

# Focused groundwater recharge in a dryland environment: hydrometric and isotopic evidence from central Tanzania

**Makutapora Basin  
(2015-16 El Niño)**

**David Seddon<sup>1</sup>, Japhet Kashaigili<sup>2</sup>, Richard G. Taylor<sup>1</sup>,  
Mark Cuthbert<sup>1,3</sup>, Lucas Mihale<sup>4</sup>, Catherine Mwihumbo<sup>4</sup>,  
Alan MacDonald<sup>5</sup>**

<sup>1</sup>UCL Geography, UK; <sup>2</sup>Sokoine University of Agriculture, Tanzania;

<sup>3</sup>Cardiff University, UK; <sup>4</sup>Ministry of Water, Tanzania;

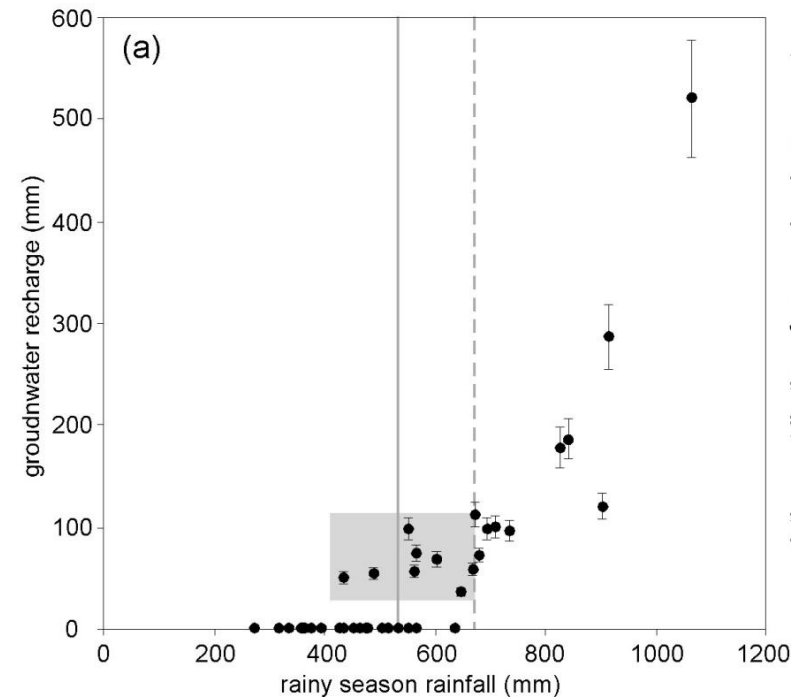
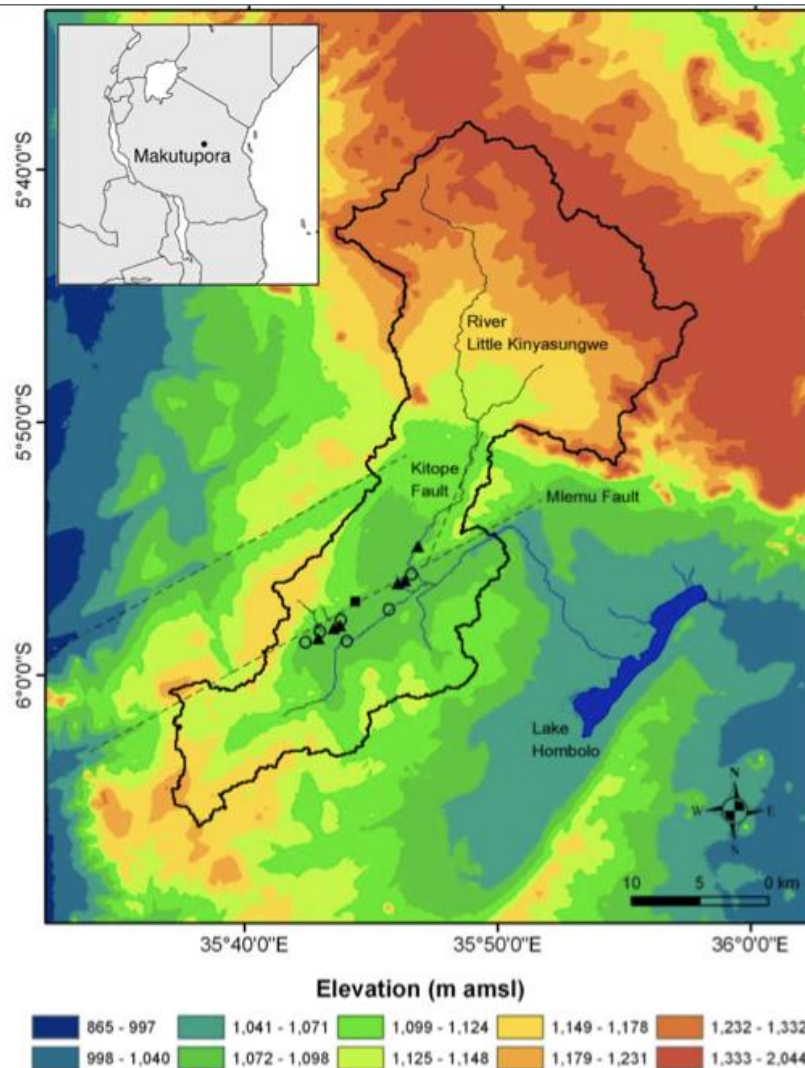
<sup>5</sup>British Geological Survey, UK

*EGU2020, Session HS8.3.5 Irrigation, soil hydrology and groundwater management for resilient arid and semi-arid agroecosystems*

© David Seddon 2020. All rights reserved



- supplies  $>50\,000\text{ m}^3$  of safe water daily to the city of Dodoma in central, semi-arid Tanzania



- recharge associated with extreme seasonal rainfall during El Niño events

*Taylor et al. (2013) Nature Climate Change 3: 374-378.*



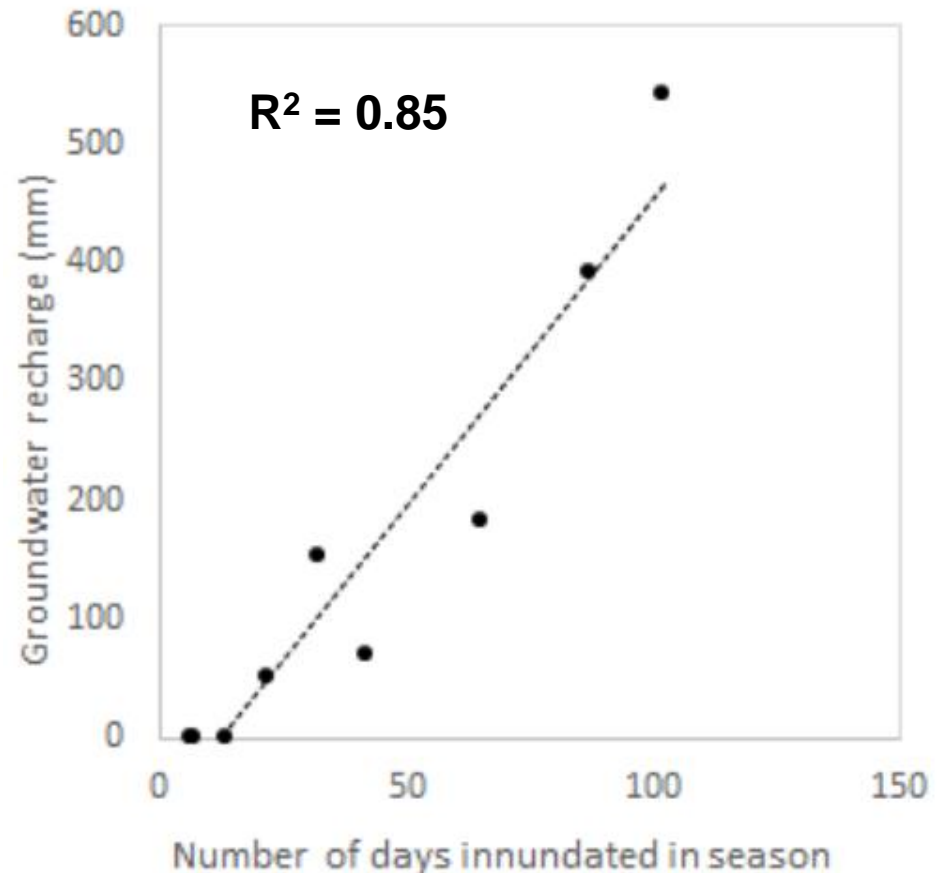
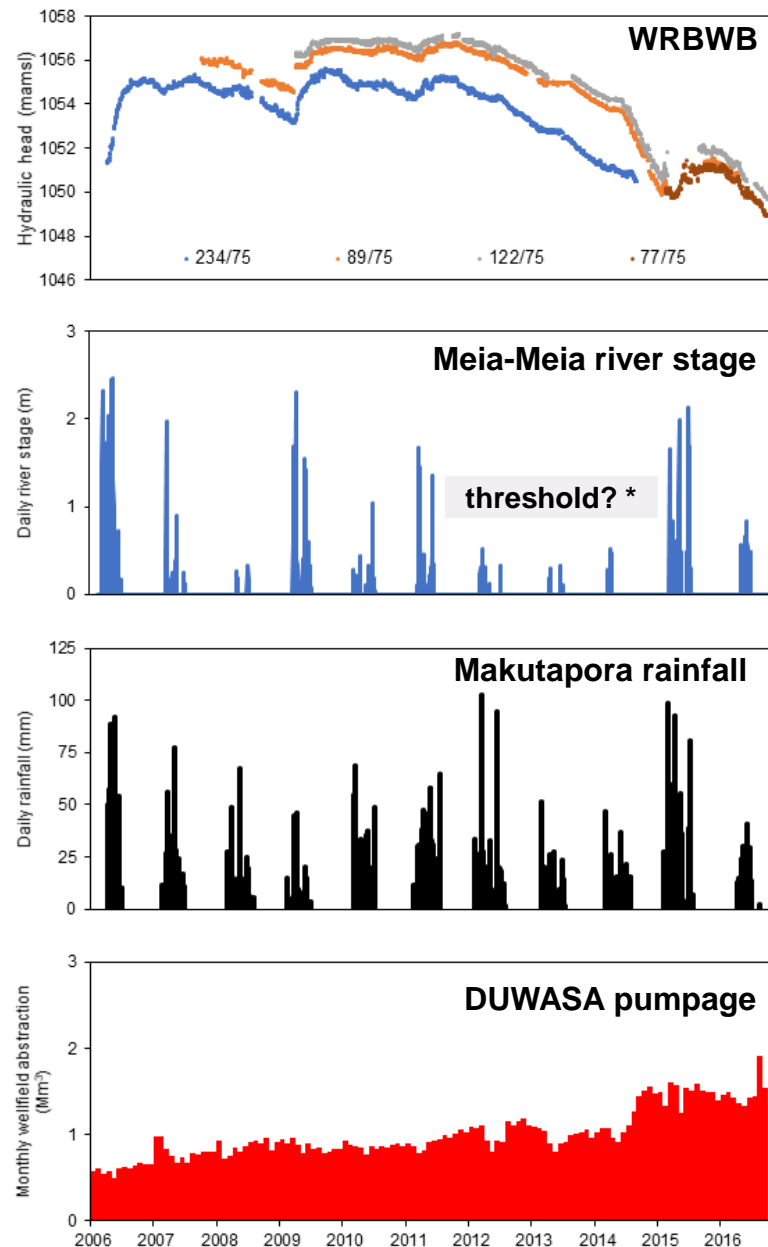
**MINISTRY OF WATER  
DIRECTORATE OF WATER  
RESOURCES  
WAMI-RUVU BASIN  
WATER OFFICE**  
STATION NAME: **LITTLE KINYASUNGWE**  
AT **MAYAMAYA**  
STATION NUMBER: **LOCAL**

***How does recharge to this weathered crystalline rock aquifer system occur?***

- **directly from rainfall?**
- **indirectly via leakage from ephemeral streamflow?**

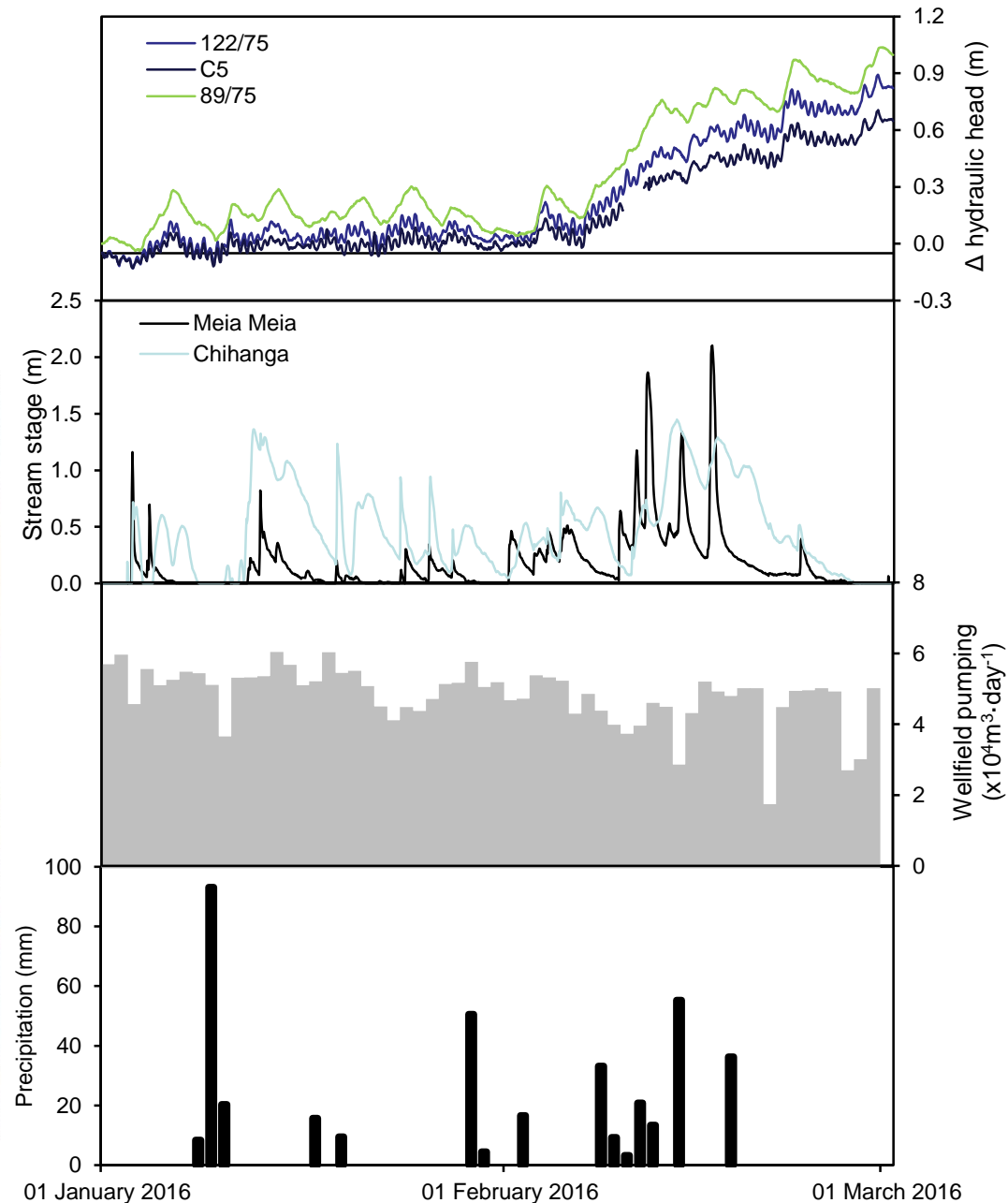


- groundwater recharge correlates most strongly to the seasonal duration of ephemeral stream flow

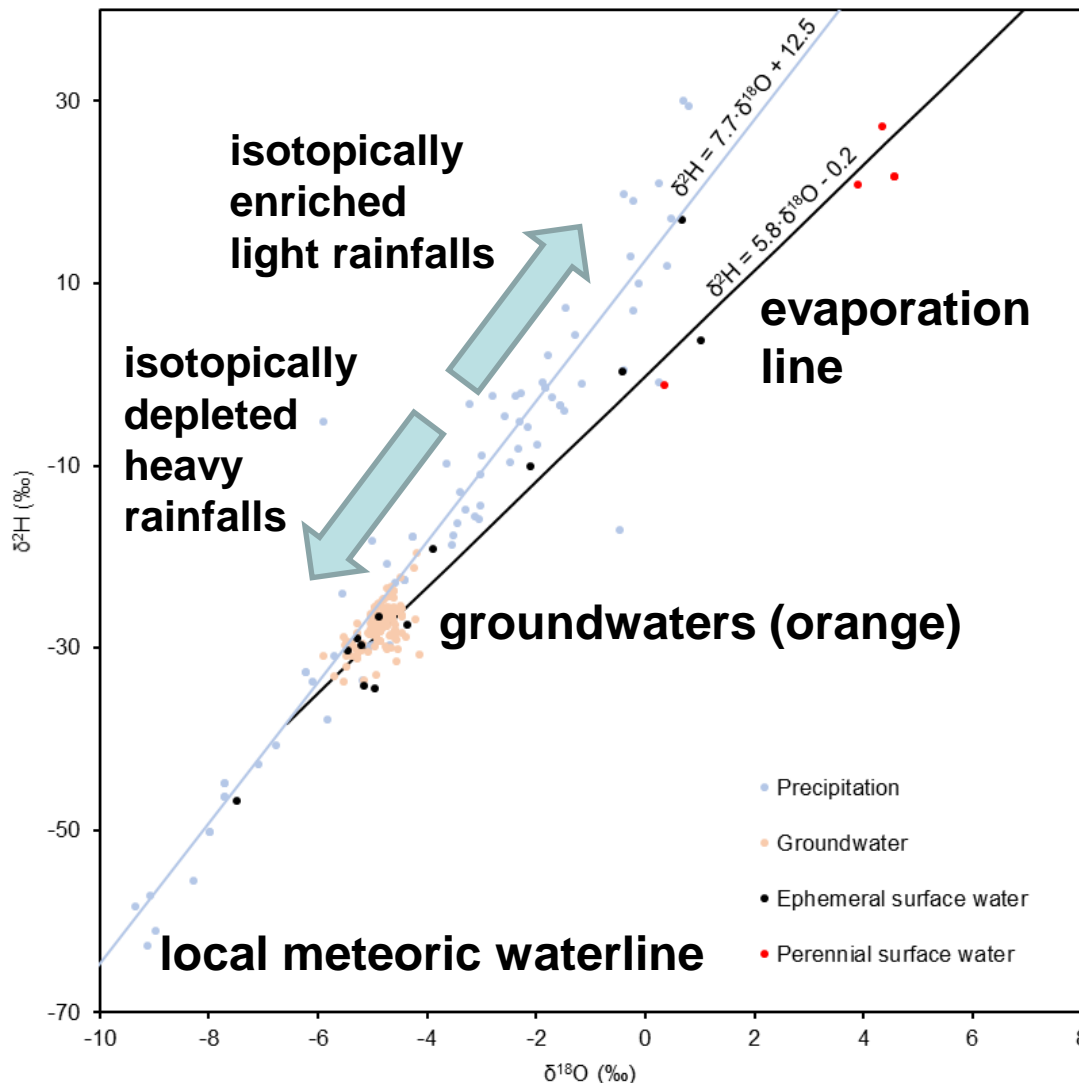


\* see presentation of Zarate *et al.* in this session

- groundwater levels respond to ephemeral streamflow, not localised rainfall at Makutapora



- stable isotope ratios ( $\delta^2\text{H}$ ,  $\delta^{18}\text{O}$ ) in groundwater traced to heavy ( $> 70^{\text{th}}$  percentile) rainfalls



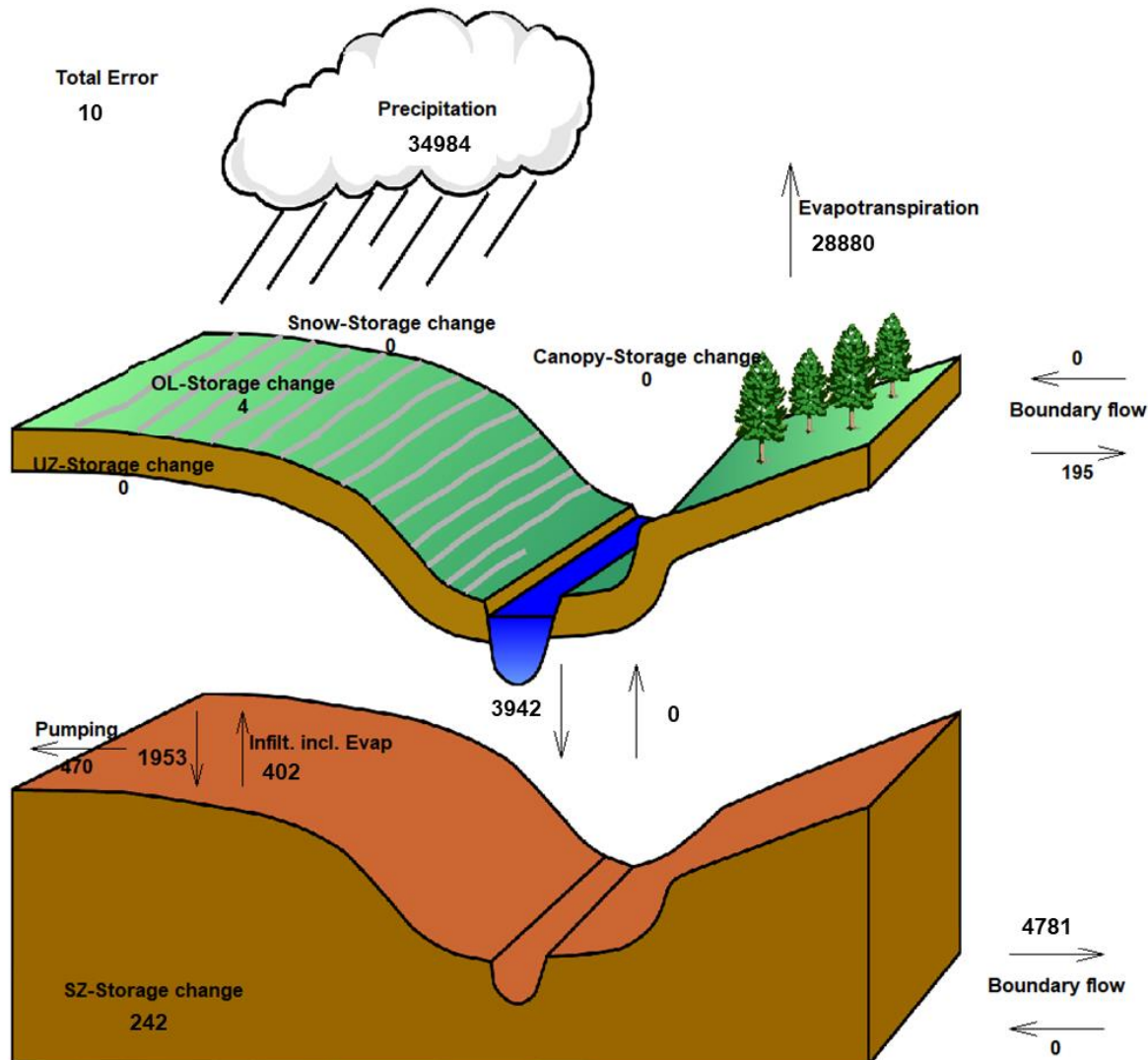
- evidence of minor evaporative enrichment consistent with ephemeral stream flow

- in the drylands of central Tanzania, groundwater recharge to the wellfield supplying Tanzania's capital city occurs, in part, via ephemeral stream flows (generated by heavy rainfalls) that leak to the subsurface (focused recharge) – *groundwater in drylands can be critically connected to surface waters*
- precise pathways remain uncertain and may involve threshold dependent infiltration “windows” via faults and stream reaches underlain by coarser, fluvial sediments
- identification of focused recharge to the wellfield raises the possibility of Managed Aquifer Recharge strategies to amplify replenishment

# **SUPPLEMENTARY SLIDES**



- conceptual model of groundwater recharge test using an integrated surface water – groundwater model



- model calibration to stream stage (very good NSE= 0.88) and groundwater levels (satisfactory, NSE = 0.56)
- **focused recharge** accounts for ~ **two-thirds** of total recharge recorded from 1955 to 2016

