

MODFLOW or FEFLOW: A Case Study of Groundwater Model Selection for the Upper Waikato Catchment, New Zealand

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Abstract

Groundwater in the Waikato region is a valuable resource for agriculture, water supply, forestry and industries. The 434,000 ha study area comprises the upper Waikato River catchment from the outflow of Lake Taupo (New Zealand's largest lake) through to Lake Karapiro (a man-made hydro lake with high recreational value) (Figure 1). Water quality in the area is naturally high. However, there are indications that this quality is deteriorating as a result of land use intensification and deforestation. Compounding this concern for decision makers is the lag time between land use changes and the realisation of effects on groundwater and surface water quality. It is expected that the effects of land use changes have not yet fully manifested, and additional intensification may take decades to fully develop, further compounding the deterioration. Consequently, Environment Waikato (EW) have proposed a programme of work to develop a groundwater model to assist managing water quality and appropriate policy development within the catchment.

One of the most important and critical decisions of any modelling exercise is the choice of the modelling platform to be used. It must not inhibit future decision making and scenario exploration and needs to allow as accurate representation of reality as feasible. With this in mind, EW requested that two modelling platforms, MODFLOW/MT3DMS and FEFLOW, be assessed for their ability to deliver the long-term modelling objectives for this project. The two platforms were compared alongside various selection criteria including complexity of model set-up and development, computational burden, ease and accuracy of representing surface water-groundwater interactions, precision in predictive scenarios and ease with which the model input and output files could be interrogated. This latter criteria is essential for the thorough assessment of predictive uncertainty with third-party software, such as PEST.

This paper will focus on the attributes of each modelling platform and the comparison of the two approaches against the key criteria in the selection process. Primarily due to the ease of handling and developing input files and interrogating output files, MODFLOW/MT3DMS was selected as the preferred platform. Other advantages and disadvantages of the two modelling platforms were somewhat balanced.

A preliminary regional groundwater numerical model of the study area was subsequently constructed. The model simulates steady state groundwater and surface water flows using MODFLOW and transient contaminant transport with MT3DMS, focussing on nitrate nitrogen (as a conservative solute).

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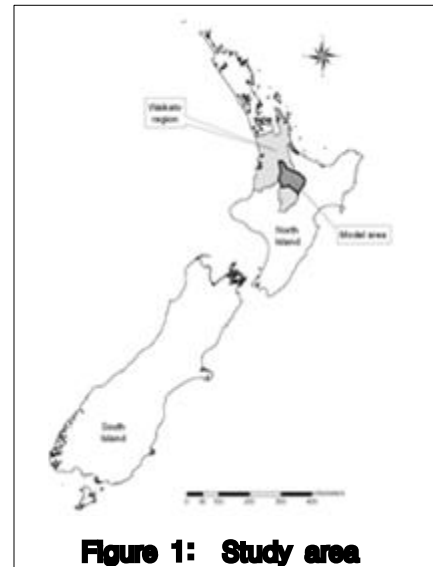


Figure 1: Study area

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