

A forced-gradient tracer test on the Hansrivier Dyke: Beaufort West, South Africa

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Abstract

A field-scale pumping test and uranin tracer test was carried out at Hansrivier Farm in Beaufort West to determine the hydraulic properties of the Hansrivier Dyke/Karoo sedimentary rock aquifer. Analysis of borehole images and pumping test results reveal that the fractured-rock aquifer is highly transmissive due to the influence of the Hansrivier Dyke; however its influence is concentrated on extremely limited conductive zones. Results of the tracer test show that chemical transport can take place via multiple flow paths with differing hydraulic properties, such as fracture aperture, connectivity and permeability. Furthermore, diffusion of a tracer into fractures and rock matrix has a universal retardatory travel time due to the various flow paths. In order to interpret the tracer test data, the Single Fissure Dispersion Model (SFDM) was used for inverse modelling of the breakthrough curves. The resulting effective diffusion coefficients are comparable with laboratory-derived values, and are therefore considered to be representative of the investigated part of the aquifer.

Keywords: Beaufort West, hydrogeology, fractured rock aquifer, tracer test, pumping test, Single Fissure Dispersion Model