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ORIGINAL ARTICLE

Solute transport modeling of the groundwater for quaternary aquifer quality management in Middle Delta, Egypt

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KEYWORDS

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MODFLOW;
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Finite difference;
Middle Delta

Abstract Groundwater contamination is a major problem related strongly to both; protection of environment and the need of water. In the present study groundwater quality was investigated in the central part of the Nile Delta (El-Gharbiya Governorate). El-Gharbiya Governorate is an agricultural land and its densely populated area inhabited, includes small communities which totally not served by public sewers. Hydrochemical analyses were used to assess the quality of water in samples taken from the canals, drains and groundwater. A laboratory study and mathematical modeling works were presented. Two numerical computer models by the applying of finite difference method were adopted. Both models deal with the flow as a three-dimensional and unsteady. Results obtained include determining the levels of water and the values of solute concentration and distribution of it in the region at different times. The groundwater model MODFLOW was used to deal with the hydrodynamics of the flow through porous media. A solute transport model which can be communicated with MODFLOW through data files MT3DMS, was used to solve the problem of contaminants transport and the change of their concentrations with time. A proposed groundwater remediation scheme by using group of extraction wells was suggested at Birma region where the concentration values of ammonium contaminant are the up most according to hydrochemical analyses results. Proposed scenario for cleaning is to use a set of wells to pump contaminated groundwater extraction for treatment and reused to irrigation.

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1. Introduction

Slow movement of water through the ground means that residence times in groundwater are generally longer than surface water. Once groundwater polluted, it can remain so for several decades, or even for hundreds of years until they can be cleaned if cleaning was actually possible. Sources of contamination of groundwater are numerous. Sources of pollution

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from human activities can be distinguished as domestic, agriculture and industrial.

1.1. Modeling of groundwater

Groundwater modeling consists of physical modeling and mathematical modeling. Physical modeling can be classified to Hele-shaw, sand tanks and electric analog models. Mathematical modeling can be classified to analytical and numerical models. Details of these models were presented by Harr [12]. The numerical techniques used the finite difference methods (FDMs), the finite element method (FEM) and boundary element method (BEM). Comprehensive treatments of the applications of these numerical methods to groundwater problems

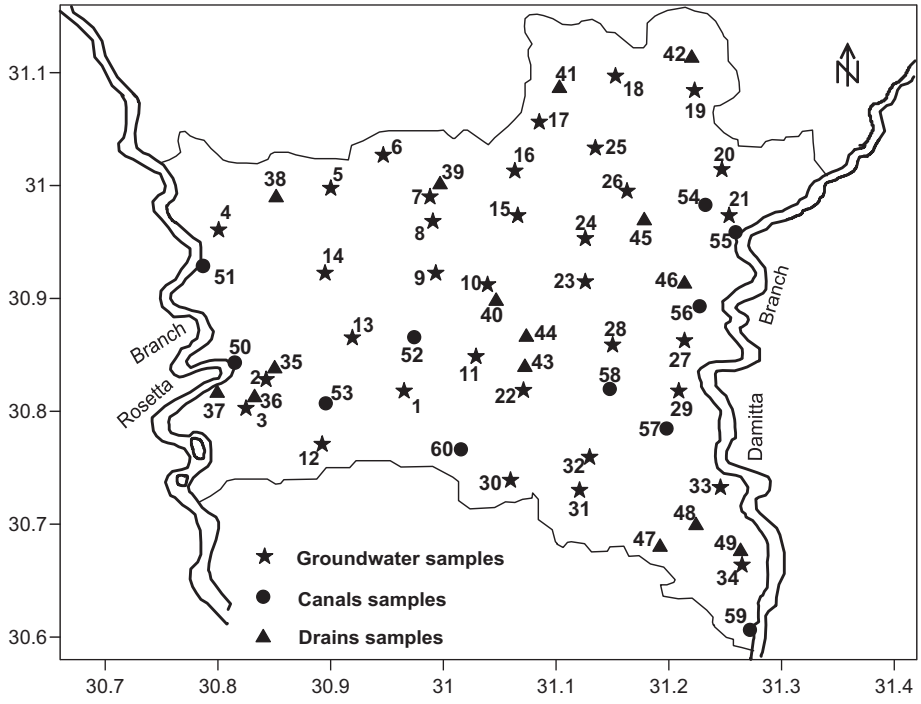

Figure 1 Locations of surface and groundwater samples.

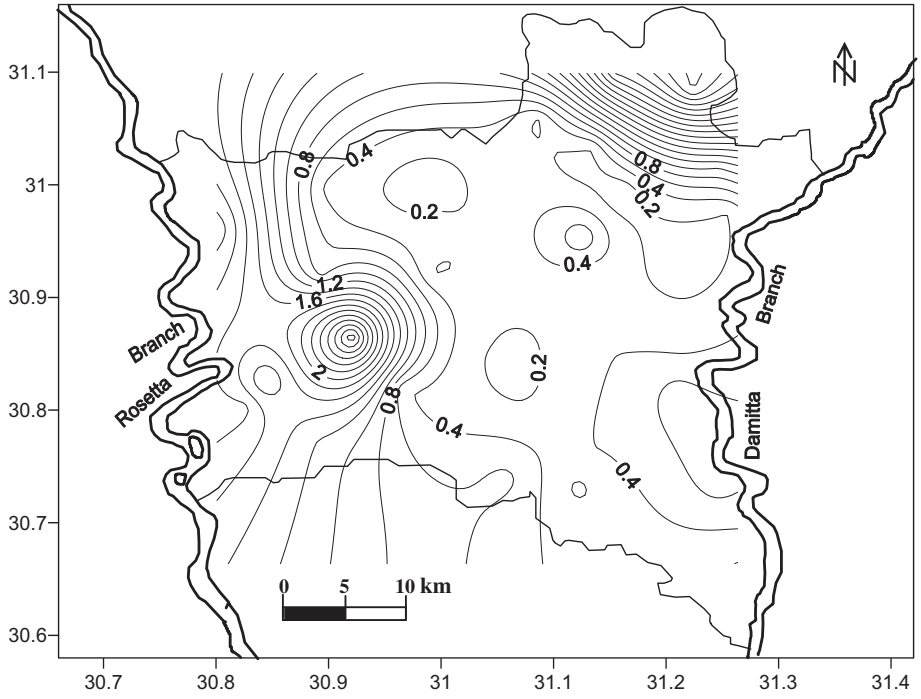

Figure 2 Iso-contour map of ammonium concentration in mg/L for groundwater samples.