesting Manual – South West Native Forests*, FPC.

Forest fire management:

Controlled burning should be conducted on a scale and at a frequency to minimise erosion from overland runoff into reservoirs. Therefore, only small proportions of land in a catchment should be burnt in any one year. Guidelines on how to address water quality protection objectives in the Controlled Burning Prescription should be documented by CALM, DoE and WC.

Bauxite mining:

- Alcoa World Alumina Australia, 2005, *Environmental Management Manual, Bauxite Mining Operation*s, Alcoa World Alumina Australia.
- McIntosh, K.S. and Cronin, D.J., 2003, *Bauxite Mining in Water Supply Catchments – Water Conservation and Quality Protection*, Alcoa World Alumina Australia.
- Water and Rivers Commission, 2000. Water Quality Protection Guidelines (Nos 1 – 11): *Mining and Mineral Processing*, Water and Rivers Commission. Available from: <http://drinkingwater.environment.wa.gov.au>.

Motor rally events:

- Water and Rivers Commission, 2003, Statewide Policy No. 13 *Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land*, Water and Rivers Commission. Available from: <http://drinkingwater.environment.wa.gov.au>.
- Water Corporation, 2002, 'Managing Motoring Events in Catchments', Draft. *Source Protection Operations Management Manual SG 097.2*, Water Corporation.

Recreation in PDWSAs:

- Water and Rivers Commission, 2003, Statewide Policy No. 13 *Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land*. Water and Rivers Commission. Available from: <http://drinkingwater.environment.wa.gov.au>.

Research projects:

Participants should be educated on personal hygiene, erosion prevention and water quality protection objectives in a PDWSA prior to entering the catchment.

Major roads, roads and tracks, infrastructure maintenance:

Drainage must be controlled to prevent soil erosion and minimise sediment transport. Chemical application to control vegetation should be minimised

- Lloyd, B. and Van Delft R., 2001, *Erosion and Sediment Control Manual for the Darling Range, Perth Western Australia*, Upper Canning/Southern Wungong Catchment Team, Department of Agriculture.

Extractive industries / gravel pits:

- Department of Conservation and Land Management, 1993, *Policy Statement No. 2 Local Government Authority Access to Basic Raw Materials from State Forest and Timber Reserves*, Department of Conservation and Land Management.
- Department of Conservation and Land Management, 1986, Policy Statement No. 10 *Rehabilitation of Disturbed Land*, Department of Conservation and Land Management.
- Water and Rivers Commission, 2000, Water Quality Protection Note *Extractive Industries within Public Drinking Water Source Areas*, Water and Rivers Commission. Available from: <http://drinkingwater.environment.wa.gov.au>.

Chemical and fuel storage:

- Water and Rivers Commission, 2002, Water Quality Protection Note *Toxic and Hazardous Substances Storage within Public Drinking Water Source Areas*, Water and Rivers Commission.
- Water and Rivers Commission, 2002, Water Quality Protection Note *Chemical Spills – Emergency Response Planning*, Water and Rivers Commission.
- Water and Rivers Commission, 2000, Water Quality Protection Note *Temporary Above Ground Chemical Storage within Public Drinking Water Source Areas*, Water and Rivers Commission.

- Water and Rivers Commission, 1999, Water Quality Protection Note *Above Ground Chemical Storage Tanks within Public Drinking Water Source Areas*, Water and Rivers Commission.
- Water and Rivers Commission, 1998, Water Quality Protection Note *Temporary Skid Mounted Fuel Transfer and Storage within Public Drinking Water Source Areas*, Water and Rivers Commission.
- Water and Rivers Commission, 1998, Water Quality Protection Note *Temporary Above Ground Fuel Storage within Public Drinking Water Source Areas*, Water and Rivers Commission.

Available from: <http://drinkingwater.environment.wa.gov.au>.

Mechanical servicing and workshops:

- Water and Rivers Commission, 2002, Water Quality Protection Note *Mechanical Equipment Washdown*, Water and Rivers Commission. Available from: <http://drinkingwater.environment.wa.gov.au>.
- Water and Rivers Commission, 2002, Water Quality Protection Note *Mechanical Servicing and Workshop Facilities*, Water and Rivers Commission. Available from: <http://drinkingwater.environment.wa.gov.au>.

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Level 8 141 St Georges Terrace
Perth Western Australia 6000
PO Box K822 Perth Western Australia 6842
Telephone (08) 9222 7000
Facsimile (08) 9322 1598
E-mail info@environment.wa.gov.au
www.environment.wa.gov.au

Hyatt Centre
Level 2 3 Plain Street
East Perth Western Australia 6004
PO Box 6740 Hay Street East Perth Western Australia 6892
Telephone (08) 9278 0300
Facsimile (08) 9278 0301
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