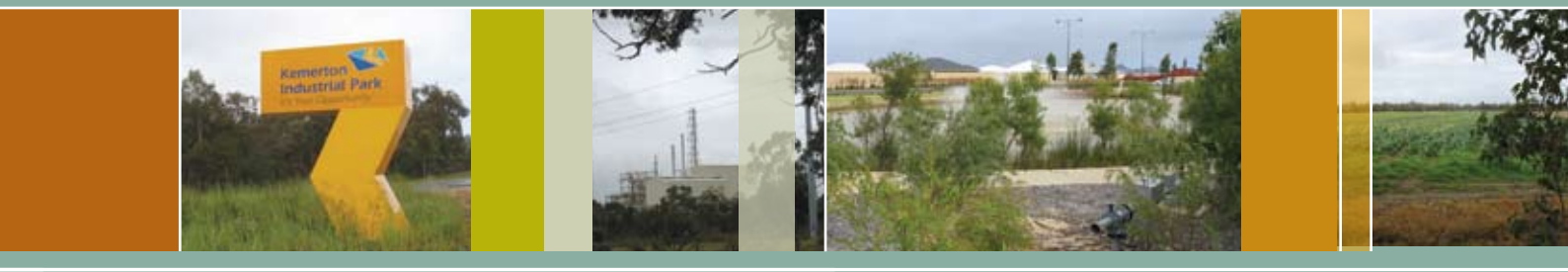
Department of Water
Government of Western Australia

Kemerton Groundwater Subareas
Water Management Plan

December 2007



Water Resource Allocation and Planning Series
Report no. WRAP 17

Department of Water
Government of Western Australia

Kemerton Groundwater Subareas

Water Management Plan

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Department of Water

168 St Georges Terrace
Perth Western Australia 6000
Website www.water.wa.gov.au
Telephone +61 8 6364 7600
Facsimile +61 8 6364 7601

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Cover photograph

Local Kemerton groundwater subareas commercial water uses.

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Summary

The Department of Water manages the State's water resources. We do this by informing the government and the community on the quantity, quality, use and availability of water resources. It's our duty to ensure that Western Australia's water resources are planned to balance the needs of water users with those of the environment.

The Kemerton Industrial Park was chosen by the government as a strategic industrial site for the South West region. The site was investigated to determine its potential to provide groundwater on a sustainable basis to potential industries located within the park. The investigations have provided new information on the hydrogeology of the area, potential use of the groundwater and identification of groundwater-dependent ecosystems. This allowed Allocation Limits to be set for the plan area. The summary table below shows the Allocation Limits and available water for the superficial and regionally confined aquifers in the Kemerton subareas.

Table 1.1 Summary of Allocation Limits and available water for the Kemerton subareas (as of 31 July 2007)

Ground-water area	Subarea	Aquifer	Allocation Limit (ML/year)	Available water (ML/year)
South West Coastal	KIP North	Superficial	790	757
	Myalup	Superficial	7,350	173
	Wellesley	Superficial	2,150	1,220
	Kemerton North (confined aquifers)	Leederville	3,500	300
		Cattamarra Coal Measures	6,000	6,000
Bunbury	KIP South	Superficial	210	–19
	Australind	Superficial	690	82
	Kemerton South (confined aquifers)	Leederville	5,000	147
		Cattamarra Coal Measures	4,000	3,008

KIP = Kemerton Industrial Park; ML = megalitre

Source: Table 5.2 and Table 5.3

This plan provides a basis for groundwater licence assessments and allocation within the Kemerton subareas, for industrial use within the park, and for agricultural, town water supply and other uses outside the park. The assessments and allocation are based on managing the impacts of groundwater abstraction to ensure that the identified high value groundwater-dependent ecosystems and existing users are protected.

1 Introduction

The Department of Water manages the State's water resources. We do this by informing the government and the community on the quantity, quality, use and availability of water resources. It's our duty to ensure that Western Australia's water resources are planned to balance the needs of water users with those of the environment.

The name of this plan is the Kemerton Groundwater Subareas – Water Management Plan and will be referred to as 'this plan' in this document. This plan has been developed by the Department of Water (the department) to guide groundwater management in the Kemerton subareas. The primary purpose of this plan is to:

- ensure that the groundwater resources of the Kemerton subareas are allocated equitably and used sustainably in the long term, taking into consideration potential impacts on the social, economic and environmental values in the subarea
- ensure that current water users are not adversely impacted by the release of water to new users
- prescribe the rules and protocols that will apply in the assessment of licence applications and water resource development proposals, and the issue of groundwater resource entitlements
- prescribe the monitoring requirements for the groundwater resource and associated values.

1.1 Background

In 2000, the Western Australian Planning Commission prepared a report, titled *Industry 2030* (WAPC 2000), on the state government's adopted strategic planning framework for addressing the industrial land and port access needs of the Greater Bunbury region over the next 30 years. In the report, the Kemerton Industrial Park (KIP) was one of several potential industrial sites for the South West region and since the publication of the report, the KIP has been chosen as the preferred site.

In 1999, as part of developing the Industry 2030 report, consultants Bowman Bishaw Gorham and Rockwater studied water resources in the KIP and immediate surrounding area (BBG 1999). The study was predominantly a desktop assessment of the potential impacts of groundwater abstraction by industrial developments (including water supply and drainage) on the local wetlands and groundwater-dependent ecosystems. The study also highlighted water information gaps and, consequently, a more detailed second phase water study was recommended.

Consultants Aquaterra and ATA Environmental undertook the second phase for the Kemerton Technical Working Group comprising LandCorp, Department of Industry and Resources and the Water and Rivers Commission. The major objectives for the second phase of the water study were:

- the acquisition and assessment of new hydrogeological data, with existing information, to address a range of specific (water-related) environmental objectives, including the identification of local groundwater-dependent ecosystems.

- an understanding of the interactions between the significant values of the surface water, groundwater and dependent ecological systems (achieved largely through the development and use of a multilayered groundwater model).
- the development of a refined water management plan that identifies interrelationships between water and environmental values and issues, so that the development and operation of the KIP will not impact significantly upon the environmental values of the area.

A draft plan was released for the Kemerton subareas in 2005. While not deviating from that draft significantly, this plan updates some aspects of that document to improve the management of the groundwater resource, and therefore replaces the 2005 draft plan.

This plan has been prepared to incorporate the KIP in the new Kemerton subareas (see Section 1.4). It draws on the work of Aquaterra and ATA Environmental and applies the management principles and policies of the Department of Water.

1.2 The water accounting period

For the purposes of groundwater allocation management and planning for commercial and industrial uses, the water accounting period for the Kemerton subareas starts on 1 January and ends on 31 December annually. All management decisions and monitoring practices undertaken by the department for commercial and industrial licences will be based on this water accounting period.

For the purposes of groundwater allocation management and planning for horticultural uses, the water accounting year for the Kemerton subareas starts on 1 July and ends on 30 June annually. All management decisions and monitoring practices undertaken by the department for horticultural licences will be based on this water accounting year.

Splitting the water accounting period for the different categories of use assists the department to manage the groundwater resources of the Kemerton subareas by:

- spreading the workload over twelve months
- capturing the full irrigation season, in the case of horticultural licences.

Where reporting of annual rainfall is a licence requirement, it should be for a calendar year.

1.3 Date of commencement and life of this plan

This plan will take effect on **1 January 2007**. Within seven years of the plan's implementation, the Department will consider whether action needs to be taken to review, amend or revoke the plan.

1.4 The Kemerton subareas this plan applies to

The Bunbury Groundwater Area was proclaimed under s. 26B of the *Rights in Water and Irrigation Act 1914* (RiWI Act) on 20 June 1975 and subdivided into seven subareas. The South West Coastal Groundwater Area was proclaimed on 22 April 1977 and subdivided into 11 subareas.

A proclaimed groundwater area under the RiWI Act prohibits the construction of water bores and the taking of groundwater without a licence issued by the department, other than for domestic and stock purposes from the superficial aquifer. Licensing of abstraction from bores is the primary tool for regulating the amount of groundwater taken for consumptive use.

The KIP crosses the boundary between the Bunbury and South West Coastal Groundwater Areas and covers portions of the Myalup, Wellesley and Australind subareas (Figure 1.1). To improve management, this plan has realigned the subareas. For the superficial aquifers, the new subareas will based on the major land use (Figure 1.2) and, because of their regional nature, the regionally confined aquifers amalgamated into two subareas (Figure 1.3).

For the purpose of this plan:

- The superficial aquifers are divided based on the major land use into the Myalup (rural, mainly horticulture), Wellesley (rural, mainly grazing), KIP North (potential heavy industry), KIP South (existing and further potential heavy industry), and Australind (urban and rural).
- Regionally confined aquifers are simplified into two subareas, Kemerton North and Kemerton South.

The Yarragadee aquifer exists in the Kemerton South subarea, but since early 2007 has been consolidated into a single subarea within the Bunbury Groundwater Area for water management purposes.

Action[1] 1 – Further subarea changes are required to represent hydrogeological understanding and to encompass the Kemerton Industrial Park into one groundwater area.

This plan recommends:

- *That the proclaimed southern boundary of the South West Coastal Groundwater Area be relocated to the north to encompass the Myalup and Wellesley subareas into the Bunbury Groundwater Area*
- *Extending the eastern proclaimed boundaries of the Bunbury and South West Coastal Groundwater Areas to the Darling Fault to wholly encompass the sedimentary aquifers of the Perth Basin.*

[1] Actions have been identified throughout this document to improve the management of the Kemerton water resources. These will be implemented by the department. For all actions see Table 7.2 in Section 7.2.

The recommended changes to the proclaimed groundwater area boundaries will require de-proclamation and re-proclamation and approvals from both houses of parliament. Subarea boundaries are not proclaimed boundaries and, as such, can be amended at any time.

1.5 Waters this plan applies to

This plan applies to water that percolates from the ground to a well or other works, as defined in s. 2 of the RiWI Act as 'underground water' or 'underground water resource', and commonly referred to as 'groundwater' or 'groundwater resource'.

The groundwater in the Kemerton subareas is divided into four distinct groundwater resources based on the hydrogeology of the:

- superficial aquifer
- Leederville aquifer
- Yarragadee aquifer
- Cattamarra Coal Measures aquifer.

Other sources of water may be available (such as non-traditional sources, waste-water treatment or piping water into the area), however, these will not be covered in this groundwater management plan. If you require further information on water resource availability, please contact the department's Bunbury office.

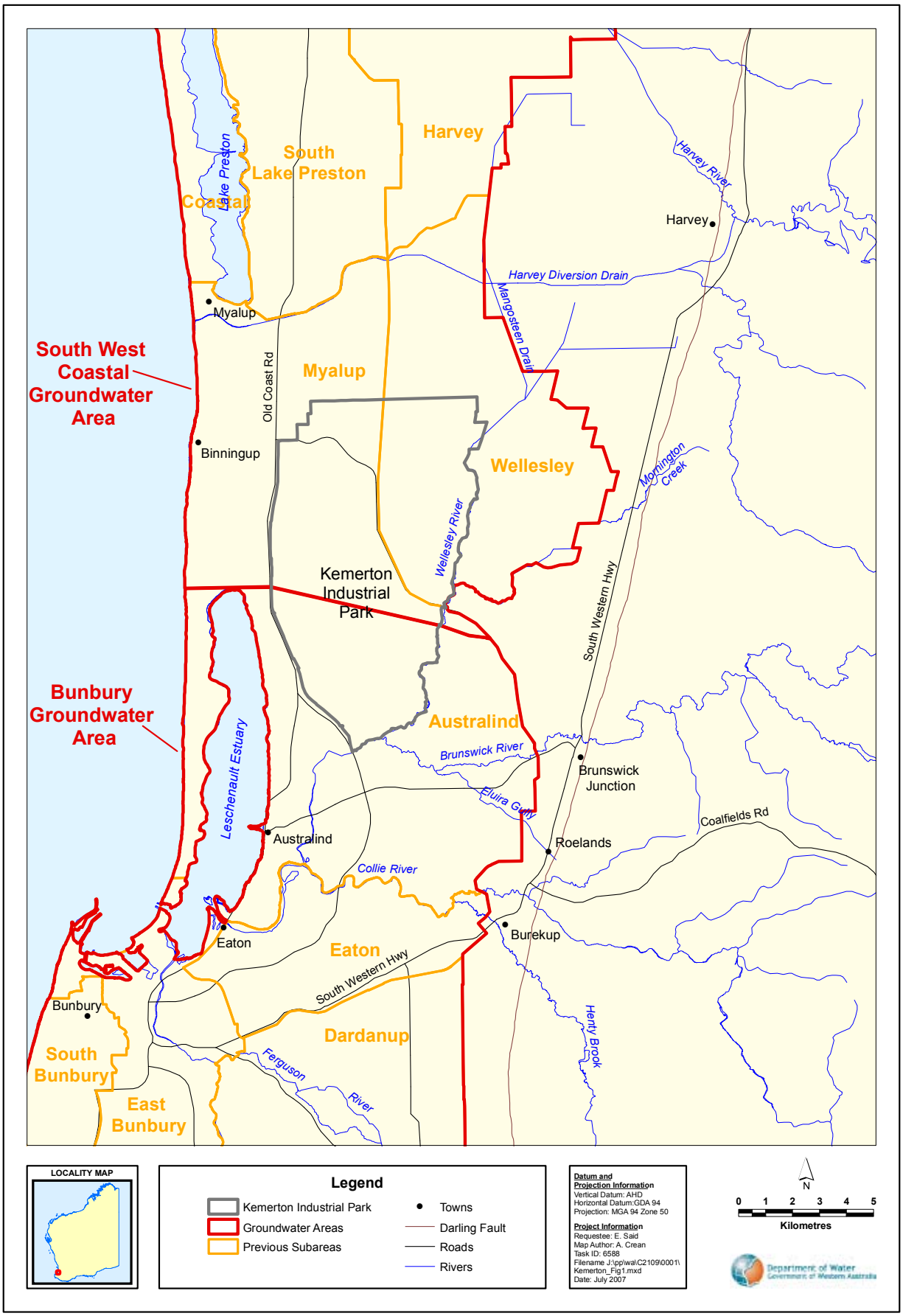

Figure 1.1 Map showing previous subareas within the South West Coastal and Bunbury Groundwater Areas

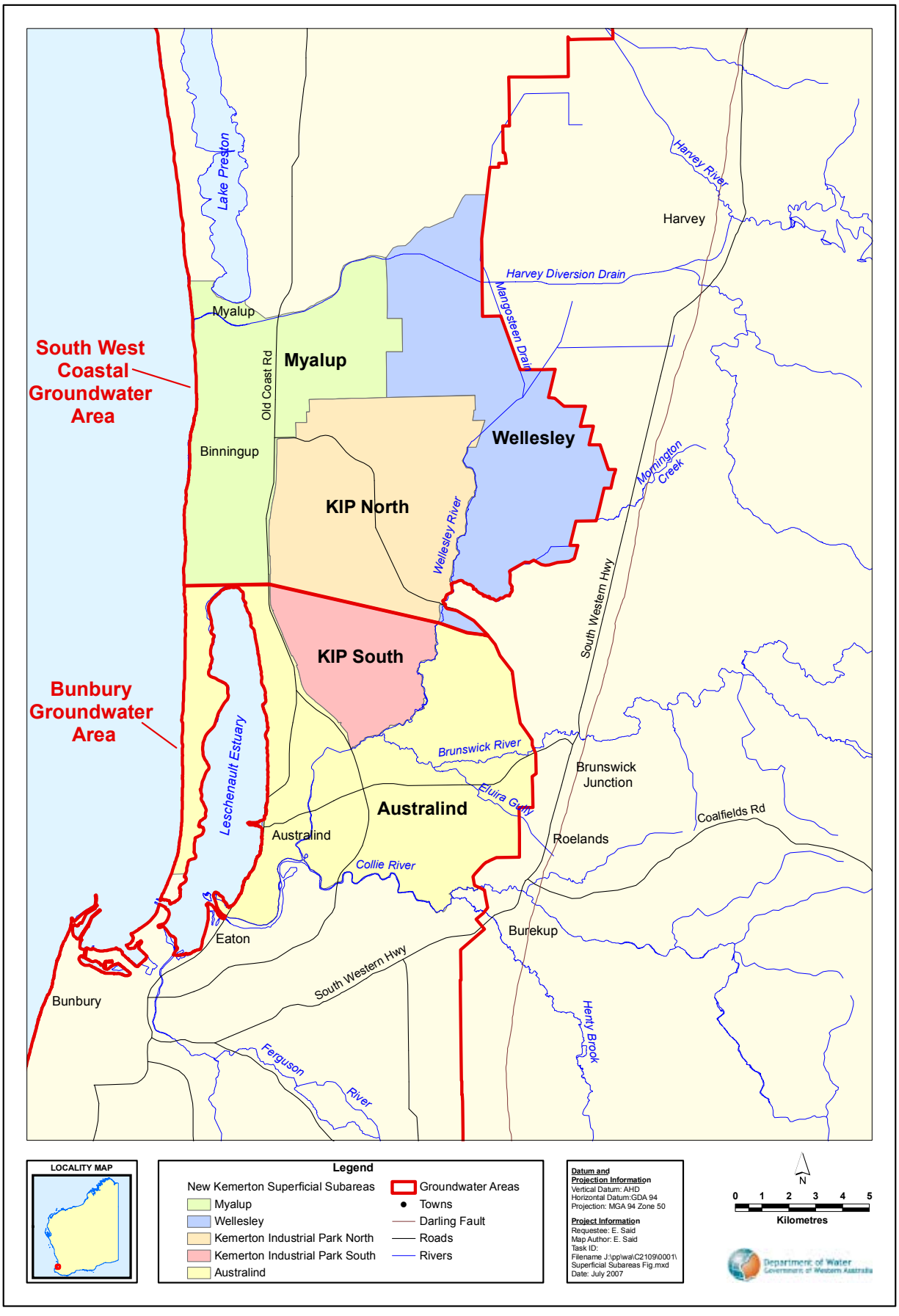

Figure 1.2 New subareas for the superficial aquifers within the South West Coastal and Bunbury Groundwater Areas

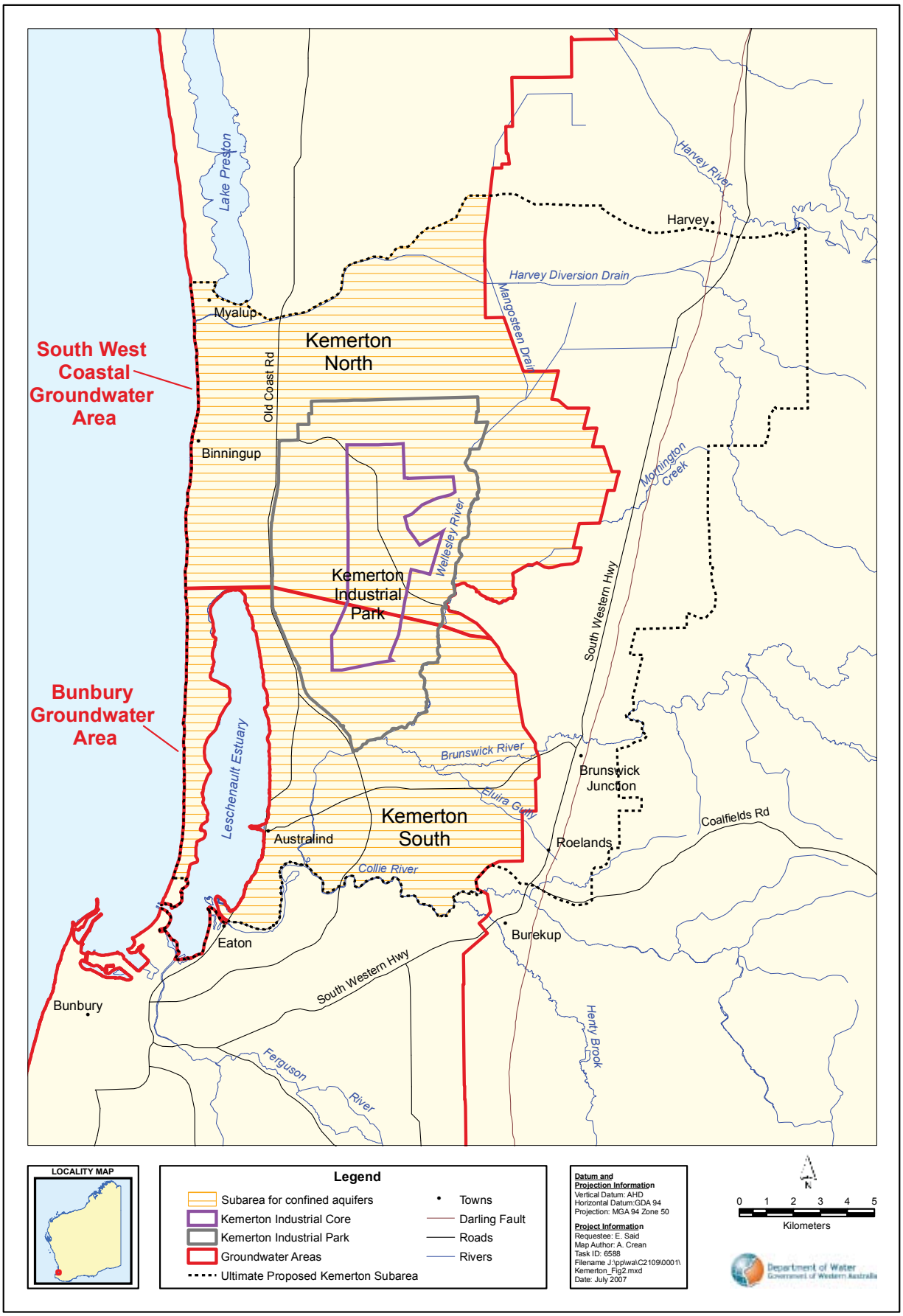

Figure 1.3 New subareas for the regionally confined aquifers within the South West Coastal and Bunbury Groundwater Areas

2 Characteristics of the Kemerton subareas

The characteristics of the Kemerton subareas described below, are summarised from the Kemerton Water Study Phase 2 (Aquaterra and ATA Environmental 2002) which should be referred to for more detail.

2.1 Physical characteristics

The Kemerton subareas are on the Swan Coastal Plain with the western half characterised by three sets of stabilised sand dunes that are parallel to the coast, and the eastern half by a flat alluvial plain mostly of clayey sand and dissected by man-made drainage channels. Lakes and wetlands occur between the low-lying areas of the dunes.

The Kemerton subareas have a Mediterranean-type climate characterised by hot, dry summers and cool, wet winters during which much of the rainfall occurs. The long-term average annual rainfall is about 830 mm, but from 1970 to 1999 the average was 753 mm, and this is the figure used for groundwater modelling. Average annual evaporation in the area ranges from 1,000 mm at the Parkfield Station to 1,850 mm at the Wokalup Station.

2.2 Land use

Most of the land in the Kemerton subareas is used for pasture or is natural bushland. The Kemerton Industrial Park is in the centre of the subareas, a silica sand mine is in the middle north, horticulture and tree farming in the north-west, and the towns of Australind, Binningup and Eaton at the periphery, toward the coast. Land use types are illustrated in Figure 2.1.

2.3 Surface water

West of the Wellesley River, the surface water is characterised by natural wetlands while in the east, it is characterised mainly by man-made irrigation channels and drains to remove excess winter rainfall and lower the watertable for pasture. The irrigation water is sourced from the Wellington and Harvey dams and is distributed through a series of channels on the coastal plain. Excess irrigation water from the channels is discharged into the Wellesley, Brunswick, Collie and Harvey rivers, which discharge along the coast. A large proportion of annual flow for each of the rivers occurs between June and September.

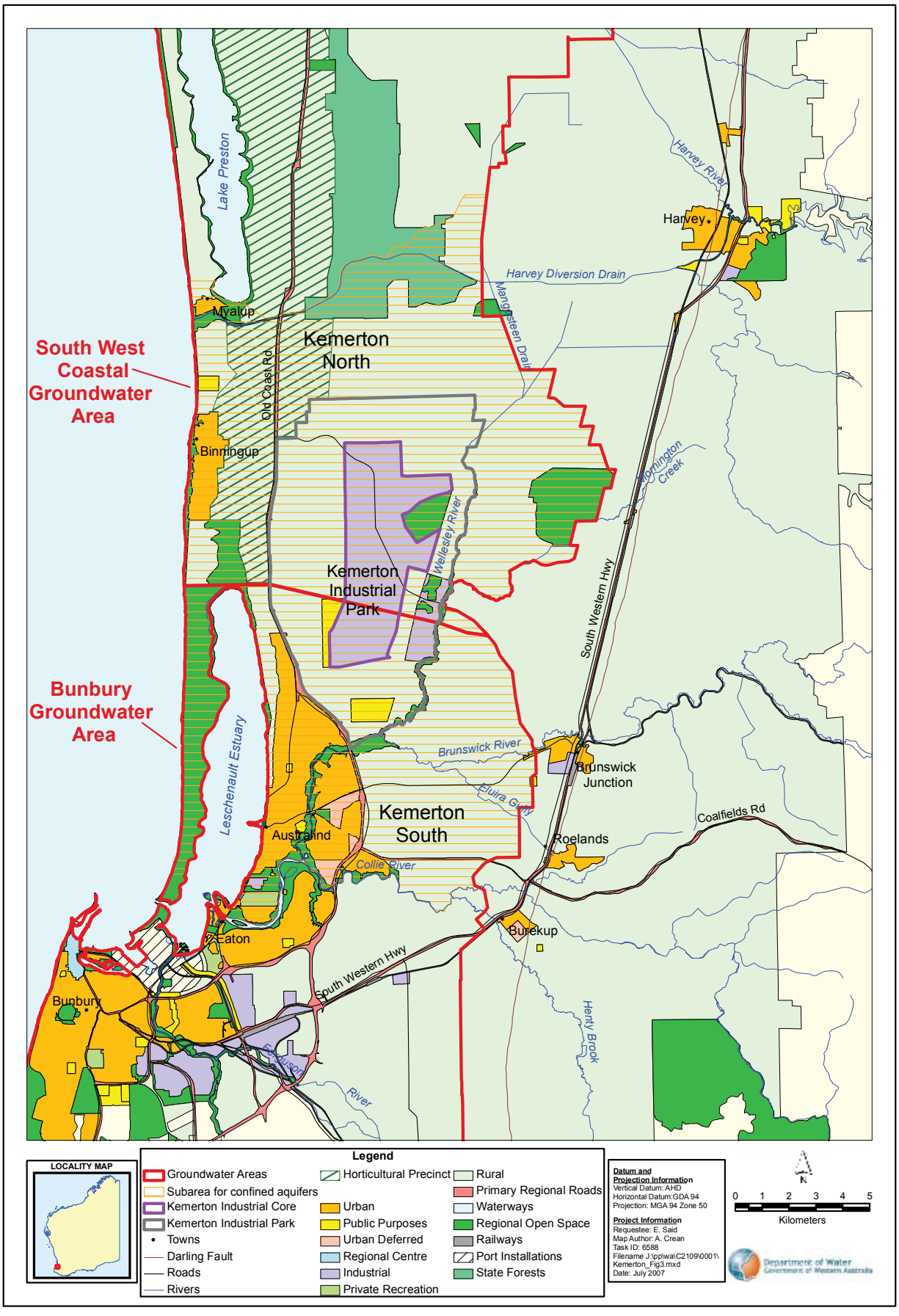

Figure 2.1 Land use in the Kemerton subareas (derived from the Greater Bunbury Scheme (WAPC 2000))

3 Characteristics of the groundwater resources

The following hydrogeological descriptions are taken from the Kemerton Water Study Phase 2 (Aquaterra and ATA Environmental 2002), which should be referred to for additional technical details.

3.1 Superficial aquifer

The unconfined superficial aquifer consists predominantly of clay and sand in the east and sand and limestone in the west, and attains a saturated thickness of approximately 20-40 metres.

Topography, drainage and surface geology influence the hydrogeological regime of the superficial formations, giving rise to the potential for groundwater mounding to occur in areas of higher ground (AGC Woodward-Clyde 1993), such as the Mialla Groundwater Mound (located east of Binningup) and between the Old Coast Road and the Wellesley River (Hammond 1989).

The aquifer is recharged by rainfall, but a large proportion of the infiltration is lost because of evapotranspiration from wetlands and areas where the watertable is shallow. Estimates of groundwater recharge for the area range between 5 and 40 per cent of annual rainfall (Aquaterra and ATA Environmental 2002: Figure 9.7).

Groundwater flow is generally westwards from the Darling Scarp, except in the eastern half of the Mialla Groundwater Mound where the groundwater flow is generally to the east towards the Wellesley River. Seasonal variations in the watertable are about one to two metres and can usually be correlated with the variations in rainfall. Groundwater discharges locally to watercourses, swamps and wetlands (including Myalup Swamp), the Wellesley River and Leschenault Inlet. There is also leakage to the underlying Leederville aquifer and to the Indian Ocean across a saline interface. In the clay soil in the east, the superficial aquifers are heavily drained to allow for grazing.

Groundwater to the west of the Wellesley River is generally fresh to marginal - 250-1,500 mg/L total dissolved salts (TDS) - and is generally brackish to the east. In local discharge areas west of the Wellesley River, the salinity can be as high as 20,000 mg/L TDS. Fresh groundwater (< 500 mg/L TDS) is generally more extensive at the watertable than at the base of the aquifer. The groundwater salinity generally increases in the direction of groundwater flow, but there are significant local variations due to differences in permeability, evapotranspiration, leakage from clays and irrigation. A saline interface occurs along the western boundary of the aquifer at the coast.

Action 2 – A technical review of the salinity effects of irrigation and appropriate mitigation identified in the Myalup and other related subareas will be completed.

Action 3 – A review of the buffering capacity of soils in this area will be completed to examine acid sulfate soil issues.

3.2 Leederville aquifer

The regionally confined Leederville aquifer is recharged mainly by downward leakage from the overlying superficial aquifer. Upward leakage from the deeper regionally confined Yarragadee aquifer in the southern part of the Kemerton Subareas may also occur (AGC Woodward-Clyde 1993).

Regional groundwater flow is westward, discharging offshore. Discharge is also likely to occur through upward leakage into the superficial aquifer between Myalup Swamp and the saline interface closer to the coast. Artesian flows may be encountered in the low-lying area west of Myalup Swamp.

Groundwater is freshest (850–1,500 mg/L TDS) between the main recharge area and the saline interface near the coast. The remainder of the aquifer is brackish to saline (1,500–19,000 mg/L TDS). The saline interface is estimated to occur at a depth of around 45 m in the Leederville aquifer (below the base of the superficial formations), between one and two kilometres inland from the coast.

3.3 Yarragadee aquifer

The regionally confined Yarragadee aquifer underlies the Leederville aquifer but is only in the southern part of the Kemerton subareas; it consists predominantly of sandstone. Monitoring bores near Bunbury indicate that the Yarragadee aquifer and the Cattamarra Coal Measures aquifer form a single flow system (Wharton 1979) or are in hydraulic continuity. Recharge to the aquifer is likely to occur mostly from the south or south-east (Wharton 1979) where the aquifer outcrops, and the groundwater flow is generally east to west, discharging out to sea.

The salinity of the aquifer is between 300 and 8,000 mg/L TDS. Groundwater is freshest in the upper part of the flow system and is brackish to saline in the lower part (Wharton 1979).

3.4 Cattamarra Coal Measures aquifer

The Cattamarra Coal Measures aquifer is a regionally confined multilayered aquifer composed of siltstone and shale interbedded with sandstone. Monitoring bores in the area show that recharge by downward leakage probably does not occur within the Kemerton subareas, but may occur to the north. To the south, the aquifer is likely to be in hydraulic continuity with the Yarragadee aquifer and groundwater throughflow from the Yarragadee to the Cattamarra Coal Measures aquifer could occur. The natural seasonal variation in water levels is about 0.5 m.

The groundwater salinity ranges between 2,510 and 26,100 mg/L TDS and in general, the groundwater salinity is lower in the south than in the north. The fresher quality groundwater in the southern part of the aquifer is likely to be attributed to the throughflow from the Yarragadee aquifer. The Cattamarra Coal Measures aquifer can be divided locally into two parts separated by a shale layer, with an upper sequence containing fresher quality groundwater and a lower sequence containing brackish groundwater (Rockwater 1996). The active flow system in the west contains brackish groundwater (2,500–7,000 mg/L TDS) and the remainder of the aquifer is saline. The salinity levels are probably a reflection of the distance from recharge and the low permeability of the sediments. In the area of the Kemerton Industrial Park, the water is mostly brackish (< 3,000 mg/L TDS).

4 Management framework

Groundwater management in Western Australia is guided by legislation, regulations, principles, frameworks, policies and strategies at the national and state level. The principles adopted for groundwater management in the Kemerton subareas are listed below.

4.1 Principles

Water resource management principles adopted in this plan, to be taken into account when considering licensing of groundwater abstraction in the area, are as follows:

- groundwater entitlements are allocated in the order in which licence applications are received by the department (ie on a 'first in, first served' basis)
- water resources should be shared equitably between ecological needs, social expectations and demands to consume water for economic benefit
- the use of groundwater should be compatible with the desired local, regional and state economic and social development
- the allocation of water should be fair and equitable to allow both short-term and long-term planning, and land use objectives to be met
- natural ecological processes and the biodiversity of groundwater-dependent ecosystems are to be maintained at an acceptable level of risk
- where there is the potential for significant impacts arising from groundwater abstraction
    - individual licensees are responsible for determining potential impacts from pumping on identified high value groundwater-dependent ecosystems and existing users
    - the department is responsible for determining regional impacts on high value groundwater-dependent ecosystems and existing users
- all groundwater development must include consideration of, and appropriate investment in, water efficiency measures.

Community education on groundwater matters and involvement in the decision-making process are essential in sustaining a strong and effective groundwater management effort.

Action 4 – The department will contact water users to discuss water management and options to help improve the long-term sustainability of commercial operations.

Water management decision making will use the above principles and will also consider those overarching principles defined in the South West Regional Water Plan.

5 Groundwater availability

The availability of groundwater for abstraction is based on a water balance between how much water is entering the groundwater system as recharge, how much is naturally discharging from the system, and how much groundwater (in the form of a water regime or water levels) is required to maintain high value groundwater-dependent ecosystems. In the Kemerton Water Study Phase 2 (Aquaterra and ATA Environmental 2002), a detailed groundwater model was developed with coverage over the Kemerton subareas and the four aquifers. Groundwater abstractions were simulated to estimate the potential susceptibility of ecosystems to groundwater level drawdowns. From the potential groundwater abstraction simulations, the available groundwater and the estimated Allocation Limits for each of the aquifers were established.

5.1 Groundwater-dependent ecosystems

The high value groundwater-dependent ecosystems in the Kemerton subareas include permanent and seasonal wetlands. Several of the wetlands are identified in the gazetted *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (EPA 1992). These wetlands and lakes are protected from activities such as draining, filling, mining, pollution or any alteration to their hydrological function. Several of the wetlands are also identified as Conservation and Resource Enhancement category wetlands. Conservation category wetlands support a high level of ecological attributes and functions (WRC 2001a). Resource Enhancement category wetlands may have been partially modified but still support substantial ecological attributes and functions (WRC 2001a). Both of these categories are of a high priority for protection by the department, which will act in a precautionary way towards activities that may lead to further loss or degradation. The locations of these wetlands are shown in Figure 5.1.

Terrestrial vegetation and the ecosystems it supports can also be groundwater-dependent. This vegetation is most susceptible to any decline in the groundwater level (such as in times of drought), as their root systems have adapted to the shallow groundwater.

Banksia ilicifolia is a species that is prominent within the Jarrah–Marri–Banksia woodland and is widespread throughout the Kemerton subareas. *Banksia ilicifolia* is phreatophytic (accessing water from the groundwater level) and poorly adapted to a sudden or rapid decline in the water table (Groom et al. 2000). It is a species that is restricted in its distribution by the depth to groundwater (usually occurs where depth to groundwater is 2–10 m) (S Nicoski and R Froend, Edith Cowan University, unpub. data).

Ecological Water Requirements (EWRs) are the water regimes needed to maintain ecological values of groundwater-dependent ecosystems at a low level of risk (Water and Rivers Commission 2000). Froend and Zencich (2001) determined the EWRs for the Perth region; these were adopted in the second phase water study by Aquaterra (Aquaterra and ATA Environmental 2002) to determine acceptable groundwater abstraction scenarios in the Kemerton subareas.

The water requirement criteria for the terrestrial vegetation are a set of critical tolerance levels of groundwater drawdown impacts, for three categories of depth to groundwater (Table 5.1).

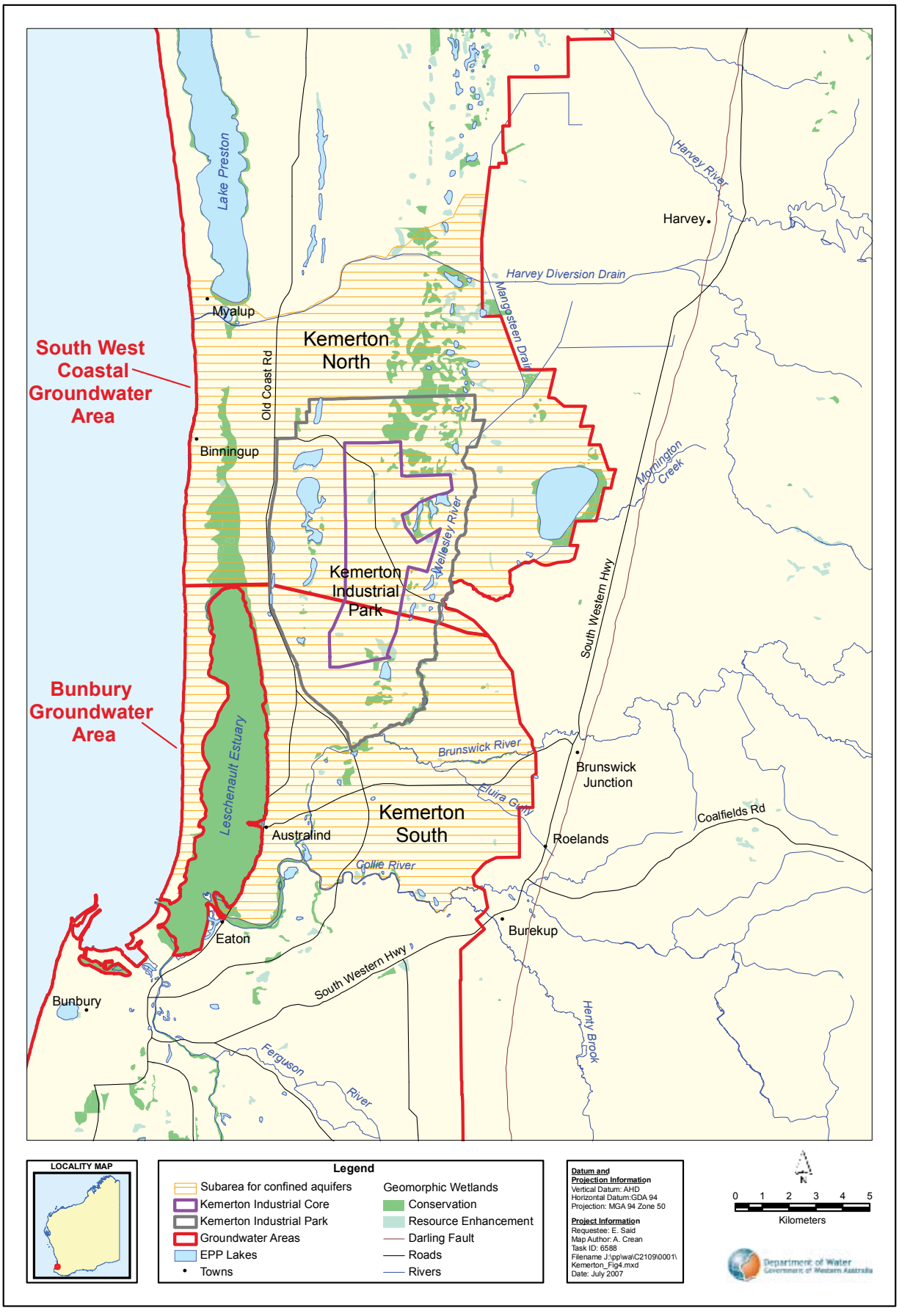

Figure 5.1 Conservation category and environmental protection policy wetlands

Table 5.1 Ecological Water Requirement criteria: critical tolerance levels of extended groundwater drawdown impact for terrestrial vegetation

Wetland category	Depth to groundwater (m)	Critical levels of drawdown (m)
1	0–3	0.75
2	3–6	1.25
3	6–10	1.75

There are no established critical levels of drawdown for groundwater at depths exceeding 10 m and no significant groundwater-dependent ecosystems were considered in the determinations on groundwater availability under these circumstances.

In wetland areas where the groundwater is at or very close to the ground surface, the EWRs criterion is a maximum allowable net drawdown of 0.25 m of the watertable caused by groundwater abstraction and/or other factors[2]. It must be noted that the above criteria were used as a general guide for a regional assessment of the aquifer performance and in this case were used to determine the Allocation Limit of the aquifers in the Kemerton subareas. Site-specific work may still be required by licensees to identify actual high value groundwater-dependent ecosystems and the impact of their abstraction on these.

Action 5 – Specific Ecological Water Requirements will be established for key groundwater-dependent ecosystems in the Kemerton subareas.

Action 6 – New vegetation and water level monitoring will be analysed and reported publically.

5.2 Allocation Limit

The Allocation Limit (AL) is the maximum annual volume of groundwater that is available for abstraction.

Every groundwater abstraction has a degree of impact on the natural groundwater resource regime and its dependent values. In this plan, the AL is set to ensure that the annual groundwater abstraction regime does not have unacceptable impacts on the groundwater resource (quantity and quality) and its high value dependent ecosystems (wetlands, terrestrial vegetation, surface water base flow, etc.).

A review of the local area model and the South West Groundwater Areas water management plan have provided a better understanding of the movement of water between subareas and the water required to maintain salinity interfaces and environmental water. The ALs below better reflect the current knowledge and replace the figures in the 2005 draft plan.

[2] This critical level does not include impacts by climate change. However, it is unlikely that water level reduction in this developed area is solely impacted by climate change.

Superficial aquifer allocation limits

The ALs for the superficial aquifers are as follows.

KIP North and KIP South subareas

The department has determined that Allocation Limits in the vicinity of the Kemerton Industrial Park (KIP) should be 1 GL/year, which is equivalent to 790 ML/year and 210 ML/year for the KIP North and KIP South subareas respectively, based on area. Modelling indicates that this level of superficial aquifer abstraction coupled with optimum bore location will not unacceptably impact on groundwater-dependent ecosystems, such as the wetlands and the terrestrial vegetation nearby.

Myalup subarea

The AL for the Myalup subarea is 7,350 ML/year and is based on a rainfall recharge of 25%, rainfall of 800 mm/year and an area of 52 km^2, and allows 30% of this to mitigate any coastal saline intrusion. The rainfall recharge of 25% is based on a composite of Safety Bay Sand (0.4 of area times 40% recharge rate), Tamala Limestone (0.15 of area times 5% recharge rate), and Tamala Sand (0.4 of area times 20% recharge rate) and Peaty Deposits (0.05 of area times 15% recharge rate), which gives 25% recharge – recharge rates based from the Kemerton Water Study (Aquaterra and ATA Environmental 2002).

Wellesley subarea

The Wellesley subarea has an AL of 2,150 ML/year. Bassendean Sand is present in the northern part of the subarea and has been modelled with a recharge rate of 40%, which gives a potential recharge of about 6,400 ML/year (3,200 kL/ha) assuming a rainfall of 800 mm/year and an area of 20 km^2. The area to the east of KIP is mostly Guildford Clay over an area of about 35 km^2, which from the modelling has a potential recharge of 4,200 ML/year (1,200 kL/ha) assuming rainfall of 800 mm/year and a rainfall recharge of 15%. The total potential recharge is therefore about 10,600 ML/year.

However, in this area, water on the surface and in the watertable is heavily drained to allow for pasture and grazing and therefore the real recharge, compared to potential recharge, is limited. By far the greatest potential for groundwater development will be in the northern part of the subarea that is underlain by Bassendean Sand. The amount of water is further reduced to ensure that enough recharge in the northern areas is reserved to maintain aquifer quality and dependent environmental values. Accounting for this, the allocation of 2,150 ML/year is about 30% of potential recharge in the northern part of the subarea underlain by the Bassendean Sand and some minimal recharge in the east of the subarea, underlain by the Guildford Formation.

Australind subarea

The Australind subarea is mostly underlain by low yielding Guildford Clay to the east of the Brunswick River with a smaller area of Bassendean Sand and associated Conservation Category Wetlands next to the river. West of the Brunswick River the land is heavily urbanised and is underlain mostly by permeable Tamala Sand that accounts for most of the groundwater licences. The area of Tamala Limestone and Safety Bay Sand to the

east of the Leschenault Estuary is about 21 km^2, which from the modelling has a potential recharge of 3,400 ML/year (1,600 kL/ha) assuming rainfall of 800 mm/year and a recharge rate of 30%.

Groundwater flows westwards through the Tamala Sand into the Leschenault Estuary, which is a Conservation Category Wetland. The AL has been set at 690 ML/year to maintain sufficient flows into the environmentally sensitive Leschenault Estuary.

In addition to ALs, any local abstraction in the superficial aquifers in all the subareas will be carefully assessed. The assessment of new or amended licences is supported by an impact management framework established through monitoring and licence conditions, to ensure that the concentration of draw does not impact on the security of supply to existing users, groundwater quality and the environment.

Demand for water in the superficial aquifer is currently greatest for the horticultural industry in the Myalup subarea and the area is experiencing increased salinity levels, indicating abstraction of groundwater is having an impact (Kern 1998). The department will liaise closely with water users in this area to review water use practices and halt any further decline in water quality.

The superficial aquifer ALs are summarised below in Table 5.2.

Table 5.2 Allocation Limits and licensed entitlements for the Kemerton subareas for the superficial aquifer (as of 31 July 2007)

Ground-water area	Subarea	Allocation Limit (ML/year)	Licensed entitlements (ML/year)	Public water supply reserve (ML/year)	Stock and domestic (ML/year)	Unlicensed stock and domestic (ML/year)	Available water (ML/year)
South West Coastal	KIP North	790	18	0	7	15	757
	Myalup	7,350	6,803	0	10	374	173
	Wellesley	2,150	878	0	10	52	1,220
Bunbury	KIP South	210	222	0	5	7	–19
	Australind	690	427	0	45	181	82

KIP = Kemerton Industrial Park; ML = megalitre

Confined aquifer allocation limits

The department has determined the annual AL for the regionally confined aquifers primarily using the Kemerton Groundwater Model (see Section 5.5) as follows.

Leederville aquifer

The groundwater model identified that a further 4,000 ML/year was available in the Leederville aquifer. In the Kemerton South subarea, the AL for the Leederville aquifer was increased by 1,000 ML/year in 2003 following the Kemerton Water Study (Aquaterra and ATA Environmental 2002). The other 3,000 ML/year has been added to the Kemerton

North subarea. This will spread the groundwater availability almost evenly between the Kemerton North and South subareas. The ALs in the Leederville aquifer are 3,500 ML/year for Kemerton North subarea and 5,000 ML/year for Kemerton South subarea. However, with the expected increase in population and full development of the KIP, demand for a public water supply will also increase. Public water supply is the highest value use of water and to cater for the expected demand, the additional 3,000 ML/year will be reserved for public water supply only.

Cattamarra Coal Measures aquifer

The groundwater model identified that a further 9,000 ML/year was available in the Cattamarra Coal Measures aquifer. No AL was assigned in the previous Myalup and Wellesley subareas, but in the amalgamation to form the Kemerton North subarea, the Cattamarra Coal Measures aquifer will have an AL of 6,000 ML/year. The remaining 3,000 ML/year will be added onto the Kemerton South subarea, which will make the AL for the aquifer in that subarea 4,000 ML/year. More water has been apportioned to the Kemerton North subarea as the Kemerton South subarea had an existing 1,000 ML/year AL in the Cattamarra Coal Measures aquifer and a 4,000 ML/year AL in the Yarragadee aquifer. The Yarragadee aquifer in this area is regarded as being in hydraulic continuity with the Cattamarra Coal Measures aquifer and therefore the regional management of the Yarragadee aquifer needs to consider its impact on the Cattamarra Coal Measures aquifer within the Kemerton subareas.

The confined aquifer ALs are summarised below in Table 5.3.

Table 5.3 Allocation limits and licensed entitlements for the Kemerton subareas for the regionally confined aquifers (as of 31 July 2007)

Ground-water area	Subarea	Aquifer	Allocation Limit (ML/year)	Licensed entitlements (ML/year)	Public water supply reserve (ML/year)	Stock and domestic (ML/year)	Water allocated
South West Coastal	Kemerton North (ex-Myalup & Wellesley)	Leederville	3,500	150	3,000	50	90
		Cattamarra Coal Measures	6,000	0	0	0	0
Bunbury	Kemerton South (ex-Australind)	Leederville	5,000	4,848	0	5	97
		Cattamarra Coal Measures	4,000	992	0	0	25

KIP = Kemerton Industrial Park; ML = megalitre

Recognising that the Kemerton Industrial Park is a key demand centre for water, it should be noted that as of 31 July 2007, total water available for this industrial area is 10,193 ML/year. This does not include access to water available in the superficial in Myalup, Wellesley and Australind subareas, as the park is not located within these subareas. Applications for available water is subject to the licensing assessment process outlined in this plan.

5.3 Over allocation

Table 5.2 shows that the KIP South subarea of the superficial aquifer is over allocated. This has occurred because the ALs have been reduced to recognise the need to secure quality water supply for existing users as well as environmental needs. This is not a significant over allocation and immediate and critical impacts are not expected.

In this area there will be no more licences issued and the department will identify unused allocations that are no longer required and investigate options for water users to find alternative sources of water in this area such as the underlying confined aquifers.

Through monitoring and a review of environmental impact this allocation may be adjusted to reflect the actual impact of the existing allocation.

Action 7 - A compliance survey will be completed in the Kemerton Industrial Park South subarea and a report on the alternative options and environmental risk of the current allocation will be made.

5.4 Impacts of climate change

The Allocation Limits for the Kemerton subareas were calculated based on the current understanding of the prevailing climatic conditions (rainfall period of 1970-99 for the Central Coast District). A long-term shift to drier years is likely to alter the recharge from rainfall and reduce the availability of water. This could result in a reduction of the Allocation Limit, which may require a corresponding reduction in groundwater abstraction. Alternatively, a long-term shift to wetter years could have the opposite effect. Consequently, if water availability is significantly affected by a change in climate, then a change in the water allocation will be assessed.

Action 8 – The Kemerton groundwater model will be reviewed in line with the updates to the South West Aquifer Modelling System Groundwater Model (SWAMS, regional model covering several groundwater areas) and agreed climate change scenarios, to determine future Allocation Limits and licensing rules.

5.5 Groundwater model

A numerical five-layered Kemerton Groundwater Model was developed as part of the Kemerton Water Study (Aquaterra and ATA Environmental 2002). The model is capable of simulating water level response under various abstraction scenarios, potential impacts on groundwater-dependent ecosystems (based on the EWR criteria stipulated above) and the characteristics of the groundwater resource, such as the encroachment of seawater on the groundwater interface.

The model completely covers the Kemerton subareas and the unproclaimed Perth Basin areas to the east, an area of approximately 25 km × 25 km, with a resolution of 100 m × 100 m. The model takes into account the interaction between surface water and groundwater, evapotranspiration, leakages and throughflow between aquifers, the interface between seawater and groundwater and existing abstraction (based on licensed allocation).

The model is the property of Landcorp and a formal request to Landcorp is required to obtain a copy.

6 Groundwater use and licence assessment

6.1 Allocation basis

Licence applications for the Kemerton subareas will be assessed in the order in which they are received ('first in, first served'). Under normal licence application procedures, some applicants are requested to provide additional information before their application can progress through the assessment process for approval.

6.2 Determining the level of assessment for a licence application

The department's *State-wide Policy Report No. 19 – Hydrogeological Reporting Associated with a Groundwater Well Licence* contains a method for determining the level of assessment to be applied to licence applications.

Under the Kemerton plan, deciding on the level of assessment has been simplified so that the volume of groundwater under application will determine the level of assessment. Three levels of assessment are prescribed for abstractions.

1 50 ML/year or less.

2 Between 50 ML/year and 250 ML/year.

3 More than 250 ML/year.

These levels correspond with assessment levels H1, H2 and H3 in State-wide policy report no. 19.

The department will assess the licence applications based on their adherence to protocols, outlined below, for each assessment level.

Level 1 threshold – groundwater licence applications of 50 ML/year or less

Applicants applying for a licence to abstract up to 50 ML/year must meet the following requirements:

- The department's standard licence assessment process will apply. Generally, a hydrogeological and impact assessment report will not be required by the applicant unless there is likely to be a significant impact on high value groundwater-dependent values or other users.
- The bore construction must meet at least the minimum requirements that have been set for Australia (LWBC and NMBSC 2003).
- Section 26E of the *Rights in Water and Irrigation Act 1914* RiWI Act (RiWI Act) will apply (eg providing the department with completed bore details that include lithological logs, geophysical logs, bore construction details, pumping test data, water quality, bore yield, etc.).
- Bores into shallow superficial aquifers should generally not be constructed where they may potentially affect high value wetlands (WRC 2001a). If no alternative options exist, the applicant will need to commission an environmental impact assessment on the wetland, by a suitably experienced and qualified professional, to demonstrate negligible impact to the high value wetland.

- In areas where groundwater abstraction is highly concentrated or where local intensive abstraction occurs, the applicant will need to demonstrate negligible cumulative impact on groundwater-dependent ecosystems and existing users.

Level 2 threshold – groundwater licence applications between 50 ML/year and 250 ML/year

Applications requesting abstraction of between 50 and 250 ML/year must meet the requirements of the level 1 threshold plus:

- An environmental impact assessment statement may be required from the applicant, in particular if there are high value groundwater-dependent ecosystems within the zone of influence of the proposed abstraction. Such a statement would be in the form of a professional report that defines the zone of influence of the proposed abstraction, identifies any high value groundwater-dependent ecosystems within this zone and clearly addresses the risks to any of these groundwater-dependent ecosystems.
- A simple analytical model may be required to demonstrate the potential groundwater level drawdown on the high value groundwater-dependent ecosystems.

Level 3 threshold – groundwater licence applications of more than 250 ML/year

Applications requesting abstraction of more than 250 ML/year must meet the requirements of the level 1 and 2 thresholds plus:

- A comprehensive assessment of the groundwater level drawdown within the zone of influence, ideally using the Kemerton Groundwater Model described in Section 5.5. Such abstractions may require local scale assessment of the hydrogeology, groundwater-dependent ecosystems, surface water interaction and impacts on existing users.
- A determination of the impacts on other users and cumulative impact on groundwater-dependent ecosystems determined by the applicant from a groundwater flow model, such as the Kemerton Groundwater Model.
- A groundwater level change criteria based on the modelling results, which must not be exceeded.

6.3 Assessment of impacts on groundwater-dependent ecosystems

The groundwater-dependent ecosystems in the Kemerton subareas are mainly permanent and seasonal wetlands. Individual licensees are responsible for providing information on their potential pumping impacts on these groundwater-dependent ecosystems as well as existing groundwater users. It is the responsibility of applicants to demonstrate that their proposed development will be sustainable in the long term[3].

The impacts on high value groundwater-dependent ecosystems will be assessed with reference to the Kemerton Water Study Report (Aquaterra and ATA Environmental 2002), which contains the current information on the hydrogeology and environmental values.

[3] Including consideration of climate change where appropriate.

As noted in Section 5.1, the Ecological Water Requirement (EWR) criteria will be used for licensing and additional site-specific work may be required if an applicant's abstraction regime could have a significant impact on high value groundwater-dependent ecosystems.

This may include:

- determining the EWRs for the high value groundwater-dependent ecosystems
- setting groundwater level criteria at each groundwater-dependent ecosystem and associated monitoring bores
- monthly monitoring of water levels and water quality, including baseline levels, and in accordance to Davis and Horwitz (1997) and ANZECC and ARMCANZ (2000)
- seasonal monitoring of biological condition
- reporting to the department on groundwater level trends, trends in biological condition, the relation between the two, and compliance with groundwater level criteria
- identifying triggers and associated management actions, including switching off production bores, to ensure criteria are met.

Applicants are advised to contact the department's South West Regional office in Bunbury for advice on the appropriateness of these requirements to their application and for the scope of work required for licence consideration, before undertaking additional work to generate this information. Provision of information that does not satisfy the department's requirements will result in the application not being approved.

A source of information on the environmental values of the area is the Environmental Protection Authority Bulletin 1108 (EPA 2003). The bulletin made recommendations on environmental issues to the Western Australian Planning Commission's Greater Bunbury Scheme (WAPC 2000).

6.4 Licensing rules

1 The Kemerton subareas are within the South West Coastal and Bunbury Groundwater Areas, which are proclaimed under the RiWI Act, and as such, access and use of groundwater is subject to licensing under s. 26GY(2)(b).

2 Licences to abstract groundwater are the primary allocation management instruments both in defining the amounts of water that can be taken and in placing conditions on the taking of water. Licensing is administered with the intention of:

   - limiting the abstraction of groundwater within the limits of the sustainable groundwater yield of the resource
   - preventing problems before they occur
   - monitoring the extent of water abstraction
   - identifying and securing the rights of users
   - sharing the resource.

3 Where relevant, and if groundwater abstraction does not cause adverse impacts to the aquifer, significant groundwater-dependent ecosystems or existing users, the existing policy of an absolute maximum of 4 ML/ha for horticultural usage

or 1.5 ML/lot/year for special rural zones will apply to the superficial aquifer. It is expected that 4 ML/ha will not be required in the majority of cases through efficient irrigation and water management.

4 The requirement for efficiency and reduced rates of pumping is because the 4 ML/ha/year limit currently applied to much of the horticultural industry may not be sustainable in the longer term, especially if the bores are configured along the flow lines and/or are concentrated, as this has the potential of recycling the used groundwater. Inefficient configuration and over pumping of water is one of the causes of the increase in groundwater salinity (see Kern 1998). This has impacts on the long-term condition of the productivity of the soil as well as quality of produce and neighbouring water users.

5 A 500 m buffer will apply to properties next to the Leschenault Estuary, Lake Preston or other areas of high salinity. The area within the buffer will not be included in the calculation for determining the maximum possible annual water entitlement.

6 Proponents must show, to the department's satisfaction, a water balance for how much water is required for a particular use with efficiency measures included (such as soil moisture probe results) to identify the volume and rate of water required. Through this process it is expected that 4 ML/year will not be required for the majority of operations.

6.5 Licence applications

1 Applications for licences made under Division 2 of Schedule 1 of the RiWI Act will be accepted by the department and either granted or refused at the discretion of the department in accordance with clause 7(1). In exercising that discretion, the department is to have regard to all matters that it considers relevant in accordance with clause 7(2).

2 Licences for groundwater exploration purposes (a licence under s. 26D of the RiWI Act) may be issued for a period of up to 12 months or as determined by the department. This s. 26D licence will allow applicants to investigate whether there is sufficient water available to meet the requirements and to determine any likely impacts caused by pumping. The department gives no guarantee that licences to take water (a licence under s. 5C of the RiWI Act) will be issued at the completion of the investigation.

3 Investigations and information required by the department must be completed in reasonable time as defined in the *State-wide Policy Report No. 17 – Timely Submissions of Required Further Information.*

4 Discharges of abstracted groundwater (including for testing the sustainability of the resource, such as pumping tests) will need to meet water release criteria, approved by the department, relevant to the discharge site, such as creeks or infiltration trenches. The criteria are required to ensure that the quality of the water, the health of the flora and fauna and the soils at the discharge site are not compromised.

6.6 Monitoring groundwater abstraction quantity

1 In accordance with Schedule 1, clauses 46 and 47 of the RiWI Act, all new and renewed licences of more than 50 ML/year, and licences for commercial use, will require the licensee to provide, install and appropriately maintain a department approved flow meter. The flow meter is to be installed to each groundwater abstraction instrument, such as a bore, that is the subject of a licence to take water.

   The setting of the 50 ML/year threshold will support the accounting for water as required under the National Water Initiative and reduce the risk of impact on current user's capacities to access their water. This will be relevant in the Kemerton subareas where industrial and horticultural abstractions may be close together. Under the *Blueprint for Water Reform in WA* (Department of Water 2007) existing licences of more than 50 ML/year will be metered. In addition metering of existing water licences below 50 ML/year may also be required where circumstances warrant, such as where:

   - there are specific risks to EWR criteria levels, water quality and impacts on other water users;
   - trading is undertaken or there is an intention to trade;
   - there is conflict over water use;
   - there is community demand for water metering;
   - the requirement to meter is specified in an existing management plan or licence; or
   - it is required to properly manage the resource.

2 Licensees subject to metering are required to read their meters monthly and supply the data to the department one month after the end of the water accounting year with the following information:

   - volume of groundwater pumped from each bore at the close of each month
   - what the water is used for
   - for agricultural use, the type and area of crops irrigated and the method of irrigation.

3 Licensees subject to metering have the responsibility to ensure that the water pumped is measured accurately.

4 The department may at any time test a meter or require a meter to be tested independently by the licensee.

5 The quantity of water flowing past the meter will be presumed to be the quantity of water that has actually been taken by the licensee. If the meter is not working properly, missing for repairs, installed incorrectly, or interfered with in any way to show a reduced volume of water being used, the department will conservatively estimate the volume of water used during the period when the meter was not working.

6 The department reserves the right to prescribe fees for the testing or reading of a meter.

6.7 Monitoring groundwater abstraction quality

The department may require the licensee to monitor the quality of the groundwater to ensure that its beneficial uses are not compromised. Monthly monitoring of groundwater salinity may be required. In this case, the licensee must report an increase in the salinity of the groundwater resource to the next threshold salinity category (Table 6.1) to the department within seven days. For example, if groundwater abstraction leads to an increase of groundwater salinity from fresh to brackish quality, then the department must be notified. It is in the interest of groundwater users to monitor the quality of their groundwater, in particular its salinity. Deterioration of groundwater quality could lead to undesirable impacts on the activities of users and the environment. Depending on the area and circumstance the department may also require, as part of the licensee's licensing condition, monitoring of other analytes.

Table 6.1 Salinity water quality guideline

Salinity (mg/L TDS)	Salinity status
< 500	Fresh
500–1,000	Marginal
1,000–2,000	Brackish
2,000–5,000	Moderately saline
5,000–10,000	Saline
10,000–35,000	Highly saline
> 35,000	Hyper-saline

TDS = total dissolved salts

Source: NHRMC and NRMCC (2004)

6.8 Managing groundwater quality

This plan addresses the management of the groundwater resource and the licensing associated with sustainable abstraction from this resource. Point source pollution of groundwater through industrial or other activities is not covered in this plan and is regulated through the *Environment Protection Act 1986*. The Department of Environment and Conservation is responsible for ensuring appropriate quality monitoring and industry compliance with this Act. The Department of Environment and Conservation use licences under the *Environmental Protection Act 1986* and associated conditions to initially reduce the risk of pollution events, and to ensure remediation action when they do occur. The Department of Environment and Conservation should be contacted if evidence of a pollution event has been identified.

6.9 Monitoring groundwater levels

The department may require the licensee to establish groundwater monitoring bores in the vicinity of the groundwater abstraction site to monitor the impact of the abstraction on the groundwater levels. Monthly monitoring of groundwater levels (in m AHD[4]) may be required for one year and if the groundwater level trend shows no significant lowering of the groundwater level, then twice-yearly monitoring at the extreme ends of the season cycle (such as one in April and one in October) may be adequate.

It is in the interest of the user to monitor the groundwater levels as any reduction or reducing trend in the levels could limit the availability of the resource. The reduction may have a significant impact on the activities that relied on the water and therefore the user could plan for options or implement measures to prevent the reduction in the groundwater levels.

6.10 Licence conditions

These conditions are in accordance with Schedule 1, division 3 of the RiWI Act.

1 Licence conditions will be at the discretion of the department in accordance with clause 15(2), current policies and procedural instructions and this plan.

2 Conditions will be placed on licences issued within the Kemerton subareas, appropriate to the abstraction of water, the activities being undertaken and the potential or demonstrated impacts of those activities on any identified environmental, social and economic values.

3 Information collected as part of licence condition compliance is used in conjunction with the department's regional water monitoring program to protect neighbouring groundwater users, minimise environmental degradation and maintain the long-term sustainability of the aquifer system.

6.11 Livestock and domestic water

Groundwater use for domestic purposes and livestock is acknowledged as a priority need for all landholders and no groundwater licence is required *(Rights in Water and Irrigation Exemption and Repeal (Section 26C) order 2001)* for this type of use of water from the superficial aquifers. However, under s. 5C of the RiWI Act, if the groundwater is from a regionally confined aquifer, then a groundwater licence will be required.

It is advised that land holders and local governments contact the department about the suitability of domestic bores (existing properties or subdivision) in the Kemerton subareas to avoid unnecessary costs if the water quality or availability risks have not been considered.

[4] Australian height datum

6.12 Development plans and reporting conditions

Applications for licences must be accompanied by a detailed development plan and timetable that stipulates the required water need for each stage of the development. Should the total requested water be available, the department may gradually increase the allocation to satisfy the water needs in accordance with the agreed development timetable. If the proposed development does not take place or is delayed, the licensee should show cause as to why the allocation should be renewed for the following years or stages. In the event that less water is required for the development than originally anticipated, or there is adverse impact on other users or the environment, the licensed allocation may be reduced. *State-wide Policy No. 9 - Licensing - Staged Developments (2003)* will be used to manage these situations.

Conditions can be applied to licences to monitor and report on aquifer performance in response to groundwater abstraction. Key performance indicators may include the routine measurement of groundwater levels and salinity. Monitoring is not necessarily restricted to the development area. Where required, the department can also request off-site monitoring of impacts. This information is used in conjunction with the department's regional water monitoring program to protect neighbouring groundwater users, minimise environmental degradation and maintain the long-term sustainability of the aquifer system.

6.13 Trading water entitlements

The ability to trade water entitlements is provided by schedule 1, division 7 of the RiWI Act and the relevant procedures or policies detailed in the department's *State-wide Policy No. 6 - Transferable (Tradeable) Water Entitlements for WA* (WRC, 2001b).

6.14 Acid sulfate soils

Acid sulfate soils are soils that contain iron sulfides, predominantly as pyrite. These soils are benign when undisturbed, but the exposure of the pyrite to air, such as by drainage, dewatering (water level declines by pumping groundwater) or excavation of soil can generate substantial amounts of sulfuric acid. The discharge of acidic water into waterways and wetlands could lead to the loss of aquatic biodiversity. The infiltration of acidic water could significantly contaminate the groundwater with acid, metals and other contaminants that are toxic to humans and other biota. Lowering of acidity in soil water or water bodies can change community composition of dependent biota whereby acid-tolerant species are favoured and those that are intolerant disappear from that environment. In effect, the impact will lead to the deterioration of the quality of the groundwater. It is in the proponent's best interest to assess the existence of acid sulfate soils in their area of application, as the development of acidic water could compromise the integrity of infrastructures, equipments and the health and safety of workers.

The department may require the proponent to establish an appropriate acid sulfate soils management plan to ensure groundwater quality and dependent ecosystems are not significantly impacted. Particular areas of concern relevant to this plan include estuaries, floodplains and wetlands, and generally in areas with clayey soil. More detail and updated information on acid sulfate soils are available from the Department of Water website (www.water.wa.gov.au).

7 Plan implementation

7.1 Monitoring

Regional groundwater level and water quality monitoring are fundamental components of this plan. Monitoring is required to ensure that the groundwater resources of the Kemerton subareas are managed within their Allocation Limits, that groundwater quality is not deteriorating because of groundwater abstraction, and to assist in the identification of potential unacceptable impacts to high value groundwater-dependent ecosystems and existing users. Ongoing monitoring of groundwater level and water quality has the potential to identify early, any undesirable groundwater resource changes and/or trends.

For the life of this plan:

- Regional groundwater monitoring data will be used to ensure the management objectives of this plan are met.
- The monitoring information will be used to review the state of the water resource and Allocation Limits in the future.
- A brief groundwater performance appraisal will be prepared by the department's Water Investigation and Assessment Branch periodically or when significant issues arise. At the minimum, the appraisal should contain brief assessments of the groundwater level and salinity level trends.

The existing regional groundwater monitoring program is detailed in Table 7.1 and the locations of the monitoring bores are shown in Figure 7.1.

Table 7.1 Regional groundwater monitoring program[a]

Bore line	Aquifer	Parameter
Binningup Line	Superficial	Groundwater levels and salinity
	Leederville	Groundwater levels and salinity
	Cattamarra	Groundwater levels and salinity
Bunbury Shallow	Superficial	Groundwater levels and salinity
	Leederville	Groundwater levels
	Yarragadee	Groundwater levels
Harvey Shallow	Superficial	Groundwater levels
Kemerton	Leederville	Groundwater levels
	Cattamarra	Groundwater levels
Lake Clifton	Superficial	Groundwater levels
Leschenault Peninsula	Leederville	Groundwater levels

a All bore lines are monitored every two months.

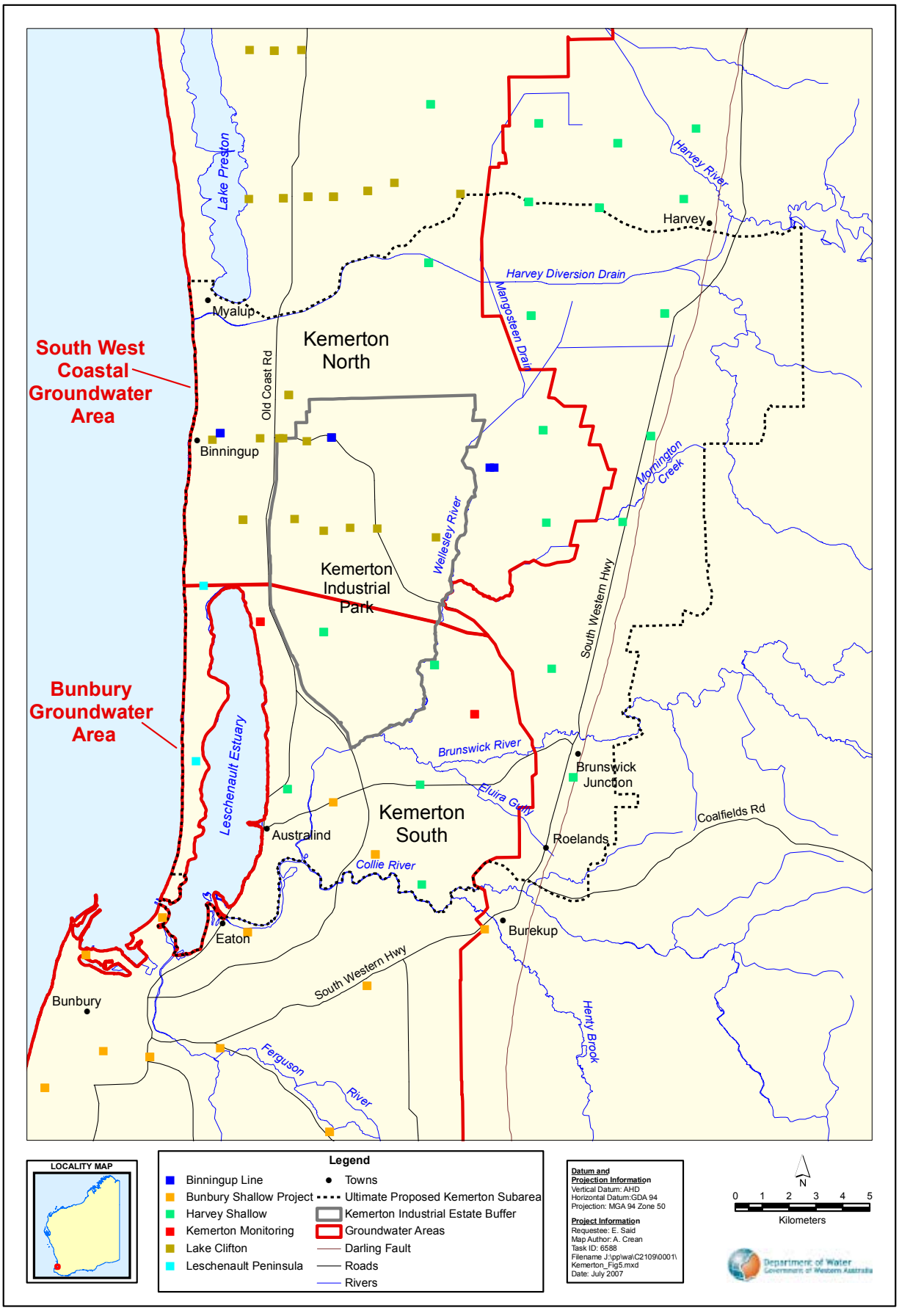

Figure 7.1 Regional groundwater monitoring bores

Action 9 – This monitoring program will be reviewed to account for environmental and other work identifying adjustments in monitoring requirements (i.e. salinity reporting).

7.2 Actions

Actions have been identified throughout this document to improve the management of the Kemerton water resources. These actions will be implemented; however, the department may decide that further actions are also required depending on the ongoing monitoring results and further analysis of the resource condition. Table 7.2 identifies these actions and others that are deemed as necessary; all are the responsibility of the Department of Water.

Table 7.2 Actions for the Department of Water for the management of Kemerton water resources

Action number	Action	Trigger/timeline
4	Department advice to water users to ensure efficient operations under this plan	Within 1 year of the plan
–	Engage users in program of awareness of trading concepts	Within 1 year of the plan in the Myalup Subarea When confined aquifers reach 80% allocated in the KIP
–	Provide an assessment of future industrial water demands from the KIP	Within 1 year of the plan
2	Technical report reviewing salinity impacts of water use and recommending mitigation/efficiency measures	Within 2 years of the plan
6	New vegetation monitoring outputs reported	Within 2 years of the plan
7	Compliance survey of the KIP South superficial abstraction and report on current management against the identified over allocation	Within 2 years of the plan
1	Proclamation of new groundwater areas and subarea changes	Within 3 years of the plan
3	A report reviewing the soil buffering capacity of the Kemerton soils	Within 3 years of the plan
5	Local Ecological Water Requirements will be established for key groundwater-dependent ecosystems in the Kemerton subareas	Within 3 years of the plan

Action number	Action	Trigger/timeline
8	Review of modelling and climate change scenarios	Within 3 years of the plan
9	The monitoring program (Section 7.1) will be reviewed	One year after actions 2, 3 and 5 are completed
–	A formal water use survey and follow up compliance program will be completed before the review of this plan to confirm changes in use of water and ensure accurate accounting and licensing of water for future planning	Use approaching 80% of Allocation Limit in the KIP Within 3 years of the plan for Myalup
–	Review allocation plan	Use approaching 90% of total Allocation Limit. Significant and continuing (4 years) breech of environmental water criteria levels Significant and continuing (5 years) increase in salinity of superficial aquifer Before 2013

KIP = Kemerton Industrial Park

7.3 Evaluation and reporting

A status report will be released by the Department of Water two years after publication and then every two years after this. This report will identify all actions required by the plan that have been completed or are pending, will describe changes in the allocation of water and will report analysed monitoring results tracking the water resource condition. This will be advertised in the local paper and made available through the Department of Water website.

If the triggers mentioned in Table 7.2 or other significant impacts and issues not recognised under this plan are occurring, this report may recommend a review of the plan.

7.4 Review of this plan

This plan will be reviewed or replaced within seven years. The department, in consultation with the community, will take into account any relevant reports and information gathered from the monitoring program and consider if changes need to made to this plan.

The purpose of the review is to decide whether the plan's provisions remain adequate and appropriate for the sustainable management of the groundwater resources in the management area.

The minister may direct that this plan be reviewed earlier than seven years due to changes that require changes to the rules and policies of this plan.

The review may recommend the continuation of this plan, or the development of an amended plan.

Corrections for clerical mistakes, errors, inaccuracies or omissions, or the replacement of any outdated factual information may be made at any time and will be publicly declared.

Western Australia is currently reviewing legislation for the management of water resources. Any significant changes in legislation that may affect this plan will need to be noted and the appropriate changes made through review.

Glossary

Abstraction	The permanent or temporary withdrawal of water from any source of supply, so that it is no longer part of the resources of the locality.
Allocation limit (AL)	The amount of water set aside for annual licensed use. In the Department's current water licensing system, the allocation limit is a volumetric licensing limit. As such, the allocation limit does not always account for basic stock and domestic water rights which do not require a licence. However, the meaning of the term will become broader as the Department's water accounting systems are developed.
Aquifer	A geological formation or group of formations that is able to receive, store and transmit significant quantities of groundwater.
Confined aquifer	An aquifer that is confined between aquitards and containing water under pressure.
Domestic use	The use of a water resource that is not for commercial purposes.
Ecological values	The natural ecological processes occurring within water-dependent ecosystems and the biodiversity of those systems.
Ecological Water Requirements (EWR)	The water regime needed to maintain the ecological values of (including assets, functions and processes) water-dependent ecosystems at a low level of risk.
Equity	Treating those in the same circumstances in the same manner, through a system of principles, policies and processes that supplement the common and statutory law framework.
Evapo-transpiration	The combined loss of water by evaporation and transpiration. It includes water evaporated from the soil surface and water transpired by plants.
First in, first served	A process by which groundwater entitlements are allocated in the order in which licence applications are received by the department.
Groundwater	Water which occupies the pores and crevices of rock or soil beneath the land surface.
Groundwater area	An area that is proclaimed under the *Rights in Water and Irrigation Act 1914* (RiWI Act) and used for water allocation planning and management.
Groundwater-dependent ecosystem (GDE)	An ecosystem that is partially or fully dependent on groundwater for its sustained existence.
Groundwater level	The top of the water surface of an aquifer.

Leakage	The flow of water from one aquifer to another.
Policy	Refers to a guideline that is not directly supported by any legislation but has been adopted by the department as its guideline.
Public water supply reserve	A volume of groundwater that has been reserved for town water supply purposes (drinking water for human consumption) and, where appropriate, to satisfy the water requirements for developments of state significance under State Agreements to which the *Government Agreements Act 1979* applies.
Recharge	The downward movement of water, usually expressed as a percentage of rainfall depending on the stratigraphy, that contributes to the groundwater resources of an aquifer system.
Regionally confined aquifer	Regionally meaning it is confined and/or artesian at any point within the plan area.
Salinity	The measure of total soluble salt (i.e. mineral constituents in water). Water resources are classified on the basis of salinity in terms of total dissolved salts (TDS) or total soluble salts (TSS). Measurements are usually milligrams per litre (mg/L) or parts per thousand (ppt).
Subarea	A subdivision within a Surface or Groundwater Area, defined for the purpose of managing the allocation of groundwater resources. Subareas are not proclaimed and can therefore be changed internally without being gazetted.
Surface water	Water flowing or held in streams, rivers and other wetlands on the surface of the landscape.
Sustainability	Meeting the needs of current and future generations through integration of environmental protection, social advancement and economic prosperity.
Throughflow	The flow of water within an aquifer
Transferable (tradable) water entitlement (TWE)	The ability to transfer or trade a licensed water entitlement, or a part thereof, within a common water resource, to another person.
Water entitlement	The quantity of water that a person is entitled to take annually in accordance with the *Rights in Water and Irrigation Act 1914* or a licence.
Water regime	A description of the variation of flow rate or water level over time. It may also include a description of water quality.
Water resource	Watercourse, wetland or underground water source to which s. 5C of the *Rights in Water and Irrigation Act 1914* applies.
Watertable	The top of the water surface of a superficial aquifer.

Acronyms and abbreviations

AL	Allocation Limits
EWR	ecological water requirement
KIP	Kemerton Industrial Park
ML	megalitre
RiWI Act	*Rights in Water and Irrigation Act 1914*
TDS	total dissolved salts

Volumes of water

Volumes of water are measured in litres. Different volumes of water are referred to in this document.

One litre	1 litre	1 litre	(L)
One thousand litres	1,000 litres	1 kilolitre	(kL)
One million litres	1,000,000 litres	1 megalitre	(ML)
One thousand million litres	1,000,000,000 litres	1 gigalitre	(GL)

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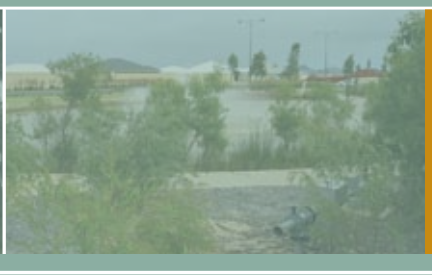
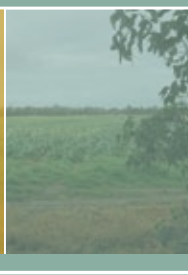

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