South West groundwater areas
water management plan —
allocation

Draft for public comment

Department of Water

Water resource allocation planning series no 21

February 2008
Acknowledgements

The Department of Water would like to thank the following for their contribution to this publication: Patrick Seares, Rebecca Palandri, Natasha Del Borrelo, Adrian Goodreid, Travis Cattlin, Penny Wallace-Bell, Phil Commander, Annaleisha Sullivan, Mick Owens, Susan Worley and the South West Region.

For more information about this report, contact:

South West Regional office, Bunbury
35-39 McCombe Road
Bunbury WA 6230
or
PO Box 261 Bunbury WA 6231
PH: 08 9726 4111
Fax: 08 9726 4100

February 2008

ISSN 1327-8428 (pbk)
ISSN 1834-2620 (pdf)

ISBN 978-1-921094-96-5 (pbk)
Foreword

This draft plan provides water users and the wider community the opportunity to comment on the Department of Water’s proposed management approach for groundwater in the south-western corner of the state.

Our goal is to manage the water resources in the best interest of the whole community, considering carefully the sometimes competing demands of regional development and protection of the South West’s natural assets. This goal is becoming ever more challenging in the context of a drying climate.

Many farmers and regional towns in the eastern states are having a hard time because water was allocated before the drying climate was recognised, and now some are only receiving a small amount of their entitlements. At the same time the environment is also being affected as the available water is stretched to meet demand.

This plan is a major step in avoiding these issues in the South West. It aims to ensure that a safe amount of water is made available so people have security in their entitlements, that the South West’s environment we all value is protected, and that people will use their water more efficiently as it is recognised for the valuable resource it is.

Your input on our South West groundwater areas water management plan is important. It will help us achieve the right balance between the productive use of this water and conservation of precious natural resources.

Once you have read this document, please send your comments to allocationplanning@water.wa.gov.au by 19 May 2008. Alternatively you may post your comments to the address at the front of this document.

John Ruprecht
A/Director General, Department of Water
South West groundwater areas

Legend
- Plan boundary
- Proclaimed groundwater areas
- Towns
- Major rivers

Sources
Department of Water acknowledges the following datasets used in the production of this map:
- Glenn Loomes - Contour Areas - Metadata data
- Western Australia Towns - CL1 - 2005
- Global Map Data Australia H - GDA - 20/05/2001
- Plan_Boundary, DEW - 06/11/2002
- Proclaimed_GW_Areas, DEW - 12/10/2002
- Geohydrology, Geological (Hierarchy) - DEW - 08/05/2006

Datum & projection information
- Vertical Datum: AHD
- Horizontal Datum: GDA 2000
- Projection: MGA 94 Zone 50

Locality map

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Summary

What is this all about?

The Department of Water manages how much water is taken from rivers and groundwater systems through water management (allocation) plans.

Our plan sets out where further water is available, how much water is left for the environment and the policies for how all groundwater abstraction and use will be managed in the area. The plan also provides for water trading on fully allocated resources.

Why are we doing this?

The work for this plan began in response to the now withdrawn proposal, to abstract 45 GL/a from the Yarragadee aquifer for the Integrated Water Supply Scheme.

Although this proposal is not proceeding, it highlighted the south west as a priority area of the state for closer management, due to reducing rainfall, increased demand and better understanding of the groundwater system.

This plan sets our consistent approach to allocation and licensing within the area. The plan shows the key considerations we addressed in providing security of supply to current users and the environment, while assessing the amount of water available for new commercial and private users.

What is the picture for South West groundwater areas and its water resources?

The South West is experiencing a climate change pattern with less and less rainfall reaching the groundwater system every year. In addition to this we have seen major growth in the number of people living in the area, as well as in commerce and local industries. All rely on secure water supplies. There are currently around 4000 groundwater licences to abstract water within the area.

This plan covers the important Yarragadee aquifer as well as the groundwater resources of Leederville and superficial aquifers among others. The water levels in some of these aquifers are beginning to decrease due to reduced rainfall and abstraction. In some of the northern aquifers the recycling of salt through irrigation is having an impact on groundwater quality.

The environment in the South West is highly valued by the community as well as being recognised for its outstanding biodiversity. Key features, such as some of the Blackwood River tributaries and important coastal plain wetlands and lakes have been identified for careful management. Currently the environment is sustained by the existing water level regime but increased abstraction on top of the predicted reductions in rainfall would result in future impacts.
**What is the strategy for the South West groundwater areas?**

In some parts of the South West current water use has reached the full allocation limit. In other areas there is water available for further use.

The environment is protected through this plan. The allocation limits have been set to minimise the predicted risk to wetlands and rivers in the future, while sustaining reasonable growth in the region. The environmental monitoring program and the impact management policies in this plan, outline how risk is managed on a local basis to avoid unacceptable impacts from local water abstraction.

This plan defines allocation limits to ensure that there is enough water to secure supply to existing licensed users. This means that in some areas the allocation limits have been decreased due to our improved understanding of reducing rainfall, the environment and hydrogeology. Water has not been made available in areas where it could lead to an increased risk of restrictions on existing licensees.

Water has been reserved to ensure clean safe drinking supplies are available for local towns to expand provided this water is used efficiently.

Water will not be allocated above the allocation limits as set in this plan. This means that to continue developing in some parts of the region, with limited water available, new and existing commercial water users will have to start thinking about how they can use water more efficiently, use alternative supplies, find fit for purpose water or trade for water. This is particularly true with the Yarragadee aquifer.

In areas of full allocation the plan promotes a trading environment. People are encouraged to be more efficient so that others can purchase these water efficiency gains to sustain regional commercial development. Some areas in the South West have already been operating successfully in a trading market for a number of years.

The following is a summary of the percentages of available water for future allocation in the South West groundwater areas:

- **Bunbury groundwater area** has 25% of the allocation limit remaining for licensing in the superficial aquifer, with 10% remaining in the Leederville aquifer, less than 1% in the Yarragadee aquifer and 75% from the Cattamarra Coal Measures.

- **Busselton–Capel groundwater area** has 20% of the allocation limit remaining for licensing in the superficial aquifer, with 20% remaining in the Leederville aquifer, less than 4% in the Yarragadee aquifer.

- **Blackwood groundwater area** has 85% of the allocation limit remaining for licensing in the superficial aquifer, with 1% remaining in the Leederville aquifer, 25% in the Yarragadee aquifer and less than 1% from the Lesueur Sandstone aquifer.
• South West Coastal groundwater area (partially present in the plan area) has 50% of the allocation limit remaining for licensing in the superficial aquifer, less than 1% in the Leederville aquifer and 100% from the Cattamarra Coal Measures.

The Yarragadee is often the preferred aquifer in the South West and therefore has been developed faster than other aquifers. Although 45 GL/a was considered with stringent local impact management in one area, this plan recognises that not as much water from the Yarragadee aquifer can be safely made available to be used widely across the groundwater areas by smaller users, without the same level of impact management or regional hydrogeological understanding.

Currently there is 75 GL/a of licensed use in the Yarragadee aquifer with an additional 20 GL/a of water allocated in this plan. Of this 20 GL/a the plan reserves approximately 15 GL/a for town water supply, and after existing pending licenses (submitted prior to this plan) are assessed and responded to, there will be little available water from this aquifer for new licences.

Any water from the Yarragadee aquifer remaining or ‘new’ water found through investigations will be released through an appropriate mechanism to be announced by the department. Otherwise, water users will need to look to efficient use of alternative aquifers, surface water or potential trading for further development.

**How did the Department of Water develop this draft plan?**

Work on the South West groundwater area management plan effectively began in late 2002 as part of the South West Yarragadee licence investigations and assessment.

The Department of Water and the Water Corporation have completed groundwater investigation and modelling alongside ecological assessments, community consultation, water user surveys and monitoring data assessments. The department has used the best information there is available to develop this plan. The supporting technical work was a huge investment by the government in this part of the state.

Recognising that there are still gaps in this priority area of the state, the department aims to continually improve our management through the joint funding between the department and the federal government of over $6 million of further work in the next three years to develop a new plan in 2011. This new work will ensure that the south western corner is understood and managed as well as any other regional groundwater systems in Australia.
How can you have your say?

This draft plan has been developed to give the water users and the wider community of the South West the opportunity to provide feedback to the department on our approach to groundwater management in the South West. We will review and consider your comments before finalising our groundwater management plan. We will produce a statement of response, which will summarise your views and comments and how we have considered them. This response will be released with the final water management plan. We may quote directly from your comments, so please state clearly if you do not wish us to do so.
How to use this document

*What is a water management plan and why is it necessary?*

Chapter 1 outlines what the water management plan is, what it will address and the area it covers. Chapter 2 covers local factors and issues that we consider in all our management planning and licensing decisions.

*How much water is available?*

Chapter 3 outlines how much water is currently used and how much could be available for further allocation.

*What is the licensing and allocation strategy?*

Chapter 4 outlines the rules and policies that govern how we will manage water in the South West groundwater areas.

*How will this plan be implemented and reviewed?*

Chapter 6 details how the plan will be implemented, what we need to do to ensure the plan is successful in managing the resources, and how the plan will be reviewed in the future.

*Technical information and supporting documents*

We have used a number of reports to determine the water management and licensing strategy for the South West groundwater areas.

You may access the majority of these reports on our website [www.water.wa.gov.au/allocationplanning](http://www.water.wa.gov.au/allocationplanning).

If you are unable to access the internet, please contact the Department of Water through the contacts listed on the second page of this document.

*Actions and implications for licensing*

The actions described in this plan are found in Chapters 2 to 5 and are summarised, with their associated time frames for completion, in Chapter 6. The actions are the department’s commitments to future investigations and planning work and providing information to the public.

The implications for licensees and licensing officers are detailed in Chapter 2. The information described in Chapter 2 may have implications for the licence assessment process or for a licence application and should be noted before beginning the licensing process.
1 The plan

1.1 Purpose of the plan

This water management plan provides the department’s direction on the taking and use of groundwater resources in the South West groundwater areas. The planning process considered the ecological, social and economic values of the water resources, the community’s input over several years and a range of consultation processes. It achieves a balance between current and future users, and the protection of the dependent environment.

This plan is based on the need to provide a clear and consistent direction to current and future water users in areas that are under pressure from increasing abstraction and climate change.

The key drivers of this plan are:

- a response initially, to the proposed abstraction of 45 GL/a from the Yarragadee aquifer for the Integrated Water Supply Scheme (IWSS) (see ‘South West Yarragadee proposal for IWSS supply’)
- the need for a consistent approach to water management in the area
- the need to provide certainty to current water users on water availability and security
- clear community concern over water management and the environment.

The plan provides a response for how the department will manage:

- the potential effects of reduced rainfall in the South West
- existing and potential environmental impacts from water abstraction
- increased water demand for irrigation and other regional industries
- increased growth in south-western towns and subsequent public water supply demand.
This plan details:

- the South West groundwater areas allocation planning boundaries, by groundwater subarea and resource (aquifer)
- the amount of groundwater available for allocation, the allocation limit and the amount already licensed
- how groundwater will be allocated across competing uses
- the monitoring strategies to improve our understanding of the resource, important groundwater-dependent ecosystems (GDE) and the impacts of current and future use
- the water management framework including:
  - the principles and objectives (or targets) for water use and management
  - policies to manage water abstraction and use to help achieve these objectives
  - how the plan will be reviewed and evaluated over time.

### The South West Yarragadee proposal for IWSS supply

In 2002 the Water Corporation began the process of applying for a licence to abstract 45 GL/a from the Yarragadee aquifer. This water was to be used to supply the Integrated Water Supply Scheme which provides water for Perth, the Wheatbelt, some south-western towns and the Goldfields. The hydrogeological understanding at the time indicated that the aquifer may have been able to supply this water sustainably.

Considerable investigation and modelling of the system was completed and in early 2007 the Environmental Protection Authority determined that the proposal was environmentally acceptable given a range of stringent conditions. The work also identified that if the pattern of reducing rainfall continued it may threaten the long-term security of this supply.

In 2007 the Western Australian Government determined that the preferred option for supplying the Integrated Water Supply Scheme was a climate independent desalination plant. This decision effectively shelved the Yarragadee proposal.

The investigation and assessment was carried out as part of the Yarragadee proposal by the Department of Water and the Water Corporation. It has substantially improved our ability to sustainably manage the existing and increasing pressure of regional water supply and commercial demands being placed on the groundwater resources and the South West environment. The information gathered has contributed to the development of this plan.
1.2 The plan area

The South West groundwater areas include the proclaimed groundwater areas of Bunbury, Busselton–Capel, and Blackwood plus the southern part of the South West Coastal groundwater area. The plan area also includes two portions of unproclaimed areas (Karri-Blackwood and Karri-Bunbury groundwater subareas). The plan only applies to artesian groundwater in the unproclaimed areas. The plan covers a large area of approximately 8250 km².

1.2.1 Resources

This plan covers all of the groundwater resources located in the South West groundwater areas. These are the superficial, Leederville, Yarragadee, Lesueur Sandstone, Sue Coal Measures, Cattamarra Coal Measures and fractured rock aquifers. These resources are described in Chapter 2 and detailed information on each of these resources can be found in the reports listed in the bibliography.

The plan applies to the groundwater resources in the South West groundwater areas. It will only refer to surface water expressions of groundwater (i.e. wetlands or stream flows) where these are dependent on groundwater and must be considered in any decisions about groundwater. Surface water management for this area is covered in the Whicher surface water management plan, (DoW forthcoming).

1.2.2 A separate plan for the Kemerton subareas

The area shown in green in Figure 9 and 10 will be managed under the existing Kemerton subareas local water management plan (DoW 2007c) which can be found at www.water.wa.gov.au/allocationplanning. This is due to the existence of a local numerical model and the need for specific management rules relating to this area. However, the policies in this plan also apply to the Kemerton subareas. It is anticipated that during the next review of this plan the Kemerton subareas and their rules will be assimilated.
2 Considerations for water management

2.1 Hydrogeology

The South West groundwater areas cover a large area of complex hydrogeology (Figure 1 and 2; Appendix A). The aquifers have been grouped into several key hydrogeological units for the purposes of management. The combination of the various layers (or 'Members') within a hydrogeological formation (e.g. Leederville aquifer – Vasse, Quindalup and Mowen Members) is based on a number of factors including age of the geological layers, distinctive rock/sediment characteristics, hydraulic connectivity between the layers and separation by major confining layers.

The hydrogeology in some areas leads to surface expressions of groundwater which maintain important environmental features. This can be in the form of a wetland or stream where the superficial aquifer nears the surface, through to areas where the Yarragadee and Leederville aquifers outcrop at the surface and discharge water into the Blackwood River and its tributaries to maintain flows through summer.

2.1.1 Major aquifers

The major aquifers (ordered from shallow to deep) are the superficial, Leederville and Yarragadee aquifers.

Superficial aquifer

The superficial aquifer is the water table aquifer across the majority of the plan area. The sediments on the Swan and Scott Coastal Plains are collectively termed the superficial formations and comprise the superficial aquifer. The superficial formations are the Yoganup Formation, Guildford Formation, Bassendean sand, Tamala Limestone and Safety Bay Sand. The superficial aquifer is separated from the underlying Leederville aquifer by a major confining layer called the Mowen aquitard.

Apart from the coastal dunes, the formations are generally less than 10m thick (saturated thickness), and are only a few metres thick on the western part of the coastal plains. Bore yields in the superficial aquifer on the coastal plains are highly variable and depend on sediment type (e.g. clay will typically yield less water than saturated sands). Currently, the general trend in water levels on both coastal plains is a slow decline, over the last 20 years, in summer minimum levels with steady maximum levels in winter when the superficial aquifer is recharged by rainfall.

Leederville aquifer

The Leederville aquifer is a confined aquifer that underlies the superficial formations on the coastal plains, and occurs, in places, at the surface on the Blackwood Plateau, where it is weathered and lateritised. The Mowen aquitard consists of the Quindalup and Mowen Members where they are dominated by clay and silty clay.
units. Where the Quindalup Member is dominated by sand, and the Mowen Member thins, there is a coincident increase in sand content. As a result these members effectively become part of the Leederville aquifer (Water Corporation 2005b; Figure 12 and Figure 13).

This aquifer is typically about 100 m thick, reaching in excess of 200 m in places. The Leederville aquifer is the most widely utilised aquifer on the Swan Coastal Plain, as it is relatively shallow, contains generally fresh groundwater, and is higher yielding than the superficial aquifer. The current trend in Leederville water levels is a slow decline of up to one to two metres over 20 years in summer water levels and due to the confined nature of the aquifer, and the winter levels are also slowly declining. It should be noted that a significant portion of this decline has occurred over the last five year low rainfall period, which may have also induced higher levels of pumping. In some areas more pronounced declines are apparent such as around the Jindong agricultural area. A sea water interface is close to, or is intersecting the coast between Dunsborough and Bunbury.

**Yarragadee aquifer**

The Yarragadee aquifer is a mostly confined aquifer comprised of the Yarragadee Formation, basal units of the overlying Parmelia Formation and parts of the underlying Cockleshell Gully and Lesueur Sandstone. The Yarragadee aquifer is unconfined where it outcrops in areas on the Blackwood Plateau and subcrops beneath the superficial aquifer. The Yarragadee aquifer is confined where it is separated from the overlying Leederville Formation by the discontinuous aquitards formed by the Bunbury Basalt and shale units of Parmelia Formation.

The South West Yarragadee aquifer is a regional aquifer, meaning that abstraction from any location may have an impact on the pressure of water at discharge points (e.g. at the Blackwood River). It is the largest aquifer system of the plan area, occurring throughout the Bunbury Trough and contains mostly fresh groundwater. The aquifer thickness ranges from about 300 m to 1700 m within the Bunbury Trough through the main part of the aquifer and is shallow (approximately 15 m below surface) south of Bunbury and in several places on the Blackwood Plateau (recharge area).

The Yarragadee aquifer is made up of several sub-units, each with distinct lithological and hydraulic properties. The main component of the Yarragadee aquifer is the predominantly sandy Unit 3 which has a maximum thickness of about 800 m (Water Corporation 2005b; Figure 12 and Figure 13). Groundwater from the Yarragadee aquifer discharges to Millyeannup Brook, Poison Gully and to the Blackwood River itself where the Blackwood River valley is deeply incised into the outcrop area. The discharge maintains perennial flow in the tributaries and permanent pools in the river. Bores in this area are capable of large yields of up to 6000 to 20 000 kL/day. Groundwater level trends for the Yarragadee aquifer shows
declines of up to two metres over the last 10 years. A sea water interface in this aquifer intersects the coastline at Bunbury.

2.1.2 Other aquifers

There are a number of less significant aquifers which occur at varying depths in relation to the major aquifers. They include the Cattamarra Coal Measures, Lesueur Sandstone, Sue Coal Measures and the fractured rock aquifer.

**Cattamarra Coal Measures**

The Cattamarra Coal Measures is one of two formations that comprise the Cockleshell Gully Formation. The Cattamarra Coal Measures are a regionally confined multi-layered aquifer composed of siltstone and shale interbedded with sandstone. The groundwater salinity ranges between 2500 and 26 000 mg/L TDS and in general, the groundwater salinity is lower in the south than in north. The fresher quality groundwater in the southern part of the aquifer is likely to be attributed to the throughflow from the Yarragadee aquifer. In the area of the Kemerton Industrial Park, the salinity is mostly brackish. The depth and the salinity of this aquifer restrict its utilisation for consumptive use and the measurement of water levels shows they are steady.

**Lesueur Sandstone aquifer**

The Lesueur Sandstone aquifer incorporates the Lesueur Sandstone and Sabina Sandstone formations. The aquifer occurs throughout most of the southern Perth Basin except for the northern Vasse Shelf and in the southern part of the shelf just east of Augusta (Water Corporation 2005b). The aquifer is only exploited for groundwater on the Vasse Shelf where it is overlain by the Leederville Formation or the superficial formations. It outcrops east of Alexander Bridge on Brockman Highway and possibly near the Scott River. To find out more about the hydrogeology of the Lesueur aquifer drilling investigations will be completed in 2009–10.

**Sue Coal Measures**

The Sue Coal Measures is the lowermost unit in the Southern Perth Basin, overlying basement rock (Water Corporation 2005b). It is deeply buried within the Bunbury Trough and occurs below the Leederville Formation or the superficial formations on the Vasse Shelf, with no outcrop at ground level. The formation has a maximum known thickness of approximately 1,800m in the Vasse Shelf and is intensely faulted. The sandstone is consolidated and partially cemented, and typically has a low permeability. Thin, coarser, less cemented layers may be present locally. The ability to abstract water from this aquifer is variable due to its hydrogeological characteristics. Existing (but limited) measured data shows the water levels are generally steady in this aquifer.
Fractured rock

The Leeuwin complex is classified as a fractured rock, in which groundwater is restricted to fractures in the crystalline basement rocks (bedrock), and to a thin weathered zone and overlying superficial formations. Caves and cavities are common in the Tamala Limestone which directly overlies the bedrock. Where the limestone occurs there is rapid drainage of surface waters, and the presence of underground streams. Depending on the bedrock topography the drainage is known to discharge into springs along the coast.

The nature of the fractured rock restricts the location and volume of water that can be abstracted. The water level information in this area does not lend itself to a generalised comment due to the fractured nature of the aquifer and the complexity in determining linkages between water levels, pumping and recharge.
Figure 1  Geological cross-section (west to east) of the Southern Perth Basin
Figure 2: Surface hydrogeology of the plan area
2.1.3 Water management and use implications

The understanding of groundwater in this region has been greatly improved through the work by the Department of Water and significant investigation by the Water Corporation. Due to the high cost (> $500,000 each bore) of deep aquifer investigations our understanding remains at a regional scale, with local investigations only completed for a few areas. There is a continuing level of uncertainty that must be accounted for in planning and licensing decisions.

Allocation limits are designed to manage the sustainable abstraction of the groundwater resources. The allocation limit is determined by the department as the safe portion of the recharge volume for each aquifer that can be used for abstraction without affecting dependent ecological and social/cultural systems.

Allocation limits are set with a recognition of the uncertainty in aquifer understanding. While there may be significant storages of water within aquifers, it is often the small amount of water level change that occurs at the water table (or to the pressure head in confined aquifers) that may adversely affect important environmental features or the bore yields of existing water users.

When considering allocation limits for each aquifer it is important to recognise that if too much water is taken out of the deeper aquifers, this may induce more leakage from the shallow aquifers above, which could lead to impacts on dependent systems at the surface. This is because there are often gaps in the confining layers where leakage between aquifers can occur. As can be the case with the Yarragadee aquifer, these impacts may occur tens of kilometres from where the water is abstracted.

Because of the inherent uncertainty about the impacts of abstraction and climate variability, implementing an effective monitoring program to assess these effects is extremely important. The monitoring program for the South West groundwater areas is discussed in Chapter 5.

Information on the hydrogeological characteristics of the aquifers and geological formations summarised in this section are described in detail in the various reports listed in the bibliography. Hydrogeological and geological maps are also located in Appendix A.

Modelling groundwater

The SWAMS version 2 (Water Corporation and Department of Water) regional groundwater model was used to predict the potential localised and cumulative drawdown effects of groundwater abstraction and to formulate a 3-dimensional water balance.

Abstraction of groundwater was accounted for by including current groundwater licenses and predicted future town water supply abstractions in the model. The resulting watertable drawdown map was used to quantitatively assess the risk to representative groundwater-dependent ecosystems (GDEs).

The 3-dimensional water balance for each aquifer was used to quantitatively define the available water for each aquifer within each subarea. A water balance is defined as the amount of water entering (input) and leaving (output) a groundwater system. Inputs to the system include rainfall recharge, aquifer leakage (into other aquifers) and stream leakage. The outputs include plant water use (transpiration), atmospheric evaporation, abstraction of groundwater, discharge to streams and flow through to the ocean.

For the model, the superficial aquifer (unconfined aquifer) water balance is the sum of the inputs and outputs without including the ocean discharge component. The available water in the superficial aquifer is the sum of the water balance, less the required volume of water to maintain the GDEs at an acceptable level of risk.

The water balance of the Leederville and Yarragadee aquifers (confined) is the sum of the inputs and outputs only. The confined aquifer water availability is defined as the amount remaining after the sea-water/freshwater interface boundary is met ensuring there is throughflow into the ocean without causing movement of the sea water boundary inland. It also allows enough throughflow to satisfy user abstraction in the neighbouring groundwater subareas.
Implications for licensing

1. Recognise the level of uncertainty in aquifer knowledge in your area and approach your decision making appropriately.

2. The taking of water from one aquifer may have consequences on other aquifers and the people who use them. Use of hydrogeological advice and the available models is recommended and important for decision making.

3. Variability within aquifers means that the impact of taking water from one part of an aquifer may not be the same as in another part of that aquifer. The compounding effect of multiple abstractions on an aquifer is considered in licensing decisions.

4. Water yields and water quality vary between and within aquifers. It is important to consider whether the likely yields and water quality of the proposed source are appropriate for use. Understanding the source of your water is critical and discussions with the department will aid in your business planning.

Action 1 – Further investigations into the hydrogeology of the South West groundwater areas will be completed and reported on by 2011, to reduce uncertainty in groundwater management decisions and form part of the review of this plan.

Action 2 – The groundwater model used for planning and management will be improved over the next three years to better identify impacts on surface water expressions resulting from water use and allocation. This will improve ongoing management by providing important input into licensing decisions.

Action 3 – An investigation to identify and quantify probable causes of water level declines in aquifers such as reduced rainfall, abstraction, drainage and other activities will be completed in 2008. This will inform the review of this plan and also local actions that may be necessary to address impacts.

2.2 Climate change

Winter rainfall in the South West has decreased since the mid-1970s by about 10–15% (IOCI 2002). It was not a gradual decline but more of a switching into an alternative rainfall regime where there has been a pronounced decrease in autumn and early winter rains (IOCI 2002). This reduction in rainfall is likely to continue with less recharge to aquifers and lower and less frequent stream flows (IOCI 2005).

Through climate modelling the CSIRO (Hennessy et al., 2006) has predicted that from 1990 to 2030 the South West may experience a 5% to 11% decline in average rainfall based on a low (0.54°C by 2030) and high (1.24°C by 2030) global warming scenario, respectively.
The department has used the SWAMSv2 groundwater model to account for the declines in rainfall already experienced in the South West and those predicted by the CSIRO (see ‘Modelling climate uncertainty’).

Despite the uncertainties of climate change the department is satisfied that the best available scientific knowledge has been used to anticipate further decreases in rainfall in the plan area. Further, by utilising the predictive capability of the SWAMS groundwater model we have been able to estimate and, in principle, account for these potential impacts in our decisions to determine allocation limits.

**Modelling climate uncertainty**

Calibration of a model is the process where parameters in the model are fine tuned to get the best possible match between modelled and real water level trends over a defined period.

The SWAMSv2 model (transient mode) was calibrated over the period 1990 to 2003 using the average rainfall over this period, which was about 7% lower than the long-term average. This corresponded to about 655 GL/a of gross recharge.

For the modelling of future allocation scenarios (2003–2033) recharge was reduced further to account for rainfall over the period 1971–2003, which was about 9% lower than the long-term average (Stratgen 2004; Varma et al., 2006). This corresponded to about 620 GL/a of gross recharge.

To account for future climate change recharge was reduced by an additional 5% to 590 GL/a to represent the declines in annual rainfall predicted by the CSIRO (Hennessy et al., 2006).

**2.2.1 Water management and use implications**

Accounting for climate change in our management and planning is an on-going process for the department. For example a project is underway (Action 3) to improve the SWAMS groundwater model’s ability to determine recharge and shallow aquifer interaction. This will enhance our assessment of climate change impacts along with improved monitoring to ground truth modelling predictions.

Another project will investigate the groundwater dependence of South West vegetation communities, create a conceptual model that predicts how that community will react to different hydrological regimes, including climate change, and develop a management framework. This will improve the department's ability to make predictions and decisions about acceptable hydrological regimes at key groundwater dependent ecosystems, set adaptable ecological water requirements that account for climate change and assist in setting environmental water provisions for management plans.
In summary, the reductions in rainfall that have already occurred together with the likelihood of further drying through climate change have and will reduce the water available for consumptive use in the South West groundwater areas. It is important for all water users to become efficient in their use of water.

**Implications for licensing**

1. Where the department determines that an application for a groundwater licence requires computer modelling to assess the impacts of a proposal the proponent will be asked to include predicted declines in rainfall in the modelling scenarios.

2. Drought contingency plans may be necessary for large applications, particularly water service providers, with a variety of water sources needed to meet the required demand.

3. New proposals or reviews of existing licences should include options to improve water use efficiency to maximise economic outcomes with limited water. Inefficient use of water will not be supported.

### 2.3 Groundwater quality

#### 2.3.1 Groundwater salinity

In the confined aquifers, such as Leederville and Yarragadee, groundwater is generally fresh, with minor areas of brackish water. Salinity is generally lowest in the recharge areas, increasing along the groundwater flow path towards the coast. The salinity originates as salts in rainfall, concentrated through evaporation and evapotranspiration. The salinity tends to be low in transmissive sandy soils, and greatest in sediments of lower permeability. There is some interaction along the seawater interface near the coastline.

Water table (generally superficial aquifer) groundwater can become saline through secondary salinity processes such as recirculation of irrigation water. Recirculation occurs where water is continually abstracted and re-applied from the same aquifer with evaporation, evapotranspiration and added salts from fertilisers increasing the salt content each time it is used. This concentrates the salt in the water and when it drains through the soil profile into the water table and is used again the cycle continues. This has become an issue for the coastal plain north of Bunbury in the Lake Preston area.

Historically water quality measurement in the department’s regional monitoring bore network has occurred infrequently, so regional trends in water quality, including salinity, are difficult to ascertain. Currently a regional water quality measurement program is being developed and monitoring will be initiated as part of the implementation phase of this plan. See the *South West groundwater areas monitoring program*, (Goodreid & Wallace-Bell, forthcoming) report for more information on water quality measurement and monitoring.
2.3.2 Sea water interface

The sea water interface occurs where fresh groundwater meets and mixes with saline groundwater along the coast. Where freshwater is discharging as throughflow into the sea, the interface will be maintained offshore. Once the freshwater throughflow is reduced by cumulative drawdown from abstraction wells or long term declines in rainfall, the sea water interface gradually moves inland. It is imperative that throughflow to the ocean be maintained in all aquifers to ensure groundwater remains fresh for coastal users.

Maintaining discharge of fresh groundwater into the ocean may also be important for near-shore marine ecosystems. Hatton and Evans, 1998, indicated that most estuarine or marine systems only utilise groundwater to a limited extent, though some have been known to exhibit a response to changes in groundwater availability or quality (Froend and Loomes 2005).

The sea water interface in the superficial aquifer on the Swan Coastal Plain usually occurs naturally as a wedge of sea water extending as much as one kilometre inland at the base of the aquifer, with fresh groundwater discharging to the seashore above it. The Scott Coastal Plain is considered to have significant sea water interface issues in the superficial aquifer.

In the Leederville aquifer, tongues of saline water are intersected at various depths along the coastline of Geographe Bay. This also occurs in the Yarragadee aquifer, where saline groundwater has been encountered near the coast at Bunbury, where it directly underlies the superficial aquifer. At Busselton, where the natural potentiometric head in the Yarragadee aquifer is 15 m above sea level, fresh groundwater is inferred to extend many kilometres offshore.

2.3.3 Acid sulfate soils

Acid sulfate soils (ASS) are naturally occurring soil sediments containing sulfide minerals, predominantly pyrite (an iron sulfide). Potential acid sulfate soils (PASS) are benign ASS in an undisturbed state below the watertable. However, when these soils are drained, excavated or the water table is lowered, the sulfides can react with oxygen from the air to form sulfuric acid. Other complex secondary reactions can also occur, including mobilisation of metals. When PASS has been disturbed and there is evidence of oxidation the soils become actual ASS.

Disturbance of PASS can cause the iron sulfides to oxidise. Disturbed PASS materials can result in contamination of shallow groundwater with high concentrations of dissolved Iron (Fe) and Aluminium (Al) as well as other trace metals.

Work by the Department of Environment and Conservation (DEC) in coastal areas of the Plan area indicate that much of the low-lying lands of the Swan and Scott Coastal Plains have areas containing PASS materials (Figure 3). There are several sites in
the plan area that have exposed PASS materials resulting in ASS generation, supporting this indication. The department will carefully assess any water use in these areas to aid the current management in place and avoid any further water quality impacts.

2.3.4 Water management and use implications

We recognise that abstracting groundwater will lower the potentiometric heads (water levels) in aquifers and reduce throughflow which may also cause inland movement of the sea water interface. Allocation limits must be set to avoid these impacts where possible. In areas where the sea water interface is already moving inland, or exists naturally in an aquifer, limits and policies must be set to reduce or manage this impact. By limiting and managing abstraction in areas at risk, any increase in salt levels in existing bore users in coastal areas should be prevented.

In areas of known PASS risk in the South West groundwater areas we must account for possible cumulative drawdown effects of groundwater abstraction on the water table when setting allocation limits. Licensing policies and conditions must also be set to manage how groundwater is abstracted and used in these areas to prevent mobilisation of ASS.

Implications for licensing

1. Water application rates may need to be limited in areas at risk of increasing salinity due to salt recycling.

2. A water balance for irrigation needs to be undertaken to minimise the chance of salt recycling and the resulting damage to soil quality and reduction in crop yields.

3. Concentration of water abstraction near the coast may result in localised movement of the sea water interface inland. This issue will need particular attention in the assessment or review of coastal public water supply schemes and other large licences close to the coast.

4. In PASS areas it is essential to liaise with DEC regarding the assessment of licences and their potential for acidification of soils.

5. DEC manages acid sulfate soils where impacts are identified and the site is classified as contaminated under the Contaminated Sites Act 2003.

6. Groundwater abstraction will be carefully assessed in areas of high risk of PASS and identified sites of ASS exposure. Monitoring may be required by licensees in these areas.

7. Dewatering for any period of time can cause exposure of PASS material. Any proposal requiring dewatering will need to investigate whether the area contains PASS materials and demonstrate how mobilisation of ASS will be avoided or potential impacts mitigated.
**Action 4** – Provide information to water users in the northern Bunbury groundwater area and other areas where the risk of salt recycling exists.

**Action 5** – Ensure there is an adequate program to monitor the sea water interface and other water quality parameters to support effective ongoing management.

**Action 6** – Report on the current understanding of the buffering capacity of sediments with associated ASS risk to inform the review of this plan and advise local governments in land-use decisions.

**Action 7** – Work with other agencies to provide an information package for landholders on the issue and management of sediment acidification to assist ongoing management.
Figure 3 Location of potential acid sulfate soil risk areas
2.4 Hydrology

There are significant surface water resources in the South West. The seasonal variability in these systems is generally influenced more by rainfall, and changes in rainfall patterns, than by groundwater. However, groundwater can play a vital role in a waterway, particularly over the summer period. The surface water hydrology and its management in the area of this plan are covered by the *Whicher surface water management plan – allocation*, (DoW forthcoming).

Hydrological analysis suggests that there are strong connections in some South West river systems, which indicate that groundwater contributions are a significant flow source. Additionally, some of the internationally and nationally important wetlands within the plan area, such as Lake Jasper and the Vasse-Wonnerup estuary, are also groundwater-dependent.

Most surface water sources in the plan area are dependent on rainfall runoff to maintain streamflow. However, groundwater maintains river pools and summer flow in some rivers, supporting important environmental values that would otherwise be absent. For example, the Yarragadee aquifer supports the lower reaches of the Blackwood River, downstream of Milyeannup Brook. The tributaries Poison Gully and Milyeannup Brook are also dependent on the Yarragadee for their summer flow.

The Leederville aquifer also discharges into the lower Blackwood River between Nannup and Milyeannup Brook and downstream of Layman Brook. St John and Rosa brooks, and upper Margaret River are Leederville-dependent and many rivers on the coastal plains such as the Scott and Capel rivers are also supported by groundwater (Figure 4).

2.4.1 Water management and use implications

The connectivity between surface and groundwater is currently being investigated in several major rivers in the South West (Blackwood, Capel, Margaret and Brunswick rivers). There are also new proposals planned for studies on groundwater and surface water interactions in the plan area (see Chapter 5 and 6).

To ensure consistency with other departmental water management plans the allocation limits and licensing policies take into consideration the connected systems and support the *Whicher surface water management plan – allocation*, (DoW forthcoming).
Implications for licensing

1. Always consider the *Whicher surface water management plan* alongside this plan as a new (or an increase to an existing) licence application may affect surface water systems.

2. Where groundwater is not available due to the allocation limits being reached, there may be surface water resources that can be accessed as an alternative.

3. An excavation dug as part of a dam construction is likely to intersect the water table. This will fill part of the dam which may require a groundwater licence, as this is part of the water being pumped.
Figure 4 Known locations of surface water/groundwater connectivity in the plan area
2.5 Groundwater-dependent ecosystems

The plan area is included in a much larger and internationally recognised South West botanical province that stretches from Geraldton to Esperance. Within the plan area there are several internationally important wetlands and a number of nationally and state recognised ecosystems (Hyde 2006). The natural environment is appreciated by the many people who both live in and visit the area and the need for conservation of this environment has been stated repeatedly in almost all community consultation that has been conducted as part of this planning process.

All ecosystems depend on water to sustain their existence. However, not all ecosystems depend primarily on groundwater as the source of that water. While the number and the geographic spread of groundwater-dependent ecosystems (GDEs) in the South West groundwater areas is very large (Figure 5), the level of groundwater-dependence and the environmental importance of the ecosystems vary greatly. In addition, depending on the nature of the geological formation on which they lie, some groundwater-dependent ecosystems may be affected only by local changes in water regimes, while others may be affected by changes within aquifers at great depth and many kilometres away.

The South West groundwater areas cover a large area of complex hydrogeology. In the South West there are the three aquifers that most groundwater users access. They are the superficial, Leederville and Yarragadee aquifers. The declining rainfall also affects each of these aquifers and drainage and land-use activities affect the superficial aquifer further. All of these aquifers support GDEs.

In the superficial aquifer abstraction, drainage and the pattern of reduced rainfall may affect GDEs within those areas, depending on the magnitude of these changes and their proximity to dependent ecosystems. Many wetlands of recognised (legislated) significance exist in these areas.

The less permeable nature of the Leederville aquifer provides lower bore yields but also offers some protection to GDEs from groundwater level changes by muting the transmission of impacts through the aquifer. However, in some areas dependent ecosystems may still be affected by Leederville aquifer abstraction or reductions in recharge from climate change. Upper Margaret River, St John Brook and Reedia wetlands are examples of some such systems (Figure 6 and 7).

In most areas impacts on GDEs from water level changes within the Yarragadee aquifer are prevented or inhibited by other less permeable aquifers, aquitards or aquicludes that lie between Yarragadee and the GDEs on the land surface, such as the Leederville aquifer.
Exceptions to this are:

- part of the Blackwood River valley, where the Yarragadee aquifer is close to the surface and directly supports wetland and river systems
- parts of the Swan and Scott Coastal Plains, where the aquifers that lie above Yarragadee aquifer do not present an effective barrier to prevent changes being transferred to the water table at the surface.

These areas are more at risk from the combined effects of groundwater abstraction and reduced rainfall and consequently have been the focus of recent investigations to determine the ecological values and ecological water requirements.

### 2.5.1 Representative GDE sites

Wetlands of high conservation value and areas of terrestrial vegetation were chosen as representative GDE sites through a selection process that used wetland and vegetation mapping information together with an analysis of aerial photography, site visits and literature reviews. The representative sites are shown in Figure 6 and 7.

Generic ecological water requirements in the form of maximum drawdown and rate of change criteria were established at each reference site. Site-specific work was done at approximately thirty representative GDE sites with the aim of developing a more detailed understanding of the water requirements. At some of these sites a management trigger and response framework has been applied (Section 4.5, Appendix B) and this work is continuing so that the frameworks can be expanded to other sites when sufficient measurement data has been collected.

A summary of the investigations that have been carried out by the department can be found in Hyde 2006, Del Borrello (forthcoming) and other documents listed in the bibliography.

### 2.5.2 Water management and use implications

The department considers the ecological values that are dependent on groundwater when making decisions on the allocation and management of groundwater resources.

Although there are many sites of significant value, not all are groundwater dependent. The department has recognised this and aims to monitor the selected representative sites (Figure 6 and 7) to ensure that the majority of dependent ecosystems, including the ones identified to be most at risk from abstraction or climate change, are managed, without unacceptable loss of values due to drawdown. Effective monitoring is necessary to ensure that policy and allocation management decisions are effective in protecting critical environmental assets. The level of community interest in this aspect of water management is high and there will be public reporting of environmental monitoring and management outcomes by the department through the annual evaluation statement.
The department recognises that reductions in rainfall are forecast for this area which may have a significant impact on the water supply to ecosystems as well as potential pumping impacts. This has been factored into the allocation decision making process and is accounted for in all of the modelling underpinning this plan.

**Implications for licensing**

1. While Figure 5 indicates the priority areas for groundwater-dependent systems, be aware that there are many others that have ecological values and must be considered in licensing. Where the water table occurs within 10 m of the surface, native vegetation in such areas is likely to rely on groundwater to some degree. In general, the shallower the water table, the greater the level of dependence.

2. Other impacts on potential GDEs need to be considered (i.e. rainfall reduction, drainage etc.) in licence assessments, as well as the effects of pumping.

3. Recognise that while one licence may not individually affect these sites, cumulative abstraction may lead to impacts and that use of the SWAMS model may be required to account for these impacts.

4. Recognise that although there may be impacts associated with the connectivity between aquifers and that abstraction in one aquifer may affect another with potential flow on effects to GDEs.

5. Recognise the location of potential groundwater-dependent ecosystems in relation to any proposed abstraction points and consider carefully the position and depth of bores and the rate of abstraction to minimise the impact on environmental features.

6. A proposed application which is likely to impact on a GDE is likely to have monitoring conditions (or an operating strategy) associated with the licence that will include triggers and responses. These will be in line with the framework developed in Appendix C.

**Action 8** – Conduct additional investigations at key sites for aquifer connectivity and the potential response to abstraction and climate change to allow detailed ecological water requirements to be identified and a trigger-response framework established. This will inform the review of this plan.
Figure 5 Potential groundwater-dependent systems of recognised environmental, social and/or cultural value
Figure 6  Location of representative GDEs (Myalup to Dunsborough)
Figure 7  Location of representative GDEs (Blackwood Plateau and Scott Coastal Plain)
2.6 Groundwater-dependent cultural and social values

The *in situ* cultural and social values relate to water found in its natural place. They are non-consumptive values which are captured through assessment of future water demand assessments and community consultation.

The *in situ* social values we consider include:

- recreational and tourism pursuits, for example, day use and camping, swimming, paddle sports, recreational fishing
- landscape and aesthetic values, (e.g. sense of wilderness and observing nature)
- educational and scientific values
- aboriginal cultural values (see ‘Aboriginal heritage and cultural values’)
- Australian and other heritage values.

Through planning, the department endeavours to identify the places where social and cultural values are linked to groundwater, and account for them. This accounting is referred to as a social water requirement. The social water requirement is often framed as a water level or water regime that needs to be met to protect the social and cultural values at a particular location.

A part from some key areas identified through the Yarragadee proposal process, the majority of cultural and social values were considered to be satisfied through meeting the ecological water requirements. That is, by providing a water regime to maintain the ecological values at a low level of risk, the social and cultural values are also protected.

To date the department has focused its efforts to determine social water requirements on the Blackwood River and tributaries below Nannup and Lake Jasper and the eastern Scott Coastal Plain area. We concentrated on these areas because of their high ecological, cultural and social values and because of their potential to be impacted by Yarragadee aquifer abstraction in particular.

The Blackwood River cuts through one of the few small areas where the Yarragadee aquifer is exposed at the land surface. The Yarragadee aquifer is present across most of the South West groundwater areas but it is generally deep and overlain by other formations. Reductions in water levels within the aquifer therefore become most apparent at the surface in such areas where the aquifer is shallow or overlain by thin superficial formation (i.e. the lower Blackwood River, parts of the eastern Scott Coastal Plain and a small area around the City of Bunbury). Therefore, these areas are particularly susceptible to impacts from Yarragadee abstraction.
Areas of the Scott Coastal Plain, especially Lake Jasper are very significant to the Nyungar people and have high ecological and social values. A significant proportion of the land area is remnant vegetation vested as National park and nature reserve. Social and cultural values co-exist with economic development primarily in the form of irrigated agriculture.

Identified groundwater-dependent social and cultural values are protected through similar processes as the ecological values – via our allocation limits, licence assessments, licence conditions and through monitoring and review. Continued investigation and planning work will help to improve our understanding of these values and their management.

**Aboriginal heritage and cultural values**

*The Aboriginal people of the south-west are collectively known as the Nyungar people. The Nyungar people have a strong association with the environment and its natural resources, utilising it according to their lore and caring for Country. For the Nyungar people, Country is physically, spiritually, economically and culturally essential for survival, (SWCC 2005).*

Understanding and respecting Aboriginal heritage and cultural values as they relate to water is an integral component of our work. We commissioned two studies in the Blackwood GWA (Goode 2003; Goode and Irvine 2006) to explore Aboriginal cultural values and determine the water requirements to support these values.

These reports discussed Aboriginal heritage as defined under the relevant legislation and also endeavoured to identify the underlying Aboriginal social and cultural values of the region’s water sources and their significance to the maintenance of Aboriginal culture and life styles.

Aboriginal heritage sites are sites of significance to Aboriginal people. The sites are listed on the Aboriginal Site Register which is held under Section 38 of the state's Aboriginal Heritage Act 1972. In the South West these sites tend to be located near various water sources, such as rivers, creeks, lakes, swamps and estuaries, confirming the importance of these waterways as areas favourable for camp sites and resource exploitation (O’Connor et al., 1995; Goode 2003).

The department recognises that Aboriginal cultural values extend beyond the Site Register and reflect their strong spiritual connection with the environment. The ability to teach future generations from a natural homeland is at the heart of the aboriginal community’s desire to maintain the ecological integrity of areas that may be affected by groundwater abstraction (Goode and Irvine 2006).
2.6.1 Water management and use implications

The department considers cultural and social values that are dependent on groundwater when making decisions on the allocation and management of groundwater resources. This consideration is formalised through our Statewide policy no. 5 – Environmental water provisions policy for Western Australia, (EWP Policy) WRC 2000a. The department recognises that detailed work is required to identify social and cultural water requirements.

The department is currently undertaking a project to define most social and cultural values as they relate to water over the entire South West groundwater areas. This information will be used to develop a decision support system for use by our licensing officers and provide the foundation data for determining social water requirements in other areas.

For a description of the processes to determine the cultural and social values in these areas and some of the challenges of determining social water requirements refer to Goode and Irvine 2006 and Goodreid 2007 or see the bibliography.

Implications for licensing

1. Recognised social and cultural values that are dependent on groundwater and any associated impacts resulting from abstraction will be considered in licence assessments.

2. Native Title rights will be considered as part of the assessment of a licence.

3. Identification and assessment of impacts on Aboriginal Heritage sites is the responsibility of the proponent and the Department of Indigenous Affairs. Proponents must follow the appropriate processes under the Aboriginal Heritage (WA) Act 1972 and the Native Title (State Provisions) Act 1999.

Action 9 – Further define the groundwater-dependent cultural and social values in the South West groundwater areas to inform the review of this plan.

Action 10 – Create a GIS-based decision support tool that identifies groundwater dependent features and their associated cultural and social values to assist ongoing management.

Action 11 – Determine water requirements for groundwater-dependent cultural and social values in the South West groundwater areas to inform the review of this plan.
2.7 Water use

Approximately 140 GL/a of water is already used in the plan area for a range of activities. These include licensed commercial and water supply operations as well as small scale domestic and stock abstraction which is exempt from licensing.

Across the plan area, from all aquifers, public water supply accounts for 32% of total licensed entitlements. Horticulture (17%), pasture production (15%) and mining (13%) make up the bulk of the remaining licensed entitlements (DoW 2007, licensing database). Water licensed in the Yarragadee aquifer is allocated for public water supply (40%), mining (20%), horticulture (16%) and pasture production (13%). The licensed allocations in the Leederville are predominantly for public water supply (22%), horticulture (21%) and pasture production (16%).

Land use in the plan area is predominantly state forest (Figure 8) which limits access to groundwater. Water use in these areas is restricted to small patches of cleared private land, public water supply and emergency use for fire fighting. The coastal plains and the Leeuwin–Naturaliste Ridge are the major areas of water use, concentrating the pressure on the resources in these areas.

As one of the fastest growing areas of the state the land use in the plan area continues to change. Land-use changes, especially development of the Swan Coastal Plain, lead to subsequent changes in water use, an increased demand for public water supply and increased demand for local domestic and garden bores. Changes to rural land use and re-zoning have also increased the number of smaller irrigation projects instead of the larger water using operations. Of particular note is the trend in subdivisions and re-zoning of land from broad scale agricultural to viticulture and rural lifestyle blocks.

Recent surveys in the South West (2003 and 2004 licensing and compliance surveys conducted by the department) show that there are some areas where licensees are not using their full groundwater allocations. In fully or near fully allocated areas, this prevents other potential users from accessing this water to expand their business or begin new operations, reducing industry potential in the South West. Policies in this plan support the statewide policy on recouping this unused portion of water$^1$ for reallocation to productive use.

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$^1$ This does not apply to water that has been saved through improved efficiency as identified in the policy section of this plan
Figure 8  Freehold and crown land (including state forest)
2.7.1 Public water suppliers

There are three licensed water service providers supplying public drinking water in the plan area from groundwater resources. They are the Water Corporation, Bunbury Water Board (AQWEST) and the Busselton Water Board.

Population growth in the plan area has lead to an increase in the amount of groundwater abstracted and treated for public water supply (PWS) purposes. In recent years, due to the expanding urban development and increases in transient (from tourism) and permanent populations along the Swan Coastal Plain, there has been an increase in the demand for larger PWS.

Local governments are beginning to apply stricter water use efficiency requirements on new developments and water use efficiency plans (WUEP) are being developed between the department and local government authorities to further improve efficiency measures. For more information and statistics on water service providers including licensed allocations and reserved water see Chapter 3 and Appendix C.

2.7.2 Water management and use implications

Water is a limiting factor for growth in the South West. The department recognises this and has reserved groundwater for future public water supply in the region (section 2.8). The constraints of climate change and its impact on recharge and rainfall runoff is likely to restrict growth in the longer term for irrigation and other consumptive use.

Existing licensed entitlements, unlicensed and/or exempt domestic, stock and garden use are protected in this plan through the allocation limit decision-making process. This process has allowed for some water to be available for consumptive use in the superficial, Leederville and other minor aquifers on the coastal plains (see Chapter 3 and section 2.8).

Implications for licensing

1. Demand for water will be restricted by the allocation limits and policies set in this plan.

2. Water demand is restricted by aquifer location and its characteristics. It is important to understand the aquifer characteristics before submitting a licence application as while the water may be available for allocation, it may not be accessible on a specific property.

3. Where an applicant believes more water can be taken sustainably than the allocation limits allow, the applicant may choose to investigate the groundwater resource in order to prove that the additional water can be abstracted, with no unacceptable impacts to existing users or environmental values.
4 Any of these planned investigations are required to be reviewed by the department before they commence and the results of the investigations will be reviewed by the department before an entitlement is issued. No licences will be issued unless the department is satisfied the investigation work has proven additional water can be sustainably taken for the duration of the proposed abstraction period.

Action 12 – Carry out water use surveys in priority areas to identify unused allocations and recoup according to Statewide policy no. 11.

Action 13 – As part of the implementation of this plan a review of the PWS licences is required to meet the water efficiency objectives of this plan. The department will ensure the conditions set on all water service providers are consistent with one another.

2.8 Future demand for water

Economic projections and future water demand reports have been undertaken for the plan area and are listed in the bibliography.

2.8.1 Public water supply demand

Consumption of water for public water supply in the South West groundwater areas is projected to grow by up to 10 GL over the next 25 years. In Brennan, 2007, an examination of existing public water supply licences revealed that it was likely that unless additional water was made available some towns would face shortages of scheme water over the next few years, while Busselton currently had more than enough water to meet its own and neighbouring towns’ requirements to 2031.

Any future water use for public drinking water will be required to meet water use efficiency targets in line with the per person consumption targets (<100 kL/person) identified in the State Water Plan, (DPC 2007). Although the target is specifically for Perth based household consumption the department encourages all water service providers to meet this target across the state.

2.8.2 Irrigated agriculture

Estimates of the potential future demand for water for irrigated agriculture, horticulture, viticulture and other production have been calculated in various studies (Economic Consultancy Services 2003a, 2003b and 2005; Brennan 2006 and 2007) and are based on the rate of growth in produce markets (including export) and on land availability. However, growth in demand for water is more likely to be influenced by growth in the former, rather than the latter. These studies predicted a growth in
demand of between 120 and 300 GL/a by 2030 from both groundwater and surface water resources, if water were not a limiting factor for development.

It should be noted that the forecast agricultural water demands presented in these studies are an indication of the potential for irrigation demand, but actual water use will be limited by water resource scarcity. Under more extreme water scarcity, where the irrigated horticulture and viticulture sector competes with town, mining and industrial sectors for water, growth will be curtailed beyond the 30-year forecasts.

2.8.3 Ministerial and other departmental commitments

The state government and the Department of Water have reserved groundwater for high value public water supplies to 2036 for the South West Region. The decision to reserve this water (largely from the Yarragadee aquifer) is to minimise the health risk of contaminating the future drinking water sources and to secure a source to meet the anticipated growth in demand. Details of the reserve are shown in Table 3 and an explanation of how this reserve may be accessed is given in Chapter 4, section 4.3.2.

Under normal circumstances groundwater cannot be traded beyond a subarea boundary. However, a special exemption has been made for two mineral sands mining companies, Iluka Resources Limited and Cable Sands (Bemax Resources), which operate within the plan area. The state government has acknowledged, prior to this plan being developed, the significant economic contribution of mineral sands mining to the South West and due to the existence of a number of mining leases spread across the plan area, the companies are permitted to use or trade their licensed Yarragadee entitlement across subarea and groundwater area boundaries. However, this agreement remains subject to the 10-year licence time frame, the licence assessment process and the policies for trading outlined in this plan (except section 4.2.3: Trading (g)).

2.8.4 Water management and use implications

The department manages water demand through setting the allocation limits and the licensing process. The process for setting the allocation limits is summarised in Chapter 3. The licensing process and the policies and rules associated with assessing and issuing a licensed entitlement are detailed in Chapter 4. The policies developed in this plan detail how water will be managed to achieve the best outcome for water users, the water resource and future demand.

Water has been reserved for public water supply (Table 2) to meet the expected demand in population growth in the major towns in the South West. Demand for water from all other sectors will be restricted by the available water (Table 2) for each subarea and aquifer. In areas of high demand for water and low availability (allocation) we will be actively recouping unused licensed entitlements and implementing trading of water. Trading will be implemented in subareas that are fully allocated (Table 3).
The implementation of water use efficiency measures is encouraged in all water use sectors.

**Implications for licensing**

1. Any unused water should be reviewed and opportunities for improved water efficiency considered when reviewing and/or renewing licenses.

2. Allocation of groundwater for drinking water and domestic purposes has a higher priority than for other consumptive purposes.

3. Where water is unavailable from the desired aquifer to meet future applications, licensing officers will identify other aquifers, surface water and trading as potential options to satisfy demand and provide this information to applicants.

4. With water trading being implemented as areas become fully allocated, any water no longer used, as a result of implementing water use efficiency measures, can be traded.

**2.9 Community input into planning**

Water management planning continually seeks and recognises community input, through existing community and representative groups and through targeted consultation activities. Throughout the community consultation period the department has recorded the major issues that have been raised by the community and aims to address each of these through our planning processes (Table 1) and further investigation work.

How the department aims to manage the South West groundwater resources is an important issue for the South West community, as the region has undergone a major period of population growth, diversification of industry and agricultural expansion. This growth has lead to an increase in the volume and range of activities for which water is used. Over the past five years, the department has undertaken a number of community workshops, presentations, updates, media releases, discussions with stakeholder groups, and individual conversations with licensees. The initial round of workshops was carried out in 2003 in regards to the Water Corporation’s proposal to take water from the Yarragadee aquifer. From this initial consultation a number of community issues of relevance to all aquifers were highlighted.

The key issue voiced by the community is that there is a need for sound management of groundwater resources to protect the environment and the current users of the resource. This ranges from protecting small domestic use to larger agricultural and industrial use. A major theme coming out of all community consultation is the need for openness and accountability in decision-making and the need to base those decisions on good scientific knowledge and understanding. This will help ensure community confidence that future use is sustainable and that
management will be continually improved as further investigations increase our understanding of the resource.

Table 1  Summary of the major community concerns and how the department* is addressing them (2000-2007)

<table>
<thead>
<tr>
<th>Area</th>
<th>Community Issues</th>
<th>How will these issues be addressed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogeology</td>
<td>Water availability: How much can be drawn from the aquifer sustainably?</td>
<td>See Chapter 3, section 3.1.2, allocation limits.</td>
</tr>
<tr>
<td></td>
<td>Recharge: Where are the recharge areas for different aquifers? What are the recharge rates?</td>
<td>The recharge information is contained in the supporting documents listed in the bibliography.</td>
</tr>
<tr>
<td></td>
<td>Monitoring: What monitoring will be done and has been done to manage the aquifers?</td>
<td>A comprehensive monitoring program has been developed (Chapter 5), with annual review and updates and is available as a supporting document on the department’s website.</td>
</tr>
<tr>
<td></td>
<td>Aquifer inter-relationships: How do the aquifers interact with each other and with surface water systems?</td>
<td>This is currently being investigated further. Our current knowledge can be found in the documents listed in the bibliography.</td>
</tr>
<tr>
<td></td>
<td>Sea water intrusion: How is it managed?</td>
<td>The sea water interface will be managed through responsible allocation limits (Chapter 3).and ongoing licence assessment (Chapter 4), investigations and monitoring (Chapter 5).</td>
</tr>
<tr>
<td></td>
<td>Climate change: Is this taken into account when modelling groundwater?</td>
<td>The allocation limits (Chapter 3), environmental water provisions and modelling have all taken climate change into consideration.</td>
</tr>
<tr>
<td></td>
<td>Water quality: How will the influence of abstraction on water quality be managed and monitored? How will the use of water be managed to reduce impacts such as nutrients in groundwater systems or waterways?</td>
<td>Water quality monitoring forms a significant part of the new monitoring program for the South West (Chapter 5). Licensees will also be required to monitor water quality for various types of activities. Please see the policy section for more information (Chapter 4).</td>
</tr>
<tr>
<td></td>
<td>Acid sulfate soils – will they be managed?</td>
<td>The monitoring program (Chapter 5) will assist in managing ASS issues, in addition to the DEC involvement in assessing proposals for water quality issues. We will manage PASS through our policies and management zones/buffers to ensure that any PASS sites are managed appropriately.</td>
</tr>
</tbody>
</table>
### Community Issues

<table>
<thead>
<tr>
<th>Area</th>
<th>How will these issues be addressed?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>What are the potential impacts of taking water on forests and nature reserves?</td>
</tr>
</tbody>
</table>

### Ecology

<table>
<thead>
<tr>
<th>Ecology</th>
<th>Will potential impacts be managed for wetland and lake systems such as Lake Jasper, Vasse Wonnerup Wetlands?</th>
<th>This is managed through our regional monitoring (Chapter 5) and local scale monitoring, our management zones, buffers, trigger/response criteria and policies (Chapter 4).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Is there any impact on marine systems?</td>
<td>This has been considered in the development of the allocation limits and will be further investigated in the future. In maintaining the current sea water interface (throughflow to the ocean) for each of the aquifers any impacts on offshore groundwater discharges is unlikely.</td>
</tr>
<tr>
<td></td>
<td>What could be the impact on the salinity of rivers e.g. Blackwood if fresh water discharge is reduced?</td>
<td>Some increase in summer salinity may be expected if groundwater discharge to the Blackwood is reduced. However, unacceptable reductions in discharge are not anticipated under the proposed allocation limits. Investigations are currently ongoing into the complex relationships between groundwater abstraction and discharge into the Blackwood. Investigations into salinity tolerance thresholds of native fish in the Blackwood are also occurring. Expected output in 2008–2009.</td>
</tr>
<tr>
<td></td>
<td>What are the local and regional future water needs?</td>
<td>This has been investigated and planned for through our reserving of water for public supply and understanding future demand. An assessment was made by Brennan, 2007 (see bibliography) that was used as a guide to regional demand.</td>
</tr>
</tbody>
</table>

### Economic

<table>
<thead>
<tr>
<th>Economic</th>
<th>Will the plan ensure that future water supplies are available for local communities?</th>
<th>Where water is available for licensing demand can be met (Table 3). Water has been reserved for public supply in the region for local towns (Chapter 3).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Will future population growth be taken into account in planning?</td>
<td>Future demand and population growth in and around existing urban areas has been taken into account through the public water supply reserve, management considerations and allocation limit setting (Chapter 3).</td>
</tr>
<tr>
<td></td>
<td>What is the true cost of town water supply?</td>
<td>The cost of town water supply is set by the public utility that supplies the water.</td>
</tr>
<tr>
<td>Area</td>
<td>Community Issues</td>
<td>How will these issues be addressed?</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td></td>
<td>How will existing water supplies for agriculture be protected?</td>
<td>Current and existing use has been accounted for in the modelling and allocation limit setting. This includes understanding current impacts and where future impacts are likely. The policies will also protect existing users (Chapter 3). In some cases areas are over-allocated and surveys will be carried out to ensure water is being used efficiently.</td>
</tr>
<tr>
<td></td>
<td>How are plantations managed?</td>
<td>See section 2.9.1</td>
</tr>
<tr>
<td></td>
<td>How can allocation limits address the current and future agricultural needs?</td>
<td>Prevention of unacceptable environmental impacts and ensuring security for existing users are priority issues when setting allocation limits. In some subareas and aquifers it was not possible to make more water available without compromising these factors. Where water is not available from desired aquifers other aquifers or trades may be possible. The department will be looking to recoup unused entitlements and will re-release recouped water for consumptive use if not required by the environment.</td>
</tr>
<tr>
<td>Social</td>
<td>Will the plan ensure Aboriginal heritage and cultural values linked to water resources are protected?</td>
<td>Yes. The cultural water dependent sites are protected through the same means as groundwater-dependent ecosystems of high ecological value in the planning process. These sites have been identified and are currently being investigated further across the whole South West.</td>
</tr>
<tr>
<td></td>
<td>European heritage values: will these be protected?</td>
<td>They are met in the same way as the cultural sites.</td>
</tr>
<tr>
<td></td>
<td>Recreational reserves: What are the risks to reserves, how will they be managed?</td>
<td>Reserves are managed by DEC. The department is actively working with DEC to ensure that high value GDEs within reserves are protected.</td>
</tr>
<tr>
<td></td>
<td>Equity issues: Distribution of a resource, how can it be done equitably?</td>
<td>Our existing policy of ‘first in first served’ applies in areas where water is still available. In areas which are fully allocated or over allocated trading rules will apply.</td>
</tr>
</tbody>
</table>

*The Department of Water has previously been known as the Water and Rivers Commission (1995-2003) and the Department of Environment (2003-2006).

2.9.1 Current issues

Self management

The irrigation review and water reform process identified that irrigation cooperatives have produced many benefits for agricultural producers and water management in Western Australia (see Irrigation Review Steering Committee 2005, DPC 2007).

Self management is where the local community have an active role in managing and decision making in water resource management. There are a series of potential
arrangements for self management and associated self funding from full irrigation cooperatives, such as Harvey Water, to user groups providing advice to the department on management decisions.

The potential for this arrangement in groundwater is a new occurrence in Western Australia and informed policy development is required.

**Action 14** – The department will provide part funding for a south west community to carry out an independent case study of possible self management arrangements for groundwater.

**Plantation management**

As identified in Table 2, the management of plantations is of interest to the South West community.

The department has accounted for existing plantations on the coastal plains in developing the allocation limits for the superficial aquifer. While plantations do intercept recharge and use groundwater, these activities are not able to be licensed under the existing *Rights in Water and Irrigation Act, 1914 (RiWI Act)* legislation.

Local government authorities are the lead decision-makers on plantation proposals. Work is being carried out by the department to better understand the impacts of plantations on groundwater and a policy to guide plantation management is due for release by the department in 2008.

Under new water legislation being prepared the department will be able to account for and manage plantation water use and this will be reflected in the revised statutory water management plan in 2011.

**Action 15** – Provide a draft policy addressing plantation management for comment from interested parties.

### 2.9.2 Water management and use implications

In response to the communities request to be kept informed of local water resource condition and progress of research and management activities, the department will report on the various commitments listed throughout the plan and describe how we are meeting the plan actions and objectives. This will be reported through the annual evaluation statement as identified in Chapter 6. This information will be made publicly
available to ensure that the community has access to the most up to date information to aid in their understanding and use of the water resources in the South West.

**Implications for licensing**

1. Under current legislation applications for proposals to take water over 100,000kL/a will be advertised for public submission. Proponents will be required to submit a public notice regarding their proposal for applications regarding trading or requests for water greater than 100 000 kL/a. The department may request further information from an applicant to help address community concerns regarding a proposal.

**Action 16** – Report publicly on the plan implementation and monitoring as per the schedule outlined in this plan. Develop a program of stakeholder consultation for the review of this plan.

### 2.10 Other plans and strategies

This plan has considered a range of other government plans and strategies developed by the Department of Water and other agencies. Appendix D identifies the relevant documents and their relationship to this plan.

**Implications for licensing**

1. A change in, or development of a new water use activity, must consider the relevant departmental and other government agency legislation and policies. The department will not issue licences for activities that are not in line with existing government legislation and policies.

2. Water access and use should be consistent with the range of policies for your area. Reviewing these other plans and early liaison with departmental licensing officers may ensure a timely assessment of a licence application or trade.
3 Water allocation

3.1 Groundwater use and availability

3.1.1 Subareas

Subareas are management units within each groundwater area. Their boundaries are based on hydrogeological information, such as fault lines or major aquifer features. Allocation limits and use information is provided on a subarea basis, and in some cases specific licensing rules apply. To find out which subarea a property is located in contact one of the department’s three South West regional offices.

The subareas for the superficial and Leederville aquifers (Figure 9) are defined along hydrogeological boundaries and are aligned with the closest cadastral feature (i.e. a road or property boundary). This is to avoid a single person having different allocation rules on either side of their property.

The subareas for the Yarragadee and other deep aquifers (Figure 10) are defined on the groundwater area boundaries and key geological boundaries. The subareas for the Yarragadee are larger than the superficial and Leederville boundaries reflecting the regional nature of the aquifer and the potential for impacts to be transferred across large distances.

3.1.2 Allocation limits

An allocation limit is the amount of water that can be taken from a water resource after decisions have been made about what water must be left in the system to support ecological and social/cultural values, maintain the sea water interface, account for climate change and secure existing water users’ rights for each aquifer. The department has determined the allocation limit for each water resource in the South West groundwater areas by applying the RiWI Act, Statewide policy no. 5\(^2\) and the methodology outlined in section 3.1.4.

Allocation limits may be further modified during the life of this plan based on improved information on the resource gained through further investigation and ongoing measurement and monitoring. Any changes to the allocation limits will be publicly reported, through advertisement in the state and local newspapers, media statements and on the department’s website.

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\(^2\) This policy is to be reviewed by the department to account for the signing of the National Water Initiative and subsequent water reform process.
The RiWI Act and Statewide policy no. 5 provide the framework for the allocation limit methodology. The methodology provides the process for determining how much water must be left in the environment (environmental water provision), and hence defines what can be licensed for consumptive use (allocation limit).

The determination of the environmental water provisions are made following consideration of:

1. ecological, social and cultural water requirements
2. current and potential consumptive requirements
3. community input
4. public interest.

**3.1.3 Resource use**

There are three categories of ‘use’ in the allocation limit decision-making process:

1. **Licensed entitlements**: is the total (annual) volume of water that has been allocated to a licensee to use water for a specified activity.

2. **Stock, domestic and garden use**: at a small scale is generally exempt from licensing. However, the department must estimate and account for this use when allocating water so as not to over-allocate an aquifer. The information presented in Table 2 includes both licensed (confined aquifers) and unlicensed stock, domestic and garden use.

3. **Public Water Supply reserves**: are the specified volumes of water that are set aside for future public water supply use. This water is not actively being abstracted, but is excluded from the available water to be allocated for future use, to ensure a clean and secure drinking water source is available in the future for the expanding South West community. As demands increase, this water will be made available to water service providers subject to stringent conditions and management.

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**Action 17** – Carry out a survey of stock, domestic and garden use to improve licensing and water use information to inform the review of this plan.

**Action 18** – Investigate the potential for temporary licensed entitlements of five to ten years from Yarragadee PWS reserve for commercial operations as part the implementation of this plan.
Cowaramup groundwater model

Drilling investigations in the Cowaramup groundwater subarea commenced in 2005, and the information collected through the construction of the monitoring bores, existing geological and water-use data has been developed into a local area groundwater model for the Leederville aquifer, Sue Coal Measures and superficial aquifer on the Vasse shelf.

The investigation report and modelling results will be available in early 2008, following release of this draft plan. This information will be incorporated into the review of the South West groundwater areas plan prior to the revised statutory allocation plan being prepared in 2011. This means that the allocation limits for the aquifers of the Cowaramup groundwater subarea will be revised, including the subarea boundaries, to better reflect the improved understanding of the hydrogeological formations and groundwater flow in this area.

For more information on the Cowaramup drilling investigation please see Cowaramup groundwater investigation, (Schafer et al., 2008).

3.1.4 Methodology used to determine the allocation limits

A review of the previous allocation limits for each of the groundwater resources in the South West groundwater areas plan was essential to define the available water for allocation now and into the future, while protecting the in situ water values. The methodology of the previous allocation limits and the new allocation limits can be found in South West groundwater areas: review of the groundwater allocation limits (DoW forthcoming).

The major factors in the review of the allocation limits were:

- the effects of climate change and its impact on rainfall
- the importance of the cultural and ecological assets of the South West
- security of entitlements and protection of water quality into the future for current water users
- the growth of drinking water needs.
The methodology used to determine allocation limits in the South West groundwater areas is summarised as follows:

1. Identification of *in situ* environmental values and consumptive requirements (both existing use and predicted demand).
2. Modelling of several scenarios showing predicted impact under a range of abstraction regimes.
3. Definition of the resource objectives for aquifer systems and dependent environmental values through consultation on community preferences and departmental review.
4. Definition of final model scenario and calculation of the associated water balance.
5. Consideration of the following factors for each subarea and aquifer, resulting in revised allocation limits: measurement data, modelling outputs (water balance), management objectives for each area, environmental values, existing groundwater use, current and likely future land use, risks to water quality (PASS) and the mitigation of impacts through licence assessment and ongoing management.
6. Review of the proposed allocation limits derived following Step 5 against coarse allocation limit calculation methodologies (using basic hydrogeological principles) and a expert advice.
7. Final allocation limit.

The final allocation limits are presented in Table 2.

### 3.1.5 Water availability

Water availability is the allocation limit less the existing uses of water described in section 3.1. This is the water that is currently available for licensing and is identified in the last column of Table 2. Water availability will obviously change as new licences are issued or existing licences are cancelled. To find out the most up-to-date water availability figures following release of this plan please contact one of the department’s three South West regional offices.

**Remaining water in the Yarragadee and other aquifers**

Over the whole plan area the there is water available for allocation in the superficial aquifer north of Myalup, with limited availability on the coastal plains and the Leeuwin-Naturaliste ridge. There is less than 25% available from the Leederville aquifer across the plan area, with the majority available on the Scott Coastal Plain (where the aquifer is present). The Yarragadee aquifer is open for trading in the Bunbury and Busselton–Capel groundwater areas, with 25% remaining for allocation in the Blackwood groundwater area.
While Table 2 indicates that there is water available in the Yarragadee and other aquifers, it is expected that part or all of this water will be taken up by existing and pending licence applications where decisions have been deferred until the completion of this plan. As such, it is important that any new proponents contact one of the department’s three South West regional offices to identify if there is any remaining water for allocation in their subarea.

3.1.6 Over-allocated subareas

An analysis of measurement data and modelling information has shown that in some areas there is currently too much water being taken out of the system. In Table 2 this is represented as an over-allocation of water in these subareas (negative available water). In most cases this over-allocation has resulted after existing limits had to be reduced to take account of likely future reductions in recharge due to climate change. As a result, areas that were already close to or at full allocation under the old allocation limits are now over-allocated.

In these areas the department will seek to reduce the amount of over-allocation by reviewing current licensees’ use of water and recouping any water that has been allocated but is not or has not been used. The over-allocated subareas will be carefully monitored over the term of this plan to ensure there are no adverse impacts to the environment, the resource or existing groundwater users from this over-allocation. If, at the end of the planning period in 2011 the system remains in an over-allocated state and impacts have become apparent, further measures will then be employed to reduce the level of abstraction.

**Action 19** – As part of the implementation of this plan, water use surveys will be conducted in all fully and over-allocated areas and the department will initiate processes to recoup unused water from licensees.
<table>
<thead>
<tr>
<th>Groundwater area</th>
<th>Subarea</th>
<th>Aquifer</th>
<th>Allocation limit</th>
<th>Licensed entitlements**</th>
<th>Estimated exempt use</th>
<th>PWS reserve</th>
<th>Water available</th>
</tr>
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<td>South West Coastal (part in plan area)</td>
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<td>3 076 750</td>
<td>0</td>
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<td>Yarragadee</td>
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<td>Aquifer</td>
<td>Allocation limit</td>
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<td>Estimated exempt use</td>
<td>PWS reserve</td>
<td>Water available</td>
</tr>
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<td><strong>Busselton–Capel</strong></td>
<td>Cape to Cape North</td>
<td>Superficial</td>
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<td>0</td>
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<td>50 000</td>
</tr>
<tr>
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<td>3 000 000</td>
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<td><strong>Total</strong></td>
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<td></td>
<td>211 430 000</td>
<td>137 677 110</td>
<td>2 217 000</td>
<td>13 287 000</td>
<td>58 248 890</td>
</tr>
</tbody>
</table>

*Note that water available = allocation limit – licensed entitlements – Public Water Supply reserve – estimated unlicensed use. It is important to note that the water available for many of the subareas and aquifers has already been applied for and is pending assessment. The water available is current as at November 2007. Any further allocations will reduce the amount of water available. Please refer to the department’s licensing system or contact the department for an update on water availability.

**Licensed entitlements are current as of November 2007. The estimates of unlicensed use are based on local knowledge, water user surveys and a desk top review of aquifer location, depth and number of lots with an average use of 100–300kL/a abstraction for domestic and garden use in small lots and 1500kL/a for larger lots with stock water.
Figure 9  Groundwater subareas for the superficial and Leederville aquifers
Figure 10  Groundwater subareas for the Yarragadee and other aquifers
3.1.7 Trading

Trading is officially open for the subareas and aquifers listed in Table 3 only. This means that in these subareas any application, other than for stock, domestic and garden (subject to policies in section 4.3.6), will be required to trade with another licensee to gain a new water entitlement, subject to the trading policies in section 4.3.4.

The department will announce when an area is open for trading by advertising in local and state newspapers under the Public Notice section. The information will also be available on the department’s website, www.water.wa.gov.au.

Applications for a new entitlement, or existing licensees wishing to expand their enterprises in a fully committed groundwater resource, will need to purchase their entitlement from another licensee. The ability to transfer or trade water entitlements is provided for by Schedule 1, Division 7 of the RiWI Act and in Statewide policy no. 6 – Transferable (tradeable) water entitlements in Western Australia (WRC 2001). This plan clarifies Statewide policy no. 6 in the plan area, providing a local context and further defining the rules associated with decision making for trading.

All official trades (documented on the department’s water licensing database) that have occurred in the plan area prior to this plan’s implementation are recognised and acknowledged as a defined asset separate from the land.

It is important to note that you can only trade water if you can successfully demonstrate that you have used (measured through meter readings or other approved method) the water in accordance with your licence conditions and comply with the policies stated in this plan (section 4.3.4) and Statewide policy no. 6 – Transferable (tradable) water entitlements for Western Australia (WRC 2001).

### Table 3  Subareas and aquifers officially open for trading

<table>
<thead>
<tr>
<th>Groundwater area</th>
<th>Subarea</th>
<th>Aquifer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bunbury</td>
<td>Bunbury–Yarragadee</td>
<td>Yarragadee</td>
</tr>
<tr>
<td>South West Coastal</td>
<td>Lake Preston South</td>
<td>Superficial</td>
</tr>
<tr>
<td>Busselton–Capel</td>
<td>Dunsborough–Vasse</td>
<td>Leederville</td>
</tr>
<tr>
<td></td>
<td>Donnybrook</td>
<td>Leederville</td>
</tr>
<tr>
<td></td>
<td>Busselton–Yarragadee</td>
<td>Yarragadee</td>
</tr>
<tr>
<td>Blackwood</td>
<td>Blackwood–Yarragadee</td>
<td>Yarragadee</td>
</tr>
</tbody>
</table>

**Action 20** – Provide information to groundwater users by June 2008 on how to operate under a RiWI Act trading environment.

**Action 21** – Review the allocation limits for the 2011 statutory plan, prior to commencement of the drafting, based on the monitoring and investigation information that will be collected over the 2008–2011 period.
4 Allocation and licensing

Allocation and licensing policies ensure the allocation of water in an equitable and considered way. Allocation policies provide advice on where and under what circumstances water may be taken and how water abstraction is managed.

All statewide policies endorsed by the department are applied through this plan. All state and Commonwealth legislation relating to water and its use apply to this plan area. Specific aspects of existing statewide policies were developed further to be more applicable at a local scale for the management of water resources in the plan area.

The allocation policies were developed to support the principles and objectives of the plan. They were developed in the context of a competing atmosphere for consumptive water, and aim to provide a sound basis for groundwater licensing over the life of the plan. The policies aim to protect all groundwater use and as such cover ecological, social and economic aspects; and water quality and quantity.

Licensing decisions should be based on the best available scientific knowledge and through the decision making process, take into consideration local and regional scale impacts of abstraction. Licensing of groundwater in the plan area is administered by the department’s South West region offices.

High value GDEs, areas of social/cultural significance, and sites of potential acid sulfate soil risk that may be affected by abstraction may have local area rules applied to them (section 4.4) in addition to the policies outlined in section 4.3. These additional requirements are in place to protect high value areas or areas at high risk of impact. Trigger/response criteria also apply to some sites (see section 4.5).

The licensing process and forms for licence applications can be found on the department’s website or by contacting one of the department's three South West regional offices. Applicants should be aware of the licensing policies and local area rules that may apply to them before submitting their groundwater licence application to the department.

Licensing fees

Annual licensing and application fees will apply to groundwater licences in the South West groundwater areas. Water licence holders, who are licensed for >1500 kL/a, will be required to pay an annual administration fee. Any new applications will be charged a non-refundable $200 application fee. For more information on licence fees, where they apply and the schedule of fees email licencefees@water.wa.gov.au or visit the department’s website www.water.wa.gov.au.
4.1 Principles for managing water in the South West groundwater areas

The principles provide the basis for operational policies and licensing decisions in the South West groundwater areas. These principles will be considered in all current and potential operations, where water is used or there are impacts on the resource. The broader strategic principles for water management will be defined in the *South West Regional Water Plan*, (DoW forthcoming) and apply to the plan area.

**Principle 1** – The environment has a right to water. Abstraction of groundwater must not place key ecological values at an unacceptable level of risk.

**Principle 2** – Existing users security of supply should not be unacceptably reduced by making more water available for new users.

**Principle 3** – Water is a valuable resource and should be used as efficiently as possible to maximise regional and state development.

**Principle 4** – Everyone has the right to access clean drinking water

**Principle 5** – Ecological, social and cultural groundwater-dependent values must be identified and predicted impacts to them accounted for in water allocation decisions.

**Principle 6** – Water users and the wider community will be advised about data collected through monitoring, ongoing management and future planning of their water resources, and will have their concerns documented and considered in decision making.

**Principle 7** – Adaptive management will be employed to ensure that as the water resource situation changes the level of management will be adjusted accordingly.
4.2 Objectives for managing water in South West groundwater areas

The objectives for managing water in South West groundwater areas are based on the considerations in Chapter 2. The department will, where appropriate, initiate additional investigations and monitoring programs to ensure that management objectives are met.

The objectives of this plan are:

Objective 1 – Maintain the sea water interface to protect coastal water users and groundwater-dependent ecological, social and cultural values.

Objective 2 – Key ecological, cultural and social values are to be maintained and protected at an acceptable level of risk from groundwater use.

Objective 3 – Maintain the groundwater quality for fit for purpose use at a low level of risk to the environment and water users.

Objective 4 – Minimise impacts of new groundwater developments on existing licensed groundwater users.

Objective 5 – Licences in over-allocated areas are reviewed and amended through the implementation of this plan.

Objective 6 – Unused water entitlements are actively recouped across the plan area.

Objective 7 – Regular public reporting will be made against the management objectives outlined in this plan.

Objective 8 – The community will be consulted in the ongoing work to review this plan and their concerns will be recorded and reported.

Objective 9 – Water service providers are expected to develop plans to achieve and implement improvements to water delivery and efficiency (usage per capita) by 20% by 2011.

Objective 10 – Good water management will be implemented through licensing, measurement, monitoring, auditing, compliance and reporting to provide transparency and accountability of water use.
4.3 Policies for water take and use

Allocation policies are the procedures and rules required by the department to ensure that available water is allocated according to the Rights in Water and Irrigation Act 1914 (RiWI Act). Allocation policies provide a structure for assessing and issuing licences. Policies also act as guidance to ensure water is allocated in line with ecological, social and economic considerations within the South West groundwater areas.

4.3.1 Allocation policies — first in first served

All applications for water, including licence renewals, are managed and assessed on a first-in-first served basis. However the first-in-first served principle for allocation of water will not apply to the Yarragadee aquifer and the Leederville aquifer in all fully allocated or previously fully allocated subareas only.

This principle is also not applicable in areas where trading has been initiated. In areas of trading it is up to the trading parties to negotiate the sale and work with the department on the acceptability of the trade. Trades will not be accepted if the water has not been used (see section 4.3.4 under ‘Trading’).

Alternative allocation policy

To ensure the value of water is recognised and that any water available is used, alternative water allocation processes, such as expressions of interest, auctions or merit selection, will be used to release water were the first-in-first served principle does not apply. This will support the establishment of a market and ensure that the value of water is recognised.

Proponents who apply for any remaining water will be informed if the allocation decision will be made by an alternative process and they will be notified of when this action takes place.

Yarragadee aquifer

To ensure existing user security and low environmental risk the amount of water available from the Yarragadee aquifer is now limited.

There are a number of existing pending licence applications that will be considered under this plan. These will be assessed and addressed appropriately. If, after the pending licenses are reviewed, there is water still available in the Yarragadee the water will be released for further use.
Releasing future water — 2009

Water may be released for licensing following completion of groundwater investigations, when new information becomes available, or where water is recouped from users who are not using their full water entitlements in 2009. This will result in a change to the allocation limits. All amendments to the allocation limits will be publicly stated in the annual evaluation statement for this plan, and licensees will be notified.

The water may be released in two ways:

1. In areas that are close to, fully allocated, or in any Yarragadee subarea, alternative mechanisms such as expressions of interest, auctions or merit selection will be used to release this water. This will support the establishment of a market and ensure that the value of water is recognised. The department will advertise well in advance when and how the release will be managed, and provide advice to all interested parties well in advance of the action.

2. In aquifers that are not fully allocated, other than for the Yarragadee aquifer, the department will adjust the allocation limit upwards and maintain the first-in-first served approach.

4.3.2 Water use policies

Water efficient use

Water should be used efficiently and proposals should show how their water use will be efficient with regard for industry standards or good management practice (ie Department of Agriculture and Food advice). Larger operations may be required to demonstrate water conservation measures (see section 4.3.6).

Fit for purpose

Where possible, uses requiring lower quality water should be matched with appropriate sources. In areas of limited high quality water availability, alterations to proposals (ie alternative irrigation infrastructure) can allow the use of lower quality water such as high nutrient, saline or recycled water.

Alternative supplies

If alternative supplies such as recycled, drainage water, desalination or reuse of re-injection water are part of a proposal, contact the department office as early as possible to determine the approval and supporting information required.

Recouping

The department will actively recoup water throughout the plan area from all aquifers to ensure that the water is being used efficiently and can be re-allocated for use. This will ensure equity for trading and maximise the use and productivity for each water resource.
4.3.3 Environmental policies

Environmental impact assessment, supplementation, trade-offs and offsets

a Environmental values will be protected through the rules in this plan as they guide licence assessment under section 7(2) of the RiWI Act.

b Supplementing water flows or water levels is a valid offset measure but must be shown to be compatible and achievable for the purpose of maintaining a specified water level and water quality of a given system. Short term (e.g. life of mine site; <10 years) supplementation of water levels and quality, with recovery to baseline conditions or as defined by the department (prior to abstraction), may be considered; however ongoing supplementation will not be considered as an offset measure for groundwater abstraction without Ministerial approval.

c If a major project is submitted where scale or scope mean that it cannot be considered under this plan and the RiWI Act, the proposal may be referred to the Environmental Protection Authority (EPA) for assessment. The department will provide the EPA with advice. EPA approval of a proposal does not guarantee approval of the water licence. The department must still assess the groundwater licence application.

d Environmental Offsets – Position statement no. 9 (EPA 2006) will be applied in the department’s assessment of a proposal requiring trade-offs or offsets. Any costs associated with recovery of impacts resulting from the abstraction and/or the offsets/trade-off measures will be borne by the licensee.

Water quality

e The department may require a licensee to monitor, measure, and report on salinity, acidity and other analytes as part of the licence conditions if it is considered that their water usage may affect these parameters. It is in the interest of groundwater users to measure the quality of their groundwater resource, in particular its salinity and acidity. Deterioration of groundwater quality may lead to undesirable impacts on the activities of users and the environment.

f If water is going to be used for personal drinking water supplies (where there is no scheme water supply available) it is advisable that the water is filtered, treated and tested according to public health advice available from the Department of Health. The Department of Water also provides guidance for community and private drinking water supply through water quality protection notes:

- Private drinking water supplies, Water Quality Protection Note no. 41 (DoW 2004) provides advice on water drawn for household usage, farm and pastoral lease supply, processing of commercial products, and irrigation of gardens and crops
• **Community drinking water sources – protection and management**
  Water Quality Protection Note no. 9 (DoW 2006b) provides advice on any water resources used for domestic drinking water supply that is managed by a local group for household (drinking) water supplies.

Also see *Australian drinking water guidelines* (Australian Government 2004) and *Australian and New Zealand guidelines for fresh and marine water quality* (ANZECC and ARMCANZ 2000), which provide information on relevant drinking water quality criteria.

The department may require a licensee to measure the quality of the groundwater to ensure that its beneficial uses are not compromised. Water use must not increase the background levels such that it adversely affects a water dependant system (including other users). This includes activities such as dewatering, excavating, application of nutrients, discharge of waste water and irrigation or processing with saline water.

Where a licence application has the potential to increase the background salinity and/or acidity of a groundwater resource, or proposes nutrient application, the department may apply additional licence conditions to manage any associated impacts and protect groundwater quality and dependent systems.

The department’s water quality protection information should be used in assessing licence applications which have the potential to impact on water quality. In particular information contained in the *Nutrient and irrigation management plans* Water Quality Protection Note no. 33 (DoW 2006c) should be applied.

A licensee must report any increase to the existing salinity of the groundwater resource in use (to the next threshold category in Table 4) to the department within seven days. The department will provide advice to the licensee and may require pumping from this source to be restricted until the salinity levels return to the baseline conditions. This may include amendment of licence conditions, increased monitoring and remediation.

**Table 4 Salinity threshold categories (Australian Government 2004)**

<table>
<thead>
<tr>
<th>Salinity type</th>
<th>Range (mg/L TDS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
<td>&lt; 500</td>
</tr>
<tr>
<td>Marginal</td>
<td>500-1000</td>
</tr>
<tr>
<td>Brackish</td>
<td>1000-2000</td>
</tr>
<tr>
<td>Moderately saline</td>
<td>2000-5000</td>
</tr>
<tr>
<td>Saline</td>
<td>5000-10 000</td>
</tr>
<tr>
<td>Highly saline</td>
<td>10 000-35 000</td>
</tr>
<tr>
<td>Hypersaline</td>
<td>&gt; 35 000</td>
</tr>
</tbody>
</table>
k It is the responsibility of the applicant to establish whether the area of application contains potential acid sulfate soils (ASS), and if the proposed abstraction, including drainage, may generate acidic water and soils. The department will provide advice to the applicant on the location of potential ASS risk areas and sites of known ASS.

A licence to take groundwater water (5C) or a licence to construct or alter a well (26D) should not be granted until the risks associated with the cone of groundwater depression that intersects with any identified potential ASS are addressed.

The licensee will be required to address the risks through demonstrating that the impacts can be managed by initially undertaking an ASS investigation. Where ASS are identified the licensee will develop and implement an Acid sulfate soil management plan (ASSMP) in accordance with the Department of Environment and Conservation’s Acid sulfate soil management series of guidelines listed on their website (www.environment.wa.gov.au under ‘Land: Acid sulfate soils’). The information submitted in the ASSMP will be used to develop licensing conditions and monitoring and measurement requirements for the licence.

**Nutrient impact management plans**

l Upon request by the department a Nutrient and irrigation management plan must be completed for applications that have the potential to contaminate water sources off-site through activities conducted on-site by the application of nutrients, including the addition of water soluble soil improvements.

This includes activities where the site:

- is irrigated with wastewater from intensive animal industries and/or municipal wastewater treatment plans
- has intensive animal holding in paddocks (e.g. feedlot)
- is irrigated land where fertilisers, chemical pest control and animal wastes are routinely applied (e.g. turf farms, summer pasture, woodlots, sport and recreational facilities)
  
  or
  
- is an intensive horticultural pursuit in or near an environmentally sensitive area, public water supply reserve, underground water pollution control areas or natural water body.

The information submitted by the licensee will be used in the licence assessment process to specify the licence conditions and/or additional monitoring/measurement requirements in an operating strategy.
**Point source pollution and contaminated sites**

m  Point source pollution of groundwater through industrial or other activities is regulated through the *Environmental Protection Act 1986*. The DEC should be contacted if evidence of a pollution event has been identified.

n  New bores should not be drilled within 500 m of an identified contaminated site (see *Contaminated Sites Register*). The applicant must demonstrate that the proposed abstraction will not affect the water levels connected to the contaminated site, the environment or public health.

Bores near an identified contaminated site may require additional assessment to determine the potential impacts of the application.

This policy does not apply to monitoring bores, bores constructed for environmental management purposes or remedial work associated with the contaminated site.

**Managing the sea water interface**

o  Groundwater abstraction from the water table aquifer near the coast should be limited to minimise the risk of the sea water interface moving inland. Where the water table aquifer is accessed, the installation of multiple spaced bores with low flow pumps are recommended, to spread the draw and minimise the potential water level decline. The department will provide advice on the location of the bores and if monitoring is required.

**Wetland and GDE impact management**

p  The department may require the licensee to undertake additional work to ensure that groundwater abstraction has negligible impact on the ecological values of wetlands or other groundwater-dependent ecosystems. This work may include:

- a hydrogeological assessment of the impact of the proposed licence on surrounding GDEs. The scale of assessment will be dependent on the proposed groundwater take and the ecological value of surrounding GDEs. *Statewide policy no. 19 – Hydrogeological reporting associated with a groundwater well licence* (DoW 2007b) may be used as a guide to the scale of assessment required.

- ecological water requirements defined for high value GDEs that may be impacted from the proposal. Ecological water requirements (EWRs) are the water regimes needed to maintain GDEs at a low level of risk (refer to *Statewide policy no. 5*). In the case of wetlands and native vegetation this regime will usually refer to a minimum groundwater level and possibly a maximum rate at which the groundwater level should be allowed to decline.
The predicted drawdown of the proposal will then be assessed against the EWR to ascertain whether impacts to the GDE are likely or unlikely. If impacts are likely, the proponent must address impact mitigation options and/or the proposal may be referred to the EPA for environmental impact assessment. Ongoing measurement of water levels against the EWR is likely to be required and this may be in association with periodic measurement of ecological health (e.g. vegetation condition, fauna surveys).

- installation of shallow monitoring bores to measure the groundwater level at relevant locations and monthly measurement of water levels and water quality (where risk is from ASS or nutrient application), including baseline levels in accordance with the *Australian guidelines for water quality monitoring and reporting* (ANZECC & ARMCANZ 2000)
- annual report submitted to the department on trends observed and measurements for groundwater level, biological condition and compliance with groundwater level/EWR criteria for the area defined. Reporting requirements and frequency may be increased if criteria are breached
- compliance with triggers and associated management actions defined by the department, including switching off production bores, to ensure criteria are met.

All groundwater licence applications must comply with relevant environmental legislation as well as the policies and rules contained within this plan.

### 4.3.4 Social and economic policies

Any one changing or applying to change land zoning or expand an urban development should consult with the department before gaining planning approvals to ensure that any dewatering or potential irrigation requirements can be met.

*Urban land use and development*

- All urban land requiring groundwater for irrigation of parks, gardens, public open space and maintenance of artificial wetlands or constructed lakes (see the department’s position statement on *constructed lakes*) must provide the department with a water efficiency management plan (WEMP). The WEMP should detail the whole water balance cycle including the water re-use and recycle systems, metering and monitoring requirements, irrigation schedule, and time frame for development of new areas. The WEMP will be assessed by the department and will be used to develop licensing conditions and monitoring requirements.
Current licence holders of large entitlements (>500 000 kL/a) should have a WEMP completed by 2010. The information submitted will be used to review and amend these licences.

b All new developments will be assessed as per Statewide policy no. 9 – Water licensing – Staged developments (WRC 2003a). Provision of a detailed timeline for development and a specified completion date for inclusion in the staged development condition on the licence is required. This must include the completion date where the full licence entitlement usage will be reached.

Non-compliance with the staged development conditions associated with a licensed entitlement may result in an amendment to the licensed entitlement or licence conditions.

Cultural

c Native Title is considered in conjunction with water resource development proposals. Notification under the Native Title Act 1993 is not required where:

- Native Title has been extinguished by a prior grant of an tenure (e.g. freehold land, residential leases, commercial leases, exclusive agricultural and exclusive pastoral leases, conditional purchase leases and war service settlement (perpetual) leases)
- water usage is consistent with the purpose of the tenure (e.g. water use in relation to a mining tenure is for mining related purposes)
- the taking of water is within the purpose of a reserve or within the statutory powers enabling the management of the reserve (e.g. crown reserve)
  
  or

- the licence is a renewal, re-grant, re-making or an extension of term of a previous licence granted before 23 December 1996
- the licence is for the same term as the previous licence.

If the proposal does not comply with these points, then the department will advise the claimant and the proponent in writing, requesting comments on the proposal by Native Title claimants. Comments from claimants must be provided in the reasonable timeline as identified in the letter of advice from the department.

Comments received by the department from the native title claimants will be considered in the assessment of the application to take water under section 7(2) of the RiWI Act. If no comments are received in the defined timeline, assessment will proceed.
d The department, during the notification period or during ongoing negotiations, will assess any application that requires notification through the Native Title claimants. The potential water that this application would use will not be allocated until the negotiations are completed. This does not result in any exemption to the Statewide policy no. 17 – Timely submission of required further information (DoW 2007a).

Trading

The ability to trade water entitlements is necessary when the available water is fully committed. Trading can occur in subareas that are not fully allocated, however it is unlikely when there is available water for licensing.

Trading rules and restrictions are designed to protect the water resource from unacceptable impacts. Therefore all trades will be assessed as a new licence application.

Applications to Trade - general information

e The department must approve all trades of licensed entitlements, either a complete or partial trade or transfer of the entitlement.

f All applications to trade or transfer are subject to the provisions of the Rights in Water and Irrigation Act 1914 and Regulations 2000, the Environmental Protection Act 1986, Statewide policies (Department of Water) and the policies and rules outlined in this plan.

g All applications to trade are assessed as a new license application in accordance with the RiWI Act and the provisions of this plan.

h Licensees contemplating entering the trading market for an additional or new entitlement should ensure that the entitlement can be pumped sustainably before they enter into the trade and the that application complies with the provisions of this plan. This may require submission of an application to carry out exploratory works or pump testing (see Statewide policy no. 19)

i Trades are limited to the consumptive (actually abstracted or used) part of the water entitlement.

j No trading of water between aquifers will be accepted.

k No trading of water between groundwater management areas or groundwater management subareas will be accepted.

l Fractured rock aquifer entitlements are not tradable.

m Licensed domestic, stock and garden entitlements are non-tradable and must stay with the property. These entitlements may be transferred to the new owner of the property.
n  A trade is not to result in an increase in the concentration of use (increase in abstraction within a small area) such that the cumulative impacts would trigger the water level and environmental criteria set for that area.

o  Leasing of licensed entitlements can only be accepted for a period less than the original licence tenure of the vendor’s entitlement; and only where impacts from the purchaser’s bore location are acceptable (assessed as per new licence application) for the duration of the lease agreement.

p  The department will not be involved in setting the market price for trading groundwater entitlements. However, the prices paid for trades will be publicly available from the department.

q  An existing licensed entitlement for water can be purchased without demonstrating use if the entitlement is purchased for protection of a critical environmental asset (ecological and/or social asset’s protection). Water traded for this purpose is effectively traded for non-consumptive use (no abstraction) to the identified critical environmental asset.

Vendor and purchaser responsibilities

r  It is the responsibility of both the vendor and the purchaser to provide requested information to the department, including proof of use (measured through metering) as part of the assessment of the trade. This is usually through the provision of meter readings. Licensees who do not have meters fitted to their production bores may not be permitted to trade until the licensee can demonstrate use over the period the licence has been in force.

s  The volume of the traded entitlement will be added to the purchaser’s existing or new entitlement. Licence conditions will be added to an existing licence to minimise or monitor any potential impacts of the additional volume.

 t  If a vendor’s total entitlement is traded permanently (full or part entitlement) the vendor’s licence will be amended (partial trade) or cancelled (full trade). Where the trade is for the full entitlement any further use of the vendor’s bore(s) must cease, with the bore(s) capped and the pump(s) removed or fully decommissioned.

  If there is a need to use the vendor’s bore(s) following trading of the water entitlement a new licence application will have to be submitted and assessed by the department.
Metering and water use

u Accurate measurement of use of the water entitlement is a prerequisite for trading and must be proven to the department before the entitlement can be traded.

This is usually through the provision of meter readings. It is the responsibility of the licensee to demonstrate their historical use of the licensed entitlement. Licensees who do not have meters fitted to their production bores may not be permitted to trade until the licensee can demonstrate use over the period the licence has been in force.

v Water efficiency gains can be traded and will not be recouped by the department. Water efficiency gains are a result of implementing more efficient distribution systems for using a licensed entitlement; as a result the excess can be traded. Where a change of purpose occurs for a licensed entitlement (e.g. pasture irrigation converting to irrigation of wine grapes) the subsequent excess allocation can be traded, provided that use has been proven.

Dewatering

The following outlines the department’s policies on dewatering and dewatering discharge. It is important to note that it is the department’s responsibility to licence dewatering activities and manage the impacts associated with the dewater discharge through licensing conditions and assessment (operating strategy and licensee monitoring).

Where impacts occur as a result of a dewatering operation then remediation and/or mitigation activities may be requested. Any significant dewatering operations (confined aquifer, long term operations, and large volumes) may require assessment under the *EP Act 1986*. These applications will be referred to DEC for advice and assessment.

w All dewatering activities, including disposal of discharge water must comply with existing legislation and departmental Statewide policies. Under the *RiWI Act 26C Exemption order (Dewatering)*, licensing exemptions apply to dewatering in relation to construction and use of a *non-artesian* well if:

- the only water that is able to be taken from the well is from the water table aquifer
- the water is taken from the well at a pump rate of less than 5 L/sec over a period of less than seven days
- the water taken from the well is taken for the purposes of dewatering.
All dewatering activities not exempt under the RiWI Act 26C Exemption order (Dewatering) must be licensed, including the discharge of the waste water into the environment. The disposal and treatment of the discharge water, particularly in potential ASS areas, should be managed in accordance with the EP Act and the DEC guidance and policy documents.

Where dewatering activities are required to be licensed the following applies:

- dewatering activities located in areas where there is a risk of disturbance to ASS the department may require the licensee to submit an Acid sulfate soil management plan (ASSMP) in accordance with the Department of Environment and Conservation’s Acid sulfate soil management series of guidelines listed on their website (www.environment.wa.gov.au under ‘Land: Acid sulfate soils’).

Where land use planning conditions (Western Australian Planning Commission conditions) require development of an ASSMP as part of the development proposal it can be submitted as part of the licence application. The department will assess the existing ASSMP and request further work if required.

The department may request pump tests and/or a local area groundwater model to determine the extent of the groundwater drawdown and predicted impacts relative to the occurrence of potential acid sulfate soils. Groundwater level and quality measurement may also be required.

- for significant dewatering operations (>6 months duration, pump rate >5 L/sec, regionally confined aquifer), pump tests and/or a local area groundwater model to may be required to determine the extent of the groundwater drawdown. Groundwater monitoring bores should be installed with water levels and quality measured on a regular basis to determine if dewatering is influencing the background levels (pre-dewatering). The department will advise the licensee when monitoring is required.

- for significant dewatering operations (>6 months duration, pump rate >5L/sec, regionally confined aquifer) where water is reused or disposed of a WEMP should be submitted. This information will be used in assessing the licence application and methodology for dewater discharge or reuse.
y The following are the department’s preferences for acceptable methods of discharging high quality dewatering discharge:

- used for fit for purpose activities (e.g. processing and dust suppression; irrigation). The proponent needs to show that it is of suitable quality for the purpose of use.
- allowed to infiltrate over an expanse of land designated by the department for the operation
- reinjected back into the water table aquifer at designated sites specified by the department

or

- allowed to flow (either through a pipe or overland) into a designated drain or water course/wetland specified by the department (provided no significant erosion is predicted or impacts observed on the water quality). Where the discharge water flows into a designated wetland or watercourse the department, prior to the operation commencing, will assess it.

In areas where the dewatered discharge is treated and of low quality these methods can be used, however the department must approve the purpose of discharge, rate, location and any subsequent treatments required to minimise the impacts including where mitigation measures may be needed. The department, in consultation with the licensee, will determine the method of dewatering discharge.

z The water quality of the dewatering discharge should be measured both before and after any treatment processes. See water quality protection documents on dewatering for *Dewatering of soils at construction sites* water quality protection note no. 13 (DoW 2006d) and *Mining and Mine processing – Mine dewatering* water quality protection guidelines no. 11 (WRC 2000b), for more information.

Where impacts on water quality, water levels or other users (including the environment) occur outside the area of operation it must be immediately reported to the department. The dewatering operation may be directed by the department to cease pumping until the impacts are addressed. The department will advise the licensee if any remediation is required as a result of the impact.
**Major projects**

It should be noted that major projects requiring water for production or development may involve assessment by, or advice from, the EPA and/or other government departments (e.g. WAPC, DIA, DPI, DOIR and local governments). It is important that the proponents of these projects come to the department early in their scoping phase rather than at the end when a license is required, as there may not be water available for the completion of the project.

Failure to do this may result in proponents having to repeat work and lose significant time to satisfy departmental requirements or may find that their operation is no longer feasible due to water management or availability issues.

**4.3.5 Public water supply**

a The intent to access the PWS reserves must be identified, including short/long term supply options in a Public Water Supply (PWS) ‘source development plan’ submitted to the department. These source development plans will provide the department with information on when future demand will require the uptake of the PWS reserve and whether all reasonable efficiency measures have been applied beforehand. Water service providers should liaise with the department to further identify the requirements of source development plans.

b All PWS licences must be undertaken in accordance with the Drinking water source protection plan implemented by the department for a given water resource.

c In areas of PWS with a high risk of contamination, or potential decrease in supply due to surface water and groundwater supply changes, drought contingency plans should be developed to document the implementation of drought management and emergency supply options.

d Public water service providers can not access reserved water until triggers for new sources are reached as per the department-approved source development plan.

e The use of the water allocated for public water supply must be efficient. A Water Efficiency Management Plan must be submitted with the application before accessing reserved water is allowed. It is anticipated that there would be reductions in the per capita consumption in all towns before further water is allocated.

f Existing applications prior to this plan will be continued in their current form without source development plans.
Temporary allocation of reserved water

- The department may temporarily allocate the unused portion of a PWS reserve if it will not be accessed in a ten year time frame (identified through a source development plan), for another purpose. This temporary allocation of the PWS reserve, subject to the assessment process, is for short term (<10 year) applications only. It can not be traded and is classed as a non-renewable licence. A maximum of 75% of the total PWS reserved water for a given aquifer and subarea can be temporarily allocated at any one time.

- All temporary allocations will be assessed as per this plan and will be subject to a legal agreement between the department and the licensee. The term of the licence tenure and lease arrangements (including market price) will be included in the agreement. The agreement is to ensure the return of the water following the expiry of the temporary licence.

- If a PWS choose not to use the reserved water it may be re-allocated back into the system for use.

Exporting water out of the region

- Future water use for sustainable regional growth and development will be satisfied before water is exported out of the region. The area that water is being exported to must have a deficit of supply with all other reasonable supply and demand management options implemented to the department’s satisfaction.

4.3.6 Licensing rules and requirements

Licensee’s responsibilities

- It is the individual licensee’s responsibility to provide the department with the requested information to enable the complete assessment of their licence application. Any requested information will be assessed in accordance with Statewide policy no. 17 – Timely submission of required further information (DoW 2007a).

- It is the licence holder’s responsibility to make an application to extend the term of their existing licence prior to the expiry date. In fully-allocated areas, licensees must not allow their licences to expire as the department cannot guarantee that the licence will be renewed if left to expire.

- All monitoring and reporting requirements associated with a groundwater well licence must be consistent with Statewide policy no. 19. This includes hydrogeological reports, monitoring reports (water use and quality) and what level of information is required to be submitted to the department for review.
d With the licensee’s permission all information submitted by a licensee on water level, water chemistry, abstraction (metered use) and hydrogeological work (including any local models) will be used in the department’s reporting on aquifer condition in the plan area.

**General requirements for licensing**

e The standard licence tenure for new commercial licences will be managed in accordance with Statewide policy no. 9. Upon meeting the development conditions the licence tenure becomes 10 years unless otherwise stated. The standard licence tenure for Public Water Supply and domestic, stock and garden licences is 10 years unless otherwise stated on the licence.

f The construction or alteration of a bore/s (either artesian or non-artesian) requires a 26D licence under the *RiWI Act, 1914*. Upon completion of the bore construction or alteration the borehole log and completion details (Form L) must be submitted to the department within 28 days.

g Private domestic water supply requirements in areas with no access to scheme water must be satisfied before water is allocated for private commercial or public use, including in fully allocated areas.

h Recouping of unused water entitlements will be undertaken by the department for all aquifers in line with Statewide policy no. 11 – *Management of unused water entitlements* (WRC 2003b).

i Where allocation limits have not been reached the first in first served basis for licence assessment and allocation will apply. In fully allocated aquifers trading rules apply.

j All new licence applications requesting >100 000 kL/a must be advertised in the Public Notice section of a local newspaper and a state newspaper, with invitation to comment (15 days following the advertisement notice) on the application. The public comments are to be submitted to the department. Proof of advertising must be submitted to the department.

k All abstraction from the superficial aquifer, other than for non-intensive stock, domestic and/or garden use is to be licensed.

l Where the regionally confined aquifer thickness is greater than 200m, bores drilled into this aquifer should be staggered in depth, as well as laterally, to more efficiently utilise the groundwater resources and minimise draw down impacts on the aquifer and its users.

m All applications that are required to provide the department with additional information following submission of their application must comply with Statewide policy no. 17.
n The fractured rock and superficial aquifers on the Leeuwin-Naturaliste Ridge (Cape to Cape South and North) are connected to sensitive groundwater-dependent systems and surface water systems. No new licensed entitlements other than for stock, domestic or garden use will be issued until the department, over the next 5 years (2008–2013), has carried out further investigations.

Stock, domestic and/or garden bores

o The RiWI Act Exemption and Repeal (Section 26 (C)) Order 2001 (domestic bore exemption) applies to the plan area. Any subsequent amendments to this order also apply.

p Aquaculture is considered to be stock raised under intensive use and therefore is not exempt from licensing.

q All applications for domestic and garden use in urban developments from a regionally confined aquifer, where scheme water is available, are subject to the licensing rules of this plan and will only be allocated a maximum of 500 kL/a. Existing licences will be amended upon renewal.

r For all domestic and garden applications that are from a regionally confined aquifer in rural areas where scheme water is not accessible the maximum allocation is 1500 kL/a.

s Allocations for intensive stock production must be based on the water requirements per head of stock. Allocations for commercial garden irrigation (e.g. botanic garden, entrance statements) must be based on the plant’s watering requirements per hectare. Water supply for domestic residences for commercial purposes (e.g. chalets, bed and breakfast etc.) is 150 kL/a/residence.

t Irrigation of gardens, lawns and recreational areas from all bores is restricted to between the hours of 6pm and 9am all year round. Alternate day water restrictions from groundwater bores applies to irrigation of gardens, lawns and recreational areas. Recently the Perth region\(^3\) has introduced restrictions on domestic bore owners to improve the efficiency of water use. The department recommends that water users in the South West follow this example as identified in Table 5.

\(\text{Table 5 Recommended watering day roster in the plan area}\)

<table>
<thead>
<tr>
<th>House or Lot number</th>
<th>Watering day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odd numbers (1, 3, 5, 7, 9)</td>
<td>Monday, Wednesday, Friday</td>
</tr>
<tr>
<td>Even numbers (2, 4, 6, 8, 0)</td>
<td>Tuesday, Thursday, Saturday</td>
</tr>
</tbody>
</table>

\(^3\) The department will consider enforcing these watering times through the legislative reform process.
Operating strategies

u Operating strategies will be applied as per this plan and Statewide policy no. 10 – Use of operating strategies in the water licensing process (WRC 2004). Operating strategies are applicable to any licensed entitlement where additional monitoring is needed to ensure any adverse impacts from abstraction are identified and managed.

Operating strategies are to be developed in conjunction with the licensee, with all conditions and requirements in the strategy to be auditable and appropriate for the purpose of the abstraction, (see Statewide policy no. 10). Information submitted in the operating strategy will be used by the department to develop licence conditions associated with the abstraction and monitoring of the licence application.

The department may require operating strategies to be developed for applications undergoing an assessment under Statewide policy no. 19.

Climate considerations

v Decision making on licences will take into consideration climate uncertainty in allocation and licensing decisions, including the subsequent impacts on the environmental assets, existing use and reliabilities of supply.

4.3.7 Measurement, monitoring and compliance

Metering requirements

a All new groundwater licences over 50 000kL/a are subject to a condition requiring installation and maintenance of a department approved flow meter to measure abstraction. All bores from all aquifers are to be metered (all entitlements over 50 000 kL/a or as specified in a management zone).

Metered bores to be read monthly, with readings submitted annually as per the date specified in the licence conditions. The frequency of meter readings can be increased (e.g. H3) or decreased (e.g. H1) as per the risk assignment.

b All abstraction (over 50 000kL/a) with the potential to unacceptably impact on other existing users and/or groundwater-dependent ecosystems will be required to be metered in case mitigation measures are required.

c Any communal bores used by one or more landholders, with access to the bore for consumptive purposes, must be metered, where the combined use is >50 000 kL/a.
**Bore construction**

d For new applications >500 000 kL/a into a confined aquifer a geophysical log must be submitted to the department. The department will assess the geophysical log and associated information (e.g. pump test; lithology) and provide advice to the applicant on where the bore can be screened. Forty-eight hours notice is required to be given to the department before drilling commences.

e The department will provide advice to the licensee on the time frame, disposal or discharge location for the pump test water for any pump testing that is required in the construction of a production bore. This may include treatment of the pump test discharge water to ensure that there are no impacts associated with its disposal. The hierarchy of preferred pump test water disposal is as per dewater discharge (section 4.3.4 Dewatering) in this plan.

f Following completion of the bore construction it is the licensee’s responsibility to submit Form L or a certified driller’s borehole construction report, including lithology, geophysical log and pump test results before a licence to take (5C) the water is issued.

g The construction, modification or decommissioning of monitoring and abstraction bores must be in accordance with Groundwater monitoring bores Water Quality Protection Note no. 30 (DoW 2006e) and Minimum construction requirements for water bores in Australia, (NMBSC 2003).

h Bores abstracting groundwater from a confined aquifer are required to be pressure cement grouted through overlying aquifers to stop intermixing of groundwater with varying water quality. Tremmie cement grouting is required for water table aquifer bores to ensure that the bore is protected from above ground contamination.

i The casing of collapsed, decommissioned or abandoned bores must be sealed, at the licensee’s or property owner’s expense. Any sealing of bores must be in accordance with the Minimum construction requirements for water bores in Australia, (NMBSC 2003).

**Monitoring bores**

Monitoring bores provide the means to measure the individual local area impacts of a specific licence application. Individual licensees are responsible for monitoring and managing the impacts of their own operations on the accessed or overlying aquifers. The department is responsible for monitoring and managing the regional impacts.

j Applications for a licence >500 000 kL/a or requiring a H2/H3 risk assessment may be required to install one or more water level monitoring bores, unless it can be demonstrated to the departments satisfaction that a monitoring bore is not required (e.g. existing monitoring bore can be used).
The licensee is responsible for monitoring, maintaining and constructing a private monitoring bore. Results of the measurements are to be submitted together with the metering results annually.

- private monitoring bores must be located on land owned by the licensee or land that the licensee has legal access to. The department will provide advice to the licensee on the preferred location of the monitoring bore.
- the frequency and duration of the measurement of the static water level readings (mAHID) or water quality parameters will be defined in the licence conditions and will be reviewed on an annual basis. The frequency and duration of the monitoring period will reflect the level of impact and risk associated with the licence application assessment.

Compliance

The department is responsible for ensuring that industry, government and all sectors of the community comply with water resource management legislation. The department uses education and advice, monitoring and compliance audit inspections, and enforcement action to ensure compliance is met.

- Routine compliance surveys will be conducted for all licensees every 3-5 years for entitlements >50 000 kL/a and upon renewal of licences <50 000 kL/a.
- The department will undertake enforcement action when it is required to protect the State’s water resources by ensuring that the requirements of the legislation are complied with. When making decisions on enforcement action and exercising its legislative powers, the department will apply the principles outlined in the enforcement and prosecution policy.

4.4 Management zones

Management zones have been established in the plan area to cater for specific water resource management issues (Figure 11). To address these issues local area rules have been established. They are designed to provide increased protection from the impacts of groundwater abstraction and to ensure that future use and the environment are managed effectively.

The additional rules have been made to the assessment process in areas which have management zones because local issues may require more stringent protection, investigation or monitoring before water can be used. It may be necessary to prove that the water can be abstracted without impacting upon groundwater-dependent systems and other users. It may also mean that some users are restricted to protect the resource from further abstraction, to protect the dependent systems and the water resource (particularly the recharge areas and connected systems).
4.4.1 How to use the management zone tables

The following tables (tables 6–9) will be used in the licence assessment process by the department to determine where additional rules apply to minimise the risks associated with a new groundwater licence. These local area rules are used in conjunction with the policies detailed in section 4.3.

Table 6 describes the management zones by groundwater area and subarea and their corresponding local area rules.

Table 7 details the local area rules that may apply for each management zone. Table 8 is a reproduction of table 1 from Statewide policy no. 19 (DoW 2007b).

Table 9 outlines the justifications for each management zone.

The process for applying the local area rules and the additional assessment and investigations required for a new licence application is:

- Determine if a new application is within a management zone (Figure 11)

Using Table 6 determine which local area rule/s apply for the management zone (Table 7) and where additional points are required for the assessment process described in Table 8

- Apply the local area rules to the new licence (conditions and restrictions) and Table 8 to the licence assessment process

- Inform the applicant of what is required to be provided to the department to complete the assessment of the licence and if any additional conditions will be put on their licence (if issued) to ensure that they are aware of the increased restrictions on groundwater use in this area

- Complete the licence assessment.
Figure 11 Management zones for the plan area
Table 6  Management zones - location and rules

<table>
<thead>
<tr>
<th>No</th>
<th>Groundwater area</th>
<th>Subarea</th>
<th>Aquifer</th>
<th>Local area rule applies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Blackwood</td>
<td>Beenup</td>
<td>Superficial, Leederville</td>
<td>+3 points to c and d. Local area rule 3 and 6 apply</td>
</tr>
<tr>
<td>2</td>
<td>Blackwood</td>
<td>Scott and Jasper</td>
<td>Superficial, Yarragadee</td>
<td>+3 points to d. Local area rule 1 and 3 apply</td>
</tr>
<tr>
<td>3</td>
<td>Busselton–Capel and Blackwood</td>
<td>Blackwood Plateau North and South</td>
<td>Yarragadee, Leederville</td>
<td>+3 points to d. Local area rule 3 and 5 in areas of freehold land</td>
</tr>
<tr>
<td>4</td>
<td>Busselton–Capel and Bunbury</td>
<td>Dunsborough-Vasse, Busselton–Capel, Bunbury West, Australind, Myalup, Lake Preston North and South, and Coastal</td>
<td>Superficial, underlying connected aquifer</td>
<td>+2 points to e; +2 points to d; +1 point to c. Local area rule 1, 3 and 4 apply</td>
</tr>
<tr>
<td>5</td>
<td>Busselton–Capel</td>
<td>Busselton–Capel and Cowaramup</td>
<td>Unknown</td>
<td>+2 points to d. Local area rule 2 and 3 apply</td>
</tr>
<tr>
<td>6</td>
<td>Busselton–Capel and Blackwood</td>
<td>Rosa, Cowaramup, Blackwood Plateau North and South</td>
<td>Leederville</td>
<td>+1 point to b and d. Local area rule 3 and 6 apply</td>
</tr>
<tr>
<td>7</td>
<td>Busselton–Capel</td>
<td>Dunsborough-Vasse</td>
<td>Leederville</td>
<td>+3 points to b and c. Local area rule 2 and 3 apply</td>
</tr>
<tr>
<td>8</td>
<td>Bunbury</td>
<td>Bunbury West</td>
<td>Superficial, unconfined Yarragadee</td>
<td>+1 point to c and e. Local area rule 1, 2, 3 and 5 apply</td>
</tr>
<tr>
<td>9</td>
<td>Bunbury and South West Coastal</td>
<td>Lake Preston North and South, Coastal, Kemerton Industrial Park (North and South), Australind and Myalup</td>
<td>Superficial</td>
<td>+3 points to e; +1 point to c. Local area rule 1, 3, 4 and 5 apply</td>
</tr>
<tr>
<td>10</td>
<td>Busselton–Capel and Bunbury</td>
<td>Busselton–Capel and Australind/ Kemerton South</td>
<td>Leederville, Yarragadee</td>
<td>+2 points to c and d. Local area rule 2 and 3 apply</td>
</tr>
</tbody>
</table>

Table 7  Local area rules

<table>
<thead>
<tr>
<th>Rule no.</th>
<th>Local area rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water quality measurement must be undertaken annually for salinity for the water table aquifer at the end of summer (March/April). Where the salinity has increased the user must follow policies outlined in section 4.3.</td>
</tr>
<tr>
<td>2</td>
<td>Minimum bore and screen depth for new applications to construct a production bore will be determined by the department and stated on the 26D licence conditions.</td>
</tr>
<tr>
<td>3</td>
<td>All local abstraction to cease if water levels drop to below set environmental trigger level, until impacts can be determined and mitigated.</td>
</tr>
<tr>
<td>4</td>
<td>Allocation from the water table aquifer a maximum of 4000 kL/ha, following assessment and where no potential impacts are demonstrated (groundwater quality and quantity).</td>
</tr>
<tr>
<td>5</td>
<td>Domestic (150 kL/a) and/or garden bores (400 kL/a) only with maximum allocation of 550 kL/a.</td>
</tr>
<tr>
<td>6</td>
<td>No new bores to be constructed in the specified aquifer, other than for monitoring purposes or remediation.</td>
</tr>
</tbody>
</table>
How to use table 8

Assign points for each column in Table 8 for volume, allocation, potential impacts of other users/GDEs and salinity. Add points to give a score = (a + b + c + d + e.)

0 – 7 points  Generally no assessment required, unless other knowledge of risks indicates that H1 level assessment (desktop Hydrogeological Assessment) is warranted.

8 – 12 points  H1 level assessment (desktop Hydrogeological Assessment). However, low volume applications with low risk of impacts may not warrant an assessment. These cases can be discussed with the Regional Hydrogeologist.

12 – 18 points  H2 level assessment (basic Hydrogeological Assessment including installation and testing of investigation bores).

> 19 points  H3 level assessment (detailed Hydrogeological Assessment including installation and testing of investigation bores, and a groundwater model).

Table 8  Decision table for Hydrogeological Assessments (Statewide policy no. 19, DoW 2007b)

<table>
<thead>
<tr>
<th>Volume requested (kL/a)</th>
<th>Level of allocation</th>
<th>Potential for unacceptable impacts</th>
<th>Existing salinity* (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10 000 (0 points)</td>
<td>0-30% (0 points)</td>
<td>Impacts unlikely (0 points)</td>
<td>Fresh &lt;500 mg/L (4 points)</td>
</tr>
<tr>
<td>10 001 – 50 000 (2 points)</td>
<td>30-70% (1 points)</td>
<td>Impacts possible (2 points)</td>
<td>Marginal TDS 501-1 500 mg/L (3 points)</td>
</tr>
<tr>
<td>50 001 – 250 000 (4 points)</td>
<td>70-100% (3 points)</td>
<td>Impacts likely (5 points)</td>
<td>Brackish TDS 1 501-5 000 mg/L (2 points)</td>
</tr>
<tr>
<td>250 001 – 500 000 (6 points)</td>
<td>&gt;100% (5 points)</td>
<td>Impacts likely (5 points)</td>
<td>Saline TDS 5 000-50 000 mg/L (1 points)</td>
</tr>
<tr>
<td>500 001 – 1 000 000 (8 points)</td>
<td></td>
<td></td>
<td>Hypersaline &gt;50 000 mg/L (0 points)</td>
</tr>
<tr>
<td>1 000 001 – 2 500 000 (15 points)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;2 500 000 (20 points)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Policies or management plans developed for specific areas may override this decision making process in those areas.

*Salinity categories obtained from National Land and Water Audit (NLWRA 2000).
### Table 9  Management zones - description and justification

<table>
<thead>
<tr>
<th>№</th>
<th>Description</th>
<th>Aquifer</th>
<th>Justification and risk/impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Buffer zone area defined by ASS plume from Beenup mine site.</td>
<td>Leederville &amp; superficial</td>
<td>Existing ASS impact. Area needs to be monitored to ensure that the impacts of the plume moving into surface water systems (Scott River and Hardy Inlet) is minimised. Reduce abstraction in the area to minimise water level changes and exposure of ASS to surface.</td>
</tr>
<tr>
<td>2</td>
<td>Scott Coastal Plain wetlands – including Lake Jasper</td>
<td>Superficial</td>
<td>Impact of declining water levels (abstraction) from underlying aquifers and connected systems over 30 year modelling time frame is predicted.</td>
</tr>
<tr>
<td>3</td>
<td>Discharge and recharge (groundwater) areas of the Blackwood River (including Hut pool, Poison Gully etc.) and Yarragadee outcrop area (recharge zone).</td>
<td>Leederville &amp; Yarragadee</td>
<td>Area at risk from regional abstraction which may affect water levels in the recharge area and cause changes to the discharge zones on the Blackwood River and tributaries, affecting associated GDE. Potential impact from abstraction close to the river (near Nannup) from local abstraction. Increase measurement and minimise risk to recharge zone from regional abstraction.</td>
</tr>
<tr>
<td>4</td>
<td>Swan Coastal Plain wetlands – including Stirling wetlands, Vasse-Wonnerup estuary, wetlands north of Bunbury.</td>
<td>Superficial and underlying connected aquifer</td>
<td>Local impact of abstraction (declining water levels and impact to GDE) from underlying aquifers and connected systems. Decrease in run off and changes to drainage from agricultural and urban activities. Control abstraction to minimise risk (social and ecological sites) from regional and local abstraction.</td>
</tr>
<tr>
<td>5</td>
<td>Ironstone communities (Swan Coastal Plain).</td>
<td>Unknown</td>
<td>Unknown risks (precautionary approach). Requires increased monitoring and limits to minimise increased abstraction.</td>
</tr>
<tr>
<td>6</td>
<td>Margaret River pools and Leederville outcrop area (recharge zone).</td>
<td>Leederville &amp; Yarragadee</td>
<td>Likely impact from local and regional abstraction on water levels. Minimise risk to social and ecological sites from regional and local abstraction. Minimise risk to recharge zone from regional abstraction.</td>
</tr>
<tr>
<td>7</td>
<td>Jindong agricultural area.</td>
<td>Leederville</td>
<td>Manage the current impacts associated with concentration of drawpoints in the Leederville aquifer (current water level decline). Reduce abstraction (to allow for aquifer recovery) and encourage spread of draw points (location and depth).</td>
</tr>
<tr>
<td>8</td>
<td>Bunbury west subarea.</td>
<td>Yarragadee – superficial</td>
<td>Manage the connected system of the superficial and underlying unconfined Yarragadee from increased abstraction. Manage the impacts of increased urban development and concentration of domestic bores.</td>
</tr>
<tr>
<td>9</td>
<td>Water quality issues for the Swan Coastal Plain (north of Bunbury) and Kemerton Industrial Park.</td>
<td>Superficial</td>
<td>Minimise current salt recycling and water table aquifer quality (nutrients and potential ASS). Minimise current impacts to water table levels. Restrict potential nutrient and pollution impacts on water table aquifer.</td>
</tr>
<tr>
<td>10</td>
<td>Known areas of groundwater baseflow from regional aquifers</td>
<td>Leederville &amp; Yarragadee</td>
<td>Manage the other connected systems of the surface water and groundwater baseflow in major water sources (Capel and Brunswick Rivers) from increased regional and local abstraction. Existing abstraction may require increased monitoring. Does not cover the Margaret and Blackwood rivers (see other areas)</td>
</tr>
</tbody>
</table>
5 Monitoring the groundwater resources

5.1 Monitoring program

The objective of the monitoring program for the South West groundwater areas is to ensure the department’s management of water resources is maintaining the integrity of the resource for consumptive use while protecting the dependent social, cultural and ecological values.

The supporting document *South West groundwater areas monitoring program* (Goodreid & Wallace-Bell forthcoming) outlines the department’s commitments to monitoring, including water levels, water quality and key environmental criteria sites across the plan area. Please refer to this document for monitoring related information.

The monitoring program for the South West groundwater areas is comprised of four sub-programs addressing key areas of water management (Table 10). The program is part of the plan implementation and will provide a measure of the success of the South West groundwater areas plan in achieving the stated water resources objectives. This monitoring and review is a core component of adaptive management triggering management action where unforeseen or unacceptable impacts begin to occur.

The monitoring network for each sub-program is detailed in Appendix E and a brief description of each is presented in Table 10.
Table 10  Summary of the monitoring program and activities

<table>
<thead>
<tr>
<th>Monitoring sub-program</th>
<th>Activities</th>
<th>Location &amp; Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater levels</td>
<td>Monitor groundwater levels.</td>
<td>Licence compliance and impacts to other groundwater users. Aquifer connectivity. Impacts of climate change. The groundwater level network (~450 bores) is measured 6 times per year to capture maximum and minimum water levels.</td>
</tr>
<tr>
<td>Groundwater quality</td>
<td>Parameters measured include groundwater salinity, nutrients, industrial contaminants and acidity arising from the oxidation of ASS.</td>
<td>Sea water intrusion investigation.</td>
</tr>
<tr>
<td>Environmental water provisions</td>
<td>Groundwater-dependent vegetation condition monitoring. Groundwater level measurement at representative GDEs.</td>
<td>Triggers and responses for groundwater levels have been established for some representative GDEs. Eco-hydrological and hydrogeological investigations. Ecological water requirements studies for vegetation. Monthly groundwater measurement and annual vegetation condition monitoring at 39 sites across the South West groundwater areas. Ecological water requirements determined for 24 of these sites.</td>
</tr>
<tr>
<td>Connected surface water and groundwater systems monitoring and investigations</td>
<td>Surface water levels and flow measurement. Groundwater monitoring bores have been installed specifically to measure water levels at some connected systems. The groundwater level monitoring network is utilised to measure groundwater levels near connected systems.</td>
<td>Hydrological and inter-connectivity investigations. Eco-hydrological studies. Ecological water requirements studies. Blackwood, Capel and Donnelly Rivers have annual flow snapshots and long term investigations. Margaret River pools have constant water level measurement. Lake Jasper has constant water level measurement. Ecological water requirements investigations being conducted for Margaret, Brunswick Capel and Blackwood Rivers, and Wilyabrup and Cowaramup Brooks.</td>
</tr>
</tbody>
</table>
5.2 Monitoring program analysis and review

The department will review each of the sub-programs annually. This review will include analysis and reporting of measured results (as detailed in Chapter 6) and consideration of the success of the monitoring sub-program against its objectives.

5.2.1 Groundwater levels

The groundwater levels sub-program will be reviewed annually by assessing trends, particularly in areas with high levels of abstraction and areas where the risk of the sea water interface is known to be high, such as around Bunbury and Busselton town sites. Abnormal water levels and trends will instigate a management response to investigate the measured results and management actions will be enacted as required.

It is recommended in the monitoring program that groundwater level data should be statistically analysed every 4 years. This should include:

- analysis of groundwater level data from monitoring bores in unconfined conditions against long term rainfall using a technique similar to the cumulative deviation from mean annual rainfall (CDFM). This analysis will be used to help determine the impact of climate change
- analysis of groundwater levels in confined and unconfined aquifer bores to detect trends, and correlate against groundwater abstraction in the area
- correlation of groundwater levels from nested bores to help ascertain the interconnectivity between aquifers. Nested bores are a group of bores drilled next to each other where each bore intercepts a different aquifer or intercepts various levels within the same aquifer
- report on the analysis of the groundwater level trends and their correlations with abstraction, climate and interconnectivity.

The first statistical analysis of groundwater level trends and response to abstraction and climate in the South West groundwater areas is currently being undertaken by an external consultant on behalf of the department and is due for completion in early 2008.

5.2.2 Groundwater quality

The groundwater quality sub-program (Goodreid & Wallace-Bell, forthcoming) will be reviewed annually for each of the groundwater quality parameters. It must be emphasised that with the development of the new groundwater quality program the department is in a phase of collecting and consolidating baseline data. Management trigger levels will be based on best available knowledge and data will be reviewed against those levels. Better informed triggers will be developed over the longer term as data is synthesised and the dynamics of the groundwater systems are better
understood. Management responses will develop in parallel with this increased knowledge.

5.2.3 Environmental water provisions

The relationship between groundwater levels and vegetation condition at representative groundwater-dependent ecosystems is reviewed as part of the environmental water provisions sub-program. This is important both for the long term understanding of the environmental condition in response to climate change and regional use as well as providing information for the triggers and response process.

To better understand water level trends at GDEs the department is currently defining a control site network to measure groundwater levels where human impacts are minimal, so the impacts of reduced recharge can be assessed. The department will use this network to better understand the specific impacts of pumping and other activities as separate from the natural pattern of groundwater level decline due to reduced rainfall.

5.2.4 Connected systems investigations

The connected systems sub-program has been initiated with the proposed investigations centred on the Blackwood, Donnelly, Capel and Margaret rivers. The annual review of this information will be focused on the consolidation of sampling points, collation and assessment of data, and the longer term development of management triggers based on the synthesis of the data collected.

5.2.5 Triggers and responses for the environmental water provisions program

This section identifies specific triggers and responses for managing particular high-value groundwater-dependent ecosystems in the three groundwater areas. While only a few sites have been identified in this plan due to the existence of limited site-specific data, the number of sites will be expanded over the next 12 months and again over the next 2–4 years prior to the implementation of the statutory groundwater allocation plan as the amount of data increases.

While there will never be the capacity to monitor every GDE in the Bunbury, Busselton–Capel and Blackwood groundwater areas, the trigger-response sites may also act as indicators for other sites in similar geomorphological settings.
As part of the groundwater allocation planning process, a variety of studies have been conducted over the past five years to:

- identify potential groundwater-dependent ecosystems
- ascertain which potential GDEs may be at risk of impact due to drawdowns caused by current and future groundwater pumping at the local or regional scale
- select a number of high conservation value GDE ‘reference sites’ for a local-scale evaluation of risk using the available numerical groundwater models
- determine the ecological water requirements of some of the GDE ‘reference sites’ in high and lower risk areas through more detailed, site-specific investigation.

This work (to December 2006) has been summarised in Hyde 2006, *A summary of investigations into the determination of ecological water requirements for the South West groundwater areas.*

The work to begin determination of ecological water requirements at reference sites, which initially involves shallow drilling, establishment of vegetation transects and ongoing measurement of water levels, water quality (in some instances) and vegetation condition, is being carried out in stages across the three groundwater areas. As such, the quantity of available data varies from site to site depending on when monitoring began.

Whether quantitative management triggers could be established at a site in time for the release of the groundwater management plan was therefore determined by the amount of baseline data on vegetation condition and the prevailing water regime that was available at each site.

While triggers and responses have been recommended for a limited number of sites at this point in time, monitoring and evaluation is continuing at other reference sites where shallow bores and vegetation transects have been established (see Goodreid & Wallace-Bell forthcoming). Work is ongoing to establish bores and vegetation transects at sites where this has not yet occurred, such as near the upper Margaret River, Reedia wetlands in the lower Blackwood River area and in the western Scott Coastal Plain.

Where a decline in ecological health and/or a notable decline in groundwater levels occur at any of the monitored GDEs where a trigger and response has not been specified appropriate actions will be taken to investigate the cause and a suitable management response will be developed for that site. This information will be included in the department’s annual reporting associated with the groundwater management plan.

The sites where a management trigger and response framework will apply for the initial period of this plan are listed in Table 11 and 13. The frameworks are shown in
Appendix B. Specific triggers and responses will be developed for other Representative GDE sites in the following two to three years when sufficient measurement data is collected at those locations. Full details of the management trigger and response framework are available in the supporting document: *South West groundwater areas: triggers and responses*, Del Borrello 2008.

**Table 11** Established preliminary with EWR criteria and where management trigger and response frameworks should be applied

<table>
<thead>
<tr>
<th>Site name</th>
<th>Groundwater area</th>
<th>Subarea</th>
<th>Monitoring bore name</th>
<th>EWR trigger (m AHD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kemerton</td>
<td>Bunbury</td>
<td>Australind</td>
<td>EW1</td>
<td>8.05</td>
</tr>
<tr>
<td>Hay Park</td>
<td>Bunbury</td>
<td>Bunbury West</td>
<td>EW2</td>
<td>2.73</td>
</tr>
<tr>
<td>Harewoods Rd</td>
<td>Bunbury</td>
<td>Bunbury West</td>
<td>EW5</td>
<td>5.72</td>
</tr>
<tr>
<td>Ludlow Rail Reserve</td>
<td>Busselton–Capel</td>
<td>Busselton–Capel</td>
<td>BN10S</td>
<td>7.50</td>
</tr>
<tr>
<td>Ruabon Reserve</td>
<td>Busselton–Capel</td>
<td>Busselton–Capel</td>
<td>EW10</td>
<td>17.16</td>
</tr>
<tr>
<td>Ambergate Reserve</td>
<td>Busselton–Capel</td>
<td>Busselton–Capel</td>
<td>BN32S</td>
<td>16.85</td>
</tr>
<tr>
<td>Poison Gully</td>
<td>Blackwood</td>
<td>Blackwood Plateau–South</td>
<td>Poison Gully-wetland</td>
<td>30.47</td>
</tr>
<tr>
<td>Reedia</td>
<td>Blackwood</td>
<td>Blackwood Plateau–South</td>
<td>BP64B</td>
<td>23.99</td>
</tr>
<tr>
<td>Black Point Rd</td>
<td>Blackwood</td>
<td>Jasper</td>
<td>Black Point Rd</td>
<td>42.69</td>
</tr>
<tr>
<td>Lake Jasper</td>
<td>Blackwood</td>
<td>Jasper</td>
<td>EW8</td>
<td>38.50</td>
</tr>
</tbody>
</table>

**Table 12** Groundwater-dependent surface water sites where site-specific management trigger and response frameworks should be applied

<table>
<thead>
<tr>
<th>Site name</th>
<th>Groundwater area</th>
<th>Subarea</th>
<th>Management trigger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackwood River – Darradup Gauging Station</td>
<td>Blackwood</td>
<td>Blackwood Plateau–South</td>
<td>Flow below historical minimum during months of summer baseflow</td>
</tr>
<tr>
<td>Blackwood River – Hut Pool Gauging Station</td>
<td>Blackwood</td>
<td>Blackwood Plateau–South</td>
<td>Flow below historical minimum during months of summer baseflow</td>
</tr>
</tbody>
</table>
**Action 22** – Annually review and report on water level measurement data in areas of high groundwater abstraction and in areas of sea water intrusion risk along the coast.

**Action 23** – Annually review and report on data collected through investigations of water quality and during regular water quality measurements. Annually review water quality management triggers and responses.

**Action 24** – Annually collate, analyse and report on data collected from investigations of connected systems. Develop management triggers and responses for these systems when knowledge and understanding of the system is sufficient to make such decisions.

**Action 25** – Analyse water levels on a monthly basis over the summer period and vegetation condition on an annual basis following spring measurements at GDE sites where management triggers and responses have been established.

**Action 26** – Analyse water levels at all other representative GDE sites in March–April each year and review vegetation condition annually following spring measurements. Develop an appropriate management response where undesirable changes in water regime or vegetation condition occur.
6 Implementing and reviewing the plan

The South West Region has been recognised as a priority area for water management planning by both the state and federal governments. The South West groundwater plan must be successfully implemented if it is to achieve the goal of sustainable management of the groundwater resources. After a period of time the plan must also be reviewed to check whether it is achieving the water management objectives set out in Chapter 4.

6.1 Implementing the plan

Table 13 provides a summary of all the actions identified relating to the implementation of the plan. Actions are either given a specific deadline or will occur in response to a particular trigger being reached (e.g. percentage of an allocation limit). Actions relating to the revision of this plan and development of the statutory plan are listed in section 6.3.

**Table 13 Department of Water actions for the plan implementation**

<table>
<thead>
<tr>
<th>Action</th>
<th>Summarised description</th>
<th>Trigger/Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Develop an information package for water users affected by salt recycling.</td>
<td>Within six months of final plan publication.</td>
</tr>
<tr>
<td>5</td>
<td>Initiate an improved program for water quality and sea water interface monitoring.</td>
<td>2008 and ongoing.</td>
</tr>
<tr>
<td>7</td>
<td>Provide advice to landholders on the issue and management of PASS.</td>
<td>Within 1 year of plan publication.</td>
</tr>
<tr>
<td>10</td>
<td>Create a GIS-based decision support tool that identifies GDEs and their associated cultural and social values.</td>
<td>Within 1 year of plan publication.</td>
</tr>
<tr>
<td>12 and 17</td>
<td>Conduct water use surveys in priority areas and report on outcomes at a subarea level, including recouping, over-allocation and domestic supply</td>
<td>Each year until 2011.</td>
</tr>
<tr>
<td>13</td>
<td>Review PWS licences for PWS reserve access requirements.</td>
<td>Within two years of plan publication.</td>
</tr>
<tr>
<td>16</td>
<td>Provide report on water resource and environmental condition including upcoming stakeholder consultation opportunities.</td>
<td>Annual plan evaluation statement.</td>
</tr>
<tr>
<td>18</td>
<td>Investigate the potential for temporary licensed entitlements of 5-10 years from Yarragadee PWS reserve for commercial operations.</td>
<td>Within 1 year of plan publication.</td>
</tr>
<tr>
<td>19</td>
<td>Release advice on the operation of trading to water users.</td>
<td>Within one year of final plan publication.</td>
</tr>
<tr>
<td>21</td>
<td>Review allocation limits for improved information.</td>
<td>As investigations and new information becomes available (annual review).</td>
</tr>
<tr>
<td>22–26</td>
<td>Annual aquifer review on groundwater level trends, water quality, connected systems and vegetation communities.</td>
<td>Annual monitoring evaluation statement.</td>
</tr>
<tr>
<td>-</td>
<td>Create a decision support tool for licensing officers.</td>
<td>Within two years of the plan publication.</td>
</tr>
</tbody>
</table>
Further research and investigations (the Australian Government’s Water Smart Australia programme)

There has been significant research and investigation of the South West groundwater system by the Department of Water and further work by the Water Corporation as part of the former proposal to access Yarragadee water for the IWSS. The Yarragadee investigations included extensive drilling in the state forest area of the South West groundwater areas and other work to identify the potential impacts of abstracting 45 GL/a from the aquifer.

Understanding of the entire groundwater system, not just the Yarragadee aquifer, is important for groundwater management. It is also important to note that, with the costs of single exploratory bores reaching into the hundreds of thousands of dollars, perfect knowledge may never be achieved. As such, the department, with funding assistance from Water Smart Australia, will carry out more than $7 million dollars of innovative research and investigation to allow the best possible management of this complex groundwater system.

This work will culminate in the development of an improvement to this plan, resulting in a statutory water management plan for allocating water, by 2011. Further advice and progress on this work will be provided through the annual evaluation statement described in section 6.2.

6.2 Evaluating the implementation of the plan

The department (South West Region) will release an evaluation statement for this plan each year until the plan is superseded by the statutory water management plan in 2011. The statement will identify the status of all actions required by the plan and how the plan is being implemented. It will report on the department’s progress against objectives in Table 14 and any actions that have been triggered, resulting from changes in the resource condition or availability.
<table>
<thead>
<tr>
<th>Nº</th>
<th>Objective</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Maintain the sea water interface to protect coastal water users and groundwater-dependent ecological, social and cultural values.</td>
<td>Coastal bores should not show significant long term increase in salinity.</td>
</tr>
<tr>
<td>2</td>
<td>Key ecological, cultural and social values are to be maintained and protected at an acceptable level of risk from groundwater use.</td>
<td>Unacceptable ecological impacts at GDE reference sites are shown not to be caused by abstraction, or impacts are reversed/reduced to acceptable levels after management action is taken.</td>
</tr>
<tr>
<td>3</td>
<td>Maintain the groundwater quality for fit for purpose use at a low level of risk to the environment and water users.</td>
<td>Groundwater quality does not reach DEC reporting levels for acidity, or cross salinity thresholds for significant portions of any subarea as a result of abstraction</td>
</tr>
<tr>
<td>4</td>
<td>Minimise impacts of new groundwater developments on existing licensed groundwater users.</td>
<td>Internal audit of licence processing and consistency shows continual improvement.</td>
</tr>
<tr>
<td>5</td>
<td>Licences in over-allocated areas are reviewed and amended through the implementation of this plan.</td>
<td>Ongoing licensing and monitoring.</td>
</tr>
<tr>
<td>6</td>
<td>Unused water entitlements are actively recouped across the plan area.</td>
<td>Surveys of licences in over-allocated areas will be completed and recouping applied where appropriate.</td>
</tr>
<tr>
<td>7</td>
<td>Regular public reporting will be made against the management objectives outlined in this plan.</td>
<td>Annual evaluation statement.</td>
</tr>
<tr>
<td>8</td>
<td>The community will be consulted in the ongoing work to review this plan and their concerns will be recorded and reported.</td>
<td>Consultation opportunities and key responses identified in annual reporting.</td>
</tr>
<tr>
<td>9</td>
<td>Water service providers are expected to develop plans to achieve and implement improvements to water delivery and efficiency (usage per capita) by 20% by 2011.</td>
<td>Report on PWS activities in 2011 annual evaluation statement.</td>
</tr>
<tr>
<td>10</td>
<td>Good water management will be implemented through licensing, measurement, monitoring, auditing, compliance and reporting to provide transparency and accountability of water use.</td>
<td>In conjunction with the annual evaluation statement a detailed review of monitoring information will be produced every four years and placed on the department’s website.</td>
</tr>
</tbody>
</table>

### 6.3 Revising the plan

A review and revision of this plan will be carried out following release of each annual evaluation statement. The review may recommend that this plan is adequate for water management into the future, or it may recommend that a revision and update is required. This will also include an assessment of the ability of the current policies and triggers to achieve the desired objectives in the plan. Corrections of clerical mistakes, factual errors, inaccuracies, omissions, or updating of any outdated information in this plan may be done at any time.
Western Australia is currently updating and reviewing its state water resource legislation. Any significant changes in legislation, that may affect this plan, will be noted and the necessary changes made.

Throughout this document actions have been identified that will contribute to the review of this plan and the development of the statutory water management plan through investigation and research. These actions are described in Table 15. As with the actions for plan implementation, the progress against them will be reported through the annual evaluation statement and changes made to the plan as needed.

The funding for this work is partly provided by the Australian Government’s Water Smart Australia Programme. A more detailed summary of the research and investigation activities will be provided in 2008.

Table 15  Department of Water actions for the development of the statutory water management plan

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Further hydrogeologic investigations.</td>
</tr>
<tr>
<td>2</td>
<td>Updated SWAMS model.</td>
</tr>
<tr>
<td>3</td>
<td>Investigate probable causes of water level declines in aquifers (reduced rainfall, abstraction, drainage and other activities).</td>
</tr>
<tr>
<td>6</td>
<td>Report on PASS buffering capacities and knowledge gaps.</td>
</tr>
<tr>
<td>8</td>
<td>Conduct additional investigations at key GDE sites for aquifer connectivity, response to abstraction and climate change, to update EWR and trigger/response management.</td>
</tr>
<tr>
<td>9</td>
<td>Further define the groundwater-dependent cultural and social values.</td>
</tr>
<tr>
<td>11</td>
<td>Report identifying groundwater dependence of cultural and social sites.</td>
</tr>
<tr>
<td>14</td>
<td>Provide part funding to a community for a case study into groundwater ‘self management’.</td>
</tr>
<tr>
<td>15</td>
<td>Provide a draft policy on plantation management for community comment.</td>
</tr>
<tr>
<td>20</td>
<td>Provide a information package to licensees on how to operate under a RiWi Act trading environment.</td>
</tr>
<tr>
<td>-</td>
<td>Review and revise the South West groundwater areas plan.</td>
</tr>
</tbody>
</table>

6.4 Statutory water management plan

The next phase of planning for the South West groundwater areas will begin following completion and release of this plan. This will include implementing the new monitoring program, further investigations and an update of the SWAMS model. On completion of this phase a statutory water management plan will be developed under the new water resource management legislation.

The department has committed to the completion of a statutory water management plan, under new water resources management legislation, for the South West groundwater areas by 2011. The department has received funding from the Australian Government’s Water Smart Australia programme for a number of projects that will build on existing information and contribute to the development of the statutory plan over the next four years.
Some of the new concepts that future statutory water management plans may contemplate for the South West groundwater areas include:

1. establishment of consumptive pools – the amount of a water resource that can be made available for abstraction from a given water system under the rules of the relevant water plan
2. conversion of existing water licences to new perpetual water access entitlements – issued as a share of water from the consumptive pool as defined in the relevant water plan
3. description of the locally applicable water trading rules
4. specification of any water resource management requirements, such as for water metering or measurement
5. account for and regulate water intercepting activities – accounting for interception activities (such as the use of water by plantations) in the water balance to provide greater certainty for users as well as regulation of intercepting activities to protect the integrity of the water resource.

These changes will only be introduced where there is a demonstrable need and after comprehensive consultation with stakeholders and the wider community in the South West.

6.5 Water management planning and water reform

In 2006 the Western Australian Government became a signatory to the National Water Initiative, Australia’s National blueprint for water reform, to which all state and territory governments are committed. The National Water Initiative recognises the importance of increasing the productivity and efficiency of Australia’s water use, ensuring efficient water services to both rural and urban communities and protecting the health of surface and groundwater systems.

Western Australia’s water reform agenda is guided by three critical documents:

- *State Water Plan (DPC 2007)*
- *Western Australia’s Implementation Plan for the National Water Initiative (DoW 2007)*
- *Government Response to a blueprint for water reform in Western Australia (WRIC 2007).*

This *South West groundwater areas water management plan* for allocation sets out how the groundwater areas are allocated and managed until the statutory plan is completed in 2011 under the new water resources management legislation. These new statutory plans will be consistent with the intent of the National Water Initiative.
Appendices

Appendix A — Hydrogeological and geological diagrams and maps

Figure 12 Geological diagram showing distribution of Leederville Formation and older formations
Figure 13 Geological diagram showing units beneath the Bunbury Basalt and Leederville Formation
Figure 14  Groundwater salinity in the Yarragadee aquifer
Figure 15  Potentiometric head in Yarragadee aquifer
Figure 16 Surface geology of the plan area
Figure 17 Geology of the plan area
Appendix B — Triggers and responses at specific sites

Adverse trend detected in water table monitoring at GDE reference site:
- breach of EWR trigger, or
- declining trend (>90% likely), or
- sudden large drop or rise in water level (>50% larger than normal seasonal variation)

Review vegetation condition monitoring data (note: vegetation condition may need re-checking if some time has passed since it was last monitored).

Has there been a decline in vegetation condition? Yes No

Vegetation may have been affected by a change in water availability. Review data to determine if vegetation may also be affected by water quantity changes or a biological factor such as insect attack or diseased.

Water regime change may not be significant enough to affect vegetation. OR
There may be a lag between water regime change and decline in vegetation condition.

Continue to monitor vegetation. Monitoring may need to be increased to include a summer/autumn round.

1. If the decline in condition is severe, notify DEC if appropriate (TEC). Develop temporary artificial maintenance scheme if feasible e.g. drippers, sprinkler system, manual watering.
2. If EWR trigger has not been breached, the trigger should be reviewed.
3. If a review of water level monitoring data shows that abstraction is the cause of the water level change, develop plan to reduce abstraction and implement if decline in vegetation condition is significant.
4. Undertake review of allocation limits for implementation in next planning period.
5. Report findings.
6. Continue to monitor vegetation. Monitoring may need to be increased to include a summer/autumn round.

Has a suitable climate reference site been identified? Yes No

Conduct analyses to identify cause of water regime change, e.g. statistical analysis of hydrographs, investigation of surrounding abstraction, review of local water level monitoring data.

Is abstraction causing decline in water levels? Yes No

Site may be responding to climate influences. Review water quality and biological data.

1. Conduct license compliance check.
2. Investigate whether reductions in local abstraction or changes to abstraction practices will result in reduced impact at GDE reference site. Develop plan to reduce abstraction and implement if change to water regime is severe or a breach of EWR trigger coincides with a significant decline in vegetation condition.
3. Undertake review of allocation limits for implementation in next planning period.

Are land use changes or drainage causing changes to water regime? Yes No

Work with relevant agencies/land owners to develop strategies to halt land use impacts and restore site hydrology.

Has there been a change in water quality beyond trigger levels? Yes No

Conduct water quality sampling.

Does hydrograph deviate from climate reference site? Yes No

Site not responding to climate influences. Review water quality and biological data.

Continue monitoring. Review vegetation condition and water level monitoring data.

1. Notify DEC if appropriate.
2. Conduct investigation to determine cause of WQ change.
3. Develop plan to effect improvement in WQ and return WQ to within trigger limits (these actions may be related to actions to stabilise water regime).

Is site in ASS or sea water interface risk zone? Yes No

Conduct water quality sampling.

Review vegetation and water level monitoring data.

Review vegetation condition monitoring data.

Has water level been monitored? Yes No

No monitoring data

Figure 18 Management trigger and response framework — wetland vegetation
Figure 19  Management trigger and response framework — wetland water regime
Figure 20  Framework for management of lower Blackwood River baseflow
Appendix C — Water service providers

Busselton Water Board (BWB) formed in 1906 is the licensed water service provider that supplies potable water for domestic consumption and town needs, for light industry, commerce and other civil purposes for the City of Busselton. BWB does not provide water for irrigation or large industrial purposes and their activities are constrained to the urban areas around the town of Busselton. Water use for the BWB has increased with population growth in the Town site of Busselton and its surrounding suburbs.

Bunbury Water Board (AQWEST) formed in 1906 is the licensed water service provider that supplies potable water for domestic consumption and town needs (except for Pelican Point), for light industry, commerce and other civil purposes for the City of Bunbury. Water use for the AQWEST has increased with population growth in the Town site of Bunbury and its surrounding suburbs.

The Water Corporation (WC) is the water services provider for the remaining town and small hamlets in the South West Region. They also supply water for domestic consumption and town needs, for light industry, commerce and other civil purposes. All WC supplies are restricted to the town sites, and do not supply water to rural properties in the region. The WC supplies many growing town sites and localities with potable water from a variety of sources including groundwater and surface water.
Table 16 Town water supply licensed allocations for the plan area (2007)

<table>
<thead>
<tr>
<th>Town</th>
<th>Service provider and site name</th>
<th>Licensed entitlement (GL/a)</th>
<th>Water resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>Busselton</td>
<td>Busselton Water Board</td>
<td>1.0</td>
<td>Leederville</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17.0</td>
<td>Yarragadee</td>
</tr>
<tr>
<td>Bunbury</td>
<td>AQWEST</td>
<td>4.4</td>
<td>Yarragadee</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.8</td>
<td>Yarragadee</td>
</tr>
<tr>
<td>Capel</td>
<td>Capel well field</td>
<td>0.40</td>
<td>Yarragadee</td>
</tr>
<tr>
<td>Donnybrook</td>
<td>Donnybrook well field</td>
<td>0.45</td>
<td>Leederville</td>
</tr>
<tr>
<td>Dunsborough, Quindalup, Yallingup</td>
<td>Quindalup well field</td>
<td>0.70</td>
<td>Sue Coal Measures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.75</td>
<td>Leederville</td>
</tr>
<tr>
<td>Margaret River</td>
<td>Margaret River and Ten Mile Brook</td>
<td>1.0</td>
<td>Margaret River – Ten Mile Brook</td>
</tr>
<tr>
<td>Peppermint Grove Beach</td>
<td>Peppermint Grove Beach well field</td>
<td>0.11</td>
<td>Yarragadee</td>
</tr>
<tr>
<td>Australind</td>
<td>Australind well field</td>
<td>0.01</td>
<td>Yarragadee</td>
</tr>
<tr>
<td>Boyanup</td>
<td>Boyanup well field</td>
<td>0.33</td>
<td>Yarragadee</td>
</tr>
<tr>
<td>Binningup</td>
<td>Binningup well field</td>
<td>0.21</td>
<td>Leederville</td>
</tr>
<tr>
<td>Dalyellup</td>
<td>Dalyellup well field</td>
<td>1.0</td>
<td>Yarragadee</td>
</tr>
<tr>
<td>Dardanup</td>
<td>Dardanup well field</td>
<td>0.08</td>
<td>Leederville</td>
</tr>
<tr>
<td>Eaton</td>
<td>Eaton well field</td>
<td>1.5</td>
<td>Yarragadee</td>
</tr>
<tr>
<td>Myalup</td>
<td>Myalup well field</td>
<td>0.06</td>
<td>Leederville</td>
</tr>
<tr>
<td>Brunswick Junction</td>
<td>Beela pipe head</td>
<td>0.56</td>
<td>Beela Pipe head</td>
</tr>
<tr>
<td>Collie</td>
<td>Wellington dam</td>
<td>0</td>
<td>Collie/Harris Rivers</td>
</tr>
<tr>
<td></td>
<td>Mungalup dam</td>
<td>0.5</td>
<td>Collie/Harris Rivers</td>
</tr>
<tr>
<td></td>
<td>Collie/Harris dams</td>
<td>15.0</td>
<td>Collie/Harris Rivers</td>
</tr>
<tr>
<td>Augusta</td>
<td>Fisher Road well field</td>
<td>0.32</td>
<td>Lesueur Sandstone</td>
</tr>
<tr>
<td></td>
<td>Leeuwin spring</td>
<td>0.12</td>
<td>unproclaimed</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>53.6</td>
</tr>
</tbody>
</table>
### Appendix D — Other plans and strategies to be considered in this area

<table>
<thead>
<tr>
<th>Plan</th>
<th>Consideration</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Water Plan</td>
<td>Strategic Direction</td>
<td>DoW</td>
</tr>
<tr>
<td>South West Regional Water Plan</td>
<td>Strategic Direction, South West community issues, Overarching water management issues</td>
<td>DoW</td>
</tr>
<tr>
<td>Whicher surface water management plan (allocation)</td>
<td>Surface water management plan for the majority of the plan area</td>
<td>DoW</td>
</tr>
<tr>
<td>Kemerton subareas water management plan (allocation)</td>
<td>Compliments the South West groundwater areas plan in the Kemerton Subareas</td>
<td>DoW</td>
</tr>
<tr>
<td>Bunbury water reserve, Bunbury-Busselton drinking water source protection plan</td>
<td>Manages land and water use activities in this area to ensure safe drinking water quality</td>
<td>DoW</td>
</tr>
<tr>
<td>Donnybrook water reserve drinking water source protection assessment</td>
<td>Manages land and water use activities in this area to ensure safe drinking water quality</td>
<td>DoW</td>
</tr>
<tr>
<td>Dunsborough and Yallingup town water supplies drinking water source protection plan</td>
<td>Manages land and water use activities in this area to ensure safe drinking water quality</td>
<td>DoW</td>
</tr>
<tr>
<td>Leeuwin Springs and Fisher Road wellfield water reserve drinking water source protection plan</td>
<td>Manages land and water use activities in this area to ensure safe drinking water quality</td>
<td>DoW</td>
</tr>
<tr>
<td>Margaret River catchment area (including Ten Mile Brook catchment area) drinking water source protection plan</td>
<td>Manages land and water use activities in this area to ensure safe drinking water quality</td>
<td>DoW</td>
</tr>
<tr>
<td>Preston Beach drinking water source protection plan</td>
<td>Manages land and water use activities in this area to ensure safe drinking water quality</td>
<td>DoW</td>
</tr>
<tr>
<td>Tanjannuerup Creek dam catchment area drinking water source protection plan</td>
<td>Manages land and water use activities in this area to ensure safe drinking water quality</td>
<td>DoW</td>
</tr>
<tr>
<td>The Leschenault estuarine system, South-Western Australia: condition statement and recommendations for management</td>
<td>Environmental monitoring and management criteria for the area. Strategic planning and recommendations for future work.</td>
<td>DoW</td>
</tr>
<tr>
<td>South West Natural Resource Management Strategy</td>
<td>Natural resource planning and management</td>
<td>SWCC</td>
</tr>
<tr>
<td>Greater Bunbury Regional Scheme</td>
<td>Statutory planning scheme for land use and zoning</td>
<td>WAPC</td>
</tr>
<tr>
<td>Busselton Wetlands Conservation Strategy (DRAFT)</td>
<td>Land use and environmental management in wetland areas</td>
<td>WAPC</td>
</tr>
<tr>
<td>Augusta-Walpole Coastal Strategy (DRAFT)</td>
<td>Statutory planning scheme for land use and zoning</td>
<td>WAPC</td>
</tr>
<tr>
<td>Leeuwin-Naturaliste Ridge statement of planning policy report</td>
<td>Land use change and planning</td>
<td>WAPC</td>
</tr>
</tbody>
</table>

WAPC – Western Australian Planning Commission
DoW – Department of Water
SWCC – South West Catchments Council
DEC – Department of Environment and Conservation
Other documents to consider

River Action Plans, DoW

- Capel River Action Plan, 1999
- Carbanup River Action Plan, 2000
- Ellen Brook River Action Plan, 2005
- Margaret River Action Plan, 2003
- River Action Plan for the Cape Naturaliste Streams, 2006
- River Action Plan for the Gynudup Brook and Tren Creek, 2004
- Vasse River Action Plan, 2000

National Parks management plans, DEC

- Benger Swamp nature reserve, 1988
- Leeuwin-Naturaliste National Park, 1989
- Leschenault peninsula conservation park, 1999
- Parks of the Leeuwin-Naturaliste ridge, Scott National Park and Gingilup Swamps nature reserve, 2008
- Yalgorup national park, 1995

Major legislation relating to water resource management in the South West

Commonwealth legislation

- Commonwealth Environmental Protection and Biodiversity Act 1999
- National Water Commission Act 2004
- Natural Heritage Trust Act of Australia 1997
- National Environmental Protection Council Act 1994
- Aboriginal and Torres Strait Islander Heritage Protection Act 1984
State legislation

- Conservation and Land Management Act 1984
- Native Title (State Provisions) Act 1999
- Aboriginal Heritage Act 1972
- Country Areas Water Supply Act 1947
- Environmental Protection Act 1986, amendment 1998
- Environmental Protection Regulations 1987
- Heritage of Western Australia Act 1990
- Metropolitan Water Supply, Sewerage and Drainage Act 1909 (including by-laws)
- National Trust of Australia (WA) Act 1964
- Rights in Water and Irrigation Act 1914, Regulations 2000
- Water Agencies (Powers) Act 1984
- Soil and Land Conservation Act 1945, Regulations 1992
- Town Planning and Development Act 1928
- Waterways Conservation Act 1976
- Western Australian Planning Commission Act 1985
- Pollution of Waters by Oil and Noxious Substances Act 1987
- Contaminated Sites Act 2003
Appendix E — Monitoring network

Table 17 Monitoring network (number of bores in aquifer)

<table>
<thead>
<tr>
<th>Area</th>
<th>Groundwater monitoring line</th>
<th>Superficial</th>
<th>Leederville</th>
<th>Yarragadee</th>
<th>Gull</th>
<th>Cockleshell</th>
<th>Lesueur</th>
<th>Sandstone</th>
<th>Sue Coal</th>
<th>Measures</th>
<th>Parmelia</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swan Coastal Plain</td>
<td>Bunbury Shallow (BY)</td>
<td>18</td>
<td>12</td>
<td>18</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Busselton Shallow (BN)</td>
<td>28</td>
<td>64</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Donnybrook (DNB)</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Picton (PL)</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yalgorup Lakes (Y)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lake Clifton (D, E, F &amp; G)</td>
<td>34</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Harvey Shallow (HS)**</td>
<td>55</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Binningup Line (BLP)</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kemerton (KE)</td>
<td>0</td>
<td>2</td>
<td>0</td>
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<td>Boyanup (BL)</td>
<td>1</td>
<td>4</td>
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<td>Quindalup* (Q)</td>
<td>0</td>
<td>3</td>
<td>10</td>
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<td>Leschenault Peninsula</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
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<tr>
<td></td>
<td>Jindong Project (BJM)</td>
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<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>7</td>
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<tr>
<td></td>
<td>Capel Farms (JMB)</td>
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<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
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<tr>
<td></td>
<td>Environmental Water (EW) Bores***</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16</td>
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</tr>
<tr>
<td>Blackwood Plateau</td>
<td>Cowaramup (CL)</td>
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<td>10</td>
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<td></td>
<td>Karridale (KL)</td>
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<td>Environmental Water Bores***</td>
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<td>10</td>
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<tr>
<td>Scott Coastal Plain</td>
<td>Scott Coastal* (SC)</td>
<td>16</td>
<td>18</td>
<td>21</td>
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<td></td>
<td>Environmental Water Bores***</td>
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<td>Total</td>
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<td>187</td>
<td>152</td>
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<td>12</td>
<td>14</td>
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<td>463</td>
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</tr>
</tbody>
</table>

*These bore lines also have monitoring bores on the Blackwood Plateau.

**Only the HS line bores located in the plan area.

***EW bores not illustrated in Figure 21, but see Figure 6 and Figure 7.
Table 18 Water Corporation Blackwood Plateau bores

<table>
<thead>
<tr>
<th>Area</th>
<th>Groundwater monitoring line</th>
<th>Aquifer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Blackwood Plateau (BP) Water Corporation Bores</td>
<td>Superficial</td>
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<tr>
<td>Blackwood Plateau</td>
<td>Blackwood Plateau (BP) Water Corporation Bores</td>
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</table>

Table 19 Groundwater-dependent reference sites for wetland vegetation

<table>
<thead>
<tr>
<th>Site name</th>
<th>Area</th>
<th>Location</th>
<th>EWR defined</th>
<th>Monthly groundwater level monitoring</th>
<th>Annual vegetation monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jangardup Rd</td>
<td></td>
<td>E: 0376796</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td></td>
<td></td>
<td>N: 6195468</td>
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<tr>
<td>Black point Rd</td>
<td></td>
<td>E: 0374002</td>
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<td>Yes</td>
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<tr>
<td></td>
<td></td>
<td>N: 6202371</td>
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<td>Pneumonia Rd</td>
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<td>N: 6198769</td>
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<td>Black Point Rd-Fouracres Rd</td>
<td>Scott Coastal Plain</td>
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<td>N: 6202796</td>
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<tr>
<td>Black Point Rd-base of dunes</td>
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<td>E: 0367690</td>
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<td>Black Point Rd-dunes</td>
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<td>N: 6196134</td>
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<td>Lake Jasper - East</td>
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<td>Lake Jasper - South</td>
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<td>N: 6190681</td>
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<td>Darradup Rd-west</td>
<td>Blackwood Plateau</td>
<td>E: 0383500</td>
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<td>Yes</td>
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<td>N: 6215756</td>
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<td>Darradup Rd east - wetland</td>
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<td>Longbottom Rd-wetland</td>
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<td>E: 0371576</td>
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<tr>
<td>Poison Gully</td>
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<td>E: 0366689</td>
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<td>Yes</td>
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<tr>
<td>Brockman Hwy wetland</td>
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<td>N: 6228296</td>
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<td>Stewart Rd Causeway</td>
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<td>E: 0372104</td>
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<td>N: 6212136</td>
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<td>Kemerton Buffer Zone</td>
<td>Swan Coastal Plain</td>
<td>E: 0384906</td>
<td>Interim</td>
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<td>N: 6323330</td>
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<td>Hay Park</td>
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<td>N: 6307073</td>
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<tr>
<td>Franklandia nature reserve</td>
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<td>E: 0378756</td>
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<td>Manea Park</td>
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<td>N: 6305770</td>
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### South West groundwater areas water management plan: Draft for public comment

#### Table 20 Groundwater-dependent reference sites for terrestrial vegetation

<table>
<thead>
<tr>
<th>Site name</th>
<th>Area</th>
<th>Location</th>
<th>EWR defined</th>
<th>Monthly groundwater level monitoring</th>
<th>Annual vegetation monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black point Rd</td>
<td>Scott Coastal Plain</td>
<td>E: 0377818 N: 6205052</td>
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<td>Yes</td>
<td>Yes</td>
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<td>Black Point Rd-Fouracres Rd</td>
<td>Scott Coastal Plain</td>
<td>E: 0374672 N: 6202799</td>
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<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Scott Rd</td>
<td></td>
<td>E: 0383669 N: 6189305</td>
<td>Yes</td>
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<tr>
<td>Jack Track</td>
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<td>E: 0367274 N: 6206784</td>
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<tr>
<td>Darradup Rd east</td>
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<tr>
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<tr>
<td>Brockman Hwy</td>
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<td>E: 0372341 N: 6228259</td>
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<td>E: 0375826 N: 6219540</td>
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<tr>
<td>Poison Gully</td>
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<td>E: 0366889 N: 6223558</td>
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<tr>
<td>Taylor’s nature reserve</td>
<td>Swan Coastal Plain</td>
<td>E: 0333600 N: 6263170</td>
<td>Interim</td>
<td>Yes</td>
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</table>
Figure 21 Location of the departmental regional monitoring bores and their aquifers
Figure 22  Location of the Blackwood Plateau monitoring bore series
# Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>abstraction</td>
<td>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.</td>
</tr>
<tr>
<td>allocation limits</td>
<td>The amount of water set aside for annual licensed use. Each water resource (aquifer) within a subarea has AL set and will be amended over time to reflect significant measurement outcomes and sustainability determinations.</td>
</tr>
<tr>
<td>aquifer</td>
<td>A geological formation or group of formations that is able to receive, store and transmit significant quantities of groundwater.</td>
</tr>
<tr>
<td>artesian aquifer</td>
<td>A confined aquifer in which the hydraulic pressure will cause water to rise in a bore or spring above the land surface. If the pressure is insufficient to cause the well to flow at the surface, it is called a sub-artesian aquifer.</td>
</tr>
<tr>
<td>artesian well</td>
<td>A well, including all associated works, from which water flows, or has flowed, naturally to the surface.</td>
</tr>
<tr>
<td>baseflow</td>
<td>The component of stream flow supplied by groundwater discharge.</td>
</tr>
<tr>
<td>bore</td>
<td>A narrow, normally vertical hole drilled in soil or rock to measure or withdraw groundwater from an aquifer.</td>
</tr>
<tr>
<td>calibration</td>
<td>Calibration of a model is the process where parameters in the model are fine tuned to get the best possible match between modelled and real water level trends over a defined period.</td>
</tr>
<tr>
<td>(groundwater model)</td>
<td></td>
</tr>
<tr>
<td>confined aquifer</td>
<td>An aquifer lying between confining layers of low permeability strata (such as clay, coal or rock) so that the water in the aquifer cannot easily flow vertically.</td>
</tr>
<tr>
<td>critical asset</td>
<td>An ecological, social or cultural site of significance that has been identified by the Department of Water as being groundwater-dependent and requires protection to ensure that the values associated with the site are maintained at a low level of risk.</td>
</tr>
<tr>
<td>dewatering</td>
<td>Removing underground water to facilitate construction or other activity. It is often used as a safety measure in mining below the water table or as a preliminary step to development in an area.</td>
</tr>
<tr>
<td>discharge</td>
<td>The water that moves from the groundwater to the ground surface or above, such as a spring. This includes water that seeps onto the ground surface, evaporation from unsaturated soil, and water extracted from groundwater by plants (evapotranspiration) or engineering works (groundwater pumping).</td>
</tr>
<tr>
<td>draw down</td>
<td>The lowering of a watertable resulting from the removal of water from an aquifer or reduction in hydraulic pressure.</td>
</tr>
<tr>
<td>Ecological water</td>
<td>The water regime needed to maintain ecological values of water-dependent ecosystems at a low level of risk.</td>
</tr>
<tr>
<td>requirements</td>
<td></td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>entitlement</td>
<td>The annual quantity of licensed groundwater abstraction in kilolitres/year (kL/a).</td>
</tr>
<tr>
<td>Environmental water provisions</td>
<td>The water regimes that are provided as a result of the water allocation decision-making process taking into account ecological, social, cultural and economic impacts. They may meet in part or in full the ecological water requirements</td>
</tr>
<tr>
<td>evaporation</td>
<td>Loss of water from the water surface or from the soil surface by vaporisation due to solar radiation.</td>
</tr>
<tr>
<td>evapotranspiration</td>
<td>The combined loss of water by evaporation and transpiration. It includes water evaporated from the soil surface and water transpired by plants.</td>
</tr>
<tr>
<td>first-in-first-served</td>
<td>A process by which groundwater entitlements are allocated consistent with the order in which licence applications are received by the Department of Water.</td>
</tr>
<tr>
<td>groundwater</td>
<td>Water which occupies the pores and crevices of rock or soil beneath the land surface.</td>
</tr>
<tr>
<td>groundwater area</td>
<td>The boundaries that are proclaimed under the Rights in Water and Irrigation Act 1914 and used for water allocation planning and management.</td>
</tr>
<tr>
<td>groundwater subarea</td>
<td>Areas defined by the Department of Water within a groundwater area, used for water allocation planning and management.</td>
</tr>
<tr>
<td>groundwater-dependent ecosystem</td>
<td>An ecosystem that is dependent on groundwater for its existence and health.</td>
</tr>
<tr>
<td>hydrogeology</td>
<td>The hydrological and geological science concerned with the occurrence, distribution, quality and movement of groundwater, especially relating to the distribution of aquifers, groundwater flow and groundwater quality</td>
</tr>
<tr>
<td>licence</td>
<td>A formal permit which entitles the licence holder to ‘take’ water from a watercourse, wetland or underground source</td>
</tr>
<tr>
<td>m AHD</td>
<td>Australian Height Datum – height in metres above Mean Sea Level + 0.026m at Fremantle.</td>
</tr>
<tr>
<td>non-artesian well</td>
<td>A well, including all associated works, from which water does not flow, or has not flowed, naturally to the surface but has to be raised, or has been raised, by pumping or other artificial means</td>
</tr>
<tr>
<td>precautionary principle</td>
<td>Taking a cautious approach to development and environmental management decisions when information is uncertain, unreliable or inadequate</td>
</tr>
<tr>
<td>Public water supply reserve</td>
<td>Reservation of a volume of water to supply drinking water for human consumption.</td>
</tr>
<tr>
<td>purchaser</td>
<td>A person receiving the trade is referred to as the purchaser. Any person permitted by the RiWI Act to hold a water licence is potentially able to purchase a licensed entitlement.</td>
</tr>
</tbody>
</table>
recirculation Where water is continually abstracted and re-applied from the same aquifer.

recharge Water that infiltrates into the soil to replenish an aquifer

salinity The measure of total soluble salt or mineral constituents in water. Water resources are classified based on salinity in terms of total dissolved salts (TDS) or total soluble salts (TSS). Measurements are usually in milligrams per litre (mg/L) or parts per thousand (ppt).

social value A particular in-situ quality, attribute or use that is important for public benefit, welfare, state or health (physical and spiritual).

social water requirement Elements of the water regime that are needed to maintain social and cultural values.

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.

sustainable groundwater yield The amount of water that can be abstracted/extracted over time from a water resource while maintaining the ecological values (including assets, functions and processes).

throughflow The flow of water within an aquifer.

trade Sale of part or all of a licensed entitlement/s, by a licensee (vendor) to a second party (purchaser). This involves moving the point of abstraction from one property to another.

transfer A transfer is a change in ownership of the water licence associated with the sale of the property to which the licence applies. There is no change in the location of the abstraction. Licences can be transferred without recompense

transpiration The water taken up by plants normally measured in millimetres.

unconfined aquifer Is the aquifer nearest the surface, having no overlying confining layer. The upper surface of the groundwater within the aquifer is called the watertable. An aquifer containing water with no upper non-porous material to limit its volume or to exert pressure.

unconformity A discontinuity in rock sequence indicating interruption of sedimentation, commonly accompanied by erosion of rocks below the break or the interface between such strata.

vendor A license holder wishing to trade a water entitlement is referred to as the vendor. Any person permitted by the RiWI Act to hold a water licence is potentially able to sell a licensed entitlement.

water efficiency The minimisation of water use through adoption of best management practices.

water entitlement The quantity of water that a person is entitled to take on an annual basis in accordance with the RiWI Act 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 reserve**
An area proclaimed under the Metropolitan Water Supply Sewerage and Drainage Act 1909 or Country Areas Water Supply Act 1947 to allow the protection and use of water on or under the land for public water supplies.

**water table**
The saturated level of the unconfined groundwater. Wetlands in low-lying areas are often seasonal or permanent surface expressions of the watertable.

**well**
An opening in the ground made or used to obtain access to underground water. This includes soaks, wells, bores and excavations.

**wellfield**
A group of wells used to measure or withdraw groundwater, including for scheme supply.

**wetland**
Wetlands are areas that are permanently, seasonally or intermittently waterlogged or inundated with water that may be fresh, saline, flowing or static, including areas of marine water of which the depth at low tide does not exceed 6 metres.

**yield**
The volume of water that may be drawn from a well or water supply system measured in cubic metres per day, gigalitres per year, or equivalent

**Volumes of Water**

<table>
<thead>
<tr>
<th>Units</th>
<th>1 litre</th>
<th>1 litre</th>
<th>1 litre</th>
</tr>
</thead>
<tbody>
<tr>
<td>One litre</td>
<td>1 litre</td>
<td>1 litre</td>
<td>1 litre</td>
</tr>
<tr>
<td>One thousand litres</td>
<td>1000 litres</td>
<td>1 kilolitre</td>
<td>(kL)</td>
</tr>
<tr>
<td>One million litres</td>
<td>1 000 000 litres</td>
<td>1 Megalitre</td>
<td>(ML)</td>
</tr>
<tr>
<td>One thousand million litres</td>
<td>1 000 000 000 litres</td>
<td>1 Gigalitre</td>
<td>(GL)</td>
</tr>
</tbody>
</table>

**Specific trading definitions**

**AGREEMENT or LEASE**

An agreement or lease is a temporary (short term <10 years) trade of a licensed entitlement (part or full entitlement) and is generally an annual lease from one licensee to another (change in location of abstraction). The term of the lease or agreement must be less than the vendor’s licence tenure specified on the licence.

Temporary and permanent trades have different considerations for impacts as temporary (<10 years) trades may have acceptable impacts (subject to departmental decisions) as it is only short term – whereas a permanent trade to the same area may be refused or have more stringent conditions as it is presumed to be for a longer term of abstraction.
PROOF OF PURCHASE

Proof of purchase must be submitted to the department following approval to trade. It is the responsibility of both the vendor and the purchaser to ensure adequate contractual documentation is used in the trade.

*Proof of purchase – licensed entitlement:* The price of the entitlement purchased, the volume purchased the location of the draw point and purpose of use must be supplied to the department to finalise the trade.

*Proof of purchase – water associated with the sale of land:* Land that has been bought with ‘water’ included in the price of the sale must be provided, with individual proof of purchase of the water to the Department of Water. The water purchased must be clearly defined in the bill of sale and on the transfer of licence ownership. This information must be supplied to the department for review of the water licence.

Land that has been bought with water associated with the land sale price is not considered traded entitlements where allocation limits have not be reached and trading has not officially commenced (as announced by the department).

Any water purchased prior the 2000 amendments to the *RiWI Act* is not considered an official trade as all water in the plan area was not fully allocated and the potential for trade was not legislated. This means that any land purchased with water included in the total has no ‘water’ value other than the infrastructure associated with the water use.
## Acronyms

<table>
<thead>
<tr>
<th>Full Title</th>
<th>Acronym</th>
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<tbody>
<tr>
<td>Acid sulfate soils</td>
<td>ASS</td>
</tr>
<tr>
<td>Agriculture and Resource Management Council of Australia and New Zealand</td>
<td>ARMCANZ</td>
</tr>
<tr>
<td>Australian and New Zealand Environmental Conservation Council</td>
<td>ANZECC</td>
</tr>
<tr>
<td>Australian height datum (in metres)</td>
<td>AHD</td>
</tr>
<tr>
<td>Bunbury Water Board</td>
<td>AQWEST</td>
</tr>
<tr>
<td>Commonwealth Scientific and Industrial Research Organisation</td>
<td>CSIRO</td>
</tr>
<tr>
<td>Department of Environment and Conservation</td>
<td>DEC</td>
</tr>
<tr>
<td>Department of Indigenous Affairs</td>
<td>DIA</td>
</tr>
<tr>
<td>Department of Water</td>
<td>DoW</td>
</tr>
<tr>
<td>Eastern Scott Coastal Plain</td>
<td>ESCP</td>
</tr>
<tr>
<td>Ecological water requirements</td>
<td>EWR</td>
</tr>
<tr>
<td>Environmental Protection Authority</td>
<td>EPA</td>
</tr>
<tr>
<td>Environmental protection policy</td>
<td>EPP</td>
</tr>
<tr>
<td>Environmental water provisions</td>
<td>EWP</td>
</tr>
<tr>
<td>Groundwater area/s</td>
<td>GWA</td>
</tr>
<tr>
<td>Integrated water supply scheme</td>
<td>IWSS</td>
</tr>
<tr>
<td>Local government area</td>
<td>LGA</td>
</tr>
<tr>
<td>Modular three-dimensional finite-difference ground-water flow model</td>
<td>MODFLOW</td>
</tr>
<tr>
<td>National water initiative</td>
<td>NWI</td>
</tr>
<tr>
<td>Potential acid sulfate soils</td>
<td>PASS</td>
</tr>
<tr>
<td>Public drinking water source area</td>
<td>PDWSA</td>
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<tr>
<td>Public water supply</td>
<td>PWS</td>
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<tr>
<td>Reasonable regional needs</td>
<td>RRN</td>
</tr>
<tr>
<td>Rights in Water and Irrigation Act, 1914 and Regulations, 2000</td>
<td>RiWI Act</td>
</tr>
<tr>
<td>Social water requirements</td>
<td>SWR</td>
</tr>
<tr>
<td>South West aquifer modelling system</td>
<td>SWAMS</td>
</tr>
<tr>
<td>South West Catchments Council</td>
<td>SWCC</td>
</tr>
<tr>
<td>Threatened ecological community</td>
<td>TEC</td>
</tr>
<tr>
<td>Water and Rivers Commission</td>
<td>WRC</td>
</tr>
<tr>
<td>Water Corporation</td>
<td>WC</td>
</tr>
<tr>
<td>Water efficiency management plan</td>
<td>WEMP</td>
</tr>
<tr>
<td>Water resource management committee</td>
<td>WRMC</td>
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