LB/DON/13/1997
(3)

RECIPIENT BASED ENVIRONMENTAL MANAGEMENT PLAN FOR AN INDUSTRIAL ESTATE

Mookiah Thiruchelvam
Department of Civil Engineering
University Of Moratuwa
Sri Lanka

September, 1997

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

මොරටුව විශ්ව විද්‍යාලය. ශ්‍රී ලංකාව
මොරටුව.

67400

67400
UM Thesis
Coll.
624"97"
628.5

This thesis was prepared and submitted in partial fulfilment of the Master's Degree in Environmental Engineering and Management to the Civil Engineering Department of the Faculty of Engineering, University of Moratuwa, Sri Lanka.

67400

This thesis, "**Recipient Based Environmental Management Plan for an Industrial Estate**", is hereby approved as partial fulfilment of the requirement for the degree of Master of Engineering in Environmental Engineering and Management.

Department of Civil Engineering
University of Moratuwa
Moratuwa

UOM Verified Signature

Thesis ~~Advisor~~

University of
Electronic Th
www.lib.mrt.

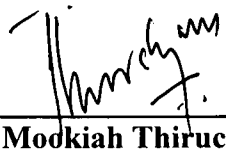
UOM Verified Signature

Head of the Department

Date: 06/06/17

DECLARATION

This thesis has not been previously presented in whole or part to any university or institute for a higher degree.



Mookiah Thiruchelvam
September, 1997

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

ACKNOWLEDGEMENT

This research was conducted under the supervision of Dr S Bhuvendralingam, senior lecturer, University of Moratuwa to whom I am most grateful for his support and guidance during every phase of my research. I also wish to express my gratitude to the course co-ordinator, Prof (Mrs) N Ratnayaka for giving her generous support whenever needed.

This study could never have been completed satisfactorily without the help of many others and I would like to take this opportunity to thank them, most sincerely.

I would like to gratefully acknowledge the financial assistance and facilities given towards the successful completion of this study by the Natural Resources and Environmental Policy Project of the United States Agency for International Development (NAREPP - USAID) Sri Lanka and greatly appreciate the encouragement given by its staff.

I like to place on record my appreciation to the University of Moratuwa for providing the opportunity to carry out this research and enabling me to use their library facilities.

I wish to thank the Metropolitan Environmental Improvement Programme -Colombo for the use of their resources and Dr Ravi Pereira for help in editing and final preparation of this document.

Finally, I owe a deep dept of gratitude to my parents and my wife Vathsalyaharini for the constant encouragement and assistance given throughout the study.

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

ABSTRACT

The Government of Sri Lanka (GOSL) has committed itself to establish 15 or more industrial estates through the Ministry of Industrial Development (MID) at various locations in the island. These industrial estates would house medium and high polluting industries and have central effluent treatment facilities. The GOSL has two main objectives in embarking on this course of action. The first being to generate employment in rural areas by promoting regional development and the second being to minimise the impact of industrial pollution on the environment.

The objective of this research was to provide inputs into a conceptual - internal environmental management plan for an actual industrial estate (Waljapala Watta - near Minuwangoda in the Gampha district) identified by the MID. Central to this was the development of an empirical model that could be used to determine the mix of industries that would best suit the location based on the carrying capacity of the environment. For simplicity and clarity in developing the model only two parameters namely air and water quality were considered which are the two important criteria in Sri Lanka's context.

Data for development of the model, and specifically for Waljapala Watta, was taken from the initial environmental examination conducted by the Natural Resources and Environmental Policy Project (NAREPP) team. Probable values with reasons for using them were utilised in instances where data was not available.

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations

The conclusion that was derived from the model was that this method could be used empirically for determining the mix of the industries for a given location as well as to assess the risk levels involved based on the carrying capacity of the natural environment. For Waljapala Watta the model predicts that the best industrial mix would be any dry processing industries due to the reason that the carrying capacity of the nearest water body Mapalam Oya has a limited carrying capacity based on its minimum flow rates.

Table of Contents

Acknowledgement i
Abstract ii
Table of Contents iii
List of Acronyms v
List of Tables vi
List of Figures vii

1. INTRODUCTION 1

1.1. THE PROBLEM 1
1.2. RESEARCH OBJECTIVES 1
1.3. APPROACH (SCOPE OF WORK) 2
1.3.1. Background 2
1.3.2. Research Methodology 3
1.3.3. Scope of the Research 3
1.3.4. Assumptions 4
1.3.5. Organisation of the Report 4

2. LITERATURE REVIEW 8

2.1. INDUSTRIAL ESTATE -CONCEPT 8
2.1.1. Clustering Industries 8
2.1.2. Site Selection 9
2.1.3. Policy on Industrial Estate 10
2.2. INDUSTRIAL ESTATE DEVELOPMENT AND EIA 10
2.2.1. Scope of the Present EIA Process 10
2.3. CARRYING CAPACITY 11
2.3.1. The Concept of Carrying Capacity 11
2.3.2. Previous Studies Based of Carrying Capacity 12
2.3.3. Improvement Suggested in the Present Study 12

3. ANALYTICAL METHODOLOGY 13

3.1. INTRODUCTION 13
3.2. AIR QUALITY MODEL 13
3.2.1. Theory 13
3.2.2. The Brookhaven Modification: 14
3.2.3. Development of the Model: 15
3.2.4. Example: 17
3.3. WATER QUALITY MODEL: 22
3.3.1. Theory 22
3.3.2. One-Dimensional Modelling Approach 22
3.3.3. Development of the Model: 24
3.3.4. Example: 28

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations

4. RESULTS **46**
4.1. AIR QUALITY: 46
4.2. WATER QUALITY: 46
5. DISCUSSION **47**
5.1. RECOMMENDATION TO A MANAGEMENT PLAN 47
6. CONCLUSIONS AND RECOMMENDATIONS **49**
6.1. CONCLUSIONS 49
6.2. RECOMMENDATIONS 49
7. REFERENCE **51**
8. ANNEXES **52**

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

List of Acronyms

BOD	Bio-chemical Oxygen Demand
BOI	Board of Investment
CEA	Central Environmental Authority
d	day
DFCC	Development Finance Corporation of Ceylon
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
FTZ	Free Trade Zone
g	gramme
GOSL	Government of Sri Lanka
ha	hectare
IDB	Industrial Development Board
IEE	Initial Environmental Examination
km	kilometre
l	litre
LA	Local Authority
m	metre
max	maximum
mg	milligrammes
MID	Ministry of Industrial Development
min	minimum
NAREPP	Natural Resources and Environmental Policy Project
NBRO	National Building Research Organisation
NDB	National Development Bank
°C	° Celsius
RISC	Regional Industrial Service Committee
s	seconds
SPM	Suspended Particulate Matter
t	tonne
UDA	Urban Development Authority
USAID	United States Agency for International Development

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations

List of Tables

Table 1	Rating Of Sites According To Pollution Assimilative Capacity And Resource Availability	6
Table 2	Pasquill Stability Types (Peavy, Et Al., 1985	14
Table 3	Brookhaven Diffusion Parameters [CISIR Paper]	15
Table 4	Input Data For Air Quality	19
Table 5	Calculations For Carrying Capacity	19
Table 6	Calculations For Carrying Capacity (Contd.)	20
Table 7	Input Data For Waljapala Watta	28
Table 8	Mapalam Oya Calculation For Minimum Flow	30
Table 9	Mapalam Oya Calculations At Average Flow Condition	32
Table 10	Dadugam Oya Calculations For Average Flow Condition	34
Table 11	On Site Drain At Average Flow Calculation	36
Table12	Carrying Capacity For Mapalam Oya At Minimum Flow Condition	39
Table13	Carrying Capacity For Mapalam Oya At Average Flow Condition	41
Table14	Carrying Capacity For Dadugam Oya At Average Flow Condition	43
Table15	Carrying Capacity For Onsite Drain	45
Table 16	Carrying Capacity For Waljapala Watta - Air Quality	46
Table 17	Carrying Capacity For Different Water Bodies	46

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

List of Figures

Figure 1	Summary Of Current Process For Siting Industrial Estates In Sri Lanka	5
Figure 2	Research Methodology	7
Figure 3	Location Map For Waljapala Watta	18
Figure 4	Carrying Capacity Based On Different Pollutants	21
Figure 5	Typical Oxygen Sag Curve Using The Equation 3.3.4	24
Figure 6	Carrying Capacity - Mapalam Oya Minimum Flow Condition	38
Figure 7	Carrying Capacity - Mapalam Oya Average Flow Condition	40
Figure 8	Carrying Capacity - Dadugam Oya Average Flow Condition	42
Figure 9	Carrying Capacity - Onsite Drain	44
Figure 10	The Proposed Method For Industrial Siting And Determining Carrying Capacity	50

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk