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Dynamic analysis of groundwater discharge and partial-area contribution to Pukemanga Stream, New Zealand

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Abstract. The proportion and origin of groundwater contribution to streamflow from agricultural catchments is relevant to estimation of the effects of nitrate leached from the soil on the quality of surface waters. This study addresses the partitioning of streamflow contributions from near-surface runoff and from groundwater, each with different contributing land area, on a steep pastoral hillslope in a humid climate. The 3 ha headwater catchment of the perennial Pukemanga Stream, in the North Island of New Zealand, was instrumented for continuous observation of climatic data, streamflow and groundwater level. The dynamics of groundwater levels and groundwater contribution to streamflow were analysed by means of a one-parameter, eigenvalue-eigenfunction description of a 1-D aquifer model. Model results for seven years of daily data predict that 36– 44% of the topographical catchment contributes groundwater to the stream. The remaining groundwater generated within the catchment contributes to streamflow outside the catchment. Groundwater was calculated to be 58– 83% of observed annual streamflow from the topographical catchment. When the smaller groundwater catchment is taken into account, the groundwater contribution to streamflow is 78– 93% on a unit area basis. Concurrent hourly data for streamflow and groundwater levels at two sites indicate the dynamic behaviour of a local groundwater system. Groundwater flow dynamics that support the perennial nature of this headwater stream are consistent with the size of the groundwater body, porosity of the subsurface material, and hydraulic conductivity derived from partitioning of streamflow contributions.

◻ Final Revised Paper (PDF, 1472 KB)   ◻ Discussion Paper (HESSD)

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