



Department of Water
Government of Western Australia



Mundaring Weir Catchment Area Drinking Water Source Protection Plan



Department of **Water**
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Mundaring Weir Catchment Area Drinking Water Source Protection Plan

Goldfields and Agricultural Water Supply

Perth Integrated Water Supply System

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Contents

Contents	iii
Tables	iv
Preface	v
Summary	vi
1 Drinking water supply system.....	1
1.1 Existing water supply system	1
1.2 Water treatment	1
1.3 Catchment details	2
1.3.1 Physiography and vegetation.....	2
1.3.2 Climate.....	3
1.3.3 Hydrology.....	3
1.4 Future water supply requirements.....	3
1.5 Protection and allocation.....	4
1.5.1 Existing water source protection	4
1.5.2 Current allocation licence.....	4
2 Water quality	7
2.1 Microbiological contaminants	7
2.2 Health related chemicals.....	8
2.3 Aesthetic characteristics	8
3 Land use and contamination risk.....	10
3.1 Existing land uses	10
3.1.1 Freehold land.....	10
3.1.2 Crown land.....	11
3.1.3 Recreation	13
3.2 Proposed land uses	14
4 Catchment protection strategy.....	16
4.1 Protection objectives	16
4.2 Proclaimed area	16
4.3 Priority classifications.....	16
4.4 Protection zones	18
4.5 Land use planning.....	20
4.6 Best management practices.....	20
4.7 Surveillance and By-law enforcement	21
4.8 Emergency response	21
4.9 Recommended protection strategies.....	21
5 Recommendations	56
Appendices.....	59
Glossary	64
References	66
Contributors	69

Appendices

Appendix A — Water Quality	59
Appendix B – Photographs	62

Figures

Figure 1. Mundaring Weir Catchment Area locality map	5
Figure 2. Existing Mundaring Weir Catchment Area	6
Figure 3. Land tenure and activities in the Mundaring Weir Catchment Area	15
Figure 4. Proposed catchment area, priority classifications and protection zones for Mundaring Weir Catchment Area	19

Tables

Table 1. Land use, potential water quality risks and recommended strategies	23
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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 Mundaring Weir Catchment 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 multiple barrier 'catchment to consumer' approach to protect public drinking water. 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 Goldfields and Agricultural Water Supply, and the Perth Integrated Water Supply System. It discusses existing and future 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 relevant Shire's Town Planning Schemes, consistent with the Western Australian Planning Commission's *Statement of Planning Policy No. 2.7 - Public Drinking Water Source Policy*. Other stakeholders should use this document as a guide for protecting the quality of water in the 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 Mundaring Weir is located approximately 30 km east of Perth, in the Darling Range (see Figure 1). The weir was constructed across the Helena River valley between 1898 and 1903, and is a strategic source of public drinking water for the Goldfields and Agricultural Water Supply Scheme and the Perth Integrated Water Supply Scheme.

The Mundaring Weir Catchment Area was proclaimed under the *Country Areas Water Supply Act 1947 (CAWS)*, in 1972, to ensure protection of the water source from potential contamination.

This Drinking Water Source Protection Plan aims to protect the quality of drinking water in the Mundaring Weir Catchment Area for public supply. This is achieved through the identification of potential contamination risks associated with land use practices in the catchment and the recommendation of protection strategies to ensure these are effectively managed.

The majority of the Mundaring Weir catchment is State managed (public) land. State Forest covers an extensive area of the catchment and is vested in the Conservation Commission to be managed on their behalf by the Department of Environment and Conservation. Most of this area is also covered by Land Act Reserve 6203, which is vested in the Water Corporation for water catchment purposes. Neither vesting has priority, nor has an agreement for joint management of the coinciding areas been established between the organisations.

Use of the State Forest currently includes land and forest management, such as timber harvesting and fire protection, and an extensive range of recreation. This recreation includes some approved events, as well as other unauthorised activities that occur as a result of open access to the catchment.

Approved recreation in the catchment includes orienteering, rogaining, bushwalking, mountain bike riding activities and two designated off-road driving tracks. The Bibbulmun Track (with its designated campsites), Kep Track and Munda Biddi Trail also passes through the catchment. A motocross facility near Chidlow and several rifle ranges also operate on Crown land.

Unauthorised activities that occur in the catchment include fishing and marroning, camping in undesignated areas and vehicle use away from designated tracks or public roads.

The remaining land in the catchment is privately owned and occurs mainly in the north-eastern and north-western sections of the catchment. Land use on these properties is primarily low intensity, extensive agriculture, such as cropping and grazing. The Water and Rivers Commission and the Water Corporation also own in

freehold title significant areas of land within the catchment for water resources management purposes.

The catchment has been subject to CAWS Act clearing controls since 1978. Anyone proposing to clear native vegetation in the catchment is required to apply for a licence to clear. Licence applications are refused where there is a risk that the proposed clearing would cause salinisation of water resources. If a licence application is refused the CAWS Act contains provisions for the payment of compensation and to date compensation has been paid to approximately 2,660 hectares of native vegetation in the catchment. Since July 2004 clearing state-wide is controlled under the *Environmental Protection Act 1986*.

It is recommended that State managed (public) land in the catchment area be managed for Priority 1 water source protection. A Reservoir Protection Zone is also proposed to protect the Mundaring reservoir from immediate risks to water quality.

Private land in the catchment should be managed for Priority 2 water source protection. Based on the current land use activities, it is recommended that the current intensity of private land is maintained, and that support is provided to private landowners to reduce the potential risks of contamination.

The Shire of Mundaring depot and the Lakes service station and roadhouse are located on the northern catchment boundary and should be managed for Priority 3 source protection. It is recommended that all waste water from the sites be diverted away from the catchment.

In order to ensure the long-term protection of the water quality of this source, it is also recommended that the Mundaring Weir Catchment Area and associated priority classifications be recognised in the relevant land planning strategies.

The by-laws applicable to public drinking water source areas (PDWSA) will be strengthened to ensure that this catchment can be adequately protected, in accordance with the recommendations made in this plan.

1 Drinking water supply system

1.1 Existing water supply system

The Mundaring Weir was constructed across the Helena River valley between 1898 and 1903, forming Lake C Y O'Connor (more commonly known as the Mundaring reservoir). The weir is constructed of concrete, and is 308 m long and 40.2 m high (see photo 1 in Appendix B). The reservoir has a capacity of 63.6 gigalitres (GL) and a top water level of 137.4 m AHD.

The Mundaring reservoir is the primary source of water for the Goldfields and Agricultural Water Supply (G&AWS), and the only source of water for several local areas in the vicinity of the reservoir (including Mundaring and Sawyers Valley). Water abstracted from the reservoir is supplied to the G&AWS through the main pipeline. The areas local to the reservoir are supplied by off-takes from the main pipeline, via several service storage tanks.

The Mundaring reservoir is also part of the Perth Integrated Water Supply System (IWSS). This system is able to supply water to consumers in the Perth Metropolitan area, Goldfields and agricultural regions, Mandurah and Harvey, depending on consumer requirements and system operation.

To augment supplies from the reservoir water is also pumped back from the Lower Helena Pipehead Dam downstream. This pumpback water consists of runoff from the Lower Helena catchment, and during dry periods, is supplemented with ground or surface water from the Perth IWSS. The Lower Helena Pipehead Dam provides approximately 40% of the total water distributed to the G&AWS.

1.2 Water treatment

A multiple barrier approach is used in the management of drinking water quality. Catchment management for the protection of the water source is the first important barrier. Water treatment is another barrier to ensure water is safe to supply to the public. It is important to note that treatment can improve water quality but does not remove all hazards to public health. Therefore, effective catchment protection is essential.

The treatment of water abstracted from the Mundaring reservoir currently includes fluoridation (using fluosilicic acid) and disinfection. Water supplied to the G&AWS is disinfected by chloramination, which involves pH adjustment followed by chlorine injection and ammonia injection. Injection of ammonia ensures that the disinfection continues to be effective over a long time period. When the reservoir supplies the Perth metropolitan area, the water is disinfected by chlorination in place of chloramination.

Due to the potential water quality hazards in the Mundaring reservoir, particularly with regard to elevated turbidity and natural organic matter, it may be necessary for water sourced from the reservoir to be filtered prior to supply. This would add a further barrier to protect consumers from contamination. The Water Corporation is investigating a proposal for a new water treatment plant with filtration, disinfection, fluoridation and pH adjustment.

1.3 Catchment details

1.3.1 Physiography and vegetation

The Mundaring Weir catchment is located in 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, migmatite and doleritic intrusions (King and Wells, 1990).

The catchment area comprises three major landform units: major valleys combining slopes and floors, lateritic uplands and minor valleys within the upland surface.

The major valleys of the Mundaring catchment are defined as the Murray soil type, and are deeply incised with red and yellow soils on slopes, which are susceptible to erosion (Croton and Dalton, 1999).

The minor valleys are characterised by the Yarragil and Pindalup soil types. The Yarragil unit consists of sandy gravels on slopes and orange soils on swampy floors, while the Pindalup type consists of gravely duplex soils on slopes with grey sands, duplex yellow soils and orange soils in broad valley floors. The risk of erosion of these soils varies from low to high.

The lateritic uplands are represented by the Dwellingup and Yalanbee soil types, which form a gently undulating landscape. These soils consist of duricrusts and sandy gravel or predominantly fine gravels respectively, and have a relatively low risk of erosion (Croton and Dalton, 1999).

The majority of the catchment is covered by open forest or woodland, dominated by jarrah (*Eucalyptus marginata*) and wandoo (*Eucalyptus wandoo*) species (see photo 2 Appendix B). There are also several areas of pine plantations, generally located along streamlines, and some private land that has been cleared for agriculture.

Over its history, the Mundaring catchment has been modified from its original native forest condition through human use. Land use has also resulted in significant degradation in some sections of the catchment, particularly in areas of steeper slopes and adjacent to major stream and riparian zones.

1.3.2 Climate

The region has a Mediterranean-type climate, with warm, dry summers and cool, wet winters.

The average annual rainfall (1975 to 2005) near the Mundaring Weir is 904 mm and along the eastern edge of the catchment is 600 mm. The long-term average annual rainfall for the Mundaring Weir is approximately 1040 mm representing higher rainfall patterns prior to the 1970's. The majority of the rainfall occurs during the winter months.

The average annual pan evaporation ranges across the catchment, between 1900 in the east and 2100 mm in the west. For most of the catchment, the monthly pan evaporation is in excess of the rainfall for seven or eight months of the year (Croton and Dalton, 1999).

1.3.3 Hydrology

The Mundaring Weir catchment has a total area of 1470 km². It includes the catchments of the upper Helena River and the Darkin River. Figure 1 shows the locality of the Mundaring Weir Catchment Area. Average annual rainfall in the catchment varies between 1100 mm in the west and 600 mm in the east.

The long-term mean annual stream flow entering the Mundaring reservoir is 43.8 GL. However, due to the prolonged period of low rainfall in recent years, the mean annual stream flow has significantly reduced to 17.2 GL. The long-term average annual draw from the Mundaring Weir catchment is 22.3 GL. The total annual draw from the Mundaring reservoir, including pumpback from the Lower Helena Pipehead Dam, is 31.3 GL.

The major source of stream flow in the catchment is generated by lateral flow through the upper soil layer over the winter months. The catchment hydrology also includes the presence of permanent shallow groundwater in the soil profile, which may discharge to streams in the valley floors.

1.4 Future water supply requirements

The Mundaring Weir water supply as a major drinking water source is not expected to change in the foreseeable future, although the quantity taken from the reservoir may depend on climatic variations and be subject to operational variations in water supply and demand.

1.5 Protection and allocation

1.5.1 Existing water source protection

The Mundaring Weir Catchment Area was proclaimed under the *Country Areas Water Supply (CAWS) Act 1947* in 1972 to ensure protection of the water source from potential contamination. Figure 2 shows the existing Mundaring Weir Catchment Area.

Additional land use controls were enacted over the Mundaring Weir catchment in December 1978 when the catchment was proclaimed under Part IIA of the CAWS Act to restrict the clearing of native vegetation that would cause salinisation of water resources.

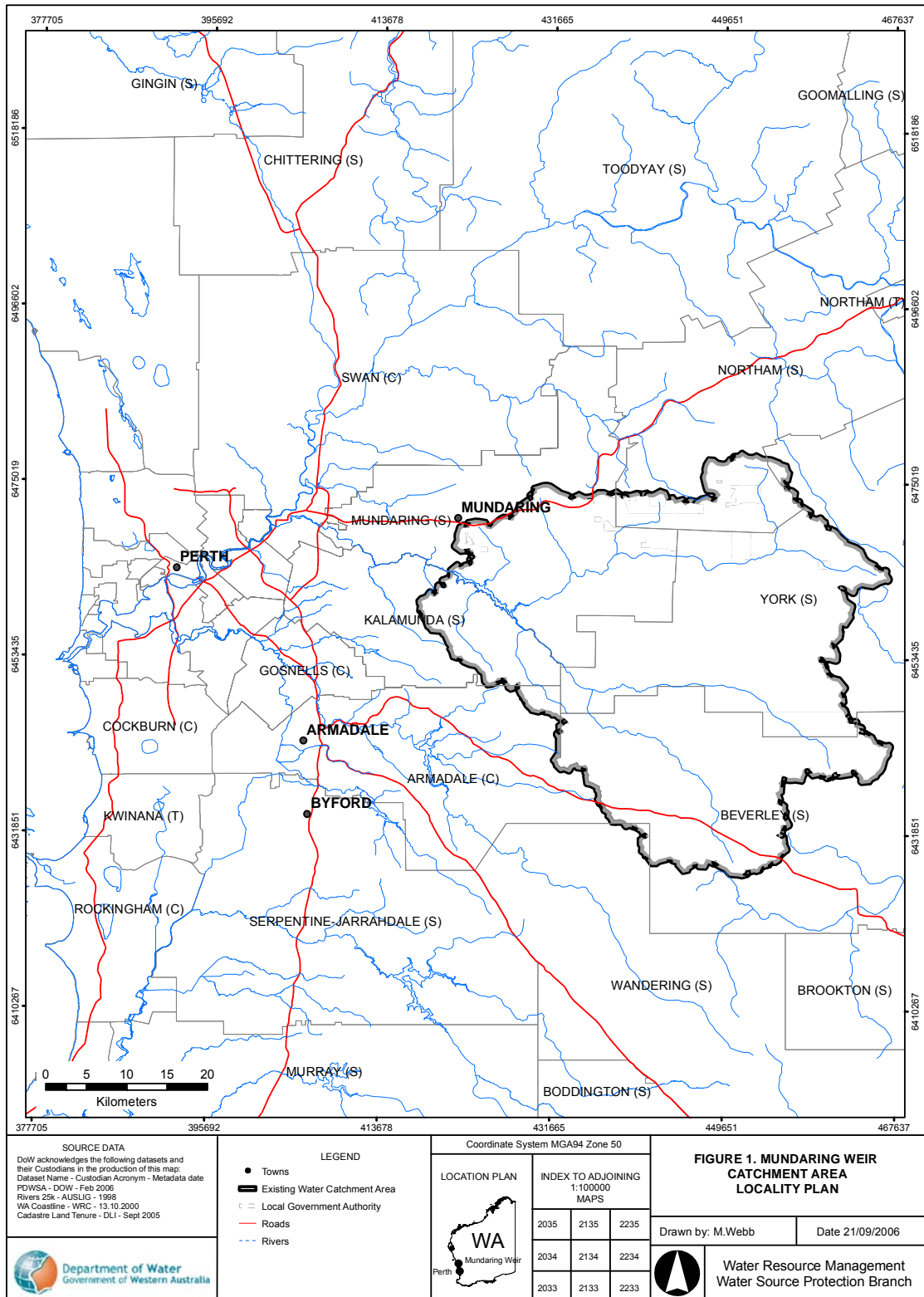
The Lower Helena Pipehead Dam Catchment Area was proclaimed under the CAWS Act in 1973 and amended in 1983. The source protection issues in this catchment will be addressed through the Middle Helena Land Use and Water Management Strategy.

1.5.2 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 Act (RIWI) 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 boundary of the Mundaring Weir Catchment Area is also the boundary of the Mundaring Weir Surface Water Area, proclaimed under the *RIWI Act 1914*.

The Water Corporation (the Corporation) is licensed by the Department of Water (the Department) to take up to 22.3 GL per annum from the Mundaring reservoir.



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Figure 1. Mundaring Weir Catchment Area locality map

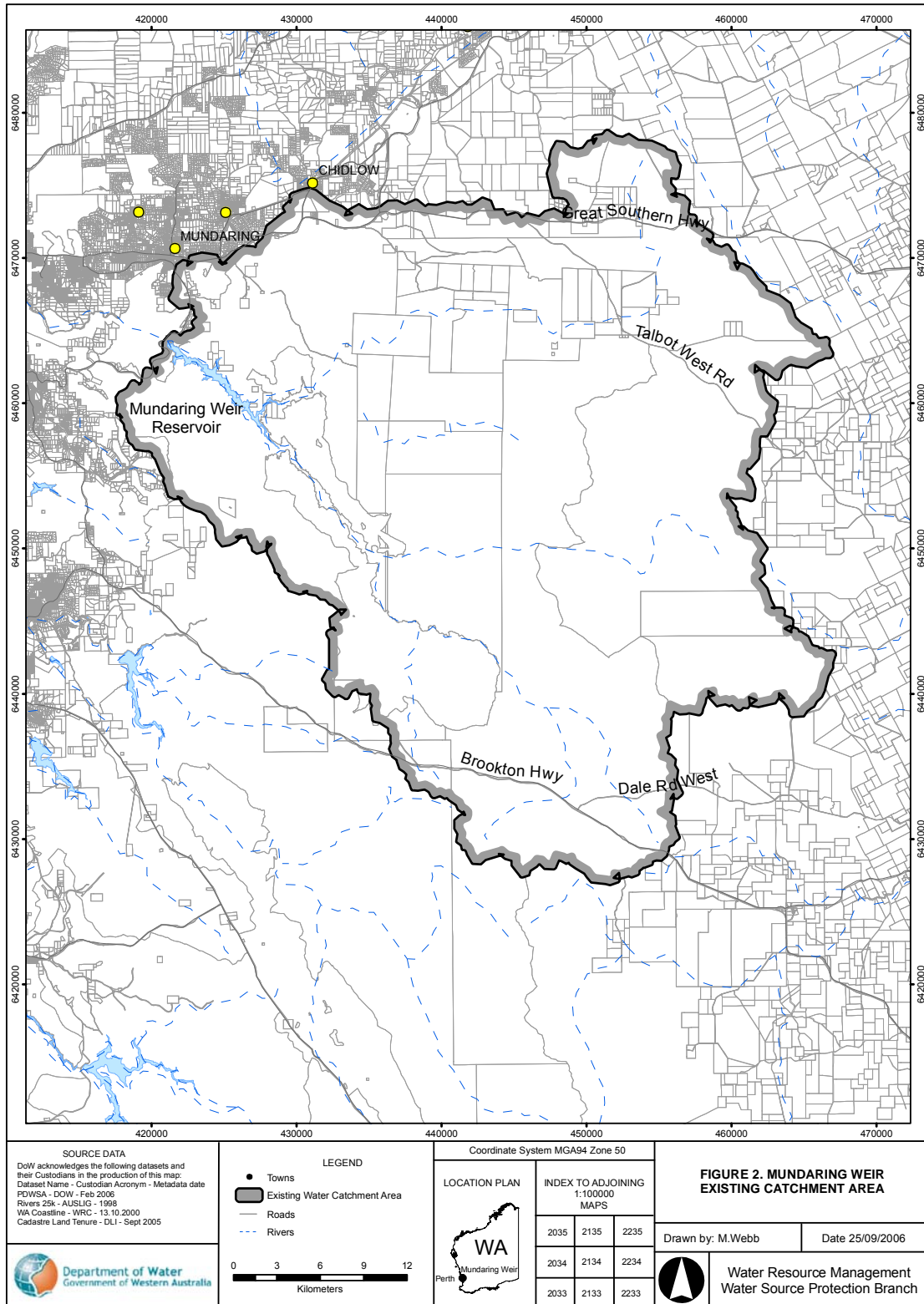


Figure 2. Existing Mundaring Weir Catchment Area

2 Water quality

The water quality in the Mundaring reservoir is routinely monitored by the Water Corporation. Water samples are analysed for a comprehensive range of water quality parameters, including pH, turbidity, colour, conductivity, iron, manganese and aluminium. In addition, the turbidity of the major tributaries of the reservoir have been intermittently monitored by this Department and the Corporation.

The levels of parameters monitored in the reservoir such as pH, sodium, chloride, sulphate, and hardness are within the acceptable limits.

Blue green algae have been visually identified in the reservoir on several occasions.

A summary of the results of the comprehensive water quality analyses is shown in Appendix A.

2.1 Microbiological contaminants

Microbiological testing of raw water samples from the Mundaring reservoir has been conducted weekly since 1999 and at regular intervals prior to that year.

In Australia *Escherichia coli* has now replaced thermotolerant coliform as the key indicator of bacterial contamination. During the reviewed period of January 2001 to October 2006, positive *Escherichia coli* counts were recorded in 67.6% of raw water samples. Approximately 3.7% of these samples had *Escherichia coli* counts greater than 20 cfu/100 mL, which implies that for these samples, disinfection alone may not be sufficient.

Catchment sampling undertaken in the past has, on occasion, yielded high thermotolerant coliform counts. Some particularly high results were produced at four sampling points:

- *Wundabiniring Brook/Gt Southern Hwy*, downstream of a number of rural properties in the north east of the catchment: *up to 1500 cfu/100 mL*.
- *Darkin River/Qualen Rd 1*, downstream of a large grazing property approximately 30 km south east of the reservoir: *up to 880 cfu/100 mL*.
- *Darkin River/Qualen Rd 2*, downstream of the above point, approximately 10 km south east of the reservoir: *up to 400 cfu/100 mL*.
- *Helena Brook/Gorrie Rd*, located in a pine plantation 5 km east of the reservoir, downstream from a number of land uses (including a rifle range, motocross circuit and recreation ground): *up to 580 cfu/100 mL*.

High bacteriological counts have been detected in the Darkin and Little Darkin Rivers, downstream of wildfire-affected areas. These results demonstrate the importance of buffering vegetation in stream-zones and catchments.

In order to reduce the occurrence of high bacteriological and thermotolerant coliform counts several recommendations have been made under Section 5. These include the establishment of a reservoir protection zone, controls on recreational activities and restoration of buffers adjacent to the reservoir and streamlines.

2.2 Health related chemicals

The raw water is monitored for herbicides on a quarterly basis. Dieldrin is the only herbicide to have been detected. However, the levels remain well below the NHMRC guideline values.

Nitrogen (Nitrite + Nitrate), Manganese, Boron and Barium have been detected from reservoir samples and other raw water samples taken from feeder streams. Manganese has also been detected in catchment sampling.

All detected levels of Nitrogen, Boron and Barium have been below their respective Australian Drinking Water Guidelines (ADWG) health values.

One sampling point in the reservoir yielded high values of Manganese in the mid 1990s. Manganese occurs naturally in water, but high levels may be a function of reservoir dynamics and poor quality of inflows. This is also the case with Boron and Barium. Nitrate occurs naturally, but may also originate from other sources such as intensive farming practices (NHMRC & ARMCANZ, 1996).

2.3 Aesthetic characteristics

Turbidity is caused by suspended material such as soil particles and organic matter in the water. The turbidity in both the Helena and Darkin Rivers has routinely exceeded the National Health and Medical Research Council (NHMRC) aesthetic guideline.

Turbidity levels in the Mundaring reservoir are generally lower than in the tributaries. In the Helena River, approximately 18% of all samples were above the guideline limit, while the corresponding figure for the Darkin River is 19%.

The salinity of the water in the reservoir has increased substantially, and is currently approximately twice the value for other Darling Range sources. However salinity is still below the NHMRC aesthetic Guideline level of 500 mg/L. Even though 97% of the catchment is forested, the salinity of runoff is very sensitive to the remaining 3% clearing. Land clearing remains the major evident risk to the reservoir salinity so the catchment requires continuing vigilance and some level of salinity management (Department of Water, 2007).

The colour levels measured in the reservoir have exceeded the aesthetic guideline value in recent years. Similarly, the iron and manganese concentrations have also periodically exceeded the NHMRC aesthetic guidelines. This may be a result of vegetation characteristics and due to erosion of the soil in the catchment, which is naturally high in these elements.

The elevated aesthetic levels are likely to be linked to erosion in the catchment. There are a number of human activities in the catchment that may cause or exacerbate this (see section 3.1.3 *Recreation*).

3 Land use and contamination risk

3.1 Existing land uses

Land uses in the Mundaring Weir catchment include:

- Management of State forest,
- infrastructure corridors,
- recreation on State land,
- agriculture in the form of grazing, orcharding, viticulture, plantations and horticulture,
- a commune,
- a Shire Depot and animal pound, and
- a service station on freehold land.

Land tenure in the catchment is shown in Figure 3.

3.1.1 Freehold land

Freehold land comprises approximately 5% of the catchment area, and occurs mainly in the north-eastern section of the catchment. There are also a few smaller blocks of freehold land close to the reservoir in the north-west, and a large block in the south-eastern section of the catchment.

Land use on these properties is primarily low intensity extensive agriculture, including cattle, sheep and horse grazing and cereal crops. There are also several orchards, viticulture, tree plantations, hobby farms, apiaries and rural residences. Other specific uses include a commune, the Mundaring animal pound and Shire Depot and the Lakes roadhouse and service station. These last two uses occur on properties overlapping the catchment boundary.

Private land

Private land in the north-west of the catchment is mostly zoned for rural landscape living with no further subdivision recommended under the Shire of Mundaring Town Planning Scheme (TPS). These properties usually have a house and uses include stock grazing, orchards, keeping of horses and a vineyard. Another property in the vicinity is zoned for Special Purpose – Commune. Additionally, part of the property zoned for Public Purpose – Shire Depot overlaps the catchment boundary. This land houses the Shire Depot and animal pound.

Private land in the north and north-east of Mundaring catchment is mostly zoned General Rural under the Town Planning Schemes of the Shire's of Northam, York and Mundaring. Rural land uses include grazing, cropping, and maintenance of natural vegetation.

Immediately to the north of Manaring Lake, on the corner of Great Eastern Hwy and Great Southern Hwy, is The Lakes service station which is zoned under the Shire of Mundaring TPS for Special Purpose – Caravan Park/Restaurant/Service Station. This property lies on the gazetted catchment boundary.

The Mundaring Weir catchment is a gazetted clearing control catchment, which provides a mechanism for Government purchase of clearing rights. It also assists with offsetting the impacts of water quality protection strategies on landowners. The former Water Authority purchased clearing rights or compensated those who did not gain approval to clear on several properties in the north-east of the catchment.

Department of Water and Water Corporation freehold land

The Department of Water has recently changed names from the Water and Rivers Commission (WRC). This change will not be legal until legislation is passed by Parliament to repeal the *Water and Rivers Commission Act 1995* and subsequently abolish the WRC. Hence the properties mentioned as being owned by the Department of Water are still legally owned by the WRC.

11684.6 ha of land in the catchment is freehold owned by the Department of Water, including large properties known as Flynn Block (formerly Flynn's Farm) and Clifford Block. Some areas of this land that were cleared for previous agricultural use have not yet been revegetated. There are 330 ha of pine plantation on Flynn Block. About 400 ha of cleared land has been replanted with Wandoo (*Eucalyptus wandoo*). The areas of cleared land are subject to considerable trespassing for illegal recreation.

The Water Corporation has freehold ownership of three small properties in the catchment, two of which were previously agricultural properties. Should treatment of water from Mundaring proceed, additional land will need to be acquired for a water treatment plant. A site has not yet been finalised but it is likely to be within the catchment.

3.1.2 Crown land

State forest and reserves

The majority of the Mundaring Weir catchment is Crown land. State forest (numbers 7, 13 and 22) covers an extensive area of the catchment. It is vested in the Conservation Commission and managed by the Department of Environment and Conservation (DEC) on their behalf.

Lands within the Mundaring Weir catchment identified as proposed National Parks and Conservation Parks in the *Forest Management Plan 2004-2013* have now been created and vested in the Conservation Commission of Western Australia (Figure 3). These areas include existing Conservation Parks, some sections of State Forest and Reserve 6203, and Department of Water freehold land.

Land and forest management

Forestry activities in the catchment include plantation and native forest timber harvesting (see photo 3 Appendix B). Plantation timber production is an on-going activity, and occurs predominantly as pine plantation in the Gorrie and Beraking plantations, along the Helena and Darkin Rivers respectively. Establishment and previous harvesting in these plantations did not include the retention of unharvested buffer zones adjacent to watercourses.

Native forest timber harvesting has occurred in the catchment with plans for harvesting to occur in 2008. Silvicultural management of Wandoo has occurred on some parts of Flynn Block in the past.

Land management includes fire protection, such as prescribed burning and maintenance of fire access tracks, and feral animal control using traps and aerial baits. Activities are mostly conducted by DEC, but also by Water Corporation Rangers.

Firewood collection and other private resource harvesting, including apiaries, wildflower picking and seed collection, also occur in the State Forest. In addition, a commercial sand mine is currently in operation, and the catchment and reservoir have been used for research projects.

Vegetation clearing controls

The Department of Water is responsible for administering the *Country Areas Water Supply Act 1947* (CAWS) Part IIA "Control of Catchment Areas and Water Supply Reserves" and the associated Clearing Licence Regulations 1981. The catchment has a high susceptibility to salinisation if land is cleared.

The *CAWS Act* requires the owner or occupier of controlled land in the course of exercising any statutory function, to apply for a clearing licence. The Act provides for compensation to be paid to the landowner in the event a licence application is refused. Compensation has been paid to preserve approximately 1980 ha of bush in the catchment to date.

3.1.3 Recreation

There is significant pressure for recreation in the Mundaring Weir catchment, and an extensive range of recreational activities currently occur. These include some approved recreation, as well as other unauthorised activities resulting from open access to the catchment.

A Disease Risk Area (DRA) has been declared by DEC across a significant proportion of the catchment, which involves restrictions on access to this area.

Historically there were two motor rally events, Rally Australia and the Clubman Rally, and an enduro motorcycle event established in the catchment. The Rally Australia and Clubman Rally events were staged in State Forest, in areas close to the reservoir, as well as on Flynn Block. The enduro motorcycle event was staged in an area of State Forest to the extreme south-east of the catchment. The Enduro event has not been staged in recent years and is no longer considered an established event. The last event for Rally Australia was staged in 2006.

The West Australian Junior Motocross Club conduct monthly activities at Eric Walter Park, a site they lease from the Shire of Mundaring. The Shire leases the property from the Corporation. The lease is renewable at 5 yearly intervals and is due for renewal in 2010. This type of activity is conditional upon the development of an approved environmental management plan. The Corporation also conduct regular inspections of the facility. In addition, approved orienteering and rogaining events are held in the catchment every year. Three rifle ranges are also located in the catchment, all in close proximity to one another in Sawyers Valley near the catchments northern boundary.

A range of recreational activities is associated with the Perth Hills National Park Centre that is located in the north-west of the catchment near the weir, within 800 metres of the waterbody. This centre is sponsored by DEC and attracts approximately 20 000 visitors annually. The centre organises many group activities in the catchment, including bushwalking, picnicking and camping, and is also responsible for managing the Catchment Carers Trail – a guided walk trail. The focus of most of these organised activities is an area of land close to the reservoir. However, these same activities also occur throughout the catchment on an informal basis, without being part of an approved or organised group.

The Bibbulmun Track is also present in the catchment (Figure 3). The track passes close to the northern side of the reservoir, and then crosses the Helena and Darkin Rivers and continues south out of the catchment. There are five designated campsites located approximately every 10 km along the route. However, the use of the track is increasing and unauthorised camping now occurs between designated sites.

The Mundaring Weir Precinct Long Walk Trail uses an area just north of the reservoir, near the western boundary of the catchment, and also utilises part of the Bibbulmun Track (Figure 3).

The Kep Track is a newly established multi-use track which passes through the north-west of the catchment, finishing at the Mundaring Weir. It is part of the Golden Pipeline Project, developed by the National Trust of Australia (WA).

There is also the Munda Bididi Trail, a long distance mountain bike trail, which passes through the western edge of the catchment, to the north and the south of the reservoir (Figure 3). There are no campsites associated with this trail within the Mundaring catchment.

Unauthorised activities, including fishing, marroning, hunting, camping, vehicle access away from designated tracks or public roads and rubbish dumping, also occur in the catchment. In particular, marroning is prevalent in the reservoir and tributaries over the summer period, and the Department's freehold properties are used extensively for unauthorised camping, hunting and bushwalking. Swimming is prohibited in the reservoir under the *CAWS Act* by-laws.

Vehicle access (away from designated tracks and public roads) is a prohibited activity that occurs extensively throughout the catchment. It occurs on an individual basis, as well as in organised groups or training courses, and typically involves vehicles such as four wheel drives (4WDs), motor cycles (including trail bikes) and unlicensed cars.

Unauthorised use of 4WDs is intensified in Clifford Block and Flynn Block, particularly with vehicles crossing through the Helena River. In addition, several sections of the Helena River in Clifford Block are used illegally for training to practice water crossings and vehicle recovery. This results in new tracks continually being developed and widened in swamp areas adjacent to the watercourse, causing loss of riparian vegetation (see photo 4 Appendix B).

The Chambers Block farmhouse area (on Flynn Block) and the Barton's Mill area are also highly frequented for unauthorised vehicle use, and the dumping of stolen cars and rubbish often occurs at these sites.

3.2 Proposed land uses

It is anticipated that private land within the catchment will continue to be used for low intensity agriculture or other low intensity use, and further fragmentation should not be permitted. This activity is compatible with the priority 2 source protection classification proposed.

Timber harvesting will continue within areas of public land with some native forest harvesting planned for 2008.

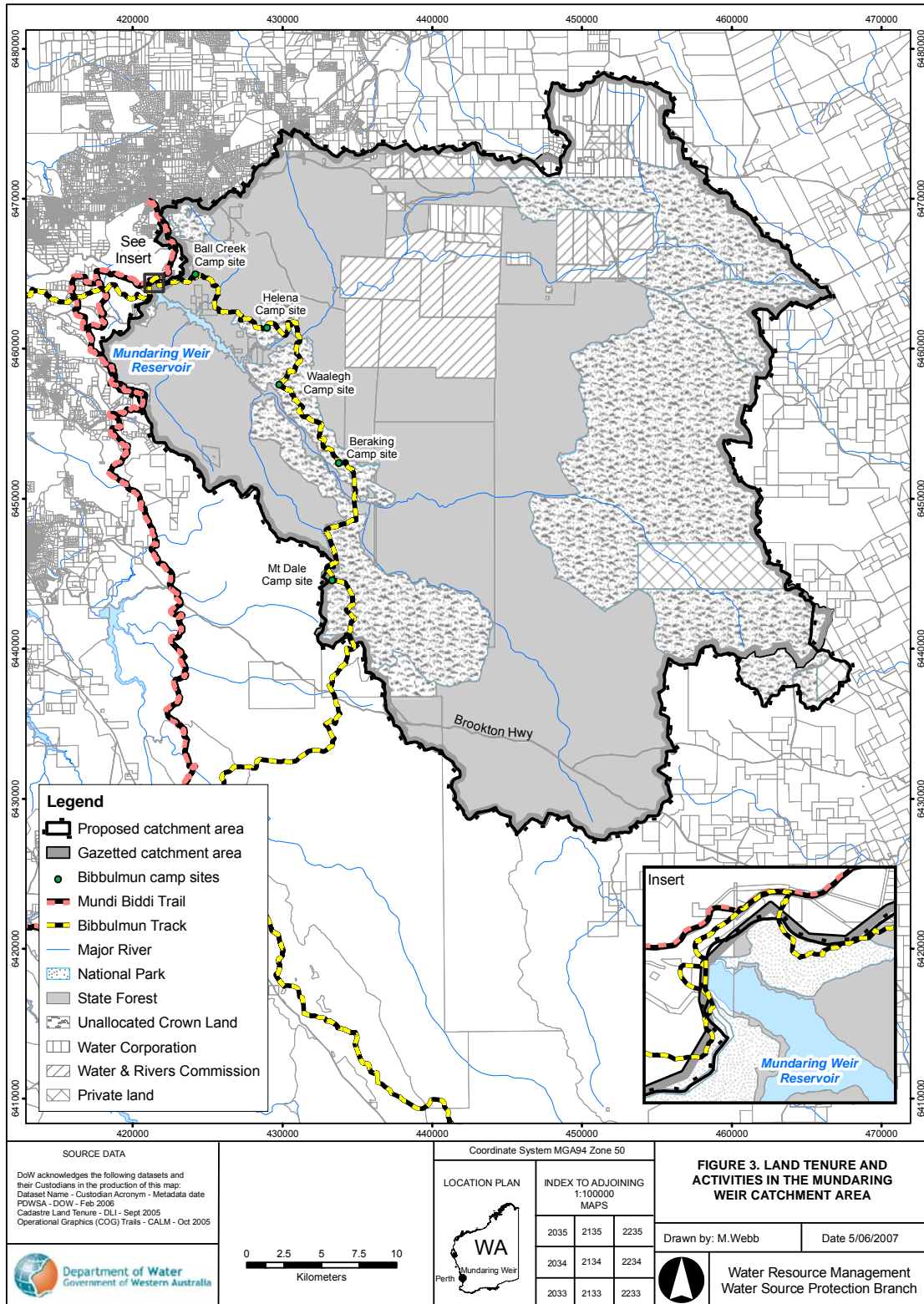


Figure 3. Land tenure and activities in the Mundaring Weir Catchment Area

4 Catchment protection strategy

4.1 Protection objectives

The objective of this plan is to protect this water source in the interest of providing safe drinking water. However the rights of existing approved land users to continue in the Mundaring Weir catchment are recognised.

The Priority 1, 2 and 3 classifications proposed for this catchment have fundamental water quality objectives of risk avoidance, risk minimisation and risk management, respectively.

The overall source protection objective for the catchment is to maintain existing water quality and initiate measures to improve water quality where possible.

This plan aims to balance water quality protection, and social needs and aspirations as much as possible.

Current freehold land uses are generally compatible with the Priority 2 classification. This plan recognises the right of existing approved land uses to continue to operate in the catchment. The Department will not be placing new restrictions on existing practices. However, the adoption of best management practices is encouraged for water quality protection

4.2 Proclaimed area

The Mundaring Weir Catchment Area was proclaimed under the *CAWS Act* in 1972. The boundary of the proclaimed area will be amended to more accurately represent the physical catchment boundary, specifically in the southeast corner. The Department is also progressing changes to the by-laws to provide equivalent catchment protection to those catchments which also provide water to the IWSS.

The existing and proposed Mundaring Weir Catchment Areas are shown in Figure 4.

4.3 Priority classifications

All public land in the Mundaring Weir 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 as:

- The Mundaring reservoir is the primary source of public drinking water for the G&AWS, without which supply to this region can not be maintained, and should be afforded the highest level of protection; and
- Most existing land use practices are compatible with P1 source protection, or can be managed for P1 source protection with the use of best management practices.

The WA Junior Motocross Club operates club rooms and facilities at Eric Walter Park on Old Northam Road, in a P1 area, in the north of the catchment. This type of established and historically approved activity is non-conforming and conditional in drinking water catchments and requires the development of an environmental management plan. The land on which the facility is operated is zoned for Public Purpose. The land is owned by the Water Corporation (leased to the Shire who sub-let to the Motocross Club). New motor sport events are not supported.

The Chidlow Recreation Ground lies on the northern catchment boundary on land zoned for Public Open Space and a community hall lies on a small lot zoned for Public Purposes. These lots should be classified Priority 2 (P2) and conditions defined by the Department for the operation of the site to minimise risk to water quality.

Most of the privately-owned land in the catchment should be managed for P2 source protection (Figure 4). The objective of this priority classification is to ensure that there is no increased risk of pollution to the water source.

The P2 classification for private land is appropriate as most of the private land in the catchment is used for low intensity agriculture or low density residential living. The Shire Depot and animal pound property that overlaps the catchment boundary is not ideally located. This is not a desirable location for the pound because water quality is potentially compromised by deposit of animal manure and runoff from the site, however because of the size and ownership of the lot, it should be classified as Priority 3 and managed accordingly.

There are two Rural Landscape Living (RLL)-zoned properties in the north-west of the catchment that are smaller than 2 ha. These are Lot 1696 Mundaring Weir Road, and 295 McCallum Road. As land uses are compatible with Priority 2 classification and due to their proximity to water courses, these two properties should be classified P2 despite their small size. A further two RLL-zoned properties between 1 and 2 ha in area overlap the catchment boundary (Lots 22 and 23 Darkan Street) and should be classified Priority 2, with only that area within the catchment necessarily managed as such.

Private land in the north and north-east of Mundaring catchment that is mostly zoned General Rural under the Town Planning Schemes of the Shire's of Northam, York and Mundaring should be classified P2.

The Lakes service station property that lies on the gazetted catchment boundary on the corner of Great Eastern Hwy and Great Southern Hwy should be classified Priority 3 (P3) with the condition that all drainage from the site is directed away from the catchment.

The detail of general land use compatibility under each classification is outlined in the Water Quality Protection Note *Land Use Compatibility in Public Drinking Water Areas*. This document provides general guidance on the compatibility of future land use development. It is not an exhaustive list of land uses and will be updated as clarification of uses is requested and industry standards change. The term conditional is used where the land can usually be compatible with the objectives of source protection, with adoption of appropriate site management practices. Generally these are practical steps to protect water resources from potential contamination and cover issues such as fuel and chemical storage, nutrient application and waste disposal. This document is available at the Department of Water website www.water.wa.gov.au, select *Water Quality>Publications>Water Quality Protection Notes*, where it is periodically updated.

4.4 Protection zones

To protect the reservoir from immediate risks to water quality such as human contact, it is recommended that the catchment be managed with a Reservoir Protection Zone (RPZ). This is a key barrier for protecting the reservoir and drinking water quality.

A RPZ is usually defined by a two kilometre buffer area around the top water level of the reservoir, including the reservoir itself, and not extending outside the catchment area.

The development of organised events within the RPZ would be opposed, and general public access to the area would be prohibited. Existing activities within this zone, such as the Bibbulmun track, will be periodically reviewed for compliance with water quality protection objectives.

Figure 4 shows the proposed RPZ.

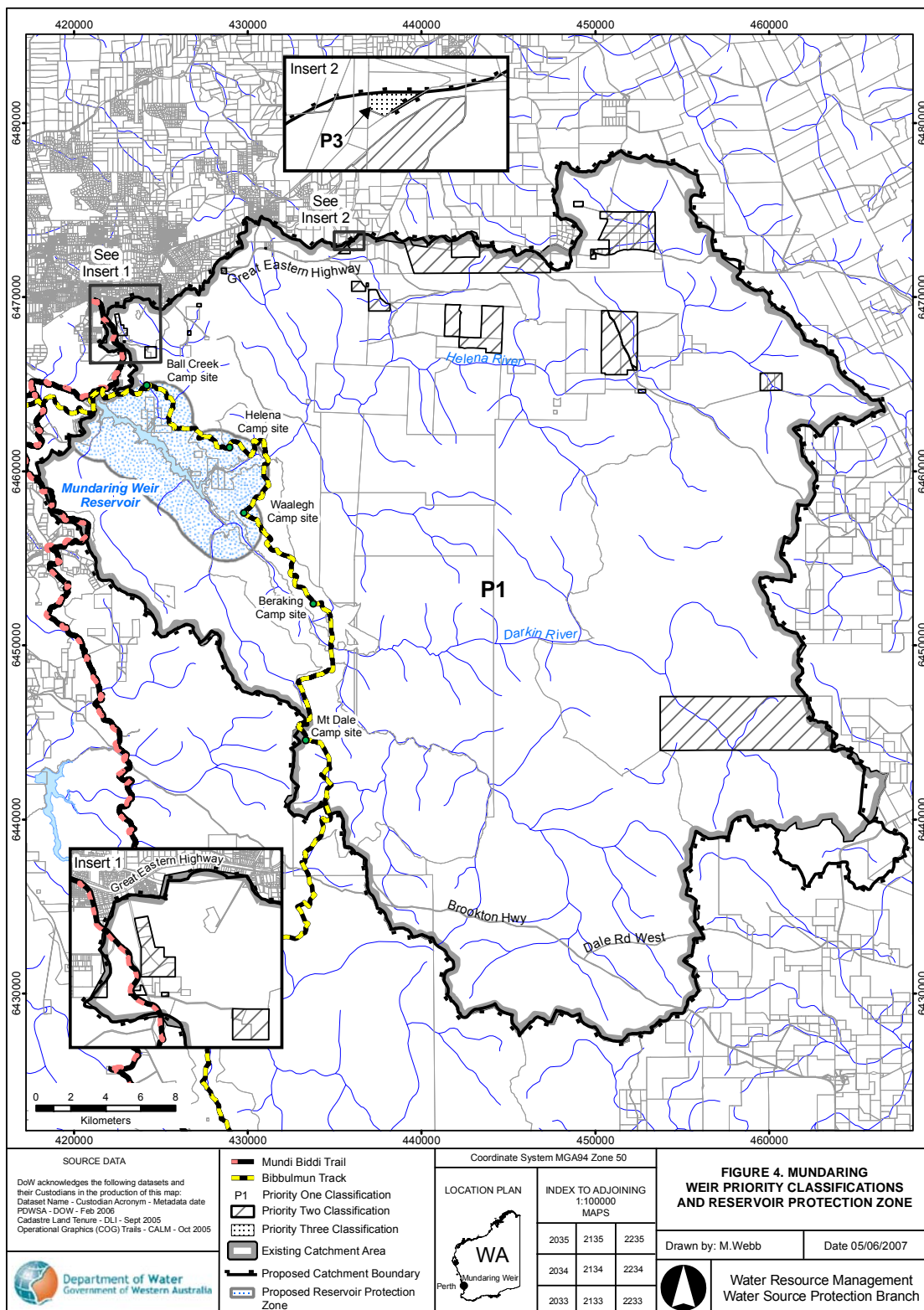


Figure 4. Proposed catchment area, priority classifications and protection zones for Mundaring Weir Catchment Area

4.5 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* (SPP 2.7) (Western Australian Planning Commission, 2003) it is therefore appropriate that the Mundaring Weir Catchment Area and priority classifications be recognised by a Special Control Area in the town planning schemes for each relevant local government authority. In accordance with SPP 2.7 any development proposals located within this area, or deemed likely to affect the protection objectives of the catchment should be referred to the Department of Water for advice and recommendations.

4.6 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. Examples include: water quality protection notes *Land use compatibility in Public Drinking Water Source Areas* and *Orchards in Sensitive Environments*, which are listed in the References section. The guidelines help managers reduce the risk of their operations causing unacceptable environmental impacts. They are recommended as best practice for water quality protection.

Education and awareness (e.g. signage and information material) is a key mechanism for water quality protection, especially for those people visiting the area who are unfamiliar with the Mundaring Weir Catchment Area. A brochure will be produced once this Plan is endorsed, describing the catchment, 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.

4.7 Surveillance and By-law enforcement

The quality of public drinking water sources within country or metropolitan areas of the State is protected under the *Country Areas Water Supply Act (1947)* or *Metropolitan Water Supply Sewerage and Drainage Act (1909)* respectively. Proclamation of these areas allows existing by-laws to be applied to protect water quality.

The Department of Water considers by-law enforcement, through on-ground surveillance of land use activities in Public Drinking Water Source Areas as an important water quality protection mechanism. Surveillance is also important in raising the general level of awareness of the need to protect water quality.

Signs are erected to educate the public and to advise of activities that are prohibited or regulated. This Plan delegates the responsibility of surveillance and by-law enforcement to the Water Corporation.

4.8 Emergency response

Escape of chemicals during unforeseen incidents and use of chemicals during emergency responses can result in water contamination. The City of Armadale and Shires of Mundaring, Kalamunda, Northam, York, Beverley and Wandering Local Emergency Management Advisory Committee (LEMAC) through the East Metropolitan Emergency Management District should be familiar with the location and purpose of the Mundaring Weir 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 should have an advisory role to any HAZMAT incident in the Mundaring Weir Catchment Area.

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

4.9 Recommended protection strategies

Table 1 identifies the potential water quality risks associated with existing land uses in the Mundaring Weir Catchment Area and recommends protection strategies to minimise these risks.

The success of these recommended protection strategies can be partly assessed by analysing stream flow and water quality monitoring data for the catchment. There are currently a number of monitoring sites in the catchment where collection of this data is occurring. The ongoing operation of these sites will provide a valuable source of data for future assessment of this source protection planning.

Following publication of the final Mundaring Weir Drinking Water Source Protection Plan, an Implementation Strategy will be drawn up based on the recommendations in Table 1. It will describe timeframes and funding sources for the recommended protection strategies and identify responsible stakeholders. This is reflected in the Recommendations section of this plan.

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

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Land and forest management</i>					
Feral animal control <ul style="list-style-type: none"> • Foxes • Feral pigs 	The major risk to water quality associated with feral animals is pathogen contamination. Feral pigs involve an additional risk of turbidity through erosion from foraging and wallowing. The carcasses of the poisoned foxes may also pose a risk of pathogen contamination.	High	Feral animal control reduces the risks associated with these animals, but may introduce additional risks to water quality if not properly managed. Fox baits are not considered to have an impact on water quality. However, if animal carcasses are near watercourses they can be a contamination risk.	Fox baiting programme using 1080, which is a naturally occurring poison from a native plant. Feral pig control programme using the 'trap and shoot' method, with culled pigs disposed of outside the catchment conducted by the Department of Environment and Conservation (DEC) and Water Corporation (WC). Reservoir detention	Acceptable activity with controls <ul style="list-style-type: none"> • Ensure fox baits are located away from the reservoir and tributaries. • Develop interagency guidelines for the managed control of feral pigs that addresses issues such as the presence of hunters in the RPZ, prohibition of dogs and camping, and the disposal of carcasses outside the catchment. • Ensure licensed hunters comply with the above guidelines.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Land and forest management</i>					
Fire management <ul style="list-style-type: none"> • Fuel reduction burning • Firebreaks • Water points 	The main risk to water quality is an increase in turbidity from fuel reduction burning and the construction and maintenance of firebreaks. This is particularly true in areas close to the reservoir or tributaries with steep slopes.	High	Fire protection is an essential land management practice in the catchment, which potentially reduces the impacts of wild fires. Impacts from wild fires include erosion, turbidity and carbon/nutrient contamination from airborne and eroded ash.	Controlled burning programme to reduce fuel load. State Wildfire Emergency Management Plan. WC rangers present at fires in catchment.	Acceptable activity with best management practices. <ul style="list-style-type: none"> • Establish specific guidelines relating to water quality protection and prescribed burning. This could include the location of firebreaks, use of sumps or drains for sediment control and appropriate herbicide use. • Ensure the above guidelines are included in the burning prescription. • Ensure the Department of Health (DoH) PSC-88 and Statewide Policy No 2: <i>Pesticide use in Public Drinking Water Source Areas</i>, are used, if pesticide use is required.
	There is also a potential risk of pesticide contamination from firebreak maintenance	Medium	The use of fire protection should be managed to limit the potential for turbid runoff into the reservoir and tributaries.	Post fire controls such as coir logs, PACI dosing and water quality monitoring.	
	Turbidity may also be caused from the use of unsealed roads in the construction of, and access to, water points for wildfires.	Medium		Burn prescriptions for DEC managed land give consideration to water quality protection in the pre-burn prescription and during implementation.	
	The use of fire retardants such as Silv-Ex foam may also pose a contamination risk.	Medium			

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Land and forest management</i>					
Firewood collection	The potential risks associated with firewood collection include pathogen contamination from people near watercourses and possible rubbish dumping.	Medium	The primary concern is the presence of people near the reservoir and tributaries during firewood collection. The non-commercial collection of firewood by the public, if less than one tonne per trip, is managed by DEC via a permit system. Firewood collection, if greater than one tonne, is the responsibility of the Forest Products Commission (FPC).	DEC firewood collection permits for quantities under one tonne.	<p><i>Acceptable activity with conditions.</i></p> <ul style="list-style-type: none"> Ensure regional plans for public firewood collection areas give consideration to water quality protection objectives. Ensure all firewood collection areas within the catchment are outside the RPZ, and away from watercourses.
Sand mining	The potential risks associated with sand mining include turbidity from ineffective site and waste management, and the use of unsealed roads, and fuel spills from vehicles and machinery.	Low	The risks to water quality can be avoided through proper management such as maintenance of roads and buffer zones, and ensuring all mechanical servicing is done outside the catchment. The smaller the scale of operations, the smaller the risks to water quality are.	Regular (monthly or fortnightly) site inspections by catchment rangers	<p><i>Acceptable activity with best management practices.</i></p> <ul style="list-style-type: none"> Ensure that best management practices are adopted such as those outlined in the <i>Policy and Guidelines for construction and silica sand mining in Public Drinking Water Source Areas.</i>

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Land and forest management</i>					
Gravel pits	The main potential risks associated with gravel pits are turbidity from extraction practices, ineffective site management, the use of unsealed roads, possible fuel spills from vehicles and machinery, and illegal rubbish dumping.	Low	The risks to water quality can be minimised through proper site management including runoff control measures, and appropriate rehabilitation of the gravel pit when no longer in use.	Relevant Policy Statements and management guidelines specified in this Department's water quality protection note on extractive industries.	<p>Acceptable activity with best management practices.</p> <ul style="list-style-type: none"> Reference should be made to DEC's Policy Statement No.2 Local Government Access to raw materials from State forest and Timber Reserves, Policy Statement No. 10 Rehabilitation of disturbed land and Guidelines for the Management and Rehabilitation of Gravel Pits – South West Forest Areas. Ensure contract specifications recognise water quality protection objectives including the location of gravel pits in relation to waterbodies, effective site management, runoff control measures and appropriate rehabilitation. Approval of gravel extraction proposals should include the conditions stated in this Department's Water Quality Protection Note: <i>Extractive industries near sensitive water resources.</i> Inspect water quality protection measures on site.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Land and forest management</i>					
Native forest timber harvesting	<p>The potential risks associated with native timber harvesting include:</p> <ul style="list-style-type: none"> • Turbidity due to log handling practices and use of unsealed roads; • fuel spills from vehicles and machinery; • pesticides from harvesting practices and replanting; and • spread of forest disease such as dieback and associated loss of vegetation. 	<p>Medium</p> <p>Low</p> <p>Low</p> <p>Low</p>	<p>The potential risks to water quality can be minimised through proper management such as maintenance of roads and retention of vegetation buffers along watercourses.</p> <p>Water quality protection is a requirement of the CALM Act, which recognises water as a resource.</p> <p>Forest management activities are considered to be compatible within priority 1 protection areas, with the use of best management practices.</p> <p>Chemical toilets are prohibited within a RPZ and within 100 metres of any waterway or wetland.</p>	<p>Code of practice and guidelines for harvesting</p> <p>Catchment Ranger inspections</p> <p>Supervision of operations by the FPC</p> <p>Surveillance by DEC</p>	<p><i>Acceptable activity with best management practices.</i></p> <ul style="list-style-type: none"> • Ensure harvesting occurs in accordance with the Code of Practice for Timber Harvesting and the Manual of Management Guidelines for Timber Harvesting. • Review the road network to identify roads not essential for forest operations and management of transport thoroughfare. • Close and rehabilitate any roads not required. • Inspect water quality protection measures on site. • Review detailed harvesting plans during the planning phase to ensure water quality protection objectives are included such as the provision of chemical toilets. • Ensure contract specifications recognise water quality protection objectives. • Ensure pesticide use follows the DoH PSC-88 and Statewide Policy No.2 Pesticide use in Public Drinking Water Source Areas.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Land and forest management</i>					
Plantation harvesting	<p>The potential risks associated with native timber harvesting include:</p> <ul style="list-style-type: none"> • Turbidity due to log handling practices, use and upgrading of unsealed roads, and runoff from cleared areas; • fuel spills from vehicles and machinery; • pesticides from plantation or softwood establishment and maintenance; and • fertilisers from plantation establishment practices 	<p>High</p> <p>Medium</p> <p>Medium</p> <p>Medium</p>	<p>The impact on water quality can be reduced through proper management such as maintenance of roads, retention of vegetation buffers along watercourses, and appropriate fertiliser or pesticide use.</p> <p>Harvesting has previously occurred in the Gorrie and Beraking plantations without retaining buffer zones close to the major streamlines (Helena and Darkin Rivers).</p>	<p>Code of Practice for harvesting.</p> <p>Harvesting and establishment plans reviewed during planning phase to ensure water quality protection objectives are included.</p> <p>Regular inspections by Water Corporation rangers.</p> <p>Drainage controls.</p> <p>Supervision of operations by FPC.</p> <p>Measures outlined in the <i>Forest Management Plan 2004-2013</i>, produced by the FPC</p>	<p><i>Acceptable activity with best management practices.</i></p> <ul style="list-style-type: none"> • Work with DEC and the FPC to restore vegetation buffers adjacent to the reservoir and streamlines in harvested areas. • Ensure harvesting occurs in accordance with the <i>Manual of Management for Timber Harvesting</i> and the <i>Code of Practice for Timber Plantations</i>. • Establish protocols for joint field inspections with relevant agencies prior to harvesting operations to ensure activities do not occur in high risk areas, such as steep slopes or adjacent to watercourses. • Inspect water quality protection measures on site. • Ensure water quality protection objectives are included in harvesting and establishment plans.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Land and forest management</i>					
Plantation Harvesting (cont)	See previous page	See previous page	See previous page	See previous page	<p><i>Acceptable activity with best management practices.</i></p> <ul style="list-style-type: none"> • Ensure pesticide use follows the DoH PSC-88 and Statewide Policy No.2 <i>Pesticide use in Public Drinking Water Source Areas.</i> • Ensure contract specifications recognise water quality protection objectives including use of chemical toilets. Chemical toilets are prohibited within the RPZ and within 100m of any waterways or wetlands
Private resource harvesting <ul style="list-style-type: none"> • Apiaries • Wild flower picking • Seed collection 	The potential risk to water quality from these activities is pathogen contamination through people near the reservoir and tributaries, and associated camping.	Medium	<p>The main concern from these activities is the potential for people to be close to the reservoir or tributaries, which needs to be controlled.</p> <p>The low numbers of people involved, together with management controls, reduces the risks associated with these activities.</p>	<p><i>Acceptable activity with controls.</i></p> <ul style="list-style-type: none"> • Apply a condition of approval for apiarists, wildflower picking and seed collection that requires adherence to water quality protection objectives. • Inspect water quality protection measures on site. 	

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Land and forest management</i>					
Roads and tracks	<p>The potential risks associated with the use of roads and tracks include:</p> <ul style="list-style-type: none"> • Turbidity from erosion of unsealed roads and tracks, particularly in areas of steep slope close to the reservoir or tributaries; • fuel and chemical spills from vehicles and machinery; • pesticides from road maintenance; and • pathogen contamination from public access to the waterbody. 	<p>High</p>	<p>Some roads and tracks are necessary for timber harvesting, fire management and general land and forest management. However, it is essential they are well maintained to minimise the risk of erosion.</p> <p>Management of roads/tracks in timber harvesting areas is covered by the <i>Codes of Practice for Timber Harvesting and for Timber Plantations</i> and in the <i>Management Guidelines for Timber Harvesting</i></p> <p>Designated roads and tracks in State Forest are public roads, which significantly increases access to the catchment. Vehicle use on roads or tracks by the general public occurs extensively throughout the catchment, and there are a number of roads that are severely degraded.</p>	<p>Remedial works and inspection of tracks by Catchment Rangers.</p> <p>Runoff mitigation measures, such as table drains.</p> <p>Enforcement of restricted access to disease risk areas with gates currently installed at Reservoir and Allens Roads.</p> <p>There are also a further three gates planned to restrict access to the area between Ashendon Road and the reservoir.</p>	<p><i>Acceptable activity with best management practices.</i></p> <ul style="list-style-type: none"> • Manage roads in the plantations and State Forest in accordance with the relevant codes of practice and guidelines. • Review the road network to identify roads not essential for forest operations and management or transport thoroughfare. • Close and rehabilitate tracks that are not required. • Expand enforcement of restricted access associated with Disease Risk Areas to limit public access to areas of the catchment. • Undertake a recreation planning exercise to review public access to forest areas in the catchment. • Ensure pesticide use follows the DoH PSC-88.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Other land uses</i>					
Major roads <ul style="list-style-type: none"> • Shire roads • Main roads 	The potential risks to water quality include: <ul style="list-style-type: none"> • Fuel and chemical spills from vehicles and their loads; • herbicides from weed control on road verges; and • turbidity from erosion of unsealed roads. The risks associated with roads are reduced by increased distance from the waterbody.	Medium Low Medium	The main roads that intersect the catchment are the Great Eastern Highway, Great Southern Highway and Brookton Highway. They generally pass through the northernmost and southernmost sections of the catchment. These roads are major haulage routes, and are necessary for transportation and operations in the area. Road maintenance and management measures should be used to minimise the impact of a spill or erosion on the water quality of the catchment.	HAZMAT emergency procedures. The application of pesticides is conducted in accordance with the DoH PSC-88. 'Report pollution' signage.	<i>Acceptable with best management practices.</i> <ul style="list-style-type: none"> • Develop management guidelines for Shire roads and main roads that address water quality protection objectives, including appropriate road construction, maintenance, drainage, runoff and spill control, and weed control. • Ensure road upgrades follow alignments and incorporate measures to avoid water source contamination. • Restrict development of new roads through the catchment. • Undertake road construction and maintenance in a manner which avoids water source contamination risks.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Other land uses</i>					
Possible water treatment plant (WTP)	The main risks to water quality from this activity are chemical spills within the WTP and associated access road (from delivery vehicles). There is also the risk of by-products of the treatment process not being properly contained.	Low Low	A WTP requires transport of various chemicals to the plant and their storage and use within it. As they are approved for use in drinking water, the potential risk that they pose (from any spillage) would be much less than dangerous chemicals transported along Great Eastern Highway. The treatment process also generates by-products which must be properly disposed of, either on or off site The protection strategy for the WTP requires multiple levels of containment. This would include tank walls, surrounding sealed bunds with sufficient capacity and a stormwater drainage system discharging into a sealed overflow sump, with a return pipeline to Mundaring reservoir. All by-products would be disposed of off-site.	Public forum process for site selection through Water Corporation.	<p><i>Acceptable with best management practice.</i></p> <ul style="list-style-type: none"> Best management practices include a range of engineering design standards and compliance with Dangerous Goods Licences and Environmental Protection Conditions. Reforest an area of cleared land within the catchment that is equivalent or greater than the cleared area needed for the WTP, supporting infrastructure and additional service pipelines.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Other land uses</i>					
Research projects	The use of the catchment and reservoir for research projects involves a potential risk of pathogen contamination from people remaining in the catchment for extended periods of time.	Low	The risk posed is minimal as it is always undertaken with supervision and there are very few people involved. The approval for research projects to be undertaken in the catchment is based on the compatibility with water quality objectives.	Approval must be sought prior to research being undertaken and may be conditional, if appropriate.	<i>Acceptable activity with best management practice.</i> <ul style="list-style-type: none"> Ensure that the people involved are aware of their presence in a drinking water catchment and the importance of protecting drinking water quality.
Rubbish dumping	The potential risks associated with this activity include: <ul style="list-style-type: none"> Pathogen contamination from domestic rubbish; and nutrient, chemical, heavy metal and fuel contamination from domestic or industrial waste, and the dumping of stolen cars. 	High Medium	Rubbish dumping is often associated with informal or unauthorised recreation or access to the catchment. As all roads and tracks in the State forest are public roads, control of access is a major issue in the catchment.	Barriers and signage. Issuing of fines to offenders by catchment rangers.	<i>Rubbish dumping is not acceptable in the catchment.</i> <ul style="list-style-type: none"> Continue to develop a coordinated interagency plan to reduce rubbish dumping in the catchment. Review the road network and close roads not essential for forest operations or transport thoroughfare to limit public access. Expand signage, education and surveillance to discourage offenders.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Private land</i>					
General farming (cont) <ul style="list-style-type: none"> • Livestock grazing • Horses • Cereal crops • Orchards • Hobby farms • Apiaries • Residences • A commune 	The potential water quality risks associated with these land uses include: <ul style="list-style-type: none"> • Increased turbidity as a result of clearing and poor land management practices such as stock access to streams; and • increased stream salinity from water balance changes as a result of clearing. 	High	It is recognised that use of private land for existing approved land uses is essential for the livelihood of residents. The risks associated with these activities can be managed through education and the adoption of best management practices. The Mundaring catchment is a gazetted clearing control catchment. This provides a mechanism for Government purchase of clearing rights, and assists with offsetting the impacts of water quality protection strategies on landowners. The former Water Authority purchased clearing rights on several properties in the catchment	Subdivision restrictions and appropriate zoning through Town Planning Schemes.	Existing land uses are acceptable with best management practices. <ul style="list-style-type: none"> • Ensure the water quality protection objectives of the Priority 1, 2 and 3 classifications are recognised in the Town Planning Scheme of relevant Shires. • Assess and provide guidance on development proposals within the catchment area to ensure that water quality protection requirements are addressed, in accordance with SPP 2.7. • Oppose intensification of land use through planning approval process. • Encourage revegetation on cleared land where appropriate. • Establish a revegetation demonstration site.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Private land</i>					
Road house and service station	<p>The potential risks associated with a service station or food shop include:</p> <ul style="list-style-type: none"> • Pathogen contamination from wastewater disposal systems; and • fuel spills from vehicles, tankers and hydrocarbon waste disposal. 	<p>Low</p> <p>Medium</p>	<p>The service station lies on the catchment boundary with the Great Eastern Highway separating it from the rest of the catchment. Most of the runoff, including the septic system, discharges away from the catchment.</p> <p>The storage tanks (above and below ground) lie on the catchment boundary but it would appear that the site could be managed to ensure that all drainage flows away from the catchment.</p>	<p>The property is zoned for "Special purpose – Caravan park/Restaurant/Service station" under the Shire of Mundaring Town Planning Scheme.</p>	<p><i>Acceptable activity with best management practice.</i></p> <ul style="list-style-type: none"> • Ensure the majority of wastewater and drainage from both sites is directed away from the Mundaring catchment. • Inspect water quality protection measures on site.
Mundaring Shire Depot and animal pound	<p>The potential risks to water quality include:</p> <ul style="list-style-type: none"> • Pathogen contamination from wastewater disposal systems and animal manure; • hydrocarbons from vehicles; and • turbidity from the inappropriate management of boundary firebreaks 	<p>Medium</p> <p>Low</p> <p>Low</p>	<p>The location of animal pound is not desirable as water quality is potentially compromised by the deposit of animal manure and runoff from the site.</p> <p>The back of the property that drains into the catchment has also been used to store empty chemical drums. This should not occur.</p>	<p>The Shire Depot is zoned "Public Purpose – Shire Depot" and houses the depot and animal pound.</p>	<p><i>Acceptable activity with best management practice.</i></p> <ul style="list-style-type: none"> • Ensure the Shire of Mundaring manages the animal pound using best management practices. • Inspect water quality protection measures on site.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Recreation</i>					
Animals exercising on Crown land (dogs and other domestic animals)	The potential risk associated with this activity is pathogen contamination from people and animals in the catchment, particularly in close proximity to the reservoir and tributaries.	Medium	As animal behaviour cannot always be controlled, there is a risk of contamination, particularly close to waterbodies. Dogs have historically been allowed in the catchment. The greatest risk is assumed to be within the RPZ and near streams in the catchment.		<p><i>Exercising of animals is unacceptable in the catchment.</i></p> <ul style="list-style-type: none"> • Dogs and other domestic animals are not allowed in the catchment and particularly the RPZ. • Use signage and advertising to ensure public awareness of the risk that dogs pose to water quality and areas where they (and other domestic animals) are prohibited. • Undertake surveillance and by-law enforcement.
Camping Designated campsites (including approved temporary campsites)	The potential risk associated with camping is pathogen contamination from human and animal wastes, swimming, bathing, rubbish disposal and domestic animal contact with water.	Medium	The risks to water quality can be managed by designated campsites, such as those along the Bibbulmun Track, providing appropriate facilities and ensuring there is no access to the waterbody.	<p><i>Undesignated camping is not acceptable in the catchment.</i></p> <ul style="list-style-type: none"> • Establish regulations under the CAWS Act by-laws to prohibit camping in the catchment other than at designated sites. • Ensure permanent designated campsites are only in association with the Bibbulmun Track, are properly maintained and cater for demand. 	

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Recreation</i>					
Bushwalking (cont)	See previous page	Low	See previous page	See previous page.	<p><i>Acceptable activity, with conditions.</i></p> <ul style="list-style-type: none"> • Ensure bushwalking, including approved events and informal activity, is restricted to designated trails. • Use signage and education to inform people they are in a catchment area and ways to protect water quality, such as promotion of rubbish removal • All bushwalking through undisturbed environments (off marked trails) is an unacceptable activity in this catchment
Chidlow recreation ground and community hall	<p>The potential risks to water quality include:</p> <ul style="list-style-type: none"> • Pathogen contamination from wastewater disposal systems and presence of people and animals; • nutrient and pesticide contamination from application to playing fields and gardens; and • Litter 	<p>Medium/Low</p> <p>Medium/Low</p> <p>Low</p>	The recreation ground lies on the catchment boundary and consists of an irrigated sports oval and club room building with septic tank toilet facilities.	Application of pesticides conducted in accordance with PSC88.	<p><i>Existing facility is acceptable with an environmental management plan.</i></p> <ul style="list-style-type: none"> • Ensure an environmental management plan for the site is developed, implemented and audited, including minimum fertiliser and pesticide application. • Maintain on site signage to inform the public of the catchment boundary and significance of the Mundaring PDWSA.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Recreation</i>					
Car Rally events <ul style="list-style-type: none"> Rally Australia Clubman Rally 	The potential risks associated with car rally events include: <ul style="list-style-type: none"> Turbidity from erosion of unsealed roads, particularly on steep slopes near the reservoir; fuel spillage from vehicles; pathogen and litter contamination from spectators within the catchment; and spread of forest disease, such as dieback, and associated loss of buffer vegetation causing increased erosion. 	High Medium Medium Medium	These two car rally events have historically occurred in the catchment on an annual basis. The Clubman Rally being a local event run prior to Rally Australia. 2006 is the last year that Rally Australia will be held in the catchment and recommencement will not be supported. Clubman Rally is likely to continue as an established event.	All car rally events historically held in the catchment were approved based on an acceptable environmental management plan. This plan includes provisions for water quality such as road maintenance, spectator areas and toilets, and rehabilitation such as rubbish collection, following events. Significant emergency response processes in place.	Existing events are acceptable with an environmental management plan. <ul style="list-style-type: none"> No new rally events, or extensions to existing events, to be established in the catchment. No events to be held in the winter months. Approval for each event is subject to the review and implementation of the plan addressing water quality protection measures. Audit the implementation of the plan following the event. Prohibit vehicle maintenance in the catchment. Ensure the public are aware that only approved events are permitted in the catchment.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Recreation</i>					
Eric Walter Park (WA Motocross Club)	<p>The potential risks to water quality include:</p> <ul style="list-style-type: none"> • Turbidity from erosion of tracks and damage to vegetation; • hydrocarbon contamination from fuel spillage; and • pathogen contamination from people remaining in the catchment for extended periods of time, domestic animals and waste disposal systems. 	<p>Medium</p> <p>Low</p> <p>Medium</p>	<p>The Junior Motocross Club operates on a property leased to the Shire of Mundaring by the Water Corporation. The property is part of Reserve 6203, reserved for the Corporation for public purposes.</p> <p>The current motocross activity is high intensity, leaving much of the land bare and unvegetated, and subject to erosion. The high risks associated with the site are mitigated by the distance from the reservoir, as the site is upstream of Old Northam Rd near the northern boundary of the catchment.</p>	<p>Regular inspections by catchment rangers</p>	<p><i>Existing activity is acceptable with an environmental management plan.</i></p> <ul style="list-style-type: none"> • Ensure the lease agreement requires development, implementation and audit of environmental management plan, including erosion mitigation works and revegetation. • Investigate the opportunities for relocation of the Club to an area outside the PDWSA.
Fishing and marroning	<p>The major risks to water quality include:</p> <ul style="list-style-type: none"> • Pathogen contamination from people remaining close to waterbodies for extended periods of time. 	High	<p>Marroning poses a significant risk due to the large numbers of people in direct contact with the waterbody for extended periods of time. There are also additional associated risks such as camping and the presence of dogs.</p>	<p>Issuing of fines by Water Corporation Rangers under the <i>Fish Resources Management Regulations 1995</i>.</p> <p>Signage and surveillance.</p>	<p><i>Fishing and marroning in the reservoir or tributaries is not acceptable in the catchment.</i></p> <ul style="list-style-type: none"> • Establish stronger regulations under the CAWS Act by-laws to prohibit fishing and marroning in the catchment.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Recreation</i>					
Fishing and marroning (cont)	The major risks to water quality include: <ul style="list-style-type: none"> • Turbidity from vehicle use 	Low	Human or animal contact with water poses an immediate threat to water quality, and should be avoided.	See previous page	<i>Fishing and marroning in the reservoir or tributaries is not acceptable in the catchment.</i>
Orienteering	The potential risk to water quality from this activity is pathogen contamination from people being present in the catchment, particularly in close proximity to waterbodies.	Low	There are two organised events held annually in the catchment by Orienteering Association of Western Australia (OAWA). These events are managed through approval from DEC and the Water Corporation, and use similar sites each year. The events are well managed with the groups being very responsible and willing to promote water quality protection issues.	Liaison between the DEC and the Water Corporation for approval of events.	Acceptable activity with controls. <ul style="list-style-type: none"> • Ensure OAWA obtains approval for events, and proper management of the group is a condition of approval, such as the provision of chemical toilets. • Ensure the approved event area is outside the RPZ. • Use signage and education to inform people that they are in a Public Drinking Water Source Area and ways to protect water quality.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Recreation</i>					
Horse riding	<p>The main risk associated with this activity is pathogen contamination from people and animals remaining in the catchment for extended periods of time, particularly in areas close to waterbodies, and possible camping.</p> <p>There is an also additional risk of erosion and turbidity from the use of horses and vehicles on unsealed roads, and fuel spills from vehicles accessing these roads.</p>	<p>High</p> <p style="text-align: right;">Low</p>	<p>Horse riding poses a significant risk to water quality and should be avoided in the catchment.</p> <p>The risk is reduced where horse riding occurs along roads and tracks away from the reservoir and tributaries.</p>	<p>Water Quality Protection Guidelines No. 13 <i>Environmental guidelines for horse facilities and activities</i></p>	<p><i>Existing events are acceptable with conditions.</i></p> <ul style="list-style-type: none"> Undertake a recreation planning exercise to identify alternative horse riding opportunities. Ensure horse riding does not occur in the RPZ. Use signage to inform riders that the activity is restricted to public roads outside the RPZ. Undertake surveillance to ensure riders stay on public roads outside the RPZ. Ensure all riding is conducted in accordance with the <i>Environmental Guidelines for horse facilities and activities.</i>

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Recreation</i>					
Motor cycle events <ul style="list-style-type: none"> Enduro event 	The potential risks to water quality include: <ul style="list-style-type: none"> Turbidity from erosion of unsealed roads used in the event; fuel spillage from cycles and vehicles; pathogen and litter contamination from spectators and those staying in the catchment for extended periods of time; and spread of forest disease such as dieback. 	Medium Low Medium Medium	The Enduro event has historically been held annually in an area of State Forest in the south-east corner of the catchment. It is no longer considered an established event. The distance of the area used from the reservoir reduces the associated risks. As with car rally events, only existing motor cycle events will be approved.	Review, implementation and audit of an environmental management plan.	Existing event is acceptable with an environmental management plan. <ul style="list-style-type: none"> No additional events to be established in the catchment. Approval for each event is subject to the review and implementation of the plan addressing water quality protection measures. Prohibit vehicle maintenance in the catchment. Ensure the public are aware that only approved events are permitted in the catchment. Minimise spectator access to the catchment

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Recreation</i>					
Mountain bike riding and cycling <ul style="list-style-type: none"> • Munda Biddi Trail • Greystones Trail • Organised groups or events • Informal activities 	The potential risks to water quality include: <ul style="list-style-type: none"> • Pathogen contamination from people remaining in the catchment for extended periods with associated human waste and rubbish disposal, and possibly camping; • turbidity from the use of bikes on unsealed roads, particularly in areas of steep slope close to the reservoir; and • spread of forest disease, such as dieback, and associated loss of vegetation. 	Low	The Munda Biddi mountain bike trail is a long distance trail starting at Mundaring, which passes into the west of the catchment in two small areas. There is also a mountain bike riding event that used to occur annually on the Greystones Trail near the reservoir in the north west of the catchment. It is essential that designated or promoted tracks be regularly inspected and maintained to minimise the risk of degradation and erosion of the area. Organised activities may encourage later visits to the area by individuals. This type of access is not acceptable as it cannot be properly managed, which increases the risk to water quality.	Munda Biddi trail audit. Prior approval of organised events to be obtained from DEC Track maintenance by DEC.	Acceptable activities, with conditions. <ul style="list-style-type: none"> • No further trails to be developed in the catchment without consultation with relevant agencies. • Ensure an environmental management plan is developed, implemented and audited for the Munda Biddi Trail, which addresses water quality protection objectives, such as regular inspections and maintenance of the tracks. • Ensure organised groups obtain approval for events with the condition of proper management. • Ensure all mountain bike riding and cycling is outside the RPZ. • Use signage and education to inform people they are in a Public Drinking Water Source Area. • Greystones Trail to be closed with the offset to be located on Pauls Valley Road, Pauls Valley (opposite the Camel farm).

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Recreation</i>					
Vehicle access (away from public roads or designated tracks) (cont)	See previous page	See previous page	<p>The Chambers Block farmhouse area (on Flynn Block) and the Barton's Mill area are highly frequented for unauthorised vehicle use, and includes additional risks associated with the dumping of stolen cars and rubbish, and camping.</p> <p>The risks to water quality are intensified in Clifford Block and Flynn Block, particularly with vehicles crossing the Helena River. In Clifford Block, several sections of the Helena River are used during training courses or informally, and new tracks are continually developed in swamp areas adjacent to the waterbody.</p>	See previous page	<p><i>Vehicle access (away from public roads or designated tracks) is not acceptable in the catchment.</i></p> <ul style="list-style-type: none"> Consider enforcement of restricted access associated with Disease Risk Areas to limit public access to areas of the catchment; Use signage along the two designated tracks to advertise that driving off the designated track is not permitted. Use signage to promote awareness of the impact of unauthorised driving on water quality. Undertake surveillance to control unauthorised vehicle access in the catchment. Undertake a recreation planning exercise to locate suitable alternative sites for recreational off-road driving. Promote the adoption of the two designated tracks by relevant vehicle groups or associations to ensure they are maintained.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Recreation</i>					
Picnicking	<p>The potential risks associated with this activity are pathogen contamination from human and animal wastes and litter.</p> <p>There is also the risk of turbidity and fuel spillage from the use of vehicles.</p>	Low	<p>The risk of contamination is increased by picnic sites and associated facilities (toilets and rubbish collection) being in close proximity to the reservoir or tributaries.</p>	<p>Facilities at designated picnic sites provided by the Water Corporation</p>	<p><i>Acceptable activity, with conditions.</i></p> <ul style="list-style-type: none"> Establish regulations under CAWS Act by-laws to prohibit picnicking in the catchment other than at designated sites. Undertake a recreation planning exercise to identify picnicking opportunities within the catchment. Ensure designated picnic areas are outside the RPZ, include appropriate facilities and are located a minimum distance from a watercourse (at least 300 metres under the CAWS Act by-laws). This may involve the closure of the current picnic site on the north side of the dam wall, within the proposed RPZ. Use signage and education to inform people they are in a catchment area and ways to protect water quality, such as promotion of rubbish removal

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Recreation</i>					
Rifle range	<p>The potential risks to water quality associated with this activity include:</p> <ul style="list-style-type: none"> • Pathogen and nutrient contamination from on site wastewater disposal; and • lead leaching under certain conditions. 	<p>Low</p>	<p>The risks associated with this activity are low, and may be managed using Best Management Practices.</p> <p>However, rifle ranges are an incompatible activity in priority 1 source protection areas.</p>		<p><i>Manage as a non-conforming land use.</i></p> <ul style="list-style-type: none"> • Develop a management strategy with the site operator that specifically addresses water source protection objectives. • Ensure camping is not permitted on site. • Investigate the possibility of collection of waste lead. • Regular meetings between catchment rangers and the site operator to ensure water quality protection measures are in place and work effectively.
Swimming	<p>There is a high potential risk of pathogen contamination associated with swimming or full body contact with the waterbody.</p>	<p>High</p>	<p>Human or animal contact with the water poses an immediate threat to water quality.</p> <p>Swimming in reservoirs and feeder streams is prohibited under the CAWS Act by-laws.</p> <p>The Department of Health recommends that swimming in water used for public supply does not occur.</p>	<p>Signage and surveillance.</p>	<p><i>Swimming is prohibited in the reservoir and tributaries that traverse Crown land in the catchment.</i></p> <ul style="list-style-type: none"> • Use signage and education to ensure public awareness that swimming is prohibited. • Encourage that swimming in streams located on freehold land should not occur. • Expand surveillance and by-law enforcement.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Recreation</i>					
Recreational hunting	The presence of recreational hunters in the catchment increases the potential risk for pathogen contamination through animal carcasses, humans, dogs and litter.	High	Recreational hunting introduces significant additional risks to water quality, and the unauthorised introduction of pigs into the catchment is also associated with this activity. All recreational hunting in the catchment is illegal. It is essential that only authorised shooting occurs in the catchment, which should be part of the strictly controlled feral animal control program and undertaken in a well-managed and organised manner.		<p><i>Uncontrolled hunting on crown land is not acceptable in the catchment.</i></p> <ul style="list-style-type: none"> Introduce regulations under the CAWS Act by-laws to prohibit uncontrolled hunting in the catchment. Use signs and advertising material to advertise that hunting and shooting is not permitted. Undertake surveillance of the catchment and by-law enforcement. Support the DEC managed feral animal control program.
Rogaining	The potential risk to water quality is pathogen contamination from people in the catchment, often camping and in particular close to the reservoir or tributaries.	Low	Rogaining events are held in the catchment by the Western Australian Rogaining Association (WARA) and include the use of temporary campsites. These events are subject to approval by DEC, are generally well managed. WARA have a strict environmental policy and willingness to promote water quality protection issues.	Liaison between the Department of Environment and Conservation and the Water Corporation for approval of events with the condition of no camping.	<p><i>Acceptable activity with conditions.</i></p> <ul style="list-style-type: none"> Ensure WARA obtains approval for events with the condition of proper management. Ensure all events and temporary campsites are outside the RPZ. Ensure campsites have appropriate facilities and are located a minimum distance from waterbodies. Use signage to inform people that they are in a PDWSA and ways to protect water quality.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Department of Water freehold land</i>					
Rogaining (cont)	See previous page.	See previous page.	See previous page.	See previous page	Acceptable activity with conditions. <ul style="list-style-type: none"> • Include prohibition of camping in CAWS by-laws
DEC activities <ul style="list-style-type: none"> • Fire management • Feral animal control 	Refer to individual activities.	Medium	The forest and land management activities performed by DEC are generally acceptable with Best Management Practices.		Refer to individual activities.
Approved recreation	Refer to individual activities.	Medium	The properties are used extensively for unauthorised recreation. These activities may be controlled through the use of trespassing laws. A transition period would be necessary before laws were enforced.	Recreation activities through approved organised groups are generally acceptable with conditions and controls.	Refer to individual activities.
Unauthorised recreation <ul style="list-style-type: none"> • Camping • Bushwalking • Off-road vehicle use • Hunting 	Please refer to individual activities. There are also the additional risks of erosion and salinity associated with several sections of cleared land.	Medium	The Department owns several properties in the catchment, including Flynn Block and the Clifford Block area. This land was cleared for previous agricultural use, and has not been revegetated.		<i>Unauthorised recreation is prohibited on Department freehold land in the catchment.</i> <ul style="list-style-type: none"> • Investigate rehabilitation of cleared land with natural vegetation. • Establish a rehabilitation demonstration site on Department owned land.

Table 1. Continued

Land use / Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protective strategies
	Hazard	Management priority			
<i>Department of Water freehold land</i>					
Unauthorised recreation (cont)	See previous page	See previous page	A salt scald has been observed in the Flynn Block area. It is likely that salinisation of land and water in the catchment has occurred due to vegetation clearing for agricultural use.		<p><i>Unauthorised recreation is prohibited on Department freehold land in the catchment.</i></p> <ul style="list-style-type: none"> • Prohibit unauthorised access to Departmental properties under trespass laws. • Use signs to ensure public awareness of the private ownership of the properties. • Undertake surveillance of Department properties, with enforcement of trespass laws. • Repair fences and gates to restrict access. • Ensure that a coordinated approach to the management of Flynn Block sufficiently considers water quality protection and that appropriate strategies are implemented.

5 Recommendations

- 1 Implement the recommended protection strategies as detailed in *Table 1: Land use, potential water quality risks and recommended strategies* of this Plan. **(Applicable stakeholders)**
- 2 The boundary of the Mundaring Weir Catchment Area should be amended under the *Country Areas Water Supply Act 1947*. The map representing this new boundary should show the assigned priority classifications and reservoir protection zone. **(Department of Water)**
- 3 The *Country Areas Water Supply Act* by-laws should be strengthened to provide more protection for the Mundaring Weir Catchment Area. **(Department of Water)**
- 4 Prepare an implementation strategy for this Plan describing responsible stakeholders, timeframes and funding sources for the recommended protection strategies. **(Department of Water)**
- 5 The Planning Schemes or Strategies for the Shires of Mundaring, Northam and York, should incorporate this Plan and reflect the identified Mundaring Weir Catchment Area boundary, reservoir protection zone and Priority 1, 2 and 3 classifications. **(Shires of Mundaring, Northam and York)**
- 6 All development proposals within the Mundaring Weir 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* or *Statement of Planning Policy No.2.7 – Public Drinking Water Source Policy* should be referred to the Department of Water for advice and recommendations. **(Department for Planning and Infrastructure, Department of Environment and Conservation and Shires of Mundaring, Northam and York)**
- 7 Incidents covered by WESTPLAN – HAZMAT in the Mundaring Weir Catchment Area should be addressed through the following:
 - The Mundaring, Kalamunda, Armadale, Northam, York, Beverley and Wandering LEMAC are familiar with the location and purpose of the Mundaring Weir Catchment Area.
 - The locality plan for the Mundaring Weir Catchment Area is provided to the Fire and Rescue headquarters for the HAZMAT Emergency Advisory Team.
 - The Water Corporation provides an advisory role during incidents in the Mundaring Weir Catchment Area.
 - Personnel dealing with WESTPLAN – HAZMAT incidents in the area have ready access to a locality map of the Mundaring Weir Catchment Area and training to understand the potential impacts of spills on drinking water quality. **(Department of Water and Water Corporation)**
- 8 Surveillance should be increased to identify any incompatible land uses or potential threats within the Mundaring Weir Catchment Area. The Department of Water continues to delegate responsibility for the surveillance and enforcement within this catchment to the Water Corporation. **(Water Corporation)**

- 9 More Signage should be erected along the boundary of the Mundaring Weir Catchment Area 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)**
- 10 A review of this Plan should be undertaken after five years. **(Department of Water)**
- 11 An arrangement for the management of the coinciding areas of State Forest and Reserve 6023 should be established between the Department of Environment and Conservation and the Water Corporation. **(Department of Environment and Conservation and Water Corporation)**
- 12 Areas of cleared and degraded land in the catchment under Crown ownership should be rehabilitated and restored with native vegetation. Priority for rehabilitation should be given to streamlines, Barton's Mill, Department properties and non-essential roads and tracks. **(Appropriate Government agency with vesting)**
- 13 Agencies should meet to discuss the development of a recreation plan for this catchment. **(All agencies to participate)**
- 14 Review the requirements for stream gauging stations in the catchment to monitor for stream flow and water quality parameters, such as turbidity, salinity, colour and nutrients. **(Department of Water and Water Corporation)**

Appendices

Appendix A – Water Quality

The Water Corporation has monitored the raw (source) water quality from Mundaring in accordance with the Australian Drinking Water Guidelines (ADWG) and interpretations agreed to with the Department of Health. The raw water is regularly monitored for:

a. Aesthetic related characteristics– (Non-Health Related)

b. Health related characteristics

- Health Related Chemicals
- Microbiological Contaminants

Following is data representative of the quality of raw water in Mundaring Weir. In the absence of specific guidelines for raw water quality, the results have been compared with ADWG values set for drinking water, which defines the quality requirements at the customers tap. Results that exceed ADWG have been highlighted to give an indication of potential raw water quality issues associated with this source.

It is important to appreciate that the raw water data presented does not represent the quality of drinking water distributed to the public. Barriers such as storage and water treatment, to name a few, exist downstream of the raw water to ensure it meets the requirements of ADWG. For more information on the quality of drinking water supplied to the Goldfields and Agricultural region and Perth region refer to the most recent Water Corporation Drinking Water Quality Annual Report at http://www.watercorporation.com.au/W/waterquality_annualreport.cfm?uid=2377-9937-9579-7091.

Aesthetic Related Characteristics

Aesthetic water quality analyses for raw water from Mundaring Weir are summarised in Table 1.

The values are taken from ongoing monitoring for the period January 2001 to October 2006. All values are in milligrams per litre (mg/L) unless stated otherwise. Any water quality parameters that have been detected are reported, those that have on occasion exceeded the ADWG are shaded.

Table 2 Aesthetic related detections for Mundaring Weir

Parameter	Units	ADWG Aesthetic Guideline Value*	Mundaring Weir	
			Range	Median
Aluminium acid soluble	mg/L	0.2	<0.008 - 0.11	0.044
Colour - True	TCU	15	<1 - 15	7
Conductivity (at 25°C)	mS/m	-	32 – 88	81
Total Dissolved Solids [†]	mg/L	500	172 – 473	435
Iron unfiltered	mg/L	0.3	<0.003 - 0.95	0.116
Manganese unfiltered	mg/L	0.1	<0.002 - 0.24	0.004
Turbidity	NTU	5	0.3 - 7.8	1.2
pH measured in laboratory	-	6.5 - 8.5	6.32 - 8.13	7.68

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

[†] Calculated from Conductivity (at 25°C)

Health Related Characteristics

Health Parameters

Raw water from Mundaring is analysed for health related chemicals including inorganics, heavy metals, industrial hydrocarbons and pesticides. Health related water quality parameters that have been measured at detectable levels in the source from January 2001 to October 2006 are summarised in the Table 2. Any parameters that have on occasion exceeded the ADWG are shaded.

Table 3 Health related detections for Mundaring Weir

Parameter	Units	ADWG Health Guideline Value*	Mundaring Weir	
			Range	Median
Barium	mg/L	0.7	<0.02 - 0.11	0.078
Boron	mg/L	4	0.028 - 0.05	0.035
Manganese unfiltered	mg/L	0.5	<0.002 - 0.24	0.004
Nitrite as nitrogen	mg/L	0.91	<0.002 - 0.004	0.002

* A health guideline value is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption (NHRMC & ARMCANZ, 1996).

Microbiological Contaminants

Microbiological testing of raw water samples from Mundaring Weir is currently conducted on a weekly basis since. *Escherichia coli* counts are used as an indicator of the degree of recent faecal contamination of the raw water from warm-blooded animals. A count less than 20 most probable number (MPN) per 100 mL is typically associated with low levels of faecal contamination and is used as a microbiological contamination benchmark of the raw water (WHO, 1996). As such, counts less than 20 MPN are seen as being an indication of raw water that has not been recently contaminated with faecal material.

During the reviewed period of January 2001 to October 2006, positive *Escherichia coli* counts were recorded in 67.6% of samples. Approximately 3.7% of these samples had *Escherichia coli* counts greater than 20 MPN/100mL.

Appendix B - Photographs

Photo 1 – Mundaring Weir



Photo 2 – Mundaring Weir catchment vegetation



Photo 3 – Forestry activities within the Mundaring Weir catchment



Photo 4 – Damage caused from unauthorised vehicle use in the Mundaring Weir catchment



Glossary

Abstraction	The pumping of groundwater from an aquifer.
ADWG	The Australian Drinking Water Guidelines, outlining guideline 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.
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.
GL	Gigalitres (1000 000 000 litres)
ha	Hectares (a measure of area)
kL	Kilolitres (1000 litres)
mg/L	Milligrams per litre (0.001 grams per litre)
NHRMC	National Health and Medical Research Council.
NTU	Nephelometric turbidity units are a measure of turbidity in water.
Nutrients	Minerals dissolved in water, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorous (phosphate) which provide nutrition (food) for plant growth. Total nutrient levels include the inorganic forms of an element plus any bound in organic molecules.
Pesticides	Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms.

Pollution	Water pollution occurs when waste products or other substances, e.g. effluent, litter, refuse, sewage or contaminated runoff, change the physical, chemical biological or thermal properties of the water, adversely affecting water quality, living species and beneficial uses.
Public Drinking Water Source Area (PDWSA)	Includes all underground water pollution control areas, catchment areas and water reserves constituted under the <i>Metropolitan Water Supply Sewerage and Drainage Act 1909</i> and the <i>Country Areas Water Supply Act 1947</i> .
Reservoir	A reservoir, dam, tank, pond or lake that forms part of any public water supply works
Runoff	Water that flows over the surface from a catchment area, including streams.
Scheme supply	Water diverted from a source or sources by a water authority of private company and supplied via a distribution network to customers for urban, industrial or irrigation use.
Storage reservoir	A major reservoir of water created in a river valley by building a dam.
Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes including drinking and discharge to the environment.
Water quality	The physical, chemical and biological measures of water.
Water Reserve	An area proclaimed under the <i>Country Areas Water Supply Act 1947</i> or the <i>Metropolitan Water Supply Sewerage and Drainage Act 1909</i> for the purposes of protecting a drinking water supply.

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