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Factsheet 2

Groundwater yields in south-west Western Australia

Water for a Healthy Country Flagship

National Research FLAGSHIPS Water for a Healthy Country — CSIRO

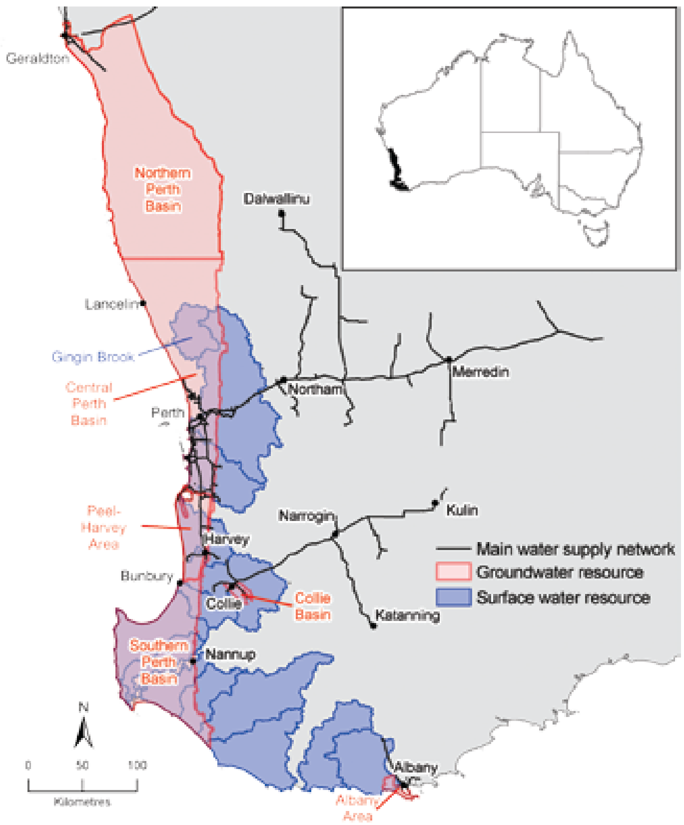
The CSIRO South-West Western Australia Sustainable Yields Project provides science to underpin the sustainable planning and management of the water resources of south-west Western Australia

Project overview

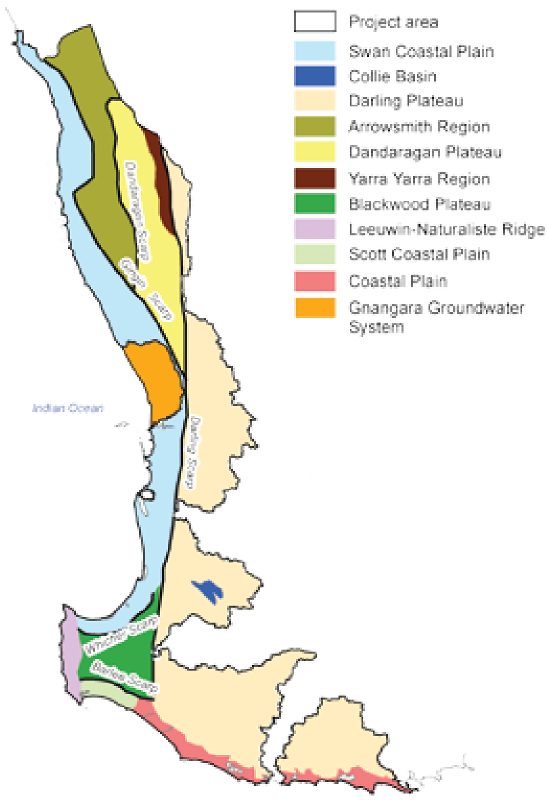
Led by CSIRO's Water for a Healthy Country Flagship, the South-West Western Australia Sustainable Yields Project is the most comprehensive assessment of the possible impacts of climate change and development on the water resources of south-west Western Australia. This region has been severely impacted by climate change having experienced a 10 to 15 percent decrease in mean annual rainfall since about 1975 which has resulted in runoff decreasing by about 50 percent. However, it is less well known how the reduction in rainfall influences groundwater recharge, groundwater levels, water dependent ecosystems and yields.

The project area covers about 62,500 km^2 and contains over 1.9 million people or 89 percent of the population of Western Australia. It is concentrated over the highest rainfall part of the south-west of the state. The project provides a nationally consistent assessment of regional water availability that is useful for water managers, environmental managers and water users when considering the possible future impacts of climate change and development on water resources and the environment.

The project estimated the likely water yield of all major fresh, marginal and brackish surface water and groundwater resources under the same climate and development scenarios as used in equivalent studies in the Murray-Darling Basin, northern Australia and Tasmania except that the historical climate data were of shorter length (1975 to 2007). In addition, the project also estimated future water demands and compared these with estimated future yields from all water resources under climate and development scenarios. Finally, the possible impact of climate change on water dependent ecosystems was assessed.



> Figure 1. Groundwater resources and surface water resources in the project area



> Figure 2. Main geomorphologic regions in the project area

Groundwater in the region

Groundwater is found in the sediments within the Perth and Collie groundwater basins and in the Albany Area (Bremer Basin). It is the main source of water used for domestic supplies, irrigation and industry in these areas (Figure 1). The Perth Basin consists of flat sandy coastal plains and uplifted less sandy plateaux (Figure 2). The Blackwood Plateau is vegetated but 56 percent of the Perth Basin has been cleared for dryland agriculture and another 3 percent is urban.

Rainfall in the region is highest in the south and along the Darling Scarp (Figure 3). Up to 80 percent of the annual rainfall occurs between May and October when temperatures are also at their lowest which makes it more effective in terms of producing runoff and recharge.

Key finding 1
Groundwater is the main water resource in the project area

Annual current groundwater use in the project area is about 850 gigalitres (GL) which is about 74 percent of all water used. The main uses are for drinking water supplies in Perth and surrounding towns; self-supply for the irrigation of public and private lawns, gardens and horticultural crops; and industrial, mining and commercial uses. Unrestricted demand projections for 2030 are between 970 and 1380 GL/year indicating that some industries and user groups might be required to increase water use efficiencies, find alternative sources or be limited by a lack of groundwater.

The highest groundwater use is concentrated in the Perth area which is an area of high population pressures and development as well as having a relatively high abundance of groundwater (Figure 4). There are three main aquifers that supply over half of the domestic water supply and about 85 percent of all metropolitan water used.

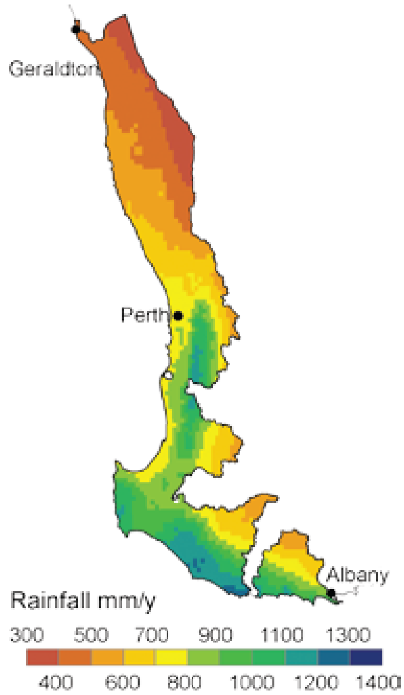
As surface water resources are progressively reduced by climate change, groundwater is increasingly the resource that is filling the gap and meeting new water demands. Therefore it is likely to be under increasing stress over time.

The drying climate and abstraction result in the loss of groundwater dependent ecosystems, especially wetlands where the watertable is within a few metres of the soil surface. The risk of environmental impacts is the main constraint to groundwater abstraction in most parts of the project area.

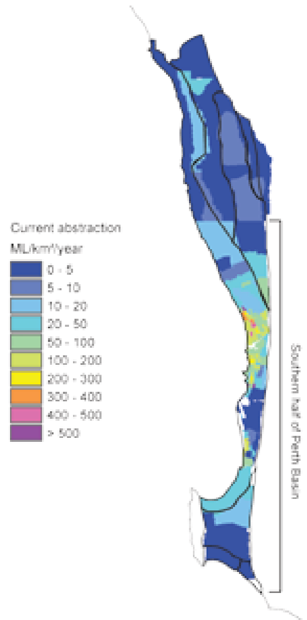
Key finding 2
A drier and hotter future climate is likely to affect groundwater levels differently depending on vegetation cover, soil type, depth to watertable and level of abstraction

The change in groundwater levels between 2008 and 2030 under future climate and development is shown in Figure 5 to be very variable. In this figure historical climate is based on the climate of the historical past (1975 to 2007), while the recent climate is based on the climate of the recent past (1997 to 2007). The median future climate is the median 2030 climate as projected by 15 global climate models and three global warming scenarios. The wet extreme and dry extreme future climate represent the wetter and drier bounds of the future climate. Future development combines the median future climate with abstraction of all available groundwater (up to full allocation limits).

Groundwater levels in 2030 projected by groundwater models for the southern half of the Perth Basin were compared with levels in 2008 (Figure 5). There is a correlation between landform and projected groundwater response.



> Figure 3. Mean annual historical rainfall



> Figure 4. Current groundwater abstractions in the Perth Basin

Key finding 3

The sandy coastal plain soils where perennial vegetation has been cleared are expected to be fairly resilient to all but extreme climate change and high abstraction. As their watertables fall, less groundwater discharges to drains and is evaporated

The Swan and Scott coastal plains show a relatively small response to projected climate change and development because groundwater levels are close to the soil surface over most of this area. Any decrease or increase in the groundwater recharge is partially compensated by a decrease or increase in the evapotranspiration and discharge to drains and ocean. Lower groundwater levels after summer allow more recharge to occur in winter. Until the winter recharge is insufficient to refill the aquifers, these areas will not experience significant falls in groundwater levels. However, a high proportion of abstraction is concentrated on these coastal plains and this is adding to the likelihood that levels will fall in future.

Areas within the Gnangara groundwater system north of Perth are expected to have falling groundwater levels where there is perennial vegetation overlying deep watertables. This is partially offset where pine plantations are expected to have been removed by 2030. However under the dry extreme future climate, groundwater levels may fall despite the removal of the pines.

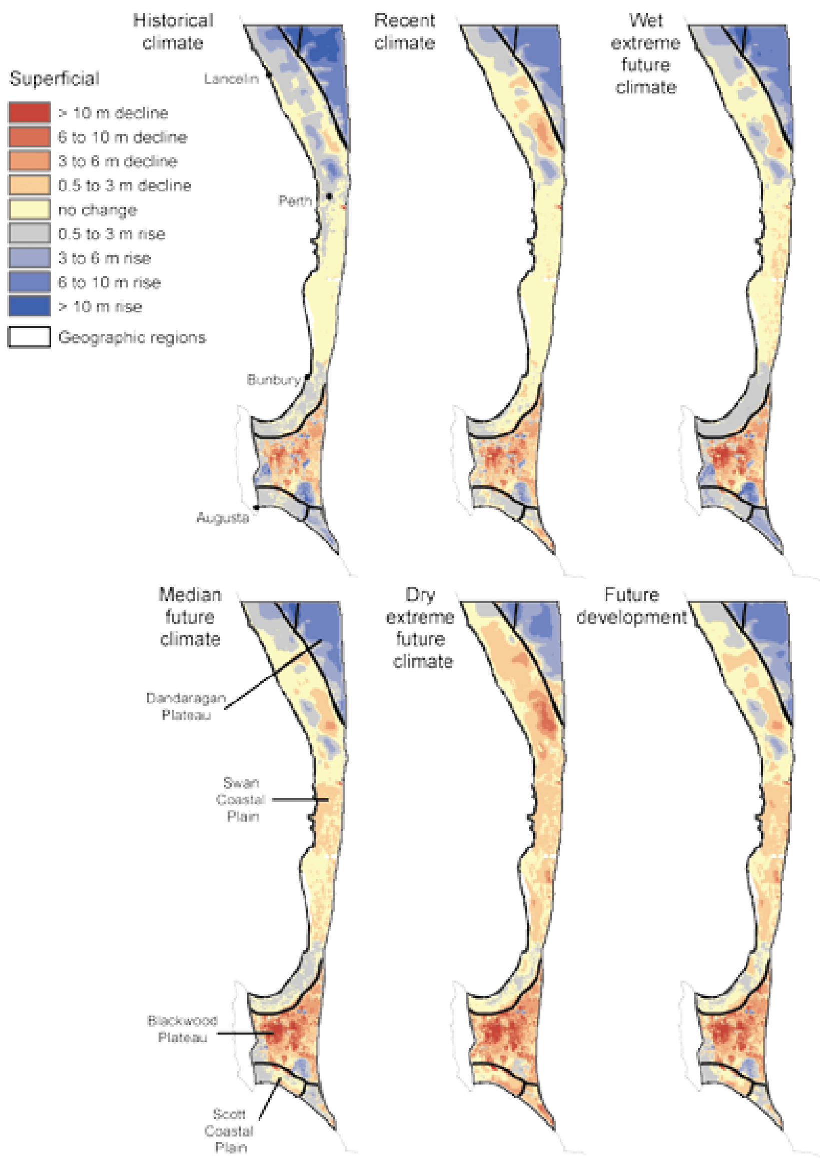
Key finding 4

Areas with perennial vegetation and clayey soils are expected to be most impacted by climate change

The Blackwood Plateau in the southern part of the Perth Basin is projected to have lower groundwater levels by 2030 and this is largely the result of the area being under perennial native vegetation and having clayey soils which limit recharge.

By contrast, the Dandaragan Plateau in the north-east has 50 percent less annual rainfall than the Blackwood Plateau but

> Sunrise over Lake Joondalup, Wanneroo, WA (CSIRO)



> Figure 5. Change in groundwater levels between 2008 and 2030 for the southern half of the Perth Basin under climate and development scenarios

is expected to have rising groundwater levels because it has been largely cleared of perennial vegetation and its soils are sandier.

Groundwater levels in areas of clayey soils associated with river deposits are also expected to be impacted by climate change although local perching of groundwater may persist.

Key finding 5

Interactions between surface water and groundwater at several locations may change in amount and type as a result of lower water levels in rivers and their surrounding aquifers

There are several areas in the Perth and Collie basins where rivers currently receive groundwater from adjacent aquifers. This enables the rivers to flow in summer and often lowers their salinity.

Determining changes to groundwater levels under future scenarios in the Collie groundwater basin is complex because of the nature of the multiple aquifers, abstraction for mining and power generation, the refilling of mine voids, interactions between groundwater and rivers, and diversions between water sources.

If groundwater levels fall faster than the level of water in the river channels then it is possible the river water will start to discharge into the aquifers. As surface water is often saltier than groundwater in those parts of the region where interactions are important, this may result in contamination of fresh groundwater near the rivers. More local information would need to be collected to evaluate whether this risk will be higher as a result of climate change.

Key finding 6

Groundwater models suitable for estimating the impact of climate change and development are required for the Northern Perth Basin and the Albany Area to extend the results of this project

It is expected that groundwater levels under dryland agriculture will continue to rise under all except the extreme dry future climate in the Northern Perth Basin provided abstraction levels are not in excess of the reduced rates of recharge. This area appears to have available groundwater at present but no groundwater model suitable for evaluating climate and abstraction scenarios exists in this area. Also, detailed information on the groundwater dependent ecosystems in this area is only being evaluated at present.

Groundwater in the Albany Area is fully allocated and utilised. Therefore any reduction in recharge is likely to result in a fall in groundwater levels unless abstraction is reduced. The estimates are very approximate and a groundwater model suitable for evaluating climate and development impacts needs to be developed for this important aquifer.

> Lake Cave near Margaret River, WA (CSIRO)

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More information on the Australian Government's *Water for the Future* plan can be found at www.environment.gov.au/water