GNANGARA UNDERGROUND WATER POLLUTION CONTROL AREA DRINKING WATER SOURCE PROTECTION REVIEW

INTEGRATED WATER SUPPLY SCHEME

WATER CORPORATION

2007

Acknowledgements

This REVIEW was prepared by the Infrastructure Planning Branch of the Water Corporation at the request of the Department of Water.

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Cover Photograph: Pinjar wellfield in State Forest (taken by David Boyd)

Purpose of this Review

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 a review of the risks to water quality in Gnangara 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 a review of risks and prepare this review document because it is the licensed water service provider for the Integrated Water Supply Scheme, which includes supply from the Gnangara 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. The initial assessment of the Gnangara Underground Water Pollution Control Area was completed in 2001 with the release of the Gnangara Land Use and Water Management Strategy.

With the completion of this review, 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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1 Water supply system overview

The revised Gnangara Underground Water Pollution Control Area (UWPCA – also referred to as the Control Area) is located between about 10 km and 70 km north of Perth. It stretches from the northern suburbs of the Perth Metropolitan Region of Western Australia to the adjacent rural Shires of Gingin and Chittering (refer to Figure 1). The Gnangara UWPCA defines the central area of the Gnangara groundwater system that provides public water supply as part of the Integrated Water Supply Scheme (IWSS). The revised Control Area incorporates parts of the existing Gnangara, Wanneroo and Mirrabooka UWPCAs.

Gnangara UWPCA has an area of nearly 815 km^2 and is located within the Cities of Wanneroo, Swan and Stirling, and the Shires of Gingin and Chittering.

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 Gnangara groundwater system comprises four wellfields, Mirrabooka, Wanneroo, Pinjar and Lexia and one independent artesian well (refer to Figure 2).

Mirrabooka wellfield was commissioned in 1971. Stage 2 (East Mirrabooka extension) was completed in 1989. The wellfield was added to in 2002 when the West Mirrabooka extension was commissioned as part of the IWSS drought relief program. The West Mirrabooka bores are located outside the UWPCA boundary. Mirrabooka wellfield currently consists of 38 production bores that draw water from the locally recharged shallow superficial formations aquifer, 6 production bores that draw water from the Mirrabooka aquifer and 5 production bores drilled into the underlying confined Leederville aquifer. Raw water is transferred via collector mains to Mirrabooka Groundwater Treatment Plant (GWTP) and then pumped to a service reservoir for distribution in the IWSS (Gordon, In prep).

Wanneroo wellfield was commissioned in 1976 and extended in 1986. Pinjar wellfield Stage 1 was commissioned in 1989. Stage 2, Part 1 was completed in 1991. The Wanneroo/Pinjar wellfield currently consists of 35 production bores that draw water from the locally recharged shallow superficial formations aquifer, 10 production bores drilled into the underlying confined Leederville aquifer and 4 production bores that draw water from the deeper confined Yarragadee aquifer. Raw water is transferred via collector mains to Wanneroo GWTP and then pumped to a service reservoir for distribution in the IWSS (Gordon, In prep).

Lexia wellfield was commissioned in 2001. The wellfield currently consists of 14 production bores that draw water from the locally recharged shallow superficial formations aquifer and 1 production bore drilled into the semi-confined Mirrabooka aquifer. Raw water is transferred via collector mains to the Lexia GWTP and then pumped to a service reservoir for distribution in the IWSS (Gordon, In prep).

Independent artesian well M2 was commissioned in 1976 and draws water from the deep confined Yarragadee aquifer. Raw water is transferred via collector mains from M2 to Mirrabooka GWTP and then pumped to service reservoirs for distribution in the IWSS (Gordon, In prep).

1.2 Water treatment

Raw water from the Gnangara groundwater system is aerated, clarified, filtered, dosed with alum, polyelectrolyte and calcium hydroxide, chlorinated and fluoridated at the Wanneroo, Mirrabooka and Lexia Groundwater Treatment Plants. Additional treatment with MIEX resin occurs for about 2/3 of the raw water at Wanneroo treatment plant prior to clarification.

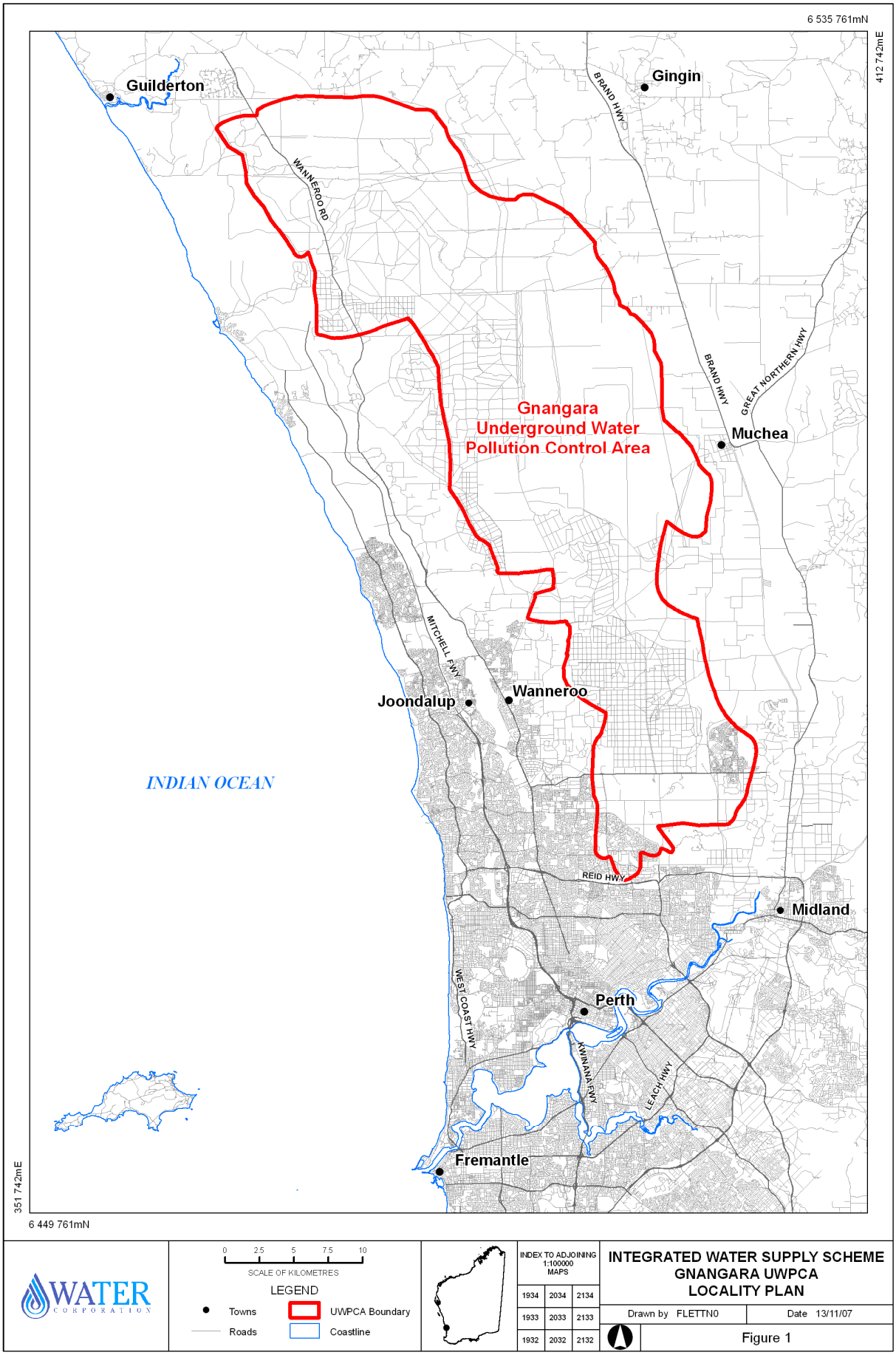

Figure 1 Gnangara UWPCA Locality Plan

1.3 Catchment details

1.3.1 Physiography

The physiography of the Gnangara UWPCA is dominated by the coastal dunes of the Swan Coastal Plain (Davidson, 1995). The area is characterised by the gently undulating quartz sand plains of the Bassendean Dune System, which range from 20 to 120 m AHD in elevation. The western margin of the UWPCA consists of calcareous sand remnants of the Spearwood Dune System. Wetlands occupy the interdunal swales of the Bassendean Dune System and the interbarrier depressions between the Spearwood and Bassendean Dune Systems and comprise swamp and lacustrine deposits of peat, peaty clay and clay.

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 along the western margin of the Control Area on the Spearwood dune system. State Forest and uncleared Public Purpose reservations cover over 80% of the UWPCA (about 680 km^2) of which about 200 km^2 has been planted with pines and the rest is natural bushland (WAPC, 2001). There are also large plots of remnant vegetation preserved in Parks and Recreation reservations. Less than 15% of the UWPCA has been cleared of native vegetation and developed for urban and rural land use activities.

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 Gnangara 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 Pinjar bores 90 and 97 – in State Forest north of Lake Pinjar

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 Bassendean Sands and Tamala Limestone, which are partially underlain by the Coolyena Group of sediments and the Leederville Formation, then partially by the South Perth Shale, Gage and Parmelia Formations, then Yarragadee Formation and Cattamarra Coal Measures.

The Gnangara 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. Ephemeral streams may provide additional recharge in the northern part of the mound. The aquifer varies in saturated thickness from about 50 metres in the northern part of the Control Area to about 70 metres in the south.

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. Groundwater in the aquifer flows south easterly to south westerly from the recharge area, discharging upwards into the superficial formations and laterally into the Kings Park Formation, located south west of the Control Area. The top of the aquifer lies at depths of 50 to 150 metres within the UWPCA and it has a maximum thickness of about 150 metres.

The Leederville aquifer is a major confined, multi layered groundwater flow system comprising interbedded sandstones, siltstones and shales that underlies the entire Control Area. It is recharged by downward leakage from the superficial aquifer where the Leederville Formation subcrops beneath the superficial formations, which occurs over the major part of the northern section of the mound and north western area of the southern section of the mound. Recharge also occurs through upward discharge from the Yarragadee aquifer where the South Perth Shale is absent. Groundwater in the aquifer flows westerly to the Indian Ocean, discharging downwards into the Yarragadee Aquifer, upwards into the superficial aquifer west of the Control Area and offshore on the ocean floor. The top of the aquifer lies at depths of 50 to 150 metres within the UWPCA and it has a maximum thickness of about 400 metres.

The Yarragadee aquifer is a major confined, multi layered groundwater system comprising interbedded sandstones, siltstones and shales within the Yarragadee and Parmelia Formations that underlies the entire Control Area. It is recharged by downward leakage from the Leederville aquifer where the South Perth Shale is absent, which mainly occurs in the north eastern area of the Gnangara Mound. 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 in the western part of the UWPCA. The top of the aquifer lies at depths of 150 to 900 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 81 490 Megalitres is considered to be the nominal sustainable yield for the currently developed wellfields within the Gnangara UWPCA.

The Gnangara 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 Integrated Water Supply Scheme 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 Gnangara groundwater system is not likely to occur before 2020.

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

Mirrabooka, Wanneroo and Gnangara Underground Water Pollution Control Areas were proclaimed in 1973, 1975 and 1990, respectively under the *Metropolitan Water Supply Sewerage and Drainage (MWSSD) Act 1909* to protect the public drinking water source in the central area of the Gnangara Mound. Mirrabooka UWPCA was extended in 1978 to include East Mirrabooka groundwater system and reproclaimed in 1981.

Wanneroo and Gnangara UWPCAs were originally proclaimed as Water Reserves under the *MWSSD Act* in 1970 and 1973, respectively. Wanneroo Water Reserve was de-proclaimed in 1981 and incorporated into the amended Gnangara Water Reserve, which was extended to cover the area delineated by the Mirrabooka UWPCA.

The UWPCAs were amended in March 2007 to align with the revised boundary set out in the Gnangara Land Use and Water Management Strategy (WAPC, 2001). The new area formed by the amendment was proclaimed as the Gnangara UWPCA. It replaces the existing Gnangara, Wanneroo and Mirrabooka 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)
- Gnangara Land Use and Water Management Strategy (WAPC, 2001)
- Review of Groundwater Protection Priority Area Boundaries Gnangara Mound (Dames & Moore, 1996)
- Gnangara Groundwater Protection - Statement of Planning Policy No.2.2 (WAPC, 2005a)
- Metropolitan Region Scheme Amendment 1036/33 (WAPC, 2005b)

The UWPCA boundaries were redefined using internationally accredited groundwater modelling software. Priority classifications of Priority 1 (P1), Priority 2 (P2) and Priority 3 (P3) were then assigned to land within the newly defined Control Area, as per the recommendations of the Gnangara Land Use and Water Management Strategy. The strategy provided a policy framework for promoting development consistent with protection and management of the groundwater system and key environmental values for the Gnangara Mound. A groundwater protection policy was then produced to set out the principles for ensuring land use changes would be compatible with the long-term protection of groundwater used for public drinking water supplies. At the completion of an extensive stakeholder and community consultation process the policy was adopted and the Metropolitan Region Scheme (MRS) was amended to add Water Catchments reservations

over P1 areas and to apply Rural – Water Protection zone to P2 water source protection areas within the UWPCA.

The UWPCA is shown in Figure 2. It is divided into planning precincts that reflect the land planning zones in the five local government areas within the UWPCA. However, the UWPCA does not protect the West Mirrabooka extension, which was constructed after the strategy was published. The UWPCA boundary may need to be further modified to incorporate the recharge area for the West Mirrabooka bores.

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.

Wanneroo Groundwater Area (GWA) was proclaimed in 1982 under the *Rights in Water and Irrigation Act 1914* to allocate groundwater resources and to manage sustainable use in the Wanneroo area of the Gnangara Mound. It was amended in 1986 and again in 1994. Mirrabooka and Gnangara Groundwater Areas were 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 81 490 Megalitres (ML)/year from the Mirrabooka, Wanneroo, Pinjar and Lexia wellfields of the Gnangara groundwater system, as part of the public drinking water supply for the IWSS. The allocation is made up of 40 550 ML/year from the superficial formation aquifer, 1 950 ML/year from the Mirrabooka aquifer, 22 840 ML/year from the Leederville aquifer and 16 150 ML/year from the Yarragadee aquifer. The nominal allocation for the independent artesian bore within the Control Area is 1 750 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 Gnangara groundwater system (including the independent artesian bore) was 60 610 ML and annual production was just over 61 150 ML.

2 Water quality

The quality of raw water from the Gnangara 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 Gnangara groundwater system supplies water to three groundwater treatment plants prior to distribution to the IWSS. Mirrabooka Groundwater Treatment Plant (GWTP) receives water from Mirrabooka wellfield, Wanneroo GWTP receives water from Wanneroo and Pinjar wellfields and Lexia GWTP receives water from Lexia wellfield.

Raw water from Mirrabooka wellfield has consistently been of good quality, and with the exception of iron, colour, pH, turbidity, and aluminium in the superficial aquifer only, has generally met ADWG values. Monitoring results indicate observed values are within the naturally occurring range for this locality and no trends are evident. Nitrates in some of the West Mirrabooka extension bores, which are located outside the UWPCA, although well below the ADWG guideline value, are above what is considered naturally occurring levels. These bores are sited in or adjacent to community parks and ovals, and fertiliser use on these grassed areas may be a possible source of nitrate. All other bores have very low levels of nitrate.

There have been no positive thermotolerant coliform counts at the Mirrabooka GWTP raw water sampling points. This is consistent with analysis of samples taken from the bores and indicates there has been no pathogen contamination of the water supply bores.

Mirrabooka wellfield salinity can be variable and is dependant upon the proportion of supply being drawn from the superficial, Mirrabooka and Leederville aquifer bores. Average salinity from the superficial aquifer and Mirrabooka aquifer is under 300 mg/L Total Dissolved Solids (TDS), but is closer to 500 mg/L from the Leederville aquifer. In recent years, about 40% of the supply has come from Leederville aquifer, resulting in an average salinity of just under 400 mg/L at the Mirrabooka raw water sampling point, which is below the ADWG value of 500 mg/L.

All other chemical components are generally within guideline values. Very low levels of barium and born occur naturally but well below the ADWG guideline value. The elevated levels of iron, colour, and turbidity observed in the wellfield, as well as aluminium and low pH within the superficial aquifer, relate to natural occurrence and are not a result of land use impacts.

Raw water from Wanneroo and Pinjar wellfields have consistently been of good quality, and with the exception of iron, colour and turbidity, has generally met ADWG values. Groundwater in the superficial aquifer has elevated aluminium and low pH, but the blended wellfield supply, which includes groundwater from the Leederville and Yarragadee aquifers, is within guideline values for these parameters. Sodium and chloride in Wanneroo Leederville aquifer bore W25 and Yarragadee aquifer bore W57 exceed the ADWG guideline values and can result in elevated salinity levels in the blended water delivered to the Wanneroo GWTP. Wanneroo Leederville aquifer bores W25 and W55 also have slightly elevated manganese. Despite these exceedances, 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 and very low levels of nitrate at the Wanneroo Groundwater Treatment Plant 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.

Pinjar wellfield salinity is relatively consistent at around 200 mg/L TDS. Wanneroo wellfield salinity can be variable depending upon the proportion of supply being drawn from individual bores. Salinity in the majority of bores is less than 300 mg/L TDS, but can be over 500 mg/L in Wanneroo W25 and well over 1 000 mg/L in Wanneroo W57. In recent years, almost 15% of the supply has come from bore W57, resulting in an average salinity of about 600 mg/L in the raw water delivered to the Wanneroo GWTP, which is above the ADWG value of 500 mg/L.

All other chemical components from both wellfields are generally within guideline values. Very low levels of barium and boron occur naturally but well below the ADWG guideline value. The elevated levels of iron, colour, turbidity, aluminium and salinity observed in the wellfields, as well as low pH within the superficial aquifer, relate to natural occurrence and are not a result of land use impacts.

Raw water from Lexia wellfield has consistently been of good quality, and with the exception of iron, colour, pH, aluminium and turbidity, 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 two positive thermotolerant coliform counts at the Lexia GWTP raw water sampling point. All other readings were zero, consistent with analysis of samples taken from the bores, and together with very low levels of nitrate recorded, indicates there has been no pathogen or nutrient contamination of the water supply bores.

Lexia wellfield salinity is relatively consistent and rarely exceeds 300 mg/L TDS.

All other chemical components are generally within guideline values. Very low levels of barium occur naturally but well below the ADWG guideline value. The elevated levels of iron, colour, aluminium and turbidity observed in the wellfield, as well as low pH in some of the bores, relate to natural occurrence and are not a result of land use impacts.

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

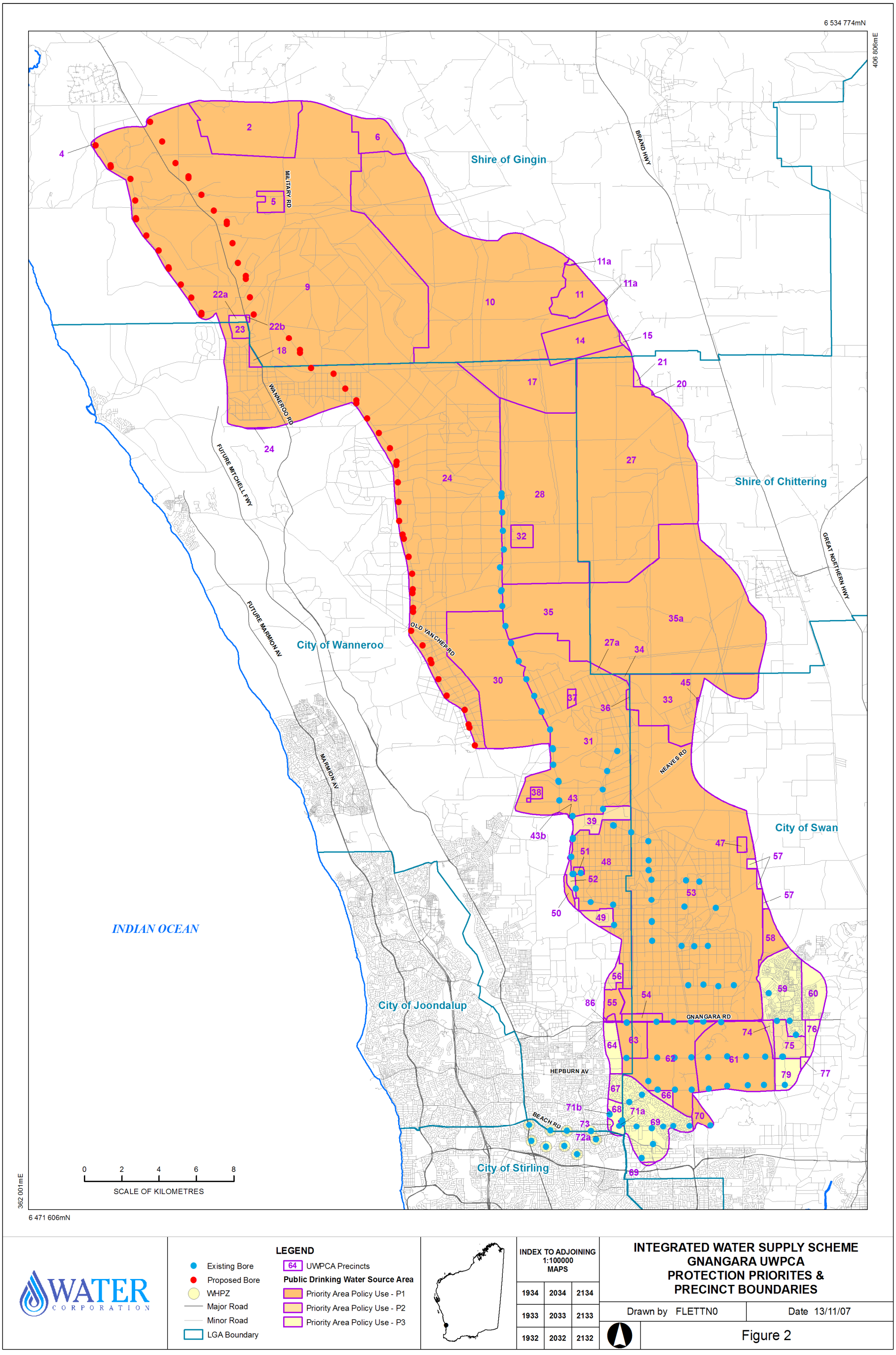

Figure 2 Gnangara UWPCA protection priority and precinct boundaries

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.

Potentially hazardous land uses and activities are shown in Figure 3 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. All the information was brought together into a single 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

Gnangara UWPCA covers four land planning zones within five local government agency boundaries. It also includes Crown Land reserves for Parks and Recreation, Public Purposes and State Forests, which are overlain with the Water Catchments reservation, which correlate with the Priority 1 (P1) source protection areas of the UWPCA.

The greater part of the land within the UWPCA is in Government ownership (about 87%), the majority of which is reserved as State Forest.

Industrial and Urban zoned land makes up just over 3% of the Control Area and is confined to the south western and south eastern margins of the UWPCA. The remaining 10% comprises privately owned Rural and Rural-Water Protection zoned 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 Industrial land

The Industrial zone covers a small area (less than 0.5% of the UWPCA) in the south western corner of the Control Area. The zone is located within a Priority 3 (P3) source protection area. There are a large number of general industry operations, light industrial businesses and service industries within the zone, 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. Garden supply businesses pose an additional risk of nutrient contamination from storage of fertilisers. Many sites have inadequate fuel and chemical storage facilities and insufficient containment of leachate in stormwater run-off.

Photo. 2 Commercial units – Malaga Industrial Area
Industrial Zone Precinct 69

Photo. 3 Waste depot – Malaga Industrial Area
Industrial Zone Precinct 69

Photo. 4 **Path Transit bus depot – Malaga Industrial Area**
Industrial Zone Precinct 69

Photo. 5 **Cement products manufacturing – Malaga Industrial Area**
Industrial Zone Precinct 69

Photo. 6 **Malaga Markets – Malaga Industrial Area**
Industrial Zone Precinct 69

There are several service stations within the Malaga industrial area that cater for the retail market and a number of commercial transport depots, which are considered high risks and rated high catchment management priorities because of potential leakage of fuel stored in underground tanks.

An industrial waste and two solid waste landfills are considered severe risks because of their potential to cause pathogen contamination. All three sites are rated high catchment management priorities.

Council managed parks within Malaga are potentially significant risks because of the application of pesticides and fertilisers and are rated medium catchment management priorities.

3.2.2 Urban land

About 3% of the UWPCA is zoned Urban, incorporating the suburbs of Alexander Heights, Ballajura and the eastern part of Landsdale in the south western corner of the Control Area and the residential subdivisions in Ellenbrook, Henley Brook and the future Albion townsite on the south eastern margin. The zone is located within a P3 source protection area.

Three retail fuel outlets in Ballajura and one in Ellenbrook are considered high catchment management priorities because they pose a high contamination threat through the possible leakage of fuel stored in underground tanks. One site in Ballajura underwent remediation several years ago after a hydrocarbon plume emanating from the site was detected in the groundwater.

The area of Landsdale previously zoned rural had a large number of intensive agricultural lots that posed a high risk to groundwater quality because of the potential for nutrient contamination from the use of fertilisers. Most of these operations are in the process of being redeveloped for urban housing. Historical uses included market gardens, plant and seed production nurseries, shadehouse plant nurseries, a citrus orchard and a vineyard. One nursery has also been a potential source of pathogen contamination because of inadequate storage of bulk manures. These old rural sites may still pose a risk to groundwater quality if rehabilitation has not been adequate to alleviate any residual contamination.

Existing land uses in the Albion townsite area include a poultry egg farm and a citrus orchard. The poultry egg farm poses a severe risk from potential pathogen contamination and the orchard poses a high threat to groundwater quality because of the use of fertilisers. Both these land uses are considered high catchment management priorities.

One lot in Landsdale and several lots in the Albion townsite area are used for stabling horses. Extensive stock grazing occurs on three lots in Albion. These activities are considered significant risks of potential pathogen and nutrient contamination and are rated medium catchment management priorities.

Potential overflows from the Water Corporation's sewerage pump station in Alexander Heights are considered a significant risk to groundwater quality and are rated a medium catchment management priority. There are numerous recreational parks and a number of artificial wetland reserves where fertiliser use may pose a significant risk. Application of fertiliser on the grounds of several primary schools and a college 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 a catering service in Ellenbrook, a hairdressing salon in Alexander Heights, and a warehouse and community swimming pool in Ballajura. An unsewered hotel/motel in the Albion townsite area presents a pathogen risk. These sites pose a significant risk and are rated medium catchment management priorities.

Residential properties within the urban subdivisions are sewered and are an acceptable land use in P3 areas, but there is significant potential for contamination from fertiliser use and spills of stored fuels and chemicals. Unsewered rural residences in Ellenbrook, Landsdale and the Albion townsite area are considered significant risks and will require sewering when subdivided. Overall, residential development is rated a medium catchment management priority.

Photo. 7 **Ellenbrook residential estate – adjacent to State Forest 65**
Urban Zone Precinct 59

Photo. 8 **Ellenbrook commercial centre**
Urban Zone Precinct 59

Photo. 9 **Pines retirement village - Ellenbrook**
Urban Zone Precinct 59

Photo. 10 Woodlake Park amphitheatre - Ellenbrook
Urban Zone Precinct 59

Photo. 11 Petrol Station - Ballajura
Urban Zone Precinct 69

Photo. 12 Ballajura Primary School
Urban Zone Precinct 69

Photo. 13 Abandoned Petrol Station – Gnangara Rd Special Rural P1 Area - Lexia
Rural Zone Precinct 54

Photo. 14 Market garden – Gnangara Rd Special Rural Area - Lexia
Rural Zone Precinct 54

3.2.3 Rural land

Rural land covers almost 9.5% of the Control Area. This includes the new Rural-Water Protection zone, which covers about 1% of the UWPCA.

Rural Priority 1

A large portion of the rural land, which is currently part of the Lake Pinjar Special Control Area and the Gnangara Road Special Rural Area, has been classified Priority 1 (P1) source protection as per the recommendations of the Gnangara Land Use and Water Management Strategy. Provision of public drinking water is considered to be the prime beneficial use of these areas and the long-term aim is to place the land in Government ownership in Parks and Recreation reservations.

Pathogens associated with faecal waste from two poultry farms in the Lake Pinjar Special Control Area present severe risks to groundwater quality. Two rural properties used for stock grazing pose a high risk because one lot next to Little Coogee Swamp was previously a piggery, and the other lot near Lake Pinjar includes stockpiles of manure. These land uses have all been rated high catchment management priorities.

Fertiliser application on several market gardens and two orchards provides a potential source of nutrient contamination and is considered a high risk and rated a high management priority.

A retail fuel outlet on Gnangara Road and adjacent tyre retailer have recently been closed down but the building shells remain. There is a possibility these sites may have remnant contamination, which may require investigation to determine if they continue to pose a threat to groundwater quality through possible past leakage of fuel and chemicals. Full rehabilitation of the sites by the owners is considered a high catchment management priority.
7
A number of land uses pose either major or significant risks to groundwater quality and are rated medium catchment management priorities. Several properties with stables and one lot used for stock grazing have the potential to cause pathogen and nutrient contamination from animal excreta. A number of industry-based activities pose a threat of pathogen, nutrient, hydrocarbon and chemical contamination. A drug treatment and rehabilitation centre on Gnangara Road is a potential source of pathogens and nutrients.

Several lots in the Gnangara Road Special Rural Area used for semi-rural living pose a significant threat due to the use of septic systems and fertilisers, and possible leakage of stored fuels and chemicals. One property in the Lake Pinjar Special Control Area includes a warehouse that has the potential to cause hydrocarbon and chemical contamination. These properties are all rated medium catchment management priorities.

Rural-Water Protection Priority 2

The Rural-Water Protection zone, which correlates with the Priority 2 (P2) source protection area, includes several market gardens, a number of orchards and a plant and seed production nursery that pose a high risk through the application of fertilisers and are rated high catchment management priorities.

A vacant property just north of Gnangara Lake, which has the abandoned structure of an ex-poultry farm, may still present a high risk of pathogen contamination from residual waste and is rated a high catchment management priority.

A large number of properties within the Neaves Road Hobby Farm subdivision and the Henley Brook Special Rural Area have stables. As well as the Pines Riding School and Agistment centre located on the western margin of the Control Area, there are two properties within the zone with intensive outdoor stock holdings and several lots with extensive stock grazing. These activities pose significant to major risks to groundwater quality because they have the potential to cause pathogen and nutrient contamination and are rated medium catchment management priorities.

Photo. 15 Western Power Ellenbrook substation – Whiteman - proposed Public Purpose Reservation Rural Zone Precinct 74

Photo. 16 Pasture and animal stabling – Lake Pinjar Special Control Area Rural Zone Precinct 30

Photo. 17 Poultry farm – Lake Pinjar Special Control Area
Rural Zone Precinct 30

Photo. 18 Ex-piggery waste disposal ponds – Lake Pinjar Special Control Area
Parks and Recreation Reservation Precinct 30

Many of the lots within the zone are used for rural, semi-rural and special rural living. They present a significant threat because of fertiliser use and possible leakage of stored fuels and chemicals and are rated a medium management priority. There is increasing pressure to subdivide these rural properties into the minimum lot size of 2 ha. This level of intensification is a conditional land use in Priority 2 (P2) areas and land planning agencies are required to ensure future development does not increase risk of pollution to groundwater in accordance with the principal of risk minimisation that applies to P2 areas.

Lorian and Vintage Parks are community parks where fertiliser use may pose a significant risk. These parks are rated medium catchment management priorities.

The power generation plant for Ellenbrook poses a major risk of contamination from leakage of stored fuels. Potential overflows from the subdivision's sewerage pump station is considered a significant risk. Both infrastructure sites are rated medium catchment management priorities.

Rural Priority 3

Part of Henley Brook Special Rural Area on the south eastern margin of the UWPCA and small portions of a number of rural lots that straddle the UWPCA boundary are proposed have been proclaimed as Priority 3 (P3) source protection areas.

A market garden and citrus orchard within Henley Brook Special Rural Area and a market garden in Warbrook Road, Bullsbrook pose a high risk to groundwater quality because of the potential for nutrient contamination from the use of fertilisers. These activities are rated a high catchment management priority and preference is for them to be replaced by lower risk land uses.

A large number of lots in the Henley Brook Special Rural Area and a lot in Warbrook Road, Bullsbrook are used for stabling horses. Extensive stock grazing occurs on four lots in Henley Brook and a lot in Neaves Road, Mariginiup. These activities pose a significant risk because they have the potential to cause pathogen and nutrient contamination and are rated medium catchment management priorities.

Rural housing in Henley Brook present a significant threat because of fertiliser use and possible leakage of stored fuels and are rated a medium catchment management priority.

3.2.4 Parks and Recreation

Parks and Recreation reserved land, which has a P1 source protection area classification, covers about 3.5% of the UWPCA and. Whiteman Park, Vacant Crown Land in the Lake Pinjar Special Control Area, Lake Jandabup, Gnangara Lake and Lexia Wetland form the largest parcels of land reserved under Parks and Recreation. With the exception of Whiteman Park, it is proposed to incorporate these nature reserves along with the majority of the land in Crown ownership (including the State Forests) within the UWPCA into a conservation park to be known as Gnangara Park (see Section 3.2.7).

A piggery within the Lake Pinjar Special Control Area, which presented a high risk to groundwater quality, was recently purchased by Government. Infrastructure on the site has been dismantled and the land reserved for Parks and Recreation, but pathogen contamination from residual waste may still be an issue. Full rehabilitation of the site is considered a high catchment management priority.

Whiteman Park includes a major equestrian centre and the Western Australian International Shooting Complex that both have potential to cause pathogen and nutrient contamination. These facilities are pre-existing non-conforming land uses in a Priority 1 (P1) area that would be incompatible under current policy. The sites are considered significant risks and are rated medium catchment management priorities.

Current activities associated with the other Parks and Recreation sites pose little risk to groundwater quality.

Photo. 19 WA International Shooting Complex - Whiteman
Parks and Recreation Reservation Precinct 61

Photo. 20 Lake Jandabup - Jandabup
Parks and Recreation reservation Precinct 50

Photo. 21 Western Power Pinjar Power Station - Pinjar
Public Purpose Reservation Precinct 32

3.2.5 Public Purposes

Public Purpose reservation has a P1 source protection area classification and covers just over 11.5% of the UWPCA, the majority of which incorporates the Royal Australian Air Force (RAAF) air weapons range. The Wanneroo Shooting Complex, located in the southern part of the range, poses a significant threat to groundwater quality because of potential contamination from pathogens, nutrients and hydrocarbons. The complex includes unsewered buildings used for functions and accommodation during competition events. Diesel is also stored onsite for power generation. The complex is rated a medium catchment management priority and Department of Water has developed a best management practice plan in consultation with the ten clubs that use the site (Taylor, 1999). The remainder of the weapons range mostly comprises uncleared bushland where little activity occurs, is considered a low risk, and rated a low management priority. It is planned to incorporate the part of the range located within the UWPCA into the proposed Gnangara Park.

RAAF also has the Gingin Airfield on the north eastern margin of the UWPCA, which is considered to pose a significant risk from potential fuel spills. The base is rated a medium catchment management priority.

Other Public Purpose land uses includes the Pinjar and Malaga Power Stations, Telstra Perth International Telecommunications Centre, Ballajura Community College and Water Corporation sewerage pump stations and groundwater treatment plants. The power station sites pose a major risk of contamination from leakage of stored fuels. The other infrastructures present a significant threat to groundwater quality. Risks include possible fuel spills at the Telstra site, pathogens and nutrients from potential overflows at the sewerage pump stations, chemical spills at the groundwater treatment plants, and nutrients from the use of fertilisers on grassed areas at the college. These land uses are all rated medium catchment management priorities.

3.2.6 State Forests

State Forest No. 65 makes up about 72% of the UWPCA, covering the majority of the land within the Control Area north of Gnangara Road. The State Forest has a P1 source protection area classification and includes large areas of native forest and pine plantation, which are harvested by the Forest Products Commission for timber production. It also includes nature reserves, which are retained for their conservation value. These land uses pose a moderate level of risk and are rated low catchment management priorities.

The ex-Gnangara Liquid Waste Disposal site, north of Gnangara Road just west of Ellenbrook is a registered Department of Environment and Conservation (DEC) contaminated site and avoidance of the pollution plume is rated a high catchment management priority.

There are a number of sand quarries located within the State Forest and a designated recreational motorcycle area in Lexia, just north of Gnangara Road, which are considered to pose significant risks because of the potential for fuel spills. These activities are rated medium catchment management priorities.

The Water Corporation's Lexia Groundwater Treatment Plant, in the south eastern corner of the State Forest, poses a significant risk from potential chemical spills and is rated a medium catchment management priority.

It is planned to incorporate State Forest No. 65 into the proposed Gnangara Park. The Department of Environment and Conservation (DEC) intends to replace areas of the State Forest currently under pine plantation with conservation and recreation areas. DEC's preferred option is to rehabilitate the plantation back to native woodland. Controlled harvesting of the native forest will continue to occur within the proposed park. Final land use will be guided by the State Government Gnangara Sustainable Strategy.

3.2.7 Formed roads

There is an extensive network of formed roads throughout the Control Area and their use 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.

Photo. 22 Ballajura Community College - Ballajura
Public Purpose Reservation Precinct 69

Photo. 23 Western Power substation - Malaga
Public Purpose Reservation Precinct 69

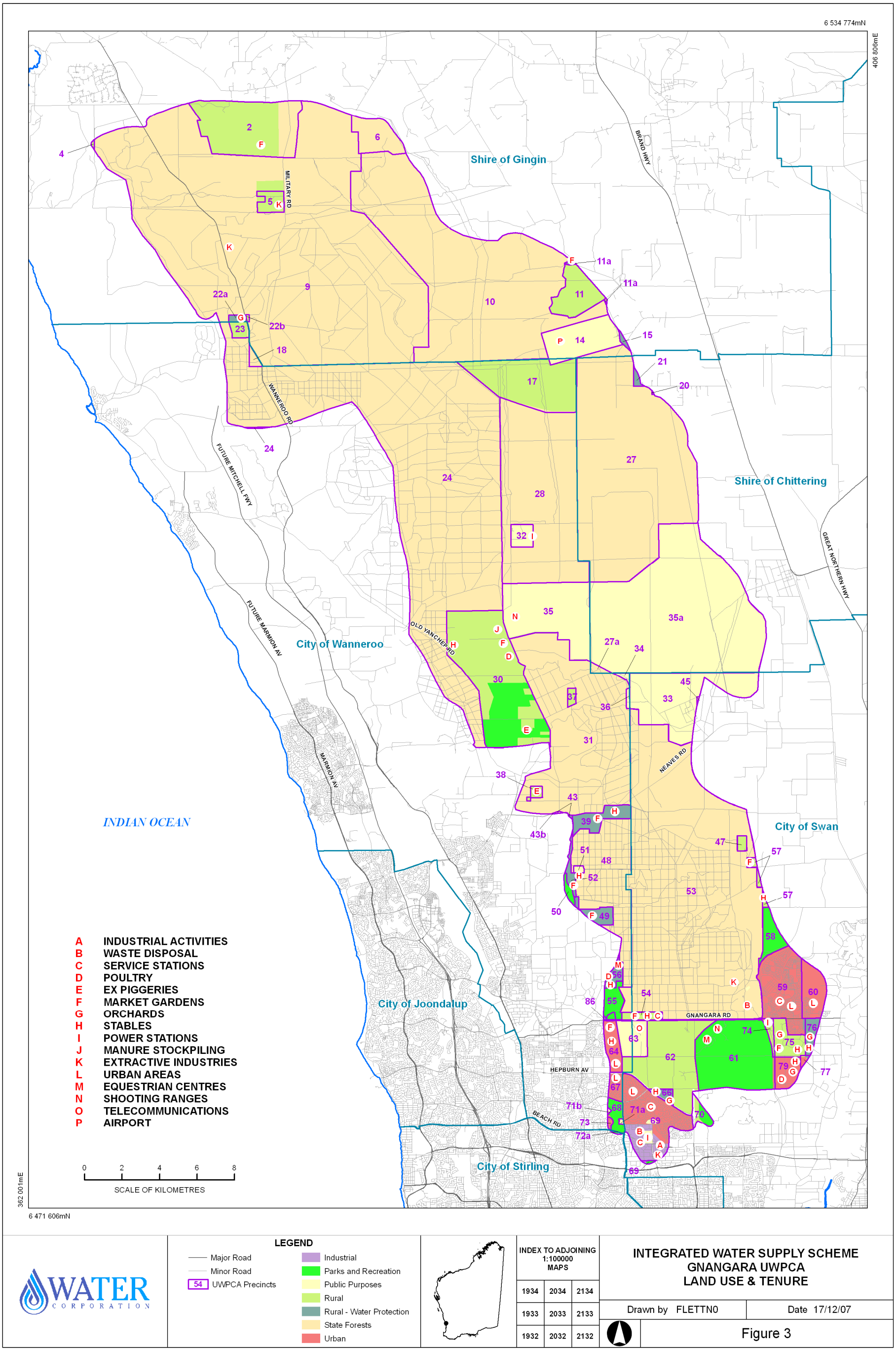

Figure 3 Land use and tenure

Photo. 24 **State Forest 65**
State Forests Reservation Precinct 24

Photo. 25 **Boundary of UWPCA near Little Coogee Swamp - State Forest 65 - Pinjar**
State Forests Reservation Precinct 31

Table 1 Drinking Water Quality Risk Assessment

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Industrial					
Landfill Class I Precinct 69	General waste	Pathogens Nutrients Chemicals	2 solid waste landfill sites Conditional land use in P3 area	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High
Landfill Class IV & V Precinct 69	Industrial waste	Pathogens Nutrients Chemicals	1 industrial waste site in Malaga Incompatible land use - Assess for relocation or closure	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High
Service station Public transport Transport & taxis Precinct 69	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land use in P3 area - 1 lot in WHPZ for bore M35 6 retail fuel outlets in Malaga Path Transit bus depot in Malaga – has inadequate storage of fuels Service stations associated with motor freight and vehicle transport 1 site associated with taxi services	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	High
Industry Extractive Precinct 69	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land use in P3 area Conditions on storage of fuels and chemicals Criteria for excavation depth and site rehabilitation Underground storage tanks prohibited 3 sites in Malaga – 1 site has inadequate storage of fuels	Water quality monitoring DoW Sand Mining policy/guidelines Well regulated industry GLUWMS, SPP 2.2, MWSSD bylaws Land Planning controls	Medium
Industry Food processing Precinct 69	Chemical spills	Chemicals	Numerous food processing businesses in Malaga industrial area Wide range of food products Conditional land uses in P3 area Some sites in WHPZ for bores M20 & M35, most sites not in WHPZ	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Industry - General Ceramic Precinct 69	Fuel and chemical spills	Hydrocarbons Chemicals	Ceramic products businesses in Malaga industrial area Incompatible land use in P3 area A number of sites have inadequate chemical storage facilities	Water quality monitoring Sewered GLUWMS & SPP 2.2 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 Dye works, Labs Precinct 69	Fuel and chemical spills	Hydrocarbons Chemicals	Several chemical manufacturing businesses, chemical laboratories, cleaning products, drycleaners, screen printers, french polishing and candle manufacturing in Malaga industrial area Inadequate storage of fuels and chemicals a common problem Conditional land uses in P3 area partly in WHPZ for bores M20, M35	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Industry - General Concrete, bricks, clay manufacture Precinct 69	Fuel and chemical spills	Hydrocarbons Chemicals	2 cement works, 1 brick, 5 concrete products, 1 clay, 2 stone manufacturing businesses in Malaga industrial area Conditional land uses in P3 area - 1 site in WHPZ for bore M35 1 site has inadequate fuel storage facilities	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Industry - General Metal production & finishing Petroleum & coal products Precinct 69	Fuel and chemical spills	Hydrocarbons Chemicals	Metal production and associated businesses Malaga industrial area Including sheet metal, housing metal and glass products, metal and steel fabricators, iron and steel forging, hand and cutting tools, mining and industrial machinery manufacturing, glass wool products, metal coating fabricators, cutlery, petroleum and coal products, transport and motor vehicle body, clutch, brake and nuts makers Inadequate storage of fuels and chemicals a common problem Incompatible land uses in P3 - some sites in WHPZ for bore M20	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Industry - General Pesticide operation Precinct 69	Fuel and chemical spills Pesticide storage	Hydrocarbons Chemicals Pesticide	Pest control services in Malaga industrial area (5 sites) Incompatible land use in P3 area 1 site in WHPZ for bore M20, 1 site in WHPZ for bore M35	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Industry - Light Precinct 69	Fuel and chemical spills	Hydrocarbons Chemicals	Numerous light industries in Malaga industrial area including: bookbinding, clothing, curtains, footwear, furniture, mattresses, floor coverings, household appliances, general materials, jewellery, medical & dental equipment, manufactured products (brooms, canvas, electronic, plastic, rubber), printing, pumps, signs, sporting equipment Some sites include offices, showroom factories and storage yards Inadequate storage of fuels and chemicals a common problem 1 plastic products manufacturer has inadequate treatment of waste Conditional land uses P3 area partly in WHPZ bores M20, M34, M35	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Industry - Mining Precinct 69	Fuel and chemical spills	Hydrocarbons Chemicals	Mining company premises in Malaga industrial area 1 industrial minerals, 1 oil Conditional land uses in P3 area	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Industry - Rural Farm supply & forest products processing Precinct 69	Fertiliser use Fuel and chemical spills	Nutrients Hydrocarbons Chemicals	Several wood, cardboard and paper products manufacturing, and one farm supply centre in Malaga industrial area Conditional land uses in P3 area	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Industry - Service Precinct 69	Fuel and chemical spills Manures	Hydrocarbons Chemicals Pathogens Nutrients	Numerous service industries in Malaga industrial area including: Beauty, weight watching, hairdressing, personal and pet services Building construction, contracting, trade and painting services Catering, cleaning, laundry services Detective and security services Earth moving, freight, removalist, packing and water drilling services Film, video production and photographic services Pool construction, fencing, garden, handyman and repair services 1 garden supply site has inadequate hardstand for manures Conditional land uses P3 area partly in WHPZ bores M20, M34, M35	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Motor vehicle repair Precinct 69	Fuel and chemical spills	Hydrocarbons Chemicals	Numerous motor vehicle repair businesses in Malaga including: Mechanical repairs, panel beating and spray painting services Machinery hire, car washes, motor cycle and lawn mowing repairs Inadequate storage of fuels and chemicals a common problem Conditional land uses P3 area partly in WHPZ bores M20, M34, M35	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Warehouse Precinct 69	Fuel and chemical spills Manures Pesticide storage	Hydrocarbons Chemicals Pathogens Nutrients Pesticides	Numerous warehouses in Malaga industrial area including chemicals, clothing, cold storage, construction materials, dairy products, electrical, floor coverings, garden products, groceries, hardware, machinery supplies, paint, paper, pharmaceuticals, poultry, meat, seafood, textiles, toiletries – also self storage units 1 garden products supplier has inadequate containment of leachate Conditional land uses P3 area partly in WHPZ bores M20, M34, M35	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Car parks Precinct 69	Fuel and chemical spills	Hydrocarbons Chemicals	Open air car park - Malaga Acceptable land use in P3 area in WHPZ for bore M35	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
Community purposes - Recreation parks Precinct 69	Human activity & litter Fertiliser use Pesticide use Animal excreta Fuel and chemical spills	Pathogens Nutrients Pesticides Pathogens Nutrients Hydrocarbons Chemicals	Community reserves in Malaga managed by City of Swan Conditional land use in P3 area Conditions on application of fertiliser and pesticide Partly in WHPZ for bores M20 & M30	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Urban					
Agriculture - intensive Market gardens Orchards, nurseries Precincts	Fertiliser and manure use Pesticide use Fuel and chemical spills	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	Conditional land use in P3 area Will require sewering when developed as an urban subdivision	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High
64			Previously Landsdale rural subdivision now zoned urban 14 lots mixed horticulture, 1 citrus orchard, 1 vineyard 6 plant seed production nurseries, 2 shadehouse plant nurseries 1 lot with inadequate storage of bulk manures is being dismantled 3 lots in WHPZ for bore M200, rest not in WHPZ		
79			Part of Albion townsite area - 1 lot currently used as a citrus orchard		
Animal husbandry Intensive - Poultry Precinct 79	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Part of Albion townsite area 1 lot currently used for poultry egg farming Conditional land use in P3 area Will require sewering when developed as an urban subdivision	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Service station Precincts	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land use in P3 area	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	High
59			Caltex petrol station - The Promenade, Ellenbrook		
69			3 retail fuel outlets in Ballajura 1 site contaminated and rehabilitated		
Agriculture - extensive Stock grazing Precinct 79	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Part of future Albion townsite area 3 lots currently used for cattle grazing Acceptable land use in P3 area with 2 lots in WHPZ for bore M182 Will require sewering when developed as an urban subdivision	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
Animal establishment Stables Precincts	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Acceptable land use in P3 area Will require sewering when developed as an urban subdivision	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
64			Previously Landsdale rural subdivision now urban - 1 lot with stables		
79			Part of Albion townsite area - Several lots currently used for stables 1 lot in WHPZ for bore M182		
Community purposes Precinct 69	Fuel and chemical spills	Hydrocarbons Chemicals	Indoor swimming pool Conditional land use in P3 area	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Education Schools Tertiary Ed centres Precincts	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	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
59			5 primary schools and Ellenbrook Christian College in Ellenbrook Also proposed State Govt high school		
67			Allinjarra primary school in Alexander Heights		
69			5 primary schools in Ballajura		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Hotel / motel Precinct 79	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Existing hotel / motel Conditional land use in P3 area in WHPZ for bore M282 Will require sewering when developed as an urban subdivision	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
Industry - Service Precincts	Fuel and chemical spills	Hydrocarbons Chemicals	Conditional land use in P3 area	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
59			Catering service - Ellenbrook		
67			Hairdressing salon in Greenpark Rd Alexander Heights		
Community purposes - Recreation parks - Artificial waterways Precincts	Human activity & litter Fertiliser use Pesticide use Animal excreta Fuel and chemical spills	Pathogens Nutrients Pesticides Pathogens Nutrients Hydrocarbons Chemicals	Conditional land uses in P3 area Conditions on fertiliser and pesticide application Community parks managed by Cities of Swan and Wanneroo	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
59			26 parks in Ellenbrook and 2 parks in Henley Brook - includes Woodlake, Lake Fresca, Brook and Sandown Parks artificial wetlands, sporting grounds, skateboard park, tennis courts, picnic areas, playgrounds, toilet blocks and passive recreation reserves Partly in WHPZ for bores L12 and L310		
60			Parks in Ellenbrook (East) - includes artificial wetlands, playgrounds and passive recreation reserves		
67			Several parks in Alexander Heights urban subdivision		
69			Parks in Ballajura - shallow depth to groundwater Includes Emu Lake and other artificial wetlands, sporting grounds, skateboard park, tennis courts, picnic areas, playgrounds, toilet blocks and passive recreation reserves		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Residential building - Group housing for aged persons Precinct 59	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	The Pines aged care facility in Ellenbrook Perth Diocesan Trustees manse (retirement village) Acceptable land uses in P3 area	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Residential building - Rural housing Precincts	Septic systems Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals	Acceptable land use in P3 area but will require sewering when developed as an urban subdivision	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
60			Existing Farmhouse - Egerton Stud		
64			Landsdale rural subdivision - 2 lots in WHPZ for bore M200		
79			Existing housing in Albion townsite area in WPHPZ for bore M162		
Residential building - Urban housing Precincts	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Acceptable land uses in P3 areas	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
59			Ellenbrook and Henley Brook urban subdivisions		
60			Ellenbrook (East) urban subdivision		
65a			Small portion of Landsdale urban subdivision that remains within new UWPCA boundary		
67			Alexander Heights urban subdivision		
69			Ballajura urban subdivision 3 lots in WHPZ for bore M410, rest not in WHPZ		
Sewer pump station Precinct 67	Septic spills Pesticide use Fuel and chemical spills	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	Water Corporation sewerage pumping station in Alexander Heights Conditional land use in P3 area	Water quality monitoring HAZMAT emergency response GLUWMS & SPP 2.2 Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Warehouse Precinct 69	Fuel and chemical spills	Hydrocarbons Chemicals	Warehouse in Ballajura with outside storage Conditional land use in P3 area	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Rural - Priority 1					
Animal husbandry Intensive - Poultry Precinct 30	Animal excreta and disposal of carcasses Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	2 poultry meat farms in Lake Pinjar Special Control Area Incompatible land use P1 area partly in WHPZ for bores P30 and P70 Regulations require faeces to be disposed off-site No further subdivision - long term aim is to place in Govt ownership	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High
Animal husbandry Intensive – ex-Piggery Precinct 38	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Ex Piggery contaminated site - next to Little Coogee Swamp Shallow depth to groundwater - now used for low intensity grazing Existing incompatible land use in P1 area - no further subdivision Long term aim is to place in Government ownership NOTE: Contamination from piggery waste may still be an issue	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High
Agriculture - intensive Market gardens Orchards Precincts	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Existing incompatible land use in P1 area - no further subdivision Long term aim is to place in Government ownership	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High
2			1 lot with mixed horticulture		
30			Lake Pinjar SCA – 4 lots mixed horticulture, 2 lots citrus orchards 1 market garden has trucks, machinery and large workshop 1 orchard on Old Yanchep Rd has 4 incompatible land uses 1 lot in WHPZ for bore W320, 2 lots in WHPZ for bore P10		
54			9 lots mixed horticulture Dismantle infrastructure & rehabilitate sites if bought by Government 3 lots in WHPZ for bores M300 and M310, rest not in WHPZ 1 lot has inadequate storage of fuels, chemicals and pesticides		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Industry - Rural Manure stockpiling Precinct 30	Animal excreta Stockpiled manures Fuel and chemical spills	Pathogens Nutrients Pathogens Nutrients Hydrocarbons Chemicals	Rural lot in Lake Pinjar Special Control Area with sheep and several chicken manure stockpiles Existing incompatible land use in P1 area - no further subdivision Long term aim is to place in Government ownership In WHPZ for bore P10	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High
Service station Precinct 54	Fuel and chemical spills Septic systems	Hydrocarbons Chemicals Pathogens Nutrients	Abandoned petrol station – Gnangara Rd Special Rural Area Was an incompatible land use in P1 area - in WHPZ for bore M310 Long term aim is to place in Government ownership NOTE: Potentially a contaminated site – needs investigating	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High
Agriculture - extensive Stock grazing Precinct 23	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Livestock grazing and native vegetation Existing incompatible land use in P1 area Long term aim is to place in Government ownership No further subdivision	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
Animal establishment Stables Precincts	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Existing incompatible land use in P1 area - no further subdivision Long term aim is to place in Government ownership	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
30			6 lots with stables in Lake Pinjar Special Control Area 1 lot in WHPZ for bore P50, 1 lot in WHPZ for bore P70		
54			2 lots with stables and 1 lot with agistment centre Dismantle infrastructure & rehabilitate sites if bought by Government 2 lots in WHPZ for bore M300, 1 lot in WHPZ for bore M310		
Community Health Centre Hospital Precinct 62	Septic systems Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals	Cyrenian House - Drug treatment and rehabilitation centre Leased from WAPC - existing incompatible land use in P1 area In WHPZ for bore M330	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Industry Extractive Precinct 5	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Quarry on Dept of Water land - conditional land use in P1 area Conditions on storage of fuels and chemicals Criteria for excavation depth and site rehabilitation Underground storage tanks prohibited	Water quality monitoring DoW Sand Mining policy/guidelines Well regulated industry GLUWMS, SPP 2.2, MWSSD bylaws Land Planning controls	Medium
Industry - Rural Farm supply centres Manure stockpiling Processing facilities Precinct 54	Septic systems Fertiliser use Fuel and chemical spills	Pathogens Nutrients Nutrients Hydrocarbons Chemicals	Existing incompatible land use in P1 area - no further subdivision Long term aim is to place in Government ownership Dismantle infrastructure & rehabilitate sites if bought by Government 3 lots in WHPZ for bore M310	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
Industry - Service Precinct 54	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Existing incompatible land use in P1 area - no further subdivision 2 lots earthmoving contractor, 1 lot water well drilling business In WHPZ for bores M300 and M310 Long term aim is to place in Government ownership	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
Residential building - Semi rural housing Precinct 54	Septic systems Fertiliser use Pesticide use Fuel and chemical spills Animal excreta	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals Pathogens Nutrients	Semi rural lots - Gnangara Road Special Rural Area Conditional land use in P1 area - no further subdivision One lot has horses, scrap metal and workshop Long term aim is to place in Government ownership Dismantle infrastructure & rehabilitate sites if bought by Government 5 lots in WHPZ for bores M300 and M310, 1 lot not in WHPZ	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
Tyres, batteries retail Precinct 54	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Abandoned retail tyre outlet – Gnangara Rd Special Rural Area Was an incompatible land use in P1 area - in WHPZ for bore M310 Long term aim is to place in Government ownership Site rehabilitation needs investigating to confirm no longer a threat	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
Warehouse Precinct 30	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Warehouse on rural lot in Lake Pinjar Special Control Area Existing incompatible land use in P1 area - no further subdivision Long term aim is to place in Government ownership	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Rural-Water Protection					
Vacant land Abandoned structure Ex-poultry farm Precinct 56	Fertiliser residual Pesticide residual Animal excreta residual	Nutrients Pesticides Pathogens Nutrients	Ex-poultry farm Conditional land use in P2 area - no further subdivision NOTE: Contamination from old poultry operation may be an issue	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High
Agriculture - intensive Market gardens Precincts	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Existing incompatible land use in P2 area - no further subdivision	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High
11a			One property with mixed horticulture		
39			2 lots mixed horticulture - 1 lot in WHPZ for bore W90		
49			4 lots mixed horticulture - shallow depth to groundwater 2 lots with workshops, 1 also has trucks, machinery and car bodies		
52			2 lots mixed horticulture 1 lot in WHPZ for bore W240, 1 lot in WHPZ for bore W250		
75			3 lots mixed horticulture in Henley Brook Special Rural Area		
Agriculture - intensive Orchards Nurseries Precincts	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Conditional land use in P2 area Can continue under agreed management regime to minimise risk Changes in land uses need planning approval	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High
22a			Low chill orchard - no further subdivision		
66			2 lots with citrus orchards in WHPZ for bore M120 Lakefarm Special Rural Area		
75			Henley Brook Special Rural Area 4 citrus orchards and 1 plant seed production nursery 3 lots in WHPZ for bore M282		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Agriculture - extensive Stock grazing Precincts	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Conditional land uses in P2 area	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
49			Cattle grazing - shallow depth to water		
75			Henley Brook Special Rural Area – 1 lot with cattle, 3 lots with sheep 1 lot in WHPZ for bore L320, 1 lot in WHPZ for bore M282		
Animal establishment Equestrian centre Precinct 56	Animal excreta Chemical spills	Pathogens Nutrients Chemicals	The Pines Riding School and Agistment centre Incompatible land use in P2 area	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
Animal establishment Intensive outdoor stock holdings Precincts	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Incompatible land uses in P2 area	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
66			1 lot intensive holding of sheep, 1 lot mixed livestock Lakefarm Special Rural Area - 1 lot in WHPZ for bore M110		
75			Henley Brook Special Rural Area, 1 lot with intensive mixed livestock		
Animal establishment Stables Precincts	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Conditional land use in P2 area - no further subdivision	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
39			Neaves Rd Hobby Farm subdivision - 24 lots with stables 3 lots in WHPZ for bore W90		
52			4 lots with stables in WHPZ for bores W240 and W250 1 larger scale with horses exercising on adjacent Crown Land		
56			7 lots with stables and 2 lots used for agistment		
66			Lakefarm Special Rural Area - 1 lot in WHPZ for bores M110 & M120		
75			Henley Brook Special Rural Area - numerous stables Partly in WHPZ for bores L300, L310, L320 and M282		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Community purposes - Recreation parks Precinct 56	Human activity & litter Fertiliser use Pesticide use Animal excreta	Pathogens Nutrients Pesticides Pathogens Nutrients	Community parks - Lorian and Vintage Parks Incompatible land use in P2 area Conditions on fertiliser and pesticide application	Water quality monitoring Sewered GLUWMS & SPP 2.2 Land Planning controls	Medium
Industry - General Energy supply Precinct 74	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Electric generation plants Incompatible land use in P2 area In WHPZ for bore L300	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
Residential building - Rural housing Precincts	Septic systems Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals	Acceptable land use in P2 area - no further subdivision	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
39			Neaves Rd Hobby Farm subdivision 46 lots with houses and 3 with buildings under construction Some properties have large workshops and old car bodies 1 also has trucks and scrap metal dump 6 lots in WHPZ for bore W90, 1 lot in WHPZ for bore W280		
49			4 lots with construction underway Shallow depth to groundwater part in WHPZ for bores W210 & W220		
52			8 rural lots - 3 properties have large workshops, 1 also has geese Partly in WHPZ for bores W240 and W250		
56			33 mixed rural lots - 2 lots have trucks, 1 also has large workshop		
66			Lakefarm Special Rural Area - 5 lots – in WHPZ for bore M110		
75			Henley Brook Special Rural Area Partly in WHPZ for bores L300 and M282		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Sewer pump station Precinct 74	Septic spills Pesticide use Fuel and chemical spills	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	Water Corporation sewerage pumping station for Ellenbrook Conditional land use in P2 area	Water quality monitoring HAZMAT emergency response GLUWMS & SPP 2.2 Land Planning controls	Medium
Rural - Priority 3					
Agriculture - intensive Market gardens Orchards, nurseries Precincts	Fertiliser and manure use Pesticide use Fuel and chemical spills	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	Conditional land use in P3 area	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High
57			Small portion of rural lot used for mixed horticulture was outside old UWPCA boundary - now in new UWPCA		
76			Henley Brook Special Rural Area – 1 lot mixed horticulture, 1 citrus orchard - were outside old UWPCA boundary - now in new UWPCA		
Animal establishment Stables Precincts	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Acceptable land use in P3 area	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
57			Small portion of rural lot with stables was outside old UWPCA boundary - now in new UWPCA		
76			Henley Brook Special Rural Area – numerous lots with stables were outside old UWPCA boundary - now in new UWPCA		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Agriculture - extensive Stock grazing Precincts	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Acceptable land use in P3 area	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
43b			Small portion of rural lot used for stock grazing Rest of lot was inside old UWPCA but not in new UWPCA		
76			Henley Brook Special Rural Area – 3 lots with cattle, 1 lot with sheep were outside old UWPCA boundary - now in new UWPCA		
Residential building - Rural housing Precinct 76	Septic systems Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals	Henley Brook Special Rural Area – now in new UWPCA Acceptable land use in P3 area	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
Parks & Recreation					
Vacant Crown Land Ex-piggery Precinct 30	Fertiliser residual Pesticide residual Animal excreta residual	Nutrients Pesticides Pathogens Nutrients	Ex-piggery - contaminated site purchased by Government to be included in Gnangara Park - now acceptable land use in P1 area NOTE: Was an incompatible land use as a piggery and contamination from ex-piggery waste may still be an issue - in WHPZ for bore P20	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	High
Animal establishment Equestrian centre Precinct 61	Animal excreta Chemical spills	Pathogens Nutrients Chemicals	Equestrian Centre for Aust Stock Horse Society, Horseman's Pony and Perth Regional Appaloosa Clubs - leased from WAPC Incompatible land use in P1 area in WHPZ for bores M340 & M350	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium
Community purposes Rifle range Precinct 61	Septic systems Fuel and chemical spills Lead shot	Pathogens Nutrients Hydrocarbons Chemicals Chemicals	WA International Shooting Complex - leased from WAPC Incorporating Australian Trap and Skeet, WA Gun Club, WA Shooting, WA Clay Target, Air Rifle Running Target, Whiteman Park Pistol, Archery Society of WA and WA Field and Bowhunters Club Incompatible land use in P1 area in WHPZ for bores M340 & M350	Water quality monitoring GLUWMS & SPP 2.2 Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Public Purposes					
Airport	Pesticide use	Pesticides	RAAF Gingin Airfield and Base – infrastructure and runways	Water quality monitoring	Medium
	Fuel and chemical spills	Hydrocarbons	Existing incompatible non-conforming land use in P1 area	HAZMAT emergency response	
Precinct 14		Chemicals	Inadequate storage of fuels and containment of stormwater run-off	GLUWMS & SPP 2.2	
Community purposes	Septic systems	Pathogens	Wanneroo Shooting Complex - incorporates 10 clubs	Water quality monitoring	Medium
Rifle range		Nutrients	Located on RAAF Air Weapons Range	GLUWMS & SPP 2.2	
	Fuel spills	Hydrocarbons	Incompatible land use in P1 area upgradient of bores P50 &P60	Land Planning controls	
Precinct 61	Lead shot	Chemicals	DoW management plan developed in consultation with clubs	DoW risk management plan	
Drinking water supply	Pesticide use	Pesticides	Water Corporation groundwater treatment plants	Water quality monitoring	Medium
treatment plant	Fuel and chemical spills	Hydrocarbons	Conditional land use in P1 and P3 areas	HAZMAT emergency response	
Precincts		Chemicals		GLUWMS & SPP 2.2	
51			Wanneroo Groundwater Treatment Plant		
71a			Mirrabooka Groundwater Treatment Plant		
Education	Fertiliser use	Nutrients	Ballajura Community College	Water quality monitoring	Medium
Schools	Pesticide use	Pesticides	Acceptable land use in P3 area	Sewered	
Tertiary Ed centres	Fuel and chemical spills	Hydrocarbons	Conditions should apply to use of fertiliser and pesticides	GLUWMS & SPP 2.2	
Precinct 69		Chemicals		Land Planning controls	
Sewer pump station	Septic spills	Pathogens	Water Corporation sewerage pumping stations in Malaga and	Water quality monitoring	Medium
		Nutrients	Ballajura	HAZMAT emergency response	
	Pesticide use	Pesticides	Conditional land use in P3 area	GLUWMS & SPP 2.2	
	Fuel and chemical spills	Hydrocarbons		Land Planning controls	
Precinct 69		Chemicals			
State Energy	Pesticide use	Pesticides	Power depots and storages - incompatible land uses in P1 & P3 areas	Water quality monitoring	Medium
Electric power supply	Fuel and chemical spills	Hydrocarbons	Power generation plants and associated infrastructure operated by	GLUWMS & SPP 2.2	
Precincts		Chemicals	Western Power	Land Planning controls	
32			Pinjar Power Station - part in WHPZ for bores P110 and P120		
69			Malaga Power Station in WHPZ for bore M34		
Telecommunication	Pesticide use	Pesticides	Telstra Perth International Telecommunications Centre	Water quality monitoring	Medium
Transmitters/receivers	Fuel and chemical spills	Hydrocarbons	Includes above ground fuel storage with bunding	GLUWMS & SPP 2.2	
Precinct 63		Chemicals	Conditional land use in P1 area in WHPZ for bores M200 and M300	Land Planning controls	

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Roads					
Major transport routes Precincts	Fuel and chemical spills	Hydrocarbons Chemicals	Formed roads are an incompatible land use in P1 areas Shallow depth to water table Existing non-conforming land use	Water quality monitoring HAZMAT emergency response GLUWMS & SPP 2.2 Land Planning controls	Medium
31			Neaves Rd partly in WHPZ for bores W90 and W280		
70			Beechboro Rd North partly in WHPZ for bore M50		
Major transport routes Precincts	Fuel and chemical spills	Hydrocarbons Chemicals	Formed roads are an incompatible land use in P1 areas Existing non-conforming land use	Water quality monitoring HAZMAT emergency response GLUWMS & SPP 2.2 Land Planning controls	Medium
9			Wanneroo Rd in future WHPZ		
18			Wanneroo Rd		
24			Wanneroo Rd		
53			Neaves Rd and Gnangara Rd partly in WHPZ Mirrabooka bores		
54			Gnangara Rd partly in WHPZ for bores M300 and M310		
61			Gnangara Rd partly in WHPZ for bore M350		
62			Gnangara Rd, Beechboro Rd North and Alexander Dr Partly in WHPZ for Mirrabooka bores		
83			Gnangara & Alexander Rds partly in WHPZ for bores M200 & M300		
Major transport routes Precincts	Fuel and chemical spills	Hydrocarbons Chemicals	Formed roads are a conditional land use in P2 areas Existing non-conforming land use	Water quality monitoring HAZMAT emergency response GLUWMS & SPP 2.2 Land Planning controls	Medium
22a			Wanneroo Rd		
39			Neaves Rd in WHPZ for bores W90 and W280		
43			Neaves Rd in WHPZ for bore W280		
74			Lord St and future Perth - Darwin Hwy partly in WHPZ for bore L300		
75			Lord St and Gnangara Rd partly in WHPZ for bore L300		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Major transport routes	Fuel and chemical spills	Hydrocarbons	Formed roads are an acceptable land use in P3 areas	Water quality monitoring	Medium
		Chemicals		HAZMAT emergency services	
				GLUWMS & SPP 2.2	
Precincts				Land Planning controls	
43b			Neaves Rd		
59			Gnangara Rd and future Perth - Darwin Hwy		
60			Gnangara Rd		
64			Alexander Dr and Gnangara Rd partly n WHPZ for bore M200		
67			Alexander Dr and Marangaroo Dr		
68			Marangaroo & Alexander Dr, Beach Rd partly in WHPZ for bore M110		
69			Alexander Dr, Beach Rd & Marshall Rd partly in WHPZ for bore M34		
71a			Alexander Dr in WHPZ M10		
76			Gnangara Rd		
State Forests					
Liquid waste	Fuel and chemical spills	Hydrocarbons	Gnangara Liquid Waste Disposal site – in recharge area bore L300	Water quality monitoring	High
Precinct 53		Chemicals	Decommissioned contaminated site but pollution plume still exists	GLUWMS & SPP 2.2	
Drinking water supply	Pesticide use	Pesticides	Water Corporation's Lexia Groundwater Treatment Plant	Water quality monitoring	Medium
treatment plant	Fuel and chemical spills	Hydrocarbons	Conditional land use in P1 area	HAZMAT emergency response	
Precinct 53		Chemicals		GLUWMS & SPP 2.2	
Industry	Septic systems	Pathogens	Conditional land use in P1 area	Water quality monitoring	Medium
Extractive		Nutrients	Conditions on storage of fuels and chemicals	DoW Sand Mining policy/guidelines	
	Fuel and chemical spills	Hydrocarbons	Criteria for excavation depth and site rehabilitation	Well regulated industry	
		Chemicals	Underground storage tanks prohibited	GLUWMS, SPP 2.2, MWSSD bylaws	
Precincts				Land Planning controls	
9			3 quarries in State Forest		
53			Rocla quarries in State Forest in WHPZ for Lexia & Mirrabooka bores		
Recreation	Fuel and chemical spills	Hydrocarbons	Designated Motorcycle Area (Lexia)	Water quality monitoring	Medium
Motorcycle area		Chemicals	Existing incompatible land use in P1 area	GLUWMS & SPP 2.2	
Precinct 53			In WHPZ for Lexia and Mirrabooka bores	Land Planning controls	

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 Implementation of 2001 management strategy recommendations

The Gnangara Land Use and Water Management Strategy completed by the Western Australian Planing Commission in 2001 provided a list of nine recommendations for implementation of the strategy. They were:

1. Amend Metropolitan Region Scheme to place Rural Water Protection zone over designated Priority 2 areas and Water Catchment reservation over designated Priority 1 areas on Crown Land and areas in private ownership on the Gnangara Mound.
2. Review and update existing *Statement of Planning Policy No. 3 Gnangara Mound Crown Land, 1995* to reflect proposed land use control guidelines.
3. Finalise *Draft Environmental Protection Policy State Groundwater, 1998* and environmental impact assessment guidelines for Environmental Management Areas associated with the public water supplies.
4. Include reserve land in the proposed Gnangara Park for Parks and Recreation in agreement with CALM.
5. Amend statutory UWPCA boundary to accord with the scientifically determined boundary; and refine as required the groundwater source protection boundary to account for detailed wellfield design.
6. Modify the *Metropolitan Water Supply Sewerage and Drainage (MWSSD) Act, 1909* by-laws to reflect the recommended priority classifications.
7. Agree on a referral process and policy application approach for assessment of planning applications within the revised UWPCA to ensure on a co-ordinated whole-of-government approach.
8. Amend local town planning schemes within the metropolitan area to accord with the MRS amendment within the statutory time frame; and amend local town planning schemes outside the metropolitan area to recognise the revised UWPCA and priority classifications with scheme provisions to reflect objectives of the SPP 3 and EPP *State Groundwater*.
9. Prepare strategies, development plans and TPS scheme reviews in the context of the Strategy text and recommendations.

Three of the nine recommendations have been completed, four are currently being progressed and two remain outstanding.

The following actions have been achieved:

- Amendment of the Metropolitan Regional Scheme to apply the Water Catchments reservation to Priority 1 areas and to incorporate the new Rural – Water Protection Zone for Priority 2 areas in 2005 (Rec. 1).
- Statement of Planning Policy 2.2 *Gnangara Groundwater Protection* gazetted in 2005 (Rec. 2).
- Proclamation of the revised UWPCA boundary (Rec. 5).

Actions currently being progressed are:

- A draft report on the changes to reserved land within the proposed Gnangara Park has been produced but requires Local Council approval before Local District Town Planning Schemes can be amended (Rec. 4).
- A review of MWSSD Act by-laws has been underway but requires further revision following a lengthy stakeholder review process. In the interim, Statement of Planning Policy 2.7 *Public Drinking Water Source Policy* gazetted in 2003 enables priority areas to be incorporated in planning decisions (Rec. 6).
- A co-ordinated whole-of-government approach to referring planning applications has been evolving under the guidance of EPP *State Groundwater*, SPP 2.2, SPP 2.7 and SPP 2.9 *Water Resources* (Rec. 7).
- Preparation of strategies, development plans and TPS scheme reviews in the context of the Strategy text and recommendations are ongoing processes (Rec. 9).

Outstanding actions include:

- The *Environmental Protection Policy (State Groundwater) 1998* is yet to be finalised but EPA Guidance Document 33 was prepared to reflect environmental impact assessment guidelines (Rec. 3).
- Amendment of local town planning schemes to reflect MRS amendment has been delayed pending finalisation of the East Wanneroo Land Use and Water Management Strategy (Rec. 8).

5 Conclusion

Current risks to water quality from activities within Gnangara Underground Water Pollution Control Area (UWPCA – Control Area) have been identified and reviewed against previous assessments.

There has been no observed increase in the overall risk to drinking water quality of the Gnangara groundwater system since the initial assessments undertaken in the late 1990s as part of the production of the Gnangara Land Use and Water Management Strategy (GLUWMS). The four wellfields within the UWPCA that supply water to the Integrated Water Supply Scheme do not show any evidence of contamination. The integrity of the groundwater resources has benefited from having the majority of the Control Area in Government ownership, which has limited development to the very southern area of the UWPCA. State Forest and uncleared Public Purpose reservations cover over 80% of the UWPCA where, other than harvesting of the native forest and pine plantations, there is very little activity. Controlling land use and activities through gazettal of the Water Catchments reservations and Rural-Water Protection zones within the Metropolitan Region Scheme, creation of special planning control areas and purchase of potentially contaminating sites by the Western Australian Planning Commission have been major initiatives in protecting groundwater quality. The extensive consultation process associated with the production of GLUWMS also provided significant community awareness of the importance of retaining the integrity of the groundwater resources of the Gnangara Mound.

Although private ownership is less than 15% of the UWPCA, there are many potential risks to drinking water quality within the Control Area. The industrialised area of Malaga, the residential areas of Alexander Heights, Ballajura, Ellenbrook and Henley Brook, past intensive rural activity in Landsdale, Gnangara Road Special Rural Area and Lake Pinjar Special Control Area present numerous opportunities for potential contamination of the groundwater system.

Nitrates in some of the West Mirrabooka extension bores, which are located outside the UWPCA, although well below the ADWG guideline value, are above what is considered naturally occurring levels. These bores are sited in or adjacent to community parks and ovals, and fertiliser use on these grassed areas may be a possible source of nitrate. All other bores within the UWPCA have very low levels of nitrate. The approach of siting superficial aquifer production bores in irrigated parks should be re-evaluated when locating future bores. The West Mirrabooka extension was constructed after GLUWMS was published and further modification of the UWPCA boundary may be required to incorporate these bores within the Control Area.

Waste disposal sites, fuel outlets, intensive animal husbandry and agricultural enterprises present the greatest threat to drinking water quality within the Control Area. An industrial waste and two solid waste landfills in Malaga are potential sources of pathogen contamination. The ex-Gnangara Liquid Waste Disposal site, north of Gnangara Road just west of Ellenbrook has a chemical pollution plume emanating from the site. Three retail fuel outlets in Ballajura, one in Ellenbrook, one on Gnangara Road and several service stations within the Malaga industrial area pose a high contamination threat through the possible leakage of fuel stored in underground tanks. One site in Ballajura underwent remediation several years ago following detection of a hydrocarbon plume emanating from the site. Ex-piggery sites near Lake Pinjar and Little Coogee Swamp, poultry farms near Lake Pinjar and the future Albion townsite and an ex-poultry farm near Gnangara Lake have the potential to cause pathogen contamination where there has been onsite disposal of faecal waste. A rural lot near Lake Pinjar used for stock grazing and a nursery at Landsdale are potential sources of pathogen and nutrient contamination because of inadequate storage of bulk manures. Several market gardens, orchards, plant and seed production nurseries, shadehouse plant nurseries and a vineyard at a number of locations throughout the Urban and Rural zones are or have been potential sources of nutrients from fertiliser application and are considered high risk sites. These land uses are all considered severe or high risks and have been rated ***High*** catchment management priorities

There are a large number of general industry operations, light industrial businesses and service industries within the Malaga Industrial Area considered ***Medium*** catchment management priorities because of the potential to cause pesticide, fertiliser, hydrocarbon and chemical contamination from leakage of stored chemicals, fuel and oil. Many sites have inadequate fuel and chemical storage facilities and insufficient containment of leachate in stormwater run-off.

There is some potential for chemical contamination from a number of sites within the urban areas including a catering service in Ellenbrook, a hairdressing salon in Alexander Heights, and a warehouse and community swimming pool in Ballajura. These sites pose a significant risk and are rated ***Medium*** catchment management priorities.

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, artificial wetland reserves and the uncontrolled domestic activities on residential properties. There are a large number of properties with stables and broadacre stock grazing in rural and semi rural areas that pose the additional risk of pathogen contamination associated with management of faecal waste. A number of industry-based activities in the rural areas pose a threat of pathogen, nutrient, hydrocarbon and chemical contamination.

The Western Australian International Shooting Complex, a major equestrian centre and Cyrenian House drug treatment and rehabilitation centre located in Whiteman Park, and the Pines Riding School and Agistment centre have potential to cause pathogen and nutrient contamination and are rated ***Medium*** catchment management priorities.

Activities on Public Purpose reservations are rated ***Medium*** management priorities because there is potential for leakage of stored fuels and chemicals include RAAF Gingin Airfield, Wanneroo Shooting Complex, power generation plants at Pinjar, Malaga and Ellenbrook, Telstra Perth International Telecommunication Centre, and Water Corporation groundwater treatment plants.

There are a number of sand quarries located within the State Forest and a designated recreational motorcycle area in Lexia, just north of Gnangara Road, which are considered to pose significant risks because of the potential for fuel spills. These activities are rated ***Medium*** catchment management priorities.

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 Control Area are considered to be a ***Low*** catchment management priority.

With the exception of Whiteman Park, it is proposed to incorporate the majority of the Crown Land (including the State Forests) within the UWPCA into a conservation park to be known as Gnangara Park. The Department of Environment and Conservation intends to replace areas of the State Forest currently under pine plantation with conservation and recreation areas. Controlled harvesting of the native forest will continue to occur within the proposed park.

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.

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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

Department of Environment

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

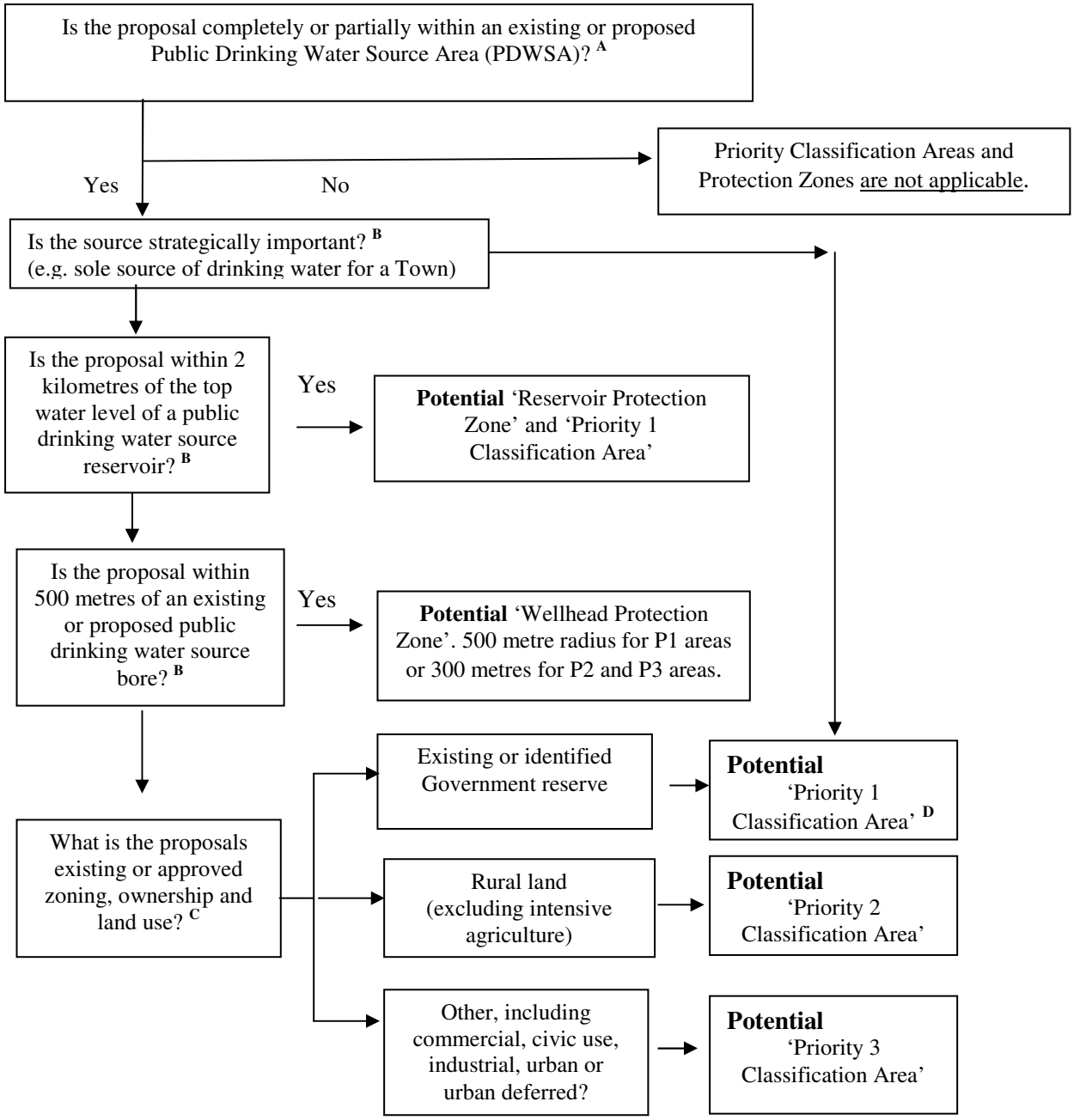
The tables in this note have been prepared for use by local governments, State planners and other agencies as a basis for regulating land use within PDWSAs. The note complements the Western Australian Planning Commission's *Statement of Planning Policy Number 2.7 (June 2003) Public Drinking Water Sources*. 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) <u>provided</u> 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 <u>limited</u> 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 <u>regular</u> additional inputs are required to support the desired land use, e.g. for agriculture- irrigation, fertilisers, pesticides, or non-forage animal feeding dominates.

Interpretation of land use recommendations for planning schemes and development approvals

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

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

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

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

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

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

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

Tables defining compatibility of various land uses within PDWSA

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

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

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

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Appendix 2 Water Quality

The Water Corporation has monitored water quality from Gnangara 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 Gnangara groundwater system supplies water to four groundwater treatment plants prior to distribution to the IWSS. Mirrabooka Groundwater Treatment Plant (GWTP) receives water from Mirrabooka wellfield, Wanneroo GWTP receives water from Wanneroo and Pinjar wellfields, Lexia GWTP receives water from Lexia wellfield.

MICROBIOLOGICAL CONTAMINANTS

Microbiological testing of the raw water from Gnangara 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 the four Gnangara UWPCA wellfields. There have been two isolated counts recorded in raw water samples from Lexia Groundwater Treatment Plant, which appear to be erroneous as they are inconsistent with all other readings.

Raw water from the Gnangara groundwater system is treated at the Mirrabooka, Wanneroo and Lexia Groundwater Treatment Plants (GWTPs). Water delivered to GWTPs is aerated, clarified, filtered, dosed with alum, polyelectrolyte and calcium hydroxide, chlorinated and fluoridated. Additional treatment with MIEX resin occurs for about 2/3 of the raw water at Wanneroo GWTP prior to clarification.

HEALTH RELATED CHEMICAL WATER QUALITY DATA

Raw water from Gnangara 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 December 2006 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 Gnangara groundwater system, but at concentrations well below ADWG.

Nitrates in some of the West Mirrabooka extension bores, which are located outside the UWPCA, although well below the ADWG guideline value, are above what is considered naturally occurring levels. These bores are sited in or adjacent to community parks and ovals, and fertiliser use on these grassed areas may be a possible source of nitrate. All bores within the UWPCA display very low levels of nitrate, many just above detectable levels.

All health related water quality parameters from Gnangara 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*
	Mirrabooka Raw Water	
Inorganics		
Nitrite +nitrate (N) #	No detection – 2.6 0.06	11.3 mg/L
Metals		
Barium	0.050 – 0.075 0.070	0.7 mg/L
Boron	No detection – 0.024 No detection	0.3 mg/L
	Wanneroo – Pinjar Raw Water	
Inorganics		
Nitrite +nitrate (N) #	No detection – 0.075 No detection	11.3 mg/L
Metals		
Barium	0.14 – 0.55 0.30	0.7 mg/L
Boron	No detection – 0.12 0.078	0.3 mg/L
	Lexia Raw Water	
Inorganics		
Nitrite +nitrate (N) #	No detection – 0.026 No detection	11.3 mg/L
Metals		
Barium	0.065 – 0.090 0.073	0.7 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.
Nitrate range observed in bore samples

AESTHETIC WATER QUALITY DATA

Aesthetic water quality analyses for raw water from Gnangara groundwater system are summarised in the following table. The values are taken from ongoing raw water monitoring from January 2000 to December 2006. 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 Gnangara 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
	Mirrabooka Raw Water	
Salinity (TFSS – CO_2)	248 – 409 382	500 mg/L
Hardness ($CaCO_3$)	80 – 113 106	200 mg/L
Turbidity	No detection – 18 10.5	5 NTU
pH	6.0 – 6.5 6.2	6.5-8.5
Colour	6 – 55 18	15 TCU
Iron (unfiltered)	0.65 – 6.0 3.1	0.3 mg/L
Manganese (unfiltered)	0.008 – 0.065 0.029	0.1 mg/L
Aluminium (unfiltered)	0.095 – 0.65 0.225	0.2 mg/L
	Wanneroo – Pinjar Raw Water	
Salinity (TFSS – CO_2)	407 – 826 578	500 mg/L
Hardness ($CaCO_3$)	84 – 127 100	200 mg/L
Turbidity	0.1 – 33 2.2	5 NTU
pH	6.3 – 7.8 6.7	6.5-8.5
Colour	2 – 100 44	15 TCU
Iron (unfiltered)	0.2– 8.0 3.8	0.3 mg/L
Manganese (unfiltered)	0.012 – 0.119 0.07	0.1 mg/L
Aluminium (unfiltered)	No detection – 1.5 0.15	0.2 mg/L
	Lexia Raw Water	
Salinity (TFSS – CO_2)	207 – 260 235	500 mg/L
Hardness ($CaCO_3$)	82 – 163 122	200 mg/L
Turbidity	1.8 – 22 6.4	5 NTU
pH	6.2 – 7.0 6.8	6.5-8.5
Colour	30 – 39 36	15 TCU
Iron (unfiltered)	1.0 – 2.4 1.6	0.3 mg/L
Manganese (unfiltered)	0.014 – 0.018 0.016	0.1 mg/L
Aluminium (unfiltered)	0.13 – 1.6 0.39	0.2 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
State owned (public) Land (P1 source protection)	
Reserves State Forest Unallocated	*Acceptable with best management practices* • 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)	*Acceptable with best management practices* • 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.
Apiarists Wildflower picking Seed collection Firewood collection	*Acceptable activity with conditions* • Activities to be restricted to outside proposed RPZ and away from feeder streams. • Apply conditions for Apiarists, 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	*Acceptable with best management practices* • 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	*Unacceptable activity* • 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	*Acceptable activity with conditions* • 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 http://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	*Acceptable activity with conditions* • 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 . http://drinkingwater.water.wa.gov.au
Horse riding events	*Acceptable with Best Management Practices* • 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	*Unacceptable activity* • 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	*Unacceptable activity* • 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	*Unacceptable activity* • 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	*Unacceptable activity* • 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	*Acceptable with best management practices* • 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	*Acceptable activity with conditions* • 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	*Acceptable with Best Management Practices* • 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)	
	Long term goal of crown ownership of private land • 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	*Acceptable with best management practices* • 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	*Manage as non-conforming land use* • Landowner can continue current activities (consistent with *Environmental Protection Act 1986* and *Country Area Water Supply Act* 1947 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	*Maintain existing planning controls* • 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	*Conditional with best management practices* • 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)	
	Acceptable with controls • 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	*Manage as non-conforming land use* • 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	*Unacceptable in current condition* • Remove all infrastructure and contaminant threats including septic system and decontaminate site. • Return site to natural bushland.
Rubbish disposal	*Unacceptable activity* • Encourage local council to close site and undertake remediation to decontaminate site. • Return site to natural bushland.
Horticulture	*Maintain existing planning controls* • 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	*Acceptable activity with controls* • 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.	*Acceptable activity with controls* • 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 • Oppose intensification of land use through planning approval process (eg those activities not acceptable in P3 areas). • 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.

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