

JAPAN INTERNATIONAL COOPERATION AGENCY
MINISTRY OF HOUSING AND URBAN DEVELOPMENT
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

THE STUDY
ON
GREATER KANDY AND NUWARA ELIYA
WATER SUPPLY
AND
ENVIRONMENTAL IMPROVEMENT PLAN
IN
THE DEMOCRATIC SOCIALIST REPUBLIC
OF
SRI LANKA

VOLUME IV

NUWARA ELIYA
(MAIN REPORT)

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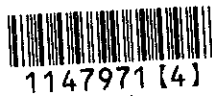
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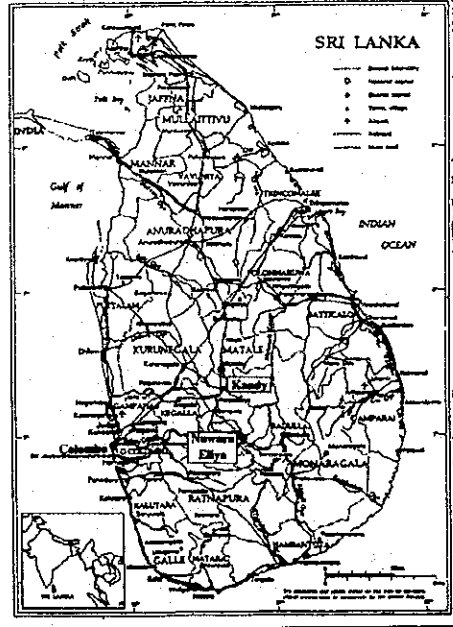
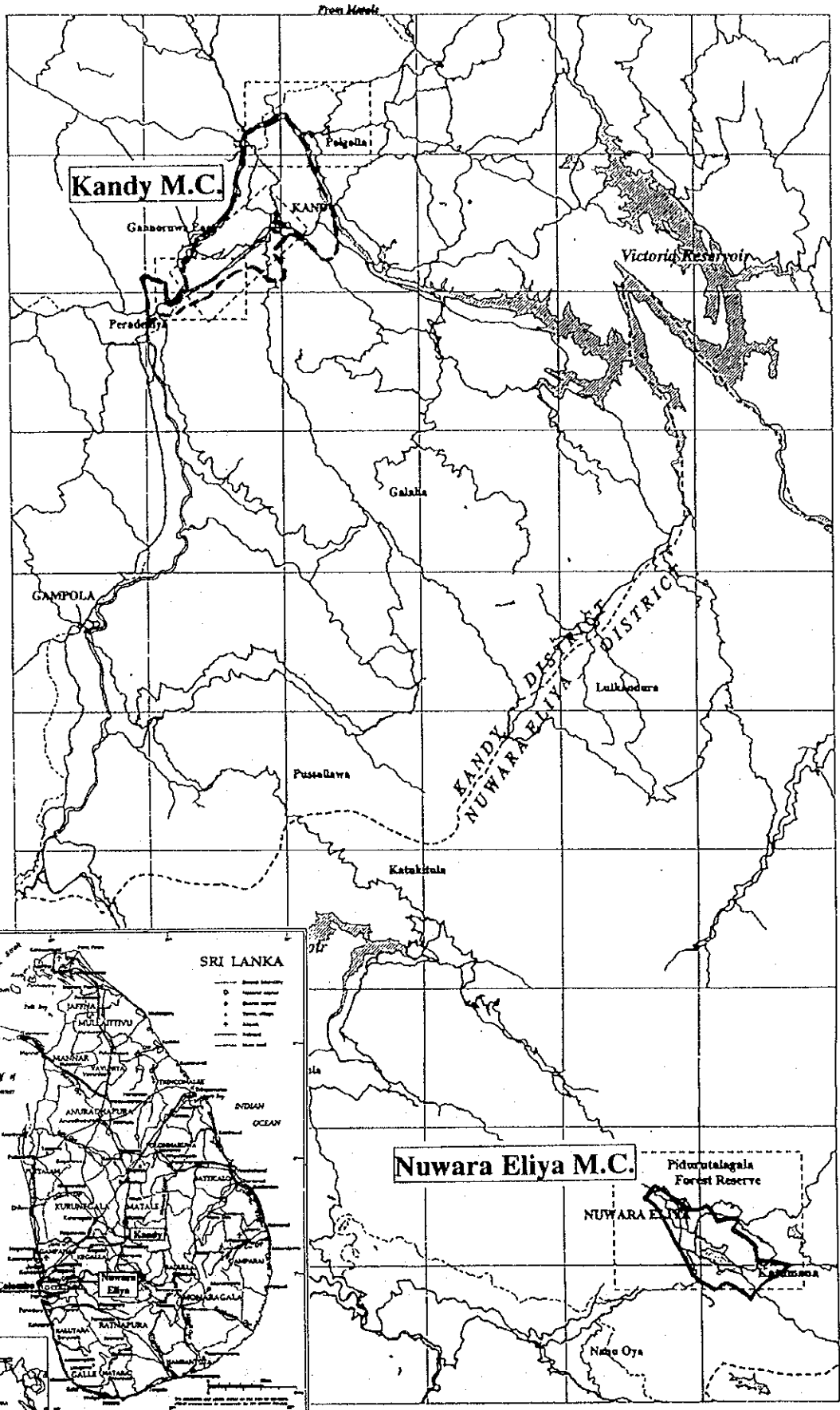
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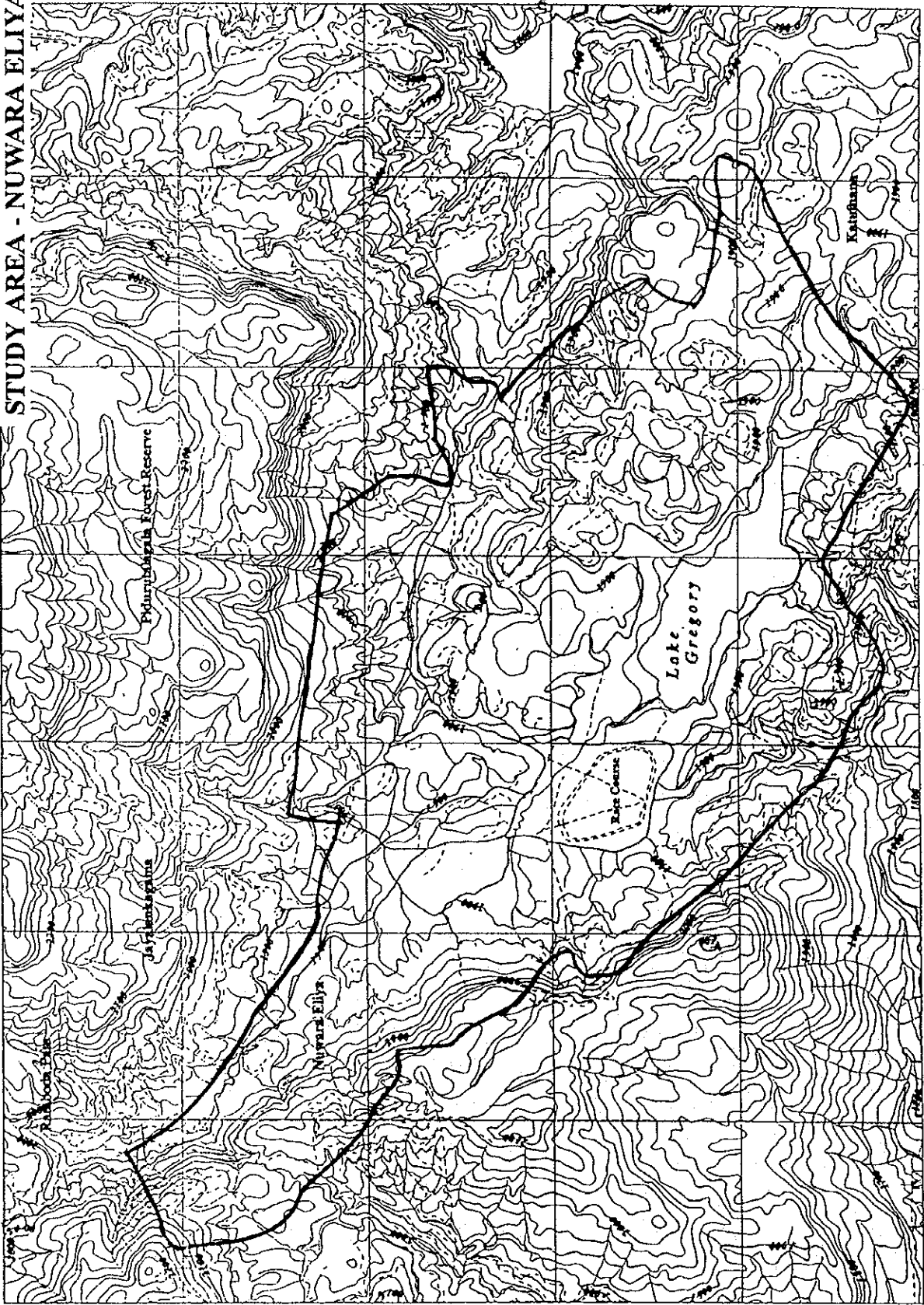


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LOCATION MAP OF STUDY AREA



STUDY AREA - NUWARA ELIYA



**GREATER KANDY AND NUWARA ELIYA
WATER SUPPLY AND ENVIRONMENTAL IMPROVEMENT PLAN**

**VOLUME IV
(MAIN REPORT, NUWARA ELIYA)**

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ABBREVIATIONS AND ACRONYMS

1. Unit

cm	centimeter
ft.	foot
g	gram
gpcd	gram per capita per day
ha	hectare (1 ha = 10,000m ²)
hr	hour
kg	kilogram
km	kilometer
km ² , or sq.km	square kilometer
kV	kilovolt
kW	kilowatt
kWh	kilowatt hour
l, or L	liter
l/day, or l/d	liter per day
l/sec, or l/s	liter per second
lpcd, or Lpcd	liter per capita per day
m	meter
m/s, or m/sec	meters per second
m ² , or sq.m	square meter
m ³ , or cu.m	cubic meter
m ³ /d, or cu.m/day	cubic meter per day
m ³ /min	cubic meter per minute
m ³ /s, or cu.m/sec	cubic meter per second
MCM	million cubic meter
mgd	million gallons per day
mg/l	milligram per liter
mm	millimeter
Mpa	megapascal
ppm	parts per million
Rs.	Sri Lankan Rupee
V	volt

2. Water Quality

BOD ₅	Biochemical Oxygen Demand (20°C, 5 days)
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
EC	Electrical Conductivity
pH	Hydrogen ion potential
SS	Suspended Solids
TS	Total Solids

3. Organizations

ADB	Asian Development Bank
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
CPC	Central Provincial Council
FINNIDA	Finnish International Development Agency

GS	Gramasevaka Divison (local administrative unit)
IBRD	International Bank for Reconstruction and Development (World Bank)
ICC	Interagency Co-ordinating Committee
IDA	International Development Association (soft loan facility of IBRD)
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency (Japan)
KMC	Kandy Municipal Council
MASL	Mahaweli Authority of Sri Lanka
MHUD	Ministry of Housing and Urban Development
MOF	Ministry of Finance
MSL	Mean Sea Level
NEMC	Nuwara Eliya Municipal Council
NHDA	National Housing Development Authority
NJS	Nippon Jogesuido Sekkei Co., Ltd.
NWSDB, or NWS&DB	National Water Supply and Drainage Board
OECD	Organization for Economic Cooperation and Development
OECF	Overseas Economic Cooperation Fund (Japan)
PS	Pradeshiya Sabha (local administrative unit)
RDA	Road Development Authority
RSC	Regional Support Center, NWSDB
UC	Urban Council
UDA	Urban Development Authority
UNDP	United Nations Development Program
UNICEF	United Nations International Children's Emergency Fund
USAID	United States Agency for International Development
WHO	World Health Organization
WRC	Water Resources Council
WRS	Water Resources Secretariat

4. Others

BOT	Build - Operate - Transfer
BWL	Bottom Water Level
CED	Central Environmental Division
CPI	Consumer Price Index
EAC	Environmental auditing Commission
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
FY	Fiscal Year
GDP	Gross Domestic Product
GL	Ground Level
GNP	Gross National Product
GST	Government Sales Tax
HWL	High Water Level
HH	Household
IBE	Initial Environmental Examination
LWL	Low Water Level
L/S	Lift Station
NGO	Non-Governmental Organization
NRW	Non-revenue Water
ODA	Official Development Assistance
PEU	Project Environmental Unit

P/S	Pumping Station
SLS	Sri Lankan Standards
STP	Sewage Treatment Plant
T.A	Technical Assistance
TWL	Top Water Level
UFW	Unaccounted-For-Water
VAT	Value Added Tax
WID	Women in Development
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant (=STP)

PART 1

GENERAL

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Preamble

The Study on Greater Kandy and Nuwara Eliya Water Supply and Environmental Improvement Plan (hereinafter referred to as "the Study") was carried out in accordance with the Scope of Work agreed between the Ministry of Housing and Urban Development (hereinafter referred to as "MHUD") and the Preparatory Study Team dispatched by the Japan International Cooperation Agency (hereinafter referred to as "JICA") on October 2, 1997. JICA had organized the Japanese Study Team (hereinafter referred to as "the Study Team") and dispatched to commence the Study from February 1998. The Study was completed on January 1999 and the entire outcome was compiled into this Report.

1.2 Background of the Study

The Greater Kandy area is located some 120 km from Colombo, capital of Sri Lanka. The Greater Kandy area has a population of 630,000 (1995) with an area of 460 km². Nuwara Eliya located approximately 80 km south of the Greater Kandy area has a population of 34,000 (1995) and an area of 12.6 km². Both areas are functioning as centers of tourism and local industries in Sri Lanka. Kandy in particular boasts cultural assets and Nuwara Eliya has famous tea plantations.

In recent years, population of the Greater Kandy area has grown rapidly to the point that water demand now exceeds that of water supply capacity. In 1994, the National Water Supply and Drainage Board (hereinafter referred to as "the NWSDB") prepared the "Water Supply Master Plan for Greater Kandy" under the financial assistance of the Finnish International Development Agency (hereinafter referred to as "FINNIDA"). However, its implementation has been suspended due to financial constraints. A pre-feasibility study of the sewerage system in the area was also prepared by the NWSDB, and although the environmental situation is not good because of the lack of a proper sewage treatment system, its implementation, however, has also been suspended.

In Nuwara Eliya, the water supply status is worse than the Greater Kandy area in general because the yield of existing water sources is much less than the present water demand in the dry season. The sanitation system in the area is also poor because of the lack of a proper

sewage treatment system.

Because of the aforementioned situation the Government of the Democratic Socialist Republic of Sri Lanka (hereinafter referred to as "the Government of Sri Lanka") requested the Government of Japan to grant technical co-operation to conduct the "Study on Greater Kandy and Nuwara Eliya Water Supply and Environmental Improvement Plan" in the Democratic Socialist Republic of Sri Lanka (hereinafter referred to as "the Study"). In response to the request of the Government of Sri Lanka the Government of Japan decided to conduct the Study.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical co-operation programs of the Government of Japan, commenced the Study, in close co-operation with the concerned authorities of the Government of Sri Lanka.

JICA dispatched the preparatory study team to identify the Scope of Work for the Study. On the basis of the Scope of Work agreed upon between the NWSDB and JICA on 2 October 1997 in Colombo, JICA made a contract with Nippon Jogesuido Sekkei Co., Ltd. on 30 January 1998 to conduct the Study.

1.3 Objectives of the Study

The objectives of the Study are:

- a. To formulate a Water Supply and Sewerage Master Plan up to the target year of 2015.
 - to review and complement the existing Water Supply Master Plan for Greater Kandy.
 - to formulate a Master Plan for Nuwara Eliya.
- b. To conduct a Feasibility Study for the priority project/s identified in the Master Plan
- c. To enable the transfer of technology to the NWSDB personnel in the course of the Study.

1.4 Scope of Work

In order to achieve the objectives outlined in Section 1.2, the Scope of Work for the Study includes the following items:

Phase I : Formulation of Master Plan

Collection and analysis of existing data and information on the water supply and sewerage sector:

The National Background:

- a. Country background
- b. Socio-economic and health indicators
- c. Sector organizations and institutions
- d. Present service coverage and standards
- e. Sector goals
- f. Financial conditions
- g. Involvement of other donor agencies

The study area:

- a. Natural conditions
- b. Socio-economic and health conditions
- c. Regional development prospects
- d. Existing and future use
- e. Water resources
- f. Sector organizations and institutions
- g. Management and budget conditions of the organizations
- h. Present service coverage and standards
- i. Environment and ecosystem

Understanding of the Existing services:

- a. Existing water supply system and its service level
- b. Existing sanitation drainage and solid waste services

Field surveys and analysis:

- a. Preliminary environmental survey
- b. Survey on public consciousness on public health and sanitation
- c. Survey on willingness and affordability to pay
- d. Water and wastewater quality

Formulation of Master Plan:

- a. Determination of planning framework
- b. Determination of basic policies, goals, targets and strategies
- c. Identification of the alternatives
- d. Outline design for suggested facilities
- e. Cost estimates
- f. Evaluation of the alternative
- g. Selection of the best alternative
- h. Organizational and institutional projection
- i. Capacity building program
- j. Financial plan
- k. Staged implementation plan
- l. Identification of the priority project/s

Phase II: Feasibility Study on the Priority Project/s

Collection and analysis of supplementary data and information on the Project area and beneficiaries:

Supplementary field survey/s, as necessary:

- a. Implementation of feasibility Study
- b. Preliminary design of facilities
- c. Equipment plan
- d. Operation and maintenance plans
- e. Organizational and institutional systems
- f. Tariff, charges and revenue systems for services
- g. Cost estimation
- h. Conduct of Environmental Impact Assessment (EIA)
- i. Comprehensive project evaluation including:
 - technical aspects (appropriate technology)
 - financial aspects
 - social aspects
 - economic aspects
- j. Implementation plan

1.5 Study Area

The study covers the following areas:

- 1) Greater Kandy area consisting of following:
 - a. Kandy Municipal Council area
 - b. a part of Kandy Four Gravets P/S
 - c. a part of Harispattuwa P/S
 - d. a part of Akurana P/S
 - e. a part of Pujapitiya P/S
 - f. a part of Patha Dumbara P/S
 - g. a part of Udunuwara P/S
 - h. a part of Yatinuwara P/S
 - i. a part of Udapalatha P/S
 - j. a part of Kundasale P/S
 - k. a small part of Patha Hewahera
- 2) Nuwara Eliya Municipal Council area

1.6 Target Year

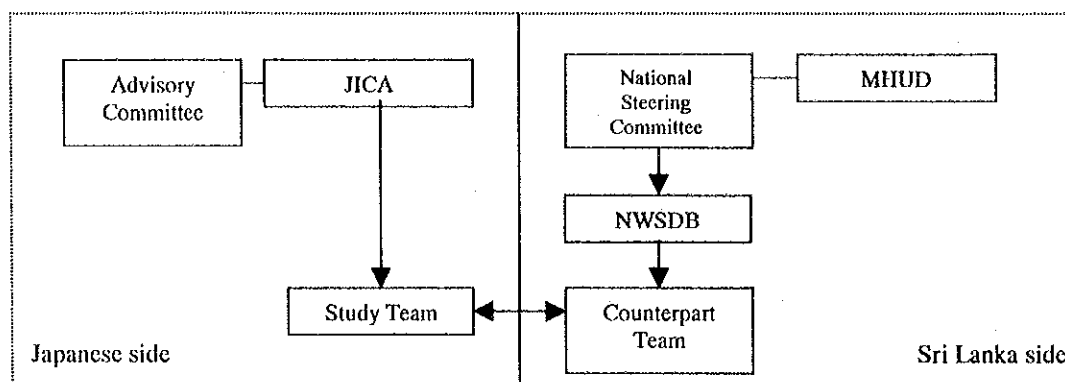
The target year of the master plans is year 2015. However, projections of served population and water demand was extended until the year 2020.

The Target year for the priority projects was set at the year 2005.

1.7 Formation of the Study

1.7.1 General

The Study was carried out in accordance with the Scope of Work agreed upon between the MHUD and JICA. The MHUD had organized the national steering committee and counter-part team, and accomplished the Study in close cooperation with the Study Team. The overall set-up for the implementation of the Study is as shown below.



1.7.2 Implementation Set-up of Japanese Side

The implementation set-up of the Japanese side consisted of the Study Team and the Advisory Committee under the general supervision of the JICA headquarters. The composition of the JICA Advisory Committee is shown below:

Mr. Yoshiki Omura	Chairperson,	Development Specialist, Institute for International Cooperation, JICA
Mr. Ichiro Harada	Committee Member Sewerage & Sanitation	Senior Researcher, Public Works Research Institute, Ministry of Construction, Japan
Mr. Atsushi Sato	Committee Member Water Supply	Planner, Water Supply Bureau, Enterprise Agency, Kanagawa Pref.

Composition of the Study Team is shown below.

Mr. Takafumi Kiguchi	Team Leader
Mr. John M. McGill	Water Supply Planning
Mr. Shigeo Sawai	Water Supply Facility Design - 1
Mr. Masaya Goto	Water Supply Facility Design - 2
Mr. Shin-ichi Osaka	Sewerage & Sanitation Planning
Mr. Richard R. Deussen	Sewerage & Sanitation Facility Design - 1
Mr. Toru Yagi	Sewerage & Sanitation Facility Design - 2
Mr. Hidemasa Sato	Geophysical Survey
Dr. James Wilkinson	Hydrogeology
Dr. Giovanni Crema	Environmental Impact Assessment
Mr. Wilfrido Barreiro	Institution / Organization
Mr. Kunimasa Nishigaya	Finance / Administration

1.7.3 Implementation Set-up of Sri Lanka Side

The implementation set-up of Sri Lanka side consists of the MHUD, the NWSDB, NWSDB counterpart personnel, and the National Steering Committee for the Study composed by representatives from authorities concerned. Overall coordination of the Steering Committee was handled by the MHUD.

The Steering Committee was organized by following representatives of relevant authorities.

Ministry of Housing and Urban Development

Mr. V. K. N. Nanayakkara	Secretary
Mr. C. H. de Tissera	Additional Secretary (Technical)
Mr. T. B. Madugalle	Consultant
Mr. Padmasiri Perera	Director (Construction)
Mr. K. T. P. Fernando	Deputy Director (Construction)

Ministry of Finance

Mr. J. H. J. Jayamaha	Director, External Resources
Ms. M. Karunaratne	Director, National Planning

Central Provincial Council

Mr. K. B. Sirisena	Chief Secretary
--------------------	-----------------

Kandy Municipal Council

Ms. J. C. Bulumulla	Municipal Commissioner
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Nuwara Eliya Municipal Council

Mr. S. D. Piyadase	Municipal Commissioner
--------------------	------------------------

National Water Supply and Drainage Board

Dr. N. S. K. N. de Silva	Chairman
Mr. W. A. Karunaratne	General Manager
Mr. K. M. N. S. Fernando	Additional General Manager, Planning and Monitoring
Mr. S. K. H. Perera	Deputy General Manager, Planning and Design
Mr. D. N. J. Ferdinando	Assistant General Manager, Japanese Project Unit
Ms. M. K. Bandara	Assistant General Manager, Planning and Design

Counterpart personnel were shown below.

Mr. P. H. Sarath Gamini	Project Manager/Chief Engineer, Planning and Design, NWSDB
Mr. S. R. Ranasinghe	Engineer, P&D, NWSDB
Mr. H. D. J. Dharmapala	Engineering Assistant, P&D, NWSDB

1.8 Organization of the Reports

The reports of the Study in the English language were compiled in the following five volumes:

- Volume 1 Summary Report
- Volume 2 Main Report (Greater Kandy)
- Volume 3 Supporting Report and Data (Greater Kandy)
- Volume 4 Main Report (Nuwara Eliya)
- Volume 5 Supporting Report and Data (Nuwara Eliya)

The Summary Report presents an abridge overview of the major study results for both study areas, while the Main Reports (Volumes 2 and 4) present the overall results of the Study for each study area. Detailed discussions, appendices, and field data are contained in the Supporting Report and Data for each study area (Volumes 3 and 5). The organizational structure of the reports requires that certain portions are repeated in different volumes.

CHAPTER 2 DESCRIPTION OF THE STUDY AREA

CHAPTER 2 DESCRIPTION OF THE STUDY AREA

2.1 General Outline of the Study Area

2.1.1 Administrative Overview and Current Sector Policies and Strategy

The Government of Sri Lanka has adopted the “some (water) for all” global strategy recommendation follows the Water and Sanitation Decade of the 1980’s. The current estimate of annual capital investments to achieve this sector’s objective by 2010 is in the order of Eight Billion Rupees. Water demand has accelerated with urbanisation and economic growth and the Government has adopted medium-term policies and strategies to address this challenge.

To improve the quality of projects, new criteria for assessing their financial viability have been formulated. Water tariffs are gradually being adjusted to reflect real production costs. To increase the operating efficiencies of the various utilities, initiatives towards reducing unaccounted-for-water have been emphasised. The Government has instituted a policy of providing a capital development grant subsidy of up to 50% of project costs in urban areas or 85% subsidy in rural areas. The loan component is provided at the rate of 10% p.a. over 24 years with a 2-year grace period (interest rate reduced from 12% p.a. in June 1998). The Government also seeks to promote and attract the participation of the private sector and community organisations in facilities construction, operation and maintenance. To improve project affordability, the Government has called for the adoption of appropriate and effective low-cost technologies and methods for service provision.

2.1.2 Relevant Sector Legislation

The **National Water Supply and Drainage Board Law (Act No 2 of 1974)**, as amended, established and directed the NWSDB to develop and manage a co-ordinated national program for water supply and sewerage for the entire country. Significantly, the Law empowers the Board to take over existing systems from local authorities under voluntary or compulsory transfer orders. The Board is also authorised to operate as a water and sewerage utility, providing services either directly to customers or through bulk supplies to local authorities, government agencies or any other organisation, who can manage the distribution of water. Many of the poorly managed and deteriorated water systems were transferred to the Board, thus increasing its utility management, operation and maintenance responsibilities. The Board has become the lead agency for planning, design and implementation of urban and rural water supplies, providing technical assistance and services to local authorities.

The **National Environmental Act (Act No. 47 of 1980)**, as amended, created the Central Environmental Authority (CEA). The CEA is mandated to protect, manage and enhance the environment; regulate, maintain and control the quality of the environment; and prevent, abate and control pollution. The Act vests broad powers and authority to the CEA and the inter-ministerial Environment Council. The CEA is responsible for formulating policy recommendations affecting natural resources, fisheries, wildlife, forestry and soil conservation. Licenses and permits are required from the CEA for discharging wastes to the environment. The CEA reviews and approves all projects.

2.1.3 Key Sector Agencies

The **Ministry of Housing and Urban Development** has the overall responsibility for promoting, guiding and co-ordinating the development of human settlements, land reclamation and the construction industry. The development of urban centres and the required urban infrastructure, including water and wastewater facilities, is a critical function. There are several authorities under its administrative control, including the *National Water Supply and Drainage Board*. The NWSDB, described in the preceding section, has decentralised its operations to five (5) Regional Support Centres and several regional and district offices. Also under the Ministry are: the *National Housing Development Authority* which is tasked with developing housing projects; the *Urban Development Authority* which is entrusted with the responsibility for integrated planning and development of socio-economic and physical infrastructure; and the *Town and Country Planning Department*, which plans (and implements) new town development schemes.

The **Ministry of Health and Women's Affairs** is responsible for the national health policy including the implementation of sanitation and hygiene education programs. The Ministry also exercises regulatory functions over water supply provision, solid waste management and pollution abatement, insofar as they affect environmental health conditions. The Ministry, through its provincial offices, undertakes a national sanitation program in co-ordination with the health departments of the various local authorities. The Ministry provides incentives for households to construct hygienic sanitary facilities.

The *Mahaweli Authority of Sri Lanka* under the **Ministry of Irrigation** administers the Mahaweli Development Program. It is tasked to lead the integrated development within the river basin. It is developing several irrigation and hydroelectric power generation projects

through dams and barrages along the Mahaweli River. The Authority monitors the quality and flow of the river and regulates the withdrawal and discharge of water.

The *Central Environmental Authority* of the **Ministry of the Environment** is responsible for, among others, water pollution control policies and standards. It undertakes a quality surveillance program for regulation and enforcement of policies and standards.

The *Department of External Resources* of the **Ministry of Finance** assesses the foreign exchange requirements; co-ordinates with external support agencies and negotiates for grant and loan financing facilities for priority projects of the various ministries. It also reviews the utilisation of external assistance funds. The principal sources of multilateral loans for water supply and sanitation in Sri Lanka are the IDA/World Bank and the ADB. The governments of France, Finland and Japan have provided significant grant funds and loans for capital improvements, rehabilitation and technical assistance.

In 1993-94, ADB and USAID assisted a project to assess and prepare an institutional strengthening and capacity building plan for the entire water resources sector. This project produced a "*Strategic Framework and an Action Plan for Comprehensive Water Resources Management*". A high-level *Water Resources Council (WRC)* was organised to oversee the Action Plan implementation and to co-ordinate resolution of inter-sectoral and intra-sectoral issues. The Council consists of six (6) Cabinet Secretaries, two (2) representatives each from the private sector and the NGO sector, one (1) representative each from the academe, from farmers' groups and from the National Planning Department of the Ministry of Finance. A *Water Resources Secretariat (WRS)* was established to support the work of the WRC. In addition, an *Interagency Co-ordinating Committee (ICC)*, consisting of selected water agency heads, was also organised to ensure the technical soundness of the decisions and actions taken. The expected final outputs of this initiative are:

- a national policy for comprehensive water resources management;
- recommendations for improved information systems for the water sector;
- a model for integrated river basin planning;
- an institutional framework for co-ordination within the water sector;
- improved skills through capacity building programs; and
- a framework for public participation in planning, implementation and monitoring.

2.1.4 Local Administrative Overview

In Sri Lanka, the general administrative or executive structure may be described through three (3) administrative structures.

(1) Central Structure.

The elected *President* appoints *Cabinet Ministers* (including the Prime Minister) from among the members of Parliament, to head the various ministries. For each of the ministries, a senior official is designated as *Secretary* to manage its activities. The ministries have departments, semi-government corporations and/or public enterprises under them to perform their functions. In most instances, the departments and corporations may even have offices located at the lower levels – up to divisional levels.

(2) Provincial Structure.

The President is also empowered to appoint *Governors* for each province. The 13th Amendment to the present Constitution calls for the *devolution* of powers and responsibilities to the lower levels of government. The powers and responsibilities devolved include: education, police, law and order, housing and construction, health, irrigation, land development, plan implementation and local government. *Provincial Council* members are elected for 4-year terms to oversee these devolved functions. Following the central-level structure, the Governor appoints Provincial Ministers, including a Chief Minister, from among the Provincial Council members.

(3) Local Government Structure.

- 1) Pradeshiya Sabha (PS's) or rural local authorities were established by law in 1987. Headed by an elected Chairman, the PS has broad powers and service functions. The PS can levy fees, raise taxes and adopt regulations.
- 2) Municipal Councils (MC's) and Urban Councils (UC's), also established by law, function in urban areas and have similar powers and responsibilities as the PS's. The Mayor is the chief executive of the MC, assisted by a Municipal Commissioner; while the UC has a Chairman, assisted by a Secretary.

The *Divisional Secretary (DS)* is the key link among the three administrative structures. The DS functions as the Additional Government Agent under the central Ministry of Public Administration, Provincial Councils and Home Affairs. The functions of the Provincial Departments at the Divisional Level are all (with few exceptions) performed by the DS. At the same time, the DS acts as the Assistant Commissioner of Local Government. At the village

level, the *Grama Niladhari* assists the DS in co-ordinating and delivering the services in one or more villages.

2.1.5 Administrative Composition of the Nuwara Eliya Study Area

The Study Area in Nuwara Eliya is administratively under the Nuwara Eliya Municipal Council. For purposes of this Study, the key administrative bodies involved are the Nuwara Eliya Municipal Council and the NWSDB. Information sharing, consultations and other administrative coordination were undertaken through the NWSDB, the lead Project counterpart.

2.2 Physical Characteristics of the Study Area

(1) Location

The Nuwara Eliya Municipality is located in the central highlands of Sri Lanka and 180 km due east of Colombo, the capital of Sri Lanka.

(2) Topography

The area lies at the foot of Pidurutalagala, the highest mountain of Sri Lanka, which rises to 2,240 m above mean sea level (amsl). The terrain consists of hills and valleys with elevations ranging from 1,800 m to 2,000 m amsl.

(3) Geology

Geomorphologically, the Nuwara Eliya area, located in the Central Province of Sri Lanka is a combination of highly variable landform units and topography. It is characterized by rugged mountain terrain, a level valley plain and immature drainage patterns.

The Nuwara Eliya area is underlain by Precambrian high-grade rocks belonging to the Highland Complex of Sri Lanka. These rocks have been metamorphosed at granulite facies conditions some. Charnockitic rocks are the most common in this area. Charnockitic rocks, particularly the acidic varieties (containing more silica) are resistant to chemical weathering and as a result they stand as topographically high features such as ridges and hills. A thin quartzite band runs east of the Nuwara Eliya Municipality. These rocks have first been folded into tight isoclinal folds and then into large open folds. The synform structures with axial planes running in the NW-SE are a result of the latter. In general (there are local variations), the strike direction of rock layers is N-S or NNW-SSE.

(4) Climate

Agro-ecologically, Sri Lanka, with an arial extent of 65,610 km², is divided into three zones, namely the wet zone, the intermediate zone and the dry zone. Nuwara Eliya falls within the intermediate zone and the most striking climatic features in Nuwara Eliya are the very frequent low intensity rainfalls and relatively low temperature when compared to the other parts of Sri Lanka. According to the report of the 5th International Meeting on Statistical Climatology, surface air temperature has recorded an increasing trend and annual rainfall has recorded a decreasing trend in the recent past in Nuwara Eliya. This phenomenon is also common to some other parts of Sri Lanka, Viz. Colombo, Ratnapura, Galle, Kandy, Batticaloa, Hambantota, Trincomalee and Badulla. A summary of the precipitation, relative humidity, sunshine and temperature data at Nuwara Eliya is presented in Table 2.1.

Due to the Presence of mountain barriers, Nuwara Eliya often experiences orographic precipitation. The moist clouds are lifted to higher altitudes and consequently undergo cooling, condensation and precipitation. Such precipitation is known as orographic precipitation. Nuwara Eliya has nearly 200 rainy days per year. Generally, mean monthly rainfall exceeds 150 mm except for the months of December, January, February, March and April. Though the number of rainy days are high, Nuwara Eliya experiences severe dry spells during February, March and April of certain years. Monthly precipitation varies between 42.1 mm in March and 263.9 mm in October.

Table 2.1 Meteorological Data in Nuwara Eliya

STATION NAME : NUWARA ELIYA
 LAT: 6.97N LON: 80.77E ELEV: 1894.6M
 ELEMENT : Precip, Monthly in Millimeters

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1987	106.5	7.7	47.4	168.0	200.8	172.3	4.0	177.3	180.1	358.9	255.1	76.4	1,754.5
1988	18.9	71.5	78.9	293.4	114.4	115.3	293.3	150.0	219.2	16.4	238.9	129.6	1,739.8
1989	139.4	22.9	58.9	70.3	273.4	201.8	530.6	144.5	217.1	270.2	228.0	95.8	2,252.9
1990	262.2	55.3	61.0	37.3	257.6	270.9	76.2	115.7	49.9	221.1	138.8	216.2	1,762.2
1991	196.3	15.4	44.3	46.7	129.4	297.3	150.8	103.7	187.8	244.3	185.0	235.6	1,836.6
1992	51.8	0.0	0.0	80.4	106.9	223.8	332.3	159.8	104.2	205.3	437.6	140.3	1,842.4
1993	36.6	56.0	35.4	29.5	298.6	332.3	264.8	43.6	108.7	402.0	258.2	232.1	2,097.8
1994	190.6	182.5	37.5	94.1	152.2	114.3	269.8	235.0	211.2	397.3	294.3	124.6	2,303.4
1995	105.3	48.7	51.6	223.8	308.3	288.4	125.1	221.2	155.2	312.4	155.6	92.1	2,087.7
1996	157.3	77.3	5.8	260.0	118.0	216.1	376.5	205.9	276.5	210.9	208.0	61.4	2,173.7
1997	1.3	18.7	29.0	220.1	163.8	115.3	110.7	71.9	330.4	447.5	289.8	229.5	2,028.0
Mo. Avg.	126.5	53.7	42.1	130.4	196.0	223.3	242.3	155.7	171.0	263.9	240.0	140.4	1,985.1

STATION NAME : NUWARA ELIYA
 ELEMENT : Mean Relative Humidity in Percent - the average of Rel Humidity at 03 and 12 hrs GMT

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr. Avg.
1987	86.0	65.0	69.3	77.1	78.2	86.2	75.9	89.7	83.6	89.4	89.0	83.9	81.1
1988	78.9	75.1	72.0	82.0	85.9	86.0	88.5	89.3	89.2	77.2	83.3	85.7	82.8
1989	82.0	57.6	57.8	71.3	88.5	90.3	89.8	87.6	88.8	86.4	85.8	82.6	80.7
1990	71.8	83.3	77.4	70.9	86.9	89.0	87.8	86.0	83.0	85.3	86.0	89.4	83.1
1991	83.1	65.3	67.9	75.1	80.6	89.5	85.3	89.3	84.0	89.1	87.0	87.3	82.0
1992	79.6	61.0	49.0	69.4	83.5	86.3	91.1	88.6	88.6	82.5	88.8	88.0	79.7
1993	75.4	67.2	65.4	71.9	85.2	87.1	91.8	86.9	85.1	89.0	87.6	90.8	81.9
1994	85.7	76.8	68.7	78.2	82.2	87.7	91.5	87.2	86.5	90.1	91.0	88.3	84.5
1995	85.3	80.6	63.0	84.4	87.3	91.1	88.6	88.2	88.0	87.5	84.1	83.0	84.3
1996	83.9	78.3	65.2	83.3	76.8	86.5	89.6	91.0	92.4	81.6	81.1	81.7	82.6
Mo. Avg.	81.2	71.0	65.6	76.4	83.5	88.0	88.0	88.4	86.9	85.8	86.4	86.1	82.3

STATION NAME : SITA ELIYA,AGMET
 LAT: 6.93N LON: 80.80E ELEV: 1860.0M
 ELEMENT : Sunshine, Monthly in Hours

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1987	176.5	238.9	537.8	193.6	188.2	164.3	244.7	153.0	188.9	102.4	121.5	190.4	2500.2
1988	159.3	207.9	222.2	163.0	145.6	128.7	134.7	127.9	132.0	200.9	153.8	136.0	1911.9
1989	179.4	240.7	247.7	196.7	163.1	142.5	134.6	155.0	149.3	130.6	143.2	150.4	2033.2
1990	223.1	155.5	196.5	212.1	93.2	62.6	18.0	130.0	104.9	115.5	125.8	85.4	1522.5
1991	168.8	229.3	237.1	225.0	199.0	94.4	111.6	108.9	160.1	75.8	155.4	114.0	1879.4
1992	195.6	276.7	285.0	219.3	159.3	139.3	69.0	143.0	92.6	146.2	107.3	102.2	1935.6
1993	200.2	237.9	254.9	206.0	150.6	246.1	104.4	163.3	134.8	107.8	183.2	72.7	2061.9
1994	123.9	173.2	345.9	201.5	187.7	146.8	95.6	151.6	139.5	109.8	93.1	149.6	1918.2
1995	210.2	181.8	242.9	202.6	182.0	83.5	157.1	141.1	140.7	131.9	147.5	201.8	2023.1
1996	256.0	156.6	511.1	182.6	271.2	279.8	65.4	187.7	54.9	152.9	241.8	176.1	2535.9
Mo. Avg.	189.3	209.9	308.1	200.2	174.0	148.8	113.5	146.2	129.8	127.4	147.3	137.8	2032.2
Day Avg.	6.1	7.5	9.9	6.7	5.6	5.0	3.7	4.7	4.3	4.1	4.9	4.4	5.6

STATION NAME : NUWARA ELIYA
 ELEMENT : Temperature, Monthly mean in Degrees C, Avg. of (Daily Max Temp + Daily Min Temp)/2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr. Avg.
1987	15.6	15.0	16.7	17.8	17.1	16.6	16.6	16.2	16.7	16.9	16.0	15.8	16.4
1988	15.4	16.5	17.6	17.5	17.6	16.5	16.1	16.1	15.8	16.3	15.9	14.8	16.4
1989	14.9	15.0	16.1	17.2	16.9	15.6	15.8	15.6	(16.1)	(16.1)	(15.9)	15.2	15.9
1990	14.7	16.4	16.8	17.7	17.1	15.8	15.6	15.5	(16.1)	16.5	15.8	15.4	16.1
1991	15.2	15.7	16.8	17.1	17.7	16.3	16.1	16.2	16.5	15.4	15.6	14.8	16.1
1992	14.6	14.4	16.5	17.6	17.1	15.8	15.5	15.7	15.7	15.4	15.8	14.9	15.7
1993	14.4	15.0	16.3	17.3	17.2	16.5	15.2	15.9	16.3	16.0	16.3	15.9	16.0
1994	15.5	15.8	16.2	17.0	17.4	16.0	15.7	15.8	(16.1)	(16.1)	(15.9)	15.8	16.1
1995	15.4	15.3	16.5	17.5	17.2	16.5	16.2	16.2	16.2	16.3	16.2	14.7	16.2
1996	14.5	15.6	16.4	17.2	17.8	16.5	15.5	15.7	15.7	15.8	15.9	15.2	16.0
1997	14.4	14.7	16.8	16.8	17.5	17.0	16.7	16.5	16.6	16.6	16.7	16.2	16.4
Mo. Avg.	15.0	15.5	16.6	17.4	17.3	16.2	15.8	15.9	16.1	16.1	15.9	15.3	16.1

Note: Figures in () are monthly average and are used for calculation of yearly average instead of lacking data.

The highest mean average temperature of 17.4°C occurs in April and the lowest is 15.0°C in January. Mean relative humidity is low during 3 months of the year (February through April). During other months it is high between 81.2 to 88.4% causing discomfort and heavy sweating in those working outdoors during sunny weather. Monthly average daily sunshine hours varies between 3.7 hours to 9.9 hours and is more than 6 hours during January to April.

2.3 Socio-Economic Perspective

2.3.1 National Overview

(1) General

With its strong human resource base and natural endowments, Sri Lanka could have achieved the growth records of its East Asian neighbours had it not been for a history of ethnic conflict, political unrest, and stop-and-go economic policies, often associated with election cycles.

Since Independence, nation-building has been strained by hostilities between the majority Sinhalese and minority Tamils. A civil war waged by Tamil separatists in the country's north and east since 1983 has exacted a heavy toll on human lives and the economy.

Sri Lanka's long-term growth rate in per capita terms compares favourably with most of the developing world, averaging 3.5 percent per year since 1960, in part reflecting its strong social indicators. But this growth performance falls short of the rates achieved by the high-performing East Asian economies such as Korea, Malaysia, Thailand, and Indonesia, because policies were less supportive of economic growth. Problems with macro-economic management have constrained domestic savings and investment and fuelled inflation. Inward-looking trade policies, excessive regulation of investment, intervention in the labour market, have impeded export growth. Pervasive controls on land ownership and use, trade, and pricing have constrained the agriculture sector's performance. Inefficient state-owned industries have burdened Government resources.

Since 1977, Sri Lanka has been trying to bring its economic policies more in line with those of the most successful Asian economies. It is seeking to increase the role of markets and the private sector by reducing restrictions on pricing, investment, and external trade and payments. However, the reform program faltered in the 1980s when Sri Lanka became immersed in civil conflict. The war destroyed infrastructure, disrupted delivery

of social services, reduced private sector confidence and investment, and diminished agricultural productivity and tourist revenues. It also led to large-scale emigration. Over the past decade, military expenditure has grown by some 3 percent to 6 percent of GDP, placing a strain on the Government's budget.

Sri Lanka's economy strengthened in the early 1990s. Private sector activity and investment was encouraged by improved macroeconomic management, the dismantling of prices, investment, and foreign exchange controls, trade reforms, and privatisation. Fuelled by the private sector, real per capita GDP has increased at an average rate of 4.3 percent during 1989-94. Both savings and investment as a ratio to GDP have also increased above their long-run trend. Privatisation, especially of small and medium firms, has been initiated. Plantation companies, which were nationalised in the 1970s, are being privatised by giving long-term land leases.

Sri Lanka's main exports are tea, rubber, garments, industrial products, and coconut products. Exports, led by garments, expanded at about 12 percent a year, and official reserves rose to 4.6 months of imports by the end of 1994. Foreign direct investment and portfolio investment roughly doubled each year, reaching about \$187 million in 1994. The overall budget deficit declined from 16 percent of GDP in 1988 to about 8 percent in 1993. In 1994, however, excessive spending prior to the election increased the fiscal deficit to 10.5 percent; it remained at about that level in 1995. Prior momentum pushed real output to about 5.5 percent in 1995 while inflation increased to 7.7 percent. The external current account deficit, which averaged just over 6 percent during 1990-93, deteriorated to 8.0 percent of GDP in 1994 and 6.8 percent in 1995, despite a strong export performance. The overall balance of payments swung into deficit in 1995 for the first time in more than five years, and the import coverage of gross official reserves dropped to 4 months by year-end.

Sri Lanka's medium-term prospects depend on the Government's ability to reverse the slippage in short-term economic management which has led to a slowdown in growth and private investment, as well as to address the longer-term development constraints. The fiscal deficit is a concern and could hinder the government's poverty alleviation objectives.

The Government's medium-term goal to sustain economic growth of 7 percent by 1998 will be far easier to reach with an end to hostilities, which place a continuing damper on the Sri Lankan economy. Achieving this pattern of growth should ensure progress in re-

ducing unemployment and poverty. Continued strong growth of exports, if sustained over the medium-term at the annual 12 percent average achieved in 1989-1994, would continue to provide the impetus for growth. This will require further diversification, as tea still accounts for more than 20 percent of total exports, and garments account for close to another 50 percent. Tourism, which experienced a major rebound in the early 1990s, can also continue to contribute significantly to growth, especially if Sri Lanka can upgrade its facilities and services to attract tourism with higher value added.

(2) Human Capital

Sri Lanka faces new "second generation" issues that are more typical of middle-income countries. For example, growing demand for higher education has become an increasing burden for already over-stretched resources, and an aging population is creating pressures for more tertiary care with high treatment costs. The government is now putting a strong emphasis on education, with the aim of improving both quality and efficiency.

(3) Strategic Objectives

Sri Lanka's strategic objectives can be summarised as achieving economic growth and poverty reductions, comparable to that of its East Asian neighbours. The Government's goal is to maintain macroeconomic stability and to complete its reform agenda. It aims to carry this out through efficient job creation, export-led growth, further upgrading of the country's human capital, and by protecting the environment.

Stimulating Private Sector Growth through enhancing competition, enabling private sector investment, and creating jobs, is also one of the key targets of the present Government. If policy reforms are forthcoming, International Donors will increase their support to Sri Lanka thus strengthening private sector growth, and helping to improve the country's inadequate and poorly maintained physical infrastructure.

2.3.2 Nuwara Eliya Municipality

About 200 years ago the study area was covered with natural forest and grass land before the tea plantations were introduced by the British. Owing to human settlements and changing land use patterns the forest coverage has been gradually reduced.

At the beginning, people were reluctant to live in this cool climate without improved infrastructure facilities. However, gradually people adapted to the climate and the town population grew.

The Nuwara Eliya Plain developed as a holiday center for the British. They used this area for health and recreational activities such as an Army Hospital, Race Course, Golf Links and Army Commander's bungalow, etc.

The British introduced tea cultivation in 1867 that rapidly spread to the entire hill country. As a result, substantial human settlements were formed in Nuwara Eliya. Subsequently, up country vegetables were introduced and were very successful. As a result, Nuwara Eliya developed a significant permanent population.

In 1881, the population of Nuwara Eliya was 1,791 and after 20 years (1901) it was 5,026. The average annual growth rate was 3.2%. The population had increased to 25,300 (estimated) in 1991. As the District Capital, Nuwara Eliya is being developed at a high rate. Health facilities, educational and community services, government departments and financial organizations have been established in the city.

The total population of the town area is estimated as 28,112 in 1994. An annual growth rate of 2.7% was recorded during the period 1981 - 1994. This growth rate is the second highest growth rate in the Central Province. Kandy is 1.6% and Matale is 0.6%. The ethnic and religious composition is quite different from other towns as 55.4% are Tamil. But a distinct feature is that Sinhalese representation in the town is much higher than in the District.

Agriculture is the most dominant economic activity in the town. Tea plantation that consumes 279 hectares of land generate only about 6% of the employment. Certain agricultural activities such as cut flowers produces higher returns from the land with 300 employment opportunities from only 17 hectares of land.

Tourism is the second with important economic activity in the town. The local authority earns 14% of their total income from the tourism sector. The industrial sector provides 2,370 employment opportunities and 5.3% of local authority income.

It is evident that the town economy is comparatively rich when compare with other towns in the Central Province. But the income distribution pattern and the economic condition of the town is not up to the desired standard. The 10.15% of the people in the town are Janasaviya

recipients, whereas 4.45% in the district. A shift of town economy from agriculture to non-agriculture sector is desired.

2.4 Present and Future Land Use

(1) Present Land Use

Historically Nuwara Eliya land use was characterized by forest or scrub lands in the high mountains, and water fetches and marshes in the middle. Flat plains are characterized by larger gardens except for a few government housing schemes. All other mountains are covered with tea, but this has now changed into a different pattern (see below):

Table 2.2 Present Land Use Pattern in Nuwara Eliya

Land Use	1996		1991
	Extent (km ²)	%	%
Residential	383.2	25.5	26.0
Commercial	34.1	2.3	2.2
Industrial	8.4	0.5	0.6
Public and Semi-Public Uses	65.6	4.4	4.4
Agriculture	230.0	15.3	14.0
Recreational	65.6	4.4	4.4
Roads	154.5	10.3	10.3
Encroachment	41.7	2.8	-
Tea Estates	234.0	16.0	-
Open bare lands	2.2	0.2	1.2
Marshy and Water bodies	72.5	4.8	5.8
Total	1,501.1	100.0	100.0
Forest	209.3	13.5	15.1

The major change in the land use pattern is the conversion of scrub or bare lands into vegetable gardens and encroachment of residential uses into physically unsuitable lands including forests.

Major land use issues in Nuwara Eliya are:

- Extensive utilization of formerly unsuitable lands for seasoned agriculture. (Cash crops)
- Utilization of recreational uses for agriculture and residential purposes.
- Expansion of settlement into the hill slopes and forestry lands.
- Sub division of larger gardens into smaller plots
- Squatter settlement in reservations and unsuitable marshy lands in highly congested areas.

- Expansion of commercial activities into unsightly lands and reservations in the town center.
- Encroachment into road reservations.
- Scattered location of public administration activities with minimum functional efficiency.
- Unorganized commercial sector activities in the town center.

(2) Zoning Plan and Zoning Regulation

There are three major sub categories in the existing plan as follows:

(a) Preservation Zones

1. Forest Reservation Zone	341.0 ha
2. Water bodies and wet land conservation zone	75.0 ha
3. Nature Conservation Zone	127.0 ha
4. Eco Tourism Promotional Zone	68.5 ha
5. Recreational Zone	106.5 ha

(b) Economic Development Zones

1. Commercial Zone	12.3 ha
2. Tourism Zone	55.5 ha
3. Industrial Zone	9.0 ha
4. Tea Cultivation Zone	178.0 ha
5. Other Agricultural Activity Development Zone	72.0 ha

(c) Social and Public Utility Development Zone

11. Residential Zone I	51.2 ha
12. Residential Zone II	159.5 ha
13. Public and Semi-public Zone	70.0 ha

TOTAL	1,325.5 ha
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2.5 Financial Status of the Study Area

The 1997 recurrent budget structure of Nuwara Eliya Municipal Council is presented on Table 2.6. Total recurrent income is Rs.37million while total recurrent expenditure is Rs.33 million. The 37 percent of annual recurrent revenue are dependent on assessment and fares. This figure is not a bad figure when we compare it with Kandy Municipal Council figures. It is considerably better than the Kandy assessment revenue figures.

However, the possibility of an increase of future revenue is limited because there are no financial resources that rely on resident's and company income within the city area. The ability to spend capital investment is severely limited because the city's recurrent budget is 69 percent occupied by personnel expenses and pension.

The water supply accounts are operated within the frame work of the general city administration without being separated as business accounts.

Table 2.3 1997 Recurrent Budget Structure of Nuwara Eliya Municipal Council

Recurrent Income Summary

(Rs.1000)

Description of Income	General Administration	Health Service	Physical Plans, Land and Building	Water Services	Common Amenities	Welfare	Total	
Assessment, Fare and Sales	9,500	0	0	3,500	0	820	13,820	37%
Rent	0	0	3,291	0	3,096	175	6,562	18%
License	110	1,273	0	0	0	0	1,383	4%
Service Charges	75	183	231	382	0	6	877	2%
Warrant Charges	240	0	10	0	20	2	272	1%
Other Income	2,340	0	491	5	15	495	3,346	9%
Income Grants	10,100	51	0	0	500	20	10,671	29%
Total	22,365	1,507	4,023	3,887	3,631	1,518	36,931	
%	61%	4%	11%	11%	10%	4%	100%	

Recurrent Expenditure Summary

(Rs.1000)

Description of Income	General Administration	Health Service	Physical Plans, Land and Building	Water Services	Common Amenities	Welfare	Total	
Salaries & Wages	3,840	4,259	5,177	3,373	364	2,691	19,703	59%
Traveling	174	46	128	42	5	7	402	1%
Supplier & Equipment	564	613	1,501	872	58	327	3,933	12%
Capital Assets Repair & Maintenance	315	200	1,303	200	250	191	2,459	7%
Transport	2,085	33	96	175	15	203	2,606	8%
Payment of Interest	0	0	0	125	25	0	150	0%
Grant & Subsidies	268	120	143	13	62	14	619	2%
Pension	3,078	145	98	65	11	50	3,446	10%
Total	10,324	5,415	8,444	4,864	789	3,483	33,318	
%	31%	16%	25%	15%	2%	10%	100%	

PART II

WATER SUPPLY

CHAPTER 3

CURRENT WATER SUPPLY SYSTEM IN THE STUDY AREA

CHAPTER 3 CURRENT WATER SUPPLY SYSTEM IN THE STUDY AREA

3.1 Existing Water Supply System

3.1.1 Existing Facilities

(1) Water Sources and Treatment Facilities

Nuwara Eliya Municipal Council records indicate that 6,101 m³/d of water were produced from various ground and surface water sources in 1997, as summarized below.

<u>Source (reservoir)</u>	<u>Production (m³/d)</u>
Haddon Hill	4,212
Lovers Leap	850
New Waterfield	228
Piyahissapura	163
Gamunu Mawatha	216
Brewery	288
<u>Shantipura</u>	<u>144</u>
Total	6,101

In addition to the above production, approximately 900 m³/d is pumped up from the Upper Lake and Race Course boreholes. The general configuration of the existing ground and surface water sources is depicted in Figure 3.1 and Table 3.1. The production figures noted above are based on dry period flow measurements in 1998.

During the previous year (1997), the only year for which a full year of flow data is available, low flows of only 4,730 m³/d were recorded, as shown in Table 3.1.

Although the available data is insufficient to calculate the frequency with which such a dry period would occur, it must be assumed for the purposes of this investigation that the safe yield of existing sources is no more than 4,730 m³/d. Although a substantial amount of additional water is available from the surface water sources during the rainy season (See above), a great deal of additional reservoir capacity will be required to utilize these excess flows.

(2) Transmission and Storage Facilities

Existing transmission mains are shown on Figure 3.2. There are 11 reservoirs in the Nuwara Eliya system with a total storage volume of 3,650 m³ with capacities ranging from a 15 m³ balancing tank to the Haddon Hill reservoir which can store 1,800 m³ (see Figure 3.1).

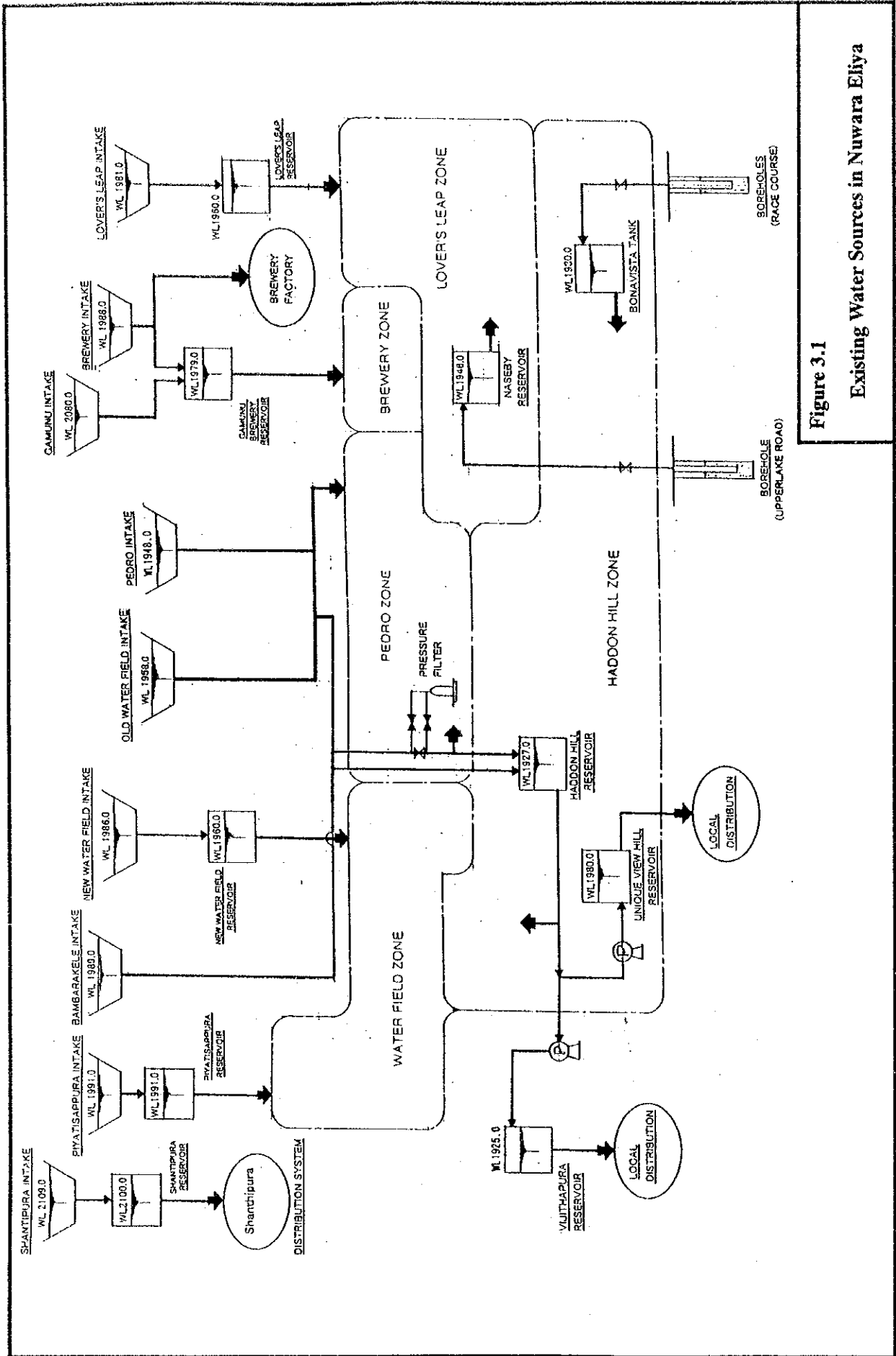


Figure 3.1
Existing Water Sources in Nuwara Eliya

Table 3.1 Existing Facilities of Water Supply System

Water Source and Intake	Capacity (m ³ /d)		Water Level (m amsl)
	Dry Season	Rainy Season	
1.Surface Water			
Shanthipura	130	883	2,109
Piyatisappura	147	1,080	1,991
Old Water Field	397	3,050	1,958
New Water Field	69	630	1,986
Gamunu	19	670	2,080
Brewery	251	1,710	1,988
Pedro	890	4,277	1,948
Lovers Leap	112	1,615	1,981
Bambarakele	1,814	4,858	1,989
Sub Total	3,830	18,773	
2.Groundwater			
Upper Lake Road	600	600	1,872
Race Course	300	300	1,868
Sub Total	900	900	
Total	4,730	19,673	
Water Treatment Facilities			
Rapid Sand Filter		(m ³ /d)	
		5,976	
Reservoir		(m ³)	(m amsl)
Shanthipura		25	2,100
Piyatisappura		190	1,991
New Water Field		70	1,960
Gamunu/Brewery		190	1,979
Lovers Leap		900	1,960
Haddon Hill		1,800	1,927
Unique View Hill		40	1,980
Vijithapura		40	1,925
Naseby		190	1,946
Bonavista		190	1,930
Total		3,635	
Pumping Facilities			
Unique View	0.54m ³ /min. × 78m × 15kW × 2sets (including one stand-by pump)		
Vijithapura	0.42m ³ /min. × 35m × 7.5kW × 2sets (including one stand-by pump)		

A part of those facilities has been provided or will be provided through an on-going ADB funded project. Most have already been completed and are already being utilized. The total length of existing distribution pipes is approximately 57 km as shown in Table 3.2.

Table 3.2 Existing Distribution Pipes

Pipe Materials	Size (mm)	Length (m)
PVC	32	400
	50	6,000
	75	8,241
	110	2,339
	160	1,735
DCI	100	16,701
	150	14,712
	200	1,000
	225	4,615
	300	968
	350	704
Total		57,415

(3) Planned or On-going Water Supply Projects

An ADB funded project to improve the Nuwara Eliya water system is under way and scheduled for completion by mid 1998. Improvements include renovation of existing intake structures; provision of chlorination equipment; new pumping equipment for one borehole; transmission mains and distribution pipes. Water from all sources is now chlorinated, and pressure filters have been provided for the Pedro source. The final design report for the ADB project recommended the development of an additional source to augment the supply to the Lovers Leap reservoir.

3.1.2 Current Issues on the Existing Water Supply Systems

Table 3.3 summarizes the identified issues of the existing water supply systems. To cope with these issues the following measures should be undertaken:

- Development of new water sources to increase raw water potential
- Increase of volume of distribution tanks
- Expansion of water supply facilities to meet the water demand
- Reduction of NRW

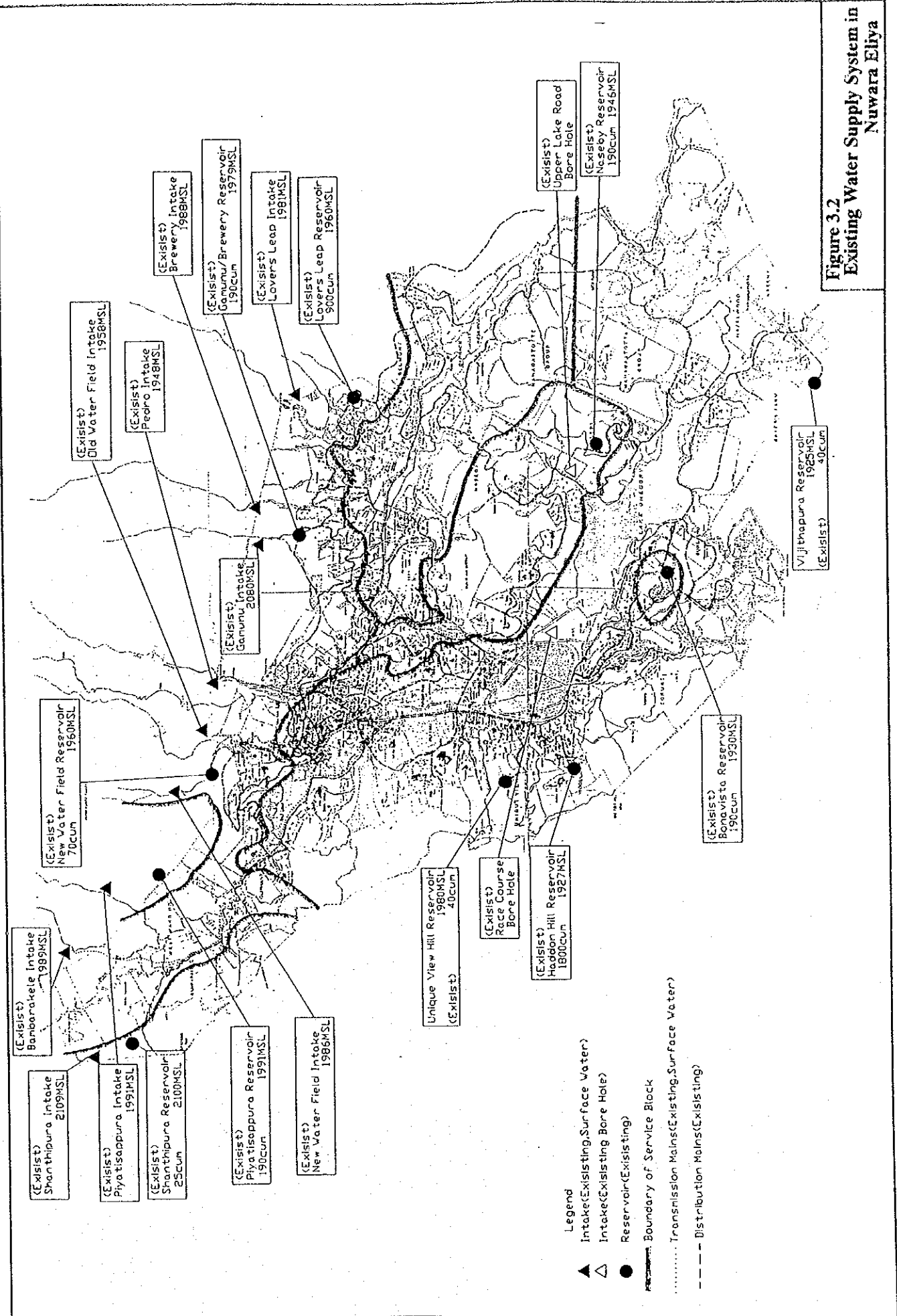


Table 3.3 Current Issues on the Existing Water Supply Systems

Name of Water Supply Facility		Current Issues	Countermeasures
Water Source and Intake	1.Surface Water		
	Shanthipura		
	Piyatisappura		
	Old Water Field		
	New Water Field		
	Gamunu		
	Brewery		
	Pedro		
	Lovers Leap		
	Bambarakele		
2.Ground Water	Upper Lake Road (for Naseby)		
	Race Course (for Bonavista)		
Water Treatment Fac.	Rapid Filter		
	Disinfection Facility		
Reservoir	Shanthipura		
	Piyatisappura		
	New Water Field		
	Gamunu/Brewery		
	Lovers Leap		
	Haddon Hill		
	Unique View Hill		
	Vijithapura		
	Naseby		
	Bonavista		
Pumping Facilities	For Unique View Hill		
	For Vijithapura		
Transmission Pipe			
Distribution Pipe			

3.2 Institutional Arrangements for Water Supply and Sanitation

(1) Functions and Responsibilities.

Water supply provision in Nuwara Eliya is a Municipal Government undertaking. The Municipal Council, through its Waterworks Office, is responsible for the production, distribution and source development activities to serve the growing demand of the Municipality. The most recent expansion plan is a feasibility study (June 1989) addressing the 1995 demands. However, the rehabilitation and expansion of the system, assisted by the ADB, are expected to be completed only this year. The new system will continue to be managed by the Nuwara Eliya local authorities. The NEMC water system also serves Buluela which is outside the political jurisdiction of the MC.

(2) Customer Base.

As of 1997, the system served a total of 3,985 connections, as follows: domestic 2,785; non-domestic, 1,200. As of July 1998, that total had risen to 4,027 connections. 93.3 percent of the connections are metered already. New meter reading and billing procedures has been implemented as of June 1998.

(3) Organizational Structure.

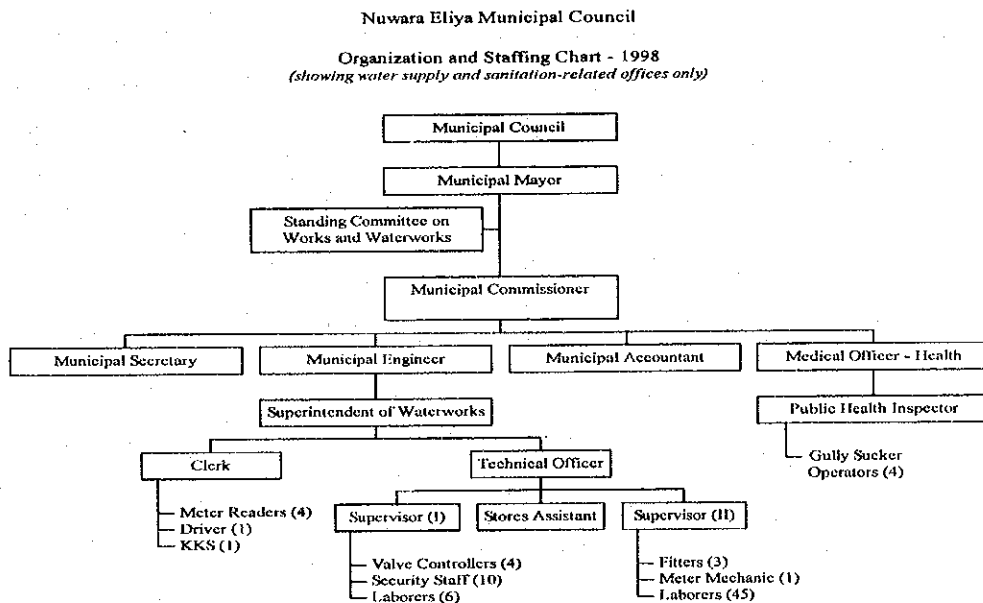


Figure 3.3 Organizational Chart & Staffing of Nuwara Eliya Waterworks Office, 1998

The Municipal Council itself is composed of ten (10) elected members. Several standing Committees have been organized, including a 4-man Committee for Works and Waterworks, to expedite the work of the Council. This Committee (and the Committee on Fi-

nance) reviews policy issues and future expansion plans prior to consideration by the entire Council. In addition, expenditures above Rs. 15,000 require Council clearance. The Council meets monthly.

(4) *Tariff Structure.*

Effective 1st January 1998, a new water rate structure was enforced. The new rates are:

Table 3.4 Water Rate Schedule (Partial) – Nuwara Eliya, 1998

Type of Accounts	Consumption, m ³				
	1-10	11-20	21-30	31-40	>40
Domestic	Basic*	Rs. 2.00/m ³	Rs. 5.00/m ³	Rs. 7.50/m ³	Rs. 10/m ³
Commercial	Rs. 7.50/m ³		Rs. 10.00/m ³		
Industrial	Rs. 12.50/m ³				

* : 1/2" - Rs.5, 3/4", 1" - Rs.10, 1-1/2", 2" - Rs.25

(5) *Staffing Levels and Personnel Administration.*

As of June 1998, only 54 of the 81 positions in the staffing chart (3.2) above were filled; the current staffing level is at 13.55 staff per 1,000 connections. Personnel classification and salary administration policies and procedures are governed by national civil service policies and standards administered by the Ministry of Public Administration. Certain formulas are mandated to determine the amount of salary increases for government employees (which is in the order of about 5 percent annually). The supervisor evaluates and recommends the approval of the annual salary increases. Almost all employees receive a favorable evaluation and recommendation, however. No other form of remuneration (either allowances or incentives) is provided, by law.

(6) *Operating Expenses*

The reported actual operating expenses for the waterworks operations in 1997 was as follows:

Personnel	2,971,811.90
Chemicals	190,750
Power	85,974
Materials	<u>1,495,324.74</u>
Total	4,743,860.64

Compared to a 1997 annual income of Rs. 2,763,346.45, an annual subsidy from the MC of Rs. 1.98 M was necessary to support the shortfall in collection. The expenditure budget for 1997 (Rs. 3,887,000) was also exceeded.

(7) *Impact of Recent Tariff Adjustment*

Table 3.5 Billing and Collection Data - NEMC, Jan 1997-Jun 1998

NEMC Month	Consumption m³	Billings Rs	Collections Rs	No of Connections
Jan-97	104,607	267,393.00	306,103.00	
Feb-97	90,650	230,129.00	201,169.00	
Mar-97	86,345	219,422.00	217,964.00	
Apr-97	85,650	222,330.00	197,323.00	
May-97	104,106	256,324.00	291,839.00	
Jun-97	108,008	271,569.00	260,288.00	
Jul-97	110,474	278,414.00	248,378.00	
Aug-97	111,612	288,753.00	222,344.00	
Sep-97	131,315	332,031.25	239,976.05	3924
Oct-97	109,064	275,522.75	151,689.90	3926
Nov-97	102,972	260,033.75	180,585.50	3933
Dec-97	137,342	328,099.75	245,687.00	3940
Total	1,282,145	3,230,021.50	2,763,346.45	
Average	106,845.42	269,168.46	230,278.87	
<i>Arrears, as of Dec 97</i>			3,846,136.88	<i>Rs.</i>
<i>Average Collection Period 1997:</i>			14.29	<i>months</i>
Jan-98		1,135,184.30	333,595.60	3948
Feb-98		794,888.60	283,982.26	3961
Mar-98		804,702.00	401,007.50	3987
Apr-98		645,145.05	362,124.60	3997
May-98		940,487.25	508,246.60	4003
Jun-98		1,013,669.11	386,731.10	4015
Average		889,012.72	379,281.28	
<i>Arrears, as of June 1998</i>			6,802,280.29	<i>Rs.</i>
<i>Average Collection Period 1998:</i>			7.65	<i>months</i>
<i>Total Connections, as of July 1998</i>			4027	
<i>Increase in Monthly Billing (Jan-Jun)</i>			3.64	<i>times</i>
<i>Increase in Monthly Collection (Jan-Jun)</i>			1.54	<i>times</i>

The recent rate adjustment implemented in January 1998 has had a dramatic effect on the utility's finances. Month on month, the recent tariff increase has yielded a 3.64 times increase in average monthly billing (between Jan-Jun 1997 and Jan-Jun 1998). However, the collections during the same period increased by only 1.54 times. With this situation, the arrearages will continue to pile up at an even higher rate. The rate increase did not have any impact on the number of new service connections. The average collection period went down from 14.29 months to 7.65 months. However, this has been mainly due to the increased monthly billings. Even though the cash position of the water supply operations has improved, more effort is needed to control arrears and improve on-time payment.

(8) *Consumption Analysis*

Table 3.6 Billing and Collection Patterns -- NEMC, 1997

<i>1997</i>	<i>Domestic</i>	<i>Non-Domestic</i>	<i>Total</i>
Billed Quantity, m ³	913,319	368,826	1,282,145
Billed Value, Rs.	850,286	2,379,736	3,230,022
Total Collection, Rs.	634,412	2,128,934	2,763,346
No of Connections	2,785	1,200	3,985
Effective rate, Rs./m ³	0.93	6.45	2.52
Average Consumption	27.3 m ³ /month	25.6 m ³ /month	
Average Monthly Bill	Rs. 25.44/month	Rs. 165.26/month	
Collection Ratio	74.6%	89.5%	

Non-domestic accounted for a low percentage (28.7%) of the consumption, but yet it contributed 73.7% of the revenues. The effective rate of water for domestic connections was Rs. 0.93 per m³; non-domestic was Rs. 6.45 per m³. The difference is rather wide and there is high risk that accounts are misclassified.

The non-domestic consumption needs further detailed review; it is unlikely that the average domestic consumption can exceed non-domestic consumption as the data shows. It has been reported that connections for customers with illegally constructed houses (i.e., not approved by the MC) are classified as non-domestic. It would be useful to see the deviation from this average.

(9) *Assessment of Institutional Strengths and Weaknesses*

- 1) It should also be noted that the financial losses have happened in spite of the relatively low production costs. The recent rate adjustment will help alleviate this situation in the future.
- 2) The average household expenditure for water was only 0.8 percent of the average monthly household income (very low; normal is 3 to 6 percent). This indicates good potential for the impact of a social marketing program.
- 3) Overall, there is a need for stronger commercial orientation of the waterworks office, a clarification of the responsibilities for collection efficiency, and establishing the link between operating budget and collection performance. Technical operations are generally well managed except for the huge non-revenue water losses. Improvements to ensure better operational control through accurate monitoring will be required.
- 4) The current ADB-assisted rehabilitation project will be put into service within the year. This is expected to improve the quality of service; however, there will have to be greater effort in improving the overall financial performance of the waterworks office. The key areas for operational improvement are increase in collection efforts and re-

duction of non-revenue water. A major public information program to conserve the "salubrious climate" of Nuwara Eliya and an increase in the willingness-to-pay will be crucial.

- 5) There is a need to clarify the responsibilities for and to define a program for promoting on-time payment by consumers. This program should go beyond the threats of service disconnection and actually provide incentives and make it more convenient for customers to pay on time.
- 6) The forecast of revenues and expenses should extend beyond the mandated one-year budgeting cycle. The waterworks office should develop at least a five-year projection of revenues and expenses; and update this annually.
- 7) Training. There is no organized or systematic program for staff development for waterworks staff. Technical assistance, possibly in the form of advanced training for selected staff, focussing on Project Management and on Operations and Maintenance, and direct posting of a sanitation/sewerage technical training expert will be useful.
- 8) Computerization. Steps will be needed to further implement customer billings, collection and records. Current initiatives to introduce computerization will be needed.
- 9) These situations point to a role which NWSDB should play in providing a focussed, systematic and continuing program to management and technical assistance and in monitoring. Effective technical and management advisory services by the NWSDB to NEMC can readily lead to substantial dividends. These services could point out policy and operating defects and taking corrective actions.

3.3 Emerging Policy, Management and Institutional Issues

(1) General Policy Issues

- 1) The NWSDB dominates the sector with a broad set of mandates which ranges from sector policy formulation, project development and construction, operation and maintenance and even regulations (tariff setting, service monitoring, etc). The NWSDB roles as system planner (and implementor), service provider and regulator are starting to conflict with each other. The exercise of regulatory functions is usually vested with a third party to ensure the adequacy and fairness of tariffs, compliance with environmental standards, adequacy of service delivery, etc. No one seems to be responsible for independent monitoring to ensure that public utilities for water and sewerage are operating within acceptable standards (water losses, collection efficiency, etc) - and that the people are indeed being served at a fair price.

- 2) There is a growing fear that in order for capital investments to take place, the NWSDB will take over the systems from local authorities - as was the case in Colombo. These issues are being raised by local officials and should be addressed squarely by the NWSDB.
- 3) In Nuwara Eliya, the MC has taken on the operation and maintenance role and the rate-setting function. However, further capital improvements on the system, including major rehabilitation works, are still within the NWSDB role. The NWSDB should continue to review the policies and institutional arrangements, particularly the sharing of responsibilities among the sector agencies, local authorities, user groups and the private sector. The goal of this review is to ensure that all residents within the Study area have reasonable access to safe water supplies, hygienic sanitation collection, and waste treatment and disposal facilities.
- 4) ***Viability of Sewerage Systems.***

To ensure the financial viability and raise the utilization rate of the new (and proposed) sewerage system, local ordinances requiring commercial and high residential water consumers to connect to the sewerage system will be needed. This can be achieved by a policy decision of the Municipal Council. In addition, a methodology for computing the sewerage tariff will have to be formulated based on the cost of operations and other cost recovery policies.

(2) ***Project Implementation Issues.***

Careful planning of the capital improvement works in water supply is needed in view of the high leakage in the old distribution lines. The interconnection (between the old and the new facilities) should be phased in zone by zone.

(3) ***Institutional Performance Issues.***

Table 3.7 presents selected performance indicators for the NEMC waterworks operations.

The general key performance issues, as previously presented include:

- 1) High non-revenue water
- 2) Uncontrolled arrears and poor on-time payment.
- 3) Inadequate operational control

Table 3.7 Summary of Selected Institutional Performance Indicators, 1997

<i>Reference Period</i>	NEMC 1997
Basic Information	
No of Customers	3,985
No of Staff	54
Total Water Produced, m ³	2,946,691
Ave Daily Water Prod, m ³ /d	8,073
Total Water Billed, m ³	1,282,145
Total Billing, Rs.	3,230,021.50
Total Operating Expense, Rs.	4,743,860.64
Total Collection, Rs.	2,763,346.45
Arrears, Rs.	3,846,136.88
Performance Indicators	
Collection Ratio, %	85.6%
Non-revenue Water, %	56.49%
Unit Cost, Rs./m ³ produced	1.61
Unit Cost, Rs./m ³ billed	3.70
Ave Collection Period, months	14.29
Staff/1,000 Connections	13.55
Operating Ratio	1.72

3.4 Financial Status of Water Supply Operations

(1) Financial Performance Summary

The water supply of Nuwara Eliya Municipality is operated within the general framework of the city administration. Water supply does not cover all costs. In addition, there is room to improve performance in unaccounted-for water, which is not well controlled.

(2) Billing and Collection Performance

The total billing amounted to Rs 3,299,301 on a volume of 1,282,086 m³. The total collection for 1997 amounted to Rs. 2,260,511 resulting in a collection ratio of 70 percent. Arrears at the end of 1997 were Rs. 4,363,135 (1.35 times the annual billing). Arrears are not well managed.

(3) Expense Control and Budgets

According to the 1997 budget, total expenditure for water supply was Rs. 4,864,000 and the composition was; Salaries & Wages 69 percent; Supplier – percent; Equipment 18 percent; Others 13 percent. The actual expenditure in 1997 was Rs. 4,563,135. The total expenditure exceeded income in the original budget (Rs. 3,887,000). Cost control systems should be established.

(4) Capital Assets

The capital investment program is separated from the recurrent budget. Annual investment in 1997 was Rs.2,759.374. Capital assets are recorded at costs. Recovery of the investment cost is not considered.

(5) Customer Service

As of 1997, the waterworks system had a total of 3,985 connections.

Residential connections	2,785;	Commercial	1,200
Metered connections	3,721;	Unmetered	234

3.5 Emerging Institutional Performance Issues

Table 3.8 presents selected performance indicators for the utilities involved in this Study. A comparison with performance indicators in Greater Colombo is also presented.

Institutional Performance: Arrears from bulk customers are a major cause for concern. This is significant because the current NWSDB policy is towards increased bulk provision in the future. Further studies may be needed to examine the terms and conditions towards bulk supplies to ensure that adequate responsibility and accountability is transferred to the “water distributor” and that NWSDB’s financial viability is not undermined.

Common financial issues are as follows:

- The water tariffs are far below the level needed to recover water production costs especially in water tariffs for domestic users. As a result, capital investment in plant and equipment is assumed to rely not on internal financial sources but on outside aid.
- NRW (non-revenue water) is too high.
- The collection rate is generally too low. The introduction of incentive schemes in water charge collection and outsourcing should be considered.
- Operational efficiency is low, and financial efficiencies are poor.
- Water supply accounts are not separated from general administration in Municipal Council accounting. Water supply accounts needs to be separated and treated like business accounts.
- Financial reporting systems should be improved.

Table 3.8 Summary of Key Institutional Performance Indicators

	NWSDB Kandy District	KMC	NEMC	NWSDB (Colombo)
Reference Period	1997	1997	1997	1996
Basic Information				
No. of Customers	34,227	17,203	3,985	178,188
No of Staff	606	267	81	1,591
Total Water Produced (m ³)	18,664,523*	11,549,078	NA	182,401,450**
Avg. Daily Water Produced (m ³)	51,136	31,641	NA	499,730**
Total Water Billed (m ³)	15,826,161	6,692,457	1,282,086	
Total Production Cost (Rs.)	148,138,791*	62,614,405	4,363,135	
Total Billing (Rs.)	93,016,000	50,099,998	3,229,301	
Total Collection (Rs.)	90,446,000	49,377,132	2,260,511	
Arrears (Rs.)	22,898,601	40,398,850	4,363,135	
Efficiency Indicators				
Collection Ratio	97.24%	98.60%	70.00%	
Unaccounted for Water	34.00%*	42.05%	NA	47.00%
Unit Production Cost	7.94	5.42	NA	2.94**
Average Collection Period (month)	3.04	9.68	NA	3.20
Number of Staff / 1,000 Connections	17.68	15.52	20.33	7.30**
Operation Ratio	1.59	1.27	1.35	0.53**
Per capita consumption (l/d)	76.95	137.86	59.98	165.00**

Note: Data with (*) are inferred from the data on Regional Support Center (Central).

Data with (**) are the data in 1995.

- Introduce a dual entry bookkeeping system that clearly identifies assets and liabilities. The flow of funds will be easily traced.
- Introduce a cost accounting system so that the cost of each cost center can be computed.
- In staff education, financial reporting (dual entry bookkeeping) systems and cost accounting system need to be incorporated.