The L.A. Colding Lecture Series

in Environmental Science and Technology

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Risks to urban groundwater from industry and sewers

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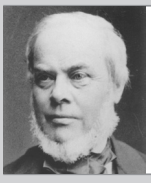
Abstract:

Urban groundwater is a resource that nowadays is little used in the UK and the Triassic Sherwood Sandstone aquifer beneath the city of Nottingham is no exception. It has not been used for drinking water or process water in the recent past because of a perception that it is at risk of pollution from multiple industrial and residential sources not least from sewage. However, it is not clear if this perception is indeed, well founded. If the risk is found to be low, we may be able to use this urban groundwater instead of relying on less sustainable rural groundwater.

The Borehole Optimisation System (BOS) is a custom Geographic Information System (GIS) application that has been developed with the objective of locating the optimum locations for new boreholes in urban areas. The risk of pollution in potential new boreholes from a range of industrial pollutants (chlorinated solvents, BTEX, MTBE) was assessed for this region. A further development of the model called BOS-Micro has been developed to analyse the risk of pollution with faecal bacteria from leaky sewers. Since there are always uncertainties with such models, it is important to validate the model to ensure it is accurately estimating the risk. Initially the risk model was validated against contaminant concentrations from 6 actual field boreholes within the study area for chlorinated solvents and BTEX, and against a national survey of MTBE concentrations. BOS-Micro was validated by comparing its predictions with field data; it successfully simulated the fate and transport of pathogenic bacteria and viruses from leaking sewers to a pumped borehole at two out of the three selected sites. The latter validation suggested that preferential flow via fractures is the most important mechanism responsible for migration of pathogens in the sandstone aquifer and that although only a small proportion of the pathogen population travel by these routes they provide the majority of the risk. It also showed that a proportion of pathogen population travel up to 18 times faster than the average groundwater velocity.

With the model validated, the risk analysis showed that at most of the sites the risk was low, assuming the water was not to be used directly for drinking water. However, if the water were subsequently treated, it would reach drinking water standard. These studies demonstrate the applicability of BOS as a tool for informing decision-makers on the development of urban groundwater resources.



Ludvig August Colding was Copenhagen´s city engineer in the period 1857-1886 and designed the city´s water supply system. He chose to base the supply entirely on groundwater. The system´s general layout and many of its details date back to Colding´s era. From 1869-1886, Colding was a professor at the Technical University of Denmark. At the age of 26, he discovered the law of conservation of energy, simultaneously with, but independently of Joule.

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