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Hydrology and Earth System Sciences
Discussions

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.

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Anonymous Reviewer #2

We thank the reviewer for their comments on the manuscript.

The main comment of this reviewer was that the paper did not discuss local and regional flow systems. While it would be ideal to integrate the groundwater-surface water system in the Tambo River catchment to a full description of the regional hydrogeology, in practice this is not possible. Our aims in this study were to examine specifically the groundwater-river interaction and the bore network that was constructed was done so

for this purpose. We know considerably less about the deeper regional flow systems than we about the local ones that interact with the river. There are few bores in this part of the Gippsland Basin and while the stratigraphy of the basin has been studied (e.g., Birch, 2003), there are sparse details on the specifics of the hydrogeology (aside from the measurements that we report in this paper, there are no measurements of hydraulic conductivity nor regional scale-age distributions in the Tambo Catchment).

We have added some more details of the regional hydrogeology (Section 1.1). While the deep regional groundwater is artesian, there is little evidence that this regional groundwater generally discharges into the middle reaches of the Tambo River. The deep groundwater has a higher salinity, is generally anoxic, and locally has higher temperatures than the shallow groundwater. There are a few springs fed by this deeper regional groundwater around Lake King; however, these are rare elsewhere. The majority of groundwater that discharges into the middle reaches of the Tambo River catchment is most likely derived from the shallower aquifer systems (Southern Rural Water, 2013). This is consistent with the presence of clays in the Gippsland Basin sediments that produce a compartmentalised aquifer system. At Tambo Upper the groundwater in the deeper (24 m) bore is artesian and anoxic and may be derived from the regional groundwater system (although this is not easy to prove). In any case, there is not much of a density contrast between the different groundwaters that would influence mixing. The "deep" groundwater has a TDS of up to 2000 mg/L, which at 20 C would have a density of 999.8 kg/m3 whereas the river water which infiltrates the hanks with a TDS of 60 mg/l would have a density of 998.3 kg/m3.

While the papers of Toth are clearly valuable in conceptualising groundwater flow systems, there seems little value in a summary of that work (which is well known generally) in this paper; we have added the reference to Toth 1963 to explain the type of flow system that we are dealing with as this will be familiar to most readers. Also to reduce confusion we have been more specific as to our use of the term "deep" noting that at most sites we could be dealing with a localised system that has shallower and slightly

deeper parts to it rather than mixing between local and regional systems.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 1651, 2014.