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In-situ characterisation of soil hydraulic attributes for the individual layers of a multilayered soil column

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Unfortunately traditional soil resource evaluation has generally not measured soil hydraulic attributes, and the lack of good quality data on these attributes is seen as a major limitation to the management of several agricultural production and environmental quality issues. Hydraulic attributes have not been routinely measured owing to their very high variability and the intensive sampling needed to reduce uncertainty to acceptable levels. However, the extreme variability of soil hydraulic conductivity may be partly an artefact of the way it has been measured, where the sample volumes used have been too small to adequately integrate the range of spatially distributed transport processes taking place. Sample volume is particularly important for measuring hydraulic conductivity at matric potentials between -10 to 0 kPa, when macropores dominate water transmission.

In this research 50 x 70 cm deep lysimeters have been used to study the dynamics of water flow in the soil pore network, at matric potentials between -10 to 0 kPa. The lysimeters contain an undisturbed silt loam soil column with three distinct layers. The soil type is typical of extensive areas in NZ's South Island, and is used mainly for intensive dairy grazing. Each column is intensively monitored at four depths, coinciding with the boundaries of each soil layer. At each depth, water dynamics in the soil pore network was continuously monitored using 7 tensiometers and 1 TDR sensor. The sensors were monitored every minute by a datalogger that also monitors infiltration and drainage rates, as well as soil temperature, for experiments of up to three months duration. Behaviour of the pore network has been studied under a range of infiltration conditions including: a) controlled surface suctions between 0 to 1.5 kPa using tension

infiltrometers, and b) flux-controlled irrigation and rainfall scenarios using a rainfall simulator.

An example of the use of this experimental setup will be presented. The $\theta - \Psi - K$ characteristics between -10 to 0 kPa have been derived for each individual soil layer, located in-situ within the intact soil column. The accuracy and precision of the $\theta - \Psi - K$ characteristics have also been estimated using the known measurement error of the sensors, plus the measured spatial and temporal variability in the measurements.