Department of Water
Government of Western Australia

Policy on Accessing the Leederville and Yarragadee aquifers in Perth

Water Allocation Policy

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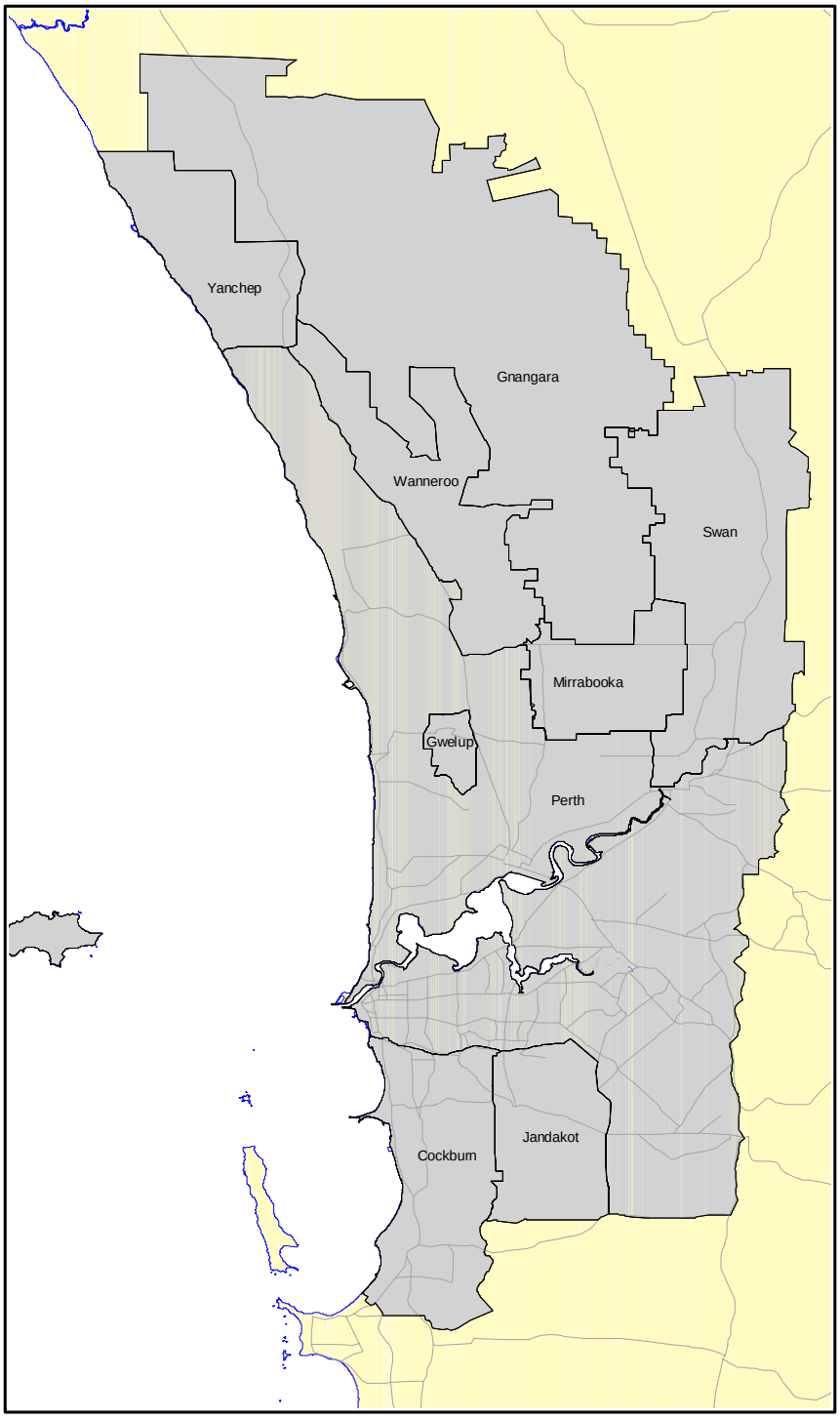

Groundwater Areas over which this policy applies

Executive Summary

Our water resources are a critical asset to the people of Western Australia. However, due to their ease of accessibility in most cases they are undervalued and can potentially be over utilised.

As our population grows, the water resources will be stressed due to increased use and competition. It is imperative that we safeguard these resources for use by future generations.

Appropriate management policies and strategies must be developed to ensure that the water resources are not over utilised. The Department's mission is 'to manage the water resources of Western Australia for the benefit of present and future generations, in partnership with the community'.

To support its mission the Department has drafted this paper setting out the policies for allocating groundwater resources from two of the main aquifers in Perth, the Leederville and the Yarragadee aquifers. The Department will use the policy outlined in this paper as an integral part of its water resources allocation strategy.

A major proposition of the policy is to limit the taking of any additional fresh groundwater from both the Leederville and Yarragadee aquifers. This aims to reduce any likely adverse long term impacts to the two aquifers and the environment they support, as current groundwater draw has reached or exceeded the sustainable limits of the aquifers.

Additional brackish and saline groundwater may be drawn from the two aquifers if the draw does not impact the environment, other groundwater users or the fresher groundwater resources.

The Department intends to give a high priority to this allocation policy. It will enable the Department to use its statutory powers in a consistent and uniform manner, and will guide the Department's response to statutory and non-statutory referrals it receives in relation to accessing the groundwater resources of the Leederville or Yarragadee aquifers in Perth.

1. Introduction

1.1 Background

The sustainable development of the State requires the availability of easily accessible water resources. These must be used in a manner so as to preserve the development options of future generations.

Perth, the centre of population and industry of this State, is located on sediments which contain large volumes of fresh groundwater. Two of the major groundwater resources in Perth are the Leederville and the deeper Yarragadee aquifers. These are found throughout the Perth region with some minor exceptions. A general description of the Leederville and Yarragadee aquifers is included in the Appendix.

Both the Leederville and Yarragadee aquifers are considered to be regional aquifers due to the fact that the impacts of taking groundwater are noticeable a large distance from the pumping bore. As such it is inappropriate to develop very localised management policies for these aquifers.

Recently, the demand from public utilities and private industries to access the groundwater resources of these aquifers has increased as the utilisation of other sources of groundwater such as the superficial aquifer, are reaching or have reached their sustainable limits. Current data, however, suggest that both the Leederville and the Yarragadee aquifers are stressed, as their potentiometric heads have been falling across the region, over a number of years, in response to pumping and a drying climate.

The Department of Water in conjunction with the Water Corporation has developed a computer model simulating the response of the two aquifers to pumping. This computer model will in the future assist the development of a groundwater allocation plan for the Perth region that will include groundwater allocation policies for the Leederville and Yarragadee aquifers.

Until that work is completed this policy will form the Department's position on accessing the groundwater resources from the Leederville or Yarragadee aquifers in Perth.

1.2 Intent

This policy is intended to facilitate the proper management of the groundwater resources in the Leederville and Yarragadee aquifers by:

- preventing the unlimited harvesting of the groundwater resources;
- ensuring the development options of future generations are maintained;

- balancing the consumptive needs, uses and social values with environmental protection;
- providing a direction as to the purposes for which the aquifers should be used;
- specifying the responsibilities of licensees, and
- providing a consistent and comprehensive approach to allocating groundwater resources from these aquifers.

1.3 Application

This policy applies to the groundwater resources within the Leederville and Yarragadee aquifers within the areas depicted on figure 1. These include the following Groundwater Areas proclaimed under the *Rights In Water and Irrigation Act 1914*:

- Yanchep
- Gnangara
- Wanneroo
- Mirrabooka
- Gwelup
- Swan
- Perth
- Cockburn
- Jandakot

It overrides any other previous policy or strategy relating to the allocation of groundwater from the Leederville or Yarragadee aquifers either as part of allocation plans for the above mentioned proclaimed groundwater areas or as stand alone policies. It replaces the Policy on Accessing the Leederville and Yarragadee aquifers in Perth, July 2003.

1.4 Governing legislation

The *Rights In Water and Irrigation Act 1914*, (RIWI Act) provides the legislation for groundwater allocation in Western Australia and vests the right to use, flow and control of water in any subterranean source in the Crown.

The RIWI Act requires the licensing of non-artesian wells in proclaimed groundwater areas. It also requires the licensing of all artesian wells.

Under this legislation any well tapping the Leederville or Yarragadee aquifers in the Perth area requires licensing from the Department.

2 Policy

To achieve the previously stated intent and underpin the policies for allocating the groundwater resources of the Leederville and Yarragadee aquifers, the Department of Water adopted the following principles:

- avoid any additional stress on the two aquifers;
- avoid any needless capital investments by licence applicants;
- recognise existing users and uses of the aquifers;
- recognise previous commitments to the Water Corporation and other licence applicants;
- refuse licence applications that have the potential to adversely impact the aquifers, the environment or existing groundwater users; and
- consider developments that need to access brackish to saline groundwater from these two aquifers.

The policies developed also recognise the hydrogeological complexities of the area and the unique nature of the two aquifers including the:

- low risk of groundwater contamination due to the mainly confined nature of the aquifers;
- relatively low rates of recharge;
- high volumes of groundwater contained in storage;
- regional nature of the two aquifers;
- high bore yields compared to bores screened into the superficial aquifer;
- hydraulic connections between the two aquifers, the superficial aquifer and surface environmental features, such as wetlands; and
- varying salinity groundwaters contained within the aquifers.

2.1 Honouring previous commitments

The Department of Water will honour all previous commitments to licensees who have adhered to the licence terms and conditions, the Ministerial agreements outlined in the Perth Drought Management Strategy (1998) and any subsequent drought management agreements.

The Department will honour all current licensed allocations, provided the licensees have met all the terms and conditions of their licences.

It will also honour the previous agreements made with the Water Corporation and outlined in the Perth Drought Management Strategy (1998), referring to the Corporation temporarily drawing additional groundwater from the Yarragadee aquifer in periods of drought, as specified in the Strategy and after agreement with the Department.

The additional groundwater will supplement the Perth Metropolitan Water Supply Scheme. It will make up the short fall in supply from the groundwater schemes tapping the superficial aquifer that have restrictions on the volume of groundwater that can be taken during drought periods, due to unacceptable environmental impacts.

Monitoring the aquifer's response to the increased pumping will also provide the necessary data to assist in the development of more informed policy positions regarding allocating water from the Yarragadee aquifer.

2.2 Licensees not adhering to conditions

The Department will rescind its commitments given to licensees who have not undertaken sufficient work or invested funds towards meeting the conditions associated with those commitments, when the commitments expire.

Persons granted licences to take and use groundwater from the Leederville or Yarragadee aquifers, who have not undertaken sufficient work towards meeting the conditions of the licence by the time the licence expires, will be informed that the Department is unlikely to renew their licences when those licences expire.

For example, the Department will rescind its commitment to a licensee who has not constructed a production bore to access the groundwater in the aquifer by the time the licence expires, as this would suggest that the licensee no longer requires the allocation. In this case the Department will not renew the expired licence.

2.3 Generally no additional water entitlements are to be approved

No long term licences for accessing the fresh groundwater resources of the Leederville or Yarragadee aquifers are to be granted for additional groundwater entitlements, other than for extenuating circumstances. To avoid any needless capital investments by applicants, the Department will inform applicants that their application to take water will most likely be refused and the applicant will be directed to access other water sources.

The 2000 National Land and Water Audit suggested that the Leederville and Yarragadee aquifers in the Perth area are fully allocated (current groundwater draw equals or exceeds sustainable yield).

Data from monitoring bores throughout the area show the aquifers are stressed. Potentiometric heads are falling in both aquifers as a result of pumping and the drying climate.

The falling potentiometric heads in the Leederville and Yarragadee aquifers will reduce the pressure differential between these aquifers and the overlaying superficial aquifer. This will induce more groundwater to leak from the overlying aquifer into the Leederville and Yarragadee aquifers, increasing the rate these two aquifers are being recharged. Eventually a steady state will be reached when the rate of recharge is similar to the level of groundwater draw. This is estimated to take more than 50 years in the Leederville aquifer and longer than 100 years in the Yarragadee aquifer at current levels of pumping.

However, inducing more groundwater leakage into the Leederville and Yarragadee aquifers will translate into watertable falls in the superficial aquifer, in areas where groundwater from the superficial aquifer recharges the Leederville and Yarragadee aquifers. If the watertable falls are near significant environmental features such as wetlands that are dependant on the watertable, the environment may be unacceptably affected.

Should additional large volumes of groundwater be pumped from the Leederville and Yarragadee aquifers their potentiometric heads will fall further. Therefore, increases to current water entitlements must be limited to a minimum if the aquifers are not to be further stressed.

In arriving at the position to limit the taking of additional volumes of groundwater from the Leederville and Yarragadee aquifers, the Department considered:

- the public interest;
- current condition of the aquifers;
- safeguarding the development options of future generations;
- the sustainability of the ecology;
- the environmental sustainability;
- economic development opportunities; and
- previous Department decisions.

This is consistent with clause 7 of Schedule 1 to the RIWI Act.

The Department working with the Water Corporation has developed a computer model simulating the response of the two aquifers to pumping with the aim of predicting the long term impacts of pumping and climatic effects.

In the future, the computer model will assist in:

- defining the allocation limits of the two aquifers more accurately;
- optimising the location of draw points (production bores);
- limiting any unacceptable environmental impacts;
- drafting more informed allocation policies, and
- optimally managing the groundwater resources of the two aquifers.

This work is continuing and is especially focusing on increasing the accuracy of the predictive abilities of the model. Eventually the computer model will assist in

the development of a water allocation plan for the Perth region. Until this work is completed, any needless expenditure of capital funds should be avoided where possible, in case the work undertaken concludes that any applications for additional water entitlements should be refused.

The Department will inform applicants requesting access to the groundwater resources of the Leederville or Yarragadee aquifers that their application is likely to be refused, as soon as possible and before the applicant expends any funds.

To prevent any unnecessary expenditure of capital, the Department will not issue any licences to explore the groundwater resources of the Leederville or Yarragadee aquifer, if the licensee is unlikely to later be issued with a production licence to take and use the groundwater.

The Department will discuss with the applicant access to other possible sources of water to meet their water requirements. This approach is consistent with Department practices. A significant number of applications for accessing the Leederville and Yarragadee aquifers have been formally refused by the Department.

2.4 Extenuating circumstances

The Department of Water may consider further applications for accessing the fresh groundwater resources of the Leederville or Yarragadee aquifers if:

- there is a significant public benefit;
- the volume requested is small (up to 50 000 kL/year); and
- the applicant demonstrates that there are no other suitable alternative water sources available.

Applications for domestic water supply would normally be considered.

Even though the aquifers are assessed to be under stress, licences to take small volumes of groundwater may still be granted in some circumstances for purposes that result in a significant public benefit. These occurrences are infrequent, and do not relate to an applicant's personal difficulties. A public benefit generally provides a benefit or gain to the community at large. Examples include:

- environmental uses, such as supplementing groundwater levels in environmentally significant wetlands or cave systems, or
- public purposes, such as irrigation of school ovals, supporting major (but non routine) public / community events, public water supplies, fire fighting or emergency services.

Water licences, even for small volumes of groundwater, will not normally be granted for commercial or industrial purposes or for irrigating local government grassed areas, unless it can be demonstrated that they provide a significant public benefit.

Before the Department will consider the granting of a licence to take water from the Leederville or Yarragadee aquifer for the purposes outlined above, the applicant must demonstrate to the satisfaction of the Department that there is no other groundwater or surface water source that can be utilised instead. This includes by purchasing the necessary water entitlements.

2.5 Licences granted for strictly limited time

The Department will consider applications for accessing the fresh groundwater resources of the Leederville or the Yarragadee aquifers for a limited time of not more than five years. The total cumulative water entitlements for such licences is limited to 3 GL/year from the Leederville aquifer and 2.5 GL/year from the Yarragadee aquifer at any one time.

These licences will not be renewed after they expire and are not transferable.

An applicant requesting a water licence for a limited term must demonstrate to the satisfaction of the Department (possibly showing contractual arrangements) that alternative viable sources of water have been identified and will be utilised to meet the applicant's water requirements after the licence expires. The applicant will need to satisfactorily assess the impacts of the alternative supply options.

Such licences will not be issued for short term projects that have a life time of less than 5 years.

The Department is prepared to consider a request by an applicant for a water licence for a strictly limited time from the Leederville or Yarragadee aquifers, if suitable alternative water supplies have been identified for use after the term of the licence expires.

An applicant requesting such a licence should be able to demonstrate to the Department's satisfaction that:

- an alternative water supply has been identified that will meet the applicant's water requirements after the licence expires (not more than five years);
- the alternative water supply identified cannot be used at present because of the time required to bring the alternative supply into operation;
- the applicant is undertaking work to make certain that the alternative water supply will be brought into operation by the time the licence expires, and
- the possible impacts of using the alternative water supply have been addressed, or are satisfactorily being addressed.

The issuing of such licences is limited to a term of at most 5 years, and for total allocations not exceeding 3 GL/year from the Leederville aquifer or 2.5 GL/year from the Yarragadee aquifer at any one time (around 5% of current draw). These licences will not be renewed and cannot be transferred or through an agreement to a third party.

For example, the Department may consider an application from a company located in Cockburn Sound that requires a supply of groundwater until sufficient waste water from the Woodman Point treatment plant is available for use to meet that company's requirements.

Under this scenario, the company would need to provide the Department a timetable for using the wastewater, contractual details and other information to satisfy the Department that the waste water will be available to the company at the pre determined time. The company will also demonstrate that the water sources currently utilised and any water efficiency measures taken will be insufficient to satisfy the water requirements of the company and the only alternative is accessing the Leederville or Yarragadee aquifers.

2.6 Accessing brackish or saline groundwaters

The Department will consider applications to access groundwater with salinity of greater than around 2,000 mg/L TDS from the Leederville or Yarragadee aquifer if the applicant can demonstrate that the taking of the groundwater will not impact on the environment, other water users, the fresher groundwater resources of these aquifers, or appreciably deteriorate the quality of the groundwater in the aquifer.

The Leederville and Yarragadee aquifers are regional aquifers extending over large areas. Both aquifers contain large volumes of groundwater some of which is brackish or saline.

Water with a salinity of over 2,000 mg/L TDS is not suitable for drinking or for watering most crops or types of grasses. Such brackish or saline waters are usually only used for industrial purposes.

The Department will consider the granting of licences to take groundwater with a salinity greater than 2,000 mg/L TDS from the Leederville or Yarragadee aquifers, if the applicant requesting the licence can demonstrate to the satisfaction of the Department that the taking of the groundwater will:

- not impact the fresher groundwater resources in the aquifer;
- not impact the environment or other water users; and
- not deteriorate the quality of the groundwater in the aquifer over time.

Applicants requesting access to the brackish or saline waters of the Leederville or Yarragadee aquifers may be required to gain approval to undertake a groundwater investigation by applying for a licence to construct a bore under section 26D of the RIWI Act.

If the quantity of water to be taken is greater than 200,000 kL/year, the Department will require the applicant to draft an operating strategy to the satisfaction of the Department, to become part of the licence conditions, as per

the Department's Statewide Policy No 10 Use of Operating Strategies in the Water Licensing Process. The strategy will also specify the actions to be taken by the licensee should the response of the aquifer to pumping be different to that originally predicted.

The Department will also inform applicants of the need to obtain other necessary approvals especially regarding the environmental impacts of the use and disposal methods of the saline groundwater.

3 Implementation

The policy will be implemented by the Department of Water's water licensing process under the *Rights In Water and Irrigation Act 1914*. Any applicant requesting access to the Leederville or Yarragadee aquifer in the Perth area should enquire about the possibility, at either the Department's:

- Kwinana Peel Regional office, if the enquiry is for the Cockburn or Jandakot Groundwater Areas, or the
- Swan Goldfields Agricultural Regional office, if the enquiry is for one of the other Groundwater Areas covered by this policy.

Any formal application for a licence should be made using the approved forms that can be obtained from any Department office and submitted to either the Kwinana Peel or to the Swan Goldfields Agricultural Region.

The guidelines associated with assessing either current licensees or applicants requesting access to the groundwater resources of the Leederville or Yarragadee aquifers in the Perth Region are outlined below. They are to remain in force until this policy is reviewed, superseded, or until changes to the guidelines are authorised by the Department of Water.

Current licensees

The Department recognises existing licences and previous commitments made to licence applicants, to draw groundwater from the Leederville or Yarragadee aquifers.

However, where it is known that an existing licensee is not utilising all of the licensed water entitlement, the licensee may be approached with the aim of reducing the entitlement to better reflect current use and near future requirements as per the Department's Statewide Policy No 11 Management of Unused Licensed Water Entitlements.

The Department may undertake a survey of use of all existing Leederville and Yarragadee licensees in the future, to determine if the licensees are using all of their water entitlement and are adhering to the licence terms and conditions.

Increases to current water entitlements

The Department will generally refuse any applications seeking to increase a licensed water entitlement from either the Leederville or the Yarragadee aquifers, unless the salinity of the groundwater taken is more than around 2,000 mg/L TDS. Applicants requesting an increase should be advised to seek alternative

water sources, including accessing the superficial aquifer if sufficient water is available and the impacts are acceptable.

Existing licensees replacing their bores

Bores have a limited lifetime. Current licensees drawing groundwater from either the Leederville or the Yarragadee aquifers may need to replace their existing bores. The Department will direct those licensees that have applied for a section 26D licence under the RIWI Act, to construct new bores replacing their production existing bores, to consider using alternative water sources.

In the case of an alternative source being suitable, such as tapping the shallower superficial aquifer, the applicant will be asked to withdraw the original application and reapply for a new water licence to take water from the new source (Section 5C licence under the RIWI Act).

If no suitable alternative water sources are found, the Department will permit the licensee to replace the existing bore by granting a 26D licence. The section 5C licence to take and use water will be reissued with a water entitlement reflecting the licensees' current use and near term requirements up to the currently licensed entitlement.

Renewal of existing licences

A current licence will be renewed when it expires if the licensee has abided by all the licence terms and conditions. If less water is drawn than the licensed water entitlement, the Department will negotiate a new entitlement with the licensee that better reflects the volume of groundwater used.

If the licensee has not satisfactorily abided with the licence terms and conditions, the licensee will be informed that unless satisfactory reasons for this can be provided the Department will take action, including possibly cancelling the licence.

Holders of water licences that have not drilled the production bore before their licence has expired, will be deemed that they no longer require the water entitlement as per the Department's Statewide Policy No 11 Managing Unused Licensed Water Entitlements. They will be informed that the Department's commitment to them has expired and the Department is likely to refuse any applications to renew their licence.

Undertaking groundwater investigations for fresh groundwater

Persons or companies that apply to take groundwater are sometimes requested by the Department to undertake an investigation (exploration) to determine

groundwater availability and the likely impacts on the environmental values of the proposed pumping.

To undertake the work, the Department issues licences under section 26D of the RIWI Act to construct a bore and in some cases may also issue licences to take water under section 5C of the RIWI Act which would be valid for a limited time.

Holders of current 26D and/or 5C licences that have been issued for the purpose of undertaking groundwater investigation (exploration) work in the Leederville or Yarragadee aquifers, but have not undertaken any work, will be informed of this policy when dealing with the Department and that any application for a production licence is likely to be refused even after completion of the drilling investigation program.

Licensees who were granted the authority to undertake groundwater investigations, but have not undertaken any investigation work such as drilling by the time that authority (licence) expires, will be informed that they should not undertake any work. They will be advised that any new application for undertaking groundwater investigations or for a groundwater licence to take water, will be considered along with other applications and is likely to be refused in line with this policy.

The Department will not issue any new licences to carry out groundwater investigations in the Leederville or Yarragadee aquifers to applicants requesting long term access to the fresh groundwater resources of these aquifers, as the issuing of any such licence may be perceived by the applicant as a commitment that the Department will issue the applicant with a licence to take and use water at a later date.

Undertaking groundwater investigations for brackish or saline groundwater

Applicants requesting to access more than 200,000 kL/year of brackish or saline groundwater from the Leederville or Yarragadee aquifers (with salinity greater than around 2,000 mg/L TDS) may be requested to undertake an investigation to determine whether the impacts on the environmental values of the proposed pumping are acceptable. In such cases the Department will issue a licence to construct a bore under section 26D of the RIWI Act and possibly a licence to take water for the purposes of the investigation.

Although the grant of these licences for investigation purposes is not an indication that a licence to take water will be granted at a later stage, the Department will consider any subsequent application on a case to case basis.

New applications to take and use groundwater

The Department will inform new applicants, requesting the taking of fresh groundwater from the Leederville and Yarragadee aquifers, of this policy and the probability of granting a licence to take water as per this policy. Where possible, the Department will direct these applicants to investigate alternative sources of water.

Applications for accessing the brackish or saline groundwater in the Leederville and Yarragadee aquifers may be requested to demonstrate the acceptability of the impacts of taking that water by undertaking a groundwater investigation.

Applications for reducing existing water entitlements

Applicants requesting a reduction in their water entitlements (possibly due to a change in land use) will be granted with a new licence with the reduced entitlement after they have obtained all the relevant approvals (environmental, shire approvals for a change in land use, etc).

Water Corporation licences

The Water Corporation currently holds a number of licences to take groundwater from the Leederville and Yarragadee aquifers and providing that water to the Perth Metropolitan Water Supply Scheme.

The Minister approved the Perth Drought Management Strategy (1998) that was drafted by the Department in cooperation with the Water Corporation. The main focus of this strategy was to permit the Water Corporation to draw additional groundwater from the Yarragadee aquifer during periods of drought to supplement other sources of water. The trigger for the additional draw is related to low dam storage levels.

In line with this decision, the Water Corporation constructed three bores screened into the Yarragadee aquifer.

Applicants requesting access to the Yarragadee aquifer for heat exchange purposes

The Department received a number of enquiries requesting access into the Yarragadee aquifer for heat exchange purposes. These enquiries were mainly made by swimming pool operators that wish to use the relatively high temperature groundwater from the Yarragadee aquifer to heat the swimming pools.

Under this scenario, the groundwater is to be drawn from the Yarragadee aquifer, pass through a heat exchanger and pumped back into the Yarragadee aquifer or any other aquifer that is considered to be under stress. There will be no net water loss from the aquifer system under these proposals.

The Department will consider such applications on a case to case basis, and may issue licences to take water to applicants if the impacts to pumping are assessed to be acceptable and there is no net loss to the aquifer system.

State Agreements

State Agreements are essentially contracts between the Government of Western Australia and proponents of major projects. They package the rights and obligations of both parties and establish a framework for ongoing relations and cooperation between the State and project proponents.

State Agreements are ratified by an Act of the Western Australian State Parliament. This enhances certainty with regards to the project, security of tenure and reduces sovereign risk.

The Department will honour State Agreements that require the provision of access to the Leederville and Yarragadee aquifers to take and use groundwater.

New bores tapping the Leederville and Yarragadee aquifers

The Department will inform licensees drilling new bores accessing groundwater from either the Leederville or Yarragadee aquifers that the potentiometric heads in both aquifers are falling and will continue to fall in the foreseeable future. The licensee should ensure the bore is designed to account for these changes.

Appendix

GENERAL INFORMATION FOR THE LEEDERVILLE AND YARRAGADEE AQUIFERS IN THE PERTH AREA LEEDERVILLE AQUIFER

The Leederville aquifer has in the past also been referred to as the shallow artesian aquifer. It consists of interbedded sandstone and shale and has a maximum thickness of around 500 metres. It is found at depths of over 200 metres below the surface. Over most of the Perth region, the Leederville aquifer is overlain by the shale beds of the Osborne Formation which act as a confining bed.

The area over which the Leederville aquifer is recharged is small, compared to the total area over which the aquifer is found. It is recharged by downward leakage from the superficial aquifer near the Darling Fault and under the Gnangara Mound, where the Osborne Formation is absent. From the recharge areas, groundwater slowly flows to discharge some distance off shore into the ocean.

Around 120 000 GL of groundwater is estimated to be contained within the Leederville aquifer. Although most of the groundwater is fresh, in some areas the groundwater has been found to be brackish.

Current use

The Leederville aquifer is the preferred source of groundwater by a large number of water users mainly because bores screened into the Leederville aquifer are generally higher yielding. The presence of the Osborne Formation as a confining bed limits any adverse environmental impacts due to pumping and reduces the risk of groundwater contamination from pollution sources.

Currently, over 60 GL/year are being drawn from the Leederville aquifer, mainly by the Water Corporation providing water to the Perth Metropolitan Water Supply Scheme but also by local authorities, schools and other community institutions and for industrial purposes.

Impacts of pumping

The Leederville aquifer is believed to be fully allocated (National Land and Water Audit). Data from monitoring bores indicate that the aquifer is stressed and potentiometric heads as falling over much of the aquifer.

The falling potentiometric head levels, increase the head difference between the superficial and the Leederville aquifers, inducing more groundwater to leak into

the Leederville aquifer, increasing recharge. The potentiometric heads will continue to fall until a new equilibrium is reached where recharge into the Leederville aquifer equals the rate of abstraction.

However, this is likely to take a long time. At current levels of pumping, steady state may be achieved after some 50 years, (Davidson, 1995). Should the level of abstraction be significantly increased, steady state will be achieved over a longer period, resulting in much lower potentiometric heads.

If the potentiometric heads fall significantly, the water table in the recharge areas of the aquifer will also fall possibly adversely impacting the environmental features (wetlands) in those areas. The falls may also result in the saltwater interface currently just offshore to slowly migrate inland. Should this happen the salinity of the groundwater pumped from Leederville bores located near the coast will gradually increase.

YARRAGADEE AQUIFER

The Yarragadee aquifer is a major confined aquifer underlaying the entire Perth Region. It consists of sandstones, siltstones and shale and is believed to be more than 2000 metres in thickness.

Previously also known as the lower artesian aquifer, the Yarragadee aquifer is confined by the South Perth Shale found over most of the region between the Leederville and Yarragadee aquifers. It is recharged by downwards groundwater leakage from the Leederville aquifer over areas where the South Perth Shale is absent, mainly just north of the Gnangara Mound and along the Darling Fault south of Perth. Groundwater flows mainly in a westerly direction to discharge offshore or into the overlying aquifers.

The Yarragadee aquifer is estimated to have in storage some 76 000 GL of fresh and over
370 000 GL of brackish groundwater, beneath the Perth region.

Current use

The Yarragadee aquifer is found at significant depths, and is therefore expensive to access. For this reason, the aquifer has not been developed to the same degree as the Leederville aquifer. Currently over 50 GL/yr has been allocated from the Yarragadee aquifer to various users. The largest user however, is the Water Corporation that taps the aquifer for scheme water supply purposes.

Bores screened into the Yarragadee aquifer are higher yielding than those screened into the Leederville aquifer as the permeability of the Yarragadee aquifer is higher than that of the Leederville aquifer.

Impacts of pumping

As the aquifer is confined over most of the Perth region, the impacts of pumping extend several kilometres from the production bore, eventually reaching the recharge areas of the aquifer.

At current pumping levels the aquifer is believed to be fully allocated. Just as in the Leederville aquifer, the potentiometric heads of the Yarragadee aquifer are falling. The heads will continue to fall until more recharge is induced into the aquifer to eventually equal the groundwater abstraction rate. It has been suggested that a steady state at current levels of pumping may be reached after 100 years (Davidson, 1995).

The saltwater interface currently some distance offshore is unlikely to migrate into the coast in the medium term unless pumping is increased considerably compared to the existing levels.

Glossary

Aquifer means a geological formation or group of formations capable of receiving, storing and transmitting significant quantities of water.

Bore means a specific type of well accessing groundwater, generally a small diameter well.

Confined aquifer is an aquifer which is located between upper and lower layers of low permeability (layers within which water does not flow freely).

Environment means livings things, their physical, biological and social surrounding and interactions between all of these.

Environmental value (also known as beneficial uses) is a value or use of the environment or any element or segment of the environment which is conducive to public benefit, welfare, safety, health or aesthetic enjoyment and which requires protection from pollution sources.

Giga litre (GL) refers to a volume that equates to one thousand million litres or one million cubic metres.

Groundwater refers to underground water and includes water that percolates from the ground into a well or other works.

Hydrogeology means the geological science associated with the occurrence, distribution, movement and quality of groundwater.

Policy refers to a guideline that is not directly supported by any legislation but has been adopted by the Department of Water as its guideline when assessing developments.

Sedimentary basin is an area containing a thick and laterally extensive sequence of sedimentary rocks that have not been severely altered or deformed.

Superficial aquifer is the unconfined aquifer found throughout the Perth area.

Sustainable yield refers to the volume of water that can be harvested each year from a water resource with acceptable impacts.

Unconfined aquifer is an aquifer without an overlying layer of lower permeability which generally gets direct vertical water recharge from the surface.

Water table refers to the surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere.

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