Groundwater Sources – An Overview

Background

Groundwater occurs in aquifers – sand or rock formations below the surface that store and transmit water through them. Rainfall seeps beneath our sandy soils to create a groundwater system made up of a number of aquifers that may be confined or unconfined.

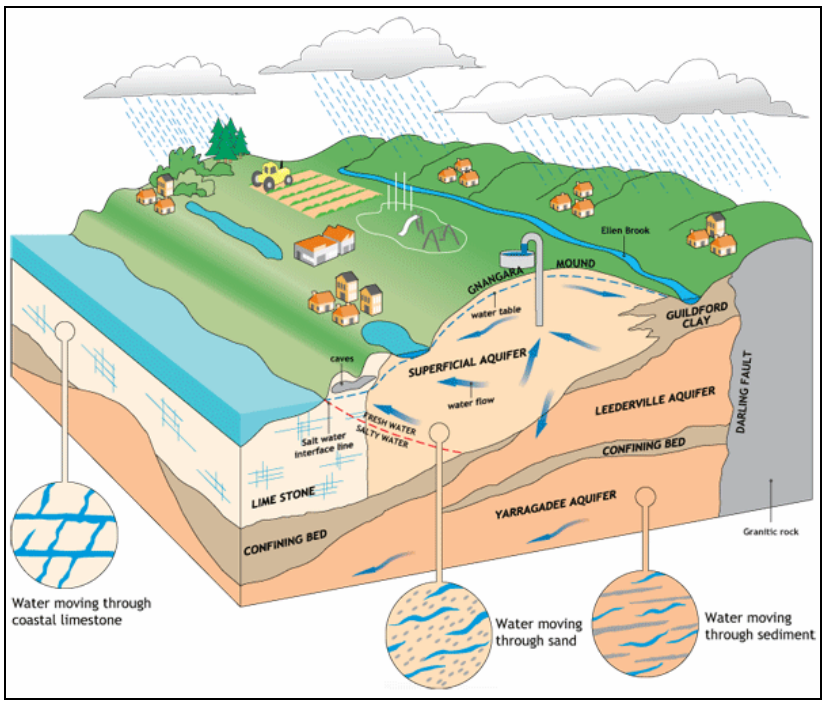
An unconfined aquifer has a direct connection with the surface, while a confined aquifer is separated from the surface by a less permeable layer called a confining bed. Shallow unconfined groundwater occurs in the superficial aquifer on the Swan Coastal Plain and groundwater levels in the aquifer usually fluctuate in response to recharge from annual rainfall.

Below this, several confined sedimentary aquifers extend to depths of several thousand metres. These aquifers can contain water that was recharged tens of thousands of years ago in areas remote from current pumping locations. As a result, these aquifers are less affected by short term changes in annual rainfall.

The Perth Basin has the largest identified fresh groundwater availability in the State and extends for about 1000 km along the coast from Augusta to just northeast of Geraldton. In the Perth Region there are three major aquifers in the Basin – the Superficial, Leederville and Yarragadee. Groundwater in the superficial aquifer supports many diverse ecosystems including lakes, wetlands and caves. The Leederville and Yarragadee aquifers are confined and underlie the superficial aquifer and extend for at least 10 kilometres off shore.

The Perth Region is heavily populated with a significant proportion of the groundwater resource accessed for agricultural use and public water supply. Perth is unique among major Australian cities in that it has been built above a large source of fresh groundwater.

Within the Perth area, there are two main groundwater systems that have been developed for public water supply, the Gnangara and Jandakot Groundwater Systems.



The development of groundwater for public supply has increased from around 10% of Perth's supply in the mid 1970's to around 60% since 2001.

The large volume of groundwater in storage in the aquifers beneath Perth, estimated at more than 500,000 gigalitres, has meant that the groundwater system provides a high level of drought security by allowing temporary depletion of groundwater storage when dam levels are low. Accessing groundwater and surface water sources together is a very efficient way of maximising resource availability.

The use of groundwater has increased by multiple users. In addition, the impacts of the shift in climate over the past 30 years on groundwater levels and the environment have become apparent. This requires a more sophisticated approach to operation of our groundwater sources.

Significant investment has been made to increase the capacity of the IWSS water grid to draw from the deeper confined Leederville and Yarragadee aquifers. This allows us to rest bores in the superficial aquifer to minimise environmental impact.

Changes in vegetation on the groundwater mounds are the result of the combined influences of climate change, land use change and groundwater abstraction. The current method of providing for environmental values of groundwater dependent systems by specifying minimum groundwater levels has been an effective way of managing a static system. However, future climate forecasts indicate that the groundwater and associated ecosystems are undergoing a dynamic change. It is likely that an adaptive approach which recognises that environmental values will change will inform water resource management.

Water Quality

Each aquifer, borefield and bore has its own characteristics. Sampling and testing is required to determine the specific water quality of each bore. Naturally elevated levels of iron, colour and turbidity often need to be reduced by treatment. Other parameters such as hardness, temperature and total dissolved solids (TDS) can sometimes be managed by blending with better quality water. The natural quality of groundwater can also be influenced by land use activities in the recharge area.

The Department of Water is responsible for defining, proclaiming and protecting the catchments of public drinking water source areas. The Department develops drinking water source protection plans to identify existing and potential threats to a drinking water source and to provide risk management strategies and programs for the ongoing management of that source.

The superficial aquifer is usually at greatest risk from chemical or microbiological contamination. Water from the confined aquifers is, by nature, largely protected from short term contamination resulting from land use activities.

TDS of the confined aquifer water in the Perth Region is variable, with some bores excellent at 200 mg/L and others exceeding 1000 mg/L. Temperature is a significant issue in the Yarragadee aquifer, with water being brought to the surface at around 40 degrees Celsius.

Fresh groundwater extends for several kilometres off shore in the confined aquifers, and is slowly being recovered as a result of increased abstraction and modification of the flow system. While this approach is likely to be sustainable for 10's to 100's of years, ultimately the recovered resource will be replaced by high TDS seawater. Increased monitoring and a long term plan will be required to manage and ensure the future for the resource.

Current Situation

Current operation of the Gnangara and Jandakot groundwater systems for public water supply is based on a variable abstraction rule that allows the annual abstraction to vary between 105 gigalitres and 165 gigalitres a year. This was developed to assist in the management of the public water supply, since the very poor 2001 winter.

The management approach for this strategic resource is being reviewed through a review of Ministerial Conditions for the Gnangara Mound, (Section 46 review) and the Gnangara Sustainability Strategy.

The Future

Managing this groundwater resource is critical to supply security for customers of the IWSS water grid. The ability to utilise the large storage volume in the confined aquifers to provide system security and minimise the impacts of a drying climate and risk of severe water restrictions is paramount. We need a more sophisticated adaptive management approach which accounts for the inevitable consequences of a drying climate.

The unique groundwater system beneath Perth offers unparalleled opportunity to deliver water benefits well into the future. Groundwater banking in the confined aquifers can be undertaken using desalinated sea water, high quality water from reverse osmosis treatment of wastewater (groundwater replenishment) and surface water that may become available in wetter years. Development can be incremental to meet system security and balance supply needs, and has commenced with the Jandakot aquifer storage and recovery (ASR) project.

More Information

- Department of Water website
  http://portal.water.wa.gov.au/portal/page/portal/WaterManagement/Groundwater

  http://portal.water.wa.gov.au/portal/page/portal/WaterQuality/Publications/WaterQualityProtectionNotes/Content/WQPN_36.pdf

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