

Modeling the groundwater flow for the City of Regina, Canada – a Case Study

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The Regina Aquifer System is located in the southeast Saskatchewan, Canada. It is one of the most complex multi-aquifer systems in Canada. The Regina Aquifer System includes the Condie Aquifer, the Regina Aquifer, the Zehner Aquifers, the Northern Aquifers and some minor aquifers. The location of the City and the approximate extent of the above aquifers are illustrated in Figure 1. A three-dimensional groundwater flow model was constructed to better understand the hydrogeologic framework of the Regina Aquifer System and to facilitate future contaminant transport modelling. The model was developed with MODFLOW for an area of 1450 km². Groundwater levels between 1988 and 1999 were simulated during the calibration process and compared to the measured levels. The model was calibrated by manual trial-and-error adjustment of parameters. Adjustment was made to parameters including recharge rate, hydraulic conductivity values, and creek bed conductance until the calibration target was met. With the general horizontal hydraulic gradient from east to west, the computed potentiometric surface reached a reasonable match with measured heads on a regional scale. The good agreement between the measured and the simulated hydraulic heads indicated that parameter values assigned to the model properly represented the field conditions. The calibrated model was then used to predict future drawdown and recovery scenarios. Particle tracking was conducted to estimate approximate contaminant movement rates and directions. Flow pathlines from two potential contamination sources were simulated. It was predicted that contamination from the PCC (Provincial Correctional Centre) and the City Landfill Site in the Condie Aquifer would not threaten water quality in the City of Regina W-wells (city production wells installed in the west of the Regina Aquifer) within 1000 years.

Sensitivity analysis on model parameters was conducted to quantitatively evaluate the impact of varying model inputs. Sensitivity analysis of the calibrated model was conducted on parameters including recharge, hydraulic conductivity, vertical hydraulic conductivity of the confining layer, conductivity of the horizontal flow barrier and creek bed vertical conductance. Based on the results obtained from the sensitivity analysis, it was concluded that the model is relatively sensitive to vertical.