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Optimal Positioning of Groundwater Supply Wells in Residential Areas

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Abstract

In most rural and sub-urban residential areas of Sri Lanka, groundwater is used for drinking and sanitation. Groundwater use for agriculture has also been intensified in the recent years. Since Sri Lankan aquifers are relatively shallow, they are quite susceptible to contamination (IWMI, 2005) from diffuse sources such as landfill sites.

In residential areas, owing to limited availability of land and the presence of soakage pits and waste landfill sites in the neighborhood, the positioning of water supply wells beyond the reach of pollutants will be a challenge in the years to come. In addition, the maximum sustainable yield of a well, the effects on surrounding wells, and other possibilities such as salt water intrusion should be considered in locating new wells, particularly if the aquifer is heavily utilized. Apart from conventional wisdom and architectural concerns, these hydrological impacts are not usually considered in positioning drinking water supply wells. As a result, instances of well water contamination, wells drying out in drought periods, abandoned wells causing several risks, and even water related conflicts are frequently reported.

This paper presents a simulation-optimization based methodology for positioning new water supply wells beyond the vicinity of contamination. The purpose of the optimization is to find where a well should be located within a specified area of land to minimize the possibility of getting contaminated or dried out within a reasonable time period. The proposed optimization model can include constraints on the effects on neighboring wells, and other undesirable impacts. A simulation model developed with MODFLOW and MT3D is used to determine the effects of potential pollution sources on the candidate well locations. The Monte-Carlo method is used with the simulation models to incorporate the uncertainty in the behavior of potential pollution source. The concept is demonstrated using a small hypothetical case study. Same methodology can be used to select landfill locations so as to minimize the effects on existing groundwater wells.

Key words: groundwater wells, positioning, simulation, optimization