EXPERIMENTAL STUDY OF HYDRODYNAMICS OF GROUNDWATER FLOW IN KARST AQUIFERS UNDER STRESSED AND UNSTRESSED CONDITIONS

By

Amin Ahmed Emam Ahmed Hassan

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

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
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Title of Thesis:

Experimental Study of Hydrodynamics of Groundwater Flow in Karst Aquifers Under Stressed and Unstressed Conditions

Key Words:
groundwater; karst aquifer; pumping wells; matrix-conduit exchange; experimental model

Summary:

Karst aquifers are characterized by the dual porosity represented in their two main domains; matrix and conduits. This research presents a large-scale laboratory model to simulate a karst aquifer with pumping wells. Pressure and discharge measurements are obtained to provide pressure head distribution, quantification of matrix-conduit exchange, and drawdown values. Results show that the matrix-conduit exchange is dependent on conduit hydraulic gradient, conduit size, and the head difference between matrix and conduit domains. Results also show that for the same pumping rate, drawdown values of matrix wells are substantially higher than that of conduit wells. Conduits can sustain much higher pumping rates than the matrix domain. Matrix-conduit exchange under pumping conditions varies according to the domain that is being pumped and the head difference between the matrix and conduit domains.

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 the references section.

Name: Amin Ahmed Emam Ahmed Hassan Date: / / 2021

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Table of Contents

List of Tables

List of Figures

Nomenclature

HGL	: Hydraulic Gradient Line
M	: Matrix
C	: Conduit
UC	: Upper Conduit
LC	: Lower Conduit
Q	: Discharge
PVC	: PolyVinyl Chloride
HP	: Horsepower
k	: Hydraulic Conductivity
C_d	: Coefficient of Discharge