DEVELOPING A COMPREHENSIVE GROUNDWATER TRANSPORT MODEL USING PARTICLE BASED TECHNIQUES

By

Khaled Ahmad Aly Mohamad

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE

In

IRRIGATION AND HYDRAULICS ENGINEERING

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FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis:

Developing a Comprehensive Groundwater Transport Model Using Particle Based Techniques

Key Words:
Co-transport of Contaminant and Colloids; Bactria; Chemical Processes; Biological Processes; RWPT; GUI (Graphical User Interface); Well Capture Zone.

Summary:

The random walk particle tracking (RWPT) method has been used to obtain the well capture zone for both homogeneous and heterogeneous media and a sensitivity analysis is conducted to study the effect of governing parameters on the obtained capture zone. In addition, a comprehensive model has been built with a friendly User Graphical Interface (GUI) combining various groundwater transport modules which had been developed at the IHD during the last two decades. All results have been compared to original modules results to ensure that each submodule is working properly.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in references section.

Name: Date:

Signature:

Acknowledgments

First of all, I have to thank ALLAH for always being by my side in each step of my life, this research could not come to light if it is not by ALLAH's reconcile and the help from people around me.

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Nomenclature

α_l	longitudinal dispersivity [L]
α_t	transverse dispersivity[L]
β	conservation factor using in bacterial lysing
λ	correlation length [L]
σ_Y^2	log conductivity variance
μ	specific growth rate of bacteria $[T^{-1}]$
μ_{max}	maximum specific growth rate of bacteria $[T^{-1}]$
θ	porosity of porous medium [1]
Δt	time step interval [T]
ba	bacteria in aqueous form
bs	bacteria sorbed on solid matrix
bDs	bacteria attached to immobile colloid particle
bDa	bacteria attached to mobile colloid particle
C	the dissolved substance concentration $[ML^{-3}]$
C_b	concentration of bacteria in the domain $[ML^{-3}]$
C_{ba}	mass concentration of bacteria in form ba $[ML^{-3}]$
C_{bs}	mass concentration of bacteria in form bs $[ML^{-3}]$
C_{bDa}	mass concentration of bacterial cells which attached to mobile colloid $[ML^{-3}]$
C_{bDs}	mass concentration of bacterial cells which attached to immobile colloid $[ML^{-3}]$