Groundwater Recharge Estimation in the Surat Basin

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BACKGROUND

- The Surat Basin makes up part of the larger Great Artesian Basin (GAB) and is a major water resource in the semi-arid interior of eastern Australia
- Groundwater models are important for predicting potential impacts of coal seam gas on groundwater resources, and post-operational recoveries. Recharge is an important input to these models

Project aims

- Develop quantitative knowledge about groundwater recharge processes and pathways in the Surat Basin
- Focusing on the unsaturated zone and priority geological outcrops and subcrops: *Gubberamunda sandstone, Main Range Volcanics* and the *Condamine River Alluvium*
- Provide recommendations for recharge inputs to regional groundwater models (see separate poster)
  - **Stage 1** (complete) – Preliminary recharge estimates (1 - 12 months)
  - **Stage 2** (complete) – Field site establishment (13 – 22 months)
  - **Stage 3** Field site operation and data analysis (23 – 50 months)

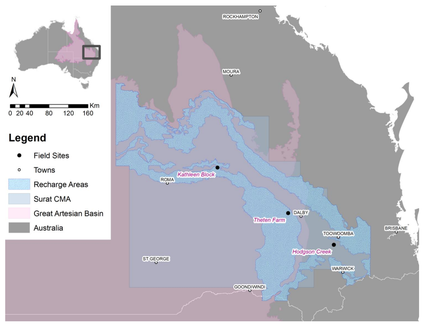
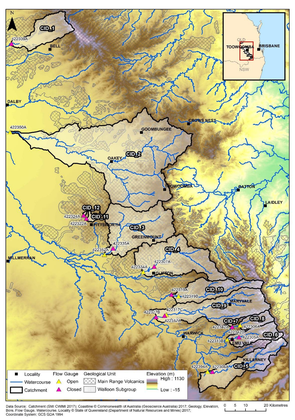


Fig. 1. Geography of the GAB, the Surat Basin, and location of study sites

Recharge rates in Main Range Volcanics



- Main Range Volcanics outcrop on eastern edge of Surat, draining into Condamine alluvium with leakage to underlying Walloon Coal Measures
- Catchment-scale recharge to unconfined aquifer reconstructed empirically in 10 catchments using time-series analysis of streamflow (Fig. 2)
- Average long-term estimates are consistent with independent methods; added value from project is improved quantification of variability
- Groundwater monitoring allows correlation with rainfall and evaporation rates to be analysed. Results show large variability of GW response; but generally slow (seasonal to annual) responses at most bores.

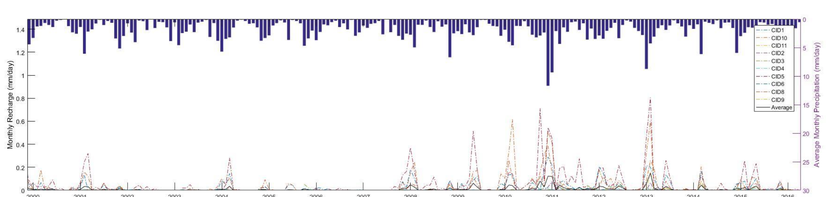


Fig. 2. Spatial and temporal variability of recharge since 2000 (some estimates go back to 1920)

Recharge processes at Theten Farm

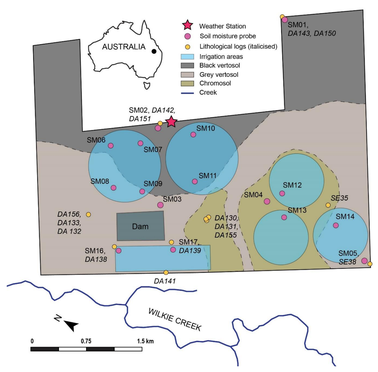


Fig. 3. Location of the soil monitoring equipment and soil types at Theten Farm

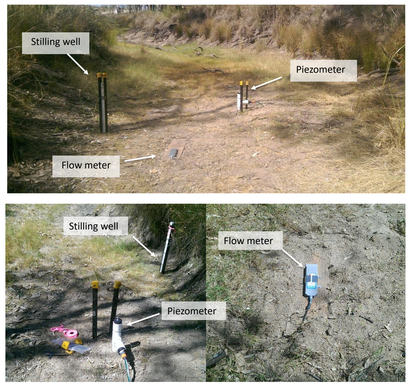


Fig. 4. Downstream and upstream (above and below) monitoring sites at Wilkie Creek

Monitoring equipment

- 16 soil moisture probes, each with 8 sensors over 4 m depth, with soil profiles.
- Creek water level, shallow groundwater level, creek bed moisture contents, photography at Wilkie Creek
- Groundwater levels, weather station

Diffuse recharge (deep drainage) results

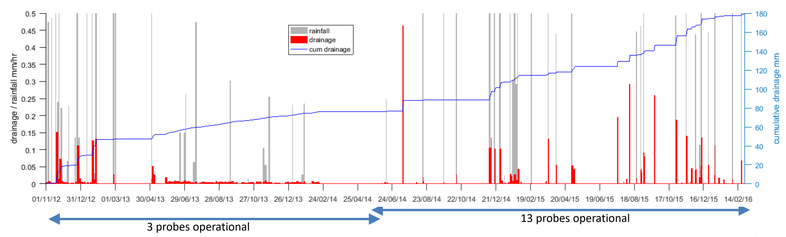


Fig. 5. Deep drainage rates reconstructed using soil moisture balance (rainfall curtailed at 0. 5mm/hr)

- Time-average point-scale deep drainage estimates were 13% (0 – 80%) of total rainfall and irrigation in Vertosol and 8% (0 – 24%) in Chromosol. This is consistent with international literature, although measurement error exists
- Controls on responses were: antecedent moisture, and rainfall volume and intensity; however high variance due to randomness of soil cracking and rainfall

Focused (creek) recharge results

- Comparison of surface water levels and groundwater pressures show downward gradient and connectivity only in large events
- Deep groundwater responses show annual scale responses and no responses to events, although monitored bores were ~1000 m from creek

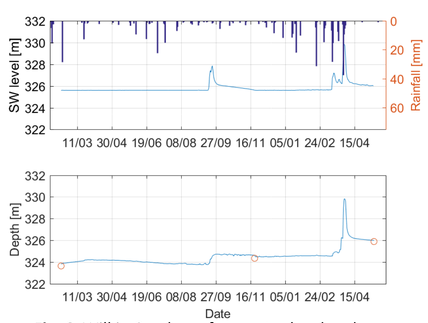


Fig. 6. Wilkie Creek: surface water level and shallow groundwater pressure

Recharge processes at Kathleen Field

Fig. 7. Upstream monitoring sites at Nine Mile Gully, Kathleen Field

Monitoring equipment

- Two sites on Nine Mile Gully to investigate potential for focussed recharge of the Gubberamunda sandstone
- Groundwater levels, weather station

Results

- Nine Mile Gully is ephemeral; only flowing after 5 near consecutive days of rainfall and a total rainfall volume greater than 33 mm
- Episodic recharge observed in one of four groundwater bores only
- Variation in groundwater recharge likely due to varying lithology and hydraulic conductivity of Gubberamunda sandstone; and potentially due to presence of concealed fault and associated angular uncomformities

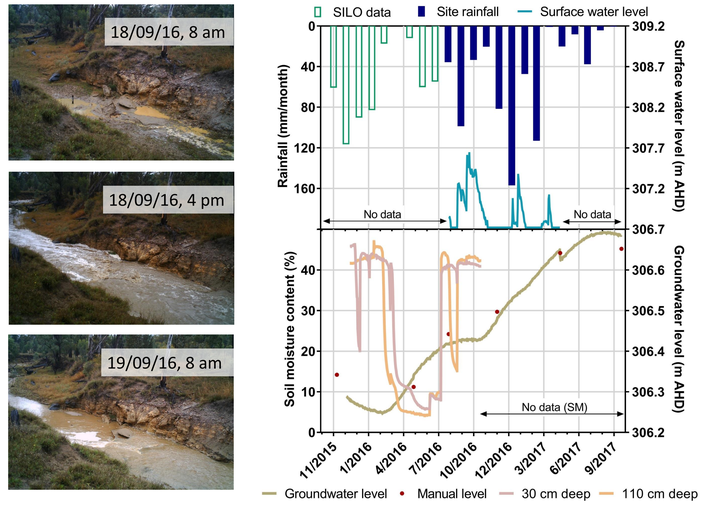


Fig. 8. Flood event in Nine Mile Gully (left); rainfall & surface water level (upper right); soil moisture content & groundwater level (bottom right)

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