

Understanding and quantifying focused, indirect groundwater recharge from ephemeral streams using water table fluctuations

Cuthbert, Mark

DOI:

[10.1002/2015WR017503](https://doi.org/10.1002/2015WR017503)

License:

Creative Commons: Attribution (CC BY)

Document Version

Peer reviewed version

Citation for published version (Harvard):

Cuthbert, M 2016, 'Understanding and quantifying focused, indirect groundwater recharge from ephemeral streams using water table fluctuations', *Water Resources Research*. <https://doi.org/10.1002/2015WR017503>

[Link to publication on Research at Birmingham portal](#)

Publisher Rights Statement:

Eligibility for repository: Checked on 11/3/2016

General rights

Unless a licence is specified above, all rights (including copyright and moral rights) in this document are retained by the authors and/or the copyright holders. The express permission of the copyright holder must be obtained for any use of this material other than for purposes permitted by law.

- Users may freely distribute the URL that is used to identify this publication.
- Users may download and/or print one copy of the publication from the University of Birmingham research portal for the purpose of private study or non-commercial research.
- User may use extracts from the document in line with the concept of 'fair dealing' under the Copyright, Designs and Patents Act 1988 (?)
- Users may not further distribute the material nor use it for the purposes of commercial gain.

Where a licence is displayed above, please note the terms and conditions of the licence govern your use of this document.

When citing, please reference the published version.

Take down policy

While the University of Birmingham exercises care and attention in making items available there are rare occasions when an item has been uploaded in error or has been deemed to be commercially or otherwise sensitive.

If you believe that this is the case for this document, please contact UBIRA@lists.bham.ac.uk providing details and we will remove access to the work immediately and investigate.

Understanding and quantifying focused, indirect, groundwater recharge from ephemeral streams using water table fluctuations

M. O. Cuthbert^{*1,2}, R. I. Acworth², M. S. Andersen², J. Larsen^{2,3}, A. McCallum⁴, G. C. Rau², J. H. Tellam¹

1. School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston, B15 2TT, UK
2. Connected Waters Initiative Research Centre, UNSW Australia, 110 King St, Manly Vale, NSW 2093 Australia
3. School of Geography, Planning, and Environmental Management, University of Queensland, Brisbane, Australia
4. Affiliated with Connected Waters Initiative Research Centre, UNSW Australia, 110 King St, Manly Vale, NSW 2093 Australia.

*Corresponding author: m.cuthbert@bham.ac.uk

Contents of this file

Table S1
Figure S1
Figure S2

Introduction

Table S1 contains construction details of piezometers from which data was collected and analysed in this paper.

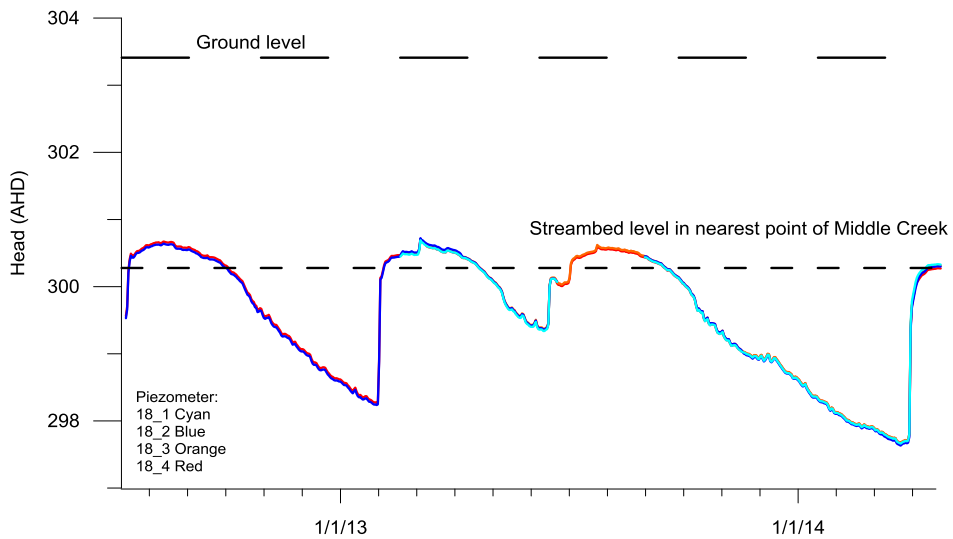
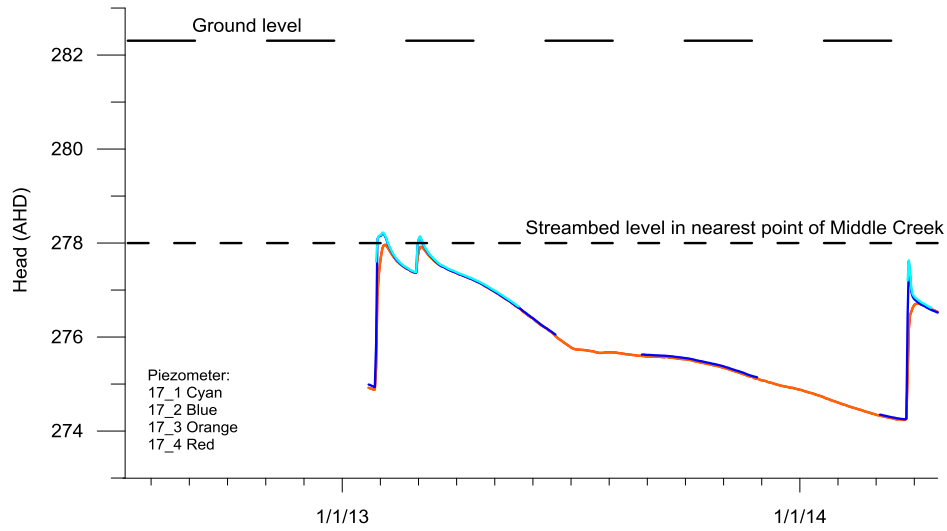
Figure S1 contains the groundwater hydrographs from Figure 7, but plotted in groups to allow more detail to be seen including their relationship to ground level and streambed levels.

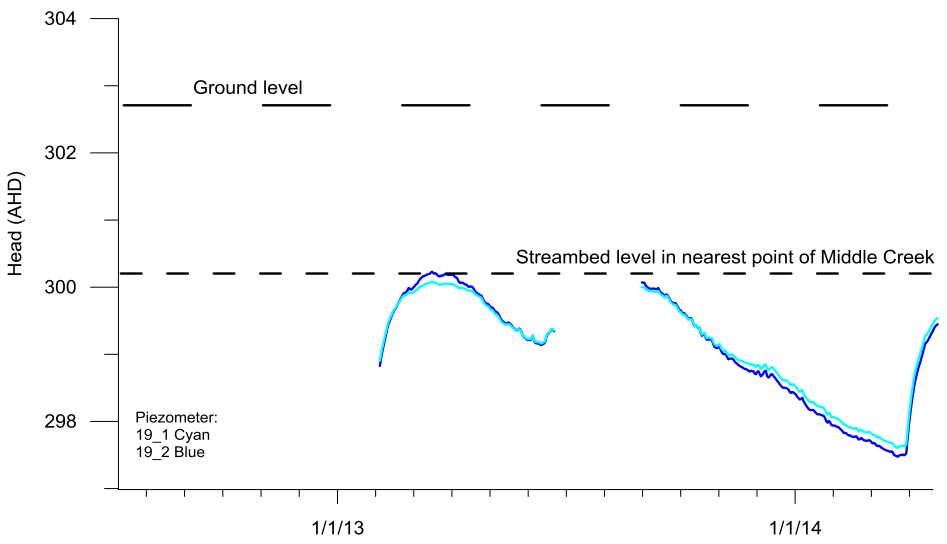
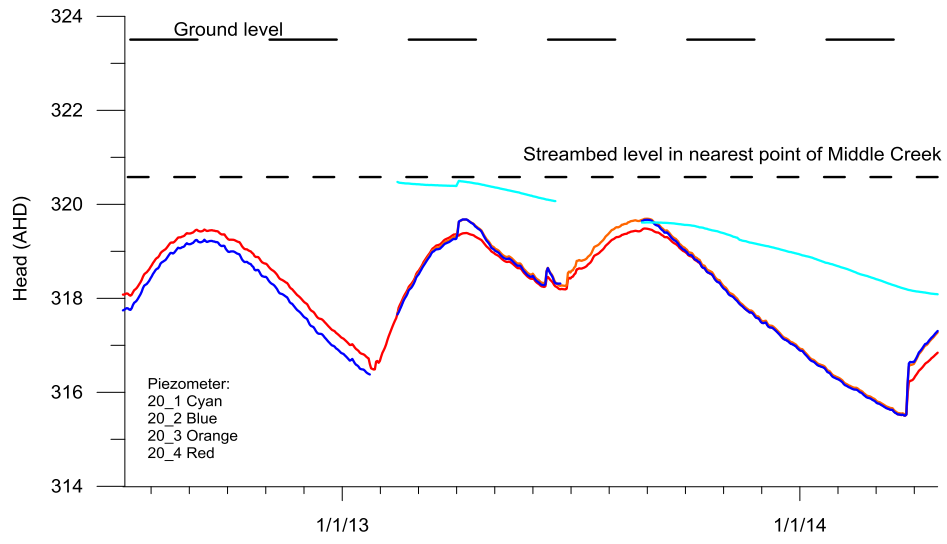
Figure S2 contains data from a pumping test which is used to support the analysis given in the paper. A description of the test is given below the figure.

Piezometer	Easting	Northing	Datum elevation (m AHD)	Screen interval (m below datum)	Screen length, radius (m)	Height of datum above ground level (m)
BH17_1	225275	6623934	283.11	6.93-7.11	0.175, 0.015	0.97
BH17_2	225275	6623934	283.11	9.49-10.49	1.000, 0.025	0.97
BH17_3	225275	6623934	283.11	26.51-26.69	0.175, 0.015	0.97
BH17_4	225275	6623934	283.11	35.47-36.47	1.000, 0.025	0.97
BH18_1	227599	6626170	304.28	9.27-9.45	0.175, 0.015	1.01
BH18_2	227599	6626170	304.28	10.96-11.96	1.000, 0.025	1.01
BH18_3	227599	6626170	304.28	17.19-17.37	0.175, 0.015	1.01
BH18_4	227599	6626170	304.28	21.78-22.78	1.000, 0.025	1.01
BH19_1	227555	6626196	303.76	8.83-9.83	1.000, 0.025	0.94
BH19_2	227555	6626196	303.76	22.37-23.37	1.000, 0.025	0.94
BH20_1	228718	6627763	324.63	9.27-9.45	0.175, 0.015	1.16
BH20_2	228718	6627763	324.63	9.21-10.21	1.000, 0.025	1.16
BH20_3	228718	6627763	324.63	29.45-29.63	0.175, 0.015	1.16
BH20_4	228718	6627763	324.63	39.79-40.79	1.000, 0.025	1.16
BH21_1	228683	6627765	324.12	5.48-5.66	1.075, 0.015	1.04
BH21_2	228683	6627765	324.12	12.28-13.28	1.000, 0.025	1.04
BH22_1	227619	6627915	312.96	8.74-8.92	0.175, 0.015	0.93
BH22_2	227619	6627915	312.96	8.36-9.36	1.000, 0.025	0.93
BH22_3	227619	6627915	312.96	29.71-29.89	0.175, 0.015	0.93
BH22_4	227619	6627915	312.96	32.73-33.73	1.000, 0.025	0.93

Table S1. Piezometer construction details

Figure S1. Groundwater hydrographs for each borehole (BH17-BH22) with respect to ground level and streambed level





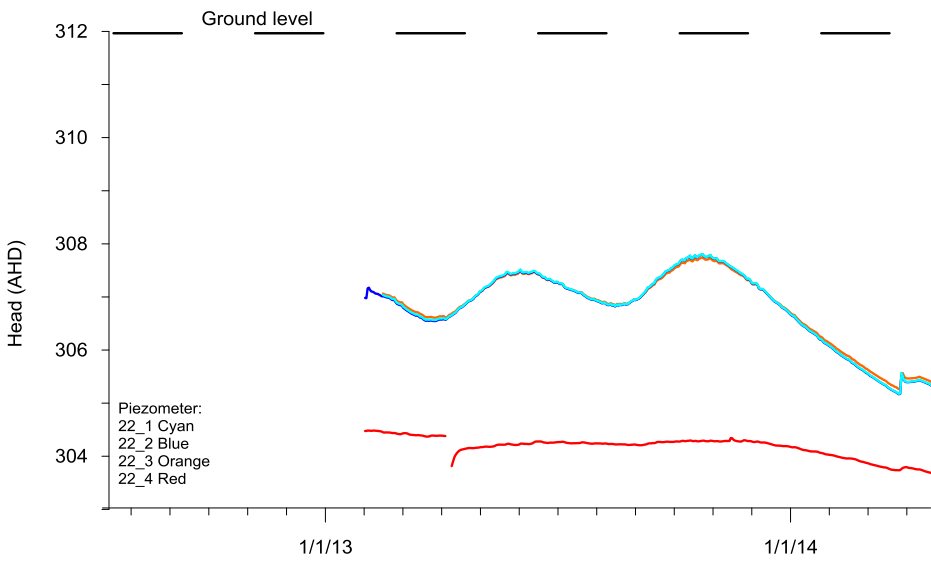
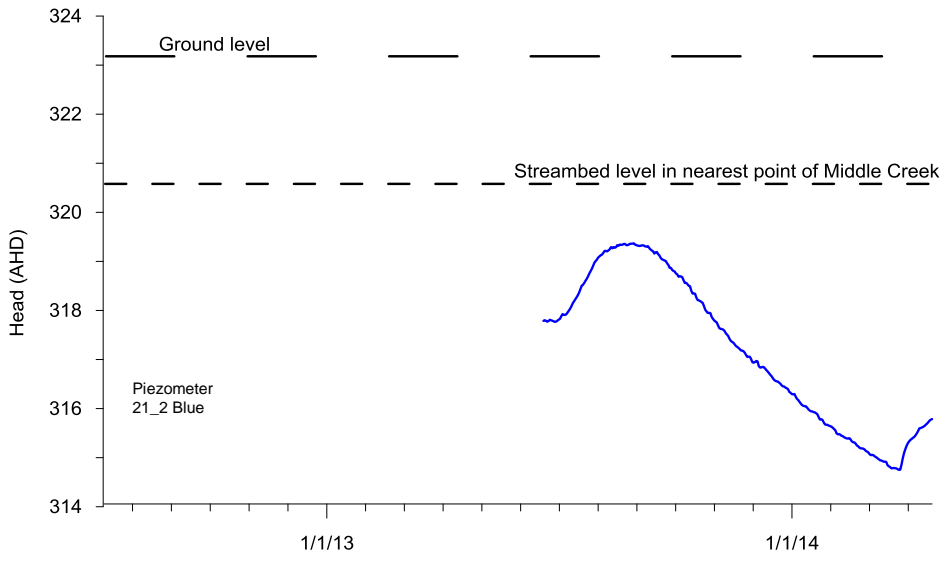
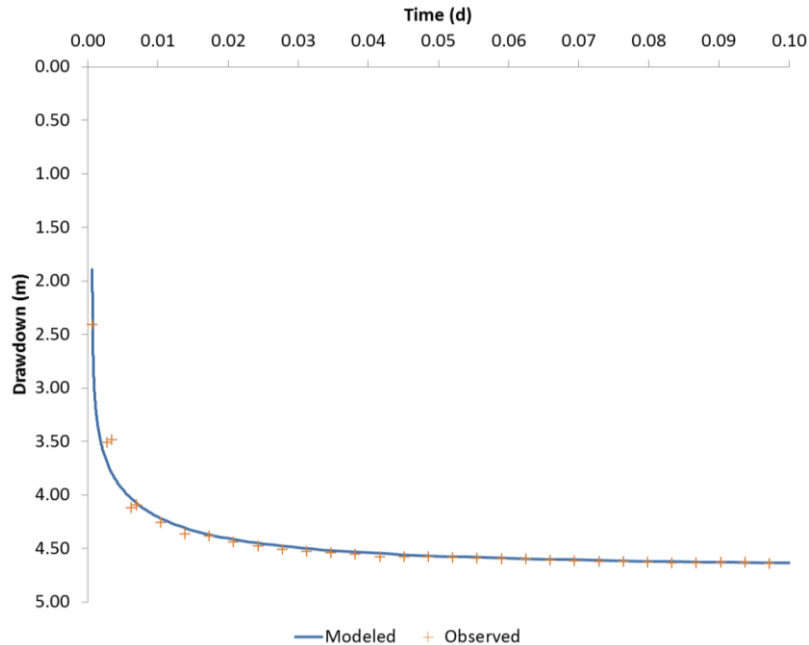


Figure S2. Drawdown data and model comparison for the Elfin Crossing Pumping Test



A pumping test was conducted in BH14 at Elfin Crossing (see Figure 6 for location), situated 35 m from edge of Maules Creek. The borehole has a diameter of 0.3 m, and is screened in the interval 12 to 24 m bgl. It was equipped with an electric pump (Grundfos SP60 with MS 4000 motor) powered by a 3-phase generator. The borehole was briefly tested for its response to pumping before starting the main test and allowed to fully recover. The pump was then continuously operated at an average rate of 5.5 L/s for 193 hours (8 days and 1 hour, from 13/01/2013 13:20 to 21/01/2013 14:20). The extracted water was released back into the creek further downstream so as not to affect the test. The drawdown in the pumping well, and in multiple short screened piezometers at various distances from the pumping well were monitored using pressure transducers. Highly variable pressure responses were seen in the piezometers indicating a very heterogeneous conditions and a full analysis is beyond the scope of this paper. Here we have analysed only the hydraulic response in the pumping well since, being screened through much of the saturated alluvial aquifer, unlike the short screened observation wells it should give an integrated hydraulic response from which the bulk properties of the aquifer can be derived.

The data were analysed using a transient model. For this analysis the Theis [1935] equation was used incorporating the superposition of an injection image well to implement a recharge boundary due to the close proximity of the perennial section of Maules Creek. The drawdown data were fitted to the model by varying the hydraulic parameters (T , S) in order to minimise the RMSE. The drawdown observations and model results are shown in Figure S2. Due to the connected adjacent creek acting as a recharge boundary, the water levels in the pumping well became steady by around 0.1 d into the test. The best fit parameters were $T = 115 \text{ m}^2/\text{d}$ and $S = 0.001$ indicating semi-confined conditions local to the well, with an R^2 value of 0.99.