

**STUDY OF URBAN WATER DEMAND AND  
DISTRIBUTION SYSTEM RELIABILITY – A CASE  
STUDY OF MAHARAGAMA WATER SUPPLY  
SCHEME, SRI LANKA**

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Thesis Submitted in Partial Fulfilment of the Requirements for the  
Degree of Master of Science in Water Resources Engineering and  
Management

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October 2015

**DECLARATION**

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person expect where the acknowledgment is made in text.

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Date

The above candidate has carried out research for the Masters thesis under my supervision.

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Dr. R. L. H. L. Rajapakse

.....

Date

## **ABSTRACT**

The purpose of a water supply distribution system is to provide safe drinking water to each consumer with adequate quantity and acceptable quality. Due to ever increasing population density, the existing water distribution networks (WDN) cannot meet the increased demand and are facing issues of inadequate supply and low pressure. The WDNs are an important component of urban infrastructure since it is directly linked to health and happiness of urban population. For the operational as well as the design aspects, it is very important to estimate water demand, that is how much water is needed and the variation in demand, that is when it is needed.

Monthly consumption per connection derived for 13 years from 2002 to 2014 and the daily average flow obtained for Mondays through Sundays for five weeks in the Maharagama Water Supply Scheme, Sri Lanka were studied based on statistical analysis using Small Samples Theory. System water balance concept was used to generate the instant flow rate time series of demand from the available service reservoir level data and pumping data. System water balance calculation was performed for service reservoir in 10 minute time steps and out flow time series was generated. Generated out flow time series was analysed using Large Sample Theory of statistics. Level of service variation with the proposed parameters was assessed with Principle Component Analysis (PCA) and simple tabular methods. Results were verified with a field questionnaire survey conducted across the study area based on individual household connections.

Significant variation of flow could be identified during the day for Maharagama Water Supply Scheme (WSS). Diurnal problem curve derived from the field survey data indicates that there is a significant problem level, which is more than 40%, during the day. Water supply system's pumping capacity was not adequate to cater the peak demand of the scheme. It reveals that elevation and the distance have a considerable effect on Level of Service for Maharagama WSS and the Service level has a significant effect on consumption quantity as well.

This study should continue to cover the comparatively old systems in Colombo and outstations. Such studies will be helpful and essential to understand the behaviour of the existing systems and to assess and evaluate the effectiveness of the new designs. This also helps to plan the augmentation work required in existing systems for service level improvement and to develop design guidelines for the future or forthcoming schemes of similar nature.

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## **LIST OF ABBREVIATIONS**

NWSDB	- National Water Supply & Drainage Board
WDN	- Water Distribution Network
DPF	- Daily Peak Factor
HPF	- Hourly Peak Factor
ANN	- Artificial Neural Network
PCA	- Principal component analysis
PC	- Principal component
LOS	- Level of service
TEC	- Towns East of Colombo
WSS	- Water Supply Scheme
GND	- Grama Niladari Divisions
DSD	- Divisional Secretariat Divisions
NRW	- Non-Revenue Water
GIS	- Graphical User Interface
MNF	- Minimum Night Flow
MSL	- Mean Sea Level