

Interactive comment on “Consequences and mitigation of saltwater intrusion induced by short-circuiting during aquifer storage and recovery (ASR) in a coastal subsurface” by Koen Gerardus Zuurbier and Pieter Jan Stuyfzand

Anonymous Referee #2

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General comments This manuscript describes solute transport modelling to evaluate the processes that contribute to salinisation of recovered water from an ASR well, along with possible mitigation strategies. Notably, the recovery efficiency of this ASR system is constrained by an extremely tight limit for chloride concentration in the recovered water of 50 mg/L. The content of this manuscript is suitable for publication in HESS, however considerable revision is required to provide the reader with adequate understanding of the site and the evaluation. It should be noted that this ASR system is not typical of ASR operations internationally.

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General editing is required to improve the fluency and precision of the language used in the manuscript; particular attention should be paid to improved use of technical descriptions (some examples are outlined in the specific comments below). While this paper stemmed from an unplanned activity (high salinity), the paper should be presented in an organised framework; the current version reads as a somewhat haphazard approach.

Please refer to the specific comments outlined below.

Specific comments

Page Line Comment 1 14 Suggest insert 'confined' into description of aquifers. 1 14 And elsewhere. Suggest replacing 'saltwater' with 'brackish'. 1 16 Explain 'properly separated' – the role of the confining layer should be made clear. 1 17 Suggest replacing SEAWAT with ' variable-density solute transport modelling (SEAWAT)'. 1 22 MPPW has not been defined. 1 28-30 Explain the role of the confining layer and why confined aquifers are targeted for storage. Introduce impact of inter-aquifer leakage. 1 28-30 First sentence needs revision to ensure it is relevant to content of manuscript – stormwater infiltration is also freshwater storage. Perhaps only include uses of confined aquifer for clarity. ASR is one managed aquifer recharge technique suited to storing fresh water in brackish aquifers.

2 1 Over citation of Bonte – revise. 2 Introduction Previous research on inter-aquifer leakage and modelling of recovery efficiency has not been adequately reviewed. 2 5 Of what wells? All wells globally? 2 7 Soil fractures should be described as fractures (aquifer is not soil zone). 2 18 Is it necessary to cite 3 Zuurbier papers? Expand review of literature as many others have stored freshwater in confined aquifer, a necessary reference is R.D.G. Pyne's Aquifer Storage Recovery: A Guide to Groundwater Recharge through Wells. 3 3 Suspect error in number, 270,000 not 270,0000. 3 Method An overview of the hydrogeology is required. Suggesting moving section 3.1 to methods. 3 Method A summary of ASR cycles is required. Suggest adding a table with dates,

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injection and recovery volumes for each ASR well. 3 3-13 The reader needs to understand all characteristics of the site, such as aquifer targeted for ASR and for ATES, EC, Cl, SO4 concentrations for each aquifer and for roof runoff. Detail in text is not adequate. 3 8 Need information about hydrogeology before describing the need for MPPW. Screen intervals for all wells should be given in text or table. Distance from ASR wells should be given for ATES and monitoring wells. 3 8 Give distance of ATES wells from ASR well, clearly identify new and old, suggest giving unique identifier (K3-a and K3-b) 3 13 Give the chloride concentrations for each end-member and quantify the amount of mixing <14 1 The monitoring wells shown in Figure 2 have not been mentioned in the text. 4 5 Give sampling frequency. 4 6 Were stable field parameters also used to indicate adequate purging? 4 16 Suggest replacing 'electronic recording' with 'continuous monitoring'. 4 21 Suggest deleting 'In'. 4 21 Give some explanation of model choice. 4 21 Sentence requires editing, move 'to' to after Chiang 2012. 5 1 Replace 'te' with 'the'. 5 8 Justify choice of end-member concentrations; text should be more specific rather than general description. 5 Overall The description of the modelling method could be improved by stating a set of clear aims for the modelling. 6 Table 1 Suggest removing VANI heading. Suggest adding more detail to show properties of each layer. 7 Table 2 Suggest replace 'infiltration' with 'injection'. 7 26 'close by' is vague, be specific. 7 Section 3.1 As mentioned previously, suggest moving to methods. 9 2 As mentioned previously, give summary of ASR cycles in Table. 9 Figure 5 Discussion on mixing is based on Cl, but you are showing EC in Figure. Suggest plotting EC, Cl and SO4. 9 Figure 5 Suspect part a y-axis should be volume not EC. 9 2-8 Give reader more detail, explain that mixing would be expected on fringe of injected bubble and therefore become evident toward end of recovery cycle. 9 2-8 Explain the freshening process in monitoring wells before describing salinisation during recovery. 10 10 Were any other tracers used to identify leakage? Age tracers? 17 Table 4 Recovery of 10018 11 Have the authors considered the economic feasibility of such a scheme? Interception of a significant volume of water must lead to significant pumping costs. What is the driver for such a scheme? 23 16 Bonte et al 2014 not cited References Some editing required,

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script errors evident for CO₂.

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