

PERTH COASTAL UNDERGROUND WATER POLLUTION CONTROL AREA DRINKING WATER SOURCE PROTECTION ASSESSMENT

INTEGRATED WATER SUPPLY SCHEME



2007



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

Important information

The *Perth Coastal Underground Water Pollution Control Area drinking water source protection assessment* (Water Corporation, 2007) was reviewed in 2012.

Please ensure you read the *Perth Coastal and Gwelup Underground Water Pollution Control Area drinking water source protection review* (2012, WRP no.136) alongside this 2007 assessment to obtain all of the information about this drinking water source.

The 2012 review considers changes that have occurred in and around the Perth Coastal and Gwelup Underground Water Pollution Control Area since the completion of the 2007 assessment. Recommendations have been prepared to ensure the ongoing protection of this public drinking water source area including amending the boundary under the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909*.

You can find the 2012 *Perth Coastal and Gwelup Underground Water Pollution Control Area drinking water source protection review* at www.water.wa.gov.au > publications > find a publication > drinking water source protection reviews or by contacting the Department of Water on +61 8 6364 7600 or drinkingwater@water.wa.gov.au.

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Cover Photograph: Roselea Estate - Stirling (taken by David Boyd)

Purpose of this Assessment

A safe drinking water supply is critical to the wellbeing of the community. Effective catchment protection is fundamental to minimising risks to public health and the cost of supplying water to consumers.

This document presents an initial assessment of the risks to water quality in Perth Coastal Underground Water Pollution Control Area. It is part of the ongoing process of protecting the quality of the public groundwater supply drawn from the Control Area.

The Water Corporation is committed to supplying the safest drinking water to its customers that is practicable. It recognises protecting Public Drinking Water Source Areas (PDWSAs - i.e. surface water catchments, underground water pollution control areas and groundwater reserves) is the most critical component of its Drinking Water Quality Management System. Statutory responsibility for managing PDWSAs in Western Australia belongs to the Department of Water (formerly the Water and Rivers Commission) and for public health with the Department of Health (DoH). The Water Corporation, as water service provider, has a responsibility to work with both organisations to protect drinking water supplies.

The Australian Drinking Water Guidelines (ADWG), developed by the National Health and Medical Research Council, provides a framework for management of drinking water quality, and proposes a multiple barrier ('catchment to consumer') approach as the most effective method of protecting drinking water. Management of the drinking water source catchment is considered the first important barrier and involves:

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

Western Australia is meeting the ADWG framework by producing Drinking Water Source Protection Plans (DWSPP) for each PDWSA and undertaking review of the risks on a regular basis (currently every 5 years).

The Department of Water requested the Corporation undertake an assessment of risks and prepare this assessment document because it is the licensed water service provider for the Integrated Water Supply Scheme, which includes supply from the Perth Coastal groundwater system. The Corporation has a good understanding of the water quality issues in the Control Area and a strong desire to ensure water quality is protected.

With the completion of this assessment, it is essential that water managers continue with and improve upon catchment preventive and management strategies and further develop and implement protection measures to ensure ongoing availability of good quality drinking water. Planning and other land use decision-makers should continue to recognise the significance of drinking water catchments in the decisions they make.

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Lake Joondalup in March 2007 - autumn groundwater level after seasonal dry



Lake Joondalup in September 2007 - spring groundwater level after seasonal winter recharge

1 Water supply system overview

The proposed revised Perth Coastal Underground Water Pollution Control Area (UWPCA – also referred to as the Control Area) is located between about 7 km and 60 km north of Perth. It covers a large part of the northern coastal suburbs of the Perth Metropolitan Region of Western Australia (refer to Figure 1). The revised Control Area boundary is yet to be gazetted under the *Metropolitan Water Supply Sewerage and Drainage (MWSSD) Act 1909* (see Section 1.6.1). The proposed UWPCA incorporates parts of the existing Perth Coastal and Gwelup UWPCAs. It will define the western area of the Gnangara Mound groundwater system that provides public water supply as part of the Integrated Water Supply Scheme (IWSS).

Perth Coastal UWPCA has an area of about 188 km² and is located within the Cities of Stirling, Joondalup and Wanneroo.

1.1 Existing water supply system

Groundwater for the IWSS is obtained from regional freshwater aquifers within the Quaternary superficial sediments, Cretaceous sandstones of the Coolyena Group and Leederville Formations and the Jurassic sandstones of the Yarragadee Formation beneath the Swan Coastal Plain.

The Perth Coastal groundwater system includes three wellfields, Gwelup, Neerabup and Yanchep and three independent artesian wells (refer to Figure 2).

Gwelup wellfield was commissioned in 1974. The wellfield currently consists of 10 production bores that draw water from the locally recharged shallow superficial formations aquifer, 3 production bores drawing water from the Mirrabooka aquifer and 5 production bores drilled into the underlying confined Leederville aquifer. Raw water is transferred via collector mains to Gwelup Groundwater Treatment Plant (GWTP) and then pumped to a service reservoir for distribution in the IWSS (Gordon, In prep).

Neerabup wellfield comprises the Quinns Rock and Whitfords series of bores. The Quinns Rock field was commissioned in 1998 and extended in 2000. The Whitfords field was commissioned in 2000 and extended in 2001. The Neerabup wellfield currently consists of 24 production bores (16 Quinns Rock bores and 8 Whitfords bores) that draw water from the locally recharged shallow superficial formations aquifer, 7 production bores (5 Quinns Rock bores and 2 Whitfords bores) drilled into the underlying confined Leederville aquifer. There is also 1 Whitfords production bore that draws water from the deeper confined Yarragadee aquifer. Raw water is transferred via collector mains to Neerabup GWTP and then pumped to a service reservoir for distribution in the IWSS. Excess water is transferred to the Wanneroo Reservoir (Gordon, In prep).

Yanchep wellfield comprises the Yanchep and Two Rocks series of bores. The Yanchep bores were commissioned in 1974 and the Two Rocks bores in 1975. The wellfield currently consists of 8 production bores that draw water from the locally recharged shallow superficial formations aquifer. Raw water is transferred via collector mains to Yanchep GWTP and Two Rocks GWTP and then pumped to service reservoirs for distribution in the IWSS (Gordon, In prep).

The three independent artesian wells B1, B2 and G7, commissioned in 1962, 1964 and 2002, respectively, draw water from the deep confined Yarragadee aquifer. Raw water is transferred via collector mains to Gwelup GWTP and then pumped to a service reservoir for distribution in the IWSS (Gordon, In prep).

1.2 Water treatment

Raw water from the Perth Coastal groundwater system is treated at the Gwelup, Neerabup, Yanchep and Two Rocks Groundwater Treatment Plants (GWTPs). Water delivered to Gwelup GWTP is clarified, filtered, dosed with polyelectrolyte and hydrochloric acid, chlorinated and fluoridated. Water delivered to Neerabup GWTP is aerated, softened, recarbonated, filtered, dosed with polyelectrolyte, carbonic acid and calcium hydroxide, chlorinated and fluoridated. Water delivered to Yanchep and Two Rocks GWTPs is softened and chlorinated.

1.3 Catchment details

1.3.1 Physiography

The physiography of the Perth Coastal UWPCA is dominated by the coastal dunes of the Swan Coastal Plain (Davidson, 1995). The area is characterised by calcareous sand remnants of the Spearwood Dune System, which range from 0 to 70 m AHD in elevation. The western margin of the UWPCA consists of the wind blown lime and quartz sand of the Quindalup Dune System. The linear lake system occupies the interbarrier depressions within the Spearwood Dune System that run parallel to the coast on the eastern edge of the UWPCA. The area comprises swamp and lacustrine deposits of peat, peaty clay and clay and includes prominent karstic features.

Natural vegetation within the UWPCA is dominated by open Banksia woodlands on the dune systems and Melaleuca sedgelands and Sheoak around the wetlands. Jarrah, Marri, Sheoak and Tuart are also found in the eastern half of the Control Area on the Spearwood dune system. Large areas have been cleared of native vegetation and replaced with urban landscapes.

1.3.2 Climate

The area has a Mediterranean climate, characterised by hot, dry summers with mild, wet winters.

The long-term average annual rainfall for the Perth Coastal area is about 830 mm. Most rain results from winter cold front systems that cross the south west of Western Australia between May and October.

Rainfall has been significantly less over the last decade and may reflect a shift in the climate pattern to one with drier winters for south west of Western Australia.



Photo. 1 Gwelup bore 80 - Sandpiper Rd Stirling

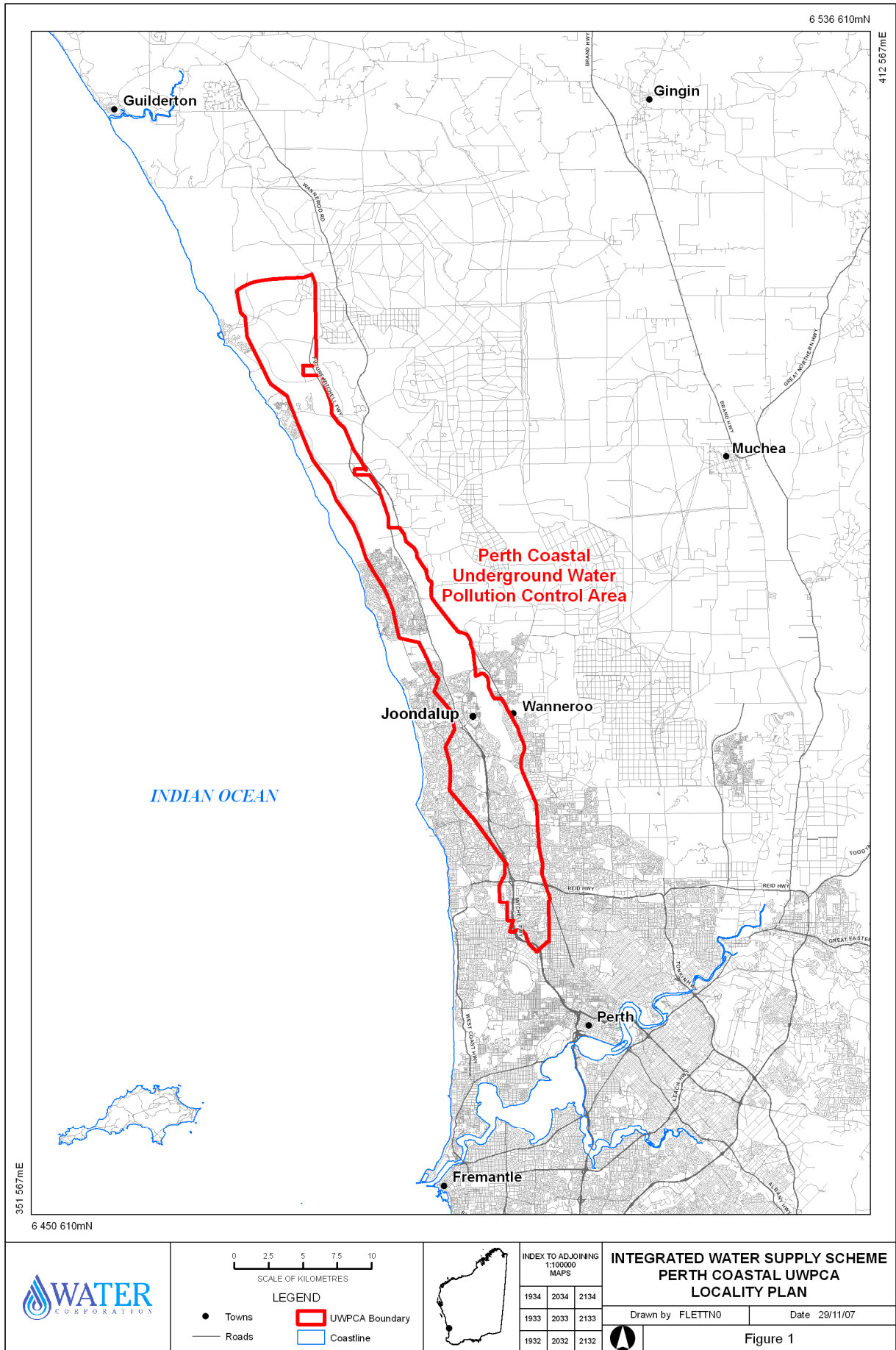


Figure 1 Perth Coastal UWPCA Locality Plan

1.4 Hydrogeology

Gnangara Mound is located within the southern area of the Dandaragan Trough, in the central part of the Perth Sedimentary Basin (Davidson, 1995). The Quaternary superficial sediments of the mound within the Control Area predominantly comprise Tamala Limestone, which are partially overlain by the Safety Bay Sands in the north western sector. The Tamala Limestone is underlain by the Coolyena Group of sediments and the Leederville Formation, then partially by the South Perth Shale, Gage Formation, then Yarragadee Formation and Cattamarra Coal Measures.

The Perth Coastal groundwater system draws water from the unconfined aquifer within the superficial formations, the semi-confined Coolyena Group Mirrabooka aquifer, and the confined aquifers of the Leederville and Yarragadee Formations.

Groundwater in the superficial formations in the southern part of the Gnangara Mound flows radially from the crest of the mound discharging into Ellen Brook, Swan River and the Indian Ocean (Davidson, 1995). In the northern part, groundwater in the superficial formations flows from the Gingin Scarp in a westerly direction to the Indian Ocean and north westerly to Gingin Brook. Recharge to the aquifer predominantly occurs by direct infiltration of rainfall. The aquifer varies in saturated thickness from about 20 metres in the northern part of the Control Area to about 45 metres along the south eastern margin.

The Mirrabooka aquifer is a major semi-confined, predominantly sandy groundwater system within the Coolyena Group Poison Hill Greensand, Gingin Chalk, Molecap Greensand and the Osborne Formation Mirrabooka Member that largely underlies the superficial formations in the southern part of the Gnangara Mound. It is recharged by downward leakage from the superficial aquifer where the two aquifers are in hydraulic continuity east of the Control Area. Groundwater in the aquifer flows generally south westerly from the recharge area, discharging upwards in the southern part of the UWPCA into the superficial formations and laterally into the Kings Park Formation. The top of the aquifer lies at a depth of about 50 metres within the Control Area and it has a maximum thickness of about 100 metres.

The Leederville aquifer is a major confined, multi layered groundwater flow system comprising interbedded sandstones, siltstones and shales that underlies the entire UWPCA. It is recharged by downward leakage from the superficial aquifer where the Leederville Formation subcrops beneath the superficial formations, which mainly occurs north east of the Control Area but also in the central and eastern areas of the UWPCA. Some recharge also occurs through upward discharge from the Yarragadee aquifer where the South Perth Shale is absent along the north eastern margin of the UWPCA. Groundwater in the aquifer flows westerly to the Indian Ocean, discharging upwards into the superficial aquifer in the central western areas of the Control Area and offshore on the ocean floor. The top of the aquifer lies at depths of 20 to 350 metres within the UWPCA and it has a maximum thickness of about 500 metres.

The Yarragadee aquifer is a major confined multi layered groundwater system comprising interbedded sandstones, siltstones and shales that underlies the entire Control Area. It is recharged by downward leakage from the Leederville aquifer where the South Perth Shale is absent, which occurs north east of the Control Area. Regional groundwater flow in the aquifer is south westerly to the Indian Ocean, discharging offshore by upwards leakage into overlying strata. Some upward discharge occurs into the Leederville aquifer where the South Perth Shale is absent just north east of the UWPCA. The top of the aquifer lies at depths of 300 to 800 metres within the Control Area and it is more than 2 000 metres thick.

Department of Water is in the process of reassessing sustainable yield of the Gnangara groundwater system. Until the assessment is complete the present annual licensed allocation of 48 000 Megalitres is considered to be the nominal sustainable yield for the currently developed wellfields within the Perth Coastal UWPCA.

The Perth Coastal groundwater system is extremely vulnerable to contamination from inappropriate land uses because of the direct recharge that occurs from rainfall across the whole Control Area, the shallow depth to the water table in many locations and the hydraulic connection between aquifers.

1.5 Future water supply requirements

By 2050, it is estimated the IWSS will be required to provide for a demand of about 455 Gigalitres (GL)/year based on a projected population in the order of 2.4 million (Fisher, 2005). The source capacity required to meet this demand is expected to be about 500 GL/year of which groundwater sources could provide about 220 GL/year. Current yield of all existing sources based on the “drier 8-year climate and streamflow regime” (1997-2005) is rated as low as 301 GL/year (including 45 GL/year from the recently commissioned seawater desalination plant).

A number of options are being considered by the Water Corporation to meet demand. Short term proposals include water trading with Harvey Water (17 GL/year) and development of the Southern Seawater Desalination Plant (45 GL/year). Commissioning of these options is expected to meet demand until 2017/18. Further major development of the Perth Coastal groundwater system is not likely to occur before 2025.

The most likely longer term options for meeting demand to 2050 are development of additional groundwater and surface water sources, desalinated seawater, and use of treated wastewater, drainage water and stormwater.

1.6 Protection and allocation

1.6.1 Existing water source protection

Gwelup and Perth Coastal Underground Water Pollution Control Areas were proclaimed in 1973 and 1989, respectively under the *Metropolitan Water Supply Sewerage and Drainage (MWSSD) Act 1909* to protect the public drinking water source in the coastal area of the Gnangara Mound. Perth Coastal UWPCA was amended in 1990 to include Neerabup National Park.

Gwelup UWPCA was also proclaimed as a Water Reserve under the *MWSSD Act* in 1973.

It is proposed to amend the UWPCA boundaries to align with the revised boundary as defined in the Review of Groundwater Protection Priority Area Boundaries Gnangara Mound. The revised area will be referred to as Perth Coastal UWPCA. It will include the parts of the existing Perth Coastal and Gwelup UWPCAs, the boundaries of which were redefined following the recommendations of a number of State Government assessments and reports on the impact of Metropolitan development on groundwater supplies. These included:

- Parliamentary Select Committee on Metropolitan Development and Groundwater Supplies (WA Legislative Assembly, 1994)
- Review of Groundwater Protection Priority Area Boundaries Gnangara Mound (Dames & Moore, 1996)

The UWPCA boundaries were redefined using internationally accredited groundwater modelling software. A priority classification of Priority 3 (P3) was then assigned to land within the newly defined Control Area.

The UWPCA is shown in Figures 2A and 2B. It is divided into planning precincts that reflect the land planning zones in the three local government areas within the UWPCA.

1.6.2 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 1914*. This Act requires a licence to draw water from surface water and groundwater areas proclaimed under the Act (except for domestic and stock use) and all artesian wells throughout the State.

Perth and Yanchep Groundwater Areas were proclaimed in 1989 and 1990, respectively under the *Rights in Water and Irrigation Act 1914* to allocate groundwater resources and to manage sustainable use in the North-

West Corridor of Perth, which includes the Perth Coastal area of the Gnangara Mound. Perth Groundwater Area was amended in 1991 and again in 1994. Gwelup Groundwater Area was proclaimed under the same act in 1996 with the formation of the then Water and Rivers Commission (now Department of Water).

The Water Corporation is licensed by Department of Water to nominally draw 48 000 Megalitres (ML)/year from the Gwelup, Neerabup and Yanchep wellfields of the Perth Coastal groundwater system, as part of the public drinking water supply for the IWSS. The allocation is made up of 27 450 ML/year from the superficial formation aquifer, 3 550 ML/year from the Mirrabooka Sands aquifer, 15 000 ML/year from the Leederville Formation aquifer and 2 000 ML/year from the Yarragadee Formation aquifer. The nominal allocation for the three independent artesian bores within the Control Area is 8 500 ML/year from the Yarragadee Formation aquifer. Annual quotas are negotiated with the Department of Water and based on storage capacity of the IWSS surface water sources and levels within the groundwater systems. The quota for 2005/06 for Perth Coastal UWPCA (including the independent artesian bores) was 53 580 ML and annual production was just over 53 800 ML.

2 Water quality

The quality of raw water from the Perth Coastal groundwater system is monitored in accordance with the Australian Drinking Water Guidelines (ADWG) and the program set out in the IWSS Water Resource Management Operation Strategy (Gordon, In prep.). Production bores and water supply sampling points are regularly monitored for microbiological contamination, health related chemicals and aesthetic chemicals and parameters.

The ADWG gives guidance on the quality of water that should be provided to consumers at the point of use.

The Perth Coastal groundwater system supplies water to four groundwater treatment plants prior to distribution to the IWSS. Gwelup Groundwater Treatment Plant (GWTP) receives water from Gwelup wellfield, Neerabup GWTP receives water from Neerabup wellfield, Yanchep and Two Rocks GWTPs receive water from Yanchep wellfield.

Raw water from Gwelup wellfield has consistently been of good quality and, with the exception of iron and turbidity, has generally met ADWG values. Although salinity is relatively consistent at around 400 mg/L TDS it does vary between individual bores. Three superficial aquifer bores and one Leederville aquifer bore have salinity above the ADWG guideline value of 500 mg/L. Hardness is also variable and is close to or above the ADWG guideline value in most superficial and Mirrabooka aquifer bores. Monitoring results indicate observed values are within the naturally occurring range for this locality and no trends are evident.

Low levels of arsenic, barium and boron occur within the superficial and Mirrabooka aquifers at levels generally well below ADWG values. Past investigation of consistently higher levels of arsenic observed in three of the bores (G70, G140 and G150) suggest it may be natural variation within the aquifer.

Nitrates in some superficial aquifer bores, although well below the ADWG guideline value, are above what is considered naturally occurring levels and probably reflect historical use of the Gwelup area for vegetable production and the past use of septic tanks for disposal of residential wastewater. There is no large scale horticulture within the area now and all lots are connected to the regional sewerage scheme. Some bores are possibly being affected by current practices, which include fertilising of nearby sporting grounds.

There has been one unrepeated positive thermotolerant coliform count at the Gwelup GWTP raw water sampling point. This is consistent with analysis of samples taken from the bores and indicates there has been no pathogen contamination of the water supply bores.

All other chemical components are generally within guideline values. The elevated levels of iron, turbidity and hardness observed relate to natural occurrence and are not a result of land use impacts.

Raw water from Neerabup wellfield has consistently been of good quality and, with the exception of iron, turbidity and hardness, has generally met ADWG values. This is achieved by blending lower salinity groundwater from the Leederville and Yarragadee aquifers with the higher salinity supply from the superficial aquifer bores. Salinity in all superficial aquifer bores exceeds the ADWG guideline value of 500 mg/L TDS. Elevated levels of chloride and carbonate occur naturally in the superficial aquifer at this locality and no trends are evident. Salinity of raw water from the Leederville and Yarragadee aquifers is consistently less than 300 mg/L.

Nitrates in some superficial aquifer bores, although well below the ADWG guideline value, are above what would be expected to be naturally occurring levels. The elevated nitrate occurs in two main clusters, one in the suburb of Clarkson and the other in Kallaroo. The bores within these clusters are located in or adjacent to community parks and ovals, and fertiliser use on these grassed areas may be a possible source of nitrate.

There has been one unrepeated positive thermotolerant coliform count at the Neerabup Groundwater Treatment Plant raw water sampling point. This is consistent with analysis of samples taken from the bores and indicates there has been no pathogen contamination of the water supply bores.

Low levels of barium and boron occur naturally in the superficial aquifer at levels well below ADWG values. Traces of arsenic have also been detected in about a third of the superficial aquifer bores. Higher arsenic levels observed in bores Q10, Q20, Q30, WT10, WT20 and WT40 at or above the ADWG value are thought to be natural variation within the aquifer.

All other chemical components are generally within guideline values. The elevated levels of iron, turbidity and hardness observed relate to natural occurrence and are not a result of land use impacts.

Raw water from Yanchep wellfield has consistently been of good quality and, with the exception of hardness, has generally met ADWG values. Monitoring results indicate observed values are within the naturally occurring range for this locality and no trends are evident. There have been no positive thermotolerant coliform counts at the Yanchep or Two Rocks GWTP raw water sampling points. This is consistent with analysis of samples taken from the bores and indicates there has been no pathogen or nutrient contamination of the water supply bores.

Yanchep wellfield salinity is relatively consistent at around 400 mg/L TDS.

All other chemical components are generally within guideline values. Very low levels of barium occur naturally within the wellfield but well below the ADWG guideline value. The elevated hardness relates to natural occurrence and is not a result of land use impacts.

Raw water from the three independent artesian wells, B1, B2 and G7 has consistently been of good quality although salinity does exceed the ADWG guideline value of 500 mg/L TDS. Sodium and chloride are close to or exceed the ADWG guideline values. Despite these exceedances, monitoring results indicate observed values are within the naturally occurring range for the Yarragadee aquifer at this locality and no trends are evident. High levels of turbidity have been observed in bores B1 and B2 and may have been an indication of bore casing condition rather than natural occurrence. The bores were relined a few years ago and since then turbidity in B2 has reduced significantly, but it remains high in B1.

There have been no positive thermotolerant coliform counts from the independent artesian wells.

All other chemical components are generally within guideline values. Low levels of barium occur naturally within the aquifer but at levels well below the ADWG guideline value.

Summary details of water quality from Perth Coastal groundwater system are shown in Appendix 2.

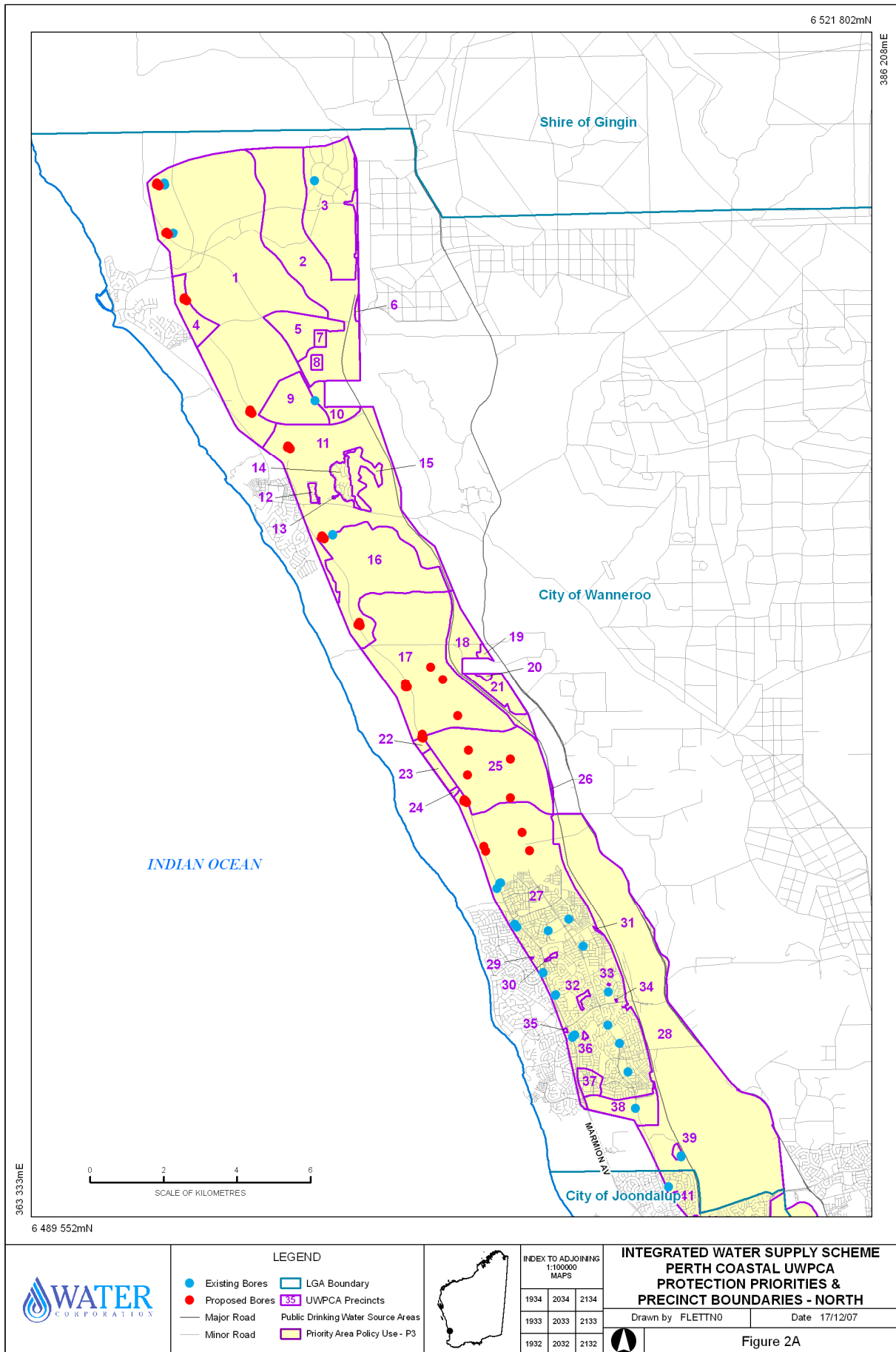


Figure 2A Perth Coastal UWPCA protection priority and precinct boundaries - North

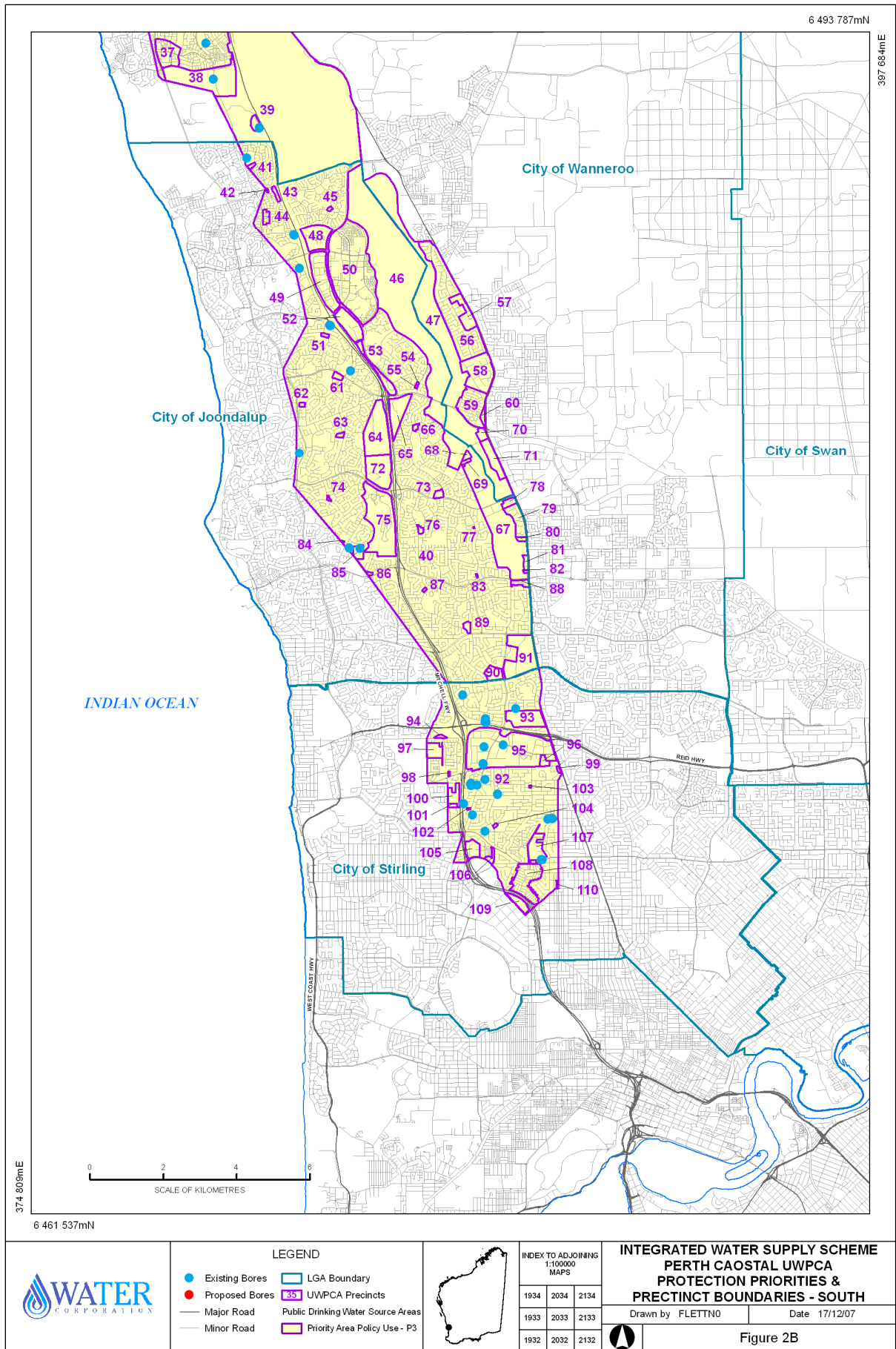


Figure 2B Perth Coastal UWPCA protection priority and precinct boundaries - South

3 Hazard identification and risk assessment

Hazards associated with existing and proposed land uses and activities in the Control Area have been identified as part of the review process. The risk posed by each hazard has been assessed and a catchment management priority of *High, Medium* or *Low* assigned.

The priority level assigned to identified hazards was determined by assessing the likelihood and consequences of the source being contaminated, taking into account current catchment preventive and management strategies. The risk assessment process was conducted in accordance with ADWG 2004 recommendations. All identified hazards were rated against a risk scale of severe, high, major, significant, moderate, low or trivial. Hazards considered a severe or high risk are assigned a high catchment management priority, those considered a major or significant risk were given a medium priority, and those with a moderate, low or trivial risk rated a low priority. The Department of Water's Water Quality Protection Note *Risk Assessment of PDWSAs* explains risk assessment in drinking water catchments. It is available on the department's website at [www.water.wa.gov.au>water quality>publications>WQPNs](http://www.water.wa.gov.au>water%20quality>publications>WQPNs).

Potentially hazardous land uses and activities are shown in Figures 3A and 3B and land uses in planning precincts assigned a high or medium catchment management priority are described in Table 1.

3.1 Land use identification

Information on land uses within the Control Area was compiled from a number of sources. Data was obtained from existing agency and corporate land and water databases, geographic information systems and aerial photography, and added to by undertaking broad scale property surveys and on-site inspection of selected sites. It is acknowledged there were limitations to the detail that could be obtained from the survey because of time constraints and the extremely large number of properties within the Control Area. It is planned to improve information during regular surveillance carried out by the Water Corporation as part of its routine operational procedures.

All the collected information was brought together into a single secure database, the Land Use Database. Department of Water will use the database as a management tool in the future development of water protection policies and strategies. Water Corporation will incorporate the database into routine operational procedures so water supply operators will have ready access to the data and be able to easily input new information about changes in land uses and activities.

3.2 Land use assessment

Perth Coastal UWPCA covers six land planning zones within three local government agency boundaries. It also includes Crown Land reserves for Parks and Recreation, Public Purposes and State Forests. The entire Control Area is classified as a Priority 3 (P3) source protection area.

The greater part of the land within the UWPCA is in private ownership (about 65%), the majority of which is zoned urban. The largest parcel of Industrial zoned is located in Balcatta, in the southern part of the UWPCA. Joondalup City in the central section of the Control Area and the future Alkimos City site, in the north are the major Central City Areas within the UWPCA.

Neerabup National and Yellagonga Regional Parks, located along the eastern boundary of the Control Area, make up a large portion of the Crown Land.

Risks posed by hazards associated with land uses have been assessed for each of the land planning zones and reserved land categories.

3.2.1 Central City Area land

The Central City Area zone covers about 4% of the UWPCA. The zone comprises the city and commercial areas of Joondalup and Stirling and future city areas of Alkimos and Yanchep.

A retail fuel outlet in the Joondalup city precinct is considered high catchment management priority because it poses a high contamination threat through the possible leakage of fuel stored in underground tanks.

The potential for chemical spills from the Joondalup Sports Arena swimming pools is considered a significant risk to groundwater quality and is rated a medium catchment management priority. The Arena ovals and Joondalup Central Park may pose a significant risk from the use of fertiliser. Application of fertiliser on the grounds of the university and the two colleges located in the Joondalup precinct is also considered a significant threat to groundwater quality. Maintenance of these grassed areas present a medium catchment management priority.

There is some potential for chemical contamination from the services provided at the Joondalup Health Campus, as well as from a dentist laboratory, and photo processor, dry cleaning and laundromat services in Joondalup. Three motor vehicle repairers, a retail tyre outlet, a number of commercial warehouses and the large car park areas within the Joondalup city precinct area pose a risk from potential leakage of fuels and chemicals. These activities and sites pose a significant risk and are rated medium catchment management priorities.



**Photo. 2 Joondalup Health Campus
Central City Area Zone Precinct 50**

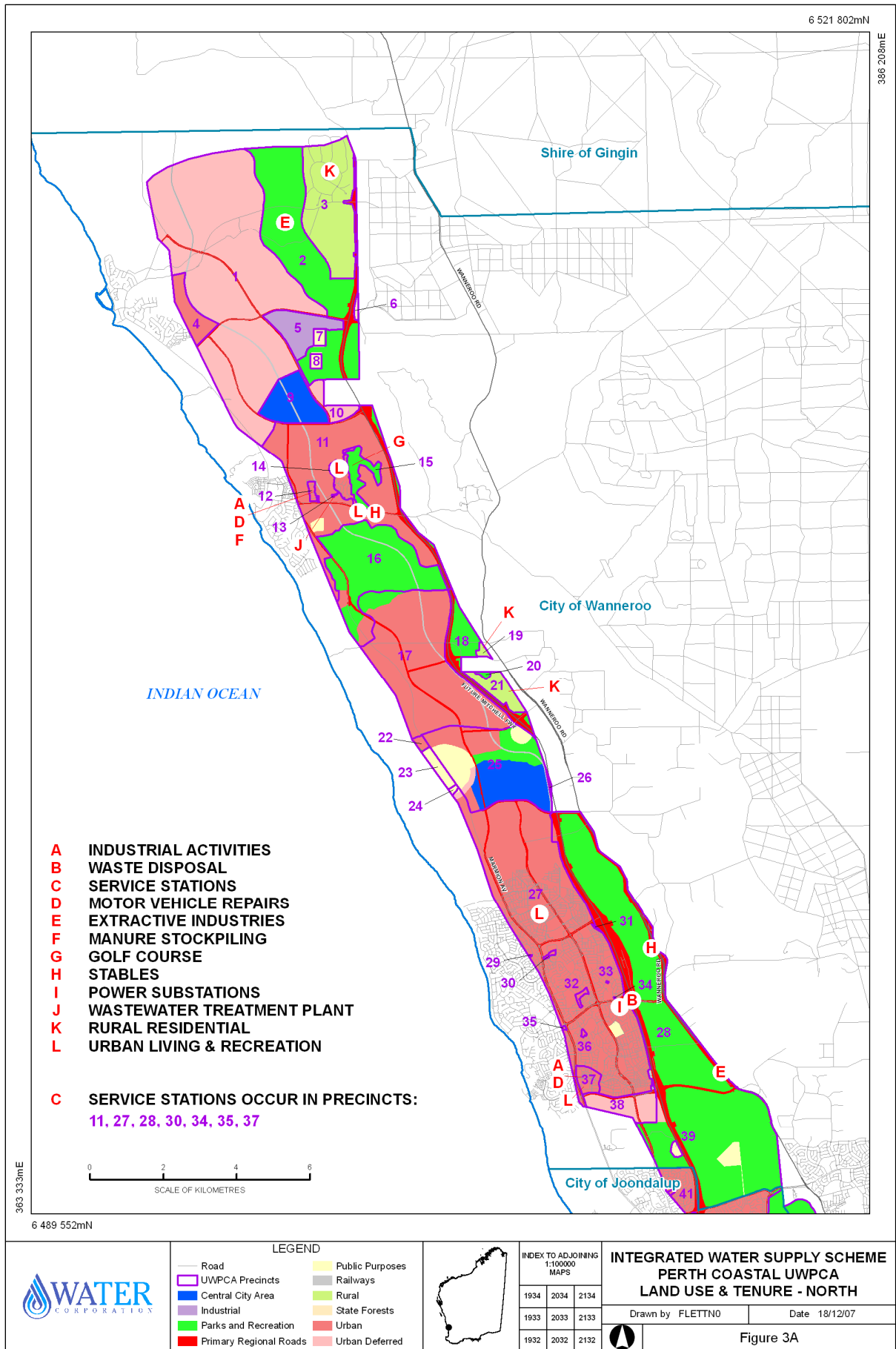


Figure 3A Land use and tenure – North

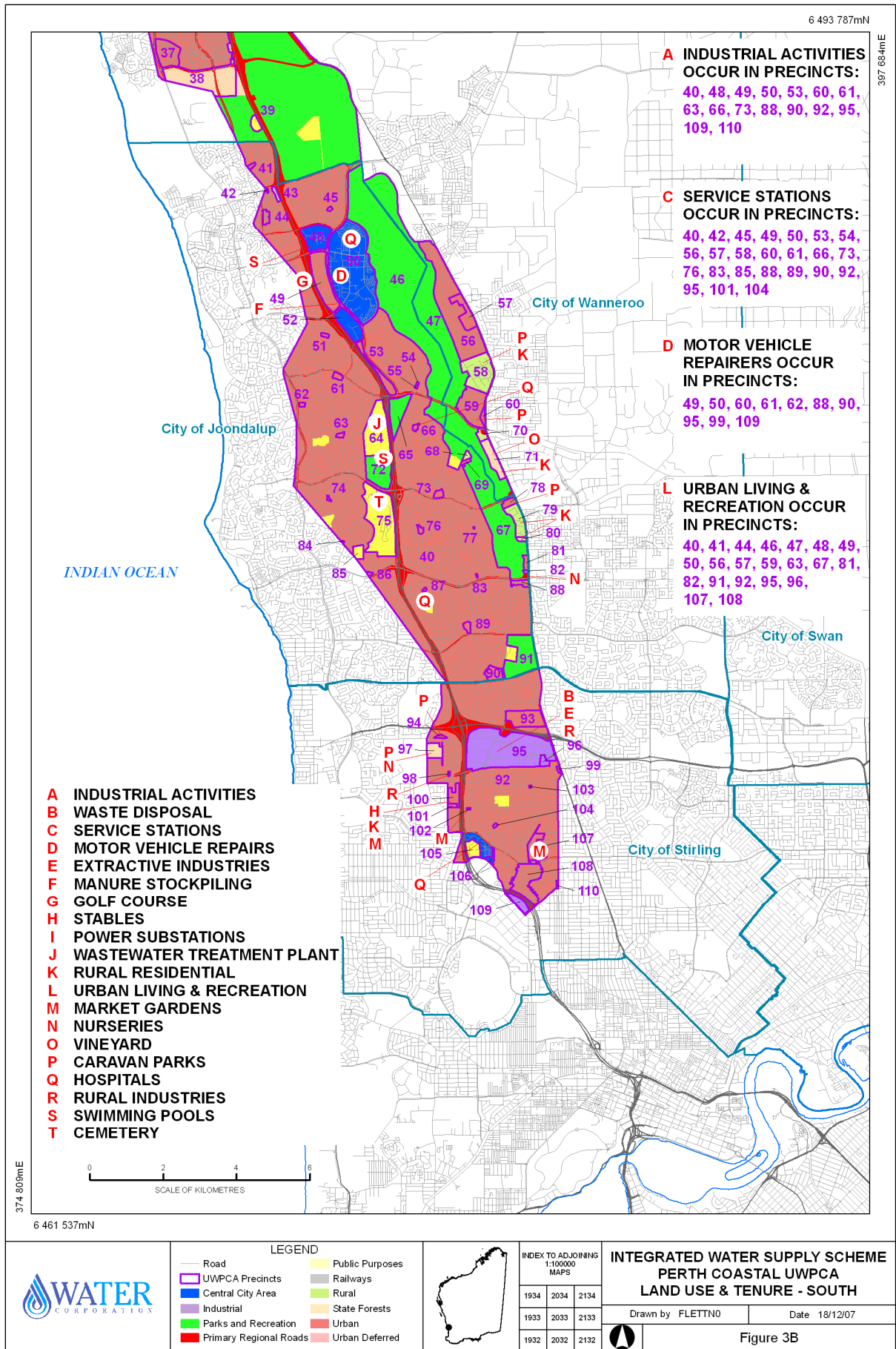


Figure 3B Land use and tenure – South



Photo. 3 Edith Cowan University – Joondalup
Central City Area Zone Precinct 50



Photo. 4 Joondalup Group Housing
Central City Area Zone Precinct 50



Photo. 5 Joondalup Arena
Central City Area Zone Precinct 48

A Western Power electric generation substation in the Joondalup city precinct is considered medium catchment management priority because it poses a major contamination threat through the possible leakage of stored fuels and chemicals.

Residential properties within the Joondalup city precinct are sewered and are an acceptable land use in a P3 area, but there is significant potential for contamination from fertiliser use and spills of stored fuels and chemicals. Overall, residential development is rated a medium catchment management priority.

3.2.2 Industrial land

About 2% of the UWPCA is zoned Industrial. The zone covers the Balcatta industrial area, part of the Osborne Park industrial area and the planned industrial area about 5 km east of Two Rocks townsite.

The Balcatta industrial area is a major industrial service centre for the northern suburbs of Perth and several of the businesses within the area are in the wellhead protection zones for water supply production bores G30, G40 and G50. These production bores have been decommissioned as a precautionary measure because of concerns about the potential detrimental impact of industrial and commercial land uses on the quality of the local groundwater.

Four industrial waste and two solid waste landfills in the Balcatta industrial area are considered severe risks because of their potential to cause pathogen contamination. The industrial waste sites are registered Department of Environment and Conservation (DEC) contaminated sites. One of the solid waste sites is the City of Stirling's waste transfer station and the other site is operated by a private contractor. All sites are rated high catchment management priorities.

Two retail fuel outlets within the Balcatta industrial area are considered high risks and rated high catchment management priorities because of potential leakage of fuel stored in underground tanks. The BP site on Erindale Road underwent remediation several years ago after a hydrocarbon plume emanating from the site was detected in the groundwater. It is adjacent to decommissioned water supply production bore G50. The Caltex site in Balcatta Road has inadequate storage and insufficient sealed hardstand area.



Photo. 6 Commercial units - Balcatta Light Industrial Area Industrial Zone Precinct 95



Photo. 7 Petrol Station and other commercial services - Balcatta Light Industrial Area Industrial Zone Precinct 95



Photo. 8 Abandoned vehicles – Yanchep Light Industrial Area Industrial Zone Precinct 5

There are a large number of food processing businesses, general industry operations, light industrial businesses, service industries, forest products industries and a mining company premises within the Balcatta industrial area, which are considered medium catchment management priorities because they pose either a major or significant contamination threat through the possible leakage of stored fuels and chemicals. A landscape supply centre and a soil stabilisation business pose an additional risk of nutrient contamination from storage of fertilisers. A number of sites have inadequate fuel and chemical storage facilities and insufficient containment of leachate in stormwater run-off. Two chemical manufacturing and supply companies are registered DEC contaminated sites.

Several motor vehicle repair businesses and a large number of warehouses in the Balcatta industrial area are considered medium catchment management priorities because they pose a major threat to water quality because of the potential for leakage of stored fuels and chemicals.

Two extractive industry sites in the Balcatta industrial area are considered to pose a significant risk because of the potential for fuel spills and are rated medium catchment management priorities.

Council managed recreation parks in the Balcatta industrial area are potentially significant risks because of the application of pesticides and fertilisers and are rated medium catchment management priorities.

Potential overflows from the Water Corporation's sewerage pump station in the Balcatta industrial area are considered a major risk to groundwater quality and are rated a medium catchment management priority.

A concrete manufacturer, a motor cycle paint and repair business, a number of metal fabricators and several light industrial businesses in the Osborne Park industrial area are considered medium management priorities because they pose a major contamination threat through possible leakage of stored fuels and chemicals.

3.2.3 Private Recreation land

The Private Recreation zone covers a small area (less than 0.5% of UWPCA) and includes Sun City Country Club Golf Course in Yanchep and a small parcel of undeveloped land next to the future Alkimos Wastewater Treatment Plant.

The golf course poses a major risk because of the application of pesticides and fertilisers and from possible leakage of fuel from an unbunded above ground storage tank and is rated medium catchment management priority.

3.2.4 Rural land

Rural land covers just under 3.5% of the Control Area. There are several pockets of rural land scattered along the eastern boundary of the UWPCA. The largest pocket is the rural and semi rural area located in the northeast corner of Control Area, centred on Breakwater Drive about 6 km east of Two Rocks. Two special residential areas used for special-rural living just south of Wanneroo townsite bordering Yellagonga Regional Park are remnant areas of rural land that are now surrounded by urban subdivisions.

An industrial waste landfill in Jacaranda Drive Wanneroo is considered a severe risk because of its potential to cause pathogen contamination. The landfill is a registered DEC contaminated site.

Lots within the rural areas of Breakwater Drive Yanchep and Pipidinny Road Eglinton present a significant threat because of fertiliser use and possible leakage of stored fuels and chemicals and are rated a medium management priority.

The Wanneroo Caravan Park and properties in the special residential areas along Scenic Drive Wanneroo and Lakeway Drive Kingsley pose a significant threat because of fertiliser use and possible leakage of stored fuels and chemicals. The caravan park and the special residential areas are sewered, but there may be some older residences still using septic systems. These land uses are rated medium catchment management priorities.



**Photo. 9 Sun City Country Club Golf Course - Yanchep
Private Recreation Zone Precinct No 15**

3.2.5 Urban land

The Urban zone covers just over 45% of the UWPCA and includes the northern corridor suburbs of Perth stretching from Osborne Park in the south to Two Rocks in the north. The eastern boundary closely aligns with much of Wanneroo Road and covers as far west as Marmion Avenue in the Whitfords and Quinns Rock areas. The Control Area incorporates a large part of the Mitchell Freeway and the northern line of Metrorail.

Three industrial waste landfills are considered severe risks because of their potential to cause pathogen contamination and are rated high catchment management priorities. The sites, which are located in Hester Avenue Ridgewood, Harvest Loop Edgewater and Ariti Avenue Wanneroo, are registered DEC contaminated sites.

There is a large number of fuel outlets located throughout the suburbs that are considered high catchment management priorities because they pose a high contamination threat through possible leakage of fuel stored in underground tanks. A large hydrocarbon spill occurred in September 2006 at the Path Transit bus depot in Joondalup. Clean up at the site is being monitored by DEC and Department of Water.

Several petrol stations in the Control Area have been closed down. Some have been replaced with group housing and others still have the shells of the station buildings standing. There is a possibility some of these sites may have remnant contamination, which may require investigation to determine if they pose a threat to groundwater quality.

Landscape supply centres in the light industrial areas of Joondalup and Stevenage Street Yanchep pose a high risk of pathogen and nutrient contamination during storm events when run-off from stockpiles that contain manures can leach onto bare ground. These sites are rated a high catchment management priority.



**Photo. 10 Prime Lifestyle retirement village – Kingsley
Urban Zone Precinct No 81**



**Photo. 11 Car sales yard – Ocean Keys – Clarkson
Urban Zone Precinct No 37**

Potential overflows from the Water Corporation's wastewater treatment plant at Yanchep are considered a high risk to groundwater quality and are rated a high catchment management priority.

A few small parcels of remnant market gardens in Stirling and Balcatta may continue to pose a high risk to groundwater quality because of the potential for nutrient contamination from the use of fertilisers. These sites are rated a high catchment management priority.

Old intensive agricultural sites and stables in Gwelup and the recently abandoned Cameleer stables near Yanchep now being redeveloped as urban lots may still pose a risk to groundwater quality if rehabilitation has not been adequate to alleviate any residual contamination.

A large number of food processing businesses, general industry operations, light industrial businesses and service industries exist at several locations within the urban areas. These businesses pose either a major or significant contamination threat through possible leakage of stored fuels and chemicals. The main sites are the light industrial areas of Joondalup, Canham Way, Greenwood and Stevenage Street Yanchep, and the commercial precincts of Ocean Keys, Pearsall, Joondalup Gateway and Wanneroo Road, Balcatta. The Yanchep light industrial area includes the regional fire station and St John Ambulance depot. The Ocean Keys, Pearsall and Wanneroo Road commercial precincts include motor vehicle sale centres. Western Power's regional electricity generation station in the Joondalup Gateway precinct and substation in the Joondalup City precinct are considered major risks because they pose a contamination threat through possible leakage of stored fuels. Overall, these commercial enterprises are considered medium catchment management priorities.

Most of smaller shopping centres located throughout the urban areas have businesses providing services associated with either food production, photo processing, hairdressing, laundering or dry cleaning. The use of chemicals by these services has the potential to be a significant risk to groundwater quality and is rated a medium catchment management priority.

Numerous motor vehicle repair businesses and warehouses located within the many light industrial and commercial centres in the cities of Stirling, Joondalup and Wanneroo are considered medium catchment management priorities because they pose a major threat to water quality from the potential for leakage of stored fuels and chemicals. Some sites in the light industrial areas of Joondalup and Canham Way, Greenwood have poor oil waste containment.

Large car park areas at Ocean Keys and Warwick Grove shopping centres pose a risk from potential leakage of fuels and chemicals and are rated medium catchment management priorities.

There is some potential for chemical contamination from the services provided at Warwick Village Nursing Home and Woodvale Private Hospital. These activities pose a significant risk and are rated medium catchment management priorities.

Potential overflows from the Water Corporation's sewerage pump stations located at several locations in the cities of Stirling, Joondalup and Wanneroo and chemical spills at its Gwelup Groundwater Treatment Plant pose a threat to groundwater quality. The sewerage pump stations are considered a potential major risk and the treatment plant a significant risk. Both activities are rated medium catchment management priorities.

There are numerous recreational parks, ovals and a number of artificial wetland reserves where fertiliser use may pose a significant risk. Application of fertiliser on the grounds of the many primary, secondary and tertiary schools and on the eastern fairways of Joondalup Country Club Golf Course is also considered a significant threat to groundwater quality. The Wanneroo Showgrounds and Yanchep Sports Club complexes, which support a number of high use recreational sports, also present an additional risk from use of pesticides. Overall, maintenance of these grassed areas within the urban areas presents a medium catchment management priority.

Caravan parks in Wanneroo, Kingsley and Gwelup pose a significant threat because of fertiliser use and possible leakage of stored fuels and chemicals and are rated medium catchment management priorities.



Photo. 12 Local urban shopping centre and petrol station - Edgewater
Urban Zone Precinct Nos 54 and 55



Photo. 13 Path Transit bus depot – contaminated site – Joondalup
Urban Zone Precinct No 49



Photo. 14 Remnant market garden - Balcatta
Urban Zone Precinct No 92



Photo. 15 Ex stables and market garden being prepared for urbanisation - Gwelup
Urban Zone Precinct No 92



Photo. 16 Chichester Park and residential subdivision - Woodvale Urban Zone Precinct No 40



Photo. 17 Roselea residential estate - Stirling Urban Zone Precinct No 92

There is significant potential for contamination from fertiliser use and spills of stored fuels and chemicals to occur on residential properties within the urban subdivisions and activities associated with urban living are rated a medium catchment management priority. A number of group housing villages are currently being developed on old petrol station sites. It may be prudent to check if adequate rehabilitation has occurred at these sites when infrastructure was removed, to ensure there is no remnant contamination threat to groundwater quality. Roselea Estate development in Stirling has been established on swampland and parts of the estate are still being excavated for peat. There is a concern acidification of the groundwater could be occurring from sulphides within the peat reacting with oxygen during excavation and development of the area. This in turn can lead to leaching of heavy metals.



**Photo. 18 Peat excavation at Roselea Estate - Stirling
Urban Zone Precinct No 92**

3.2.6 Urban Deferred land

The Urban Deferred zone covers about 10.5% of the Control Area of which the largest portion is located east of Two Rocks and a smaller parcel in southern part of Clarkson. Remnants of agricultural lots surrounded by residential subdivisions in Woodvale, Kingsley and Gwelup now form small pockets of urban deferred land that have yet to be redeveloped.

A flower production nursery in Gwelup and remains of a vineyard in Woodvale are considered high threats to groundwater quality because of the use of fertilisers and are rated high catchment management priorities.

A retail garden nursery in Kingsley is a potential source of nutrient and pesticide contamination and a rural and garden supply business in Gwelup, a nutrient and chemical contamination threat. Both land uses pose a significant risk and are rated medium catchment management priorities.

The Karrinyup Waters Caravan Park in Gwelup and rural residential properties in Kingsley and Woodvale pose a significant threat because of fertiliser use and possible leakage of stored fuels and chemicals. The caravan park and majority of the residential lots are sewered, but there may be some older residences still using septic systems. These land uses are rated medium catchment management priorities.



Photo. 19 Vineyard and Winery - Woodvale
Urban Deferred Zone Precinct No 71



Photo. 20 Cut flowers business - Gwelup
Urban Deferred Zone Precinct No 97

3.2.7 Parks and Recreation

Parks and Recreation reserved land covers about 23% of the UWPCA. A large part of the reserved land is located along the eastern edge of the Control Area and is associated with the linear lake system. Neerabup National Park, Yellagonga Regional Park, Woodvale Nature Reserve, Craigie and Warwick Open Spaces, and Crown Land east of Two Rocks and south of Yanchep form the largest parcels of land reserved under Parks and Recreation.

Three industrial waste landfills and a limestone quarry in Neerabup are considered severe risks because of their potential to cause pathogen contamination and are rated high catchment management priorities. The three landfills, which are located in Hester Avenue, Wanneroo Road and Joondalup Drive, are registered DEC contaminated sites. Further investigation of the quarry at 220 Hester Avenue is required because it appears part of it is being used as an unauthorised rubbish tip.

Quarries in Breakwater Drive, east of Two Rocks and in Wanneroo Drive, Nowergup are considered to pose a significant risk because of the potential for fuel spills. Both sites are rated medium catchment management priorities.

The traditional use of Beonaddy Reserve in Eglinton by neighbouring owners for grazing of cattle, and a horse riding school in Wanneroo Road, Wanneroo have the potential to cause pathogen and nutrient contamination and are rated medium catchment management priorities.

Yellagonga Regional Park has a number of community facilities and large areas of irrigated grass near Joondalup and Goollelal Lakes and Beenyup Swamp that are used for recreational purposes. Application of fertilisers and pesticides within the park poses a significant risk and is rated a medium catchment priority.

Application of fertilisers and pesticides used to maintain the sporting and recreational facilities within the Warwick Open Space Conservation Area and the potential for a chemical spill at the Craigie Leisure Centre swimming pool complex present a significant threat to groundwater quality. These sites are rated medium catchment management priorities.

Potential overflows from the Water Corporation's sewerage pump station in Yellagonga Regional Park are considered a significant risk to groundwater quality and are rated a medium catchment management priority.

Current activities associated with other Parks and Recreation reserved land within the UWPCA pose little risk to groundwater quality.

3.2.8 Public Purposes

Public Purpose reservation covers just under 3% of the UWPCA. The two largest sites are the Pinnaroo Cemetery and the Beenyup Wastewater Treatment Plant located in the old Tuart valley that runs along the western side of the Mitchell Freeway in the suburbs of Padbury and Craigie. Both sites are considered a high threat to groundwater quality because of the potential contamination from pathogens and nutrients. They are rated high catchment management priority sites.

Storage and servicing of rail running stock at the Metrorail Nowergup Railway Maintenance facility is considered to pose a significant risk from potential spills of fuels and oils. The facility is rated a medium catchment management priority.

Osborne Park Hospital is considered a significant threat to groundwater quality because there is potential for chemical contamination from the services provided and hydrocarbon contamination from associated car parks. The site is rated a medium catchment management priority.

Potential chemical spills at the Water Corporation's Neerabup Groundwater Treatment Plant are considered a significant risk to groundwater quality and are rated a medium catchment management priority.



**Photo. 21 Yellagonga Regional Park
Parks and Recreation Reservation Precinct No 47**



**Photo. 22 Warwick Open Space - Warwick
Parks and Recreation Reservation Precinct No 91**



**Photo. 23 Pinnaroo cemetery - Padbury
Public Purposes Reservation Precinct No 75**

3.2.9 State Forests

A very small portion of State Forest No. 65 exists on the eastern boundary of the UWPCA, due east of Two Rocks. The area is part of the native forest and pine plantation harvested by the Forest Products Commission for timber production that poses a moderate level of risk and is rated a low catchment management priority.

3.2.10 Transport Routes

Regional road and railway routes take up about 9% of the Control Area. Use of formed roads poses a significant risk from potential leakage of fuels and chemicals if a road accident was to occur. Although the likelihood of contamination occurring is low, confirmation there is a well prepared and widely distributed emergency response plan in place is considered a medium management priority. Metrorail operates an electrified rail route and maintenance of the line is considered a moderate risk that is rated a low catchment management priority.



Photo. 24 Metrorail – Joondalup Station
Central City Zone Precinct No 50



Photo. 25 Mitchell Freeway and Metrorail – Greenwood
Urban Zone Precinct No 40

Table 1 Drinking Water Quality Risk Assessment

Land Use / Activity	Hazard Event / Source	Hazard ¹	Considerations	Current Preventive Measures	Catchment Management Priority ²
<i>Central City Area</i>					
Service Station	Fuel and chemical spills	Hydrocarbons Chemicals	Caltex retail fuel outlet - Lakeside Shopping Centre Conditional land use in P3 area	Water quality monitoring Sewered Land Planning controls	High
Precinct 50					
Car parks	Fuel and chemical spills	Hydrocarbons Chemicals	Open air car park associated with shops, campuses and offices Acceptable land use in P3 area	Water quality monitoring Sewered	Medium
Precinct 50					
Community purposes	Human activity & litter	Pathogens	Conditional land use in P3 area	Water quality monitoring	Medium
Recreation parks	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Conditions on application of fertiliser and pesticide	Sewered Land Planning controls	
Precincts 48			Part of Joondalup Sports Arena complex		
			Includes sporting grounds and club facilities		
			Joondalup Central Park		
Community purposes	Fuel and chemical spills	Hydrocarbons Chemicals	Part of Joondalup Sports Arena complex	Water quality monitoring Sewered	Medium
Swimming pools, gyms					
Precinct 48			Partly in WHPZ for bore WT10 - conditional land use in P3 area	Land Planning controls	
Education	Fertiliser use	Nutrients	Acceptable land use in P3 area	Water quality monitoring	Medium
Schools	Pesticide use	Pesticides	Conditions should apply to use of fertiliser and pesticides	Sewered	
Tertiary Ed centres	Fuel and chemical spills	Hydrocarbons		Land Planning controls	
Precincts 48			Lake Joondalup Baptist College		
			Edith Cowan University and West Coast College campuses		
50					
Hospital	Fuel and chemical spills	Hydrocarbons Chemicals	Joondalup Health Campus Conditional land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Precinct 50					

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority ²
Industry - General Chemical, Dry cleaners Labs, photo processors Precinct 50	Fuel and chemical spills	Hydrocarbons Chemicals	Dentist laboratory, photo processor, dry cleaning and laundromat Joondalup city centre Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Industry - General Energy Precinct 48	Fuel and chemical spills	Hydrocarbons Chemicals	Western Power electric generation substation Incompatible land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Industry - Service Precinct 50	Fuel and chemical spills	Hydrocarbons Chemicals	Linen services for Joondalup Health Campus Conditional land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Motor vehicle repair Precinct 50	Fuel and chemical spills	Hydrocarbons Chemicals	3 motor vehicle repairers, 1 retail tyre outlet - Joondalup city centre Conditional land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Residential building Grouped housing for aged persons Precinct 50	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Apartment blocks - Joondalup city centre Acceptable land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Residential building Urban housing Precinct 50	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Urban subdivision - Joondalup city centre Acceptable land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Warehouse Precinct 50	Fuel and chemical spills	Hydrocarbons Chemicals	Commercial warehouses - Joondalup city centre Conditional land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Industrial					
Landfill Class I Precinct 95	General waste	Pathogens Nutrients Chemicals	2 solid waste landfill sites - Balcatta Industrial Area Shire waste transfer station & private sewerage disposal business Conditional land uses in P3 area	Water quality monitoring Land Planning controls	High

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority ²
Landfill Class II & III Precinct 95	Industrial waste	Pathogens Nutrients Chemicals	3 industrial waste sites, 1 rubbish disposal site DEC contaminated sites - Balcatta Industrial Area Incompatible land uses in P3	Water quality monitoring Land Planning controls	High
Service Station Precinct 95	Fuel and chemical spills	Hydrocarbons Chemicals	2 retail fuel outlets - Balcatta Industrial Area BP site - remediated contaminated site Caltex site has inadequate storage and insufficient sealed hardstand 1 site in WHPZ for bore G50 - conditional land use in P3 area	Water quality monitoring Sewered Land Planning controls	High
Community purposes Recreation parks	Human activity & litter Fertiliser use Pesticide use Animal excreta	Pathogens Nutrients Pesticides Pathogens Nutrients Hydrocarbons Chemicals	Conditional land use in P3 area Conditions on application of fertiliser and pesticide	Water quality monitoring Sewered Land Planning controls	Medium
Precincts 95	Fuel and chemical spills		Richard Gueffi Reserve - Balcatta Industrial Area Partly in WHPZ for bore G30		
96			Rickman Delawney Reserve - Balcatta Industrial Area		
Industry - Extractive	Fuel and chemical spills	Hydrocarbons Chemicals	2 sites - Balcatta Industrial Area Partly in WHPZ for bores G40, G50 Conditional land uses in P3 area Conditions on storage of fuels and chemicals Criteria for excavation depth and site rehabilitation	Water quality monitoring Sewered DoW Sand Mining policy/guidelines Well regulated industry Land Planning controls	Medium
Precinct 95 Industry - Food Dairy products Breweries Precinct 95	Chemical spills	Chemicals	Several food processing businesses - Balcatta Industrial Area Wide range of food products Some sites in WHPZ for bores G30, G40, G50 Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Industry - General Ceramic Precinct 95	Fuel and chemical spills	Hydrocarbons Chemicals	1 ceramic products business - Balcatta Industrial Area In WHPZ for bore G40 - incompatible land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority ²
Industry - General Chemical Precinct 95	Fuel and chemical spills	Hydrocarbons Chemicals	2 chemical manufacturers/suppliers - Balcatta Industrial Area DEC contaminated sites - 2 sites have inadequate storage Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Industry - General Chemical, Dry cleaners Labs, photo processors Precinct 95	Fuel and chemical spills	Hydrocarbons Chemicals	1 chemical manufacturing business, 2 chemical laboratories, 1 drycleaner, 2 photo laboratories - Balcatta Industrial Area Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Industry - General Concrete manufacture Precinct 109	Fuel and chemical spills	Hydrocarbons Chemicals	Concrete manufacturer - Osborne Park Industrial Area Conditional land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Industry - General Metal production Petroleum products Precincts 95	Fuel and chemical spills	Hydrocarbons Chemicals	Incompatible land uses in P3 Metal production & associated businesses Balcatta Industrial Area Including glass products, metal & steel fabricators, engraver, metal recycler, metal coating fabricators, precision engineering motor vehicle products manufacturers, fasteners manufacturer Some sites in WHPZ for bores G30, G40, G50 Metal fabricators - Osborne Park Industrial Area	Water quality monitoring Sewered Land Planning controls	Medium
109			1 metal and steel business, 1 powder coating business		
Industry - General Pesticide operation Precinct 95	Fuel and chemical spills	Hydrocarbons Chemicals	Pest control services - Balcatta Industrial Area Incompatible land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Industry - General Plaster products Precinct 95	Fuel and chemical spills	Hydrocarbons Chemicals	1 plaster products business - Balcatta Industrial Area In WHPZ for bore G50 - incompatible land use in P3 area Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority 2
Industry - Light Precincts 95	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land uses in P3 area Numerous light industry businesses - Balcatta Industrial Area including Agricultural machinery, batteries, canvas products, clothing Electronic equipment, curtain, furniture, household appliances General materials, medical and dental equipment, plastic products French polishing, general, industrial and motor vehicle machinery Printing, rubber products, signs, scaffolding, textiles Communications, civil works depots (shire, WC, Western Power) Some sites in WHPZ for bores G30, G40, G50 Numerous light industry workshops - Osborne Park Industrial Area	Water quality monitoring Sewered Land Planning controls	Medium
109					
Industry - Mining Precinct 95	Fuel and chemical spills	Hydrocarbons Chemicals	Mining company premises - Balcatta Industrial Area In WHPZ for bore G30 Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Industry - Rural Farm supply centres Forest products Precinct 95	Fertiliser use Fuel and chemical spills	Nutrients Hydrocarbons Chemicals	Several wood, cardboard and paper products manufacturing 1 landscape supply centre, 1 soil stabilisation business Balcatta Industrial Area - 1 site in WHPZ for bores G10, G100 Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Industry - Service Precinct 95	Fuel and chemical spills	Hydrocarbons Chemicals	Numerous service industries - Balcatta Industrial Area including Building construction, contracting, trade and fencing services Catering, cleaning and packing services, hairdressing services Detective and protective services, credit card services Earth moving, water well drilling services, audio production Some sites in WHPZ for bores G30, G40, G50 Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority 2
Motor vehicle repair Precincts 95	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land uses in P3 area Several motor vehicle repair businesses- Balcatta Industrial Area including mechanical, electrical, panel beating, spray painting, trimming, clutch and brake, radiator & engine reconditioning services, retail tyre outlets, car washes, lawn mowing services. Chemical leakage (Orbital) 10 years ago not detected at water table Some sites in WHPZ for bores G30, G40, G50 Motor cycle panel and paint repairer - Osborne Park Industrial Area	Water quality monitoring Sewered Land Planning controls	Medium
109					
Sewer pump station Precinct 95	Septic spill Pesticide use Fuel and chemical spills	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	Water Corporation sewerage pumping station Conditional land use in P3 area	Water quality monitoring HAZMAT emergency response Land Planning controls	Medium
Warehouse Precinct 95	Fuel and chemical spills	Hydrocarbons Chemicals	Numerous warehouses - Balcatta Industrial Area including chemicals, clothing, construction materials, dairy products, electrical, groceries, floor coverings, hardware, oil depot, paint, paper, pharmaceuticals, textiles, toiletries - Some sites in WHPZ for bores G30, G40, G50 Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
<i>Private Recreation</i>					
Golf course Irrigated Precinct 15	Human activity & litter Septic system Fertiliser use Pesticide use Animal excreta Fuel and chemical spills	Pathogens Pathogens Nutrients Nutrients Pesticides Pathogens Nutrients Hydrocarbons Chemicals	Sun City Country Club - Yanchep Unbundled above ground storage tank needs upgrading Conditional land use in P3 area Conditions on application of fertiliser and pesticide	Water quality monitoring Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority 2
<i>Rural - Priority 3</i>					
Landfill Class II & III	Industrial waste	Pathogens Nutrients Chemicals	Rubbish disposal site - Jacaranda Dr Wanneroo DEC contaminated site Incompatible land uses in P3	Water quality monitoring Land Planning controls	High
Precinct 58					
Caravan park	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Wanneroo Caravan Park Conditional land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Precinct 58					
Residential building Rural housing	Septic systems Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals	Acceptable land use in P3 area	Water quality monitoring Land Planning controls	Medium
Precincts 3			Breakwater Drive rural area - northeast of Two Rocks		
19			Partly in WHPZ for bore YB7 and future bores		
21			Pipidimny Road North rural area - Eglinton Pipidimny Road South rural area - Eglinton		
Residential building Special residential	Septic systems Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals	Acceptable land use in P3 area	Water quality monitoring Land Planning controls	Medium
Precincts 58			Special residential area Scenic Dr Wanneroo Some properties are likely to be sewered		
79			Special residential area Lakeway Dr Kingsley Most properties are likely to be sewered		

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority 2
<i>Urban</i>					
Landfill Class II & III	Industrial waste	Pathogens Nutrients Chemicals	Incompatible land uses in P3	Water quality monitoring Land Planning controls	High
Precincts					
27			Waste disposal site - DEC contaminated site Hester Ave Ridgewood		
40			Waste disposal site - DEC contaminated site Harvest Lp Edgewater		
56			Waste disposal site - DEC contaminated site Ariti Ave Wanneroo		
Industry - Rural	Fertiliser use	Nutrients	Conditional land uses in P3 area	Water quality monitoring	High
Farm supply centres	Fuel and chemical spills	Hydrocarbons		Sewered	
Manure stockpiling	Manures	Chemicals Pathogens Nutrients		Land Planning controls	
Precincts					
12			Hardware and landscaping supplies - Stevenage St LIA		
49			Stockpiles include manures - stormwater runs off to ground		
			Wood products manufacturing, landscaping supply centres		
			Joondalup Light Industrial Area		
			Stockpiles include manures - stormwater runs off to ground		
Service station	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land use in P3 area	Water quality monitoring	High
Precincts				Sewered	
11			Retail fuel outlet - Yanchep Beach Rd	Land Planning controls	
30			Gull petrol station - Merriwa		
34			BP petrol station - Ridgewood in WHPZ for future boresite Q80		
35			2 petrol stations, 1 with carwash - Gull & Mobil Mandarie		
			In WHPZ for bores Q110, Q120, Q130		
37			Caltex retail fuel outlet - Ocean Keys Shopping Centre		
42			BP petrol station - Currambine		
45			Gull petrol station - Joondalup		

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority ²
Service station <i>Continued</i>			Caltex fuel outlet, Path Transit bus terminal - Joondalup LIA Large hydrocarbon spill occurred at bus terminal in September 2006 Clean up being monitored by DEC 2 Mobil fuel outlets (1 with car wash), 1 Laserwash car wash Joondalup Gateway shopping precinct Peak petrol station - Edgewater Peak petrol station - Wanneroo shopping precinct BP petrol station - Wanneroo, Shell petrol station - Pearsall BP petrol station - Belridge City centre Abandoned petrol station - Woodvale shopping centre May have some remnant contamination		
49					
53					
54					
57					
60					
61					
66					
73					
76					
83					
85					
88					
89					
90					
92					
101					
104					
Wastewater Treatment plant	Septic spill Pesticide use Fuel and chemical spills	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	Water Corporation Yanchep Wastewater Treatment Plant Conditional land use in P3 area	Water quality monitoring HAZMAT emergency response Land Planning controls	High
Precinct 13					

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority ²
Agriculture - intensive Market gardens Precincts 102 107	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Conditional land use in P3 area Most sites have areas with shallow depth to groundwater Mixed horticulture lot - Odin Dr Stirling in WHPZ for bores G70, G150 1 small remnant mixed horticulture site - Grindleford Dr Balcatta Partly in WHPZ for bore G130	Water quality monitoring Land Planning controls	High
Agriculture - intensive Ex market garden Precinct 100	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Ex mixed horticulture lot - Gwelup Was a conditional land use in P3 area Currently being redeveloped as urban subdivision Future use acceptable land use in P3 area	Water quality monitoring Land Planning controls	Medium
Animal establishment Ex stables Abandoned Precinct 11	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Ex Cameleer Park stables - includes camels, horses and donkeys Was leased from Tokyu Corporation - now closed Will require sewerage when urban development occurs Current and future uses acceptable land uses in P3 area	Water quality monitoring Land Planning controls	Medium
Animal establishment Ex stables Precinct 100	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Ex stables and training track - Gwelup Currently being redeveloped as urban subdivision Partly in WHPZ bore G150 - shallow depth to groundwater in parts Future use acceptable land use in P3 area	Water quality monitoring Land Planning controls	Medium
Caravan park Precincts 59 78 92	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Conditional land use in P3 area Ocean Reef Caravan Park Cherokee Village Caravan Park - Kingsley Carine Gardens Caravan Park	Water quality monitoring Sewered Land Planning controls	Medium
Car parks Precincts 37 90	Fuel and chemical spills	Hydrocarbons Chemicals	Acceptable land use in P3 area Open air car parks - Ocean Keys shopping centre Open air car parks - Warwick Grove shopping centre	Water quality monitoring Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority ²
Community purposes Recreation parks	Human activity & litter Fertiliser use Pesticide use Animal excreta	Pathogens Nutrients Pesticides Pathogens Nutrients Hydrocarbons Chemicals	Conditional land use in P3 area Conditions on application of fertiliser and pesticide	Water quality monitoring Land Planning controls	Medium
Precincts 14	Fuel and chemical spills		St Andrews Park- includes picnic area, playground, toilet block and passive recreation area		
27			City of Wanneroo community parks and ovals	Sewered	
37			Partly in WHPZ of bores Q50, Q60, Q110, Q120, Q130, Q140, Q150		
40			Community park in Ocean Keys precinct	Sewered	
41			City of Joondalup community parks and ovals	Sewered	
44			Partly in WHPZ for bores WT10, WT50, WT60, WT70, WT80		
49			McNaughton Park Kinross - includes oval and play equipment	Sewered	
56			In WHPZ for bore Q20		
57			Community park - Currambine	Sewered	
59			Eclar Park - Joondalup Light Industrial Area	Sewered	
92			City of Wanneroo community parks and ovals		
107			Wanneroo Showground includes oval, skate park, pavilion	Sewered	
108			City of Wanneroo community parks and ovals		
			City of Stirling community parks and ovals	Sewered	
			Partly in WHPZ for Gwelup bores		
			Macedonia Park - Balcatta - includes playing fields	Sewered	
			In WHPZ for bore G130		
			Roselea Estate community parks and lakes	Sewered	
			Shallow depth to groundwater		

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority 2
Drinking water supply Treatment plant Precinct 92	Pesticide use Fuel and chemical spills	Pesticides Hydrocarbons Chemicals	Water Corporation Gwelup Groundwater Treatment Plant treats groundwater from Gwelup wellfield In WHPZ for bores G80, G160 - conditional land use in P3 area	Water quality monitoring HAZMAT emergency response Land Planning controls	Medium
Education establishment Schools Tertiary Ed centres Precincts 27	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Acceptable land use in P3 area Conditions should apply to use of fertiliser and pesticides Primary and secondary schools - City of Wanneroo Partly in WHPZ for bores Q60, Q110, Q120, Q130, Q140 Large number of primary, secondary and tertiary schools located within eastern suburbs of City of Joondalup 1 school in WHPZ for bore Q20, another in WHPZ for bore WT50 Schools - several primary, 1 secondary and 1 tertiary located within central suburbs of City of Stirling Partly in WHPZ for Gwelup bores	Water quality monitoring Sewered Land Planning controls	Medium
40					
92					
Golf course Irrigated Precinct 40	Human activity & litter Fertiliser use Pesticide use Animal excreta	Pathogens Nutrients Pesticides Pathogens Nutrients	Eastern part of Joondalup Country Club Golf Course Only fairways within UWPCA party in WHPZ for bore WT20 Conditional land use in P3 area Conditions on application of fertiliser and pesticide	Water quality monitoring Land Planning controls	Medium
Hospital Precincts 40	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
66			Warwick Nursing Home Woodvale Private Hospital		
Industry - Food Breweries Precinct 49	Chemical spills	Chemicals	Bakery, brewer, food products - Joondalup Light Industrial Area Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority 2
Industry - General Chemical, Dry cleaners Labs, photo processors Precincts 37 40 49 53 61 63 66 73 90 92 110	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land uses in P3 area Dry cleaning and laundry services - Ocean Keys precinct 1 dry cleaner and 1 laundromat Photo designs and screen printer - Joondalup LIA Dry cleaning premises Belridge Fast Photos - Belridge City shopping centre Craigie laundromat - Craigie Plaza shopping centre Linen cleaning and ironing service - Woodvale shopping centre Woodvale Drycleaners & Photoland - Woodvale shopping centre Photo processor, dry cleaners - Warwick Grove shopping centre 1 laundromat Petal Drycleaners - Main St shopping centre	Water quality monitoring Sewered Land Planning controls	Medium
Industry - General Concrete, bricks, clay Precinct 49	Fuel and chemical spills	Hydrocarbons Chemicals	Plaster products trade centre - Joondalup Light Industrial Area Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Industry - General Energy Precinct 53	Fuel and chemical spills	Hydrocarbons Chemicals	Western Power electric generation substation Leaking transformers stored out on open ground Incompatible land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Industry - General Metal production Precinct 49	Fuel and chemical spills	Hydrocarbons Chemicals	Metal production and associated businesses - Joondalup LIA Including sheet metal, housing metal and glass products Metal, steel & fence fabricators, precision engineering products Incompatible land uses in P3	Water quality monitoring Sewered Land Planning controls	Medium
Industry - General Photo processors Precinct 49	Fuel and chemical spills	Hydrocarbons Chemicals	Photo designs and screen printer - Joondalup LIA Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority 2
Industry - Light Precincts 37 49	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land uses in P3 area Light industry workshops - Ocean Keys precinct Numerous light industry businesses - Joondalup LIA including: Canvas products, chemical processing machinery, clothing Electronic equipment, curtain, furniture, household appliances Shopfitters, medical and dental equipment, postal services Fibreglass manufacture, printing, signs Light industry workshops - Pearsall commercial precinct Light industry workshops - Canham Way Light Industrial Area	Water quality monitoring Sewered Land Planning controls	Medium
60 88					
Industry - Service Precincts 12	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land uses in P3 area Service industries in Stevenage St industrial Area Includes Yanchep Fire Station, St John Ambulance station, cabinet maker	Water quality monitoring Sewered Land Planning controls	Medium
49			Several service industries - Joondalup LIA including: Building construction, contracting, trade and fencing services Detective and protective services, personal services, gardening Packing services, hairdressing services, TV repairer Swimming pool supplier and installer		
Motor vehicle sales Precincts 37 60 99	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land use in P3 area Motor vehicle sales - Ocean Keys precinct Motor vehicle sales - Pearsall commercial precinct Motor vehicle sales yard - Big Rock Toyota	Water quality monitoring Sewered Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority 2
Motor vehicle repair Precincts	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
12			Motor vehicle repair business - Stevenage St Industrial Area		
37			Includes temporary stockpiles of old tyres and batteries 2 motor vehicle repair outlets - Ocean Keys precinct		
49			Numerous motor vehicle repair businesses - Joondalup LIA Including mechanical, electrical, panel beating, spray painting, clutch, brake and radiator reconditioning services, window tinting, retail tyre outlets, car washes and lawn mowing services Some sites have poor oil waste containment		
60			Motor vehicle and lawn mower repairers Pearsall commercial precinct		
61			Auto Masters motor vehicle repairers - Belridge City centre		
62			Rhino Car Wash - Beldon shopping centre		
88			Motor vehicle, brake, clutch, lawn mower repairs - Canham Wy LIA		
90			Inadequate storage of oils and containment of spills at 1 site 2 motor vehicle repairers, 1 retail tyre outlet, 2 car washes		
99			Warwick Grove shopping centre Motor vehicle service centre for Big Rock Toyota		
Residential building Grouped housing for aged persons Precincts	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Acceptable land use in P3 area Some retirement villages include club premises, swimming pools, gymnasiums, lawn bowls, irrigated passive recreation areas and vehicle storage areas	Water quality monitoring Sewered Land Planning controls	Medium
27			Retirement villages - Merriwa & Ridgewood - includes C Class Hospital		
40			Retirement villages in Eggewater, Woodvale and Kingsley		
63			Group housing under construction on old petrol station site		
81			Craigie Plaza shopping precinct – may have remnant contamination		
92			Prime Lifestyle Retirement village - Kingsley Retirement villages in central suburbs City of Stirling		

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority ²
Residential building Rural housing Precinct 100	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Residence associated with stables North Beach Rd Gwelup Acceptable land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Residential building Urban housing Precincts 11	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Acceptable land use in P3 area Residential sites leased from Tokyu Corporation One site is used to store live military projectiles One site is used as car dump - also has oil containers	Water quality monitoring Sewered Land Planning controls	Medium
14			Sun City residential area - Yancheep		
27			Northern central urban areas of City of Wanneroo		
40			Partly in WHPZ for Quinns Bores		
56			Eastern urban areas of City of Joondalup Partly in WHPZ for Whitfords bores		
59			Central western urban areas of City of Wanneroo Adjacent to Lake Joondalup South western urban area of City of Wanneroo Adjacent to Lake Joondalup		
81			Urban area adjacent to retirement village and lake Goollelal		
92			Central urban areas of City of Stirling		
108			Partly in WHPZ for Gwelup bores Roselea Estate - City of Stirling Previously swampland - still being excavated for peat Acid sulphate soils - possibly contaminated site Partly in WHPZ for bore G130 - shallow depth to groundwater		

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority ²
Sporting or recreation Club premises	Human activity & litter Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	Yanchep Sports Club Includes tennis courts, lawn bowling rink and club facilities Conditional land use in P3 area Conditions on application of fertiliser and pesticide	Water quality monitoring Sewered Land Planning controls	Medium
Precinct 11					
Sewer pump station	Septic spill Pesticide use Fuel and chemical spills	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	Water Corporation sewerage pumping stations Conditional land use in P3 area	Water quality monitoring HAZMAT emergency response Land Planning controls	Medium
Precincts 11					
14					
27					
40					
56					
57					
92					
107					
108			Shallow depth to groundwater		
Warehouse	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Precincts 37			Bunnings warehouse Ocean Keys - hardware supplies		
49			Several warehouses - Joon dalup Light Industrial Area including Electrical, floor coverings, groceries, hardware, lighting, household appliances, farming supplies, toiletries		
53			Several warehouses - Joon dalup Gateway shopping precinct Including bedding, floor coverings, gardening, hardware, lighting		

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority 2
<i>Urban Deferred</i>					
Agriculture - intensive Market gardens, Orchards, nurseries Vineyards Precincts 71	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Conditional land use in P3 area vineyard 1 flower production nursery & ex market garden lots Ex market gardens now being redeveloped as urban subdivision Possibility of contamination from old market gardens Shallow depth to groundwater	Water quality monitoring Land Planning controls	High
97					
Agriculture - intensive Plant nurseries Garden centres Precinct 82	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Waldecks Retail Nursery Acceptable land use in P3 area Includes car park and tea rooms	Water quality monitoring Sewered Land Planning controls	Medium
Caravan park Precinct 97	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Karrynup Waters Caravan Park - Gwelup Conditional land use in P3 area Ex market garden area Shallow depth to groundwater	Water quality monitoring Sewered Land Planning controls	Medium
Industry - Rural Farm supply centres Forest products Precinct 98	Fertiliser use Fuel and chemical spills	Nutrients Hydrocarbons Chemicals	Farm, horse equipment, garden, reticulation and outdoor supplies North Beach Rd Gwelup Conditional land uses in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Residential building Rural housing Precinct 71	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Residence associated with vineyard Acceptable land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority 2
Residential building Special residential	Septic systems Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals	Southern part of special residential area - Lakeway Dr Kingsley Acceptable land use in P3 area Most properties are likely to be sewerred	Water quality monitoring Land Planning controls	Medium
Precinct 80					
Residential building Urban housing	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Previously part of Waidecks Nursery now part of residential area Adjacent to Lake Goollelal - Kingsley May have some remnant contamination Acceptable land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Precinct 82					
Parks & Recreation					
Industry Extractive	Human activity & litter Fauna excreta Fuel and chemical spills General waste	Pathogens Pathogens Hydrocarbons Chemicals Pathogens Nutrients Chemicals	Limestone quarry 220 Hester Ave Wash down waste discharges to ground Part of site is being used as a rubbish tip - needs investigating Conditional land use in P3 area Conditions on storage of fuels and chemicals Criteria for excavation depth and site rehabilitation	Water quality monitoring DoW Sand Mining policy/guidelines Well regulated industry Land Planning controls	High
Precinct 28					
Landfill Class II or III	Solid waste	Pathogens Nutrients Chemicals	3 landfill sites classified by DEC as contaminated sites located 2 Hester Ave, 1611 Wanneroo Rd and 745 Joondalup Dr Incompatible land use in P3 area	Water quality monitoring Land Planning controls	High
Precinct 28					
Agriculture - extensive Stock grazing	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Neighbouring owners graze cattle on Beonaddy Reserve Planned to cease when reserve fenced Acceptable land use in P3 area Shallow depth to groundwater	Water quality monitoring Land Planning controls	Medium
Precinct 20					
Animal establishment Stables	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Horse riding school on Wanneroo Rd Acceptable land use in P3 area	Water quality monitoring Land Planning controls	Medium
Precinct 28					

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority 2
Community purposes Conservation area	Human activity & litter Fertiliser use Pesticide use Animal excreta	Pathogens Nutrients Pesticides Pathogens Nutrients Hydrocarbons Chemicals	Warwick Open Space Conservation Area includes sporting grounds, tennis courts, tennis and lawn bowls club facilities, toilet blocks, picnic areas and passive recreation Acceptable land use in P3 area	Water quality monitoring Land Planning controls	Medium
Precinct 91	Fuel and chemical spills				
Community purposes Recreation parks	Human activity & litter Fertiliser use Pesticide use Animal excreta	Pathogens Nutrients Pesticides Pathogens Nutrients Hydrocarbons Chemicals	Conditional land use in P3 area Conditions on application of fertiliser and pesticide Shallow depth to groundwater	Water quality monitoring Land Planning controls	Medium
Precincts 46	Fuel and chemical spills		Yellagonga Regional Park incorporating Lake Joondalup Includes community facilities managed by City of Joondalup		
47			Yellagonga Regional Park incorporating Lake Joondalup Includes community facilities managed by City of Wanneroo		
67			Yellagonga Regional Park incorporating part of Lake Joondalup Beenyup Swamp, Lake Goollelal and Bindaree Park Includes community facilities managed by City of Joondalup		
Community purposes Swimming pools, gyms Precinct 72	Fuel and chemical spills	Hydrocarbons Chemicals	Craigie Leisure Centre Conditional land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Industry Extractive	Human activity & litter Fauna excreta Fuel and chemical spills	Pathogens Pathogens Hydrocarbons	Conditional land use in P3 area Conditions on storage of fuels and chemicals Criteria for excavation depth and site rehabilitation	Water quality monitoring DoW Sand Mining policy/guidelines Well regulated industry Land Planning controls	Medium
Precincts 2		Chemicals	Quarry off Breakwater Dr - east of Two Rocks		
28		Chemicals	Quarry 2389 Wanneroo Rd Nowergup		

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority ²
Sewer pump station	Septic spill	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	Conditional land use in P3 area	Water quality monitoring HAZMAT emergency response Land Planning controls	Medium
Precincts 47	Pesticide use Fuel and chemical spills		Water Corporation sewerage pumping station		
67			Water Corporation sewerage pumping stations		
Public Purposes					
Cemetery	Leachate	Pathogens Nutrients Nutrients Pesticides Pathogens Nutrients Hydrocarbons Chemicals	Pinnaroo Valley Memorial Park cemetery DEC contaminated site Includes large irrigated grassed areas and large fauna population Partly in WHPZ for bore WT90 Conditional land use in P3 area	Water quality monitoring HAZMAT emergency response Land Planning controls	High
Precinct 75	Fertiliser use Pesticide use Animal excreta Fuel and chemical spills				
Wastewater Treatment plant	Septic spill Pesticide use Fuel and chemical spills	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	Water Corporation Beenyup Wastewater Treatment Plant DEC contaminated site Conditional land use in P3 area	Water quality monitoring HAZMAT emergency response Land Planning controls	High
Precinct 64					
Drinking water supply Treatment plant	Pesticide use Fuel and chemical spills	Pesticides Hydrocarbons Chemicals	Water Corporation Neerabup Groundwater Treatment Plant treats groundwater from Neerabup Scheme Quinns wellfield In WHPZ for bore Q30 - conditional land use in P3 area	Water quality monitoring HAZMAT emergency response Land Planning controls	Medium
Precinct 39					
Hospital	Fuel and chemical spills	Hydrocarbons Chemicals	Osborne Park Hospital Conditional land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium
Precinct 105					
Service station Public transport depot Precinct 28	Fuel and chemical spills	Hydrocarbons Chemicals	Metrorail Nowergup Railway Maintenance facility Storage and servicing of rail running stock Conditional land use in P3 area	Water quality monitoring Sewered Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority ²
<i>Transport Routes</i>					
Major transport routes	Fuel and chemical spills	Hydrocarbons Chemicals	Formed roads are an acceptable land use in P3 areas	Water quality monitoring HAZMAT emergency response Land Planning controls	Medium
Precincts					
1			Breakwater Dr, Yancheop Beach Rd, Two Rocks Rd		
2			Future arterial roads partly in WHPZ for bore YB6		
3			Breakwater Dr and future Mitchell Freeway		
4			Breakwater Dr, future Mitchell Fwy		
5			Adjacent to future arterial roads partly in WHPZ for future bores		
6			Adjacent to future arterial roads		
9			Adjacent to future Mitchell Fwy partly in WHPZ for future bores		
10			Future arterial roads partly in WHPZ for bore YB6		
11			Future arterial roads partly in WHPZ for bore YB6		
12			Yancheop Beach Rd, future Marmion Ave, future Mitchell Fwy		
15			Adjacent to Yancheop Beach Rd Yancheop Beach Rd		
16			Future Marmion Ave partly in WHPZ for future bores		
17			Future arterial roads including Marmion Ave in WHPZ for future bores		
18			Future Mitchell Freeway		
19			Pipidiny Rd		
22			Future Marmion Ave partly in WHPZ for future bores		
23			Future extension of Marmion Ave		
24			Future extension of Marmion Ave		
25			Future arterial roads including Mitchell Fwy, Marmion Ave		
26			Partly in WHPZ for future bores Rural land forming part of road reserve for future Mitchell Fwy		
27			Marmion Ave, Hester Ave, Connolly Dr Future Connolly Dr, Neerabup Rd partly in WHPZ for Quimms bores		

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority ²
Major transport routes <i>Continued</i>					
28			Wanneroo, Burns Beach Rds, Hester Ave, Joondalup Dr and future Mitchell Freeway small part in WHPZ for bore Q30		
30			Marmion Ave		
31			Rural land forming part of road reserve for future Mitchell Fwy		
34			Adjacent to Hester Ave partly in WHPZ for bore Q80		
35			Adjacent to Marmion Ave in WHPZ for bores Q110, Q120, Q130		
37			Adjacent to Marmion Ave		
38			Neerabup Rd, future Connolly Dr partly in WHPZ for bore Q40		
39			Adjacent to future extension of Mitchell Fwy in WHPZ for bore Q30		
40			Mitchell Fwy, Shenton, Marmion, Whitfords, Hepburn Aves, Moore Dr, Joondalup Dr, Hodges Dr, Burns Bch, Ocean Reef and Warwick Rds, Wanneroo, Erindale, Beach Rds – partly in WHPZ for Whitfords bores		
42			Adjacent to Burns Beach Rd		
43			Adjacent to Burns Beach Rd, future Mitchell Fwy		
46			Ocean Reef Rd		
47			Wanneroo Rd and Ocean Reef Rd		
48			Adjacent to Mitchell Fwy, Joondalup Dr, Moore Dr, Shenton Ave		
49			Partly in WHPZ for bore WT10		
50			Adjacent to Joondalup Dr, future Mitchell Fwy		
52			Joondalup Dr, Shenton Ave, Grand Bvd Adjacent to Mitchell Fwy, Joondalup Dr, Eddystone Ave		
53			Partly in WHPZ for bore WT40		
56			Adjacent to Joondalup Dr, Mitchell Fwy		
57			Wanneroo Rd		
58			Wanneroo Rd		
59			Wanneroo Rd		

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority ²
Major transport routes <i>Continued</i>					
60			Wanneroo Rd		
61			Adjacent to Ocean Reef Rd		
64			Adjacent to Mitchell Fwy, Ocean Reef Rd		
65			Adjacent to Mitchell Fwy and Ocean Reef Rd		
67			Wanneroo Rd, Whitfords Ave and Ocean Reef Rd		
70			Ocean Reef Rd, Wanneroo Rd		
71			Wanneroo Rd		
72			Adjacent to Mitchell Fwy and Whitfords Ave		
73			Adjacent to Whitfords Ave		
75			Adjacent to Mitchell Fwy, Whitfords Ave		
78			Wanneroo Rd, Whitfords Ave		
79			Wanneroo Rd		
80			Wanneroo Rd		
81			Wanneroo Rd		
82			Wanneroo Rd		
88			Wanneroo Rd		
89			Adjacent to Warwick Rd		
90			Beach Rd, Erindale Rd		
91			Warwick, Wanneroo, Beach & Erindale Rds		
92			Beach Rd, Wanneroo Rd, Erindale Rd, Karrynup Rd Mitchell Fwy, Reid Hwy, Cedric St, Hutton St		
93			Partly in WHPZ for Gwelup bores Wanneroo Rd in WHPZ for bore G20		
95			Mitchell Fwy, Reid Hwy, Balcatta Rd, Erindale Rd, Wanneroo Rd		
96			Partly in WHPZ for bores G30, G40, G50 Balcatta Rd		
97			North Beach Rd		

Land Use / Activity	Hazard Event / Source	Hazard 1	Considerations	Current Preventive Measures	Catchment Management Priority ²
Major transport routes <i>Continued</i>					
98			Adjacent to North Beach Rd		
99			Wanneroo Rd		
100			North Beach Rd		
101			North Beach Rd		
104			Cedric St in WHPZ for bore G80		
106			Cedric St and Karrinyup Rd		
108			Next to Karrinyup Rd, Mitchell Fwy		
109			Partly in WHPZ for bore G130 - shallow depth to groundwater		
110			Mitchell Fwy, Hutton St Main St, Hutton St		

1. See Water Quality Hazards and Potential Impact on Consumer table.

2. Catchment Management Priority Scale Used: *High*, *Medium* and *Low*.

Table 2 Water Quality Hazards and Potential Impact on Consumer

Water Quality Hazards and Potential Impact on Consumer	
Hazard	Potential Impact on Consumer
Health	
Hydrocarbons and Chemicals	May have poor taste and smell. Some may cause cancer after prolonged exposure. Harmful by-products may be formed when combined with chlorine.
Nutrients	Nitrate is toxic to humans at high levels, with infants less than three months old being most susceptible. Nutrients can cause algal blooms.
Pathogens (Bacteria, Viruses, Protozoa)	Can cause disease such as gastro-enteritis or even death.
Pesticides	Most modern pesticides readily degrade in the environment, however in the past, pesticides containing organochlorides could bio-accumulate in humans/ animals causing toxic affects.
Toxins eg Cyanobacteria (blue green algae)	Can result in nerve damage.
Aesthetic	
Colour	Not a health consideration if derived from natural organics. Harmful by-products may be formed when combined with chlorine.
Total Dissolved Solids / Salinity	Poor taste and corrosion to pipe work and household appliances.
Turbidity	Discolouration and cloudiness of water. May reduce the effectiveness of disinfection.

Refer to the ADWG for further information about water quality hazards, available via www.health.gov.au/nhmrc/publications/pdf/eh19.pdf.

4 Conclusion

Current risks to water quality from activities within Perth Coastal Underground Water Pollution Control Area (UWPCA – Control Area) have been identified and assessed.

There are many potential risks to drinking water quality within the Control Area. The industrialised areas of Balcatta, Joondalup and Yanchep, the major commercial centres of Joondalup and Ocean Keys, the smaller numerous local suburban shopping precincts, and the residential suburbs of north coastal area of Perth provide numerous opportunities for contamination of the groundwater system.

Recorded incidents of contamination include a hydrocarbon plume emanating from a retail petrol station in Balcatta in the early 1990s and a hydrocarbon spill that occurred at the bus depot in Joondalup in 2006. The Balcatta site underwent remediation several years ago and clean up of the Joondalup site is still being monitored by government regulators.

Three water supply production bores in the Gwelup wellfield were decommissioned in the early 1990s as a precautionary measure because of concerns about potential detrimental impact of land uses in the Balcatta industrial area.

There is a strong indication acidification of groundwater is occurring around Roselea Estate, Stirling as a result of continued excavation of peat and redevelopment of the wetland for urban housing. Although there has been no impact on any public water supply bores, it appears it has affected quality of groundwater drawn on by private bores in the area.

Analysis of monitoring data has shown nitrates in some superficial aquifer bores are above what would be expected to be naturally occurring levels, although well below the Australian Drinking Water Guidelines guideline value. The highest levels are found in the Gwelup wellfield and probably reflect historical use of the Gwelup area for vegetable production and the past use of septic tanks for disposal of residential wastewater. Some bores are possibly being affected by current practices, which include fertilising of nearby sporting grounds. Slightly elevated levels in two main clusters in the Neerabup wellfield are possibly also related to application of fertilisers on nearby community parks and ovals. The approach of siting superficial aquifer production bores in irrigated parks should be re-evaluated when locating future bores.

Waste disposal sites and fuel outlets present the current greatest hazard to groundwater quality in the UWPCA and are rated **High** catchment management priorities. Four industrial waste and two solid waste landfills in the Balcatta industrial area, a limestone quarry in Hester Avenue Neerabup being used an unauthorised rubbish disposal site and several landfills located throughout the Control Area are potential sources of pathogen contamination. There are numerous fuel outlets that pose a high contamination threat through possible leakage of fuel stored in underground tanks.

Pinnaroo Cemetery and the Beenyup and Yanchep Wastewater Treatment Plants are considered a high threat to groundwater quality because of the potential contamination from pathogens and nutrients. They are rated **High** catchment management priority sites.

A flower production nursery in Gwelup, the remains of a vineyard in Woodvale, and landscape supply centres in the light industrial areas of Joondalup and Yanchep are potential sources of pathogen and nutrient contamination. A few small parcels of remnant market gardens in Stirling and Balcatta may also continue to pose a high risk to groundwater quality. These land uses are considered **High** catchment management priorities.

The traditional use of Beonaddy Reserve in Eglinton by neighbouring owners for grazing of cattle, a horse riding school in Wanneroo, a retail garden nursery in Woodvale have the potential to cause pathogen and nutrient contamination and are rated **Medium** catchment management priorities.

There are a number of sand quarries throughout the Control Area which are considered to pose significant risks because of the potential for fuel spills. These activities are rated **Medium** catchment management priorities.

There are numerous food processing businesses, general industry operations, light industrial businesses, motor vehicle sales and repair operations, service industries, and warehouses in the major commercial and industrial centres and local shopping precincts scattered throughout the UWPCA. These sites are considered **Medium** catchment management priorities because of the potential to cause chemical and hydrocarbon contamination from leakage of stored chemicals, fuel and oil.

There is some potential for chemical contamination from the services provided at the Joondalup Health Campus, Osborne Park Hospital, Woodvale Private Hospital and a number of aged nursing facilities and these sites are rated **Medium** catchment management priorities.

A number of petrol stations within the urban area have been closed down. Some have been replaced with group housing and others still have shell of the station buildings standing. There is a possibility some of these sites may have remnant contamination, which may require investigation to determine if they pose a threat to groundwater quality. Old agricultural sites being redeveloped as urban subdivisions may also still pose a risk to groundwater quality if rehabilitation has not been adequate to alleviate any residual contamination. These redeveloped sites are rated a **Medium** management priority.

Western Power's electricity generation substations in the City of Joondalup are considered **Medium** catchment priorities because they pose a major contamination threat through the possible leakage of stored fuels.

Potential sewerage overflows from the Water Corporation's sewerage pumping stations that service the urban and industrial areas, are considered a significant risk and continuation of current preventive measures is rated a **Medium** management priority.

Many activities throughout the Control Area are considered **Medium** management priorities because of their potential to transmit nutrients, pesticides, hydrocarbons and chemicals to the water table. These include irrigated community and school ovals, recreation parks, sporting complexes, swimming pool and leisure centres, caravan parks and the uncontrolled domestic activities on residential properties. Even activities in Parks and Recreation Reserves such as Yellagonga Regional Park, where there are community facilities and large grassed areas associated with recreational use of Joondalup and Goollelal Lakes, pose a significant risk to groundwater quality.

Activities on Public Purpose reservations that are rated **Medium** management priorities because there is potential for leakage of stored fuels and chemicals include the Metrorail Nowergup Railway Maintenance facility and Water Corporation groundwater treatment plants at Gwelup, Neerabup, Yanchep and Two Rocks.

There is potential for hydrocarbon and chemical contamination from vehicular movement along the high volume traffic routes in the Control Area and continued operation of HAZMAT emergency procedures is a **Medium** management priority.

Other activities in the UWPCA are considered to be a **Low** catchment management priority.

It is essential that water managers continue with and improve upon catchment preventive and management strategies and further develop and implement protection policies and guidelines to ensure ongoing availability of good quality drinking water. Examples of potential strategies used in other PDWSAs for managing drinking water quality risks can be found in Appendix 3.

Planning and other land use decision-makers should continue to recognise the significance of drinking water catchments in the decisions they make. Further advice on the importance of drinking water quality protection is available from Department for Planning and Infrastructure, the Water Corporation, Department of Water and Department of Health.

References

Dames & Moore, 1996, *Review of Groundwater protection Priority Area Boundaries – Gnangara Mound*, Dames & Moore for the Water and Rivers Commission of WA.

Davidson, W.A, 1995, *Hydrogeology and Groundwater Resources of the Perth Region Western Australia*, Bulletin 142, Geological Survey of WA.

Department of Water, Environmental Guidelines, Water Quality Protection Notes and Recreation Policy available via www.drinkingwater.water.wa.gov.au.

Fisher, S., 2005, *IWSS Source Development Plan 2005*, IPB Report No. A4-1545, Water Corporation of Western Australia.

Gordon, J., In prep., *Integrated Water Supply Scheme Water Resources Management Operation Strategy*, Draft IPB Report, Water Corporation of Western Australia.

National Health and Medical Research Council and Agriculture and Resource Management Council of Australia and New Zealand, 2004, *Australian Drinking Water Guidelines*. Further information is available via www.health.gov.au/nhmrc/publications/synopses/eh19syn.htm.

WAWA, 1986, *Gnangara Groundwater Resources Environmental Review and Management Programme*, Water Authority of WA.

Water Corporation, 2004, *SG097- Risk Assessment Process for Drinking Water Source Quality*, Water Corporation of Western Australia.

Western Australia Legislative Assembly, 1994, *The Select Committee on Metropolitan Development and Groundwater Supplies – Report*, Legislative Assembly, Perth, Western Australia.

Western Australian Planning Commission, 2001, *Gnangara Land Use and Water Management Strategy*, Western Australian Planning Commission

Western Australian Planning Commission, 2003, *Statement of Planning Policy No. 2.7 - Public Drinking Water Source Policy*, Government Gazette WA. Available via www.wapc.wa.gov.au.

Western Australian Planning Commission, 2005, *Statement of Planning Policy No. 2.2 – Gnangara Groundwater Protection*, Government Gazette WA. Available via www.wapc.wa.gov.au.

Western Australian Planning Commission, 2006, *Statement of Planning Policy No. 2.9 - Water Resources*, Government Gazette WA. Available via www.wapc.wa.gov.au.

WHO, 1996, *Guidelines for Drinking Water Quality 1996, Volume 2, Chapter 10*, World Health Organisation. Available via http://www.who.int/water_sanitation_health/dwq/en/2edvol2p1.pdf

Glossary and Acronyms

ADWG	Australian Drinking Water Guidelines, published by the National Health and Medical Research Council and Natural Resource Management Ministerial Council under rolling review.
Aesthetic	Relating to the physical characteristics of water (taste, clarity, smell and feel).
Allocation	The quantity of water permitted to be abstracted by an allocation licence, usually specified in kilolitres/year (kL/a).
Catchment	The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
Control Area	Abbreviation for Underground Water Pollution Control Area.
Diffuse Source Pollution	Pollution originating from a widespread area, e.g. urban stormwater runoff, agricultural runoff.
DWSPA	Drinking Water Source Protection Assessment
DWSPP	Drinking Water Source Protection Plan
Effluent	The liquid, solid or gaseous wastes discharged by a process, treated or untreated.
Health Related Chemical	Water quality characteristic that may pose a health risk to consumers.
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.
Microbiological Contaminant	Micro-organisms which can either directly cause disease (pathogens) or indicate the possible presence of other pathogens.
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.
PDWSA	Public Drinking Water Source Area
Pesticides	Collective name for a variety of insecticides, fungicides, herbicides, algaecides, 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 that has run off the ground surface, roads, paved areas etc and is usually carried away by drains.
TDS	Total Dissolved Solids, a measure of salinity, calculated from TFSS (Total Filterable Suspended Solids) and measured in accordance with ADWG.
Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes including drinking and discharge to the environment.
UWPCA	Underground Water Pollution Control Area.
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** Department of Water - Water Quality Protection Note:
Land use compatibility in Public Drinking Water Source Areas.
- Appendix 2** Water Quality
- Appendix 3** Example protection strategies used in drinking water catchments in
Western Australia.
- Appendix 4** Department of Water -Water Quality Protection Note:
Overview on protecting Public Drinking Water Source Areas.

Appendix 1

DoW Water Quality Protection Note

Land use compatibility in Public Drinking Water Source Areas

Refer to website <http://drinkingwater.water.wa.gov.au> for latest version.

Water Quality Protection Note

Land use compatibility in Public Drinking Water Source Areas

Purpose

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

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

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

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

Scope

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

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

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

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

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

PDWSA protection framework

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

Priority classification areas

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

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

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

Wellhead and reservoir protection zones

In addition to the three Priority Classification Areas, specific protection zones are defined to protect drinking water sources from contamination in the immediate vicinity of water extraction facilities. Within these zones by-laws may prohibit, restrict or approve defined land uses and activities to prevent water source contamination or pollution. Special conditions, such as restrictions on storage and use of chemicals, may apply within these zones. The legislation is currently being reviewed to simplify and enhance the protection of public drinking water sources.

Wellhead protection zones (WHPZ) are used to protect underground sources of drinking water. They are circular (unless information is available to determine a different shape), with a radius of 500 metres in P1 areas, and 300 metres in P2 and P3 areas. WHPZ do not extend outside PDWSA boundaries. Reservoir

protection zones (or '**prohibited zones**' as they are called in the by-laws) consist of a statutory 2 kilometre wide buffer area around the top water level of storage reservoirs in the Perth water supply area, and include the reservoir water-body. The reservoir protection zones (RPZ) apply over Crown land and prohibit public access to prevent contamination (physical, chemical and biological) of the source water. RPZ do not extend outside PDWSA boundaries. The DoE is currently considering a provision for RPZ buffer areas of less than 2 kilometres, and creation of consistent by-laws for country and Perth PDWSAs.

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

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

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

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

Compatibility of land uses within PDWSAs

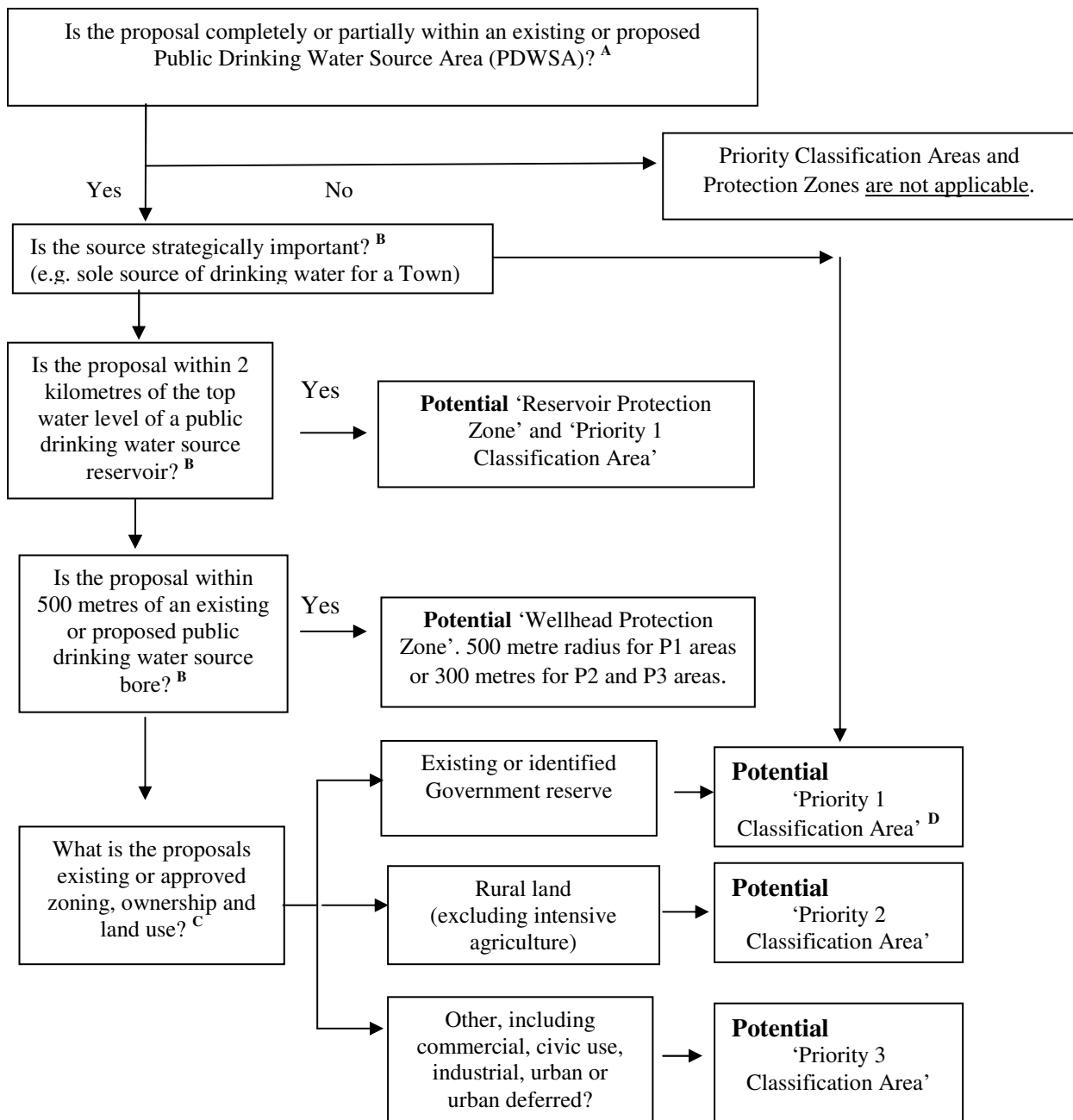
The tables in this note have been prepared for use by local governments, State planners and other agencies as a basis for regulating land use within PDWSAs. The note complements the Western Australian Planning Commission's *Statement of Planning Policy Number 2.7 (June 2003) Public Drinking Water Sources*.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

The DOE recognises that there may be special circumstances which may occasionally result in an '**Incompatible**' land use receiving approval. Where planning decisions result in this outcome it is important for project proponents to have demonstrated an overriding community benefit and that the land use will not increase the risk of contamination to the PDWSA. The DOE expects to have significant, early involvement in planning decisions of this nature to maximise the protection of the drinking water resource. It should be noted that where a water source is the sole supply for a community, or has a particularly high strategic value for the supply of drinking water, then it would be difficult to understand how that source might be put at any risk of contamination.

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

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

Diagram 1: Assessment of potential priority classification areas and protection zones



Legend

- A. The location of PDWSAs can be found in DOE’s Drinking Water Source Protection Assessments and Plans or through your regional DOE office, Local Government office, Water Corporation or from the Department for Planning and Infrastructure.
- B. Strategically significant sources and potential contamination from land uses close to drinking water reservoirs or abstraction bores are considered first, due to these involving the highest risk of contamination reaching consumers.
- C. Current zoning or land use information is available from your Local Government office.
- D. Government land is protected to achieve the highest level of safety for drinking water in all parts of a catchment through a Priority 1 classification, wherever this is reasonable and practicable.

Existing approved land uses

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

Proposed land uses

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

Definition of terms used in the following tables

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

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

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

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

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

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

Interpretation of land use recommendations for planning schemes and development approvals

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

- a) Where the table identifies a land use as '**Acceptable**', this use is permitted by DOE within that priority classification area. It may be identified as a '**P**' (permitted) use in a scheme, providing the use complies with the relevant development standards and requirements of the planning scheme.
- b) Where the table identifies a use as '**Compatible with conditions**', this use should be a discretionary use within the priority classification area and should be identified as either a '**D**' or '**A**' (after special notice) use in the scheme. Proposals for '**Compatible with conditions**' uses should **ONLY** be referred to DOE for assessment and response if they do not meet existing agency policy, guidelines or protection note measures, unless prior agreement has been made between a specific local government and DOE on alternative measures.
- c) Relevant environmental management guidelines, codes of practice, water quality protection notes or agreements should be used in the first instance to define DOE's position on any land-use and limit the need to refer proposals to the DOE. Where these do not exist, site specific advice may be provided by the DOE.
- d) Where the table identifies a use as '**Incompatible**', that use should not be permitted within that priority source protection area, and should be identified as an '**X**' (unacceptable use) in the scheme.

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

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

Tables defining compatibility of various land uses within PDWSA

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

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

Model Scheme Text & interpreted type of land use	P1 areas	P2 areas	P3 areas
Agriculture– extensive - pastoral leases	Compatible with conditions	Acceptable	Acceptable
- floriculture (non irrigated), stock grazing (excluding pastoral leases) and broad hectare cropping,	Incompatible	Compatible with conditions (see notes 11, 12)	Acceptable
Agriculture- intensive - aquaculture (fish, plants and crustaceans)	Incompatible	Compatible with conditions	Compatible with conditions
- orchards; production nurseries– potted plants; viticulture– wine and table grapes	Incompatible	Compatible with conditions	Acceptable
- floriculture; market gardens (see note 24); turf farms	Incompatible	Incompatible	Compatible with conditions
- hydroponic plant growing	Incompatible	Compatible with conditions	Compatible with conditions
- plant nurseries / garden centres	Incompatible	Compatible with conditions (see note 2)	Acceptable
Agro-forestry	Incompatible	Compatible with conditions	Acceptable
Amusement parlour	Incompatible	Incompatible	Acceptable (see note 1)
Animal establishment - animal saleyards and stockyards (see note 13)	Incompatible	Compatible with conditions (see note 2)	Compatible with conditions (see note 2)
- apiaries	Compatible with conditions	Acceptable	Acceptable
- catteries	Incompatible	Acceptable	Acceptable
- dairy sheds	Incompatible	Compatible with conditions (see notes 2, 3, 12)	Compatible with conditions (see note 3)
- dog kennels	Incompatible	Compatible with conditions	Compatible with conditions
- equestrian centres (see note 17)	Incompatible	Incompatible	Acceptable
- feedlots, intensive outdoor livestock holding	Incompatible	Incompatible	Compatible with conditions
- stables (see note 18)	Incompatible	Compatible with conditions	Acceptable
Animal husbandry- intensive - piggeries	Incompatible	Incompatible	Incompatible
- poultry farming - housed	Incompatible	Compatible with conditions	Compatible with conditions
Bed and breakfast (accommodating a maximum of 6 guests)	Compatible with conditions (see notes 6, 16)	Acceptable (see note 23)	Acceptable
- farm stay accommodation, rural chalets)	Compatible with conditions (see notes 6, 16)	Compatible with conditions (see note 4)	Acceptable
Betting agency	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Caravan park	Incompatible	Incompatible	Compatible with conditions (see note 1)
Caretakers dwelling	Compatible with conditions (see note 2)	Compatible with conditions	Acceptable

Model Scheme Text & interpreted type of land use	P1 areas	P2 areas	P3 areas
Car park	Incompatible	Compatible with conditions (see note 2)	Acceptable
Cemeteries	Incompatible	Incompatible	Compatible with conditions
Child care premises	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Cinema/ theatre	Incompatible	Incompatible	Acceptable (see note 1)
Civic use	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Club premises			
- sporting or recreation clubs	Incompatible	Compatible with conditions	Acceptable (see note 1)
- health centres	Incompatible	Incompatible	Acceptable (see note 1)
Community purpose			
- community halls	Incompatible	Compatible with conditions (see note 2)	Acceptable
- irrigated golf courses or recreational parks	Incompatible	Incompatible	Compatible with conditions (see note 11)
- motor-sports (permanent racing facilities)	Incompatible	Incompatible	Compatible with conditions
- public swimming pools/ aquatic centres	Incompatible	Incompatible	Compatible with conditions
- rifle ranges	Incompatible	Compatible with conditions	Acceptable
Consulting rooms	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Convenience store	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Corrective institution	Incompatible	Incompatible	Compatible with conditions (see note 1)
Educational establishment			
- community education centres, scientific research institution	Compatible with conditions (see note 2)	Compatible with conditions (see note 2)	Acceptable (see note 1)
- primary / secondary schools, tertiary education facilities	Incompatible	Incompatible	Acceptable (see note 1)
Exhibition centre	Incompatible	Incompatible	Acceptable (see note 1)
Family day care	Incompatible	Acceptable (see note 19)	Acceptable (see note 1)
Fast food outlet	Incompatible	Incompatible	Acceptable (see note 1)
Forestry (native forest/ silviculture/ tree farming)	Compatible with conditions (see note 11)	Compatible with conditions (see note 11)	Acceptable
Fuel depot (storage/ transfer)	Incompatible	Incompatible	Compatible with conditions
Funeral parlour	Incompatible	Incompatible	Acceptable (see note 1)
Home business	Incompatible	Acceptable (see note 20)	Acceptable (see note 1)

Model Scheme Text & interpreted type of land use	P1 areas	P2 areas	P3 areas
Home occupation	Compatible with conditions (see note 15)	Acceptable (see note 21)	Acceptable (see note 1)
Home office	Compatible with conditions (see note 15)	Acceptable	Acceptable
Home store	Incompatible	Compatible with conditions	Acceptable (see note 1)
Hospital	Incompatible	Incompatible	Compatible with conditions (see note 1)
Hotel (includes hotels, hostels, resorts)	Incompatible	Incompatible	Acceptable (see note 1)
Industry			
- abattoirs	Incompatible	Incompatible	Incompatible
- cottage	Compatible with conditions	Compatible with conditions	Acceptable
- drinking water treatment plant	Compatible with conditions	Compatible with conditions	Compatible with conditions
- extractive, includes construction/ mining camps (see note 10)	Compatible with conditions	Compatible with conditions	Compatible with conditions
- food processing, dairy product factories, breweries	Incompatible	Incompatible	Compatible with conditions (see note 1)
- general (chemical manufacture/ formulation, dry cleaners, dye works, laboratories, photo-processors)	Incompatible	Incompatible	Compatible with conditions (see note 1)
- general (metal production/ finishing, pesticide operator depots, heavy or energy industry, petroleum refineries)	Incompatible	Incompatible	Incompatible
- general (concrete batching, cement products, fertiliser manufacture/ bulk storage, wrecking)	Incompatible	Incompatible	Compatible with conditions
- general (mineral processing)	Incompatible	Incompatible	Compatible with conditions (see note 9)
- light industry	Incompatible	Incompatible	Compatible with conditions (see note 1)
- milk transfer depots	Incompatible	Incompatible	Compatible with conditions
- mining (includes mineral and energy exploration, oil or gas extraction / decontamination for transport)	Compatible with conditions (see note 9)	Compatible with conditions (see note 9)	Compatible with conditions (see note 9)
- mining (tailings dams)	Incompatible	Incompatible	Compatible with conditions (see note 9)
- mining (includes construction/ mining camps), (see note 10)	Compatible with conditions	Compatible with conditions	Compatible with conditions
- rural (animal product rendering works, tanneries, wool scours)	Incompatible	Incompatible	Incompatible
- rural (farm supply centres, manure stockpiling/ processing facilities)	Incompatible	Compatible with conditions (see note 2)	Compatible with conditions
- rural (forestry products processing– chip mills, pulp/ paper, timber preservation, wood/ fibre works, composting/ soil blending - commercial)	Incompatible	Incompatible	Compatible with conditions
- service industry	Incompatible	Incompatible	Compatible with conditions
Landfill (solid waste disposal)			
- class I (refer also to 'Storage - used tyres' advice)	Incompatible	Incompatible	Compatible with conditions
- class II or III	Incompatible	Incompatible	Incompatible
- class IV or V	Incompatible	Incompatible	Incompatible

Model Scheme Text & interpreted type of land use	P1 areas	P2 areas	P3 areas
Lunch bar	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Major transport infrastructure (roads, railways)	Incompatible	Compatible with conditions (see note 14)	Acceptable
Marina (includes boat moorings and servicing)	Incompatible	Incompatible	Compatible with conditions
Marine filling station (boat fuelling)	Incompatible	Incompatible	Compatible with conditions
Market (food; general produce; second-hand goods)	Incompatible	Incompatible	Acceptable (see note 1)
Medical centre	Incompatible	Incompatible	Acceptable (see note 1)
Motel	Incompatible	Incompatible	Acceptable (see note 1)
Motor vehicle, boat or caravan sales (sales yards)	Incompatible	Incompatible	Acceptable (see note 1)
Motor vehicle repair	Incompatible	Incompatible	Compatible with conditions
Motor vehicle wash	Incompatible	Incompatible	Compatible with conditions
National and regional parks and nature reserves	Acceptable	Acceptable	Acceptable
Night club	Incompatible	Incompatible	Acceptable (see note 1)
Office	Incompatible	Compatible with conditions	Acceptable (see note 1)
Park home park	Incompatible	Incompatible	Compatible with conditions (see note 1)
Place of worship	Incompatible	Incompatible	Acceptable (see note 1)
Plantation	Compatible with conditions (see note 11)	Compatible with conditions (see note 11)	Acceptable
Reception centre	Incompatible	Incompatible	Acceptable (see note 1)
Recreation – private (within non-designated recreation areas on Crown land)	Incompatible	Incompatible	Acceptable
Residential building			
- house	Compatible with conditions (see note 16)	Acceptable (see note 4)	Acceptable (see note 1)
- group dwellings (aged and dependent persons)	Incompatible	Incompatible	Acceptable (see note 1)
Restaurant	Incompatible	Incompatible	Acceptable (see note 1)
Restricted premises (adult interests)	Incompatible	Incompatible	Acceptable (see note 1)
Rural pursuit	See Agriculture, Animal establishment or husbandry		
Service station (includes aircraft, automotive repairs, boats, mechanical plant, service stations at transport and municipal works depots)	Incompatible	Incompatible	Compatible with conditions (refer to note 1)
Shop	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Showroom	Incompatible	Incompatible	Acceptable (see note 1)

Model Scheme Text & interpreted type of land use	P1 areas	P2 areas	P3 areas
Storage			
- used tyres (see note 22)	Incompatible	Incompatible	Incompatible
- chemical storage in under ground tanks	Incompatible	Incompatible	Compatible with conditions
- chemical storage in above ground tanks	Incompatible	Compatible with conditions	Compatible with conditions
Tavern	Incompatible	Incompatible	Acceptable (see note 1)
Telecommunications infrastructure	Compatible with conditions	Compatible with conditions	Compatible with conditions
Toilet blocks and change rooms	Compatible with conditions (see note 2)	Compatible with conditions	Acceptable
Trade display	Incompatible	Incompatible	Acceptable (see note 1)
Veterinary centre	Incompatible	Compatible with conditions (see note 2)	Compatible with conditions (see note 1)
Warehouse	Incompatible	Compatible with conditions (see note 2)	Compatible with conditions (see note 1)
Waste transfer station (includes recycling depots)	Incompatible	Incompatible	Compatible with conditions
Wastewater infrastructure			
- sewerage – gravity sewers	Incompatible	Incompatible	Acceptable
- sewerage – pressure mains	Incompatible	Compatible with conditions	Acceptable
- sewer pump stations	Incompatible	Compatible with conditions	Compatible with conditions
- treatment plants, wastewater disposal to land	Incompatible	Incompatible	Compatible with conditions
- wastewater injection into the ground (see note 25)	Incompatible	Incompatible	Incompatible
Water treatment plants (drinking)	See Industry		
Winery (includes wine tasting facilities)	Incompatible	Compatible with conditions (see notes 3 & 5)	Compatible with conditions (see note 3)

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

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

Explanatory notes related to land uses described the tables:

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

1. Must be connected to deep sewerage, except where exemptions apply under State Government Sewerage Policy. The Policy recognises that sewer connection may be impractical in some areas. Under these circumstances maximum wastewater loadings (based on people/ hectare) apply linked to the management Priority of the site.
2. The land use is normally incompatible, but may be conditionally approved where this facility is consistent with approved State and local government planning strategies or schemes.
3. The land use must incorporate best environmental management practices compatible with the management strategy for the designated priority area defined in the relevant source protection plan.
4. In Priority 2 areas: conditions may apply to density of dwellings (i.e. hectares per dwelling).
5. Size of the grape crush shall not exceed 500 tonnes per year.
6. May be approved if occupancy is of equivalent size to a single dwelling household (i.e. less than 10 people– defined by capacity of a septic tank based on-site wastewater treatment system).
7. An average, rather than minimum, lot size may be accepted if the proponent can demonstrate that the water quality objectives of the source protection area are met, and caveats/memorials are placed on titles of specified blocks stating that further subdivision shall not occur.
8. Lots should only be created where land capability assessment shows that effective on-site soakage of treated wastewater can be achieved. Conditions apply to siting of wastewater disposal systems in areas with poor land drainage and/ or a shallow depth to groundwater, animals are held or fertiliser is applied. Alternative wastewater treatment systems, where approved by the Department of Health, may be accepted with ongoing maintenance requirements.
9. Conditions are likely to be placed via a Department of Industry and Resources mineral tenement lease, and / or as a result of Minister for the Environment’s approval after an Environmental Impact Assessment.
10. Conditions apply to the storage of fuels and chemicals, the depth of excavation related to the water table and rehabilitation criteria. Underground fuel or chemical storage tanks are prohibited via DOE by-laws in Priority 1 and 2 areas within Underground Water Pollution Control Areas.
11. Conditions apply to regulate fertiliser and pesticide application.
12. Can be approved if animal stocking levels (animals per hectare, guided by the Department of Agriculture’s stocking rate guidelines) are consistent with the priority source protection area objectives.
13. This does not include stockyards occasionally used on farms or pastoral leases for animal husbandry.
14. Conditions may be imposed to cover design, construction of infrastructure and the types of goods.
15. May only be approved if *Home Occupation* relates to an existing residence.
16. Limited to one residential building per property.
17. Includes land or buildings dominantly used for the showing, competition or training of horses, and riding schools.
18. Includes any land, building or structure used for equine (e.g. horses, asses, mules and donkeys) housing, keeping and feeding and associated activities.
19. In accordance with *Community Services (Child Care) Regulations 1988: A child care service provided to a child in a private dwelling in a family of or domestic environment. No more than 5 children of pre-school age and no more than 7 children under 12 years old, including the children of the licensee or permit holder.*

20. No more than 2 employees, and the home business occupies an area up to 50 square metres. Compatible if only an office/ administrative business (i.e. overnight parking of only one commercial vehicle, no refuelling or repair/ maintenance of business vehicles, and no activities involving on-site use storage or disposal of chemicals or process wastewater).
21. Employees shall be members of the household, and the home business occupies an area of up to 20 square metres. No provision for refuelling, repair or maintenance of commercial/ business vehicles or on-site use or storage of chemicals.
22. Used tyre use, storage and disposal are subject to *Used Tyre Regulations 1996*, administered by this agency.
23. As defined in the *Model Scheme Text (1997)* or the *Residential Design Codes of Western Australia (2002)* prepared by the Western Australian Planning Commission, and covering local government planning schemes.
24. Applies to the commercial production of horticultural crops e.g. vegetables, flowers and fruit crops grown in contact with the ground. Does not apply to cereal or oil seed crops, perennials e.g. orchards, vineyards, nuts; or any crop grown separate from contact with soils in the natural environment e.g. hydroponics.
25. The use of recycled (reclaimed) water to address the diminishing level of scheme water supply in Western Australia is currently being investigated by Government. The social, environmental, health and economic issues related to this option are significant and need to be further progressed before its applicability in PDWSA is reconsidered.

More information or feedback

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

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



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Appendix 2 Water Quality

The Water Corporation has monitored water quality from Perth Coastal groundwater system in accordance with Australian Drinking Water Guidelines (ADWG) and interpretations agreed to with the Department of Health (DoH). Drinking water criteria that have been monitored together with ADWG health and aesthetic guideline values are available from the Water Corporation on request.

The Perth Coastal groundwater system supplies water to four groundwater treatment plants prior to distribution to the IWSS. Gwelup Groundwater Treatment Plant (GWTP) receives water from Gwelup wellfield, Neerabup GWTP receives water from Neerabup wellfield, Yanchep and Two Rocks GWTPs receive water from Yanchep wellfield.

MICROBIOLOGICAL CONTAMINANTS

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

There have been no thermotolerant coliform counts recorded in raw water samples from Yanchep wellfield and one unreported count recorded in raw water samples from Gwelup and Neerabup wellfields.

Raw water from the Perth Coastal groundwater system is treated at the Gwelup, Neerabup, Yanchep and Two Rocks Groundwater Treatment Plants (GWTPs). Water delivered to Gwelup GWTP is clarified, filtered, dosed with polyelectrolyte and hydrochloric acid, chlorinated and fluoridated. Water delivered to Neerabup GWTP is aerated, softened, recarbonated, filtered, dosed with polyelectrolyte, carbonic acid and calcium hydroxide, chlorinated and fluoridated. Water delivered to Yanchep and Two Rocks GWTPs is softened and chlorinated.

HEALTH RELATED CHEMICAL WATER QUALITY DATA

Raw water from Perth Coastal groundwater system is analysed for health related chemicals. Health related chemicals include inorganics, heavy metals, industrial hydrocarbons and pesticides. Health related water quality parameters that have been measured at detectable levels in the sources from January 2000 to March 2007 are summarised in the following table. All values are in milligrams per litre (mg/L).

Barium and boron have been detected in raw water samples from the Perth Coastal groundwater system, but at concentrations well below ADWG.

Although only very low readings of arsenic have been recorded at the raw water sampling points, it has been observed at levels just above the ADWG guideline value in Gwelup bores G70, G140 and G150 and Neerabup bores Q10, Q20, Q30, WT10, WT20 and WT40. Occurrence of arsenic at these levels observed in these bores is thought to be natural variation within the aquifer.

Nitrates in some superficial aquifer bores were recorded above what would be expected to be naturally occurring levels, although well below the ADWG guideline value. The highest levels were observed in the Gwelup wellfield and probably reflect historical use of the Gwelup area for vegetable production and the past use of septic tanks for disposal of residential wastewater. Some bores are possibly being affected by current practices, which include fertilising of nearby sporting grounds. Slightly elevated levels in two main clusters in the Neerabup wellfield are possibly also related to application of fertilisers on nearby community parks and ovals.

All health related water quality parameters from Perth Coastal groundwater system raw water sampling points did not exceed health guideline values and therefore present no significant health risk. These parameters will continue to be routinely monitored.

Parameter	Range of Monitored Values Min-Max Median	ADWG Health Value*
	Gwelup Raw Water	
Inorganics		
Nitrite +nitrate (N)	0.19 – 0.64 0.59	11.3 mg/L
Metals		
Arsenic	No detection - 0.004 No detection	0.007 mg/L
Barium	0.100 – 0.110 0.110	0.7 mg/L
Boron	No detection – 0.080 0.030	0.3 mg/L
Neerabup Raw Water		
Inorganics		
Nitrite +nitrate (N)	0.38 – 2.20 1.80	11.3 mg/L
Metals		
Arsenic	No detection - 0.004 No detection	0.007 mg/L
Barium	0.075 – 0.140 0.088	0.7 mg/L
Boron	No detection – 0.040 0.030	0.3 mg/L
Yanchep – Two Rocks Raw Water		
Inorganics		
Nitrite +nitrate (N)	0.55 – 2.50 1.90	11.3 mg/L
Metals		
Barium	0.030 – 0.075 0.040	0.7 mg/L
Boron	No detection - 0.02 No detection	0.3 mg/L

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

AESTHETIC WATER QUALITY DATA

Aesthetic water quality analyses for raw water from Perth Coastal groundwater system are summarised in the following table. The values are taken from ongoing raw water monitoring from January 2000 to March 2007. All values are in milligrams per litre (mg/L) unless stated otherwise. The water quality parameters that have on occasion exceeded the ADWG aesthetic guideline for supplied drinking water are shaded. Observed values are considered to be within the naturally occurring range for the Perth Coastal groundwater system and no trends are evident. The groundwater treatment plants reduce the level of concentration of these parameters to within the aesthetic guideline values.

Parameter	Range of Monitored Values Min-Max Median	ADWG Aesthetic Value
	Gwelup Raw Water	
Salinity (TFSS – CO ₂)	389 – 439 421	500 mg/L
Hardness (CaCO ₃)	152 – 180 169	200 mg/L
Turbidity	No detection – 300 14.8	5 NTU
pH	6.7 – 6.9 6.8	6.5-8.5
Colour	1 – 6 3	15 TCU
Iron (unfiltered)	6.0 – 23.0 7.75	0.3 mg/L
Manganese (unfiltered)	0.050 – 0.080 0.063	0.1 mg/L
Aluminium (unfiltered)	No detection – 0.016 No detection	0.2 mg/L
Neerabup Raw Water		
Salinity (TFSS – CO ₂)	329 – 448 422	500 mg/L
Hardness (CaCO ₃)	119 – 245 186	200 mg/L
Turbidity	0.2 – 14 7.4	5 NTU
pH	6.7 – 6.9 6.8	6.5-8.5
Colour	1 – 4 2	15 TCU
Iron (unfiltered)	0.8 – 6.0 1.2	0.3 mg/L
Manganese (unfiltered)	0.014 – 0.024 0.018	0.1 mg/L
Yanchep – Two Rocks Raw Water		
Salinity (TFSS – CO ₂)	357 – 425 400	500 mg/L
Hardness (CaCO ₃)	196 – 242 225	200 mg/L
Turbidity	No detection – 4.6 No detection	5 NTU
pH	7.3 – 7.6 7.4	6.5-8.5
Colour	No detection – 2 No detection	15 TCU
Iron (unfiltered)	No detection – 0.189 No detection	0.3 mg/L

– items shaded indicate that the ADWG has been exceeded

Appendix 3

Examples of Protection Strategies (Used in existing Drinking Water Source Protection Plans)

Activity	Recommended Protection Strategies
<i>State owned (public) Land (PI source protection)</i>	
Reserves State Forest Unallocated	<p><i>Acceptable with best management practices</i></p> <ul style="list-style-type: none"> • Encourage government agency that manages the land to include provisions for water quality protection. • Review agency management plans regularly to ensure water quality protection objectives met. • Inspect protection measures on-site.
Timber Production (State Forest)	<p><i>Acceptable with best management practices</i></p> <ul style="list-style-type: none"> • Ensure compliance with the Contractor's Timber Harvesting Manual for water quality protection. • Review 1 year and 5 year harvesting plans to ensure water quality protection objectives are met. • Inspect protection measures on-site.
Apriarists Wildflower picking Seed collection Firewood collection	<p><i>Acceptable activity with conditions</i></p> <ul style="list-style-type: none"> • Activities to be restricted to outside proposed RPZ and away from feeder streams. • Apply conditions for Apriarists, Wildflower Picking and Seed collection that meet water quality protection objectives. • Promote casual firewood collection areas outside catchment area. • Firewood collection is not authorised in vested Reserves.
Roads	<p><i>Acceptable with best management practices</i></p> <ul style="list-style-type: none"> • Review road maintenance practices and develop a plan to minimise risk to water quality. • Conduct risk assessment survey for transport of fuel and chemicals. Place signs along road with an emergency contact number for spills. • Construct sumps at major stream crossings. • Ensure emergency response process is in place and local emergency management advisory committee is aware of management requirements for drinking water catchment.
Off-road vehicle use	<p><i>Unacceptable activity</i></p> <ul style="list-style-type: none"> • Remove site as a destination in CALM "4WD Days Out of Perth" publication. • Recognise activity in regional recreation plan and look at alternative sites. Encourage involvement in organised events. • Use signage to promote awareness that off-road driving is not permitted. • Undertake surveillance to control off-road driving in the catchment.
Bushwalking	<p><i>Acceptable activity with conditions</i></p> <ul style="list-style-type: none"> • Ensure trails outside RPZ, away from streams feeding into reservoir, and cross-streams where culverts and / or bridges are established. • Compliance with the Department of Environment's Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land (Recreation Policy), available via www.drinkingwater.water.wa.gov.au. • Promote bushwalking opportunities as part of a regional recreational plan. • Use signage as education tool. • Undertake surveillance. • Require organised groups to obtain approval for events
Picnicking	<p><i>Acceptable activity with conditions</i></p> <ul style="list-style-type: none"> • Locate picnic sites outside the proposed RPZ. • Promote use of controlled picnic away from watercourses. • Promote picnicking opportunities as part of a regional recreational plan. • Prohibit dogs through education/signs, promotional material and surveillance. • Compliance with the Department of Water's Recreation Policy available via www.drinkingwater.water.wa.gov.au.
Horse riding events	<p><i>Acceptable with Best Management Practices</i></p> <ul style="list-style-type: none"> • An environmental management plan developed for each event, addressing water quality protection measures. Approval for each event subject to implementation and review of plan. • Camping will be restricted to specific sites as developed in regional recreation plan. • All events to be staged on roads and trails. Stream crossings to be on made roads at culverts or bridges. • Monitor existing events to identify water quality risks to be addressed in the environmental management plan. • No new events to operate in the catchment. • Refer to Environmental Guidelines for Horse Facilities and Activities, available via http://drinkingwater.water.wa.gov.au

Activity	Recommended Protection Strategies
Hunting	<p><i>Unacceptable activity</i></p> <ul style="list-style-type: none"> • Catchment to be closed to hunting through the CAWS Act and MWSSDB 1909 By-Laws. • Place signs throughout catchment indicating uncontrolled hunting is illegal. • Undertake surveillance of the catchment. • Control feral animal through managed program.
Swimming	<p><i>Unacceptable activity</i></p> <ul style="list-style-type: none"> • Make public aware that swimming is prohibited under the CAWS Act By-laws. • Signs in the catchment • Undertake surveillance & by-law enforcement. • Compliance with Department of Water's Recreation Policy, available via http://drinkingwater.water.wa.gov.au
Fishing Marroning	<p><i>Unacceptable activity</i></p> <ul style="list-style-type: none"> • Make public aware that fishing and marroning is prohibited under the CAWS Act By-laws. • Place signs throughout catchment indicating fishing and marroning is not permitted. • Undertake surveillance & by-law enforcement. • Signs in the catchment • Compliance with Department of Water's Recreation Policy, available via http://drinkingwater.water.wa.gov.au
Boating	<p><i>Unacceptable activity</i></p> <ul style="list-style-type: none"> • Make public aware that boating is prohibited under the CAWS Act By-laws. • Undertake surveillance & by-law enforcement. • Signs in the catchment • Compliance with the Department of Water's Recreation Policy available via http://drinkingwater.water.wa.gov.au
Motor vehicle rallies Including: Rally Australia Motor bike events	<p><i>Acceptable with best management practices</i></p> <ul style="list-style-type: none"> • No new rallies to operate in the catchment. • An environmental management plan developed for each event, addressing water quality protection measures. Approval for each event subject to implementation and review of plan. Compliance with Department of Water's Recreation Policy available via http://drinkingwater.water.wa.gov.au
Military activities	<p><i>Acceptable activity with conditions</i></p> <ul style="list-style-type: none"> • Restrict military training to outside of the RPZ. • Ensure approval for military activities contains conditions for water quality protection. • Undertake discussions with military to investigate the use of alternative areas. • Undertake surveillance to ensure compliance with approval.
Water supply construction	<p><i>Acceptable with Best Management Practices</i></p> <ul style="list-style-type: none"> • Ensure water quality risk addressed in EMP. • Work with contractors on-site and advice on issues related to water quality protection. • Monitor turbidity and undertake remediation if monitoring shows adverse impact.
Private Land (P1 source protection)	
	<p><i>Long term goal of crown ownership of private land</i></p> <ul style="list-style-type: none"> • Landowners can continue current activities with best practices being encouraged (refer to Quality Protection information. http://drinkingwater.water.wa.gov.au, select publications> Water Quality Protection Notes. • Oppose intensification of land uses through planning approval process. • Offer landowners opportunity to sell or swap their land. Purchased land to become Crown Reserve and re-vegetated. Long-term Crown ownership is preferable
Private Land - Rural (P2 source protection)	
Cropping and grazing Tree farming Viticulture	<p><i>Acceptable with best management practices</i></p> <ul style="list-style-type: none"> • Landowners continue current activities with best practices being encouraged (refer to Quality Protection information http://drinkingwater.water.wa.gov.au • Ensure Town Planning Scheme adequately controls development. • Oppose intensification of land uses through planning approval process. • Promote water quality protection.

Activity	Recommended Protection Strategies
Land clearing for broadacre farming in Clearing Control Catchments	<p><i>Manage as non-conforming land use</i></p> <ul style="list-style-type: none"> • Landowner can continue current activities (consistent with <i>Environmental Protection Act 1986</i> and <i>Country Area Water Supply Act 1947</i> approvals), with best management practices being encouraged • Continue to support changes in land use within existing approvals that reduce salinisation. • Oppose intensification of land uses through planning approval process. • Continue re-vegetation initiatives under clearing control legislation. Land transferred to Crown ownership to be re-vegetated.
Rural residential	<p><i>Maintain existing planning controls</i></p> <ul style="list-style-type: none"> • Ensure the Special Provisions for the Rural Residential Zone control development. • Encourage landowners to adopt best management practices for permitted activities (refer to Quality Protection information http://drinkingwater.water.wa.gov.au) • Oppose intensification of land use through planning approval process. • Support changes within existing approvals that reduce groundwater contamination risks. • Encourage connection to deep sewerage through planning approval process. • Promote water quality protection.
Rural development Including: Special rural zones Rural retreats Hobby farms Cottage industries Chalets Bed and breakfasts and farmstays	<p><i>Conditional with best management practices</i></p> <ul style="list-style-type: none"> • Landowners can continue current activities with best practices being encouraged (refer to Quality Protection information http://drinkingwater.water.wa.gov.au) • Ensure Town Planning Scheme adequately controls development. • Oppose intensification of land uses through planning approval process.
Private Land - (P3 source protection)	
	<p><i>Acceptable with controls</i></p> <ul style="list-style-type: none"> • Landowners can continue current activities, with best practices being encouraged (refer to Quality Protection information http://drinkingwater.water.wa.gov.au) • Ensure Town Planning Scheme adequately controls development. • Further subdivision and land use to be consistent with water quality objectives. • Oppose incompatible land uses through planning approval process. • Encourage connection to deep sewerage through planning approval process.
Power stations	<p><i>Manage as non-conforming land use</i></p> <ul style="list-style-type: none"> • Landowner can continue current activities, with best management practices being encouraged. • Support changes in land use within existing approvals that reduce groundwater contamination risks.
Disused depots Including: Water Corporation Western Power Shire	<p><i>Unacceptable in current condition</i></p> <ul style="list-style-type: none"> • Remove all infrastructure and contaminant threats including septic system and decontaminate site. • Return site to natural bushland.
Rubbish disposal	<p><i>Unacceptable activity</i></p> <ul style="list-style-type: none"> • Encourage local council to close site and undertake remediation to decontaminate site. • Return site to natural bushland.
Horticulture	<p><i>Maintain existing planning controls</i></p> <ul style="list-style-type: none"> • Landowners can continue current activities with best management practices being encouraged (refer to environmental guidelines for horticulture and/or viticulture via http://drinkingwater.water.wa.gov.au) • Oppose intensification of land use through planning approval process. • Support changes in land use within existing approvals that reduce groundwater contamination risks.
Residential	<p><i>Acceptable activity with controls</i></p> <ul style="list-style-type: none"> • Ensure Town Planning Scheme adequately controls development (refer to Quality Protection information http://drinkingwater.water.wa.gov.au) • Encourage connection to deep sewerage through planning approval process. • Further subdivision to be consistent with Draft Country Sewerage Policy 2003. • Promote water quality protection.

Activity	Recommended Protection Strategies
Industrial and commercial sites.	<p data-bbox="486 208 805 235"><i>Acceptable activity with controls</i></p> <ul data-bbox="486 241 1428 403" style="list-style-type: none"> <li data-bbox="486 241 1428 315">• Landowner can continue current activities. They are also encouraged to upgrade existing facilities to meet DoE recommendations (refer to Quality Protection information http://drinkingwater.water.wa.gov.au) <li data-bbox="486 322 1428 371">• Oppose intensification of land use through planning approval process (eg those activities not acceptable in P3 areas). <li data-bbox="486 378 1428 403">• Support changes in land use within existing approvals that reduce contamination risks.

Appendix 4

DoW WQPN Overview on protecting Public Drinking Water Source Areas

Note WQPN subject to change. Refer to the Department of Water website <http://drinkingwater.water.wa.gov.au> for latest version.



WQPN 36, April 2006

Protecting Public Drinking Water Source Areas

Purpose

Drinking water catchments are proclaimed areas where stormwater run-off, seepage or infiltration is stored above or below ground then extracted to supply the community with their drinking water needs. Surface and underground water resources in these areas are highly vulnerable to contamination by a range of land uses. A Source Protection Strategy has been prepared and endorsed by Government to ensure our water supplies remain safe for water consumers. This strategy involves constraints on land development, restrictions on people's access and exclusion of high risk activities in the most vulnerable parts of the catchment. This note provides detailed information on these catchment protection measures.

The Department of Water is responsible for managing and protecting the State's water resources in association with other State Government agencies. It is also a lead agency for water conservation and reuse. This note offers:

- the Department's current views on land development in drinking water source catchments;
- guidance on acceptable practices used to protect the quality of Western Australian water resources; and
- a basis for the development of a multi-agency code or guideline designed to balance the views of industry, Government and the community, while sustaining a healthy environment.

Introduction

The Department of Water is custodian of the statutes used to protect public drinking water source catchments. The Department works with other State agencies such as the Department of Health, the Western Australia Planning Commission and water service providers to manage the water quality within drinking water catchments. This will ensure the continued availability of 'safe, good quality drinking water' and protect public health now and into the future at a reasonable cost to consumers.

This note provides an overview of the policies and processes used to protect public drinking water catchments, also known as Public Drinking Water Source Areas (PDWSAs), that supply major population centres and rural towns in Western Australia.

A PDWSA is either the catchment area of a surface water source (reservoir) or the recharge area of a groundwater source (borefield). These areas are proclaimed as Water Reserves, Catchment Areas or Underground Water Pollution Control Areas under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*, and Water Reserves or Catchment Areas under the *Country Areas Water Supply Act 1947*. For a list of gazetted PDWSAs, see Water Quality Protection Note *Gazetted Public Drinking Water Source Areas*.

Please note that both the departments of Health and Water do not recommend the use of rainwater or private bore water for drinking water purposes where a scheme water source is available. This is because the catchments of these other sources are generally not protected from contamination and they are not analysed or treated to meet the relevant health guidelines for drinking water. However such sources can be useful for non-potable uses such as in washing machines, toilets or for gardens.

If a scheme supply is not available it is important that the consumer implements the necessary measures to ensure their drinking water source is safe to drink (ie arrange water analyses and treatment as required). Further information on the management of drinking water supplies is provided in Water Quality Protection Notes *Private water supplies* and *Community drinking water sources*.

Who is involved in protecting our drinking water supplies?

The community, land owners, developers, industry, agricultural producers, Local Government Authorities, water service providers and the State Government must share responsibility for the condition (quality) and availability (quantity) of our drinking water. All of these stakeholders play a significant role in the development of Drinking Water Source Protection Plans for PDWSAs. They may also be involved in the implementation of the recommendations in the plans.

The role of the **Department of Water** includes responsibilities in defining, proclaiming and protecting PDWSAs. The Water Source Protection Branch within the Water Resources Division is responsible for preparing policies and guidelines; Drinking Water Source Protection Assessments; Drinking Water Source Protection Plans; and advising other decision-making agencies on catchment and source protection requirements. The Department promotes a coordinated approach to catchment protection encompassing a variety of related measures including regional and local land use planning; health; and environmental legislation.

This Department administers the State's catchment protection legislation by:

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

The Department also provides the Minister for Water Resources with assessment, planning and water resource management advice through its Water Services Planning Branch. This branch also provides support to the Minister in meeting the obligations of existing legislation. These obligations include the approval of major works such as water tanks and mains, the approval of prices set in by-laws and the appointment of members to the Regional Water Boards.

The **Department of Health** (DoH) has primary responsibility for public health. The role of the DoH is to minimise human exposure to environmental health hazards that pose or have the potential to pose a health risk and to reduce the incidents and impact of communicable disease. To safeguard against unhealthy drinking water, the Department works closely with DoH and individual water service providers.

The DoH also chairs an inter-agency committee, called the Advisory Committee for the Purity of Water, established in 1925. This Committee is charged with the ongoing responsibility of advising the State on drinking water protection issues from 'catchment to consumer'.

The **Department for Planning and Infrastructure** (DPI) has a significant role in the protection of PDWSAs. The progress of Land Use and Water Management Strategies (eg Gnangara, Jandakot, Middle Helena and East Wanneroo) and Planning Bulletins prepared by DPI, together with development of specific Statement of Planning Policies (SPP) by the Western Australian Planning Commission (eg SPP 2.2, 2.7 and 2.9) help protect PDWSAs from inappropriate land use developments.

The **Economic Regulation Authority** is another Government agency with a key role in regulating drinking water supplies. The Economic Regulation Authority is the independent economic regulator for Western Australia. It oversees regulation and licensing in the State for the gas, electricity, water and rail industries and inquires into matters referred to it by the State Government. The Water Division of the Economic Regulation Authority is responsible for the functions outlined in section 4 of the *Water Services Licensing Act 1995*. These functions include licensing water service providers and monitoring the operational performance of water industry service providers. The licences are designed to maintain a high quality of water services to the public. In general, licensees must undergo audits to ensure the effectiveness of their systems and meet certain service standards specified in their licence. The Water Corporation is the largest licensee and services around 96% of the State water service market. Other water service providers include the Busselton Water Board and Aqwest (Bunbury Water Board).

The **Water Corporation** was formed in the mid 1990s. This followed the split of the former Water Authority of Western Australia as part of the Council of Australian Government (COAG) Water Industry Reform initiatives. The Corporation is the major licensed water service provider in Western Australia, supplying the Perth metropolitan area as well as a further 230 towns across the State. Although it is a Corporation, subject to corporation law and managed by a board of directors (including a Managing Director or CEO), the State Government is the sole shareholder. The Corporation is required to return a dividend, based on the Government's investment in the Corporation's assets, and in return receives Customer Service Obligation (CSO) payments to subsidise uneconomic services that are required to be provided by the Government. The Corporation also pays Federal tax equivalents to the State Government in accordance with the COAG reform agreement.

Source Protection Operational Agreements exist between the Department of Water and the Water Corporation, which assigns roles, clarifies responsibilities and ensures the catchment protection process is carried out effectively. Under legislative powers, the Department may delegate certain catchment management functions to the Water Corporation (or other water service providers). Delegation is appropriate as the Corporation has a strong vested interest in assuring high quality drinking water from PDWSAs and is also prepared to resource catchment management functions.

Currently, delegated functions relate to catchment surveillance, enforcing by-laws regarding transient catchment activities, entry onto land and catchment management planning. The extent of delegated responsibilities may vary between catchments.

Why should we protect our drinking water supplies?

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

In the mid 1990s, the COAG reform process took an initiative to pursue the sustainable use of water resources by protecting and enhancing their quality, while maintaining economic and social development. This was achieved through the development of a National Water Quality Management Strategy (NWQMS) comprising 21 national guideline documents. Two of these focused on drinking water:

- *Australian Drinking Water Guidelines- Summary*; and
- *Australian Drinking Water Guidelines (ADWG) 2004* (previously published in 1987 and 1996).

The *Australian Drinking Water Guidelines 1996* first recognised water source protection through catchment management as an effective approach to preventing contamination of drinking water sources and undertook to investigate this issue further.

In May 2001, Western Australia supported the NWQMS (including the drinking water guidelines) through the launch of its own *State Water Quality Management Strategy (SWQMS)*. In late 2002, the 1996 guidelines were updated and released for public comment. The current guidelines were approved in 2004. A consumer guide to the *ADWG 2004*, called *Water made clear*, was also released to raise awareness of the need to protect drinking water from 'catchment to consumer'.

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

In 2000, the State Legislative Council's Standing Committee on Ecologically Sustainable Development published a report, *Quality of Perth's Water Supply*, expressing confidence in the system used to manage and operate Perth's water supplies. The Standing Committee noted, however, that various activities posed a contamination risk to water supplies. It found as a "***first priority that water sources be protected through good land use planning***". It also noted that "***Using treatment to deal with contamination is a second-best option***". The Committee "***found support for adopting catchment protection as the major weapon in preventing contamination of water supplies***".

In November 2001, in support of this finding, the Western Australian Planning Commission (in consultation with the then Water and Rivers Commission) released the Statement of Planning Policy 2.7 *Public Drinking Water Source Policy* for public comment. This Policy was gazetted in June 2003 and guides State and Local Government land use planning decisions in PDWSAs, through provisions in the Metropolitan Region Scheme and local Town Planning Schemes.

Although the above committees were reporting on Perth's water supplies, their findings apply to all public drinking water sources in Western Australia. This is especially true when a community is reliant upon a single drinking water resource (such as the groundwater bore network in Kununurra or surface water dam in Quinninup) rather than an integrated series of sources (such as those that supply Perth). Contamination of a single resource from inappropriate land use planning or polluting activities within the catchment can have significant health and economic impacts, which can be avoided.

In February 2003, the Western Australian Government released its *State Water Strategy – Securing our Water Future*. Although prepared in response to a number of forums around the State focusing on drought, it did make a significant statement about protecting our public drinking water sources.

The Government's response to Section 8.6 on Catchment Protection and Land Use Controls was ***“recognition of the primacy of water quality in the management of drinking water catchments, to protect the long term sustainability of the resource, will be used to guide catchment management decisions.”***

In September 2003, the Western Australian Government also released its State-Sustainability Strategy *Hope for the future*. Drinking water catchments are recognised in that Strategy as important 'natural resources' together with the other more common natural resources (eg agriculture, fisheries, forestry, mining, tourism, aquatic systems, coastal and marine environments and rangelands). The 'vision' in the Strategy is that **“Drinking water sources are fully protected for future generations.”**

The Strategy lists the following 'actions'. That stakeholders:

- “Work to ensure all present and future drinking water sources are protected.” (Action Number 3.48); and
- “Ensure the activities in catchments are actively managed and sustainable...” through “...investigation of the impact of active catchment management strategies that enhance water quality and quantity outcomes...” (Action Number 3.51).

What are we protecting the drinking water supplies from?

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

Potential contaminants may include:

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

Although treatment processes can remove many contaminants such treatment increases the cost of the water supply, and continuous effective removal of all contaminants is not considered technically or economically feasible. If contamination does occur, the opportunity to locate and develop a replacement source is often limited, and the provision of alternatives, such as bottled drinking water, is costly and can only be considered a short-term solution.

Preventing contamination before it occurs alleviates the need for costly treatment or development of more costly alternative sources. There is a substantial ongoing financial cost to be borne in sampling and testing for contaminants if they become prevalent in drinking water sources. The benefits (environmental, social and economic) of avoiding contamination through best management decisions and practices are recognised in the *ADWG 2004*.

Drinking water quality and safety cannot be taken for granted. Consultation with the community and other stakeholders is necessary to establish State and Local Government legislative and non-legislative controls. These controls are needed to manage a number of threats to drinking water areas, including inappropriate:

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

Drinking water that is not properly treated, or which travels through an inadequately maintained distribution system, also poses a serious public health risk. Several relatively recent events have occurred nationally and internationally that highlight the importance of protecting the drinking water catchment and the need for a multi-barrier approach.

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

At Walkerton (Canada) in 2000 a drinking water tragedy occurred where a pathogenic *Escherichia coli* outbreak resulted in over 2300 cases of illness amongst 4,800 residents, 70 people were hospitalised and 7 deaths were attributed to the outbreak. A judicial inquiry concluded that the likely initial cause of the outbreak was from manure application on farmland within the catchment (a common practice) that resulted in bacteria contaminating the shallow underground waterbody used to supply drinking water to the town.

Other contributing factors to the outbreak included a high rainfall event immediately prior to the contamination outbreak, an inadequate disinfectant dose rate and monitoring issues related to the distribution system. It is important to appreciate that the drinking water system at Walkerton operated for more than eight years without major incident up until the year 2000. The over-reliance on treatment to provide a safe drinking water supply was highlighted and a new approach adopted that considered the combination of catchment protection and improved treatment to provide a more reliable and safe supply to consumers.

How do we protect Public Drinking Water Source Areas in Western Australia?

A 'catchment to consumer' multiple barrier risk based management approach is used to protect drinking water quality in Western Australia, consistent with the *ADWG 2004*.

Catchment management for protection of water quality is considered the first important barrier. Historically, a heavy reliance was placed on treating water to achieve the desired level of safety, but it is now recognised that treatment alone does not remove all hazards to public health. Effective catchment protection is also essential.

Other barriers that can be used include:

- selection of an appropriate, safe, high quality source (where alternatives exist);
- controls over land uses and high risk human activities in catchments underpinned by statutory measures;
- protective buffer zones to bores, reservoirs and feeder streams;
- catchment protection strategies for education, surveillance, enforcement, monitoring and reporting;
- pre-treatment of drinking water, for example, the use of detention and settling in reservoirs to allow microbes to die off;
- protection of water storage, for example water tanks and reservoirs;
- disinfection of drinking water before it enters the distribution system and provision to ensure an adequate disinfectant residual throughout that system; and
- maintaining the distribution system as a whole including the pipe system, vermin proofing of water tanks and preventing back-flow.

These barriers are promoted and implemented in a range of legislation, policy, plans and guidelines used by this Department. Proclamation processes provide a legislative definition of each PDWSA and allow by-laws to be applied. Departmental policy describes the roles and responsibilities of key stakeholders.

Drinking Water Source Protection Plans reflect risks to a PDWSA and recommend protection strategies to deal with those risks (eg priority areas and protection zones). Guidelines (eg Water Quality Protection Notes) provide best practice to protect water quality (eg vegetative buffers).

Drinking Water Source Protection Plans and Drinking Water Source Protection Assessments

Drinking Water Source Protection Plans (DWSPP) are a key component of the 'catchment to consumer' protection strategy for Western Australia's drinking water supplies. This is reflected in the Government's report *Securing our Water Future – A State Water Strategy for Western Australia (2003)* which states that **“Water Source Protection Plans should be completed for all public drinking water supply catchments throughout the State.”** A DWSPP aims to identify existing and potential threats to a drinking water source, and provide risk management strategies and programs for its ongoing management and protection. Plans are prepared in consultation with the community, potentially affected stakeholders (eg landowners), Local Government Authorities and the State Government.

Stakeholders are strongly encouraged to consider the risks and potential consequences of inappropriate land use planning or human activities in PDWSAs (eg contamination of the resource and costs to clean-up or establish a new drinking water source). It should be noted that some land use activity restrictions might apply through land planning processes in order to achieve a safe, good quality drinking water supply.

Providing a basis for establishing compatible land uses within PDWSAs, the DWSPP is only one of a suite of measures used by this Department to meet its drinking water protection responsibilities. As at June 2005, there were 136 drinking water sources requiring a plan. Of this, 52 have been completed and are available on the Department's Internet site. The State Government has committed to completion of another 24 Plans by 2008.

While the full suite of DWSPPs await completion, land planners and developers need to be aware of the location and risks to existing drinking water catchments. To assist with this process, this Department is preparing Drinking Water Source Protection Assessments (DWSPA). These Assessments provide a broad overview of catchment risks, current land uses and a basic understanding of the drinking water catchment and supply system. They are not intended to include extensive data, but instead to characterise the drinking water system by providing useful information for decision makers.

Generally, the DWSPA will be a desktop assessment followed by a site visit and discussions with the relevant Local Government Authority. Sometimes the DWSPA may be all that is required to achieve good land planning/ activity controls (eg through planning schemes or strategies) for the protection of drinking water source areas. The DWSPA provides a basis for the development of the more elaborate and publicly consulted DWSPP as described above.

Priority classification areas and protection zones

Priority 1 (P1) source protection areas are defined to ensure that there is no degradation of the water source. P1 areas are declared over land where the provision of high quality public drinking water is the prime beneficial land use. P1 areas would typically include land under public ownership. P1 areas are protected in accordance with the objective of *risk avoidance*.

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) exists. Protection of public water supply sources is also a high priority relative to other land use values in these areas. P2 areas are protected in accordance with the objective of *risk minimisation*.

Priority 3 (P3) source protection areas are defined where it is necessary to manage the risk of pollution to the water source, and where water supply sources need to co-exist with other existing land uses such as residential, commercial and light industrial developments. P3 areas generally include the need for deep sewerage. P3 areas are protected in accordance with the objective of *risk management*.

Reservoir Protection Zones (RPZ) are defined to protect surface water sources from contamination. An RPZ consists of an area two kilometres around the top water level of a reservoir and includes the reservoir itself. These zones do not extend outside the catchment area (ie downstream from the dam wall). Generally conditions apply in these zones to prevent people from entering the RPZ to avoid the risk of contamination. By-law changes are currently being consulted to allow the “two kilometre” limit to be defined in DWSPPs “*up to two kilometres*”.

Wellhead Protection Zones (WHPZ) are defined around groundwater abstraction bores. In the absence of modelled alternative zone shapes, WHPZs in P1 areas are set at a 500 metre radius around bores, and in P2 or P3 areas they are set at a 300 metre radius around bores.

In priority areas and protection zones there is a strong reliance on landowners, developers, regulators and other users to be aware of the drinking water resource and risks, such that the adoption and implementation of best management practices will help protect the drinking water source.

Existing, lawfully established but non-conforming land uses in PDWSAs are allowed to continue, however land users will be encouraged to adopt environmentally responsible/best practice land use methods.

The Department’s Water Quality Protection Note *Land Use Compatibility in Public Drinking Water Source Areas* provides guidance on the types of land uses appropriate within P1, P2 and P3 areas. A flow diagram within the note also demonstrates how priority classifications and protection zones are determined.

Vegetative buffers

The Water Quality Protection Note *Vegetation buffers to sensitive water resources* describes the Department’s approach to the use of vegetative buffers as a protection mechanism between drinking water resources and land use activities. These buffers are recommended in PDWSAs where they can be established.

More Information

Your views on this note are welcomed. Feedback provided on this topic is held on Department of Water file number **18856**. To comment on this note or for more information, please contact our Water Source Protection Branch at our Atrium office in Perth. Phone: (08) 6364 7600 (business hours); fax: 6364 6525 or contact us via *E-mail Drinking Water* at our Internet site: <http://drinkingwater.water.wa.gov.au>, citing the topic and version.

This note will be updated periodically as new information is received or industry/activity standards change. Updates are placed on our Internet site <http://drinkingwater.water.wa.gov.au>, select *Publications> Water Quality Protection Notes*.

For our regional office contact details, visit our Internet site at www.water.wa.gov.au, see listings under *Regional Information*, use the phone book or contact our Head Office (details overleaf).

The State Government in October 2005 announced the formation of the Department of Water. From January 2006 the Department of Water assumed primary responsibility for managing the State's water resources. Once the Department of Water is legally established, it will replace many of the functions of the present Water and Rivers Commission and operate in parallel (with separate powers) to the Department of Environment. The custodian and recommendations made in this note will then change to match the assigned responsibilities of the departments of Environment or Water.



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Appendices

Appendix A - References and further reading

1. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia, National Health and Medical Research Council and Natural Resource Management Ministerial Council publications
 - a. *National Water Quality Management Strategy* documents, see Internet site: www.deh.gov.au/water/quality/nwqms/.
 - b. *Australian Drinking Water Guidelines 2004*, see Internet site: www7.health.gov.au/nhmrc/publications/synopses/eh19syn.htm.
 - c. *Water Made Clear – A consumer guide to accompany the Australian Drinking Water Guidelines 2004*, see Internet site: www7.health.gov.au/nhmrc/publications/_files/eh33.pdf.
2. Department of Water (Western Australia) publications
 - a. Drinking Water Source Protection Plans
Published plans covering water supply schemes across Western Australia are available as PDF files via the Internet link provided below or by contacting the nearest Departmental office.
 - b. Water Quality Protection Notes
 - *Protecting Public Drinking Water Source Areas*
 - *Land use compatibility in Public Drinking Water Source Areas*
 - *Gazetted Public Drinking Water Source Areas*
 - *Private water supplies*Available at Internet site: <http://drinkingwater.water.wa.gov.au>, select *Publications*.
3. Department of the Premier and Cabinet, 2003,
The Western Australian State Sustainability Strategy, see Internet site: www.sustainability.dpc.wa.gov.au/docs/Strategy.htm.
4. Government of Western Australia,
State Water Quality Management Strategy, see Internet site: <http://drinkingwater.water.wa.gov.au>, select '*Publications*', '*Policies*'.
5. Hrudey, S.E. & E.J., 2004, *Safe Drinking Water – Lessons from Recent Outbreaks in Affluent Nations*, IWA Publishing, Cornwall, UK. Available for purchase from www.iwapublishing.com/template.cfm?name=isbn1843390426.
6. Select Committee on Metropolitan Development and Groundwater Supplies, 1994, *Report of the Select Committee on Metropolitan Development and Groundwater Supplies*.
7. Standing Committee on Ecologically Sustainable Development, 2000, *The Quality of Perth's Water Supply – 9th report*, available from www.parliament.wa.gov.au/parliament/commit.nsf/0/5C2474A038D3E281482569A10017EDAB?opendocument.

8. Water Corporation *Securing our Water Future: A State Water Strategy for Western Australia*, available from www.watercorporation.com.au/Docs/State_Water_Strategy_complete.pdf.
9. Western Australian Planning Commission
- a. Statement of Planning Policies
- SPP 2.2 *Gnangara Groundwater Protection*
 - SPP 2.3 *Jandakot Groundwater Protection Policy*
 - SPP 2.7 *Public Drinking Water Source Policy*
 - SPP 2.9 *Draft Water Resources*
 - SPP 3.2 *Planning for Aboriginal Communities*
- Available from Internet site:
www.wapc.wa.gov.au/Publications/Statements+of+planning+policy/default.aspx.
- b. Land Use and Water Management Strategies
- Jandakot Land Use and Water Management Strategy
 - Gnangara Land Use and Water Management Strategy
 - Middle Helena Catchment Area Land Use and Water Management Strategy
 - East Wanneroo Land Use and Water Management Strategy
- Available from www.wapc.wa.gov.au/Publications/default.aspx.

Appendix B - Statutory requirements and approvals relevant to this note include:

What is regulated	Statute	Regulatory agency
Development approval for land use activities Town Planning Schemes (incorporating SPPs)	<i>Town Planning and Development Act 1928</i>	Local government authority
Impact on the values and ecology of the environment including waters	<i>Environmental Protection Act, 1986</i> Parts III and IV	Minister for the Environment advised by the Environmental Protection Authority
Licensing, works approvals and registration of prescribed premises; pollution abatement	<i>Environmental Protection Act 1986</i> Parts V and VI	Department of Environment
Management of Western Australia's water resources	<i>Water and Rivers Commission Act 1995</i>	Department of Water
Licence to use surface water and groundwater from declared areas and all artesian bores	<i>Rights in Water and Irrigation Act 1914</i>	
Development and operations in Public Drinking Water Source Areas	<i>Metropolitan Water Supply, Sewerage and Drainage Act 1909</i> <i>Country Areas Water Supply Act 1947</i>	
Safety of community water supplies	<i>Health Act 1911</i>	Department of Health – Environmental Health
		Local government authority
Licensing and monitoring water service providers	<i>Water Services Licensing Act 1995</i>	Economic Regulation Authority – Water Division

Appendix C - Development proposals near sensitive water resources

Where facilities are to be constructed or upgraded near sensitive waters, including PDWSAs, Waterways Management Areas, the Swan River Trust Area or within 500 metres of any conservation category wetland, proponents should supply a notice of intent to the Department, including the following details:

1. Site owner or operating tenant's contact name and address details.
2. A site plan showing the location of the facility.
3. Description of the activities that will be carried out.
4. Description of materials/chemicals stored or handled on site.
5. Description of the types and quantities of waste that will be generated at the facility.
6. Proposals for chemical containment, waste management and disposal (with design sketches).
7. Details of any contingency measures to minimise the impacts of chemical spills, and disposal of contaminated waters from fire, flood or other emergency.