

Management of a Karoo fractured-rock aquifer system – Kalkveld Water User Association (WUA)

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Abstract

Due to large-scale development of groundwater resources for irrigation purposes the Kalkveld area has been identified by DWAF as an area where a water user association (WUA) should be established in order to achieve better management of the resource. The area represents typical Karoo type fractured-rock aquifers, which consist mainly of sandstone, mudstone, shale and siltstone. The majority of boreholes drilled in Karoo formations have very low immediate yields (<1 l/s). However, large volumes of groundwater are pumped from boreholes in the Kalkveld area for irrigation of commercial crops. Thus, these aquifers have a more complex and unpredictable behaviour than normally described in the literature.

Groundwater management units have been delineated based on: similar hydraulic properties; recharge characteristics; land use; geology (including the distribution of surface calcrete deposits); rainfall; and hydrochemistry. A numerical flow model was constructed for the area to evaluate the impact of increased abstraction on the groundwater resources as well as to evaluate the response of the delineated water management units/areas. To facilitate long-term management of the groundwater resources a user-friendly prediction and management tool was developed. The tool together with the recommended monitoring and management measures should enable DWAF and the WUA to manage the groundwater resource in a sustainable manner.

Keywords: groundwater, management tool, Karoo, fractured aquifer

Background

Due to large-scale development of groundwater resources for irrigation purposes the Kalkveld area has been identified by DWAF as an area where a water user association (WUA) should be established in order to achieve better management of the resource. This process was initiated in 1999 for the Kalkveld area, which consists of the quaternary catchments C52G, C52H, C52J and C52K and includes the irrigation development areas around Bainsvlei, De Brug and Petrusburg (see Fig. 1). The Kalkveld area falls within Modder and Riet Rivers sub-catchments within the Upper Orange Water Management (UOWMA) area. The four quaternary catchments were grouped together because of similar geology (and geohydrology) and agricultural activities. For administrative management purposes the area was divided into a Petrusburg sub-area (C52K) and a Bainsvlei sub-area (C52 G, H and J).

The main aim of this project, sponsored by DWAF, was to establish a management and monitoring plan for implementation by the Kalkveld WUA, such that the long-term sustainable use of the groundwater resource would be ensured (Usher et al., 2004).

Description of the study area

Climate

The study area has a fairly arid climate with very hot summers and cool to cold winters, and predominantly summer rainfall. Maximum temperatures vary from 31°C in summer to -2°C in winter. Average yearly rainfall for the Bloemfontein weather

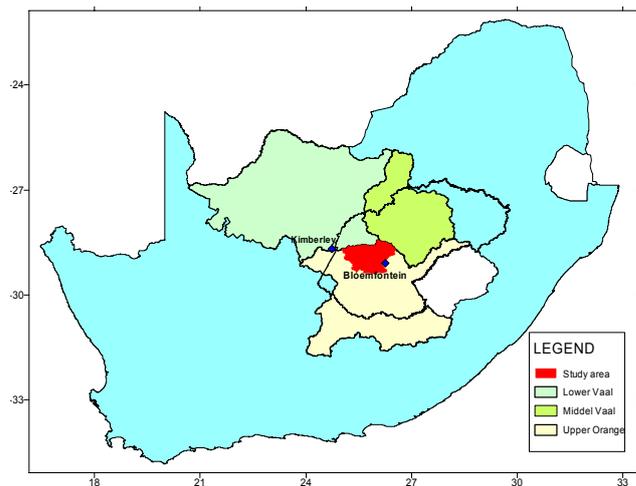


Figure 1

Locality of the study area within the water management areas

station is 559 mm. The study area covers a large geographical area (10 700 km²) and rainfall data were obtained from three other weather stations, namely: Petrusburg, Dealesville and Krugersdrift Dam. As part of the monitoring programme in the Petrusburg sub-area, three additional rainfall data-loggers were installed in proximity of the town. A comparison of all rainfall data revealed that there is great spatial variability in rainfall across the area. The highest average annual rainfall is recorded at Bloemfontein (560 mm/a) and the lowest annual rainfall at Petrusburg (390 mm/a).

Topography and hydrology

Much of the study area has generally flat to slightly rolling topography, broken only by drainage lines and the occasional

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