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Risks to urban groundwater from leaking sewers and contaminated land

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The recognition that urban groundwater is a potentially valuable resource due to growing pressures on perceived less polluted rural groundwater has led to a requirement to assess the groundwater contamination risk in urban areas from (a) industrial contaminants such as chlorinated solvents, and (b) microbiological pollution from leaking sewers. The development of a probabilistic risk based management tool that predicts groundwater quality at potential new urban boreholes is beneficial in determining the best sites for future resource development. The Borehole Optimisation System (BOS) is a custom Geographic Information System (GIS) application that has been developed with the objective of quantifying the risk of pollution to groundwater in urban areas. BOS links four components to provide probabilistic estimates of the concentration of a range of pollutants at any location. The components are (1) a catchment zone model which using a groundwater flow model to give a probabilistic estimate of the catchment of a borehole, (2) a landuse module which contains definitions of all the industrial land parcels and their potential pollution for six dates in the 20th century, (3) a sewer network map, again organised by dates, and (4) a probabilistic fate and transport model for the behaviour of pollutants in the unsaturated and saturated zones. The system is described in more detail by Tait et al. (Environmental Modelling & Software 19 (2004) 1111-1124).

This paper applies the BOS model to an urban Triassic Sandstone aquifer in the city centre of Nottingham, UK. All simulations were for a ‘standard’ borehole pumping 500 m3/d, typical for this aquifer. There are two modes of use of BOS, firstly for a single borehole, such as a potential new water supply. Secondly, the analysis can be repeated for multiple locations to amp risk over a large area. Risks of pollution were assessed for contaminants with different source and transport characteristics. The first

was the ubiquitous chlorinated solvent PCE, which has been in use for several decades, is a DNAPL, and is not easily degraded. Results indicate that northeastern, eastern and central regions have the lowest potential PCE concentrations in abstraction groundwater and therefore are the best sites for locating new boreholes. These locations coincide with aquifer areas that are confined by drift deposits. Conversely southern and northwestern areas are unconfined and have a shallower depth to groundwater. These areas have the highest potential PCE concentrations in abstracted groundwater. The newer contaminant MTBE, which is released into the environment as part of fuel LNAPLs, was also analysed, and also found to be predominantly in the southern,city centre, area. Microbiological pollution, which originates for leaking sewers in the UK as there are virtually no urban septic tank systems, was the third pollutant to be analysed. These were found to be an very low risk unless catastrophic failure of sewers took place. These studies demonstrate the applicability of BOS as a tool for informing decision-makers on the development of urban groundwater resources.