AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
CIVIL ENGINEERING DEPARTMENT
PUBLIC WORKS SECTION

WATER LOSSES MANAGEMENT USING ON-LINE MONITORING, GIS, AND MODELLING WITH WATERCAD

A Thesis submitted to the Faculty of Engineering
Ain Shams University
For the Fulfillment of M.Sc. Degree in Civil Engineering

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STATEMENT

This dissertation is submitted to Ain Shams University, Faculty of Engineering for the degree of M.Sc. in Civil Engineering.

The work included in this thesis was carried out by the author in the department of Public Works, Faculty if Engineering, Ain Shams University, from March 2011 to Dec 2012.

No part of this thesis has been submitted for a degree or a qualification at any other University or Institution.

Date ----/2013

Signature ---------

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DEDICATION

I dedicate this work for anyone who might find this work useful or to whom is concerned.

For the people, whom without this work would not have been completed, my mentors Prof Habib Muhammetoglu and Prof Mahmoud Abdel Azeem.

Special thanks for my dear friend Ethem Karadirek and also Cem Çakmak who saved no effort in giving me a hand during my work.

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SPECIAL DEDICATION

To my family that supported me to go on and continue this work all over three years.
To mom and dad and my beloved fiancé.

Abstract

This research was conducted by Ahmed Hassan Mohammed under the title of “WATER LOSSES MANAGEMENT USING ON-LINE MONITORING, GIS AND MODELLING WITH WATERCAD” for obtaining the Master of Science degree from Ain Shams University.

This research has followed the most advanced techniques in water losses management that are being applied in developed countries. Using and integrating information technologies (SCADA, GIS, CIS and Hydraulic Modeling) to achieve water losses reduction. Using Active Leakage Control ALC was very important as well, because it is one of the most important factors that affect physical water losses.

By Appling such methodologies through this area of study in Antalya city and then comparing similar approach with Luxor city, is the core of this study. The results conducted by this research could be taken as a guideline for water utilities to start over their methodologies and immediately follow water losses management strategies which are; dividing network into DMAs, Pressure management, conducting water balance and leakage monitoring strategies.

After all calculating and analysis of data obtained by continuous monitoring is essential to decide the possible and suitable action to sustain the development of the water sector.

List of Abbreviations

AADD	**A**nnual **A**verage **D**aily **D**emand
ALC	**A**ctive **L**eakage **C**ontrol
ALR	**A**wareness **L**ocalization **R**epair
ASAT	**A**ntalya **S**u ve **AT**iksu Idarasi
AWWA	**A**merican **W**ater and **W**astewater **A**ssociation
CARL	**C**urrent **A**nnual **L**osses
CIS	**C**ustomer **I**nformation **S**ystem
DEM	**D**igital **E**levation **M**odel
DMA	**D**istrict **M**etered **A**rea
EPA	**E**nvironmental **P**rotection **A**gency
GIS	**G**eographic **I**nformation **S**ystem
GSM	**G**lobal **S**ystem for **M**obile
HCWW	**H**olding **C**ompany of **W**ater and **W**astewater in Egypt
HDPE	**H**igh **D**ensity **P**oly**E**ethylene
ILI	**I**nfrastructure **L**eakage **I**ndex
IWA	**I**nternational **W**ater **A**ssociation
KHZ	**K**ilo **H**ertz
KWDN	**K**onyaalti **W**ater **D**istribution **N**etwork
MDF	**M**aximum **D**aily **F**low
MLD	**M**ega **L**iter per **D**ay
MNF	**M**inimum **N**ight **F**low
MWC	**M**anila **W**ater **C**ompany
NRW	**N**on-**R**evenue **W**ater
PLC	**P**assive **L**eakage **C**ontrol
PRV	**P**ressure **R**educing **V**alve
PVC	**P**olyvinyl **C**hloride
RL	**R**eal **W**ater **L**osses
RTU	**R**emote **T**erminal **U**nit
SCADA	**S**upervisory **C**ontrol **A**nd **D**ata **A**cquisition
SI	**S**tandard **I**nternational Units
TUBITAK	**T**he Science and **T**echnological **R**esearch **C**ouncil Of **T**urkey

UARL	**U**navoidable **A**nnual **L**osses
UK	**U**nited **K**ingdom
UKWIR	**U**nited **K**ingdom **W**ater **I**ndustry **R**esearch
US	**U**nited **S**tate
WDM	**W**ater **D**emand **M**anagement
WDN	**W**ater **D**istribution **N**etwork
WDS	**W**ater **D**istribution **S**ystem
WDS	**W**ater **D**istribution **S**ystem
WL	**T**otal **W**ater **L**osses
WLTF	**W**ater **L**oss **T**ask **F**orce
ZPT	**Z**ero **P**ressure **T**est

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Chapter 1
Introduction

This study has been proposed basically to help the water administration entities to catch up with the new and modern technologies used in water management generally and water losses management especially. The GIS is playing the main role in the process because it is the first milestone of building a reliable database however this database concerns the physical characteristics of the water network, the customers' data, and the continuous monitoring data.

According to the staggering volume of water being lost all over the world in addition to the lack of water resources in most of the countries, the importance of a successful water losses management imposes itself as a cheap solution. Finding new sources of water may be even better than developing new natural source because in the case of saving water losses from water distribution networks, this water saved is treated water which means: (i) supplying additional treated water source (ii) saving cost and achieving profit to the supplying company.

This research has been conducted over two years of data collection, field investigations, result evaluation, checking data validity, and build up models. This effort can be categorized in the following phases:

1.1. Phase 1: Problem Statement

The first problem statement is the amount of water lost through the water distribution networks, which is defined by the term water losses. Some investigations were performed to identify how much the problem affects the water distribution network efficiency and what kind of actions was taken to fight with the water losses. In Egypt there is a conservative estimation of the total water losses as 50 – 60 % of the total production (Cairo water and wastewater municipality) and this is a real challenge facing the stakeholders of the water sector in Egypt. However, there is yet no clear or strict approach applied through the biggest water subsidiaries in Egypt. The problem statement has been changed from reducing total water losses to developing and conducting the right approach to manage water losses in water distribution networks.

1.2. Research objective

There were many trials by The Holding Company of Water and Wastewater (HCWW) through cooperation with other national or international technical assistance, but these trails resulted in nothing that could be achieved because of many issues, such as; lack of data, poor data recording system, the complexity of the water networks and the deterioration of the water distribution networks. Although of the continuing trials from stakeholders, still no real water losses procedures are being agreed upon all over the subsidiaries companies in Egypt. The objective of this research was to apply the accurate proper approach that is being used successfully in developed countries to a small separated water network which is defined by district metered area (DMA).

1.3. Choosing the area of study

Due to The improper data of the pilot DMAs that have been established by water authorities in Egypt such as in Luxor which was an incomplete experiment due to the missing accurate procedure and methodology, thus the results were not professionally evaluated and there was no real positive impact to the area or the network itself. Due to the unavailability of the data and the need for more experience, an international cooperation was sought with another association that has a successful experiment in water losses management. Antalya city which is located at the south of Turkey has a previous successful experiment with the water losses with cooperation with Akdeniz University in Antalya which was the technical consultant. Antalya water and wastewater authority (ASAT) divided Konyaalti region into 18 DMAs and established SCADA system for monitoring the water networks and measuring hydraulic and water quality parameters.

Through a technical visit to Antalya city for one year supported by EXCEED (exchange students program) of Germany, the stages of choosing a proper area of study (DMA no. 2 out of the 18 DMAs of Konyaalti region), data collection, data analysis and building the hydraulic model were facilitated and resulted into a complete area of study with complete and accurate data.