Government of **Western Australia**
Department of **Water and Environmental Regulation**

Important information

The *Samson Brook Catchment Area drinking water source protection plan* (2002, WRP no. 50) was reviewed in 2019.

Please ensure you read the *Samson Brook Catchment Area drinking water source protection review* (2019, WRP no. 189) alongside the 2002 plan to obtain all of the information about this drinking water source.

The 2019 review considers changes that have occurred in and around the catchment area since the completion of the 2002 plan. Additional recommendations have been prepared to ensure the ongoing protection of this public drinking water source area.

You can find the 2019 *Samson Brook Catchment Area drinking water source protection review* at www.dwer.wa.gov.au or by contacting the Department of Water and Environmental Regulation on +61 8 6364 7000 or drinkingwater@dwer.wa.gov.au.

SAMSON BROOK CATCHMENT AREA
WATER SOURCE PROTECTION PLAN

Waroona and Hamel Town Water Supply
Integrated Water Supply System

WATER AND RIVERS COMMISSION REPORT
WRP 50
2002
WATER RESOURCE PROTECTION SERIES

Water and Rivers Commission

WATER AND RIVERS COMMISSION
HYATT CENTRE
3 PLAIN STREET
EAST PERTH
WESTERN AUSTRALIA 6004

TELEPHONE (08) 9278 0300
FACSIMILE (08) 9278 0301
WEBSITE: http://www.wrc.wa.gov.au

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Cover Photograph: Gauging station downstream of Samson Brook dam [Taken by Ruth Harvey]

SAMSON BROOK CATCHMENT AREA
WATER SOURCE PROTECTION PLAN

Waroona and Hamel Town Water Supply
and
Integrated Water Supply System

Prepared under the direction of
Water and Rivers Commission
Resource Management Division
by the Infrastructure Planning Branch
of the Water Corporation

WATER AND RIVERS COMMISSION
WATER RESOURCE PROTECTION SERIES
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Acknowledgments

This report was prepared by the Infrastructure Planning Branch of the Water Corporation under the guidance and supervision of the Resource Quality Branch of the Water and Rivers Commission.

Contribution	Personnel	Title	Organisation
Program Direction	Tony Laws	Manager, Resource Quality	Water and Rivers Commission
Supervision	Stephen Watson	Program Manager, Protection Planning	Water and Rivers Commission
	Kerry Laszig	Senior Resource Protection Officer	Water and Rivers Commission
Management	Peter Coghlan	Senior Engineer	Water Corporation
Report preparation	Ruth Harvey	Engineer	Water Corporation
Drafting	Susan Taylor	Planning Information Officer	Water Corporation

For more information contact:

Program Manager, Protection Planning
Resource Quality Branch
Water and Rivers Commission
3 Plain Street
EAST PERTH WA 6004

Telephone: (08) 9278 0300
Facsimile: (08) 9278 0585

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Foreword

Water source protection plans

Water Source Protection Plans reflect the level of protection considered appropriate for specific drinking water sources (water reserves). They are developed in consultation with affected landowners and industry groups and relevant government agencies. They are also released as a draft for further public comment before being finalised. The plans identify sources of contamination that should be investigated and set out programs for management of the drinking water resource.

Proclaiming Water Reserves and Catchment Areas under the *Metropolitan Water Supply Sewerage and Drainage Act 1909* and the *Country Areas Water Supply Act 1947* protects the quality of water sources in Western Australia. The Acts' by-laws enable the Water and Rivers Commission to control potentially polluting activities, to regulate land use, inspect premises and to take steps to prevent or clean up pollution.

The Water and Rivers Commission aims to work pro-actively with planning agencies to incorporate water protection in the land planning process. This is because decisions on land use zoning and subdivision applications have a significant impact on the protection of water sources given the wide range of land uses that are assessed and may be approved. The Commission supports the amendment of Town Planning Schemes and Development Strategies that reflect land use compatible with Water Source Protection Plans. A Statement of Planning Policy: Public Drinking Water Source Policy is currently being prepared to further this process.

This Water Source Protection Plan provides a basis for establishing compatible land uses in the Samson Brook Catchment Area and is a mechanism for practical implementation of the Commission's protection strategies. Local government decision-makers, State planning authorities and operational staff are encouraged to recognise this document as a basis for ensuring the long-term protection of this surface water resource for generations to come.

Water quality protection framework

The Water and Rivers Commission is responsible for managing and protecting Western Australia's water resources. This work is undertaken in accordance with the State Water Quality Management Strategy (GWA, 2001). The Commission has developed policies for the protection of public drinking water source areas that include three levels of priority classification.

Priority 1 (P1) source protection areas are defined to ensure that there is no degradation of the water source. P1 areas are declared over land where the provision of the highest quality public drinking water is the prime beneficial land use. P1 areas would typically include land under Crown ownership. P1 areas are managed in accordance with the principle of risk avoidance and so land development is generally not permitted.

Priority 2 (P2) source protection areas are defined to ensure that there is no increased risk of pollution to the water source. P2 areas are declared over land where low intensity development (such as rural) already exists. Protection of public water supply sources is a high priority in these areas. P2 areas are managed in accordance with the principle of risk minimisation and so conditional development is allowed.

Priority 3 (P3) source protection areas are defined to minimise the risk of pollution to the water source. P3 areas are declared over land where water supply sources need to co-exist with other land uses such as residential, commercial and light industrial developments. Protection of P3 areas is achieved through management guidelines rather than restrictions on land use. If the water source does become contaminated, then water may need to be treated or an alternative water source found.

In addition to priority classifications, reservoir protection zones are defined to protect the water source

from contamination in the immediate vicinity of reservoirs. Reservoir protection zones usually consist of a 2 kilometre buffer area around the top water level of a reservoir and include the reservoir itself. These zones do not extend outside the catchment area. Special restrictions apply in these zones.

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Summary

Samson Brook is about 100 km south of Perth. It is regulated by the Samson Brook Dam. The Samson Brook Pipehead Weir, seven kilometres downstream of the main Dam, was constructed to provide Waroona and Hamel with drinking water in 1962. The Samson Brook forms part of the Waroona Irrigation District, which uses water from the Waroona, Drakes Brook and Samson Brook Dams.

It is proposed to redevelop the Samson Brook for the Integrated Water Supply System. A new pipehead dam will be constructed upstream of the existing weir. This will be connected to the Stirling Trunk Main and the Waroona and Hamel town supply.

The development of a source protection plan for this source is consistent with the statewide program to protect all public drinking water resources.

The microbiological water quality of this source exceeds levels that the World Health Organistion (WHO) drinking water guidelines considers can be adequately treated by disinfection alone. The health related chemical water quality is good, although elevated turbidity is sometimes experienced.

The quality of the surface water resource is potentially at risk from activities in the catchment area. Land use in the catchment consists principally of State Forest under a mining lease to Alcoa World Alumina Australia (Alcoa). There is also recreation activity in the catchment, most significantly fishing and marroning. The Munda Biddi mountain bike trail has been proposed to cross the Samson Brook at Scarp Road. This water source protection plan reviews the existing land uses and activities within the catchment, and makes recommendations for protection of the water source.

Currently the Samson Brook Pipehead Weir catchment is gazetted under the *Country Areas Water Supply Act 1947*. It is proposed that the catchment area be amended to reflect the location of the New Pipehead Dam and for the area to be reproclaimed under the *Metropolitan Water Supply Sewerage and Drainage Act 1909*. Currently, the two Acts have different by-laws for protection of public drinking water source areas. However, the Commission is in the process of reviewing both sets of by-laws, with the ultimate intention of promulgating consistent by-laws under the two Acts. The catchment area should be managed for Priority 1 source protection to preserve and protect the high quality of the water source.

Potential risks posed to the water quality of this source have been carefully assessed recognising the detention time in the pipehead dam is likely to be only 2-3 days. Planned treatment for this supply is disinfection, fluoridation and buffering in the short term, although filtration is being considered for implementation in the future.

The plan has undergone extensive consultation during its development. A Stakeholder Liaison Group and community open evenings provided key stakeholders and members of the public with the opportunity to raise issues for consideration and provide comments on the proposal.

The draft plan was released for public comment in May 2002 and all submissions have been considered in the preparation of this plan.

1. Introduction

The Samson Brook is located in the Harvey River Basin, approximately 100 km south of Perth and 5 km south of Waroona. Its catchment area is within the Shire of Waroona and managed by the Dwellingup office of the Department of Conservation and Land Management (CALM).

Samson Brook Dam was completed in 1941. It is 31 metres high and impounds a reservoir of 8 GL volume and 104 ha surface area at a top water level of 245 m AHD. The estimated average annual streamflow into the reservoir is 16.6 GL from a catchment area of 64 km^2. Samson Brook pipehead weir was constructed in 1962 and supplies drinking water to the towns of Waroona and Hamel. It is 1.3 m high and has negligible capacity. The contributing catchment below the dam is 10 km^2.

Figure 1 shows the location of the Samson Brook and its catchment area.

1.1 Existing water supply system

The Waroona Irrigation District uses water from Waroona, Drakes Brook and Samson Brook Dams. For the last four years, combined irrigation consumption has been around 10 GL per year, with 5 GL taken from Samson and 5 GL from Drakes Brook/Waroona. The irrigation district is under the control of Harvey Water (formerly South West Irrigation Management Cooperative).

Samson Brook Dam, also known as Lake Kabbamup, regulates the upper reaches of Samson Brook. Water is released directly into the stream as required to supply the irrigation scheme. The pipehead weir (Plate 1), 7 km downstream from the dam, is used for the Waroona and Hamel town water supply.

1.2 Existing water source protection

The Samson Brook Catchment Area was originally proclaimed in 1952 as the Waroona Water Supply Catchment Area under the *Country Areas Water Supply Act 1947* to ensure protection of the water source from potential contamination. In 2000 it was deproclaimed and simultaneously reproclaimed as the Samson Brook Catchment Area with slight modifications to the boundary. The Catchment Area was identified in the draft Peel and Greater Bunbury Regional Planning Schemes, where it is recognised as "proposed P1", subject to the development of a Source Protection Plan.

1.3 Future water supply system

The proposed new scheme will consist of a new pipehead dam, which will replace the existing weir. It will have a nominal height of 20 m and a storage volume of 300 ML. A 13 km trunk main will connect this source to the Stirling Trunk Main. Waroona and Hamel will also be serviced from the new pipehead dam. Completion is planned for June 2003.

This Source Protection Plan is written for the current and proposed future use of water from the Samson Brook for public drinking water supply. Its objective is to propose strategies that will ensure land uses and activities in the Samson Brook Catchment Area have minimal impact on the water quality of this public drinking water source.

1.4 Water resource allocation

The Proposed Harvey Basin Surface Water Allocation Plan (WRC, 1998) defines surface water available for use on an ecologically sustainable basis. There are currently three surface water allocation licences from the Harvey River, Drakes Brook and Samson Brook sources. They are issued to the Water Corporation, Alcoa World Alumina Australia and Harvey Water. Further allocations are subject to the establishment of environmental water provisions.

1.4.1 Current Water Corporation allocation licence

The applicable Surface Water Licence for the Samson Reservoir, Licence No. 0056289, applies to the Harvey River, Drakes Brook and Samson Brook. The total allocation for abstraction from these sources for the purpose of public water supply is 540 ML/year. This licence will change under the Samson Brook Redevelopment Scheme.

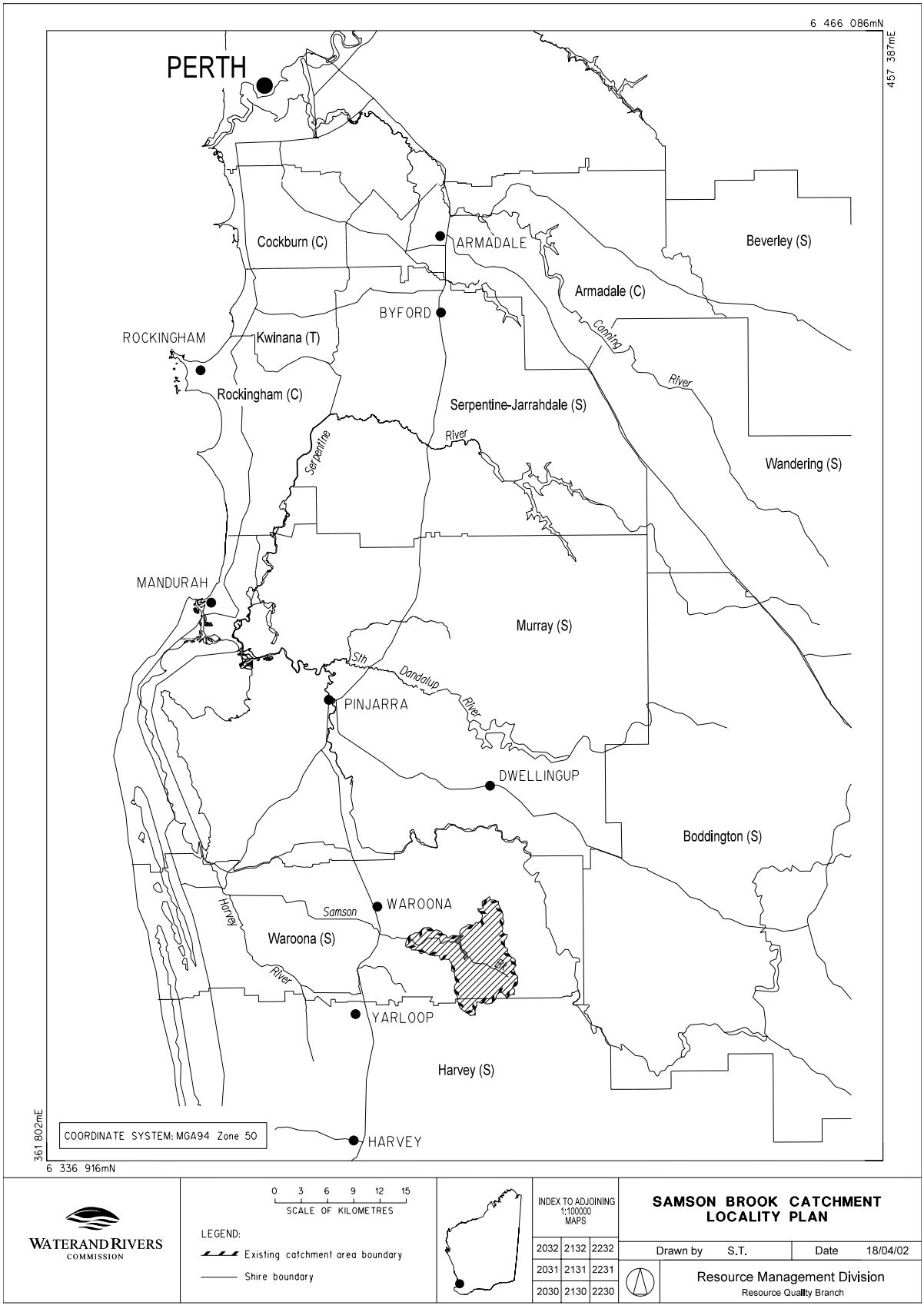

Figure 1. Samson Brook Catchment Locality Plan

Photograph 1 - Existing Pipehead Weir

2. Physiography

Samson Brook arises on the Darling Scarp, about 100 km south of Perth. The Darling Scarp is the most prominent physiographic feature of south-western Australia, rising steeply to 300 m above sea level. The Scarp is an ancient erosional feature, now lying 1-2 km east of the Darling Fault which separates the Archean Yilgarn Block from the Phanerozoic sedimentary deposits that underlie the Swan Coastal Plain to the west.

Tributaries of the Harvey River, including Samson Brook, have their headwaters in the northern jarrah forest, on the edge of the Great Plateau and ultimately drain into the Peel-Harvey estuarine system on the coast. The Great Plateau is an area of ancient, weathered rock which results in the very low nutrient status of upland streams (Bunn and Davies, 1990). In contrast, the nutrient concentration in the lowland rivers is much greater, primarily due to clearing, cultivation and drain construction on the coastal plain.

3. Climate

The area has a Mediterranean-type climate, characterised by warm and dry summers with cool, wet winters. The long-term average annual rainfall for the catchment is approximately 1200 mm and most of this falls between May and September. Rainfall is seasonal and highly predictable. The annual average evaporation is between 1200 and 1600 mm and monthly evaporation ranges from 50 mm in June to 230 mm in January.

Temperatures are warm to hot in summer and cool in winter. Summer daily temperatures generally range from 15-30 degrees C, whilst in winter the daily range is 5-15 degrees C.

Like all areas in the south-west, Waroona has received below average rainfall for the last 20 years. The effect of lower rainfall is amplified in streamflow. There has been a statistically significant reduction in streamflow for the period from 1975 to present (WRC, 1999). A decline in annual rainfall of 10% has been shown to reduce streamflow in jarrah catchments by about 30-40%.

Climate change from global warming has been examined by the Climate Impact Group in the CSIRO Division of Atmospheric Research (CSIRO, 2001). This group has developed climate change projections, which are continually updated. The latest projections for the year 2030 for the south-west of Western Australia are:

- Annual average warming of between 0.4 and 1.6 degrees C.
- Rainfall change in the autumn, winter and spring periods of –20% to +5% and rainfall change in the summer period of –10% to +10%.

Interannual- and decade-scale climate variability will continue in the future and will remain a source of uncertainty in projecting the impacts of future climate change on resource yields.

4. Hydrology

The combined catchment area for the existing Samson Brook Dam and the existing Samson Pipehead Dam is shown in Figure 2.

The proposed pipehead dam will have a surface area of 4 ha and a top water level of 130 m AHD. The catchment area for the Samson Brook Dam is 64 km^2, and streamflow at this point averages 16.6 GL per year. There is a further 10 km^2 of contributing catchment to the pipehead dam, and streamflow at this point averages 21 GL per year. The average monthly natural flow in the winter months is significantly greater than in the summer months (PWD, 1984), although this pattern has been significantly altered by releases for irrigation requirements during summer.

Water inflow to the reservoir is mostly from surface runoff over the winter months. However, groundwater seepage into the reservoir occurs from the lateritic gravels of the Darling Range.

4.1 Water quality

Water quality at the Samson Brook Dam and Samson pipehead weir is regularly monitored for pH, turbidity,

colour, conductivity, iron, manganese and aluminium. Microbiological parameters are measured monthly at

the weir. Details of typical water quality monitoring results are shown in Appendix 3.

The microbiological water quality of this source exceeds levels that the World Health Organistion (WHO) drinking water guidelines considers can be adequately treated by disinfection alone. The health related chemical water quality is good, although elevated turbidity is sometimes experienced.

4.2 Water treatment

Current water treatment for the town water supply comprises mechanical screening and disinfection. Treatment works will be refurbished as part of the redevelopment scheme.

Treatment in the short term for the integrated water supply system will include disinfection, fluoridation and buffering (the latter for pH stabilisation to prevent corrosion of the Stirling Trunk Main).

Given that there are some risks to water quality in the catchment and the need to provide water of assured quality, it is likely that further treatment will be required in the long term. This will be subject to the performance of the system. Sand filtration will ensure that turbidity levels are low and improve disinfection effectiveness. A comprehensive water quality monitoring program is in place for making decisions regarding the staging of treatment works.

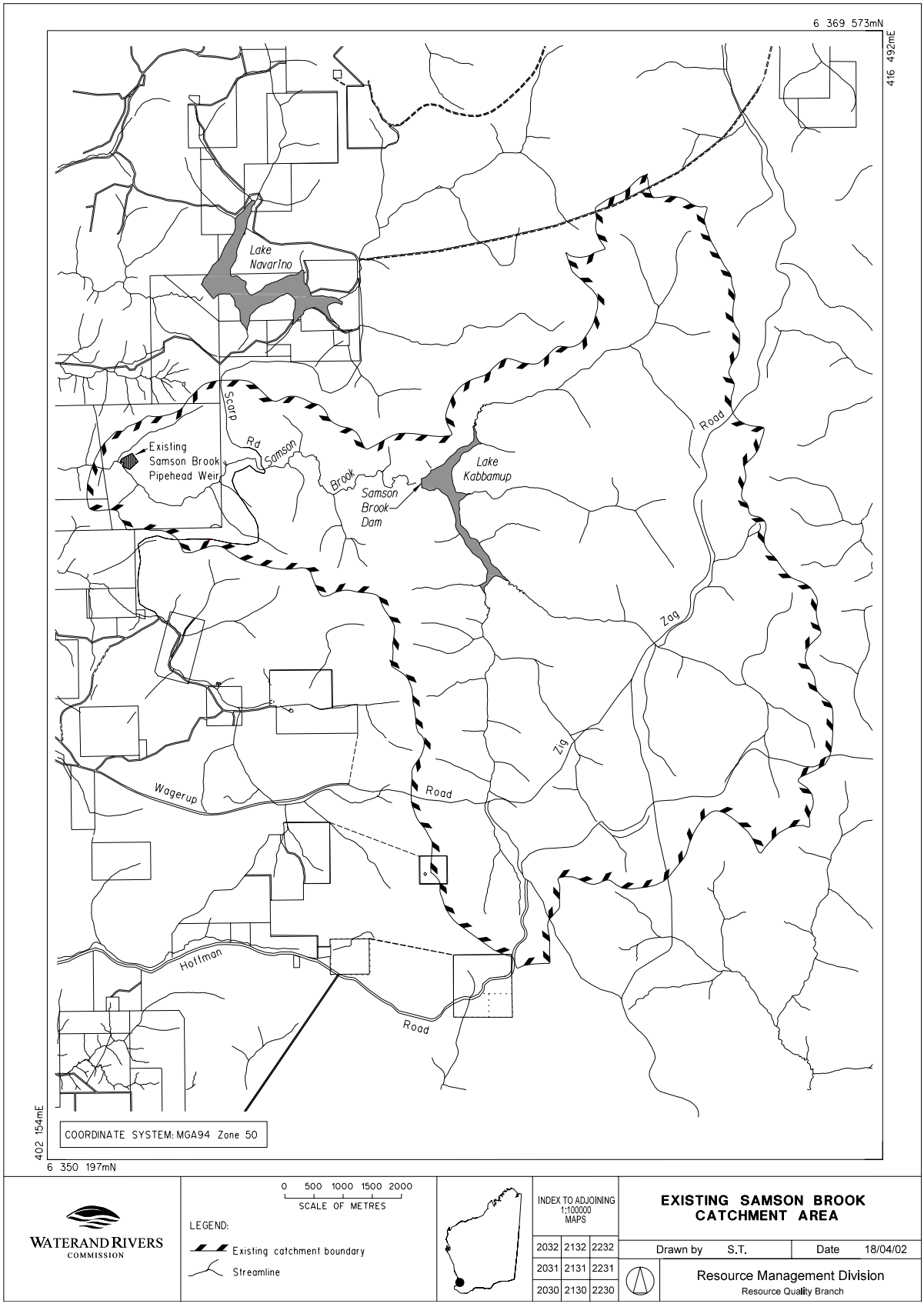

Figure 2. Existing Samson Brook Catchment Area

5. Existing land use

Existing land uses within the Samson Brook Catchment Area are shown in Figure 3.

Land use and activities in the catchment consist of:

- Private land that is undeveloped;
- State Forest, within which Alcoa World Alumina Australia (Alcoa) holds a Special Mining Lease covering most of the catchment area;
- Access roads, in particular Scarp Road; and
- Recreation.

5.1 Private land

The only privately-owned land within the catchment is a single lot upon which it is proposed to locate the new pipehead dam. It is undeveloped, and not used for residential purposes. The Water Corporation is negotiating with the owner regarding purchase of the property, as the imposition of P1 restrictions will prevent its development. There is an airstrip on the property which is used by the owner of the adjacent property for the spreading of fertilisers. The airstrip will not be in the catchment area if the pipehead dam is constructed at the proposed location, upstream of the north-eastern tributary.

5.2 Crown land

State Forest covers most of the catchment, and is vested with CALM. The forest is a dry sclerophyll forest dominated by jarrah (*Eucalyptus marginata*) with occasional marri (*Corymbia calophylla*). Understorey species include *Banksia grandis* and *Allocasurina fraseriana*.

A Special Mining Lease, granted to Alcoa in 1961, covers the Crown land in the catchment. Under the State Agreement Act, Alcoa has rights to extract bauxite from Crown land, with associated responsibilities to protect environmental values and rehabilitate mine sites. This area is currently operational as part of the Willowdale Mine operations, with bauxite being taken from the Orion crusher region in the north and east of the catchment.

The bauxite occurs in shallow deposits scattered throughout the catchment. A typical pit may cover 20 hectares and be mined to a depth of three or four metres. Ore is carried from the mine area to the crusher in the Orion Region, and transported to the Wagerup Alumina Refinery by conveyor. The causeway for the conveyor belt crosses the southern arm of the Samson Brook Dam.

Mining is a transient activity in the catchment and it is expected that Crown land will return to CALM management. Land management performed by CALM includes fire protection, such as prescribed burning and maintenance of fire breaks, and hardwood timber production. At present, hardwood logging of the jarrah forests is only undertaken for clearing prior to mining in the Samson catchment.

There are a number of access roads running through the Samson Brook Catchment. Scarp Road is particularly significant as it provides a link to the Pinjarra-Williams Road from Wagerup and access to Lake Navarino and other recreation areas on the Murray River. It runs for about 4.6 km through the catchment and crosses Samson Brook upstream of the proposed new pipehead dam.

The Mount William fire tower is also located in the catchment.

5.3 Recreation

Recreation in the State Forest is generally managed by CALM, although no designated recreation sites exist in the Samson Brook Catchment Area. Historically the forest was used for a number of activities (horse riding, mountain bike riding), however, these are less common now due to mining in the catchment and restrictions on them for management of dieback.

Samson Brook Dam is a designated marron fishery, and is snare-only. The Brook below the dam has previously been stocked with trout.

The Waroona Loop for the Munda-Biddi mountain bike trail is proposed to cross Samson Brook between the main dam and the pipehead. The Bibbulmun track

passes outside the catchment to the east, and will not be impacted by this source protection plan.

Tourism associated with recreation is important to the area and forms a part of the valuable tourism industry in the south-west of the state.

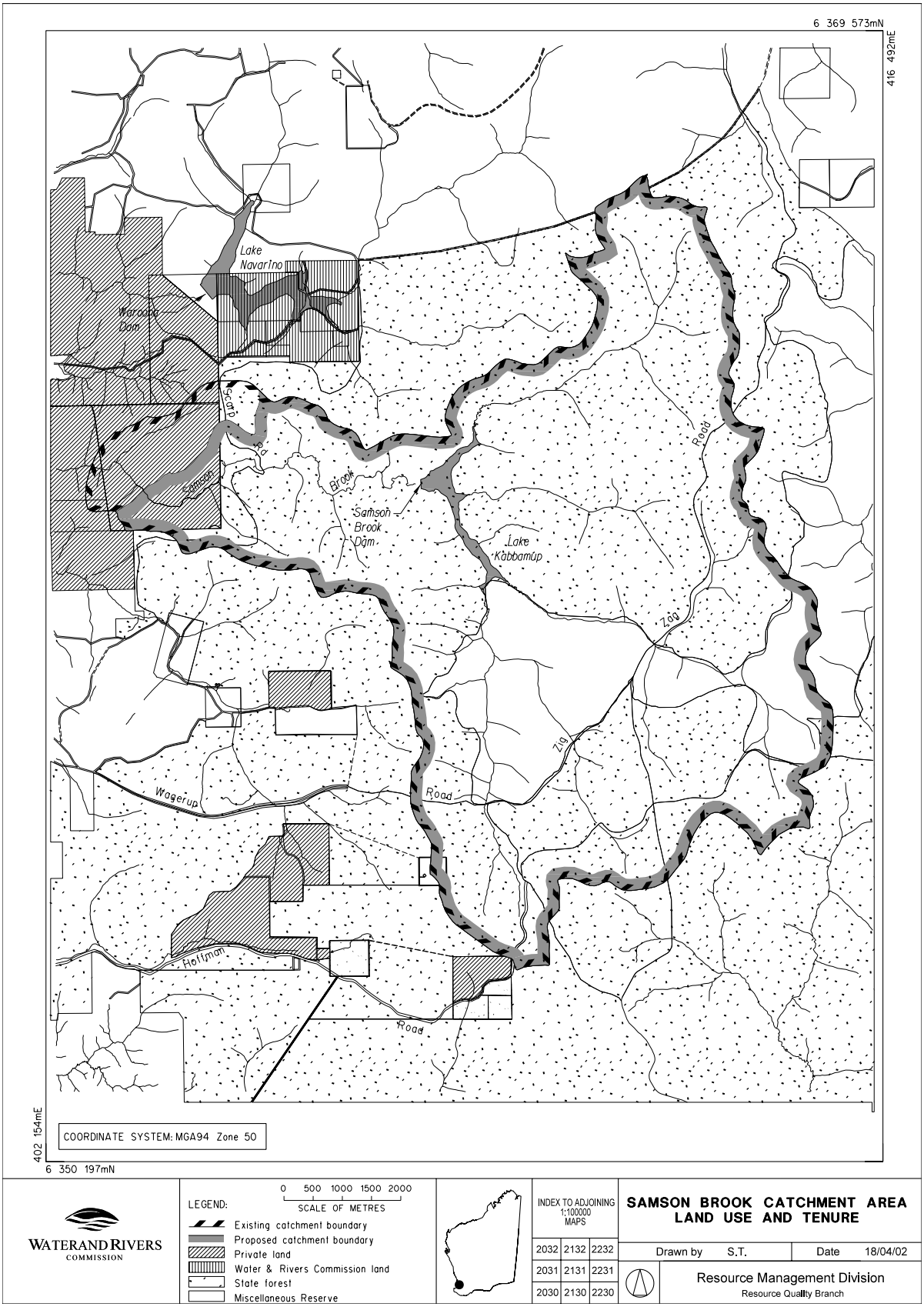

Figure 3. Samson Brook Catchment Area – Land Use and Tenure

6. Proclaimed areas and priority classification

The Samson Brook catchment was originally proclaimed under the *Country Areas Water Supply Act 1947* in 1952, as the Waroona Water Supply Catchment Area. On 14 November 2000 this catchment area was deproclaimed and simultaneously reproclaimed as the Samson Brook Catchment Area with slight modifications to the boundary. As the proposed pipehead dam will not be in the same location as the existing water supply offtake, it is proposed the catchment be reproclaimed to reflect this new boundary. The proposed Samson Brook Catchment Area is shown in Figure 4.

It is proposed to manage the Samson Brook catchment for Priority 1 source protection. The objective is to preserve the high quality of this water by avoiding risks of contamination. This classification is justified on the following basis:

- Samson Brook is the sole source for Waroona and Hamel and will serve the Integrated Water Supply Scheme from 2003;
- The existing water quality is of a high standard;
- Land is mostly in crown ownership;
- Existing land uses are generally compatible with P1 or can be managed according to P1 objectives with the use of best management practices;
- In the short term, the only treatment of water from the brook is proposed to be disinfection, fluoridation and buffering.

The detail of general land use compatibility for the Priority 1 source protection classification is listed in Appendix 1.

6.1 Reservoir Protection Zone (RPZ)

A reservoir protection zone is established to protect water quality in the reservoir from immediate risks, including human contact. It is proposed that the area surrounding the new pipehead dam and the Samson Brook Dam be managed as a Reservoir Protection Zone (RPZ). The RPZ is shown in Figure 4.

The RPZ is defined as an area within the gazetted catchment approximately 2 km from the high water level of the reservoir and includes the reservoir.

7. Management of potential water quality risks

The Priority 1 classification proposed for this catchment has the fundamental water quality objective of risk avoidance.

This plan generally recommends prohibition of activities involving human contact with the Samson Brook, Samson Brook Dam, new pipehead dam and feeder streams. Activities that require people to be close to these water bodies will be discouraged and managed accordingly.

7.1 Protection objectives

There is a substantial potential risk to water quality from possible pathogen contamination by human and domestic animal contact with water. There are many pathogens that can contaminate water supplies; a number of these are commonly known to contaminate water supplies worldwide. These common pathogens include bacteria (e.g. *Salmonella*, *Campylobacter, E. Coli.* and *Cholera*), parasites (e.g. *Cryptosporidium*, *Giardia*) and viruses. These pathogens generally arise from faecal contamination.

The percentage of humans around the world who are carriers of the various pathogens, and hence have the potential to contaminate, ranges between 0.33% (*Shigella*) and 25% (*Cholera El Tor* in Asia) depending on the pathogen in question (Geldreich, 1996). For example, it is estimated between 1-3.9% of people are infected with *Salmonella* worldwide, 0.6-4.3% with *Crytosporidium* and 7.4% with *Giardia*. Estimates in Australia for *Giardia* is as high as 20% for children in child care (Grimmond *et al*., 1988).

Even if the lower limit were taken, as may be expected in Australia, there is significant potential risk of contamination by any of these pathogens if humans, and hence human waste, are present in or near the reservoir and feeder streams.

This contamination has the potential to remain viable for a significant amount of time in water. For example, *Salmonella* is viable for 2-3 months and *Giardia* for around 1 month (Geldreich, 1996). Other references estimate viability for longer periods.

Based on the probability that a person near the reservoir is infected with one type of pathogen and the viable life of pathogens, human contact with the water and the presence of humans near the reservoir or feeder streams is a risk to public water supply quality and hence human health. While disinfection effectively kills many pathogens, it does not completely eliminate all pathogens. Preventing pathogen contamination in the water source is the most effective way of removing a public health risk.

Samson Brook, together with Samson Brook Dam and the proposed pipehead dam, is a strategic source for water supply to Waroona, Hamel and the Integrated Water Supply Scheme, supplying an estimated 300,000 people. Hence potential risks posed to water quality have been carefully assessed. Based on the potential risk posed by human contact with the water and the number of people that could potentially be affected, activities that require contact with the water body are considered not acceptable in this catchment.

Activities that do not involve contact with the water generally pose less of a risk. Consequently, activities with no water contact are generally permitted, with management conditions to ensure they do not compromise water quality objectives.

This plan aims to balance water quality protection and social needs and aspirations as far as possible. Where constraints are required, it is proposed that affected activities are catered for in other more appropriate locations.

The table in section 7.5 summarises the water quality risks associated with land uses and activities which have the potential to pose some risk to the quality of the water source. The table includes the reasoning for the acceptability of this land use/activity and recommends management and protection strategies.

7.2 Best management practices

Best Management Practices for land use activities are encouraged to help protect water quality.

Best Management Practices can be developed for an individual enterprise or have a local or regional focus and must consider the full range of economic, social and environmental issues associated with land, water and vegetation use. Development of Best Management Practices must also take into consideration the needs and concerns of users, consumers and the wider community (ARMCANZ and ANZECC, 1996).

These are often in the form of an industry code of practice or environmental guideline. They are usually developed in consultation with industry groups, producers and State government agencies.

7.3 Land use planning

It is recognised that establishment of appropriate protection mechanisms in statutory land use planning processes is necessary to secure the long-term protection of water sources. It is therefore appropriate that the Catchment Area and priority classification(s) be recognised in land planning strategies. Samson Brook Catchment Area is recognised as “proposed P1” in both the Peel and Greater Bunbury Regional Planning Schemes.

7.4 Emergency response

Escape of chemicals during unforeseen incidents and use of chemicals during emergency response can cause stream and groundwater contamination. The Local Emergency Management Advisory Committee through the Peel Emergency Management District should be familiar with the location and purpose of the Samson Brook Catchment Area. A locality plan should be provided to the Fire and Rescue Services headquarters for the HAZMAT Emergency Advisory Team. Water Corporation should have an advisory role to any HAZMAT incident in the Samson Brook Catchment Area.

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

7.5 Land use, potential water quality risks and recommended strategies

The following table details the existing land uses in the catchment, the potential water quality risks and leads through a discussion to a recommended strategy to manage the risk.

The discussion and recommended strategies balance the need to protect water quality for the community in the long-term, with the rights of land holders to continue to utilise land for lawful purposes.

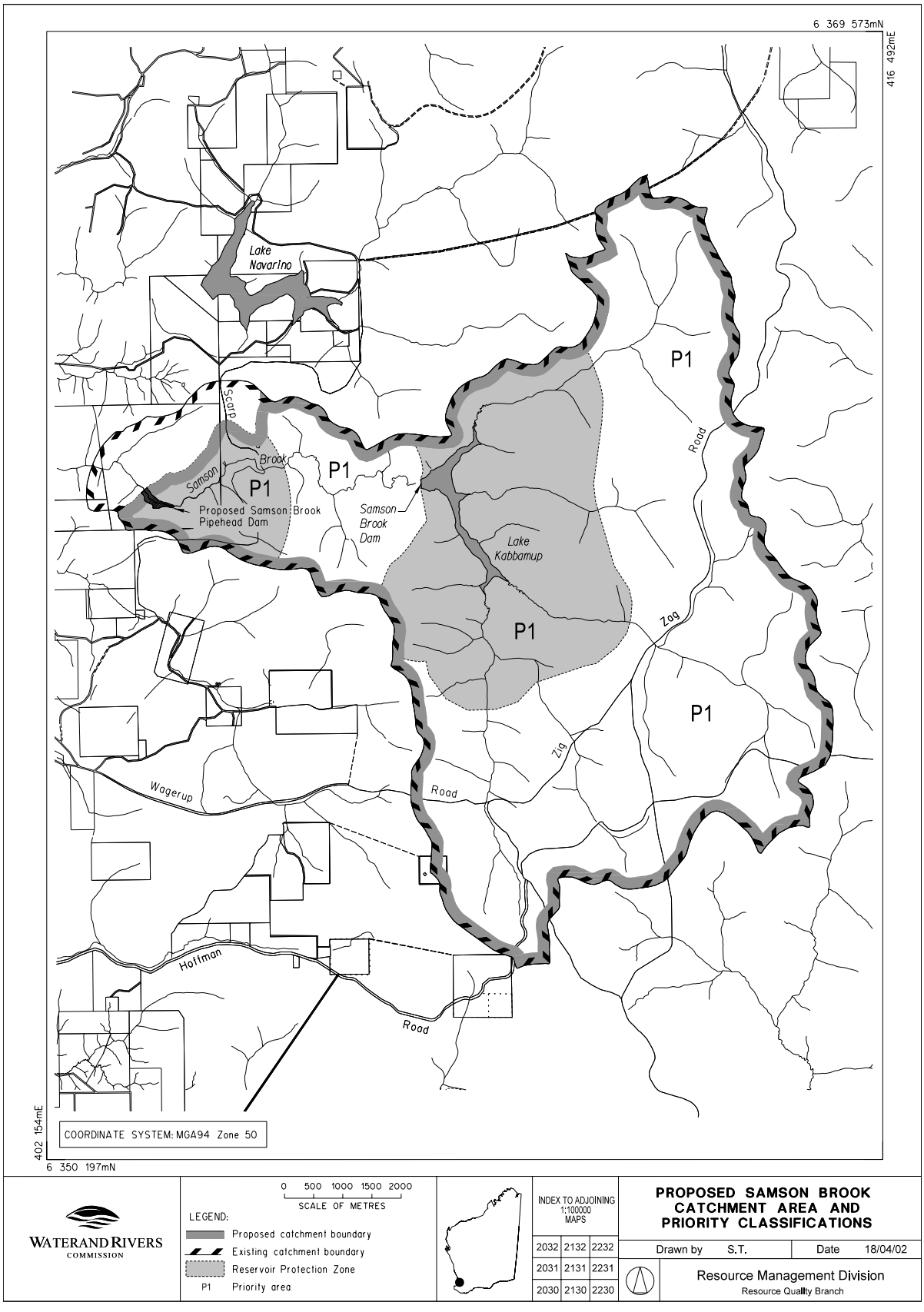

Figure 4. Proposed Samson Brook Catchment Area and Priority Classifications

Table 1. Land Use, Potential Water Quality Risks and Recommended Strategies

The following table summarises the potential water quality risks associated with the land use activities in the catchment and recommends strategies for minimising the impact on the water quality of the Samson Brook.

Activity	Potential Water Quality Risks	Consideration for Management	Recommended Protection Strategies
State Forest			
Alcoa	• High turbidity and sediment loads, due to soil and sub-soil disturbance, arising from haul roads, mining areas and rehabilitated areas; • Microbiological contamination from wastewater systems; • Hydrocarbon contamination from fuel use and storage in catchment associated with use of machinery; • Proximity of Samson Brook Dam Causeway to water body.	Alcoa has an undertaking with the State Government to protect water resources in all of the catchment areas in which it operates, or has operated (Conjurunup, North and South Dandalup, Wungong, Serpentine, Samson and Drakesbrook). Five year mine plans are updated annually and submitted to the Mine Management Planning Liaison Group (MMPLG) which comprises representatives from CALM, WRC, Water Corporation, Department of Environmental Protection and Department of Minerals and Petroleum Resources. After consideration and field inspections, feedback, including questions and concerns, are given to Alcoa. The draft plan is modified if necessary and resubmitted. The MMPLG makes its recommendations on the revised plan to the Minister for State Development.	*Mining is acceptable if carried out in accordance with "Working Arrangements between Alcoa World Alumina Australia and the Water and Rivers Commission and the Water Corporation covering Alcoa's Mining Operations in the Darling Range."* The following is a list of options that may be employed singly or in combination by Alcoa to reduce the risk of uncontrolled runoff impacting on forest, streams or reservoirs: • Schedule some clearing/mining during summer; • Install blasted or ripped drainage protection slots; • Mine out sufficient sump capacity and maintain throughout the life of the pit; • "Retreat mine" to provide storage capacity; • Split the area of the pit into smaller sections and mine and rehabilitate one at a time; • Redesign the clearing boundary so that it is on a contour on a broad bottom edge; • Increase the distance from a stream by moving the clearing boundary upslope; • Rip pit floor area to reduce runoff and build storage structures within pits; • Design haul roads so that all run off is directed to sumps; • Provide 24 hour security and emergency response facilities.

Activity	Potential Water Quality Risks	Consideration for Management	Recommended Protection Strategies
Hardwood Logging	The risks associated with hardwood harvesting include: • turbidity due to log handling practices, and use of unsealed roads and tracks; • fuel spills from vehicles and machinery; • pesticides from harvesting practices; • pathogens due to human presence including from increased public access with road upgrading • spread of forest disease.	Currently, hardwood logging occurs in conjunction with Alcoa activities. Once the area has been mined, it is likely that this will become the focus of forest management in the catchment. The impact of hardwood harvesting on water quality can be minimised through proper management. Water quality protection is a requirement of the CALM Act, which recognises the importance of water as a resource. Research has shown that timber harvesting does not necessarily lead to increased turbidity in water courses if proper harvesting management is in place (including vegetation buffers along water courses and understorey vegetation left after timber harvesting) (Borg *et al*., 1988). A further critical requirement to reduce turbidity from timber harvesting is the proper maintenance of roads – particularly those required to carry heavy log transport vehicles. Rehabilitation of roads and tracks following the harvesting process should be conducted to reduce public access and erosion problems. Baseline water quality data is frequently not available prior to harvesting, reducing the value of post-harvesting monitoring. The issues of who, when and how monitoring is conducted need to be addressed, to aid informed management of forestry in the catchment.	*Acceptable activity with Best Management Practices.* • Undertake a review of the *Manual of Management Guidelines for Timber Harvesting* and the *Code of Practice for Timber Harvesting* to ensure water quality protection objectives are addressed. For example, issues to be addressed would include appropriate road construction and maintenance, use of sumps or drains for sediment control, appropriate retention of buffer zones along watercourses, fuel storage and handling and pesticide use. • Ensure hardwood harvesting occurs in accordance with the *Code of Practice for Timber Harvesting*. • Ensure protocols are in place between relevant agencies on harvesting issues such as pesticide use and road routes and construction. • Review detailed harvesting plans during the planning phase to ensure water quality protection objectives are included. • 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 for forest operations and management or transport thoroughfare. • Inspect water quality protection measures on site.

Activity	Potential Water Quality Risks	Consideration for Management	Recommended Protection Strategies
Access Roads through catchment	The potential risks from roads include: • spills of contaminating substances such as oil, diesel or chemicals, • turbidity due to sediment in stormwater runoff resulting from erosion; and • pathogen contamination from public access. Scarp Road, crossing the Samson Brook below the main dam is considered a high risk.	These roads are necessary for regional transportation and CALM forest management. Management measures could include: • Measures to minimise traffic and the transport of hazardous goods; • Management plan to minimise the impact of spills and accidents; • Maintenance practices to consider impact on water quality; • Drainage sumps to prevent runoff entering the water; • Alignment of roads to lessen the likelihood of accidents.	*Roads acceptable with Best Management Practice.* • Consultant has been engaged to undertake risk assessment and analysis of alternatives for the Scarp Road crossing of Samson Brook. This will be done in consultation with key stakeholders (CALM, Shire of Waroona, Water Corporation and Stakeholder Liaison Group). • Develop guidelines for the management of roads and tracks that address water quality protection objectives, such as appropriate road construction and maintenance, providing adequate drainage and runoff control measures, use of culverts for stream zone crossings, and effective site management for gravel pits. • Review the road network to identify roads not essential for forest operations and management or transport thoroughfare. These may be closed and rehabilitated.
Fire Management • Fuel reduction burning • Firebreaks • Water points	Fuel reduction burning and the construction and maintenance of firebreaks have the potential to cause an increase in turbidity, particularly in the areas of steeper slope close to the reservoir and tributaries. Additional risks include carbon and nutrient contamination from airborne and eroded ash. The potential risks associated with the construction and access of water points for fire fighting include turbidity from the use of unsealed roads and tracks, fuel spills from vehicles and machinery and potentially pathogens from direct contact of firefighters with waterbodies.	Wild fire minimisation by fuel reduction burning is an established essential land management practice in the catchment, and should be managed to limit the potential for turbid runoff into the reservoir.	*Acceptable activity with Best Management Practices.* • Establish specific guidelines related to water quality protection for consideration in the burning prescription. For example, guidelines would include the location of firebreaks, the use of sumps or drains for sediment control and appropriate practices for the use of herbicides. • Ensure the above water quality protection guidelines are included in the burning prescription.
Feral Pig Control	Feral pigs pose a risk to water quality through pathogens and turbidity from foraging. Control measures can increase the risk of contamination from pig carcasses, humans, and turbidity from vehicles.	Feral pig control is important for ecological sustainability of the native environment. A feral animal control program should be consistent with water quality guidelines. Feral pig control helps to reduce the risk to water quality posed by these animals in the wild. The program needs to be undertaken in a well-managed and organised manner between key stakeholders.	*Control of feral pigs is an acceptable activity, within guidelines.* These may include: • Removal of carcasses near water courses; • Development of a program for Samson Brook catchment area between the Water Corporation, CALM and Alcoa.

Activity	Potential Water Quality Risks	Consideration for Management	Recommended Protection Strategies
Recreation			
Marroning	Marroning at Samson Brook Dam is snare-only. The potential risk of pathogen contamination is through direct human contact with the water (both the reservoir and brook) arising from people being in and around the water for extended periods without toilet facilities. There are also contamination risks from the use of bait, litter and erosion through vehicle use.	Bodily contact with the water, rubbish and human waste disposal pose an unacceptable risk to water quality. The large numbers of people who are associated with this activity exacerbate these risks. Allowing a managed recreational season was considered, but is impractical. The activity can not be undertaken without contact with the water. The marron season is not compatible with times of the year that people could potentially access the top reservoir at lower risk to public health. Due to the forested nature of the catchment and the limited ranger resources, compliance with controls is difficult to implement. Access is also an issue, as to reach the dams, traffic would have to pass through the lower catchment, which is more susceptible to contamination. The possibility of providing offsets at nearby resources exists. It is proposed to close the catchment to marroning. The proposed closure is consistent with other recreational management strategies for this catchment, and for other strategic drinking water supply catchments in the state. It is also consistent with the Water and Rivers Commission's draft *Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land.* The loss of marroning amenity to the community is acknowledged.	*No marroning in the Samson Brook Catchment Area.* • The Samson Brook Catchment Area to be proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*. By-laws prohibit marroning. • Advertise widely to ensure public awareness of restrictions, understanding of risk, and alternative resources. • The developer of the water supply source to work with Fisheries WA and the recreational fishing community to enhance nearby alternatives. Suggestions for measures so far include: – A destocking program for marron in drinking water supply dams. – Construction of habitat enhancement within the Waroona Dam when the dam is drained for remedial works to the wall. – Consideration of access issues and facilities for recreational fishers to be included in recreation planning for the area. • Development of an holistic strategy for the south west for the future development of proposed water supplies such as Logue Brook and Wellington, recognising the importance of these resources to the recreational fishing community, and in line with the principles of sustainable development.

Activity	Potential Water Quality Risks	Consideration for Management	Recommended Protection Strategies
Trout Fishing	Risk of potential pathogen contamination through people being in and around the Brook and Reservoir for extended periods without toilet facilities. There is also a risk of litter and fire problems.	Since the pipehead dam will be constructed upstream of the existing weir, the area still available for trout fishing is a significant proportion of the currently utilised area (the downstream section and McKnoe Brook). Allowing a managed recreational season was considered, but is impractical. The activity cannot be undertaken without some contact with the water, and without being in the catchment for a significant period of time. It is proposed to close the catchment to fishing. The proposed closure is consistent with other recreational management strategies for this catchment, and for other strategic drinking water supply catchments in the state. It is also consistent with the Water and Rivers Commission's draft *Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land.*.	*No fishing in the Samson Brook Catchment Area* • The Samson Brook Catchment Area to be proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*. By-laws prohibit fishing. • Advertise widely to ensure public awareness of restrictions, understanding of risk, and alternative resources. • The developer of the water supply source to work with Fisheries WA and the recreational fishing community to enhance nearby alternatives. Suggestions for measures so far include: – A stocking program for trout in existing resources – the Drakes Brook and Waroona dams. – Construction of a fish grid on the spillway at Drakes Brook Dam. – Consideration of access issues and facilities for recreational fishers to be included in recreation planning for the area. – Habitat enhancement. • Development of an holistic strategy for the south west for the future development of proposed water supplies such as Logue Brook and Wellington, recognising the importance of these resources to the recreational fishing community and in line with the principles of sustainable development.
Mountain Bike Riding	Access to stream. Pathogen and turbidity contamination if people walk in or near the stream.	The Munda Biddi mountain bike trail "Waroona Loop" is proposed to cross the Samson Brook between the Dam and the downstream pipehead dam. This loop is eagerly anticipated by the community and represents tourism opportunities for Waroona, particularly the camping and recreational areas around Waroona Dam. The trail through the Samson Brook catchment area cannot be re-routed to avoid the sensitive areas entirely, being restricted by Alcoa operations to the east, and private property to the west.	*Provision for the trail should be arranged to minimise water quality risks.* • The track should cross the stream in a manner which allows no direct access to the water. A suitable site upstream of the Scarp Road crossing and acceptable to CALM and Alcoa has been identified. • Further protection measures to be discussed with CALM, Shire and other key stakeholders. • No further trails to be developed in the catchment area downstream of Samson Brook Dam; limited trail development may be permitted upstream of Samson Brook Dam, so long as potential risks to water quality are minimised. • Maximise alternative opportunities at Waroona and Drakes Brook Dams, and at Lane Poole Reserve.

Recommendations

1. The existing Samson Brook Catchment Area should be de-proclaimed and replaced by the proposed Samson Brook Catchment Area (reflecting the new boundaries) under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909.*

2. Planning strategies should incorporate the management principles outlined in this plan and reflect the Priority 1 classification assigned to the Catchment Area.

3. All development proposals in the Samson Brook Catchment Area which are likely to impact on water quality should be referred to the Water and Rivers Commission for consideration and advice.

4. Signs should be erected along the boundaries of the proposed Catchment Area to define the area and promote public awareness of the need to protect water quality.

5. Incidents covered by WESTPLAN – HAZMAT in the Samson Brook Catchment Area should be addressed through the following measures:

- The Local Emergency Management Advisory Committee (through the Peel Emergency Management District) being familiar with the location and purpose of the Samson Brook Catchment Area.
- The locality plan for the Samson Brook Catchment Area being provided to the Fire and Rescue Services headquarters for the HAZMAT Emergency Advisory Team.
- The Water Corporation advising the HAZMAT Emergency Advisory Team during incidents in the Samson Brook Catchment Area.
- Personnel dealing with WESTPLAN – HAZMAT incidents in the area given ready access to a locality map of the Catchment Area and training to understand the potential impacts of spills on the surface water resource.

6. A surveillance program should be established to identify any incompatible land uses or potential contaminant threats within the Catchment Area.

7. Review the surface water quality monitoring program to ensure key characteristic parameters are included. Routinely review water quality analysis results to detect any increasing trends.

8. The strategies detailed in *Table 1 – Land use, potential water quality risks and recommended strategies* should be adopted.

9. Implementation of these recommendations should be reviewed annually after this plan is endorsed. A full review of this protection plan should be undertaken after five years.

Implementation strategy

No	Description	Implemented by	Timing
1.	Gazettal of Samson Brook Catchment Area under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*.	Program Manager, Protection Planning (WRC).	2003
2.	Incorporation into land planning strategies.	Shire of Waroona, Department for Planning and Infrastructure.	2002-03
3.	Referral of development proposals: (i) WRC to provide Shire of Waroona with guidelines for referral of development proposals. (ii) Referral of development proposals for comment and advice.	(i) Program Manager, Protection Planning (WRC). (ii) Shire of Waroona, Department for Planning and Infrastructure and other divisions within WRC.	(i) 2002-03 (ii) ongoing
4.	Erections of signs: (i) determine number and location of signs required in accordance with the "Source Protection Operations Signage Standard". (ii) erect signs.	(i) Regional Business Manager, Water Corporation. (ii) Regional Business Manager, Water Corporation	(i) 2002-03 (ii) 2002-03.

(contd)

No	Description	Implemented by	Timing
5.	Incidents covered by WESTPLAN – HAZMAT in the Samson Brook Catchment Area should be addressed through the following measures:		
	(i) the Local Emergency Management Advisory Committee (through the Peel Emergency Management District) being familiar with the location and purpose of the Samson Brook Catchment Area.	(i) Local Emergency Management Advisory Committee (through the Peel Emergency Management District).	(i) 2003
	(ii) the locality plan for the Samson Brook Catchment Area being provided to the Fire and Rescue Services headquarters for the HAZMAT Emergency Advisory Team.	(ii) WRC (Kwinana - Peel region).	(ii) 2003
	(iii) the Water Corporation advising the HAZMAT Emergency Advisory Team during incidents in the Samson Brook Catchment Area.	(iii) WRC (Kwinana - Peel region) / Water Corporation.	(iii) ongoing
	(iv) personnel dealing with WESTPLAN – HAZMAT incidents in the area are given ready access to a locality map of the Samson Brook Catchment Area and training to understand the potential impacts of spills on the surface water source.	(iv) Local Emergency Management Advisory Committee.	(iv) ongoing
6.	Surveillance program:		
	(i) delegate surveillance of catchment area to Water Corporation.	(i) Program Manager, Protection Planning (WRC).	(i) 2003
	(ii) implement the surveillance program.	(ii) Regional Business Manager, Water Corporation	(ii) ongoing
7.	Water quality monitoring program: Review the water quality monitoring program as per the recommendations.	Water Corporation.	ongoing

(contd)

No	Description	Implemented by	Timing
8.	Access Roads		
	(i) Assess water quality risks and ensure road maintenance programs address water quality risks.	(i) Shire of Waroona and Department of Conservation and Land Management in consultation with the Water and Rivers Commission.	(i) 2002-2003
	(ii) Construct sumps and implement protection measures as identified to control runoff and prevent risks at major stream crossings.	(ii) Water Corporation	(ii) 2003
9.	Recreation		
	(i) Invoke provisions of the Metropolitan Water Supply, Sewerage and Drainage Act By-Laws to prohibit swimming, fishing, marroning and uncontrolled hunting in the catchment.	(i) Water and Rivers Commission in partnership with the Water Corporation	(i) 2003
	(ii) Develop Recreation Plan to consider opportunities for recreation outside of the catchment area. Aspects covered will include campsites, bushwalking, off-road vehicle use, picnic sites and opportunities for fishing and marroning.	(ii) Shire of Waroona with involvement from Department of Conservation and Land Management, Water and Rivers Commission, Water Corporation and other stakeholders.	(ii) 2003
	(iii) Implement enhanced recreation facilities as identified in the Recreation Plan.	(iii) Funding and responsibilities to be determined in Memorandum of Understanding between Shire of Waroona and Water Corporation.	(iii) 2003
	(iv) Implement enhancement of fishing and marroning offsets, as identified in Table 1.	(iv) Water Corporation with Fisheries Western Australia and Recfishwest.	(iv) 2004

(contd)

No	Description	Implemented by	Timing
10.	Review of this plan and implementation strategy: (i) review implementation strategy annually. (ii) full review after 5 years.	(i) Resource Quality Branch (WRC). (ii) Resource Quality Branch (WRC).	(i) 2004 (initial review). (ii) 2009 (full review).

References

Agriculture and Resource Management Council of Australia and New Zealand and Australian and New Zealand Environment and Conservation Council, 1996, *Draft Rural Land Uses and Water Quality A Community Resource Document*, ARMCANZ and ANZECC, 1996.

Borg, H., Loh I. C. and Bell R. W., 1988, *The effect of logging stream buffers on stream sediment concentration and turbidity - Results from the Southern Forest of Western Australia*, Report No. 23, Water Authority of Western Australia, July 1988.

Bunn, S.E and Davies P.M., 1990*, Why is the stream fauna of south-western Australia so impoverished?* Hydrobiologia, 1990-04-17, 194 (2), p69-176.

CSIRO, 2001, *Climate Change Projections for Australia*, CSIRO Atmospheric Research, Victoria, 2001

Geldreich, E.E., 1996, *Pathogenic Agents in Freshwater Resources*, Hydrological Processes, Volume 10, pp 315-333, 1996.

Grimmond, T.R., Radford A.J. and Brownridge T., 1988*, Giardia carriage in aboriginal and non-aboriginal children attending urban day-care centres in South Australia*, Australian Paediatric Journal, Volume 24, pp 304-305, 1988.

Government of Western Australia, 2001, *State Water Quality Management Strategy No. 1 Framework for Implementation*, GWA, 2001.

National Health and Medical Research Council and Agriculture and Resource Management Council of Australia and New Zealand, 1996, *Australian Drinking Water Guidelines*, NH&MRC and ARMCANZ, 1996.

PWD, 1984, *Streamflow Records of Western Australia to 1982 - Volume 2 - Basins 613-617*, Water Resources Branch of the Public Works Department, WA, 1984.

WRC, 1999, *The Effect of Climate Variability on Streamflow in the South-west of Western Australia*, Water and Rivers Commission Report SWH 25 (unpublished), Water and Rivers Commission, 1999.

Glossary

Allocation	The quantity of water permitted to be abstracted by an allocation licence, usually specified in kilolitres/year (kL/a).
Alluvium (alluvial)	Detrital material which is transported by streams and rivers and deposited.
Catchment	The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
Diffuse Source Pollution	Pollution originating from a widespread area e.g. urban stormwater runoff, agricultural runoff.
Effluent	The liquid, solid or gaseous wastes discharged by a process, treated or untreated.
Leaching / Leachate	The process by which materials such as organic matter and mineral salts are washed out of a layer of soil or dumped material by being dissolved or suspended in percolating rainwater, the material washed out is known as leachate. Leachate can pollute groundwater and waterways.
m AHD	Australian Height Datum. Height in metres above Mean Sea Level +0.026 m at Fremantle.
Nutrient Load	The amount of nutrient reaching the waterway over a given time (usually per year) from its catchment area.
Nutrients	Minerals dissolved in water, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorus (phosphate) which provide nutrition (food) for plant growth. Total nutrient levels include the inorganic forms of an element plus any bound in organic molecules.
Pesticides	Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms.
Point Source Pollution	Specific localised source of pollution e.g. sewage or effluent discharge, industrial waste discharge.
Pollution	Water pollution occurs when waste products or other substances e.g. effluent, litter, refuse, sewage or contaminated runoff, change the physical, chemical, biological or thermal properties of the water, adversely affecting water quality, living species and beneficial uses.
Runoff	Water that flows over the surface from a catchment area, including streams.
Scheme Supply	Water diverted from a source (or sources) by a water authority or 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.
Stormwater	Rainwater which has run off the ground surface, roads, paved areas etc and is usually carried away by drains.
Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes including drinking and discharge to the environment.
Wastewater	Water that has been used for some purpose and would normally be treated and discarded. Wastewater usually contains significant quantities of pollutant.
Water Quality	The physical, chemical and biological measures of water.

Appendices

Appendix 1. Land use compatibility in Public Drinking Water Source Areas
Appendix 2. Samson Brook Redevelopment Stakeholder Liaison Group
Appendix 3. Water Quality Monitoring

Appendix 1. Land Compatibility in Public Drinking Water Source Areas

OCTOBER 2002

Water Quality Protection Note

Water and Rivers Commission

Land Use Compatibility in Public Drinking Water Source Areas

Purpose

This water quality protection note provides our position on land use practices and activities within areas gazetted as public drinking water sources, for protection and maintenance of the quality of the State's drinking water resources.

This note forms an integral part of the Western Australian Planning Commission's draft Statement of Planning Policy - *Public Drinking Water Source Policy* prepared by the Department for Planning and Infrastructure under Section 5AA of the *Town Planning and Development Act 1928*. The note will be reviewed in March and September each year and updated to reflect our present policy position, advances in technology or land use activity standards and decisions made concerning drinking water quality protection.

The note should be used when developing formal guidelines on land use activities in public drinking water source areas in consultation with key stakeholders, such as the Department for Planning and Infrastructure, local government and the Department of Agriculture.

Scope

The note provides our position on a range of land uses assessed against our water quality protection strategies and management objectives within Public Drinking Water Source Areas (PDWSAs). Where a specific land use has not been covered in the accompanying tables, it should be referred to our Resource Quality Branch for assessment and a written response.

PDWSAs are Underground Water Pollution Control Areas, Water Reserves or Catchment Areas declared under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or *Country Areas Water Supply Act 1947*.

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

PDWSA Protection Framework

This agency is responsible for managing and protecting the State's water resources. Our policy for the protection of public drinking water source areas includes three risk management-based priority zones for land within PDWSAs. Priority classifications are determined through specific Water Source Protection Plans, that are prepared in consultation with State government agencies, landowners, local government, and key industry and community stakeholders.

Priority 1 (P1) source protection areas are defined and managed to ensure that there is **no degradation** of the water source in these areas. This is the highest level of protection for the water sources and normally will apply to land owned or managed by State agencies. P1 areas are characterised by low-intensity and low-risk land uses, such as forestry and extractive industries. Protection of the public drinking water source outweighs virtually all other land uses. P1 areas are managed using the principle of **risk avoidance**. Most land uses are **incompatible** with P1 management objectives.

Priority 2 (P2) source protection areas are defined to ensure that there is **no increased risk of pollution** to the water source. P2 areas are declared over land where low risk development (such as low intensity rural activity) already exists. Protection of PDWSAs is a high priority in these areas. P2 areas are managed in accordance with the principle of **risk minimisation**. Some development defined as *Conditional* is allowed in P2 areas.

Priority 3 (P3) source protection areas are defined to **manage the risk of pollution** to the water source. P3 areas are declared over land where water supply sources co-exist with other land uses such as residential, commercial and light industrial developments. There is restriction on land uses considered to have significant pollution potential. Protection of P3 areas is mainly achieved through **environmental management guidelines** for land use activities. If the water source becomes contaminated, then public water supplies may need additional treatment or an alternative source located and commissioned.

In addition to the priority classifications, **wellhead protection zones** and **reservoir protection zones** are defined to protect the drinking water source from contamination in the immediate vicinity of production wells and reservoirs. Statutes provide for defined land uses and activities within these zones that are prohibited, restricted or subject to imposed agency conditions so that contamination of the water source is prevented. Special conditions, for example, restrictions on storage and use of chemicals, may be applied within these zones.

Wellhead protection zones are usually circular, with a radius of 500 metres in P1 areas and 300 metres in P2 and P3 areas. Wellhead protection zones do not extend outside PDWSA boundaries.

Reservoir protection zones consist of a 2 kilometre buffer area around the top water level of storage reservoirs and include the reservoir itself. A reduced buffer area may be applied where the reservoir is designed only for short-term storage of collected water (e.g. pipehead or pumpback dams) before transfer to a storage reservoir. Reservoir protection zones are normally only designated over Crown land and generally prohibit public access to prevent contamination (physical, chemical and biological) of the source. Reservoir protection zones do not extend outside PDWSA boundaries.

Compatibility of land uses within PDWSAs

The tables in this note define land uses as Compatible, *Conditional* (i.e. can be managed to be compatible), or **Incompatible** with the sustainable use of the drinking water source and the retention of environmental values associated with the water source. These tables have been prepared for use by local governments and other authorities as a basis for regulating land use within the PDWSAs, consistent with the Western Australian Planning Commission's draft *Statement of Planning Policy - Public Drinking Water Source Policy*.

This Water Quality Protection Note acknowledges there may be special circumstances, such as Government supported community needs or site specific circumstances, which may allow an 'incompatible' land use to be conditionally approved. In these instances, project proponents must demonstrate that there is an overriding community benefit achieved by the land use at the particular location and that the proposed land use will not increase the risk of contamination of the water resource.

More detailed information on water quality protection issues is available in the form of guidelines or water quality protection notes for some of the land uses listed in the tables. These, along with the most recent version of this note, can be found on our Internet site (**http://*www.wrc.wa.gov.au/protect/policy/***). Alternatively, information on land use and development regulation within PDWSAs can be obtained from our Regional Offices. The Resource Quality Branch, located in East Perth, is custodian of this water quality protection note and will provide strategic advice on its application and coordinate any suggested amendments.

Existing activities

We recognise that many activities covered in this note were legally established prior to gazettal of specific statutory measures to protect PDWSAs. Accordingly, we may negotiate with the operators of existing non-conforming, conditional or compatible activities to implement management practices that minimise the impact of those land uses or activities on water sources.

Proposed activities

Following consideration of this protection note, please consult our nearest Regional Office for advice on the location of Public Drinking Water Source Areas, Priority areas and protected zones, and aspects of the land use proposal that may affect water resources. All statutory State and local government planning policies, scheme provisions, and the normal planning approval processes apply and are not over-ridden by this note.

Definition of terms used in the following tables

"Compatible**"** means the land use is compatible with the management objectives of the priority classification.

"*Conditional*" means the land use can be compatible with the management objectives of the priority classification, provided appropriate site management practices are used. Conditional developments or activities should be referred to this agency for assessment and a written response.

"Incompatible" means the land use is incompatible with the management objectives of the priority classification. We will normally oppose their approval by regulators. Any contentious development proposals received may be referred for formal Environmental Impact Assessment via the *Environmental Protection Act 1986*.

"Extensive" means limited additional inputs are required to support the desired land use, e.g. supplementary animal feed only during seasonal dry periods or during the final preparation of stock for the market.

"Intensive" means regular additional inputs are required to support the desired land use, e.g. irrigation, fertilisers, or non-forage animal feed dominates.

Interpretation of land use recommendations into planning schemes and decisions

When translating the recommendations of the land use compatibility table into planning schemes and decisions, the following relationships should be used:

a) Where the table identifies a land use as "Compatible", this use is permitted within that priority source protection area. It should be identified as a "**P**" (permitted) use in a scheme, providing the use complies with the relevant development standards and the requirements of the scheme.

b) Where the table identifies a use as "*Conditional",* this land use is considered to be a discretionary use within the priority source protection area and should be identified as either a "**D**" or "**A**" (after special notice) use in the scheme. Proposals for *Conditional* uses should be referred to this agency for assessment and response, unless prior agreement has been made between a specific local government authority and this agency on regulatory measures. Specific guidelines, codes of practice or notes covering a land-use type, or memoranda of understanding may be used to define an agreed position on the land-use type or activity.

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

d) Where the table does not include a proposed land use, that use should be considered to be "**Incompatible**" until the project proponent can demonstrate that it meets the drinking water quality protection objective for the Priority area within the PDWSA.

If the land use planning approval process supports a proposal that is inconsistent with our drinking water quality protection advice for the priority source protection area, then we should be advised of this situation and the reasons for that decision. This advice will trigger an assessment of the significance of that decision to the drinking water source and will be considered in the periodic review of this water quality protection note.

Tables defining land-use compatibility with PDWSA protection objectives

Land use descriptions (**in Model Scheme Text #**)	P1	P2	P3
Agriculture (see note 10)	↓	↓	↓
- extensive(see pastoral leases below)	**Incompatible**	*Conditional* (see notes 11&12)	Compatible
- intensive aquaculture, hydroponics	**Incompatible**	*Conditional*	*Conditional*
- intensive orchards; nurseries– potted plants; viticulture– wine and table grapes	**Incompatible**	*Conditional*	Compatible
- intensive floriculture; market gardens; turf farms	**Incompatible**	**Incompatible**	*Conditional*
- intensive livestock grazing	**Incompatible**	**Incompatible**	*Conditional*
- intensive garden centres	**Incompatible**	*Conditional* (see note 2)	Compatible
- pastoral leases	*Conditional*	Compatible	Compatible
Agro-forestry	**Incompatible**	*Conditional*	Compatible
Amusement parlour	**Incompatible**	**Incompatible**	Compatible (see note 1)
Animal establishment	↓	↓	↓
- animal saleyards and stockyards (see note 13)	**Incompatible**	*Conditional* (see note 2)	*Conditional* (see note 2)
- apiaries	*Conditional*	Compatible	Compatible
- catteries	**Incompatible**	Compatible	Compatible
- dairy sheds	**Incompatible**	*Conditional* (see notes 2, 3,& 12)	*Conditional* (see note 3)
- dog kennels	**Incompatible**	*Conditional*	*Conditional*
- equestrian centres (see note 17)	**Incompatible**	**Incompatible**	Compatible
- feedlots	**Incompatible**	**Incompatible**	*Conditional*
- stables (see note 18)	**Incompatible**	*Conditional*	Compatible
Animal husbandry, intensive	↓	↓	↓
- piggeries	**Incompatible**	**Incompatible**	**Incompatible**
- poultry farming - housed	**Incompatible**	*Conditional*	*Conditional*
Bed and breakfast (bed and breakfast, farm stay accommodation, rural chalets)	*Conditional* (see notes 6 & 16)	*Conditional* (see note 4)	Compatible
Betting agency	**Incompatible**	*Conditional* (see note 2)	Compatible (see note 1)
Caravan park	**Incompatible**	**Incompatible**	*Conditional* (see note 1)
Caretakers dwelling	*Conditional* (see note 2)	*Conditional*	Compatible
Car park	**Incompatible**	*Conditional* (see note 2)	Compatible
Cemeteries	**Incompatible**	**Incompatible**	*Conditional*
Child care premises	**Incompatible**	*Conditional* (see note 2)	Compatible (see note 1)
Cinema/theatre	**Incompatible**	**Incompatible**	Compatible (see note 1)
Civic use	**Incompatible**	*Conditional* (see note 2)	Compatible (see note 1)
Club premises	↓	↓	↓
- sporting or recreation clubs	**Incompatible**	*Conditional*	Compatible (see note 1)
- health centres	**Incompatible**	**Incompatible**	Compatible (see note 1)
Community purpose	↓	↓	↓
- community halls	**Incompatible**	*Conditional* (see note 2)	Compatible

Land use descriptions (**in Model Scheme Text #**)	P1	P2	P3
- irrigated golf courses or recreational parks	**Incompatible**	**Incompatible**	*Conditional* (see note 11)
- motor-sports (permanent racing facilities)	**Incompatible**	**Incompatible**	*Conditional*
- public swimming pools/ aquatic centres	**Incompatible**	**Incompatible**	*Conditional*
- rifle ranges	**Incompatible**	*Conditional*	Compatible
Consulting rooms	**Incompatible**	*Conditional* (see note 2)	Compatible (see note 1)
Convenience store	**Incompatible**	*Conditional* (see note 2)	Compatible (see note 1)
Corrective institution	**Incompatible**	**Incompatible**	*Conditional* (see note 1)
Educational establishment	↓	↓	↓
- community education centres, scientific research institution	*Conditional* (see note 2)	*Conditional* (see note 2)	Compatible (see note 1)
- primary / secondary schools, tertiary education facilities	**Incompatible**	**Incompatible**	Compatible (see note 1)
Exhibition centre	**Incompatible**	**Incompatible**	Compatible (see note 1)
Family day care	**Incompatible**	Compatible (see note 19)	Compatible (see note 1)
Fast food outlet	**Incompatible**	**Incompatible**	Compatible (see note 1)
Forestry (native forest/ silviculture/ tree farming)	*Conditional* (see note 11)	*Conditional* (see note 11)	Compatible
Fuel depot	**Incompatible**	**Incompatible**	*Conditional*
Funeral parlour	**Incompatible**	**Incompatible**	Compatible (see note 1)
Home business (see note 10)	**Incompatible**	*Conditional* (see note 20)	Compatible (see note 1)
Home occupation	*Conditional* (see note 15)	Compatible (see note 21)	Compatible (see note 1)
Home office	*Conditional* (see note 15)	Compatible	Compatible
Home store (see note 10)	**Incompatible**	*Conditional*	Compatible (see note 1)
Hospital	**Incompatible**	**Incompatible**	*Conditional* (see note 1)
Hotel (hotels, hostels, resorts)	**Incompatible**	**Incompatible**	Compatible (see note 1)
Industry	↓	↓	↓
- abattoirs	**Incompatible**	**Incompatible**	**Incompatible**
- cottage	*Conditional*	*Conditional*	Compatible
- drinking water treatment plant (see note 10)	*Conditional*	*Conditional*	*Conditional*
- extractive, includes construction / mining camps (see note 10)	*Conditional*	*Conditional*	*Conditional*
- food processing, dairy product factories, breweries	**Incompatible**	**Incompatible**	*Conditional* (see note 1)
- general (chemical manufacture / formulation, dry cleaning premises, dye works, laboratories – analytical, photographic)	**Incompatible**	**Incompatible**	*Conditional* (see note 1)
- general (metal production / finishing, pesticide operator depots, heavy industry, power stations/gas works, petroleum refineries)	**Incompatible**	**Incompatible**	**Incompatible**
- general (concrete batching, cement products, fertiliser manufacture/bulk storage, wrecking)	**Incompatible**	**Incompatible**	*Conditional*

Land use descriptions (**in Model Scheme Text #**)	P1	P2	P3
Industry (continued)	↓	↓	↓
- general (mineral processing)	**Incompatible**	**Incompatible**	*Conditional* (see note 9)
- light industry	**Incompatible**	**Incompatible**	*Conditional* (see note 1)
- milk transfer depots	**Incompatible**	**Incompatible**	*Conditional*
- mining (includes mineral and energy exploration, oil or gas extraction / decontamination for transport)	*Conditional* (see note 9)	*Conditional* (see note 9)	*Conditional* (see note 9)
- mining (tailings dams)	**Incompatible**	**Incompatible**	*Conditional* (see note 9)
- mining (includes construction / mining camps) (see note 10)	*Conditional*	*Conditional*	*Conditional*
- rural (animal product rendering works, tanneries, wool scourers)	**Incompatible**	**Incompatible**	**Incompatible**
- rural (farm supply centres, manure stockpiling / processing facilities)	**Incompatible**	*Conditional* (see note 2)	*Conditional*
- rural (forestry products processing– chip mills, pulp/ paper, timber preservation, wood/ fibre works, composting/ soil blending - commercial)	**Incompatible**	**Incompatible**	*Conditional*
- service industry	**Incompatible**	**Incompatible**	*Conditional*
Landfill (solid waste disposal)	↓	↓	↓
- class I (refer also to 'Storage - used tyres' land use advice)	**Incompatible**	**Incompatible**	*Conditional*
- class II or III	**Incompatible**	**Incompatible**	**Incompatible**
- class IV or V	**Incompatible**	**Incompatible**	**Incompatible**
Lunch bar	**Incompatible**	*Conditional* (see note 2)	Compatible (see note 1)
Major transport infrastructure (roads, railways)	**Incompatible**	*Conditional* (see note 14)	Compatible
Marina	NA	NA	NA
Marine filling station (fuelling)	NA	NA	NA
Market (food; general produce; second–hand goods)	**Incompatible**	**Incompatible**	Compatible (see note 1)
Medical centre	**Incompatible**	**Incompatible**	Compatible (see note 1)
Motel	**Incompatible**	**Incompatible**	Compatible (see note 1)
Motor vehicle, boat or caravan sales (sales yards)	**Incompatible**	**Incompatible**	Compatible (see note 1)
Motor vehicle repair	**Incompatible**	**Incompatible**	*Conditional*
Motor vehicle wash	**Incompatible**	**Incompatible**	*Conditional*
National and regional parks and nature reserves	Compatible	Compatible	Compatible
Night club	**Incompatible**	**Incompatible**	Compatible (see note 1)
Office	**Incompatible**	*Conditional*	Compatible (see note 1)
Park home park	**Incompatible**	**Incompatible**	*Conditional* (see note 1)
Place of worship	**Incompatible**	**Incompatible**	Compatible (see note 1)
Plantation	*Conditional* (see note 11)	*Conditional* (see note 11)	Compatible
Reception centre	**Incompatible**	**Incompatible**	Compatible (see note 1)

Land use descriptions (**in Model Scheme Text #**)	P1	P2	P3
Recreation– private (i.e. not generally open to public without charge)	**Incompatible**	**Incompatible**	Compatible (see note 1)
Residential building	↓	↓	↓
- house	*Conditional* (see note 16)	Compatible (see note 4)	Compatible (see note 1)
- group dwellings (aged and dependent persons)	**Incompatible**	**Incompatible**	Compatible (see note 1)
Restaurant	**Incompatible**	**Incompatible**	Compatible (see note 1)
Restricted premises (adult interests)	**Incompatible**	**Incompatible**	Compatible (see note 1)
Rural pursuit	See Agriculture, Animal establishment or husbandry		
Service station (includes aircraft, automotive repairs, boats, mechanical plant, service stations at transport and municipal works depots)	**Incompatible**	**Incompatible**	*Conditional* (refer to note 1)
Shop	**Incompatible**	*Conditional* (see note 2)	Compatible (see note 1)
Showroom	**Incompatible**	**Incompatible**	Compatible (see note 1)
Storage	↓	↓	↓
- used tyres (see note 22)	**Incompatible**	**Incompatible**	**Incompatible**
- chemical storage in under ground tanks	**Incompatible**	**Incompatible**	*Conditional*
- chemical storage in above ground tanks	**Incompatible**	*Conditional*	*Conditional*
Tavern	**Incompatible**	**Incompatible**	Compatible (see note 1)
Telecommunications infrastructure	*Conditional*	*Conditional*	*Conditional*
Toilet blocks and change rooms	*Conditional* (see note 2)	*Conditional*	Compatible
Trade display	**Incompatible**	**Incompatible**	Compatible (see note 1)
Veterinary centre	**Incompatible**	*Conditional* (see note 2)	*Conditional* (see note 1)
Warehouse	**Incompatible**	*Conditional* (see note 2)	*Conditional* (see note 1)
Waste transfer station (includes recycling depots)	**Incompatible**	**Incompatible**	*Conditional*
Wastewater infrastructure	↓	↓	↓
- sewerage – gravity sewers	**Incompatible**	**Incompatible**	Compatible
- sewerage – pressure mains	**Incompatible**	*Conditional*	Compatible
- sewer pump stations	**Incompatible**	*Conditional*	*Conditional*
- treatment plants, wastewater disposal to land	**Incompatible**	**Incompatible**	*Conditional*
- wastewater injection into the ground	**Incompatible**	**Incompatible**	**Incompatible**
Water treatment plants (drinking)	See **Industry**		
Winery (includes wine tasting facilities) (see note 10)	**Incompatible**	*Conditional* (see notes 3 & 5)	*Conditional* (see note 3)

Subdivision	P1	P2	P3
Rural subdivision	↓	↓	↓
- to a lot size of 4 hectares or greater	**Incompatible**	Compatible	Compatible
- to a lot size less than 4 hectares	**Incompatible**	**Incompatible**	**Incompatible**
Special rural subdivision	↓	↓	↓
- to a lot size of 2 hectares or greater	**Incompatible**	*Conditional* (see notes 7 & 8)	*Conditional* (see note 8)

Subdivision	P1	P2	P3
- to a lot size between 1 and 2 hectares	**Incompatible**	**Incompatible**	*Conditional* (see notes 7& 8)
- to a lot size less than 1 hectare	**Incompatible**	**Incompatible**	*Conditional* (see note 7)
Urban subdivision	**Incompatible**	**Incompatible**	Compatible (see note 1)
Industrial subdivision	**Incompatible**	**Incompatible**	Compatible (see note 1)

Table legend:

NA Not applicable within PDWSAs

Model Scheme Text (MST) land uses are shown **bold** in the tables. Definitions covered in MST can be found in the *Town Planning Amendment Regulations 1999*.

Table reference notes:

The following notes provide interpretive information based on the scale or type of development described in the preceding tables. They do not list of all of the conditions that would apply to a development. More detailed information about best management practices is available from Environmental Management Guidelines and Water Quality Protection Notes available for a number of listed land uses. These are available on our Internet site (**http://*www.wrc.wa.gov.au/protect/policy/***) or by contacting our regional offices.

1. Must be connected to deep sewerage, except where exemptions apply under the current Government Sewerage Policy. This Policy recognises that sewer connection may not be feasible in some areas.
2. Land use not normally acceptable, but may be approved where a community need is demonstrated or if this facility is consistent with State and Local Government planning strategies and schemes.
3. Proposal must incorporate waste management practices compatible with the water source protection objectives for the management Priority of the source protection area.
4. Conditions apply to density of accommodation (i.e. people / hectare) in Priority 2 areas.
5. Size of annual grape crush shall not exceed 500 tonnes.
6. May be approved if occupancy is of equivalent size to a single dwelling household (i.e.<10 people –defined by capacity of a septic tank based on-site wastewater treatment system).
7. An average, rather than minimum, lot size may be accepted if the proponent can demonstrate that the water quality objectives of the source protection area are met, and caveats are placed on titles of specified blocks stating that further subdivision cannot occur.
8. Lots should only be created where land capability assessment shows effective on-site soakage of treated wastewater. Conditions apply to siting of wastewater disposal systems in areas with poor land drainage and / or a shallow depth to groundwater, animals are held or fertiliser is applied. Alternative wastewater treatment systems, where approved by the Department of Health, may be accepted with ongoing maintenance requirements.
9. Conditions are likely to be placed via a Department of Mineral and Petroleum Resources lease, and / or as a result of Minister for the Environment and Heritage's approval after Environmental Impact Assessment.
10. Conditions apply to the storage of fuels and chemicals, the depth of excavation related to the water table and rehabilitation criteria. Underground fuel or chemical storage tanks are prohibited in

    Priority 1 and 2 areas within Underground Water Pollution Control Areas.
11. Conditions apply to regulate fertiliser and pesticide application.
12. May be approved if animal stocking levels (animals per hectare) are consistent with the priority source protection area objectives.
13. This does not include stockyards used on farms or pastoral leases for animal husbandry.
14. Conditions may be imposed to cover design, construction of infrastructure and the types of goods.
15. May only be approved if "Home Occupation" is part of existing residence.
16. Limited to one residential building per property.
17. Includes land or buildings used for the showing, competition or training of horses and riding schools.

18. Includes any land, building or structure used for the housing, keeping and feeding of horses, asses and mules and associated incidental activities.

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

20. No more than 2 employees and less than or equal to a 50 square metre home business area. Compatible if only an office/ administrative business (ie no refuelling, repair or maintenance of commercial/ business vehicles, and no activities involving on-site use or storage of chemicals).

21. Employees shall be members of the household and less than or equal to a 20 square metre home business area. No provision for refuelling, repair or maintenance of commercial/ business vehicles or on-site use or storage of chemicals.

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

More information

We welcome your comments on this note. It will be updated from time to time as feedback is received or land-use activity standards change. We are progressively developing Water Quality Protection Notes and Environmental Management Guidelines covering the land uses described in the land use tables.

If you wish to comment on this note, please contact our Resource Quality Branch at the Hyatt Centre in East Perth.
Phone: (08) 9278 0300 (business hours);
Fax: (08) 9278 0585; or
E-mail: Use {feedback} section at our Internet address (*http://www.wrc.wa.gov.au),* citing the topic & version.

Appendix 2. The Samson Redevelopment Stakeholder Liaison Group

The Water and Rivers Commission, along with the Water Corporation would also like to thank the following individuals for their participation in the development of this plan as representatives on the Samson Redevelopment Stakeholder Liaison Group.

Representative	**Affiliation**
Mr Charlie Welker *(Chairperson)*	Welker Environmental Consultancy
Mr Kevin O'Connor	Shire of Waroona *(Chief Executive Officer)*
Cr Kris Annane	Shire of Waroona *(Councillor - since resigned)*
Mr Vernon Pitter	Landowner
Mr Alan Cook	Water & Rivers Commission *(Allocation)*
Ms Sharon Piscioneri	South West Irrigation *(Director, Waroona Irrigation District)*
Ms Kerry Laszig	Water & Rivers Commission *(Water Source Protection Planning)*
Mr Nathan Harrison	Fisheries WA
Mr Frank Prokop	Recfishwest *(Representing recreational fishers)*
Mr Richard Theobald	Health Department
Mr Ken McIntosh	Alcoa World Alumina Australia
Mr Lou Bursztyn	Department of Mineral & Petroleum Resources
Mr Tim Birmingham	Department of Conservation and Land Management
Dr Kerry Trayler	Water & Rivers Commission *(Environmental Water Provisions)*
Mr Hans Jacob	Environmental Protection Authority-Service Unit
Mr Joe Walley	Aboriginal Elder
Mr Doug Perrett	Harvey River Restoration Trust
Ms Kim Wilson	Crossing the Boundaries *(Landcare Development Officer)*
Mr Lloyd Leith	Water Corporation *(Project Manager)*

Appendix 3. Water Quality Monitoring

Water quality analyses for Samson Brook are summarised in the following table. The values are taken from ongoing raw water monitoring at the dam, pipehead and Waroona town water supply. Monitoring periods are 1991 to 2002. All values are in milligrams/litre (mg/L) or micrograms/litre (ug/L) unless stated otherwise. The water quality guidelines are the 1996 Australian Drinking Water Guidelines.

	1996 Australian Drinking Water Guidelines			
	Health Value	Aesthetic Value	units	Range of detections
Hardness as $CaCO_3$		200	mg/L	14 – 28.5
pH		6.5 – 8.5		6.4 – 7.5
Total dissolved solids		500	mg/L	84 – 146
True colour		15	HU	1 – 15
Turbidity		5	NTU	0.4 – 15
Aluminium		0.2	mg/L	0.01 – 0.5
Antimony	0.003		mg/L	<0.002
Arsenic	0.007		mg/L	<0.002
Barium	0.7		mg/L	<0.01
Boron	0.3		mg/L	<0.02 – 0.024
Cadmium	0.002		mg/L	<0.0002
Calcium			mg/L	1.2 – 3.4
Chloride		250	mg/L	40 – 66
Chromium	0.05		mg/L	<0.0005 – 0.008
Copper	2	1	mg/L	0.002 – 0.004
Cyanide	0.08		mg/L	<0.005
Fluoride	1.5		mg/L	0.05 – 0.2
Iodide	0.1		mg/L	<0.02
Iron		0.3	mg/L	0.06 – 0.46
Lead	0.01		mg/L	<0.002
Magnesium			mg/L	2.4 – 5.2
Manganese	0.5	0.1	mg/L	0.002 – 0.035
Mercury	0.001		mg/L	<0.0005
Molybdenum	0.05		mg/L	<0.01
Nickel	0.02		mg/L	<0.02
Nitrate	50		mg/L	<0.05 – 0.26
Potassium		-	mg/L	0.4 – 1.6
Selenium	0.01		mg/L	<0.003
Silica		-	mg/L	2.9 – 8.1
Silver	0.1		mg/L	<0.002
Sodium		180	mg/L	21 – 34
Sulphate	500	250	mg/L	4 – 12
Uranium	0.02		mg/L	<0.005
Zinc	-	3	mg/L	<0.02
PESTICIDES			µg/L	
Chlorpyrifos	10		µg/L	<0.002 – 0.003
Dieldrin	0.3		µg/L	<0.001 – 0.002
				No other detections
INDUSTRIAL HYDROCARBONS				No detections
Radionuclides (α screening)	500		bq/L	5
Radionuclides (β screening)	500		bq/L	128

Bacteria Sampling Results

Microbiological testing of raw water samples from Samson Brook have shown regular thermotolerant coliform counts, many in excess of 100 colony forming units per 100 mL. Thermotolerant coliforms are indicators of faecal matter.