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

# Wungong Brook Catchment Area Drinking Water Source Protection Plan

## Integrated Water Supply System

REPORT NO.65
FEBRUARY 2007

Water Resource Protection Series


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Integrated Water Supply System

Department of Water

Water Resource Protection Series

Report No. WRP 65

February 2007

# Acknowledgments


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# Preface

The Department of Water has prepared this Drinking Water Source Protection Plan to report on the activities and risks to water quality within the Wungong Brook Catchment Area and to recommend management strategies to minimise the identified risks.

A safe drinking water supply is critical to the well-being of the community and catchment protection is necessary to help avoid, minimise or manage risks to water quality. The Department is committed to protecting drinking water sources to ensure the continued supply of 'safe, good quality drinking water' to consumers.

The *Australian Drinking Water Guidelines* recommend a 'catchment to consumer' risk based approach to protecting public drinking water sources. The protection and management of drinking water catchments 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 to ensure the safest possible raw water supply.

This plan details the location and boundary of the drinking water catchment, which provides potable water to the Integrated Water Supply System. It discusses usage of the water source, describes the water supply system, identifies risks and recommends management approaches to maximise protection of the catchment.

This plan should be used to guide State and local government land use planning decisions. It should be recognised in the City of Armadale, Shire of Serpentine Jarrahdale and Shire of Wandering Town Planning Schemes, consistent with 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 this Public Drinking Water Source Area.

The stages involved in preparing a Drinking Water Source Protection Plan are:

| Stages in development of a plan | | Comment |
|---|---|---|
| **1** | Prepare Drinking Water Source Protection Assessment | Assessment document prepared following catchment survey and preliminary information gathering from government agency stakeholders. |
| **2** | Conduct stakeholder consultation | Advice sought from key stakeholders using the assessment as a tool for background information and discussion. |
| **3** | Prepare Draft Drinking Water Source Protection Plan | Draft plan developed taking into account input from stakeholders and any additional advice received. |
| **4** | Release Draft Drinking Water Source Protection Plan for public comment | Draft plan released for a six week public consultation period. |
| **5** | Publish Drinking Water Source Protection Plan | Final plan published after considering advice received in submissions. Includes recommendations on how to protect the catchment. |

# Summary

The Wungong Brook Catchment Area is located approximately 35km south east of Perth, in the City of Armadale, Shire of Serpentine Jarrahdale and Shire of Wandering. Wungong Brook Reservoir is a strategic source of public drinking water for the Integrated Water Supply System.

The Wungong Brook Catchment Area was proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* in 1925 to ensure protection of the 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 catchment; and
- recommends strategies to manage these potential risks whilst recognising current land use rights.

The majority of the catchment is under Crown ownership. An extensive area is State forest, vested with the Conservation Commission of Western Australia and managed by the Department of Environment and Conservation. Use of the State forest includes forest and plantation management, such as timber harvesting, fire management and an extensive range of recreation. Recreation activities include cycling on the Munda Biddi Trail and unauthorised activities such as fishing, marroning, camping and off-road vehicle use. Rubbish and vehicle dumping are particularly prevalent in the catchment.

A Special Mining Lease exists over the Crown land in the catchment, enabling Alcoa World Alumina Australia to extract bauxite. The Jarrahdale mine site closed in December 1998 and since then no mining activity has occurred within the catchment.

Several properties are vested in the Water and Rivers Commission (operating as the Department of Water), the City of Armadale and Main Roads Western Australia. A small area in the north of the catchment is privately owned. Land use on these properties includes an orchard, horse stables and tracks, and residences.

The following strategies are recommended to protect water quality in the Wungong Brook Catchment Area:

- Amend the existing gazetted catchment area to reflect the physical catchment boundary.
- Clearly identify the existing Reservoir Protection Zone for the catchment.
- Manage all Crown land in the catchment for Priority 1 source protection. The small area of private property should be managed for Priority 2 source protection.

- Recognise the catchment, including the Reservoir Protection Zone and the proposed priority classifications, in the relevant land planning strategies. Specifically, the City of Armadale, Shire of Serpentine Jarrahdale and Shire of Wandering Town Planning Schemes and the Metropolitan Regional Scheme.

- Implement best management practices for the current land uses within the catchment.

Priority classification areas and the Reservoir Protection Zone provide guidance on appropriate land use planning decisions and define areas where the *Metropolitan Water Supply, Sewerage and Drainage By-laws 1981* are available to protect this drinking water catchment. These areas 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 are recommended for existing or approved land uses.

The Department of Water is responsible for the development of an implementation program for the recommended protection strategies. The implementation of protection strategies will be reviewed periodically. A review of this plan will be undertaken after five years.

# 1 Introduction

The Wungong Brook dam is on the Wungong Brook, approximately 35km south east of Perth. It is a strategic source of public drinking water for the Integrated Water Supply System (IWSS). The IWSS provides water to 1.5 million people in the Perth Metropolitan area, Mandurah, Pinjarra, Harvey, the Goldfields and agricultural regions.

The majority of the Wungong Brook catchment is in the City of Armadale and the Shire of Serpentine Jarrahdale. A small part lies in the Shire of Wandering.

Figure 1 shows the location of the dam and the Wungong Brook Catchment Area.

The objective of this plan is to recommend protection strategies to ensure land uses and activities in the catchment are managed to protect the drinking water quality of this source.

## 1.1 Water storage system

A pipehead dam on the Wungong Brook was constructed in 1925. In 1975 the original dam was decommissioned, and a new dam was constructed in its place. The new dam was commissioned in 1979. The new dam has a capacity of 60GL, with a height of 65m and a length of 460m.

## 1.2 Protection and allocation

### 1.2.1 Existing water source protection

The Wungong Brook Catchment Area was proclaimed in 1925 under the *Metropolitan Water Supply, Sewerage and Drainage (MWSSD) Act 1909* to ensure protection of the water source from potential contamination.

Figure 2 shows the current gazetted boundary of the Wungong Brook Catchment Area and the proposed amendment to the catchment boundary.

### 1.2.2 Current allocation licence

Water resource use and conservation in Western Australia is administered by the Department of Water in accordance with the *Rights in Water and Irrigation (RIWI) Act 1914.* Under the Act, the right to use and control surface and groundwater is vested with the Crown. This Act requires licensing of surface water abstraction within proclaimed surface water areas.

The Wungong Brook Catchment Area is within the Wungong Brook Dam Surface Water Area proclaimed under the *RIWI Act.*

Water Corporation is currently licensed to draw 20.6GL per annum from Wungong Brook Dam, under Surface Water Licence No. 0058767, for the purpose of providing potable water for public water supply. Due to reduced inflow, Water Corporation have reduced their draw to approximately 70% of their allocation over the last five years.

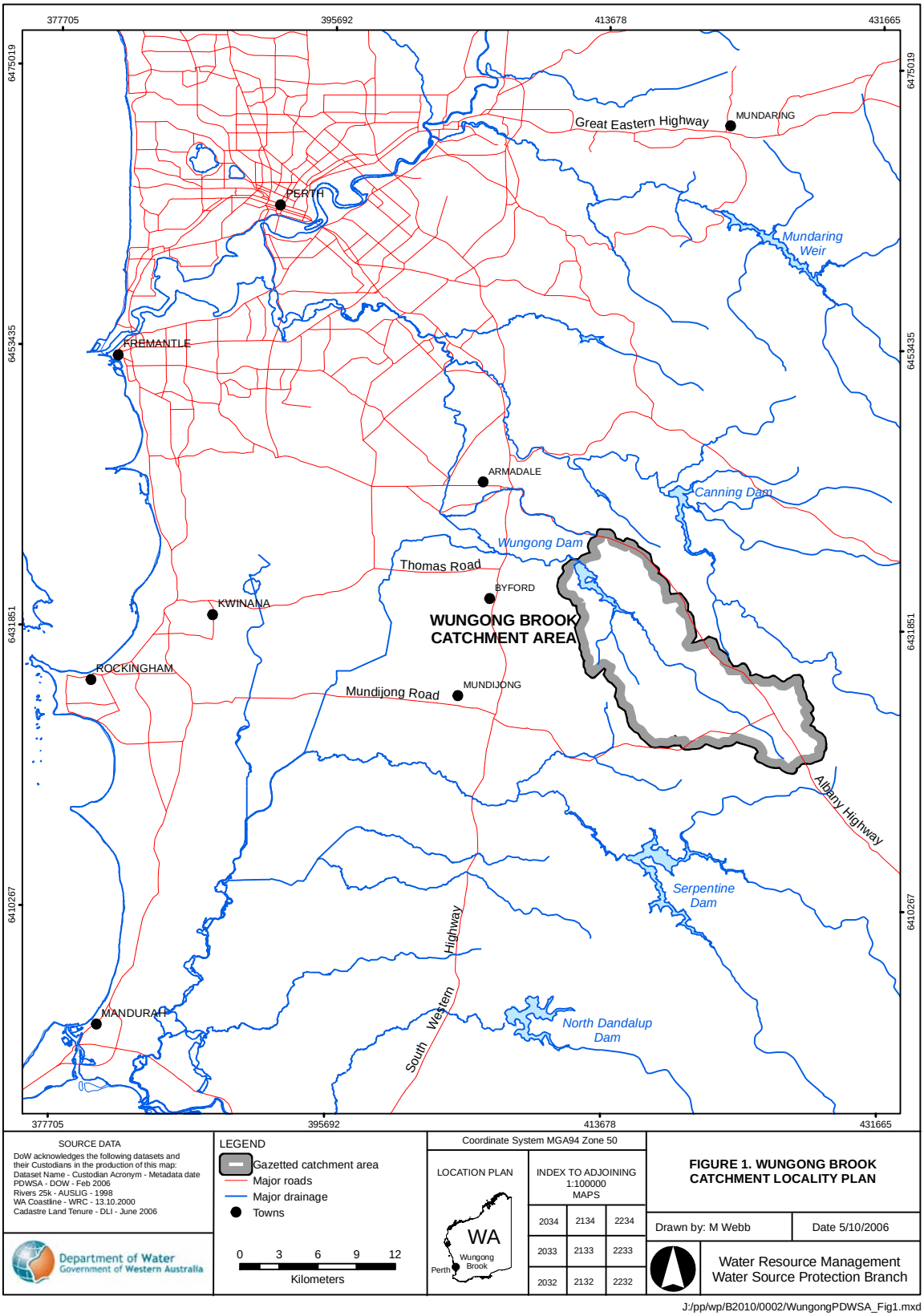


*Figure 1 Wungong Brook Catchment Area locality map*

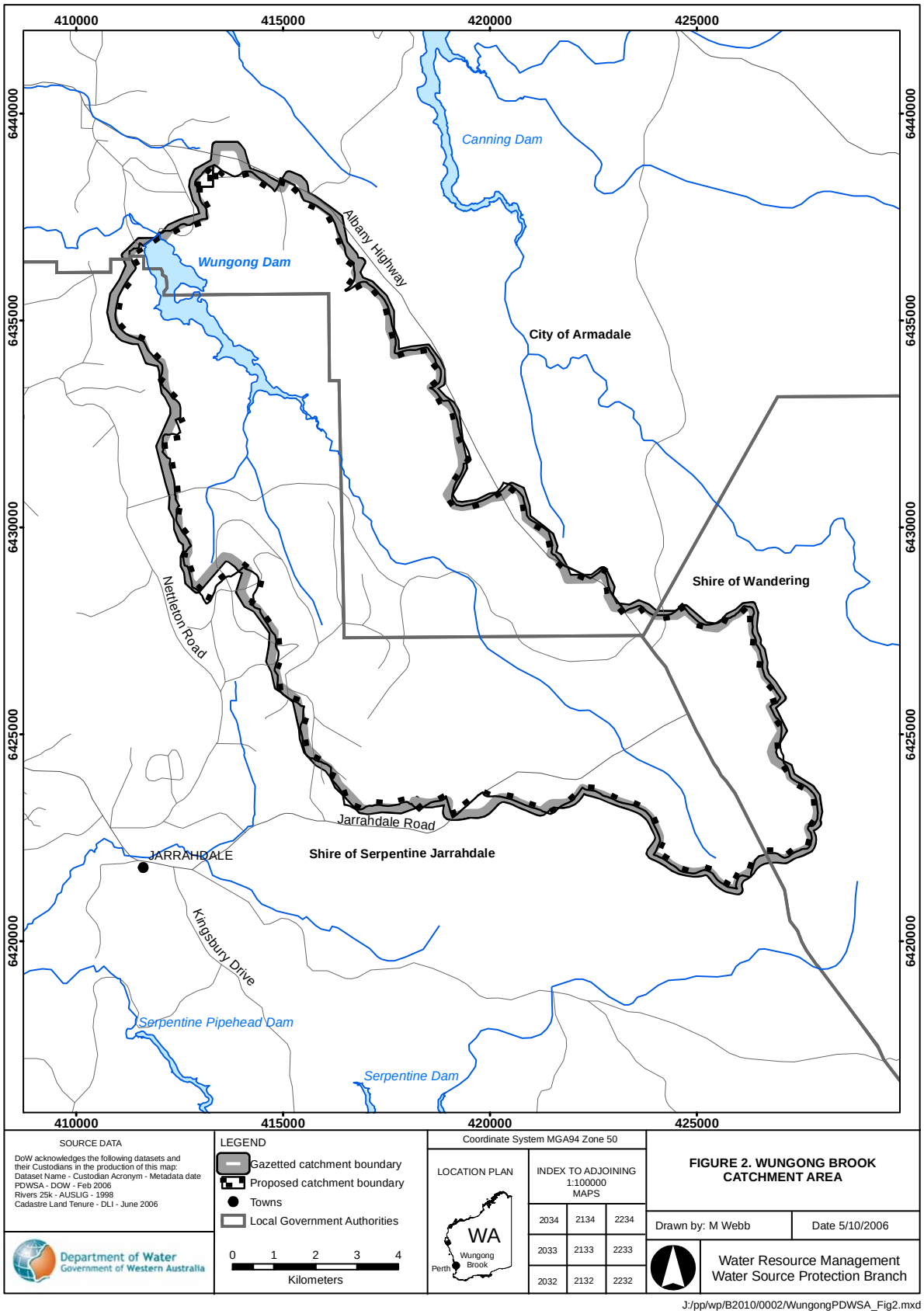


*Figure 2 Wungong Brook Catchment Area, gazetted and proposed boundary*

# 2 Catchment description

## 2.1 Climate

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

The majority of rainfall occurs between May and September. Since the mid 1970s, the south west of Western Australia has experienced a 10 to 20 per cent decline in its long term average rainfall. The average long term annual rainfall (1888 - 2005) for the catchment is approximately 1210mm, however from 1999 to 2005 the average rainfall was approximately 1041mm. The decline in rainfall has resulted in a reduction in runoff and stream flow.

## 2.2 Physiography and vegetation

The Wungong Brook catchment is located on the Darling Scarp, which forms the western boundary of the Darling Range. This area forms part of the Archaean Yilgarn Block, which consists mainly of granite, gneisses, and migmatite with intrusions of dolomite.

The major valleys of the catchment are defined as the Murray soil type, which is characterised by red and yellow soils that are susceptible to erosion. The minor valleys consist of the Yarragil soil type, which include sandy gravels on the slopes and swampy floors.

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 Cook soil type, which includes hills mantled by laterite with some rock outcrop.

The majority of the catchment is vegetated, consisting of open forest or woodland dominated by several *Eucalyptus* species. Small areas of private land have been cleared for agriculture and other uses.

## 2.3 Hydrology

The catchment has an area of 130km$^2$. The long term average volume of water entering the Wungong Brook dam is 26.1GL/year (1912 - 2000). However, due to a decline in rainfall the volume has been reduced by 26 per cent to 19.3GL/year.

# 3 Water quality and treatment

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

Water quality in the Wungong Brook dam is routinely monitored by Water Corporation to ensure compliance with the health related criteria of the *Australian Drinking Water Guidelines* (ADWG) (NHRMC & ARMCANZ, 2004). These guidelines are used in Western Australia by the Department of Health, Department of Water and Water Corporation to assess the quality of drinking water provided to consumers.

A summary of the results of a comprehensive water quality analyses of the raw water (ie pre treatment) carried out by Water Corporation between 1999 and 2004 is shown in Appendix A.

## 3.1 Microbiological contaminants

The microbiological quality of the water is monitored regularly. Thermotolerant coliforms (*Escherichia coli*) are measured as an indicator of the degree of faecal contamination of the raw water and the potential for pathogenic microbes. Positive thermotolerant coliforms were found in 43 per cent of raw water samples. Only 2 per cent of these samples had a colony count in excess of 20 colony forming units (cfu) per 100mL, which is the concentration used as a microbiological contamination benchmark by the World Health Organisation (1996). The presence of thermotolerant coliforms prior to treatment does not indicate the presence of pathogens in the water supplied to consumers.

## 3.2 Health related chemicals

The dam is monitored for pesticides, heavy metals and hydrocarbons periodically. During the monitoring period, no pesticides were recorded above the detection limit. Heavy metals and hydrocarbons did not exceed the ADWG values.

## 3.3 Aesthetic characteristics

The pH in the Wungong Brook Dam was within the range of the ADWG value. The catchment is located within a historically high rainfall zone (1200 to 1300mm isohyet) therefore it has a low salt store, which is reflected by a median conductivity value of 30mS/m. The levels of the remaining parameters monitored in the reservoir were within acceptable limits.

## 3.4 Water treatment

The treatment of water abstracted from the Wungong Brook dam is disinfected by chlorination and fluoridated before supplying the IWSS. Chlorination is an essential barrier to ensure good quality public drinking water (NHMRC & ARMCANZ, 2004).

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 and contamination risks

Land use in the catchment includes forest and plantation management, recreation on Crown land, housing and rural land use on private land.

Land use and tenure in the catchment are shown in Figure 3.

## 4.1 Potential water quality risks

The risks to water quality associated with activities in drinking water catchments include pathogen contamination, turbidity, pesticide and nutrient contamination. Pathogens pose the most significant risk to public health.

Pathogens may enter a reservoir through activities involving the direct contact of human and domestic animals with the reservoir or tributaries (ie illegal fishing, swimming), primarily through the transfer of faecal material, or indirectly through the presence of humans near the reservoir and its tributaries (and runoff transferring faecal material).

Pathogen contamination of a drinking water source is influenced by the existence of pathogen carriers (ie humans and domestic animals, such as dogs or cattle) and the opportunity for their subsequent transfer to the water source, the ability of the pathogen to survive in the water source and the concentration required to cause illness.

There are a number of pathogens that are commonly known to contaminate water supplies worldwide. These include bacteria (eg *Salmonella*, *Escherichia coli* and *Cholera*), parasites (eg *Cryptosporidium*, *Giardia*) and viruses. The percentage of humans in the world that carry various pathogens varies. For example, it is estimated that between 0.6 to 4.3 per cent of people are infected with *Cryptosporidium* worldwide, and 7.4 per cent with *Giardia* (Geldreich, 1996).

The ability of pathogens to survive in surface water differs between species. For example, *Salmonella* may be viable for two to three months, *Giardia* may infect after one month in the natural environment (Geldreich, 1996) and *Cryptosporidium* oocysts (cells containing reproductive spores) may survive weeks to months in freshwater (NHMRC & ARMCANZ, 2004).

The effects of pathogen contamination in drinking water varies significantly, ranging from mild illness to death, as was the case in Walkerton, Canada in 2000 where seven people died due to a pathogenic contamination of *Escherichia coli* in the town water source and supply. Preventing the introduction of pathogens into the water source is the most effective barrier in avoiding a public health risk.

Land use activities within the catchment can directly influence the effectiveness of water treatment. For example, off-road driving on unauthorised tracks contributes to erosion and the uprooting of vegetation. Erosion results in the mobilisation of soil particles, which are released into the air and tributaries and increase the turbidity within the reservoir. Pathogens adsorb onto these soil particles and may be shielded from the effects of disinfection. Increased turbidity also impacts upon other environmental constituents, ie smothering riparian vegetation and reducing light transfer within the water column, which affects plant growth.

## 4.2 Private land

Private land comprises a small portion of the catchment. There are seven private properties within the gazetted catchment boundary, these occur along the north western boundary of the catchment. Of these, only four properties are within the proposed Wungong Brook Catchment Area (refer to Figures 3 and 4).

Land use on these properties includes low intensity agriculture, horse grazing and stables, orchards and residences.

## 4.3 Crown land

The majority of the catchment is under Crown ownership (88 per cent). An extensive area of the catchment is State Forest 22 vested in the Conservation Commission of Western Australia and managed by the Department of Environment and Conservation.

State forest is managed for the purposes identified in the *Forest Management Plan 2004-2013* as conservation, recreation, timber production on a sustainable yield basis, water catchment protection and other purposes prescribed by the regulations (Conservation Commission of Western Australia, 2004). The *Forest Management Plan 2004-2013* is a statutory document which is applicable to State forest for ten years. It recognises water catchment protection as a statutory purpose of indigenous State forest, and water extraction as a legitimate activity.

Reserve 23592, which is located adjacent to the private property along the northern boundary of the catchment, is vested in the City of Armadale and is currently leased by the Southern Districts Rifle Club, who sublease part of the property to the Gleneagle Field Archers Incorporated. These activities are within the current gazetted catchment boundary, however they fall outside the proposed new boundary (refer to Figure 3). The safety zone (overshoot area) for the rifle range is within the proposed catchment boundary. The safety zone of the Jarrahdale Sporting Shooters Association in State Forest 22 also crosses the proposed new boundary in the south west corner of the catchment (refer to Figure 3).

### 4.3.1 Forest and plantation management

Forestry activities in the catchment include native forest and plantation timber harvesting by the Forest Products Commission. Forestry activities are governed by the *Forest Management Plan 2004-2013* and its associated guidelines and codes. Gleneagle pine plantation consists of one large plantation area on the catchment boundary and several smaller plantations along Albany Highway and Jarrahdale Road. 300ha was harvested during the summer of 2004.

State forest management is undertaken by the Department of Environment and Conservation in accordance with the defined purpose of the forest. It includes fire management, such as prescribed burning and maintenance of firebreaks, and feral animal control, using 1080 baiting for wild cats and foxes and the trapping and shooting of feral pigs.

Private resource harvesting in the State forest includes apiaries (13 sites), wildflower picking and seed collection, although the occurrence is low due to the quality of the vegetation. A permit must be obtained from the Department of Environment and Conservation to undertake these activities.

Firewood collection by the public is only permitted in designated firewood areas in State forest and timber reserves. There are no designated firewood areas within the catchment, although it is known to occur illegally within the catchment. The Department of Environment and Conservation issue licences for commercial firewood collection from State forest. This process is facilitated through the commercial harvesting of the forest by the Forest Products Commission.

The catchment and reservoir may occasionally be used for research projects, subject to approval from Water Corporation and Department of Environment and Conservation.

In 2005, Water Corporation commenced an adaptive catchment management trial within the Wungong Brook Catchment Area which aims to yield an additional 4 to 6 GL/year of stream flow, and to promote sustainable catchment management. The 12 year trial includes catchment thinning and the gradual conversion of exotic vegetation back to native species, in addition to research and environmental monitoring. It is proposed that approximately 60 per cent (7,800ha) of the catchment will be treated in this manner in a mosaic over a four to six year period. Target areas will be within rehabilitated mining areas, dense native regrowth forest and plantations. For further information refer to the *Wungong Catchment Environment and Water Management Project Report, 2005* which is available from Water Corporation's website at <http://www.watercorporation.com.au/w/wungong_index.cfm>.

### 4.3.2 Mining

A Special Mining Lease over the catchment, issued to Alcoa World Alumina Australia (Alcoa) under the *Alumina Refinery Agreement Act 1961, No. 3*, grants Alcoa rights to extract bauxite from Crown land, with associated responsibilities to protect environmental values and rehabilitate mine sites. By 2002, 2478ha of the 2481ha cleared for mining had been rehabilitated in the Wungong Brook Catchment Area. Since the closure of the Jarrahdale mine site in December 1998, no mining activity has occurred in the catchment, and there are currently no plans to mine in the next 20 years.

### 4.3.3 Recreation

Various recreational activities occur in the catchment. Approved recreational activities include bike riding on the Munda Biddi Trail, camping at the Munda Biddi campsite and the Darling 200 motor rally event.

The Munda Biddi Trail is a long distance mountain bike trail. This trail passes through the south eastern part of the catchment (refer to Figure 3). The trail lies outside the Reservoir Protection Zone and no part of the bike trail and access tracks are permitted within 50m of a stream. A campsite, easily accessible from the Munda Biddi Trail, has been built north of Jarrahdale Road and west of Albany Highway, near the Wungong Brook (refer to Figure 3). The Department of Environment and Conservation and the Munda Biddi Trail Foundation manage the Munda Biddi Trail through the implementation of management prescriptions and codes such as the *Seven Principles of Leave No Trace for Munda Biddi Trail* (CALM, no date) and *Code of the Campsite* (CALM, 2005b).

The annual Darling 200 motor rally event, hosted by the Confederation of Australian Motor Sports, was historically staged in Gleneagle pine plantation. It is now primarily based within the Serpentine Dam Catchment Area with less than 10km of the route crossing into the Wungong Brook catchment. In accordance with Statewide Policy 13 *Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land* (WRC, 2003), no new rally events in drinking water catchments will be approved in the future. For any existing events, an environmental management plan must be submitted and must meet Water Corporation, Department of Water and Department of Environment and Conservation requirements. As the risk to water quality increases during the wet season, the Darling 200 rally event is not held during winter months.

There is a short trail to the Rotary Lookout in the Reservoir Protection Zone. Water Corporation rangers regularly visit this lookout to ensure it is maintained.

Unauthorised activities also occur in the catchment, including swimming, fishing, marroning, hunting, camping, dog exercising, off-road driving, horse riding (away from designated public roads) and rubbish dumping. These activities are prohibited in the reservoir, Reservoir Protection Zone and catchment under the *Metropolitan Water Supply Sewerage and Drainage By-laws 1981*.

## 4.4 Water and Rivers Commission land and Water Corporation land

Water and Rivers Commission (WRC), now operating as the Department of Water, has freehold ownership of several properties in the catchment consisting of small cleared or partly revegetated blocks. Water Corporation manage these properties.

The safety zone (overshoot area) of the Southern Districts Rifle Club extends into WRC property in the north-east corner of the catchment (refer to Figure 3).

The Commission's freehold properties are highly frequented for the purposes of illegal recreation, often resulting in the dumping of stolen cars and rubbish. There may be some capacity to enforce trespassing laws to discourage illegal activity on these properties.

Water Corporation has freehold ownership of the two properties at the dam wall. This land is largely forested.

The land owned freehold by Water Corporation and WRC has prescribed fire regimes implemented by the Department of Environment and Conservation and Water Corporation. Feral animal control is also undertaken by both organisations on these properties.

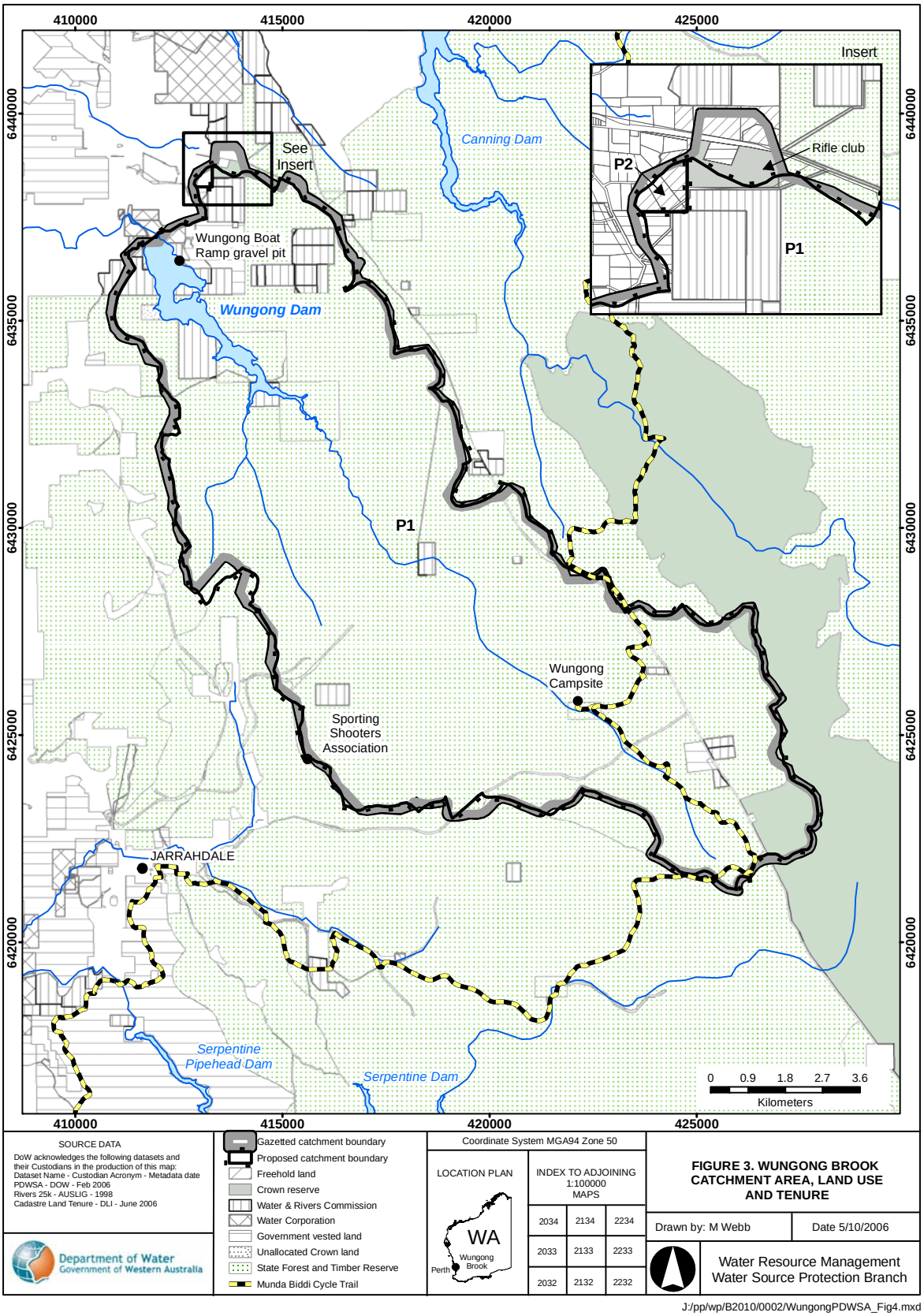


*Figure 3 Land tenure in the Wungong Brook Catchment Area*

# 5 Catchment protection strategy

## 5.1 Protection objectives

The objective of this plan is to protect drinking water quality for public health whilst acknowledging social and environmental requirements.

Prevention and the principle of the multiple barrier approach are essential features of effective drinking water quality management. If one barrier fails, the continuation of other barriers will reduce the risk of contamination being passed on to consumers. This approach has been endorsed within the ADWG (NHRMC & ARMCANZ, 2004).

Wungong Brook dam is a strategic source to the IWSS. Based on the potential risk posed by human contact with the water and the number of people that could potentially be affected, activities that involve contact with the reservoir or tributaries are considered unacceptable within this catchment.

The Priority 1 classification proposed for the majority of this catchment has the fundamental water quality objective of risk avoidance. The Priority 2 classification given to private land has the fundamental objective of risk minimisation to prevent any increased risk of contamination.

## 5.2 Proclaimed area

The Wungong Brook Catchment Area was proclaimed on 13 November 1925 under the *MWSSD Act 1909*. It is proposed to amend the original gazetted boundary to more accurately represent the physical catchment boundary.

The existing and proposed Wungong Brook Catchment Area is shown in Figures 2 to 4.

## 5.3 Priority classifications

Crown land in the catchment should be managed for Priority 1 (P1) source protection. 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:

- The Wungong Brook dam is a strategic source of public drinking water for the IWSS and should be afforded the highest level of protection.
- The land is State forest or owned freehold by State Government agencies.
- Existing land use practices can be managed for P1 source protection with the use of best management practices.

The private land in the catchment should be managed for Priority 2 (P2) source protection. The objective of this priority classification is to protect water quality according to the principle of risk minimisation.

A P2 source protection classification is appropriate for these areas as:

- The land is in private ownership.
- Existing land use practices are compatible with P2 source protection objectives with the implementation of best management practices.

It is preferable for private land within the catchment area to be retained as low intensity agriculture or native vegetation, and not be subject to subdivision.

An explanation of the priority classifications and details of land use compatibility within each priority classification are provided in the Department of Water's Water Quality Protection Note *Land Use Compatibility in Public Drinking Water Source Areas*, which is available from the Department's website.

## 5.4 Reservoir Protection Zone

A prohibited zone, also known as a Reservoir Protection Zone (RPZ ), has been established around the Wungong Brook dam under the provisions of the *MWSSD* by-laws to protect the reservoir from immediate risks to water quality. The RPZ is defined as that part of a catchment area which lies upstream of a dam and within 2km of the top water level of any reservoir in which water is or can be stored. The RPZ includes the reservoir itself, but does not extend outside the catchment area or downstream of the dam wall (refer to Figure 4).

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, 2004).

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

## 5.5 Land use planning

It is recognised under the State Planning Strategy (Western Australian Planning Commission, 1997) that the establishment of appropriate protection mechanisms in statutory land use planning processes is necessary to secure the long-term protection of drinking water sources. As outlined in Statement of Planning Policy No.2.7 *Public Drinking Water Source Policy* (Western Australian Planning Commission, 2003), it is appropriate that the Wungong Brook Catchment Area, its priority classifications and the Reservoir Protection Zone be recognised in the City of Armadale, Shire of Serpentine Jarrahdale and Shire of Wandering Town Planning Schemes and the Metropolitan Regional Scheme. Development proposals located within this area, or deemed likely to affect the protection objectives of the Wungong Brook Catchment Area should be referred to the Department of Water's Swan Avon or Kwinana-Peel Region for assessment and advice.

Further information on the strategies and policies applicable to both planning and drinking water catchments is provided in Water Quality Protection Note *Land use planning in Public Drinking Water Source Areas* (Department of Water, 2006).

## 5.6 Best management practices

There are opportunities to significantly reduce risks to water quality by carefully considering design and management practices. The adoption of best management practices for land uses will continue to be encouraged to help protect water quality. On freehold land, the Department of Water aims to work with landowners to achieve best management practices for water quality protection through the provision of management advice, and assistance to seek funding if required.

There are guidelines available for many land uses in the form of industry codes of practice, environmental guidelines or Water Quality Protection Notes. These have been developed in consultation with stakeholders such as industry groups, producers, State Government agencies and technical advisers. These guidelines help managers reduce the risk of their operations causing unacceptable environmental impacts. They are recommended as best practice for water quality protection. Examples are listed in Appendix B.

Education and awareness (eg signage and information material) is a key mechanism for water quality protection, especially for those people visiting the area who may be unaware that it's a drinking water catchment. Signs are erected in drinking water catchments to educate the public and to advise of activities that are prohibited or regulated. A brochure will be produced once this Plan is endorsed, describing the Wungong Brook Catchment Area, its location and the main threats to water quality protection. This brochure will be made available to the community and will serve to inform people in simple terms about the drinking water source and its protection.

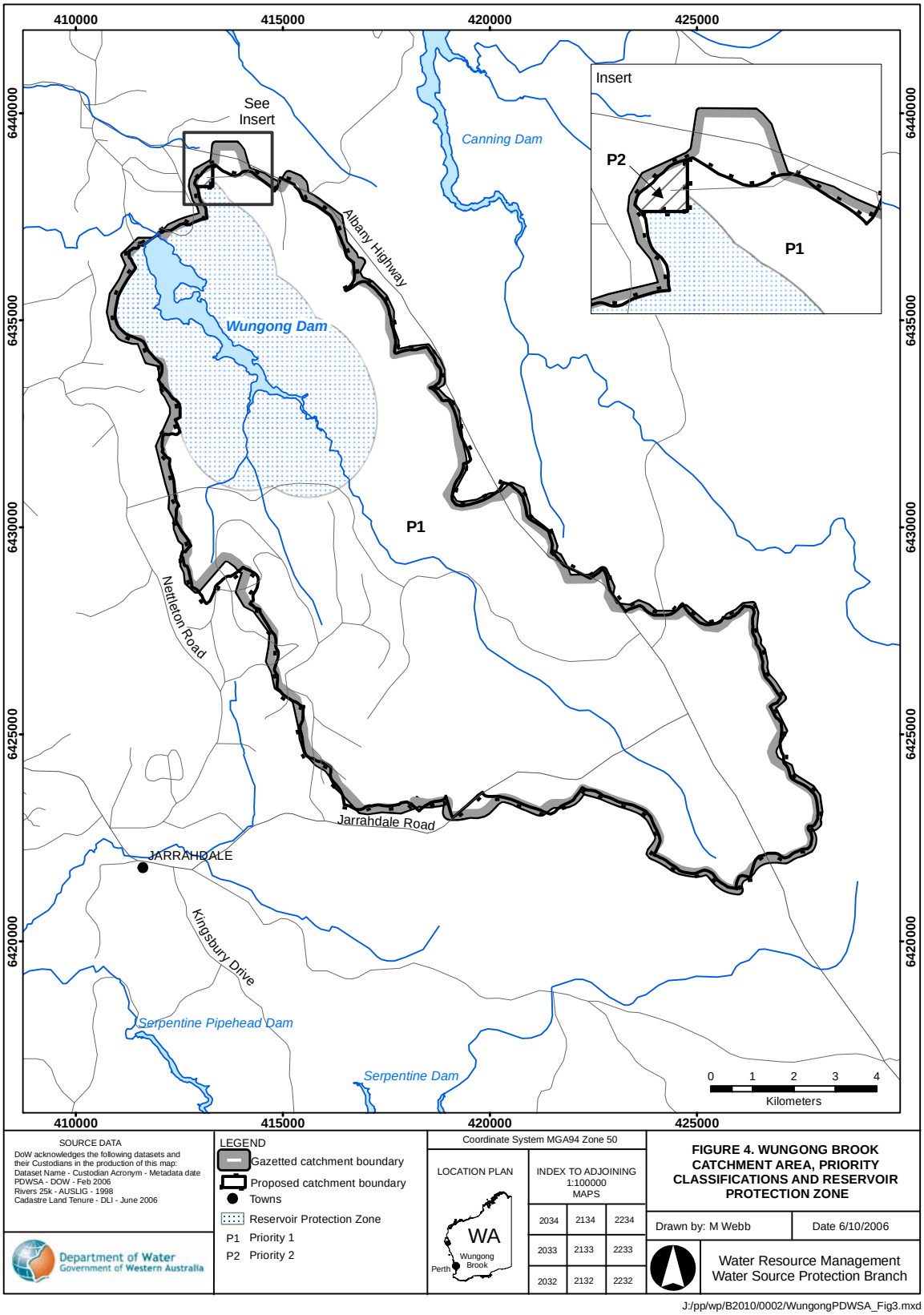


*Figure 4 Proposed priority classifications and Reservoir Protection Zone for Wungong Brook Catchment Area*

## 5.7 Surveillance and by-law enforcement

Public drinking water catchments within the metropolitan area are protected under the *MWSSD Act 1909*. Declaration of Catchment Areas, Underground Water Pollution Control Areas or Water Reserves allows the *MWSSD* by-laws to be applied to land uses and activities within the catchment to protect water quality.

The Department of Water considers by-law enforcement, through on-ground surveillance of drinking water catchments, as an important water quality protection mechanism. Surveillance is also important in raising the level of awareness of the need to protect water quality. Surveillance and by-law enforcement within this catchment has been delegated to the Water Corporation.

## 5.8 Emergency response

Discharge of chemicals during unforeseen incidents and the use of chemicals during emergency response can cause contamination of water sources. The City of Armadale, Shire of Serpentine Jarrahdale and Shire of Wandering Local Emergency Management Advisory Committees (LEMAC), through the Peel, Great Southern and South East Metropolitan Emergency Management Districts, should be familiar with the location and purpose of the Wungong Brook Catchment Area.

A locality plan should be provided to the Fire and Rescue Services headquarters for the Hazardous Materials Emergency Advisory Team (HAZMAT). The Water Corporation and the Department of Environment and Conservation should have an advisory role to any HAZMAT incidents in the catchment.

Personnel who deal with WESTPLAN – HAZMAT (Western Australian Plan for Hazardous Materials) incidents within the area should have access to a map of the Wungong Brook Catchment Area. These personnel should receive training to ensure an adequate understanding of the potential impacts of spills on the water resource.

## 5.9 Recommended protection strategies

Table 1 identifies the potential water quality risks associated with existing land uses and activities in the Wungong Brook Catchment Area and recommends protection strategies to manage and minimise these risks. Hazards identified as high risk include turbidity associated with wildfires, roads and tracks; and pathogens from pigs wallowing, decomposition of hunted animal carcasses, horse riding and people swimming, fishing or marroning in the catchment.

The management priorities have been determined using a comprehensive risk analysis spreadsheet developed by the Water Corporation, consistent with the ADWG recommendations for hazard identification and risk assessment (Water Corporation, 2006).

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

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| ***Private land*** | | | | |
| • General farming<br>• Stables<br>• Residences | • Pathogen and nutrient contamination from septic systems and domesticated animals;<br>• Increased turbidity as a result of vehicle use on unsealed roads and clearing;<br>• Chemical contamination from fertilisers and pesticides applied to pasture and gardens, and inadequate disposal and storage of chemical containers;<br>• Hydrocarbon contamination through fuel spills from fuel storage and refuelling, mechanical servicing and inappropriate waste oil practices. | Medium<br>Medium<br>Low<br>Low | There are guidelines that restrict the application of pesticides in drinking water catchments (refer to Appendix B).<br>It is recognised that use of private land for agriculture is an existing approved land use and may be essential for the livelihood of residents. The existing agricultural activities on private land are low intensity.<br>Private land in the catchment is currently zoned Rural C in the City of Armadale Town Planning Scheme (for which the minimum subdivision is 4ha and the average should be 5ha). Intensification of the land use is undesirable. | *Existing land uses are acceptable with best management practices.*<br>• Encourage landowners to adopt best management practices, particularly with regards to fertiliser and pesticide application, and stream buffer zones.<br>• Properties housing horses should adopt the *Environmental Guidelines for Horse Facilities and Activities* (WRC *et al*, 2002).<br>• Provide information and advice to landowners and local government on best management practices for domestic on-site wastewater treatment systems (refer to Department of Health, 1998), including the regular pumping out of septic systems.<br>• Ensure the water quality protection objectives of the Priority 2 classification are recognised in the City of Armadale town planning strategies and schemes. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
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| | **Hazard** | **Management priority** | | |
| Private land use<br>*(contin…)* | | | Lot 4, Lot 50 and Lot 51 Albany Highway will not fall within the catchment area when the boundary is amended to match the physical catchment. | • Refer development proposals that are inconsistent with water quality protection advice to Department of Water for comment.<br>• Oppose intensification of land use through planning approval process. |
| ***Crown land*** | | | | |
| Timber plantations | • Turbidity due to runoff from cleared areas related to logging, road repair and maintenance;<br>• Fuel spills from vehicles and machinery;<br>• Chemical contamination from fertiliser and pesticide application during softwood plantation establishment;<br>• Pathogens due to human presence. | Medium<br>Low<br>Medium<br>Medium | Forestry operations are governed by the *Forest Management Plan 2004-2013.*<br>The impact of softwood harvesting on water quality can be minimised through proper management, including maintenance of roads, retention of vegetation buffers along the reservoir and tributaries, and appropriate fertiliser and pesticide use.<br>Management practices are outlined in the *Manual of Management Guidelines for Timber Harvesting in WA* (CALM, 1999*)* and the *Code of Practice for Timber Plantations in Western Australia* (Forest Industries Federation (WA), 2006). | *Acceptable activity with best management practices.*<br>• Ensure timber plantations are managed in accordance with the *Manual of Management Guidelines for Timber Harvesting* (CALM, 1999), the *Code of Practice for Timber Harvesting in Western Australia* (CALM, 2004) and the *Code of Practice for Timber Plantations in Western Australia* (Forest Industries Federation (WA) Inc, 2006).<br>• Currently there are no softwood plantations within the RPZ. Ensure any future plantations are not within the RPZ, and no closer than 200m to the reservoir. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | Hazard | Management priority | | |
| Timber plantations<br>*(contin…)* | | | 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. The pine plantations are scattered plantations along Albany Highway and Jarrahdale Road, with the main plantation block in Gleneagle Forest.<br><br>The plantations were harvested in 2004. The width and vegetation quality of the buffer zones needs to be reviewed prior to re-planting.<br><br>Increased acidity of soil waters may affect transport of other contaminants but greater understanding of pine plantation effects is required. | • Update timber plantation and harvesting codes and manuals in accordance with Forest Products Commission (FPC), Department of Environment and Conservation, Water Corporation and Department of Water requirements.<br>• Review harvesting and establishment plans during the planning phase to ensure water quality protection objectives are included.<br>• Establish protocols for joint field inspections between relevant agencies. Inspect water quality protection measures on site.<br>• Ensure contract specifications recognise water quality protection objectives, including the use of chemical toilets, which should not be located within the RPZ or within 200m of reservoir tributaries.<br>• Ensure FPC monitor appropriate streams before and after harvesting and chemical application to identify any impacts.<br>• Ensure plantation harvesting does not occur in high risk areas, such as areas of steep slope or adjacent to the reservoir or tributaries. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
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| | **Hazard** | **Management priority** | | |
| Native forest timber harvesting<br><br>• Wungong Catchment Environment and Water Management project | • Turbidity due to log handling practices and the use of unsealed roads and tracks;<br>• Fuel spills from vehicles and machinery;<br>• Pathogens due to human presence. | Medium<br><br>Medium<br><br>Medium | Forestry operations are governed by the *Forest Management Plan 2004-2013.*<br><br>Management of native timber harvesting is outlined in the *Contractor's Timber Harvesting Manual – SW Native Forests* (CALM, 2003*)* and the *Code of Practice for Timber Harvesting* (CALM, 2004).<br><br>The impact of hardwood harvesting on water quality can be minimised through proper management (including vegetation buffers along stream beds and retaining understorey vegetation during timber harvesting).<br><br>The *Conservation and Land Management Act 1984* recognises water catchment protection as a statutory purpose of State forest.<br><br>The *Wungong Catchment Environment and Water Management Project Report* (Water Corporation, 2005) provides an outline of the project's management regime. | *Acceptable activity with best management practices.*<br>• Continue to review harvesting plans during the planning phase to ensure water quality protection objectives are included.<br>• Inspect water quality protection measures on site.<br>• Where possible, avoid logging in the RPZ, and no closer than 200m to the reservoir.<br>• Chemical toilets are to be provided for contractors working within the catchment, and not within the RPZ or within 200m of reservoir tributaries.<br>• Ensure timber harvesting occurs in accordance with the relevant forestry codes and manuals.<br>• Update timber harvesting manuals and codes in accordance with Forest Products Commission, Department of Environment and Conservation, Department of Water and Water Corporation requirements. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| Bauxite mining<br><br>*Does not currently occur in the catchment.* | • Turbidity from clear felling, ineffective site management and runoff management, and the use of unsealed roads and tracks;<br>• Hydrocarbon contamination through fuel spills from vehicles and machinery, mechanical servicing and inappropriate waste oil disposal;<br>• Pathogen contamination from increased human activity in the catchment. | Low<br><br>Low<br><br>Low | Mining operations ceased at Jarrahdale in December 1998. No mining is proposed in the next 20 years.<br><br>Alcoa World Alumina Australia holds a Special Mining Lease under the *Alumina Refinery Agreement Act 1961* through the Department of Industry and Resources.<br><br>The Mining and Management Programme Liaison Group (MMPLG) comprises representatives from the Department of Industry and Resources, Department of Environment and Conservation, Water Corporation and Department of Water. The group oversees the implementation of the *Alumina Refinery Agreement Act 1961*. This includes reviewing Alcoa's five year mine plan and enforcing environmental (including water quality protection) conditions where appropriate. Alcoa have processes in place for sediment control and the prevention of erosion. | *Acceptable if operated in compliance with conditions imposed by MMPLG.*<br>• Ensure the conditions imposed by the MMPLG specifically pertaining to water quality protection are adhered to.<br>• Ensure Alcoa's monitoring program continues. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| Bauxite mining<br>*(contin…)* | | | Monitoring studies of other water catchments have shown that bauxite mining causes transient changes to groundwater systems and stream flow volumes. | |
| Rehabilitation of mined areas<br><br>*Mining rehabilitation completed in Wungong Brook catchment.* | • Turbidity due to low vegetation cover in early stages;<br>• The leaching of nutrients from the use of fertilisers;<br>• Fuel spills from vehicles and machinery;<br>• Pathogen contamination from increased human activity in the catchment. | Medium<br><br>Low<br><br>Low<br><br>Low | Rehabilitation was completed in the catchment in 2001.<br>A rehabilitation prescription has been agreed between Alcoa and Department of Conservation and Land Management (now operating as Department of Environment and Conservation), and is included in the Alcoa/Department of Conservation and Land Management Working Arrangements.<br>Annual rehabilitation reports have been submitted to the Department of Environment and Conservation to certify that Alcoa has achieved the required standards for rehabilitation success. | *Acceptable if operated in compliance with conditions imposed by MMPLG.*<br>• Ensure Alcoa's monitoring program continues.<br>• Ensure compliance with Policy Statement No. 10 *Rehabilitation of Disturbed Land* (CALM, 1986). |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | Hazard | Management priority | | |
| Rehabilitation of mined areas<br>*(contin…)* | | | Over the next 10 years, Alcoa will be progressively applying for completion criteria certificates for rehabilitated areas within the catchment.<br>The rehabilitation program included a monitoring program 9 months and 15 months after rehabilitation.<br>The use of fertilisers during rehabilitation was minimal. Fertilisers were applied once initially in August following seeding.<br>Research to establish whether fertiliser application was affecting streams, and hence water quality in the reservoir, indicated that virtually no fertiliser was reaching the streams from this source. However, as each pit area is self-contained with no runoff, excess fertiliser would leach into groundwater. The extent of this is unknown, but is not considered to be a significant risk. | |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| Private resource harvesting<br>• Apiaries (13)<br>• Wildflower picking<br>• Seed collection | • Pathogen contamination due to the presence of people near the reservoir and tributaries;<br>• Increased turbidity due to the use of unsealed roads. | Medium<br><br>Low | The potential risks to water quality are increased when the activity is within an RPZ, near the reservoir or its tributaries.<br>The apiary permit conditions imposed by the Department for Environment and Conservation include water quality protection objectives ie camping requires the use of a chemical toilet and is not permitted within the RPZ.<br>Department of Environment and Conservation licences a number of private wildflower pickers and seed collectors. However, the low number of people involved, together with management controls, reduces the risk associated with these activities. | *Acceptable activity with conditions*.<br>• Ensure that if water is required at an apiary site it is not sourced from the reservoir but trucked in as per Department of Environment and Conservation licence conditions.<br>• Continue to 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.<br>• Apiary sites within the RPZ (currently three) should be relocated outside the RPZ when the permit is due for renewal.<br>• Inspect water quality protection measures on site. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| Fire management<br>• Prescribed burning<br>• Firebreaks<br>• Water points | • Erosion and turbidity;<br>• Carbon and nutrient contamination;<br>• Chemical contamination from fuel spills;<br>• Pathogens from direct contact of firefighters with the reservoir or tributaries, the death of animals and the loss of filtering vegetation. | Medium<br>Low<br>Low<br>Medium | Prescribed burning for biodiversity and fuel reduction is an established land management practice in the catchment and should be managed to limit the potential for turbid runoff into the reservoir.<br>Prescribed burning within the catchment is undertaken in accordance with the *Forest Management Plan 2004-2013.*<br>Firebreaks are generally cut in the event of an emergency and are not cut on a routine basis. This may change in future if burning regimes need to be altered to meet biodiversity outcomes.<br>Prescribed burning and the construction of firebreaks may increase turbidity in the short term, particularly in areas of steeper slopes close to the reservoir and tributaries. In the long term it will reduce the water quality risk. | *Acceptable activity with best management practices.*<br>• Liaise closely with Department of Environment and Conservation to ensure that specific guidelines related to water quality protection are incorporated into the burning prescription.<br>• Ensure protocols are put in place for effective communication between agencies managing the catchment.<br>• Ensure stabilisation of soil excavated during construction of water points to prevent turbid runoff into the reservoir or tributaries.<br>• Reduce fuel loads by appropriate prescribed burning.<br>• Ensure that firebreaks required on an ongoing basis are constructed to minimise soil disturbance.<br>• Emergency firebreaks should be immediately rehabilitated in accordance with Policy Statement No. 10 *Rehabilitation of disturbed land* (CALM, 1986). |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| Wildfires | • Erosion and turbidity;<br>• Carbon and nutrient contamination;<br>• An increase in pathogens due to the loss of filtering vegetation and death of animals. | High<br>Low<br>Medium | Intense wildfire can cause turbidity from airborne ash or through runoff when the burn is extinguished or followed by rain.<br>Water Corporation staff attend fires.<br>The prescribed burning program run by Department of Environment and Conservation should reduce the incidence of wildfire. | • Where location, extent or intensity of a fire suggests the need, inspect sites following fire to assess the need for turbidity mitigation works and conduct any necessary works.<br>• To ensure water quality considerations are addressed, Water Corporation staff should continue to attend all fires in catchment areas.<br>• Water Corporation staff should continue to undertake catchment inspections and post fire water quality monitoring.<br>• Ensure sites that need permanent protection from wildfire have adequate firebreaks and are considered during the Department of Conservation and Environment's Master Burn planning process. |
| Research projects | • Pathogen contamination;<br>• Increased turbidity due to the use of unsealed roads, particularly close to the reservoir. | Low<br>Low | Proponents undertaking research projects must get approval from Water Corporation and Department of Environment and Conservation before they commence. They are often supervised by Water Corporation staff. | *Acceptable activity with conditions.*<br>• Ensure education on water quality protection requirements is undertaken prior to the activity.<br>• Apply a condition of approval that requires adherence to water quality objectives. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
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| | **Hazard** | **Management priority** | | |
| Firewood collection | • Pathogen contamination through the presence of people and domestic animals near the reservoir or tributaries;<br>• Rubbish dumping;<br>• Turbidity due to the use of unsealed roads and damage to vegetation during off-road driving. | Medium<br><br>Low<br><br>Medium | The primary concern is the potential for people to be close to the reservoir or tributaries during public firewood collection.<br><br>The collection of firewood is only permitted in designated public firewood areas in State forest and timber reserves. There are no designated firewood collection points within the catchment. Most firewood collection in the catchment is illegal.<br><br>Commercial firewood collection from State forest is facilitated through the commercial harvesting of the forest by FPC. A commercial licence may be obtained from the Department of Environment and Conservation.<br><br>Rubbish dumping, including hydrocarbon waste, is often associated with public firewood collection points.<br><br>Domestic animals often accompany people during firewood collection. | *Acceptable activity with conditions.*<br>• Ensure regional plans for public firewood collection areas give consideration to water quality protection objectives.<br>• Where public firewood areas are established within the catchment, keep outside the RPZ, away from the reservoir and tributaries, and restrict activity to the edge of the catchment.<br>• Ensure public firewood areas are regularly patrolled and any dumped rubbish is removed.<br>• Use signs and brochures to promote water catchment awareness and protection.<br>• Catchment rangers facilitate water quality protection awareness during liaison with visitors to the catchment.<br>• Dogs are prohibited in the catchment unless on private property. Apply by-law enforcement. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
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| | Hazard | Management priority | | |
| Gravel pits<br><br>*Approximately 40 gravel pits within the catchment.* | • Increased turbidity from gravel extraction, localised clearing and illegal recreational use;<br>• Fuel and chemical spills from vehicles and machinery;<br>• Pathogens from human presence;<br>• Rubbish dumping often in the form of car bodies. | Medium<br><br>Low<br><br>Medium<br><br>Medium | Gravel pits are focal points for illegal and sometimes destructive recreational activities usually involving vehicles. Illegal recreational activities may also be responsible for a failure of rehabilitation in gravel pits.<br><br>The Wungong boat ramp gravel pit (Figure 3) poses a significant risk to water quality through turbidity. Erosion gullies continue down slope of the pit for 200m and drain directly into the dam (Burne, 2001). Mitigation works has been undertaken by Water Corporation.<br><br>Any new pits established by Department of Environment and Conservation are rehabilitated after use according to Policy Statement No. 10 *Rehabilitation of Disturbed Land* (CALM, 1986) and the *Code of Practice for Timber Plantations in Western Australia*, Forest Industries Federation (WA) Inc, 2006). | *Acceptable activity with best management practices.*<br>• Ensure gravel extraction occurs in accordance with the *Code of Practice for Timber Plantations in Western Australia* (Forest Industries Federation (WA) Inc, 2006) and Policy Statement No.2 *Local Government Authority Access to Basic Raw Materials from State Forest and Timber Reserves* (CALM, 1993).<br>• Ensure gravel pits are constructed outside the RPZ.<br>• Ensure contract specifications recognise water quality protection objectives.<br>• Approval of gravel extraction proposals should include the conditions stated in Water Quality Protection Note *Extractive Industries within Public Drinking Water Source Areas* (Department of Water, 2005).<br>• Pits should be rehabilitated immediately after decommissioning, in accordance with Policy Statement No. 10 *Rehabilitation of Disturbed Land* (CALM, 1986). |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
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| | **Hazard** | **Management priority** | | |
| Gravel pits<br>*(contin…)* | | | Gravel pits used for road maintenance require effective site management to reduce the risks to water quality. | • Rehabilitate and revegetate the Wungong boat ramp gravel pit.<br>• Inspect water quality protection measures on site.<br>• Restrict vehicular access to gravel pits. |
| Vehicle roads and tracks | • Turbidity from erosion of unsealed roads and tracks;<br>• Fuel and chemical spills from vehicles and machinery;<br>• Pathogen contamination from public access to the reservoir or tributaries. | Medium<br>Medium<br>Medium | Roads and tracks are necessary for forest management. It is essential they are well maintained to minimise the risk of erosion.<br>Albany Highway, Jarrahdale Road (MRWA) and Springfield Road (City of Armadale) intersect the catchment. These roads are major haulage routes necessary for transportation and operations in the area.<br>Control of access is a major issue in the catchment due to easy access off Albany Highway and Springfield Road. The highway runs within 2.5km of the dam in the north and east of the catchment. | *Accepted as necessary for forest management, requires best management practices.*<br>• Adherence to Water Quality Protection Note *Roads near sensitive water resources* (Department of Water, 2006).<br>• Review the road network to identify roads not essential for forest operations and management or transport thoroughfare. Close and rehabilitate tracks no longer required.<br>• Set a definition of 'Public Road' under the by-laws. Educate the public on the definition and implication of by-law enforcement.<br>• Ensure road upgrades follow alignments and incorporate measures to avoid or minimise water source contamination risks. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| Vehicle roads and tracks<br>*(contin…)* | | | Springfield Road leads to the dam wall. Public access to the reservoir or tributaries increases the risk associated with rubbish dumping and pathogen contamination. | • Ensure an operative emergency response procedure exists and that the LEMAC is aware of catchment boundaries.<br>• Use signs along roads to inform people of their presence in a public drinking water supply catchment. Display the emergency contact number in the event of a spill.<br>• Avoid the construction of new roads in the RPZ and throughout the catchment. |
| Feral animal control<br>• Pigs<br>• Foxes | • Turbidity from pigs wallowing;<br>• Pathogens from pigs wallowing and animal carcasses. | Medium<br><br>High | Under *MWSSD* by-laws, shooting, trapping or hunting game is prohibited in catchment areas without specific approval from the Department of Water.<br>Pig wallowing may result in the transfer of faecal material containing pathogens into the reservoir or tributaries.<br>Department of Environment and Conservation, and Water Corporation Rangers undertake feral pig control by the trap and shoot method . | *Acceptable activity by authorised personnel under strict controls*.<br>• Ensure feral pig control is performed by the 'trap and shoot' method only.<br>• Ensure carcasses are removed.<br>• Develop inter-agency guidelines for the managed eradication of feral pigs, addressing *MWSSD* by-laws and water quality protection requirements<br>• Continue using 1080 for the control of foxes within the catchment. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
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| | Hazard | Management priority | | |
| Feral animal control<br>(*contin…)* | | | Shooting to control problem animals is only undertaken by authorised personnel (Department of Environment and Conservation officers) under strict, controlled conditions as part of an integrated management program.<br>The bait used for fox control contains 1080 (sodium monofluoroacetate), which is a naturally occurring chemical that does not pose a risk to water quality. Department of Environment and Conservation policy is to ensure baits are not placed within 100m of drinking water reservoirs. | • Ensure compliance with Administrative Instruction No. 58 *Fox Baiting on CALM managed land and in other CALM programs* (CALM, 1994) and *Fox Control Manual* (CALM, 1996).<br>• Ensure compliance with *Draft Feral Pig Management Strategy for Departmental Management Land Western Australia 2005-2009* (CALM, 2005a). |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| ***Crown land – Recreation***<br>*All recreational activities within the catchment are to comply with Statewide Policy No. 13 Policy and Recreation within Public Drinking Water Source Areas on Crown Land (Water and Rivers Commission, 2003)* | | | | |
| Swimming | • Pathogen contamination associated with direct body contact with the reservoir or tributaries. | High | Swimming, bathing, bodily contact with water and washing clothes in the reservoir or its tributaries is prohibited under *MWSSD* by-laws because of the immediate risk to drinking water quality. | *Swimming is prohibited in the reservoir and tributaries in the catchment.*<br>• Use signs and promotional material to ensure the public are aware that swimming is prohibited in the reservoir and tributaries.<br>• Undertake after-hours surveillance with by-law enforcement. |
| Fishing and marroning | • Pathogen contamination from people close to or in the reservoir and tributaries, and the use of bait;<br>• Turbidity from vehicle use close to the reservoir or tributaries. | High<br><br>Low | Fishing and marroning in the catchment are prohibited under *MWSSD* by-laws.<br>Human or animal contact with water poses an immediate threat to water quality.<br>There are additional risks associated with fishing and marroning through on-site camping, the presence of dogs close to or in the reservoir or tributaries, and the use of bait. | *Fishing and marroning in the reservoir or tributaries are prohibited in the catchment*.<br>• Use signs and advertising material to ensure the public are aware that fishing and marroning are not permitted.<br>• Liaise with and advertise through the Department of Fisheries and Recfishwest.<br>• Continue to undertake after-hours surveillance of the catchment with by-law enforcement, to deter offenders.<br>• Increase the penalties associated with offences under Part 4 of the *MWSSD* by-laws. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| Fishing and marroning<br>*(contin…)* | | | *MWSSD* by-laws are enforced by Water Corporation after-hours surveillance, but penalties are small and the activities continue.<br>Preventing and discouraging these activities in drinking water catchments is essential to protect water quality. | • Use signs and advertising material to ensure the public are aware that dogs are prohibited in the catchment. |
| Bushwalking and cycling<br>• Munda Biddi Trail<br>• Informal activities | • Pathogen contamination from people in close proximity to the reservoir or its tributaries;<br>• Turbidity, primarily from cyclists. | Medium<br><br>Low | The Munda Biddi Trail, which is an informal, self-guided cycle trail, passes through the catchment.<br>The risk to water quality from cycling along designated tracks, such as the Munda Biddi Trail, can be managed through education. It is essential that designated tracks be regularly inspected and maintained to minimise the risk of degradation and erosion.<br>The Department of Environment and Conservation and the Munda Biddi Trail Foundation are responsible for management of the trail. | *Uncontrolled walking and cycling in the catchment should be discouraged*.<br>• No trails should be developed in the catchment without consultation with the relevant agencies (Department of Water, Department of Environment and Conservation and Water Corporation).<br>• Ensure that any formal trails are established outside the RPZ.<br>• Use signs and brochures to educate people on the *MWSSD* by-laws and the importance of protecting drinking water quality.<br>• Ensure compliance with the Munda Biddi management strategies and codes. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
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| | **Hazard** | **Management priority** | | |
| Bushwalking and cycling<br>*(contin…)* | | | Currently, all Munda Biddi Trail map sets include an information sheet which provides information on drinking water catchments and water quality protection.<br>Although cycling is considered a low risk, it has more of an impact than walking due to the erosion of trails (resulting from skids, sudden braking, high speeds, and damage caused to trails during wet weather use) and subsequent turbidity. | • Ensure new cycle trails adopt best management practices, such as those outlined in *Trail Solutions* (International Mountain Bicycling Association, 2004).<br>• Ensure compliance with the recommendations in Water Quality Protection Note *Tracks and Trails in Sensitive Environments* (Department of Water, 2006). |
| Animal (dog) exercising on Crown land | • Pathogen contamination from people and animals in the catchment, particularly close to the reservoir or tributaries. | Medium | It is prohibited to bring a dog into a catchment area under *MWSSD* by-laws, unless on private property. | *Dogs are prohibited in the catchment, unless on private property*.<br>• Undertake surveillance with by-law enforcement.<br>• Use signs and advertising material to ensure the public are aware that dogs are prohibited in the catchment. Signs may also be used to direct dog owners to local areas (outside the catchment) where pets are permitted.<br>• Increase the penalties associated with offences under Part 4 of the *MWSSD* by-laws. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | Hazard | Management priority | | |
| Horseriding<br>• Approved, formal activities<br>• Designated bridle trails<br>• Uncontrolled | • Pathogen contamination from people, animals, and manure, particularly in areas close to the reservoir or tributaries;<br>• Turbidity from horse riding on unsealed roads and tracks. | High<br><br>Medium | It is prohibited to ride horses in the catchment under *MWSSD* by-laws, except on public roads, in designated areas or with permission from Department of Water and Water Corporation (and also Department of Environment and Conservation if on land they manage).<br>There is one designated horse riding trail on land managed by the Department of Environment and Conservation in the catchment.<br>Horses compact ground, contributing to increased overland runoff and turbidity. The risk is reduced where horse riding occurs along roads or tracks away from the reservoir and tributaries.<br>Proximity to several stables and private property results in high numbers of illegal horse riders within the catchment. | *Horse riding is prohibited in the catchment, unless on public roads, on designated bridle trails or with relevant approvals*.<br>• Ensure horse riding is restricted to public roads and designated bridle trails, outside the RPZ.<br>• Use signs and advertising material to ensure the public are aware that horse riding is restricted to public roads and areas outside the RPZ. Signs may also be used to direct horse riders to local designated horse riding areas (outside the catchment).<br>• Undertake surveillance with by-law enforcement.<br>• Set a definition of 'Public Road' under the *MWSSD* by-laws.<br>• No new horseriding events within the catchment will be supported by the Department of Water.<br>• Ensure compliance with the recommendations of Statewide Policy 13 *Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land* (WRC, 2003). |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| Picnicking | • Pathogen contamination from people and their dogs, particularly in areas close to the reservoir;<br>• Rubbish dumping. | Medium<br>Low | The risk of contamination is increased by proximity to the reservoir. The risk is greater for undesignated sites than picnicking in designated areas due to the lack of management controls.<br>The former Gleneagle campsite now exists as a day-use site by picnickers. It is likely that risks associated with pathogen contamination will be reduced once the site is rehabilitated and toilet facilities provided.<br>Picnicking also occurs at road-side parking stops along Albany Highway. | *Picnicking is not permitted in the RPZ. It is only acceptable at designated picnic sites.*<br>• Ensure designated picnic areas are outside the RPZ and include appropriate facilities (ie. toilets), with no access provided to the reservoir or tributaries.<br>• A composting toilet should be provided at Gleneagle or the picnic site should be closed.<br>• Use signs and brochures to raise awareness of the catchment and the importance of protecting drinking water quality. |
| Rubbish dumping | • Pathogen contamination;<br>• Nutrient, chemical, heavy metal and hydrocarbon contamination from domestic, building or industrial waste, fuel, tyres and car bodies. | Medium<br>Medium | Rubbish dumping is often associated with informal or unauthorised recreation or access to the catchment.<br>Rubbish dumping in the catchment is prevalent. It is mostly localised in areas around tracks off Albany Highway. | *Rubbish dumping is prohibited in the catchment.*<br>• Continue to work with local government authorities, Department of Environment and Conservation and other relevant agencies to reduce rubbish dumping in the catchment.<br>• Undertake surveillance with by-law enforcement. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| Rubbish dumping<br>*(contin…)* | | | | • Use signage and brochures to ensure the public are aware that rubbish dumping is not acceptable and penalties apply under the *Litter Act 1979.* |
| Recreational hunting | • Pathogen contamination from feral animal carcasses;<br>• Pathogen contamination from people and dogs in the catchment. | High<br><br>Medium | Under *MWSDD 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 the Department of Water to which it may attach any conditions that it deems necessary.<br>Uncontrolled and unauthorised hunting and shooting is prohibited.<br>Illegal recreational hunting poses a serious risk to visitor safety and to water quality ie. pathogen contamination from feral animal carcasses and from people and dogs in the catchment. Dogs are prohibited in catchments. | *Recreational hunting is prohibited in the catchment.*<br>• Use signs and advertising material to advise that recreational hunting is prohibited.<br>• Continue surveillance of the catchment with by-law enforcement.<br>• Increase by-law penalties.<br>• Use signs and advertising material to ensure the public are aware that dogs are prohibited in the catchment. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | Hazard | Management priority | | |
| Recreational hunting<br>*(contin…)* | | | Surveillance by Water Corporation rangers currently reduces the occurrence of illegal hunting and the associated risks, but greater surveillance would further minimise the activity. | |
| Camping<br>• Munda Biddi Trail campsite<br>• Wild camping | • Pathogen contamination from people in the catchment, particularly close to the reservoir or tributaries. | Medium | Camping in undesignated areas (ie. wild camping) is prohibited under *MWSSD* by-laws. 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.<br>Camping at undesignated sites is likely to involve additional risks associated with illegal activities such fishing, marroning and hunting.<br>The campsite in Gleneagle has been formally closed as an overnight camping area for drivers. The site is still used illegally for camping. | *Camping at undesignated sites is prohibited in the catchment.*<br>• Use signs and advertising material to ensure the public are aware that camping is prohibited at undesignated sites in the catchment, and to educate on the importance of protecting drinking water quality.<br>• Ensure the Munda Biddi campsite is appropriately managed and educational signage is maintained to minimise the risk to water quality.<br>• Undertake surveillance of the catchment with by-law enforcement<br>• Ensure designated camping sites are established away from the reservoir and tributaries, and outside the RPZ. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | Hazard | Management priority | | |
| Camping<br>*(contin…)* | | | A campsite associated with the Munda Biddi Trail is located in the south of the catchment (Figure 3). The campsite is close to the tributaries of Wungong Brook.<br>The risks to water quality are managed by providing appropriate facilities and through education such as the *Code of the Campsite* (CALM, 2005) and Munda Biddi Trail brochures which advise that camping away from designated sites and contact with the reservoir is not permitted. The composting toilets are not chemical based and work on a natural decomposing system. | |
| Rifle range | • Heavy metal contamination from degradation of spent bullets. | Low | The safety zone of the Sporting Shooters Association is within State forest in the south west corner of the catchment (Figure 3).<br>There may be risks relating to the safety of visitors. | *Conditional approval of this existing activity has been granted.*<br>• Appropriate signage should be erected on all access points to the safety zone. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| Motor rally events<br>• Darling 200<br>• Hillclimb event | • Turbidity from erosion of unsealed roads and tracks, particularly on steep slopes close to the reservoir. Turbidity may also result from the import of fill materials for construction and maintenance of tracks;<br>• Pathogen and litter contamination from spectators entering the catchment;<br>• Fuel and oil spills from vehicles. | Medium<br>Medium<br>Low | The Hillclimb event is no longer staged in the catchment. The Darling 200, run by the Light Car Club under the organisation of the Confederation of Australian Motor Sport, was previously staged in the Gleneagle State forest blocks (on the eastern edge of the catchment). It is primarily based in the Serpentine Dam Catchment Area now, with only a small section of the route crossing into Wungong Brook Catchment Area.<br>It is recognised that rallies in the area are national events of significance for the local area, and until such time as more appropriate locations are acceptable, approval will continue to be given to stage events that have historically occurred in the catchment.<br>Motor rallying is not compatible with water quality protection objectives. No new events will be given approval. | *Existing events are permissible with best management practices.*<br>• No new events will be supported in the catchment.<br>• No extensions to established routes or stages will be permitted.<br>• Ensure an environmental management plan is developed for each event, specifically addressing water quality protection objectives approved by Water Corporation and Department of Water.<br>• Ensure road restoration and repair is implemented immediately following events.<br>• Prohibit vehicle maintenance in the catchment area.<br>• Conduct a regional recreation planning process, including identification of where recreation rally driving is acceptable.<br>• Authorised events are to comply with Statewide Policy 13 *Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land* (WRC, 2003). |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| Off-road driving<br>(away from 'public' roads)<br>• 4WDs<br>• Motorcycles<br>• Unlicensed cars | • Turbidity from erosion of unsealed roads and tracks, particularly from steep slopes close to the reservoir, and from damage to the vegetation;<br>• Hydrocarbon contamination from vehicle fuel spills;<br>• Contamination from vehicle dumping. | Medium<br>Low<br>Medium | 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 from Department of Water.<br>Off-road driving is not permitted on land managed by the Department of Environment and Conservation without a permit.<br>Off-road driving occurs extensively in the catchment, particularly by motorcyclists and drivers of unlicensed or stolen cars.<br>The risks associated with this activity are significant, particularly with regard to turbidity caused by erosion of unsealed roads and tracks.<br>This activity is also associated with the additional risks of vehicle dumping and the burning of stolen vehicles. | *Off-road driving (away from 'public' roads) is prohibited in the catchment.*<br>• Remove and deep rip all access roads to the Wungong boat ramp gravel pit, particularly Wungong Haul Road.<br>• Use signs to advertise that off-road driving away from designated roads is prohibited in the catchment.<br>• Undertake surveillance with by-law enforcement.<br>• Increase by-law penalties.<br>• Rehabilitate and revegetate gravel pits in the catchment. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | Hazard | Management priority | | |
| ***Water and Rivers Commission and Water Corporation freehold land*** | | | | |
| Unauthorised recreation<br>• Off-road vehicle use<br>• Hunting<br>• Bushwalking<br>• Camping<br>• Horse riding | • The potential risks associated with these activities have been discussed in detail in previous sections. | | WRC and Water Corporation own several properties in the catchment, most are located in the north of the catchment.<br>The properties are used extensively for unauthorised recreation. These activities could be controlled through the use of trespassing laws. | *Unauthorised access is prohibited on WRC and Water Corporation land.*<br>• Investigate the need for rehabilitation of WRC and Water Corporation properties (including stream zones) with local, native vegetation.<br>• Prohibit unauthorised access to WRC and Water Corporation properties.<br>• Maintain signs to ensure the public are aware of the private ownership of the properties.<br>• Undertake surveillance of WRC and Water Corporation properties with enforcement of trespass laws.<br>• Increase by-law penalties. |
| Fire management | • The potential risks have been described above. | | Land owned by Water Corporation and WRC is managed for fire by Department of Environment and Conservation and Water Corporation. | • Protection strategies have been described above. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | Hazard | Management priority | | |
| Feral animal control | • The potential risks have been described above. | | Water Corporation currently undertake feral pig control on WRC and Water Corporation owned land in the catchment using the 'trap and shoot' method. This method reduces the risks to water quality as animal carcasses are removed from the catchment. | • Protection strategies have been described above.<br>. |
| Rifle range | • Heavy metal contamination from degradation of spent bullets. | Low | The safety zone (overshoot area) of the Southern Districts Rifle Club crosses into WRC owned land the north west corner of the catchment (Figure 3).<br>Collection and appropriate disposal of spent projectiles and existing detrital lead should be addressed in the Southern District Rifle Club Hazard Identification Study. | *Conditional approval of this existing activity has been granted by Department of Water.*<br>• Southern Districts Rifle Club should organise an independent hazard identification study of the premises and operations.<br>• Appropriate signage should be erected on all access points to the safety template area (overshoot area).<br>• Undertake surveillance to ensure regular removal of spent projectiles by the rifle club. |

| Land use / activity | Potential water quality risks | | Consideration for management | Recommended protection strategies |
|---|---|---|---|---|
| | **Hazard** | **Management priority** | | |
| ***Other land uses*** | | | | |
| Infrastructure maintenance<br>• Bridges<br>• Roads | • Turbidity due to the use of unsealed roads by heavy machinery;<br>• Chemical contamination from pest control;<br>• Hydrocarbon contamination due to spillage of fuel from vehicles and machinery; | Low<br>Low<br>Low | Maintenance is necessary for the operation of infrastructure. The risks to water quality need to be managed, particularly in close proximity to the reservoir and tributaries.<br>Statewide Policy No.2 *Pesticide use in Public Drinking Water Source Areas* (WRC, 2000) should be considered when dealing with pesticides.<br>There are restrictions on the use of herbicides in catchment areas, refer to Public Service Circular 88 *Use of Herbicides in Water Catchment Areas* (Department of Health, 2006). | *Best management practices should be adopted for all maintenance in the catchment.*<br>• Ensure that all relevant agencies and their maintenance contractors are aware of the Wungong Brook Catchment Area boundary and the associated water quality protection objectives.<br>• Ensure responsible agencies are aware of and adhere to relevant policies and best practice guidelines including Water Quality Protection Note *Roads near sensitive water resources* (Department of Water, 2006), 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* (Department of Health, 2006). |

# 6 Recommendations

The following recommendations are proposed to help protect water quality in the Wungong Brook Catchment Area. Key stakeholders for each recommendation have been identified in parenthesis :

1 The boundary of the Wungong Brook Catchment Area should be amended under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* in accordance with the proposed boundary in Figure 2 *(Department of Water).*

2 Prepare an implementation strategy for this plan describing responsible stakeholders, timeframes and funding sources for the recommended protection strategies *(Department of Water).*

3 Implement the recommended protection strategies as detailed in *Table 1: Land use, potential water quality risks and recommended strategies* of this plan *(Department of Water and applicable stakeholders).*

4 The City of Armadale, Shire of Serpentine Jarrahdale and Shire of Wandering Town Planning Schemes and the Metropolitan Regional Scheme should incorporate the management principles outlined in this plan and the identified Wungong Brook Catchment Area boundary, Reservoir Protection Zone and priority (P1 and P2) classifications *(City of Armadale, Shire of Serpentine Jarrahdale, Shire of Wandering, Western Australian Planning Commission).*

5 All development proposals within the Wungong Brook Catchment Area that are likely to impact on water quality and/or quantity, or are inconsistent with Water Quality Protection Note *Land use compatibility in Public Drinking Water Source Areas* (Department of Water, 2004) or Statement of Planning Policy No.2.7 *Public Drinking Water Source Policy* (WAPC, 2003) should be referred to the Department of Water for advice and recommendations (*Department for Planning and Infrastructure, City of Armadale, Shire of Serpentine Jarrahdale, Shire of Wandering).*

6 Incidents covered by WESTPLAN – HAZMAT in the Wungong Brook Catchment Area should be addressed through the following:

- The locality plan for the Wungong Brook Catchment Area is provided to the Fire and Rescue headquarters for the HAZMAT Emergency Advisory Team.
- Personnel dealing with WESTPLAN – HAZMAT incidents in the area have ready access to a locality map of the Wungong Brook Catchment Area and training to understand the potential impacts of spills on drinking water quality.
- The City of Armadale, Shire of Serpentine Jarrahdale and Shire of Wandering Local Emergency Management Advisory Committees are informed of the location and purpose of the Wungong Brook Catchment Area.
- The Water Corporation provides an advisory role during incidents in the Wungong Brook Catchment Area (*Department of Water, Water Corporation).*

7 The surveillance program, and associated by-law enforcement, should continue to identify any incompatible land uses or potential threats within the Wungong Brook Catchment Area. Pursuant to Section 13(1) of the *Water and Rivers Commission Act 1995*, the Department of Water should continue to delegate responsibility for surveillance and enforcement to the Water Corporation (*Department of Water, Water Corporation*).

8 Signs should be erected along the boundary of the Wungong Brook Catchment Area and Reservoir Protection Zone to define the location and promote awareness of the need to protect drinking water quality. Signs should include an emergency contact telephone number (*Water Corporation*).

9 New recreational events or activities in the catchment should only be approved if in accordance with the requirements of the relevant agencies and the Department of Water's Statewide Policy 13 *Recreation within Public Drinking Water Source Areas on Crown Land* (WRC, 2003). New activities within the Reservoir Protection Zone will not be supported by the Department of Water (*Department of Environment and Conservation, City of Armadale, Shire of Serpentine Jarrahdale, Shire of Wandering, Department of Water, Water Corporation*).

10 Stream zones on property owned by Water Corporation or Water and Rivers Commission should be assessed for the need for rehabilitation. Any rubbish on the properties should also be removed (*Department of Water, Water Corporation*).

11 The Department of Water is to continue working with the Department of Environment and Conservation and the Forest Products Commission to update the forest plantation and harvesting manuals, codes and guidelines (*Department of Water, Department of Environment and Conservation, Forest Products Commission).*

12 A review of this plan should be undertaken after five years (*Department of Water*).

# Glossary

| | |
|---|---|
| **ADWG** | The Australian Drinking Water Guidelines, outlining criteria for the quality of drinking water in Australia. |
| **Aesthetic guideline** | NHMRC guideline level ascribed to acceptable aesthetic qualities of drinking water such as taste, smell, colour and temperature. |
| **AHD** | Australian Height Datum is the height of land in metres above mean sea level. For example this is +0.026 m at Fremantle. |
| **Allocation** | The quantity of water permitted to be abstracted by a licence, usually specified in kilolitres per year (kL/a). |
| **ANZECC** | Australian and New Zealand Environment Conservation Council. |
| **ARMCANZ** | Agriculture and Resource Management Council of Australia and New Zealand. |
| **CALM** | Department of Conservation and Land Management (now operating as Department of Environment and Conservation). |
| **Catchment** | The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater. |
| **CFU** | Coliform forming units is a measure of pathogen contamination in water. |
| **DWSPA** | Drinking Water Source Protection Assessment. |
| **DWSPP** | Drinking Water Source Protection Plan. |
| **FPC** | Forest Products Commission. |
| **GL** | Gigalitres (1 000 000 000 litres). |
| **HAZMAT** | Hazardous Material Advisory Team. |
| **Health guideline** | NHMRC guideline level ascribed based on acceptable drinking water quality for human health. |
| **IWSS** | Integrated Water Supply System – provides drinking water to 1.5 millions customers throughout Perth, Mandurah, Pinjarra, Harvey and the Goldfields and Agricultural regions. |
| **kL** | Kilolitres (1000 litres). |

| | |
|---|---|
| **km** | Kilometres (1000 metres). |
| **$km^2$** | Square kilometres (a measure of area). |
| **m** | Metres. |
| **mg/L** | Milligrams per litre (0.001 grams per litre). |
| **ML** | Megalitres (1 000 000 litres). |
| **mm** | Millimetres. |
| **MMPGL** | Mining and Management Programme Liaison Group. |
| **mS/m** | MicroSiemens per metre (a measure of the salt content of water) |
| **MWSSD Act** | *Metropolitan Water Supply, Sewerage and Drainage Act 1909.* |
| **MRWA** | Main Roads Western Australia. |
| **NHRMC** | National Health and Medical Research Council. |
| **NTU** | Nephelometric turbidity units are a measure of turbidity in water. |
| **P1, P2** | Priority 1 (P1), Priority 2 (P2).<br>Priority classification for land use management. |
| **Pesticides** | Collective name for a variety of insecticides, fungicides, herbicides, algaecides, fumigants and rodenticides used to kill organisms. |
| **Public Drinking Water Source Area (PDWSA)** | Includes all underground water pollution control areas, catchment areas and water reserves constituted under the *Metropolitan Water Supply Sewerage and Drainage Act 1909* and the *Country Areas Water Supply Act 1947*. |
| **Reservoir** | A reservoir, dam, tank, pond or lake that forms part of any public water supply works. |
| **RIWI Act** | *Rights in Water and Irrigation Act 1914* |
| **RPZ** | Reservoir Protection Zone – a 2km buffer measured from the high water mark of a drinking water reservoir, and inclusive of the reservoir. Referred to as a 'Prohibited Zone' under the *Metropolitan Water Supply, Sewerage and Drainage By-laws 1981.* |
| **Runoff** | Water that flows over the surface of 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. |
| **Tributary** | A stream, river or lake which flows into a larger stream, river or lake. |
| **Water quality** | The physical, chemical and biological measures of water. |
| **WAPC** | Western Australian Planning Commission. |
| **WESTPLAN – HAZMAT** | Western Australian Plan for Hazardous Materials |
| **WRC** | Water and Rivers Commission (now operating as Department of Water). |

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# Appendices

## Appendix A Water quality

### Explanatory Note

Following storage on site to gain the benefits of natural microbiological improvement, water from Wungong Brook Dam is disinfected by chlorination before being supplied to the public. The Water Corporation is required to comply with the health related guidelines of the Australian Drinking Water Guidelines (ADWG) but not aesthetic guidelines (ie. smell, colour). The health related and aesthetic water quality guidelines were not exceeded during the monitoring period.

### Health Parameters

Raw water from Wungong Brook 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* | Wungong Brook Dam | |
|---|---|---|---|---|
| | | | Range | Median |
| **Metals** | | | | |
| Barium | mg/L | 0.7 | 0.011 – 0.012 | 0.012 |
| Boron | mg/L | 4 | <0.02 – 0.06 | 0.037 |
| **Inorganics** | | | | |
| Fluoride | mg/L | 1.5 | <0.1 – 0.7 | 0.05 |
| Nitrate + Nitrite (as N) | mg/L | 11.3 | <0.002 – 0.1 | 0.02 |

* 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, 2004).

## Aesthetic Water Quality Data

Aesthetic water quality analyses for raw water from Wungong Brook 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.

| Parameter | Units | Aesthetic Guideline Value | Wungong Brook Dam | |
|---|---|---|---|---|
| | | | Range | Median |
| pH | | 6.5 – 8.5 | 6.67 – 8.25 | 7.23 |
| Turbidity | NTU | 5 | 0 – 4.3 | 0.6 |
| Colour | TCU | 15 | <1 - 4 | 1 |
| Conductivity | mS/m | - | 26 – 33 | 30 |
| Total Dissolved Solids | mg/L | 500 | 139 - 207 | 152 |
| Iron (unfiltered) | mg/L | 0.3 | 0.016 – 0.185 | 0.04 |
| Manganese (unfiltered) | mg/L | 0.1 | <0.002 – 0.055 | 0.006 |
| Aluminium (unfiltered) | mg/L | 0.2 | 0.014 – 0.085 | 0.03 |
| Sodium | mg/L | 180 | 38 - 51 | 44 |
| Potassium | mg/L | - | 0.9 – 1.6 | 1.4 |
| Calcium | mg/L | - | 2.4 – 3.2 | 2.8 |
| Magnesium | mg/L | - | 4.6 - 6 | 5 |
| Hardness (as $CaCO_3$) | mg/L | 200 | 25 - 33 | 28.5 |
| Alkalinity (as $HCO_3$) | mg/L | - | 8 - 14 | 12 |
| Chloride | mg/L | 250 | 69 - 85 | 76 |
| Sulphate | mg/L | 250 | 7.5 - 10 | 8.5 |
| Silica (as $SiO_2$) | mg/L | | 2.3 – 4.1 | 3 |
| Filterable organic carbon | mg/L | | 1 – 2.6 | 1.2 |

## Microbiological analysis

Microbiological testing of raw water samples is conducted on a weekly to monthly basis, particularly during summer and autumn. Thermotolerant coliform counts are used as an indicator of the degree of faecal contamination of the raw water from warm-blooded animals. A count less than 20 colony forming units (cfu) per 100mL is typically associated with low levels of contamination and is used as a microbiological contamination benchmark (World Health Organisation, 1996).

During the review period of July 1999 to July 2004, positive thermotolerant coliform counts were recorded in 43% of samples, with 2% of the positive samples exceeding 20 cfu/100 mL.

# Appendix B Best management guidelines for activities in Public Drinking Water Source Areas

## Buffers

Vegetated buffers should be maintained along all streamlines whether ephemeral or permanent.

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- NHMRC and ARMCANZ, 2004, *Australian Drinking Water Guidelines*, National Health & Medical Research Council and Agriculture & Resource Management Council of Australia and New Zealand. Available from <www.nhmrc.gov.au/publications/synopses/eh19syn.htm>.
- Department of Environment, 2002, *River restoration manual – Guides to the nature protection, rehabilitation and long-term management of waterways in Western Australia.* Available from <http://portal.water.wa.gov.au/portal/page/portal/WaterQuality/Publications/RiverRestoration>.
- 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.
- Water and Rivers Commission, 2000, *Draft Policy: Waterways WA – A policy for Statewide Management of waterways in WA.* Available from <http://waterways.water.wa.gov.au>.

## Recreation

- 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://portal.water.wa.gov.au/portal/page/portal/Policies>
- Department of Water, 2006, Water Quality Protection Note *Tracks and Trails in Sensitive Environments,* Department of Water. Available from <http://portal.water.wa.gov.au/portal/page/portal/WaterQuality/Publications/WaterQualityProtectionNotes>.

### Orchards

- Department of Water, 2004, Water Quality Protection Note *Orchards in Sensitive Environments.* Available from <http://portal.water.wa.gov.au/portal/page/portal/WaterQuality/Publications/WaterQualityProtectionNotes>.

### Pesticide application

Pesticide application should be minimised in all Public Drinking Water Source Areas. For specific needs of crops and best practice contact the Department of Agriculture.

- Department of Health, 2006, 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>.

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

### Research projects

Personnel should be educated on personal hygiene in a drinking water catchment, erosion prevention and the importance of protecting public drinking water catchments prior to any activity occurring.

- Water Corporation, 2005, *Wungong Catchment Environment and Water Management Project,* Water Corporation. Available from <http://www.watercorporation.com.au/_files/Wungong_project_document_all.pdf>

### Roads and tracks

Drainage must be controlled to prevent soil erosion and minimise sediment transport, which creates turbidity in the reservoir. Overland runoff should not be channelled into streams. Infiltration into soil should be aided at every opportunity.

- Department of Water, 2006, Water Quality Protection Note *Roads near sensitive water resources.* Available from <http://portal.water.wa.gov.au/portal/page/portal/WaterQuality/Publications/WaterQualityProtectionNotes>.

- 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, AgWA.

### Horse facilities


- Water and Rivers Commission, Western Australian Horse Council (Inc), Department of Environmental Protection, Department of Health, 2002. Water Quality Protection Guideline No.13 *Environmental Management Guidelines for Horse Facilities and Activities.* Available from <http://portal.water.wa.gov.au/portal/page/portal/WaterQuality/Publications/WQPGuidelines>.