INVESTIGATION OF RESOURCES OF A LIMESTONE AQUIFER USING A DIGITAL TECHNIQUE

BY

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This dissertation has not been submitted
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for the purpose of obtaining a degree.

V.W. de Silva.
20th March, 1986.

PREFACE

The study described in this report was carried out as a part of the course requirements for a Master's degree in Hydrology and Water Resources Engineering. The course was sponsered by the UNESCO and conducted at the University of Moratuwa, Sri Lanka. The course coordinator was Prof. V.C. Kulaindaswamy, UNESCO advisor to the dept. of Civil Engineering. Prof. Kulaindaswamy assisted by a few visiting lecturers handled the entire teaching work in the course. The auther completed the examination requirements for the Master's degree by January 1981 but could not start on a research project for some time as there was no supervisor to guide him at the time. When Dr. D.C.H. Senarath came back to the department after his sabbatical leave in March 1981 he kindly agreed to supervise this study.

After a few months of works in data collection, debugging of computer program etc. the auther had to suspend his work due to the break down of the University computer system. Sebsequently the computation work was completed while the auther was studying at the International Institute for Hydraulic and Environmental Engineering (I.H.E.) Delft, the Netherlands.

In the study no attempt has been made on the development of mathematical aspect of the model. All the emphasis was placed on studying the behaviour of the aquifer with different sets of data which were compiled on the basis of available records as well as on a number of assumptions.

The historical data available was not long enough even for proper calibration of the model. Therefore the verification of the model could not be attempted.

ACKNOWLEDGEMENTS

The auther wishes to place his deep gratitude towards Prof. V.C.Kulaindasamy for his untiring efforts to teach in the Post Graduate course which the auther had followed in the field of Hydrology. Dr. D.C.H.Senarath spent his valuble time in supervising the project, without his continuous guidance the auther would not have been able to complete this work.

Mr. M.W.P.Wijesinghe, the former Deputy General Manager, Water Resources Board of Sri Lanka has authorised the use of their records for the study. He has made valuble suggestions for the study and the auther has benefited much from his wide experience in the field of Groundwater Hydrology. Mr. J. Davis, consultant and Mr. W.P.Rodrigo, technical assistant of the Water Resources Board provided help in collecting data.

The staff of the computer centres at University of Moratuwa and I.H.E. Delft provided much assistance in carrying out computations.

Dr. K.R.Rushton of Birmingham University and Mr. W. Spaans of I.H.E.Delft made valuble comments to improve this work.

The help and moral encouragements extended by Prof. Willie Mendis, Vice Chancellor, University of Moratuwa and Prof. B.L.Tennekoon, Head of Civil Engineering department are deeply appreciated. Thanks are extended to all the staff members of the Department of Civil Engineering who in numerous ways helped to carry out this work.

SUMMARY

Modelling of a limestone aquifer in the north west of Sri Lanka is attempted. The Vanathavillu basin situated 16 km. north of Puttalam, covering an area of approximately 60 sq.km. has been studied using a mathematical model based on an implicit finite difference scheme. The study area situated in the dry zone of Sri Lanka, recieves a seasonal rainfall of about 900 mm/year, the most of which falls during the months of October to December.

In the Vanathavillu basin there are essentially two water bearing formations:

- the miocene sedimentary strata.
- the quarternary deposits which overlie the miocene strata. (referred as Moongil Aru formation)

Moongil Aru formation consists of a series of clays and silts which partly confines the miocene formation. The piezometric levels in the miocene aquifer is lower than the phreatic surface by up to 30 m in the central parts of the region. In the north the piezometric levels are slightly higher than the phreatic surface. The two water bearing formations are interdependant as leakage takes place in and out of the miocene formation. The model was developed only for the miocene formation and the water table elevations in the Moongil Aru formation assumed constant.

The miocene formation is bounded in the east by basement rock outcrops which are relatively impermeable. To the west a fault exists which runs along the coast line. This fault restricts the flow in westerly direction. It is believed that two minor faults exists along two drainage paths of Kala Oya and Moongil Aru. The piezometric levels in the north suggest that the aquifer discharges into Kala Oya which could be treated as a constant head boundary. In the south the flow direction is entirely towards north.

The area has been studied by the Irrigation Dept. and the Water Resources Board of Sri Lanka. On the basis of these investigations aquifer parameters, recharge and abstraction from the limestone aquifer have been estimated. Development plans have been prepared

on the basis of these estimates. The purpose of the present model investigation was to assess the reliability of these estimates and also to provide a tool for planning future development and management of this valuble water resource .

A number of model runs with different sets of data represnting aquifer parameters, boundaries and flows were made. The results were compared with an available two year record of piezometric levels in the limestone aquifer. Computations were made with one layer model as well as with a simple two layer model.

A single layer model with constant inflows or a simple two layer model with water table elevation treated as a constant adequately describe the behaviour of the aquifer under the present level of abstraction. But the behaviour of the aquifer with highly increased abstraction can only be modelled adequately by a two layer model representing both unconfined and semiconfined aquifers together.

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