CRC for Water Sensitive Cities

Carl Davies[1]
Carolyn Oldham[1]
Ryan Vogwill
[1] University of Western Australia

CRC Project B2.4: Hydrology and nutrient transport processes in groundwater/ surface water systems

Minimising Fill in Low Lying Urban Land

Introduction

Urban development in low lying land generally causes groundwater to rise due to increasing recharge. Importing sand fill and installing subsoil drainage beneath road verges is the typical measure to control groundwater rise so that infrastructure is protected (Figure 1).

The fill required to control groundwater results in serious concerns for sustainable development:

- Clearing of native land for sand fill supply
- Impact on housing affordability as 1-2m fill is often imported across a development (Table 1).

The volume of fill imported depends on an accurate estimation of the groundwater mound between subsoils. This project aims to determine the most appropriate approach to estimate mounding, to in turn inform sand fill requirements.

Field Results

Groundwater mounding between subsurface drains has been measured at two urban sites in Perth, Western Australia.

The monitoring has encompassed up to 3 annual groundwater peaks at Whiteman Edge, a site underlain by natural sand, and 2 annual peaks at The Rivergums, a site underlain by natural clay. Bores were placed as close to the midpoint between subsoil drains as practically possible.

Groundwater mounding of up to 0.9m has been measured between subsurface drains that are located ~80m apart in road verges. The Whiteman Edge Site has a lower mound (generally < 0.5m), compared to The Rivergums mound (~ 0.9m), despite similar fill properties and urban density (Figure 2).

Estimating Groundwater Mounding

Analysis is being undertaken to determine the most appropriate method to predict groundwater mounding at urban sites.

Modelling and analysis is currently in progress to assess the factors that affect groundwater mounding. Some of the factors that are being investigated include: soil properties (e.g. hydraulic conductivity and storage); the regional groundwater flow regime (e.g. hydraulic gradient); the underlying geology (e.g. sand, clay or semi-permeable layers); subsoil drain grade; and urban density.

This analysis will inform developers and practitioners of the pros, cons, cost and benefit of various methods to estimate groundwater mounding, such as analytical equations, 1D, 2D and 3D numerical modelling.

Figure 1: Subsurface Drainage Concept

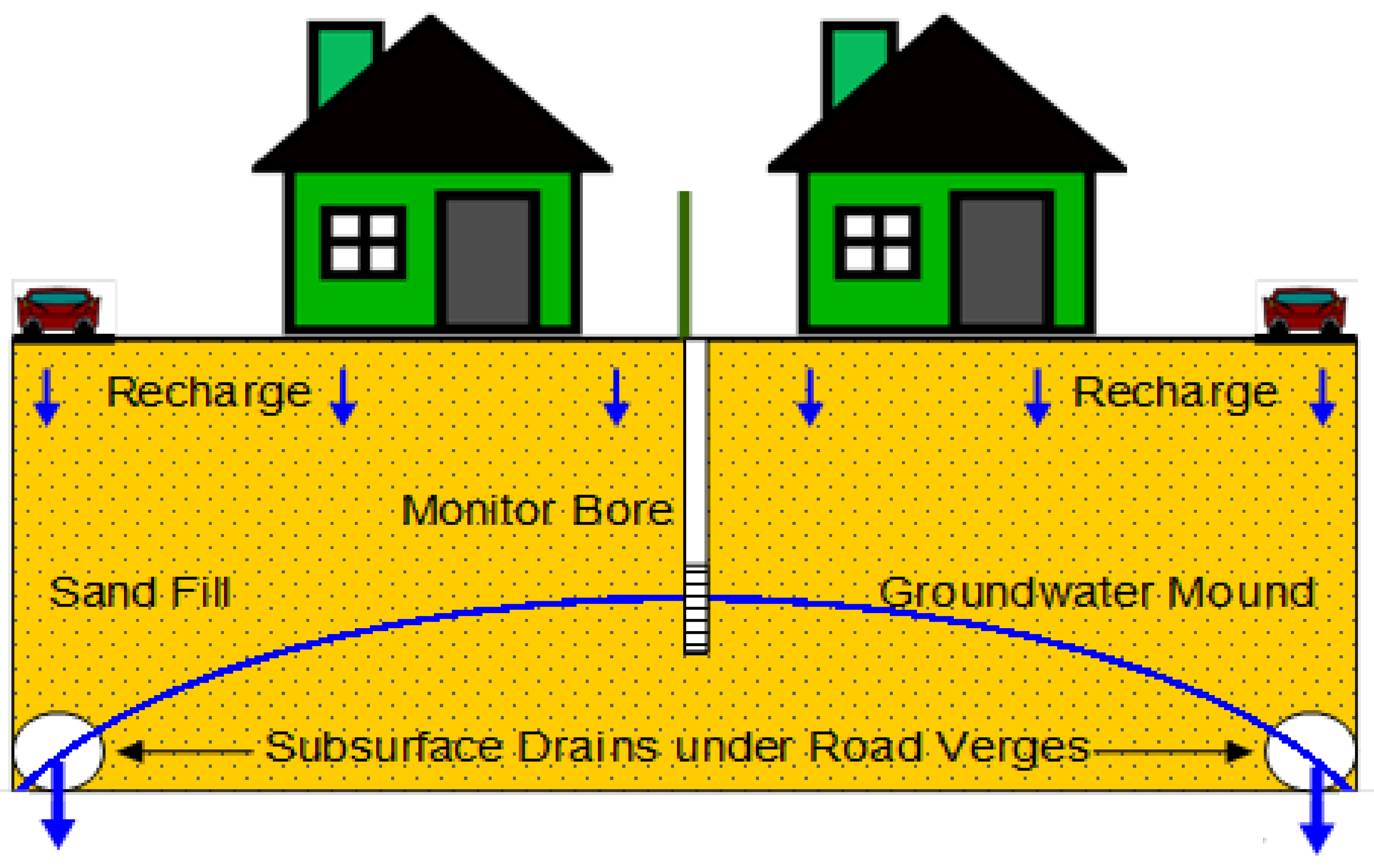
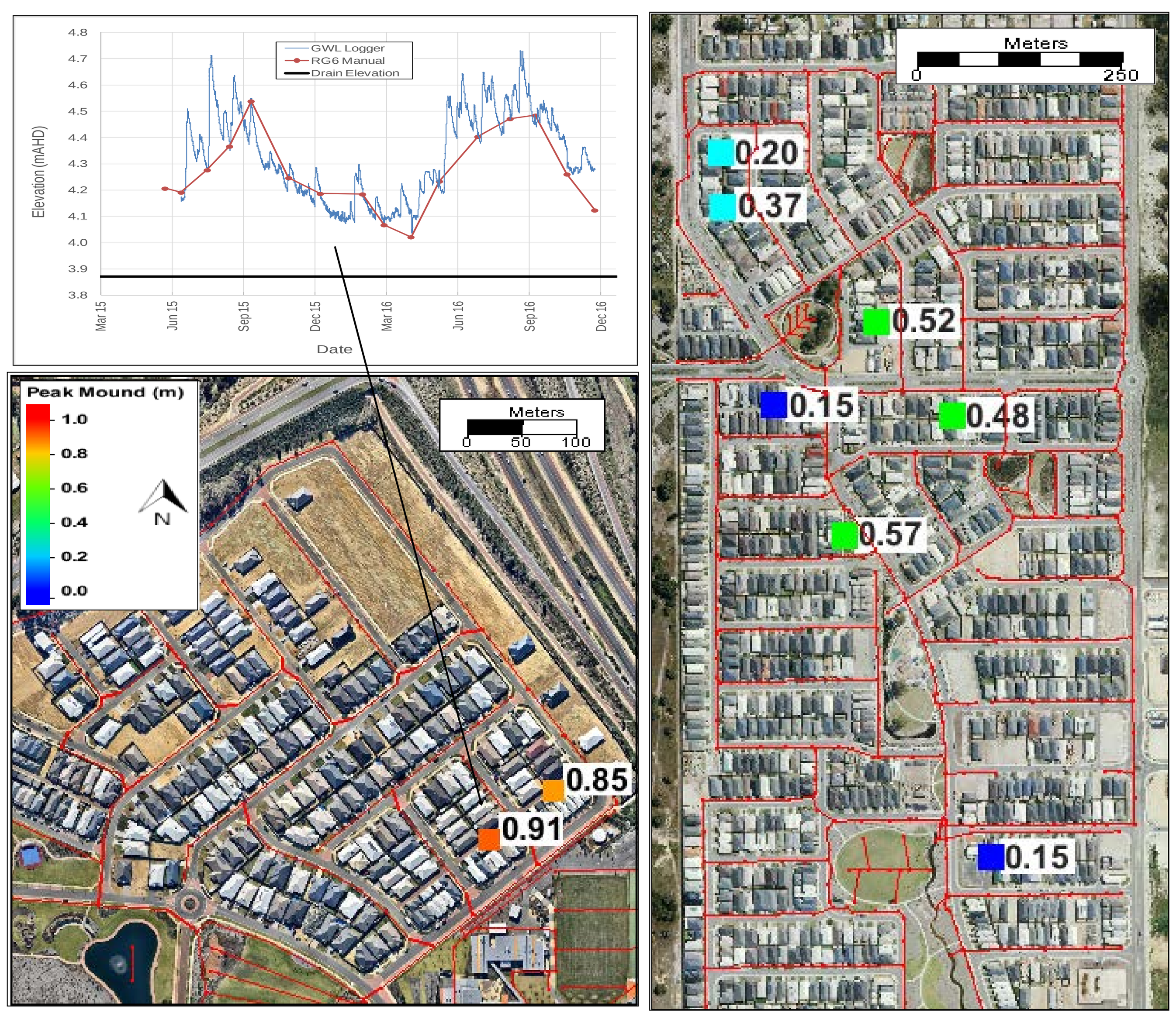


Table1: Indicative Fill Cost

Fill Thickness (m)	0.5	1	1.5
Area (ha)	50	50	50
Fill Cost ($/m^3)	20	20	20
Total Cost ($M)	5	10	15

Figure 2: Peak Groundwater Mound - The Rivergums (left) and Whiteman Edge (right). Hydrograph shows manual and logger groundwater levels for a Rivergums Bore. Subsoil drains are shown as red lines.



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