

Interactive comment on “Residence times and mixing of water in river banks: implications for recharge and groundwater – surface water exchange” by N. P. Unland et al.

Anonymous Referee #2

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Review Paper Unland and others General comments

The core of the paper includes a series of ^3H , ^{14}C and geochemical data for estimating residence times and possible mixing processes of groundwaters of different ages. The paper addresses an interesting topic of on-going research in the domain of river-groundwater interactions. It is well written and most of the figures are carefully prepared. However, after reading the paper I noticed a lack of a good concept to relate geochemical data to field experiments to find out more about river-groundwater interactions and different regional-scale flow-systems. In particular, there is a lack of a clear hypothesis for the structure of the regional scale aquifer system (permeability

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distributions) and the regional scale hydraulic potentials. The model of interaction of different aquifers presented in Fig. 12 should be discussed taking the density difference of the groundwater in the different aquifers into account. The postulation of an upward leakage of groundwater from an underlying aquifer should be based on regional scale modelling of mixing of groundwaters with changing physical properties. Without such data and a discussion (including a chapter on the hydraulics of regional scale flow systems), the only clear statement is that River Tambo represents a river with only a small amount of water loss or infiltration to the adjacent shallow groundwater system, which is actually not a surprise. The dynamics of the deeper groundwaters have to be evaluated at the regional scale (hierarchy of flow systems at different scales).

Specific comments: I propose to extend the introduction by including the role of regional scale and local scale flow systems (e.g. based on approaches presented by J. Toth) Tóth J (1995) Hydraulic continuity in large sedimentary basins. *Hydrogeology J* 3 (4):4-16. doi:10.1007/s100400050250 or Tóth J (2009) *Gravitational Systems of Groundwater Flow, Theory, Evaluation, Utilization*. Cambridge The discussion should include a chapter covering the possible role of groundwater mixing, physical properties of deeper groundwater, age distributions in systems with different scale groundwater flow systems.

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