

USING DC ELECTRICAL RESISTIVITY TOMOGRAPHY TO QUANTIFY PREFERENTIAL FLOW IN FRACTURED ROCK ENVIRONMENTS

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Abstract

Freshwater availability is being threatened in arid and semi arid areas. As a result of this and the over exploitation of surface freshwater sources, groundwater resources are increasingly receiving more attention as an alternative source of water.

Assessment of groundwater recharge is an essential part in determining the sustainable yield of aquifers in arid and semi-arid regions. Groundwater recharge estimations have received a great deal of attention especially in arid and semi-arid regions. This is due to the complexity associated with recharge estimations. There is particularly a large degree of uncertainty associated with the quantification of evapotranspiration and preferential flow and its effects on recharge estimation.

This investigation aims to identify preferential flow paths in fractured rock environments. Time-lapse Electrical Resistivity Tomography (TLERT, Lund Imaging System) is regarded as a suitable method for identifying preferential water flow. This is a geophysical method which is based on the distribution of the subsurface resistivity differences. By tracking the changes in resistivity values through time, one can identify the infiltration rate of preferential flow and matrix flow. It will also allow for the differentiation between a fast and slow flowing conduit in the area.

The results obtained from the inversion of the resistivity distribution (2D resistivity distribution images of the subsurface) indicate that there are zones of changes in the subsurface electrical resistivity. These are interpreted to be associated with preferential flow paths and exhibit a vertical “fingering” like pattern.

The results of this investigation suggest that preferential flow may have a large effect, in terms of volume and temporal distribution, on groundwater recharge. Results also suggest that TLERT is a suitable method for identifying and potentially quantifying preferential flow.

Keywords: Recharge, preferential flow, Time lapse resistivity, 2D Electrical Resistivity Tomography, infiltration rate