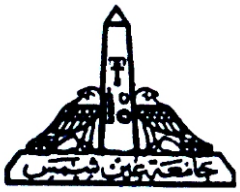

جامعة عين شمس
كلية االهندسة
قسم الرى والهيدروليكا

تقييم تجارب الشحن الصناعى للخزان الجوفى فى مصر

رسالة مقدمة كجزء من متطلبات الحصول على
درجة الماجستير فى الهندسة- رى و هيدروليكا

للمهندسة
عبير مصطفى محمد سليمان

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القاهرة 2005

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STATEMENT

This thesis is submitted to Ain Shams University, Faculty of Engineering for the degree of Master of Science in civil Engineering (irrigation and hydraulics)

The work included in this thesis was carried out by the author In the Department of Irrigation and Hydraulics. The work was carried during the period from October 2002 to 2005.

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Date : / / 2005

Signature: ----------

LIST OF ABRAVIATIONS

ARE	**Artificial Recharge Experiment**
IW 1	**Shallow Injection well no.1**
IW 2	**Deep Injection well no.2**
M.S.L	**Mean Sea Level.**
TDS	**Total Dissolved solids.**
S.P.	**Suspended Solids.**
Exp.	**Experiment**
MWRI	**Egypt's Ministry of Water Resources and Irrigation**
PW	**Present worth method.**
AW	**Annual Worth method.**
FW	**Future worth method.**
L.E.	**Egyptian currency**
MARR = I%	**Interest rate of return method.**
B	**Benefits of the proposed project.**
CR	**Capital recovery amount (i.e., the Equivalent.**
AW	**Annual cost of the Initial investment, I, including an allowance for salvage value, if any.**
O & M	**operating and maintenance cost of the proposed project .**
R_k	**Revenues for the K Th year.**
E_k	**Expenditures for the K Th year.**

t	**Project life (Estimated).**
B/C	**the ratio of the equivalent worth of benefit to the equivalent worth of cost.**

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Introduction

1.1 Background

1.1.1 Definition of artificial recharge

Artificial recharge may be defined as the planned activity of man whereby surface water from streams or lakes is made to infiltrate into the ground, commonly at rates and in quantities many times in excess of natural recharge, giving a corresponding increase in the magnitude of the safe yield). Artificial recharge was defined also as the practice of increasing the amount of water reaching the subterranean reservoir by artificial means.

Artificial recharge involves transport of water via engineering systems from land surface to underground-bearing strata, where it may be stored for future use. In natural or artificial recharge, the water at the ground surface moves down in a bulk form under ordinary hydraulic laws, subject only to the altered or reduced pressure caused by capillary within the bulk mass of the liquid

The infiltration process usually consists of a hydraulic transfer of water, accompanied by an extraction, and subsequent retention of water by the soil. As water proceeds downward, it is either totally absorbed by the soil, or reaches the water table as recharge.
Not all of the recharged water is reaching the water tables; part of it is stored in the originally unsaturated zone between the land surface and the water table. This emphasizes the importance of the unsaturated zone, and leads to the need to understand the flow behavior in the saturated-unsaturated hence, developing a model that simulates the actual flow

1.1.2 Objectives of artificial recharge

The primary objective of artificial recharge is to augment the amount of available groundwater. Other purposes include:
1) Conservation of runoff and flood waters.

2) Reduction, balance, or reversing saltwater intrusion
3) Storage of water to reduce costs of pumping and piping.
4) Storage of water during years of water abundance for use during drought years.
5) Improvement of water quality by removing suspended solids by filtration through the ground.

Artificial recharge has also various roles in waste disposal, waste treatment, secondary oil recovery, land subsidence prevention, fresh water storage in saline aquifers. On the other hand, artificial recharge may encounter some disadvantages, such as:

1) Not all added water is always recovered;

2) The area required for operation and maintenance of a groundwater supply system (including the groundwater reservoir itself) is generally larger than that required for a surface water supply system;

3) Salts like calcium, magnesium, iron, manganese, or other elements in the recharge water cannot be readily remarked

4) Clogging of aquifers is difficult to remedy. 5) Sudden water supply demands may not be met because groundwater reservoir not as easily drained;

6) Expansion of groundwater supply systems may be costly.

1.2 Feasibility of Artificial Recharge

The feasibility of artificial recharge for groundwater is generally determined by the objective behind recharging water. Main objectives of artificial recharge include:(1) water storage,(2)minimizing the water lift cost,(3) improving the quality of the groundwater, drinking water supply,(4) remediation from salt water intrusion, (5)flood control and avoiding land subsidence.

Various costs are associated with artificial recharge projects, including (1) capital (land acquisition, (2) structure construction, (3) equipment purchase,(4) replacement of some facilities and equipment over the project life period, (5)operation ,administration, maintenance, and energy costs. Groundwater recharge is considered feasible if:

(1) Benefits exceed costs.(2) Existing conditions (suitable hydro geological conditions with availability of water sources and anticipated

environmental impacts), generally affect the feasibility of artificial recharge.

1.3 WATER RESOURCES IN EGYPT:

Egypt's main water resource is the Nile River. The Nile agreement with Sudan allocates 55.5 BCM/yr to Egypt. Which amount is secured by the multi-year regulatory capacity provided by the Aswan High Dam The second water source is groundwater in the Western: Desert region and in Sinai in non renewable aquifer systems. The annual extraction from the main aquifer in these areas, the Nubian Sandstone aquifer system, is about 0.5 BCM/yr. Rainfall in the coastal zones of Egypt reaches about1.5 BCM/yr but is a rather unreliable source due to its spatial and temporal variability. Groundwater in the Nile aquifer system and desert fringes is not a resource in itself as it is replenished from the river Nile by seepage from canals and deep percolation from irrigation application The annual groundwater extraction in the: Nile aquifer system and fringes is about 4.8 billion cu m . Groundwater extraction is expected to increase considerably in the forthcoming years, thus increasing the relative importance of groundwater in the national \\'ater resources management (Fig. 1.1). Although the international community has acknowledged Egypt's efforts on birth control, the present population *of* 62 million is still continuing to increase. Increased population and higher living standards resulted in a situation where Egypt is to face the challenge of a water scarcity. Degradation of the land and water resources due to socioeconomic exploitation adds up to the water scarcity problem. Therefore the overall objective of the national water policy for the 21st century is to utilize the available convential and non-convential water resources to meet the socio-economic and environmental needs of the country.