



Groundwater flow modelling

Managing groundwater resources is complex. The geological structures in which the water lies, and the water itself cannot be 'seen', or measured directly. The effect of sinking a bore and pumping from it cannot be easily predicted – the bore may be able to supply the required amount of water indefinitely, or water levels and yields may progressively decline. Understanding how groundwater resources function, and how they respond to different management regimes is essential for the wise use of these resources.

Understanding groundwater behaviour

Hydrogeology, the science of groundwater investigation, uses techniques such as geophysics (*FactSheets 2 and 7*), exploratory drilling (*Fact Sheets 2 and 6*) and groundwater age dating (*FactSheet 8*) to build a three-dimensional picture of what an aquifer is like. Other techniques such as recharge estimation (*FactSheet 9*) and the response of the groundwater levels to existing 'abstraction' – pumping for human uses (*FactSheet 10*) – provide information on how the aquifer works.

Groundwater flow modelling

A comprehensive analysis of aquifer systems requires a way in which all known information can be brought together to predict overall groundwater behaviour and response to management. The approach used is called *groundwater flow modelling*. Computer technology is used in building a three dimensional representation of a real groundwater aquifer. The model can then be used to 'simulate', or mimic what is really happening under the ground. 'Running' the model under different conditions - for example using different abstraction (pumping) rates will produce different simulated responses in the aquifer system. These may include different rates of discharge to rivers, different aquifer storage levels and any other responses to abstraction.

The modelling software being used for the South West Yarragadee-Blackwood Groundwater Area is called 'MODFLOW'. It is an industry-standard aquifer simulation model, used all over the world in modelling how groundwater resources behave and respond to different management. In Western Australia, MODFLOW is used routinely in the mining industry, and in designing pumping regimes to obtain groundwater for mineral processing, especially in the Eastern Goldfields. It is also used to predict requirements for mine pit dewatering, as in the sand mining and coal mining areas of the South West.

The groundwater flow model for the South West Yarragadee-Blackwood Groundwater Area

Understanding how an aquifer system behaves requires the building of a Groundwater Flow Model that is particular to the aquifer situation being studied. MODFLOW will provide the framework for building a unique model of the South West Yarragadee-Blackwood Groundwater Area. Inputs to the model include the following:

- The geology of the formations in the region
- The geometry of the aquifer systems – how they fit together and the water-related (hydraulic) interactions between them
- The groundwater levels in the aquifers – termed the 'hydraulic heads'
- Estimation of how groundwater is stored and how it moves through the aquifers – termed its 'hydraulic properties'
- The rate of recharge of the aquifers in the region
- Current rates of abstraction (pumping from the aquifers)

Much of this information is derived from studies completed over the last 30 year period (see *FactSheet 2*). More recent investigations have added to the information, or have confirmed earlier findings.

The groundwater flow model is calibrated in two stages.

- A steady state calibration will present the system as it is now at equilibrium – where the volume of recharge into the aquifer equals the volume of discharge (including pumping) from it. It assumes that there is no net change in the groundwater storage levels in the aquifers. The predicted hydraulic properties will be compared to those determined through test pumping from a production bore drilled into the South West Yarragadee Aquifer on the Blackwood Plateau. The steady state model will be evaluated by external experts, who will focus on the quality of the inputs to the model.
- A transient calibration will show how the system responds to change, normally being groundwater abstraction – the removal of water from the aquifer by pumping. The model will show how groundwater levels change in response to different levels of abstraction from the South West Yarragadee Aquifer. The predictions can

be compared to actual change recorded close to the bores that provide water from the aquifer for Bunbury and Busselton. Understanding how the aquifer responds will allow predictions to be made of what will happen under a range of different groundwater pumping programs.

How are the outputs from the groundwater flow model being used?

The groundwater flow modelling will provide information on how the aquifers respond to a range of management scenarios. These scenarios will consider different rates of groundwater recharge, the impact of climate variability and change, different levels of abstraction (i.e. pumping), and different locations for production bores.

The predicted aquifer response from modelling a range of different scenarios will guide the development of the regional groundwater management strategy.

For more information contact

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