Understanding the Groundwater Recharge Process near the Ranger Mine in the Northern Territory

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Introduction

It is important to understand the processes of groundwater recharge near the Ranger mine to predict the likely impact of climate change on ground water table elevations and hence to quantify the risks to long term containment of mine tailings.

Methodology

With the daily rainfall, evapotranspiration and groundwater table (GWT) data for the period 1980 to 2005, statistical analyses have been used to test and quantify conceptual models of expected recharge processes. The simplest technique to obtain correlation between climate data and change in GWT is based on calculations of net flux, which is the difference between rainfall and evapotranspiration (ET) (Armstrong and Narayan 1998). This analysis was then extended by considering the influence of unsaturated soil thickness and the monthly net flux series with statistically significant lags as detailed in another accompanying paper (Kabir et al. 2006) The influence of these variables was quantified by the Beta values calculated from multiple regression and R^2 values (Kerr et al. 2002; Dahe et al. 2006). The Beta value represents the degree to which the independent variables are related, with a higher value showing a more important relationship.

The bores chosen for detailed analyses were those that were clearly unimpacted from mining-related activities so that the changes observed in the GWT were related to climate only.

Result:

The GWT varies significantly both in space and time over the Ranger project area and shows a distinct seasonal cycle in GWT levels. Net flux explained about 50% of the variance in GWT elevation (Figure 3). In the multiple regression analyses for selected bores, the influence of unsaturated zone thickness has been realised as a barrier to recharge. Based on the Beta values obtained for the selected bores (Figure 4), the importance of unsaturated thickness decreased in comparison to the climate as the unsaturated zone thickness increases. From the multiple regression, bore OB27, having highest R^2 value of 0.646, was selected for correlation analysis to investigate the relative influence of rainfall and ET on the recharge.

Discussion & Conclusion:

There is a significant difference in the response of GWT to positive and negative flux through saturated and unsaturated soil as it is observed that the maximum monthly rainfall is much greater than maximum monthly ET (Figure 3). The reasons behind this variation may be mentioned as firstly the availability (storage) of water and secondly the saturated hydraulic conductivity, which is many times greater than that of unsaturated soil The infiltration into and evaporation of moisture from soils is a complex process (as shown by the scatter in Figure 3). The thickness of the unsaturated zone is clearly an important factor identified by this analysis, as it influences recharge both through storage and unsaturated hydraulic conductivity. In terms of potential climate change impacts on groundwater recharge in the Kakadu region, the net effect of changes in rainfall and evapotranspiration need to be considered jointly with unsaturated soil behaviour.

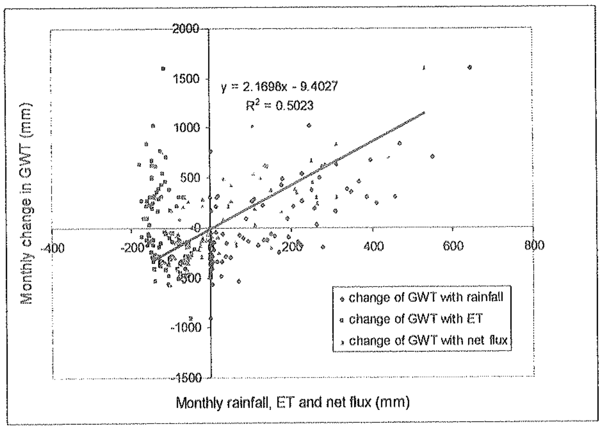

Figure 3 The monthly change of GWT of OB27 during 1981 to 1988 with the monthly rainfall, ET and net flux.

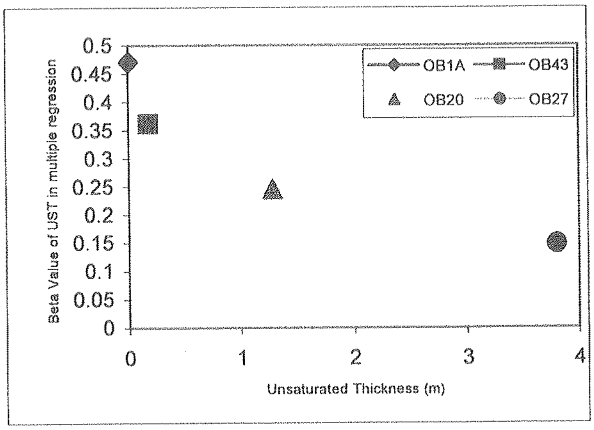

Figure 4 The Beta value of unsaturated thickness of four selected bores as computed in multiple regression.

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