Factsheet 3

Water yields and demands in south-west Western Australia

Water for a Healthy Country Flagship

National Research FLAGSHIPS
Water for a Healthy Country

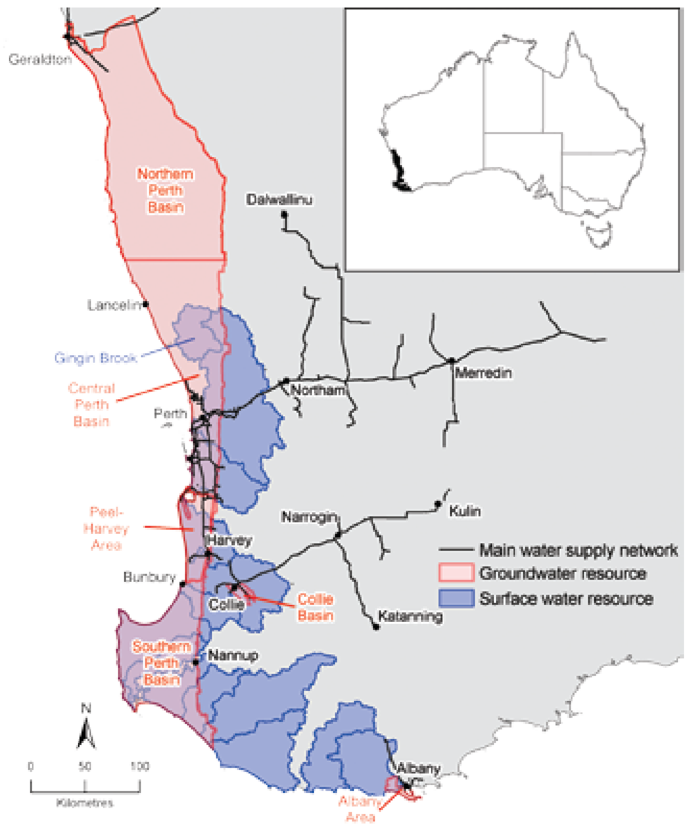
CSIRO

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 and has experienced a 10 to 15 percent decrease in annual rainfall since about 1975 which has resulted in a 50 percent reduction in runoff. However, it is less well known how the reduction in rainfall influences groundwater recharge, groundwater levels, water dependent ecosystems and yields.

The project area occupies 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 similar studies in the Murray-Darling Basin, northern Australia and Tasmania. The project has also estimated future water demands and compared these with likely future yields from all water resources under several scenarios. Finally the possible impact of climate on water dependent ecosystems was assessed at a regional scale.



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

Water in the region

Fresh runoff occurs in the short streams that drain west from the Darling Range that lies east of the Perth Basin (Figure 1). Larger streams that extend into the Wheatbelt are too saline for use. Reservoirs for metropolitan use are located in the northern part of the surface water region while large irrigation dams occur in the Harvey and Collie areas. Self-supply farm dams are common in the south-west and south.

Extensive groundwater resources are found in the Perth and Collie sedimentary basins, with less extensive resources in the west Bremer Basin near Albany. Groundwater is the main water source in these sedimentary basins, although surface water from Darling Range dams is used to irrigate coastal land west of Harvey and Collie. Wellfields provide Perth with more than half of its drinking water and groundwater supplies more than 85 percent of all metropolitan water use. On the coastal plains, self-supply groundwater is used for irrigating high-value horticultural crops around Perth, west of Harvey and south of Bunbury.

Key finding 1

Surface water yields may decrease by about 24 percent over the project area under the median future climate with greater reductions in the Donnelly and Warren basins than in the Harvey and Collie basins, all of which are important self-supply irrigation areas

Compared with current surface water yields, future yields are expected to fall by between 10 and 40 percent in all catchments under the median future climate and by between 20 and 60 percent under the dry extreme future climate (Figure 2). Of the main surface water irrigation catchments, yields in the central area around Harvey and Collie are expected to reduce by less than those in the south. The Gingin basin in the north and the Denmark basin in the south are also expected to experience significant reductions in yields.

Key finding 2

Runoff reduces by 20 to 30 percent under the median future climate and by 40 to 50 percent under the dry extreme future climate which would affect water dependent ecosystems, especially those that require high flows

Surface water modelling has indicated that, under the median future climate, runoff amounts in both winter and summer may decrease by between 20 and 30 percent compared with the historical period (1975 to 2007). The decrease may be as high as 40 to 50 percent under the dry extreme future climate.

Over 80 percent of all runoff occurs during the dam 'winterfill period' of 15 June to 15 October. Modelling indicates that high flow events may be most affected by a hotter drier climate. These events help scour and form the river channel as well as providing water for the floodplain and carbon and nutrients for downstream parts of the riverine environment.

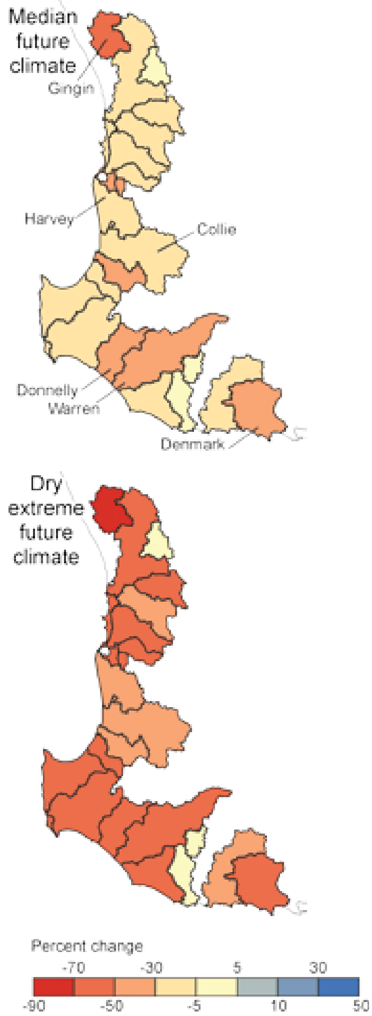
Reductions in runoff are projected to be high in the southern catchments of Kent and Denmark, and in the northernmost catchment of Gingin Brook. The reduction in runoff in these rivers during both the winter and the rest of the year under the median future climate is 40 to 65 percent compared with the historical climate, while it is between 20 and 30 percent for other rivers. Perennial flows are likely to persist in the Harvey and Collie basins, including on the coastal plain where groundwater inflow and return flow from irrigation provides reliable summer water.

Key finding 3

About 20 percent of the area where groundwater dependent ecosystems may occur could experience high or severe stress under the dry extreme future climate in the southern half of the Perth Basin

Currently the depth to watertable is within 3 m of the soil surface under about 22 percent of this area, between 3 and 6 m under about 14 percent, and between 6 and 10 m under about 10 percent. Each of these depths supports vegetation that is adapted to accessing groundwater. If groundwater levels fall too rapidly or too deeply, the vegetation composition will become stressed which may impact significantly on groundwater dependent ecosystems.

The degree of stress that vegetation types may experience because of changes in groundwater levels has been estimated using groundwater models for the southern half of the Perth Basin, and area of about 20,000 km^2. Under the median future climate about 40 percent may be impacted to some extent. Slightly less that half of this area may be severely impacted under the dry extreme future climate. Many areas with high watertables have been cleared of native vegetation which has already impacted ecological functions of groundwater dependent ecosystems, so some of these falls in groundwater levels may not affect groundwater dependent ecosystems in these areas.



> Figure 2. Changes in surface water yields under the median and dry extreme future climate

Key finding 4

Groundwater yields may decrease by between 2 percent under the median future climate and 7 percent under the dry extreme future climate. Groundwater is less impacted by rainfall reduction than streamflow because reductions in rainfall may be offset by decreases in groundwater flows to drains and evapotranspiration in areas with a high watertable

Groundwater yields are expected to decline much less than surface water yields do, with the greatest decreases being in the Blackwood groundwater area where native vegetation overlies a clayey soil type and the Collie groundwater area (Figure 3). The Gnangara area north of Perth is also likely to be significantly affected under the dry extreme future climate. The aquifer in the Albany Area may also be impacted but this was not modelled so the reliability of this estimate is low. All of the aquifers expected to be impacted by a drier climate are overlain by perennial vegetation.

Key finding 5

Demand for water is expected to grow by about 35 percent by 2030. Irrigation uses only about 35 percent of all water use, is mainly self-supplied, and is mainly used on high-value horticultural crops

Population and economic growth is very strong in south-west Western Australia and demand for water is expected to continue to grow significantly. The main demands for surface water are expected to occur in the existing irrigation areas. The greatest increase in demand for groundwater is likely in Perth and surrounding areas where there is competition between public and private water users.

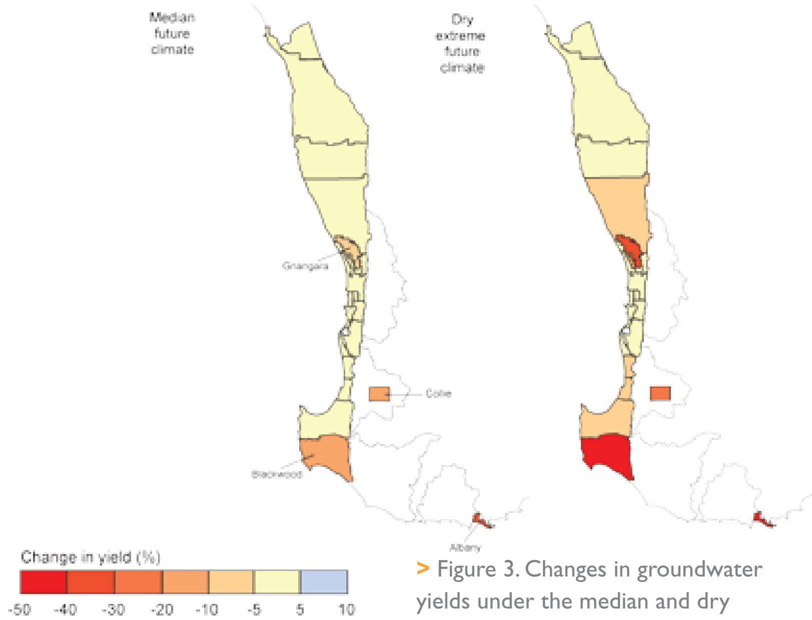
Future water demand is estimated to increase by about 35 percent by 2030 but this could range between 10 and 57 percent. Because almost all water used for irrigation is used on high-value horticultural crops, there is less incentive to trade water from low- to high-value users. In addition most water is either self-supplied groundwater or small farm dams which limits the ability to transfer water between properties unlike in major riverine irrigation schemes which are able to transfer water using interconnecting channels.

Key finding 6

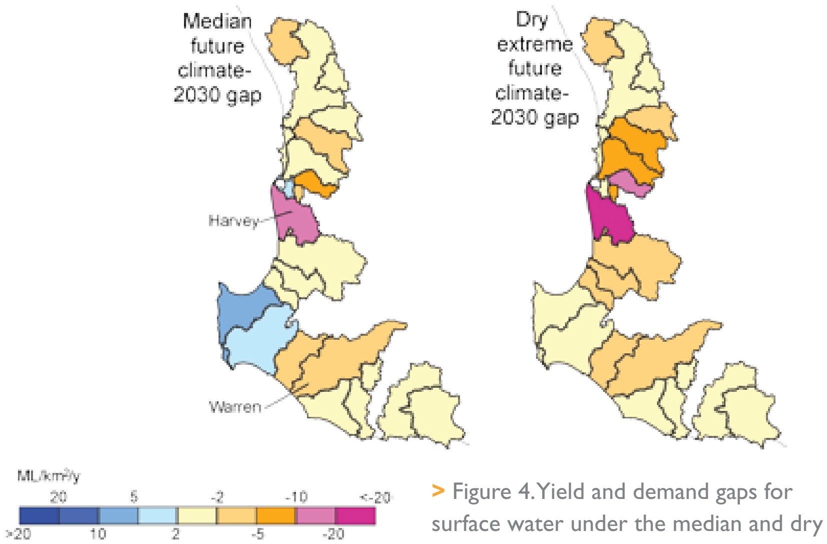
The greatest gaps between future water demands and water yields are expected to develop in the Harvey and Warren surface water catchments and in the groundwater areas around Perth and Albany

When estimated future yields and demands are compared, there are several areas where deficits may occur in future.

> Irrigation at a dairy farm near Harvey, WA (Robert Garvey)



> Figure 3. Changes in groundwater yields under the median and dry extreme future climate



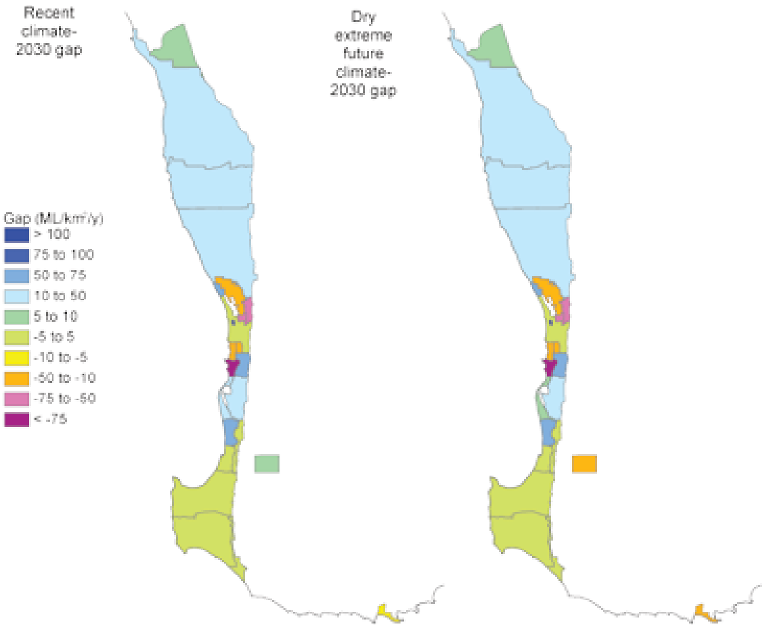
> Figure 4. Yield and demand gaps for surface water under the median and dry extreme future climate

Surface water deficits are greatest in the Harvey basin assuming that demand for irrigation will grow and water yields will decline (Figure 4). Other irrigation areas with potential gaps include the Donnelly and Warren basins. The basins that discharge water into the Integrated Water Supply Scheme reservoirs are also expected to develop a deficit, especially under the dry extreme future climate, because of reduced inflows and increased demands for water from the scheme.

For groundwater, the greatest deficits are likely to result from large increases in demand for groundwater in the Perth area at the same time that groundwater levels in the Gnangara groundwater management system are estimated to continue to decline, especially under the dry extreme future climate (Figure 5). The Collie sedimentary basin is also likely to develop a deficit if continued demand for water by industry is accompanied by declines in groundwater levels in this largely vegetated catchment. Northern Perth Basin aquifers are shown to retain surpluses of water but demands by new industries for water are hard to predict so these surpluses may be used before 2030.

These water yield and demand estimates are subject to a number of assumptions about the future climate, runoff, recharge, land uses and demand growth. The estimates are approximate only and are valid within the constraints of the models assumptions and projections. They are therefore only a guide to what may occur by 2030.

> Perry Lakes, WA (CSIRO)



> Figure 5. Yield and demand gaps for groundwater under the median and dry extreme future climate. Positive gaps are surpluses and negative gaps are deficits

For further information:

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