BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
REHABILITATION OF
KANDY WATER SUPPLY SCHEME
IN
THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

FEBRUARY, 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request from the Government of the Democratic Socialist Republic of Sri Lanka, the Government of Japan has decided to conduct a Basic Design Study on the Project for Rehabilitation of Kandy Water Supply Scheme and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Sri Lanka a study team headed by Dr. Hidenori Aya, Professor of Musashi Institute of Technology, from September 29 to October 27, 1988.

The team exchanged views with the officials concerned of the Government of Sri Lanka, and conducted field surveys. After the team returned to Japan, further studies were made. Then, a mission was sent to Sri Lanka in order to discuss the draft report and the present report has been prepared.

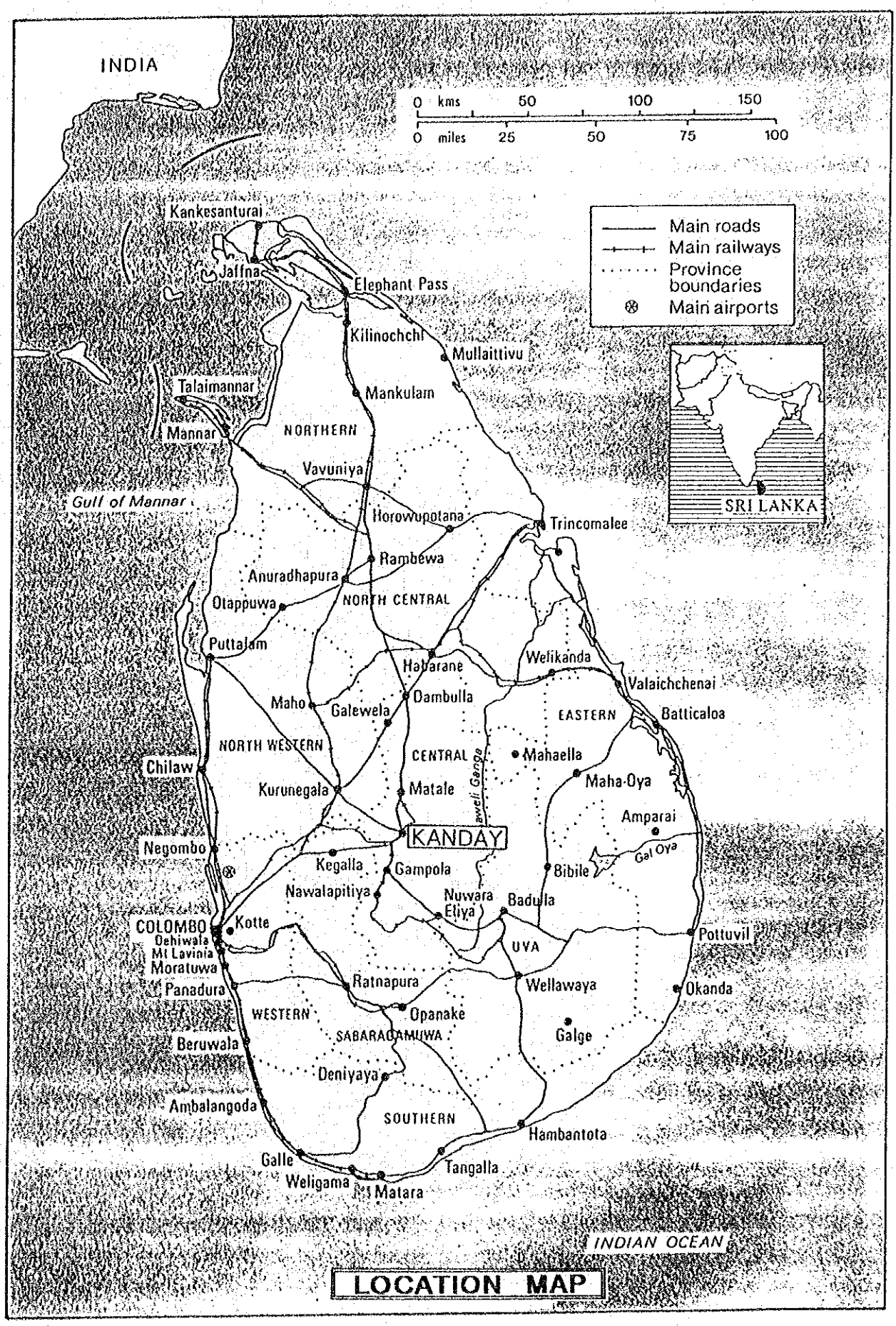
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Democratic Socialist Republic of Sri Lanka for their close cooperation extended to the team.

February, 1989

Kensuke Yanagiya
President
Japan International Cooperation Agency

Sri Lanka


INDIA
0 kms 50 100 150
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Main roads
Main railways
Province boundaries
Main airports
SRI LANKA
Kankesanturai
Jaffna
Elephant Pass
Kilinochchi
Mullaittivu
Talaimannar
Mankulam
Mannar
NORTHERN
Vavuniya
Gulf of Mannar
Horowupotana
Trincomalee
Rambewa
Anuradhapura
NORTH CENTRAL
Otappuwa
Puttalam
Habarane
Welikanda
Valaichchenai
Dambulla
Maho
Galewela
EASTERN
Batticaloa
NORTH WESTERN
CENTRAL
Mahaella
Chilaw
Kurunegala
Matale
Mahaweli Ganga
Maha-Oya
Amparai
KANDAY
Negombo
Kegalla
Gampola
Gal Oya
Bibile
Nawalapitiya
Nuwara Eliya
Badulla
COLOMBO
Kotte
Dehiwala
Mt Lavinia
Moratuwa
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Wellawaya
Okanda
WESTERN
Opanake
SABARAGAMUWA
Galge
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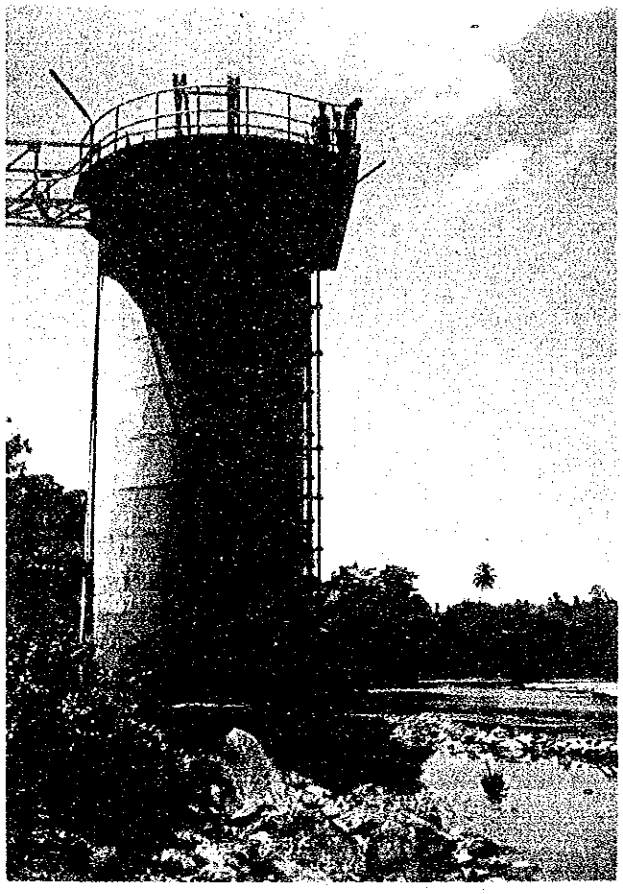
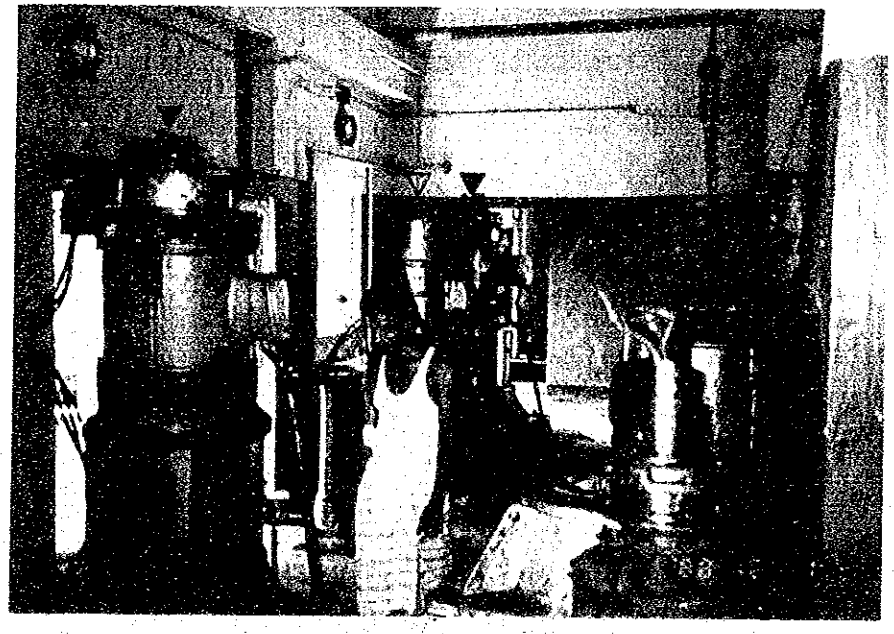
Deniyaya
Ambalangoda
SOUTHERN
Hambantota
Galle
Tangalla
Weligama
Matara
INDIAN OCEAN
LOCATION MAP

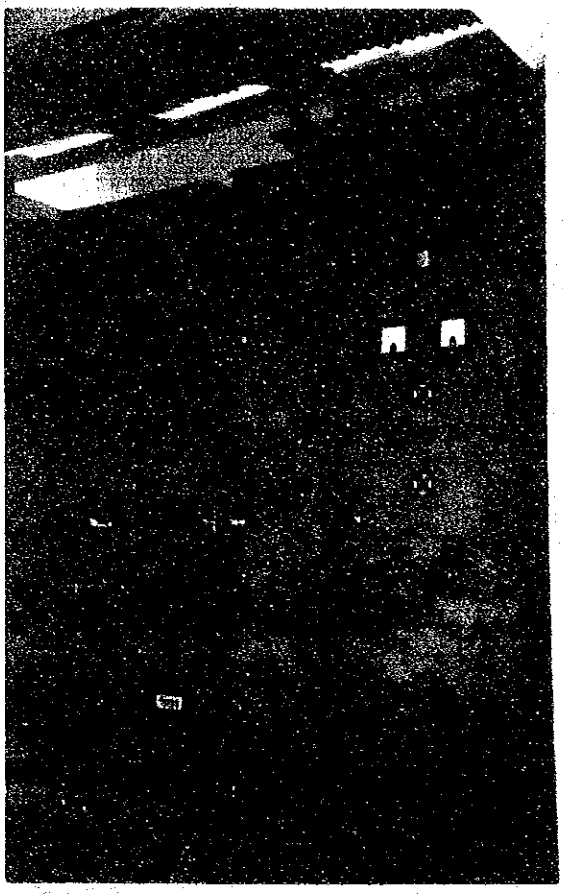


《 High Water Intake 》
The structure is in good condition.

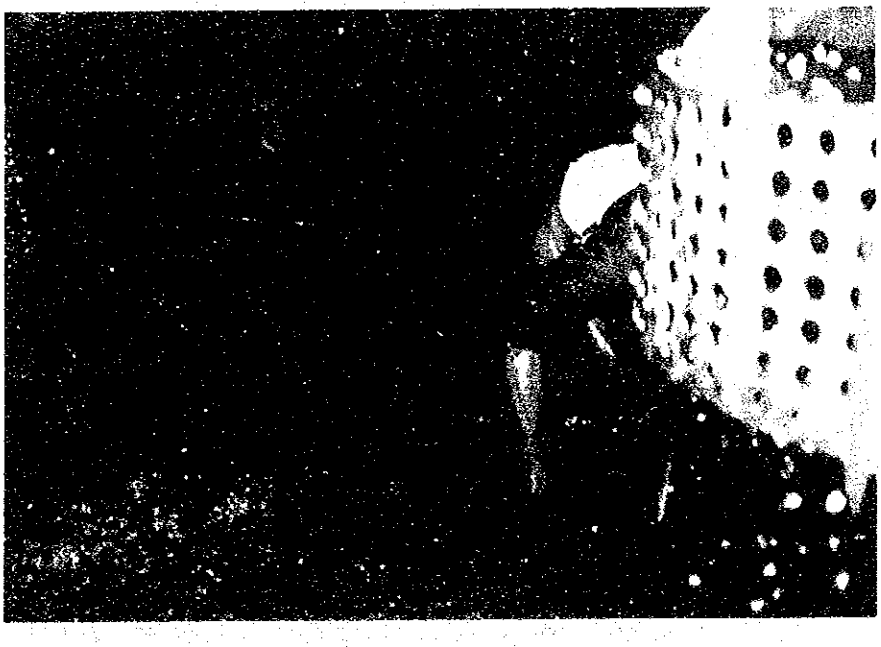


▽ French-made Pump
▼ Indian-made Pump

《 Inside of Pumping Station 》
Due to frequent repairs, Indian-made pumps have been deteriorated as French-made pump.

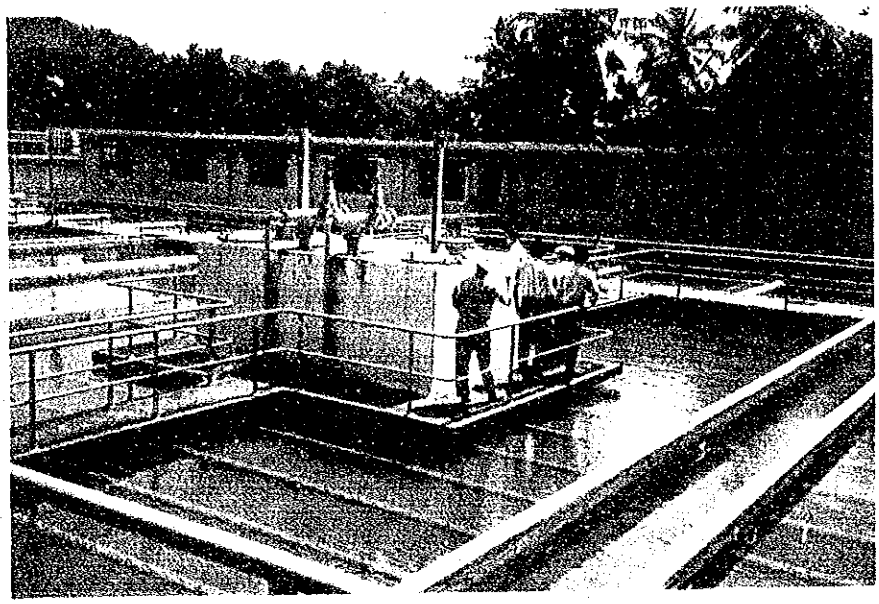


《 Control Panels of Inake Pump 》
The panels have been installed inside of a temporary house.

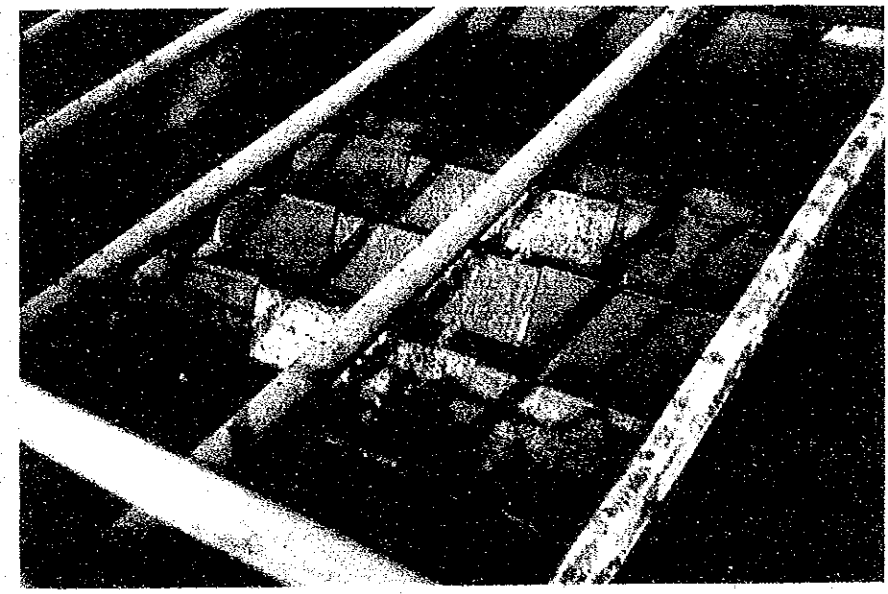


《 Sand Removal Work 》
The supply of water has to be stopped for a half day during the sand removal work which is carried out more than once a month.

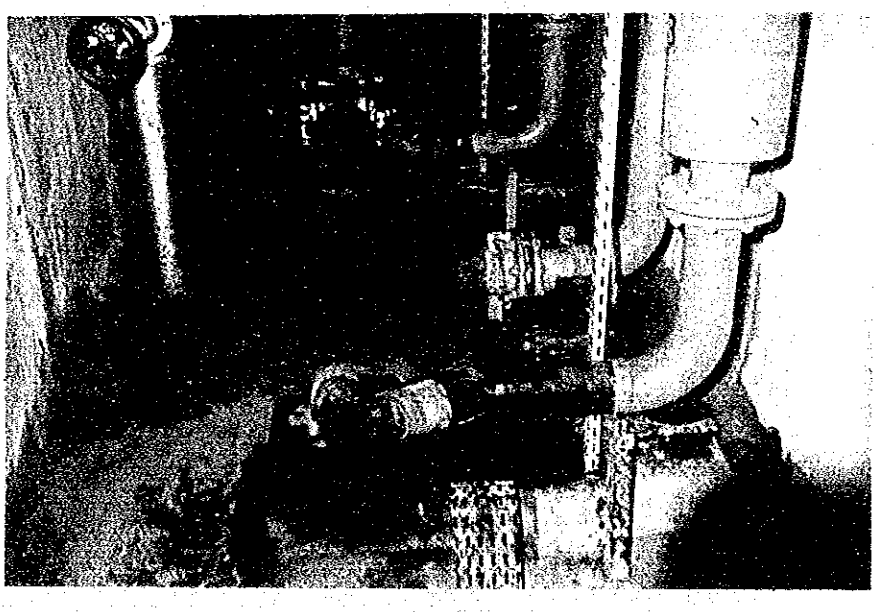
— TREATMENT PLANT —



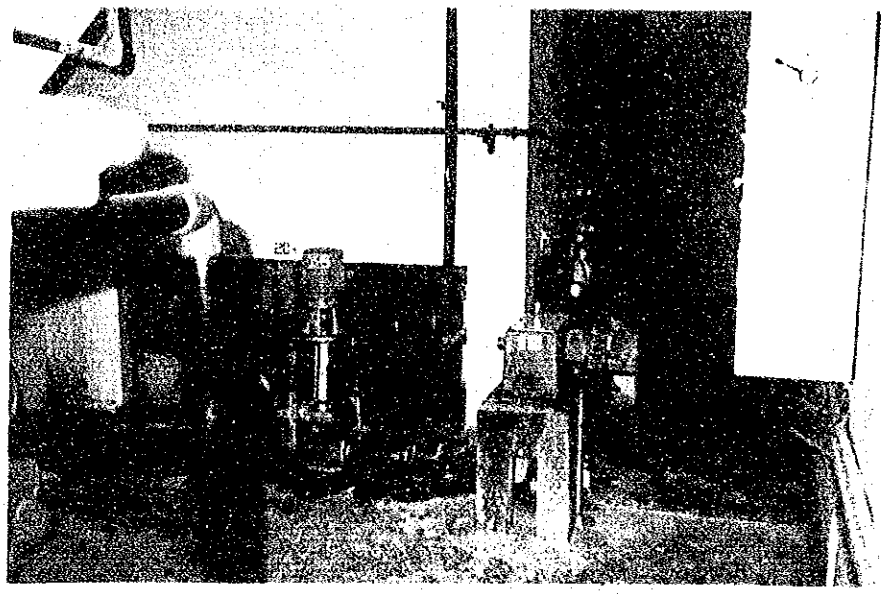
《 Main Facilities 》
A vacuum chamber of Pulsator is seen in the center. Filters and their control room are located beyond the sedimentation tanks.



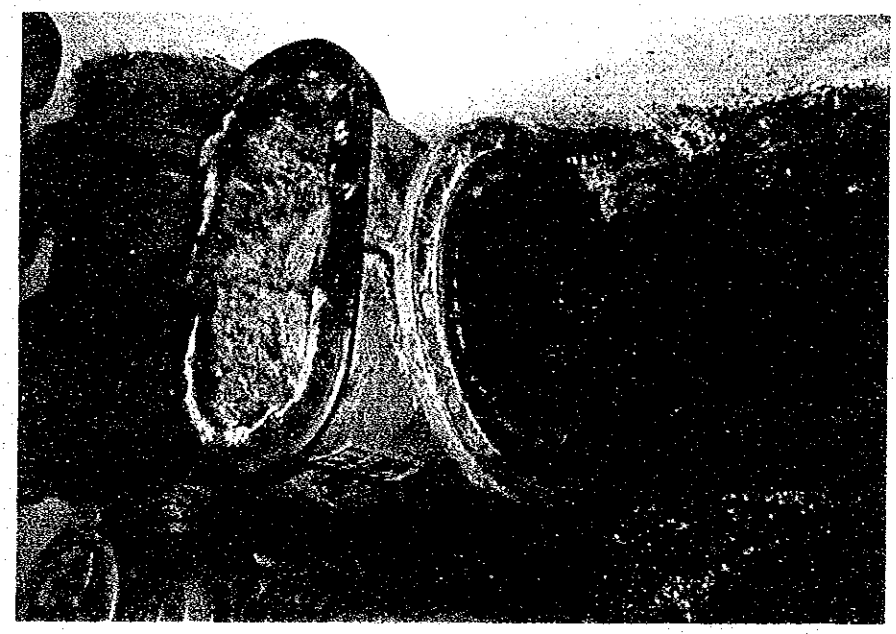
《 Sedimention Tank 》
Stilling plates have been repaired partially.



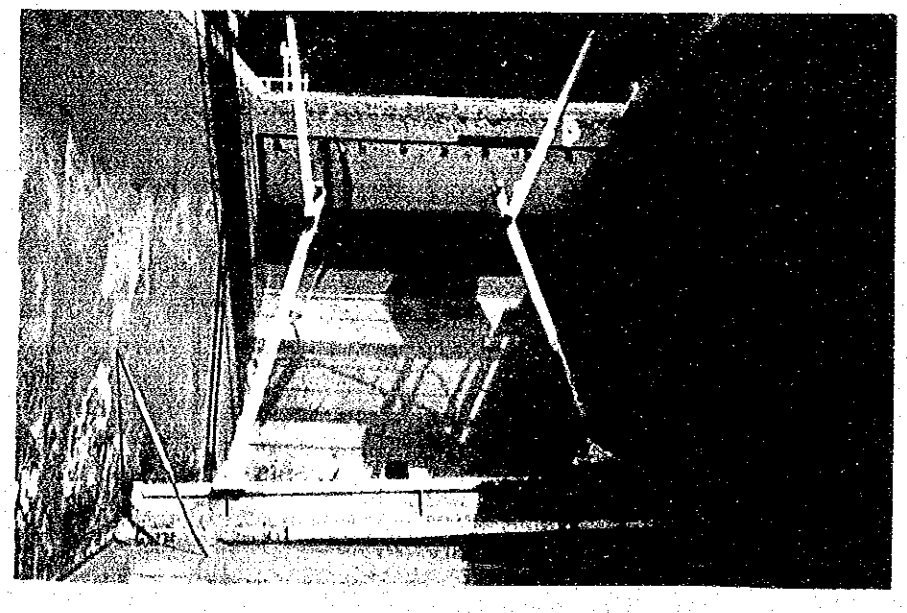
《Vacuum Pump of Pulsator》
Due to damage, a vacuum pump has been removed.



《Inside of Chemical house》
Due to deterioration, the function of Lime and Alum pumps is insufficient.



《Valve for Backwashing》
The valve connected to a filter has been removed because of damage.



《 Desludging Channel 》
Sludge collector insufficiently functions because of damage of its arms.

Summary

SUMMARY

According to the results of national census carried out in 1981, the total population of Sri Lanka is 14,850,000, of which 11,650,000 or 78.5% reside in rural areas, and 3,200,000 or 21.5% in urban areas. The annual growth rate of the population is estimated at 1.7%, and it is expected that the total population will reach 16,400,000 in 1987.

The Government of Sri Lanka considers one of its most important policies to be the improvement of the living standard of the people. A top priority has been put on improving the potable water supply and the government has undertaken economical and realistic water supply projects along with the programme entitled " the International Drinking Water Supply and Sanitation Decade (1981-1990)", which was proposed by WHO. The programme aims;

(1) to improve the existing potable water supply facilities in quality and quantity and to make a potable water supply accessible to the entire population;

(2) to improve the existing sewage disposal facilities in quality and quantity and to make these facilities accessible to the entire population; and

(3) to create awareness among the people as to the linkage between health, safe drinking water supplies and sewage disposal facilities through health education and community participation.

In accordance with the above-mentioned programme, the existing water supply facilities are being extended and improved by the Government of Sri Lanka so that the entire urban population and 50 % of the population in the rural areas can be served by the public water supply by 1990. By means of improving existing facilities, constructing community wells and installing hand pumps, the public water supply system shall be made available to the entire population by 1995.

In the urban areas of Sri Lanka, 75 % of the population is already being served by the public water supply system, and now priority is given to the rehabilitation or extension of the existing water supply facilities rather than the construction of new facilities. It has been confirmed that the entire population in

the urban areas will be served by the public water supply system in 1995. On the other hand, in the rural areas, only 5 % of the population is now being served by the public water supply system, 58 % by well water and the remaining 36% by other means such as rainfall, spring water and river water. It is, therefore, urgent to improve the present water supply conditions in rural areas.

The city of Kandy, which is the project area, is the main city located in the central highlands. Its main industries are tourism and agriculture, mainly tea production. Kandy has a population of 110,000 in 1987, which makes it the fifth largest city in the country, and is expected to have a population of about 145,000 in the year 2000.

The existing water supply facilities in the city were constructed in 1966 with the assistance of the Government of France. At first, the water supply capacity was 5.0 MGD (23,000 cu.m/day) and the service area was limited to Kandy. The water supply system has been extended to the adjacent two areas of Tenekumbura and Ampitiya since 1973. In 1983 the water supply facilities were augmented to reach a capacity of 7.5 MGD (34,100 cu.m/day) to cope with the increased water demand.

As for the existing intake system, the water is directly pumped up from the Mahaweli River. Sand and pieces of wood are mixed with the water and these are likely to damage the pumps. The main facilities of the water treatment plant have been used for more than 25 years and have become seriously deteriorated. However, financial constraints have prevented the effective repair or renovation of these intake and water treatment facilities. The present water supply capacity has been maintained at about 5 MGD despite the fact that water demand in 1988 is estimated at about 7 MGD. Sand and silt mixed in the river water accumulate on the bottom of the well of the existing pumping station. This sand and silt have to be removed more than once a month to prevent the pumps from harm. The sand and silt removal work is carried out manually in the deep and narrow well using buckets and is inherently dangerous for laborers. Water supply to the city has to be stopped for about 12 hours during the removal work. This is one of the reasons for the frequent suspension of water supply. The water supply is interrupted by frequent electric power stoppages as well. The insufficient water supply and frequent suspensions have a significant impact not only on the social life but also on the industrial development in the city.

In order to improve the existing water supply facilities in the city of Kandy, the Government of Sri Lanka has planned the Rehabilitation of Kandy Water Supply Scheme (the Project) and requested economic cooperation of the Government of Japan in the form of a grant for construction of water supply facilities and the procurement of equipment and materials for the Project. In response to the request of the Government of Sri Lanka, the Government of Japan sent a Basic Design Study Team (the Team) through the Japan International Cooperation Agency (JICA) for 29 days from September 29 to October 27, 1988.

The Team discussed the background, purpose and implementation schedule of the Project with the personnel concerned of the Government of Sri Lanka, and confirmed the scope of cooperation by the Government of Japan. The Team surveyed the existing facilities and relevant infrastructure, circumstances of the construction industry and available materials, and collected relevant data for the Project. After returning to Japan, the Team analyzed the survey results and data collected and provided the basic design for the required facilities and equipment and the management plan for these facilities. All conclusions and recommendations proposed by the Team are compiled in this Draft Final Report.

The objective of the Project is to rehabilitate and improve the existing water supply facilities and to return the present degraded capacity to the original design capacity level. The scope of the request is "to restore the original capacity of 7.5 MGD (34,100 cu.m/day) through rehabilitation and improvement of facilities from raw water intake up to/and including the treatment plant", which has been confirmed through discussions with the personnel concerned of the Government of Sri Lanka.

The recommended features of the rehabilitation plan are summarized as shown in the following table. The Project includes construction of a grit chamber and installation of new pumps. By implementing the Project, it is expected that removal work for sand and silt will never be required and that this will contribute to decreasing maintenance work. Two sets of electric generators are also to be installed at both the water intake plant and the water treatment plant in order to free the water supply from the present frequent stoppages of the electric power supply.

Main Features of Rehabilitation Plan

R : Rehabilitated
N : Newly constructed

No.	Name	Unit	Q'ty	R/N	Item to be rehabilitated/constructed
1	Water intake plant				
1.1	Low water intake	Set	1	R	Screen and lid.
1.2	High water intake	Set	1	R	
1.3	Water intake pump room	No.	1	N	3 sets of intake pumps and 2 sets of vacuum pumps.
1.4	Grit chamber	Unit	1	N	10 min. detention time.
1.5	Water transfer pump room	No.	1	N	3 sets of pumps.
1.6	Generator (incl. Bldg.)	Unit	1	N	400 KVA, 400 V.
1.7	Completion of premises	Set	1		Repair of the existing pump room, Installation of flowmeter, etc.
2	Water treatment plant				
2.1	Desludging channel	Set	1	R	Crack, Sludge collector.
2.2	Desludging channel	Set	1	N	Scum skimmer, Rapid mixer.
2.3	Pulsator	No.	4	R	Water channel partitioning plate, Piping, Valves, Vacuum pump, Desludging pipe, Tranquilizer, Upper water collection piping.
2.4	Filter	No.	9	R	Various piping, valves, etc. Adjustment & replenishment of filtration sand, Water collection strainer, Operation panel.
2.5	Water feed facility	Set	1	R	Primrose pump, Water level gauge, Flowmeter
2.6	Chemical dosing facility	Set	1	R	Mixers, Pumps, Tanks, Chlorinator
2.7	Chlorine neutralizer	Set	1	N	
2.8	Bleaching powder facility Dosing facility	Set	1	N	
2.9	Generator (incl. Bldg.)	Unit	1	N	250 KVA, 400 v, 50 Hz
2.10	Electrical equipment	Set	1	R	Switchboard & Operating panel, Monitoring panel, Receiving substation, Telephone line.
2.11	Others	Set	1	R	Equipment for Water quality testing, Workshop, Water leakage investigation equipment.
2.12	Building	Set	1	R	Repair of cracks, exteriors, lighting, etc.

The annual operation and maintenance costs required are estimated at 99 Million Yen. The required construction period of the Project will be 21.5 months including the periods for procurement, transportation and fabrication of equipment and materials. In case the project is to be implemented with grant aid

from the Government of Japan, it is recommended that the work be implemented under the following two phases.

First phase : Rehabilitation of the treatment facilities

Second phase : Rehabilitation of the intake facilities

The National Water Supply and Drainage Board (NWSDB) under the Ministry of Local Government, Housing and Construction is to be responsible for the execution of the Project on the Sri Lanka side. Since 1975, the NWSDB has been the leading institution for the development of all urban and rural piped water supply systems, urban sewerage, and rural non piped-water supply systems based on drilled wells. The NWSDB has experience constructing treatment facilities under grant aid from the Government of Japan. The chairman of the NWSDB takes full responsibility for the implementation of the Project and the Assistant General Manager (AGM) stationed at the local support center in Kandy will be in charge of supervising the construction. After the completion of the Project, operation and maintenance of the facilities will be done by the Water Works Department of Kandy city. Since this department has a long history of more than a quarter century of operating and maintaining the water supply facilities, it should be sufficiently reliable.

The water supply capacity 7.5 MGD is estimated as a target to cope with the water demand in 1991 of the city of Kandy and the two adjacent areas. With implementation of the Project, the water supply in these areas will be improved to a considerable extent and become stable. This will contribute not only to the improvement of public sanitation and the living environment in these areas, but also to upgrading the standard of living of the people. It is, therefore, concluded that the Project is feasible and appropriate as a grant aid project of the Government of Japan. In order to make the Project more effective, it is recommended that continuous efforts be made to increase the capacity of distribution reservoirs, rehabilitate distribution pipelines, improve the financial balance and strengthen the functions of the present operation and maintenance organization. Furthermore, a study concerning the development of new water resources should be commenced to establish a long-term plan for water supply works in Kandy city, taking into account the future increase in water demand in accordance with the increasing population and the need for upgrading the standard of living .

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ABBREVIATIONS

ADB	:	Asian development Bank
AGM	:	Assistant General Manager of NWSDB
DDC	:	District Development Councils
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
IDA	:	International Development Association
IDWSSD	:	International Drinking Water Supply and Sanitation decade
MLGHC	:	Ministry of Local Government, Housing & Construction
MOH	:	Ministry of Health
NWSDB	:	National Water Supply and Drainage Board
UDA	:	Urban Development Authorities
USAID	:	United States Agency for International Development
WSS	:	Water Supply Scheme

GLOSSARIES

1. Length and Height

mm	:	millimeter
cm	:	centimeter
m	:	meter
km	:	Kilometer

2. Area

Cm2	:	square centimeter
m^2	:	square meter
km^2	:	square kilometer

3. Volume

cm^3	:	cubic centimeter
l	:	liter
m^3	:	cubic meter
MGD	:	Million Gallon per Day
gal	:	gallon (= 4.546 liter)
gcd	:	gallon per capita per day

4. Weight

kg	:	kilogram
g	:	gram
t	:	ton(=1,000 kg)

5. Time

S, sec	:	second
min	:	minute
hr	:	hour

6. Electrical Measurements

KV	:	kilo volt
KVA	:	kilo volt hour
hz	:	hertz

7. Currencies

US$	:	US Dollar
Rs.	:	Rupee (=4.06 Japanese yen)

CHAPTER 1 INTRODUCTION

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The long-term plan for water supply in Sri Lanka is implemented along with " The International Drinking Water Supply and Sanitation Decade (1981 - 1990)" program proposed by WHO. The Government of Sri Lanka considers improvement of the living standards of the people as one of its top priority policies, and is pushing forward the improvement of potable water supply and sanitation by using economical and realistic methods. The on-going projects in the urban area emphasizes rehabilitation and expansion of the existing facilities rather than installing new facilities and equipment. After completion of these projects, it is expected that the ratio of population served by public water supply, 75% of total population at present in urban area, will reach 100% by 1995. The present ratio served by public water supply in the rural areas is only 5%, with 58% served by well water supply, and the remaining 36% depending on other supplies. Therefore, emphasis of public investment related to the water supply projects will be urgently shifted to the rural areas in the future.

The city of Kandy, the project area, was prosperous as the capital of the Singhala Dynasty in the past. At present, it has a population of about 110,000 (in 1987), being the fifth largest in this country. The population is estimated to reach 145,000 in the year 2000 because of the annual rate of population growth of 2.3%.

The water supply facilities in Kandy city were founded basically in 1887 by England. The facilities consisted of a distributing reservoir of 180,000 m^3, a chlorination plant, and a water distributing network. A subsequent increase in population needed expansion of the water supply facilities. And to meet the water demand, wells and pump facilities were constructed in the city. But as these facilities were insufficient in 1963, the city of Kandy formulated a plan to construct modern water supply facilities using Mahaweli river as the water source. This plan had a scale of daily water supply rate of 5 MGD (23,000 m^3/day). Implementation of this plan was completed in 1966 with a loan from France. The facilities constructed at that time, consisted of water intake facilities, a pumping plant for raw water conveyance, a treatment plant, and raw water transfer pipelines between the two plants, etc., which are the prototype of existing facilities. After partial modifications and rehabilitation, most facilities are still in use. Again, in 1980, a facilities augmentation plan was set up to meet the increased water demand. The capacity of the facilities was 7.5 MGD (34,100 m^3/day). The main facilities planned then were as follows

1. Water intake facilities

   (1) Replacement of 3 intake pumps with 4 new pumps.

   (2) Installation of sand agitation and removal equipment.

2. Water treatment facilities

   (1) Increase capacity of the facilities with no civil construction.

   (2) Installation of chlorinator.

This construction was completed in 1983, however, anti-abrasioin measures against pumping of water with high content of sand had not been considered in the design of these four pumps made in India. As a result these pumps were damaged in succession within a half year after commencement of operation. At present, only two of these pumps made in India and one pump which had been in use before the augmentation plan, (three units in total) are in operation. With repeated repairs and replacement of the parts, a maximum water intake of about 5 MGD per day is maintained at present. This plan was intended to make the maximum use of any margin inherent in the facilities of the treatment plant in order to meet the planned rate of 7.5 MGD. Both the existing facilities, water intake and water treatment, have already been operated for more than 20 years since their construction, and their mechanical and electrical equipment are considerably deteriorated. Some equipment, having failed, has been left without being repaired for financial and technical reasons. In spite of these severe operational circumstances as mentioned above, the water works department of the city is making continued endeavours to supply water with repeated efforts to remove sand from the pump wells and to repair these pumps and other various machines, whenever they are out of order. Moreover, there was a major set back in March 1988, when the main distribution pipe to R_2 reservoir burst in the treatment plant. At that time, the city area suffered a 5-day interruption of water supply. This accident affected the life of citizens and various city activities rather seriously. This also made the citizens to be awaken to the hardships which they were undergoing due to substandard conditions of the water supply. Consequently, demand was widely raised in the city for the realization of the city's water works rehabilitation project.

Under these circumstances, the Government of Sri Lanka has given a high priority to the rehabilitation project for the Kandy Water Supply Scheme, and requested the Government of Japan to execute the project under Japan's grant aid programme. In response to this request, the Government of Japan decided to take necessary measures. Accordingly, the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study Team, headed by Dr. Hidenori Aya, professor of Musashi Institute of Technology, to Sri Lanka from September 29, 1988 to October 27, 1988. This study team, in addition to the confirmation of the contents of the request made by the Government of Sri Lanka, carried out functional surveys of the existing facilities, and moreover collected the related data. The items agreed upon through discussions with the Government of Sri Lanka during the field survey were summarized as the minutes of meeting and signed by the representatives of both parties.

This report has been prepared as a basic design after studying the propriety of this project, and the contents of optimum rehabilitation of the water supply facilities, etc. through analyses made in Japan based on the field survey carried out in Sri Lanka.

CHAPTER 2 BACKGROUND OF THE PROJECT

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2.1 Outline of Sri Lanka

2.1.1 Geography, climate, and population

(1) Geography and climate

Sri Lanka is an island lying in the Indian Ocean between approximate coordinates of latitude 6° and 10° North, and longitude 79.5° and 82° East, about 30 km away from the Indian Continent. This pearshaped Island has an area of little over 65,000 square kilometers and consists of a South-Central mountainous region, generally ranging in elevation from about 500 to 2,100 meters, surrounded on all sides by coastal plains.

The Climate is tropical with little seasonal variation. Mean monthly temperatures in most parts of the island range from 26 °C to 28° C in the plains. The island can be broadly divided into a Wet Zone, covering about a quarter of the island in the South-West with an average annual rainfall of about 2,400 mm, and a Dry Zone over the rest of the island with approximately 1,400 mm of average annual rainfall. Four rainfall seasons can be discerned in Sri Lanka;

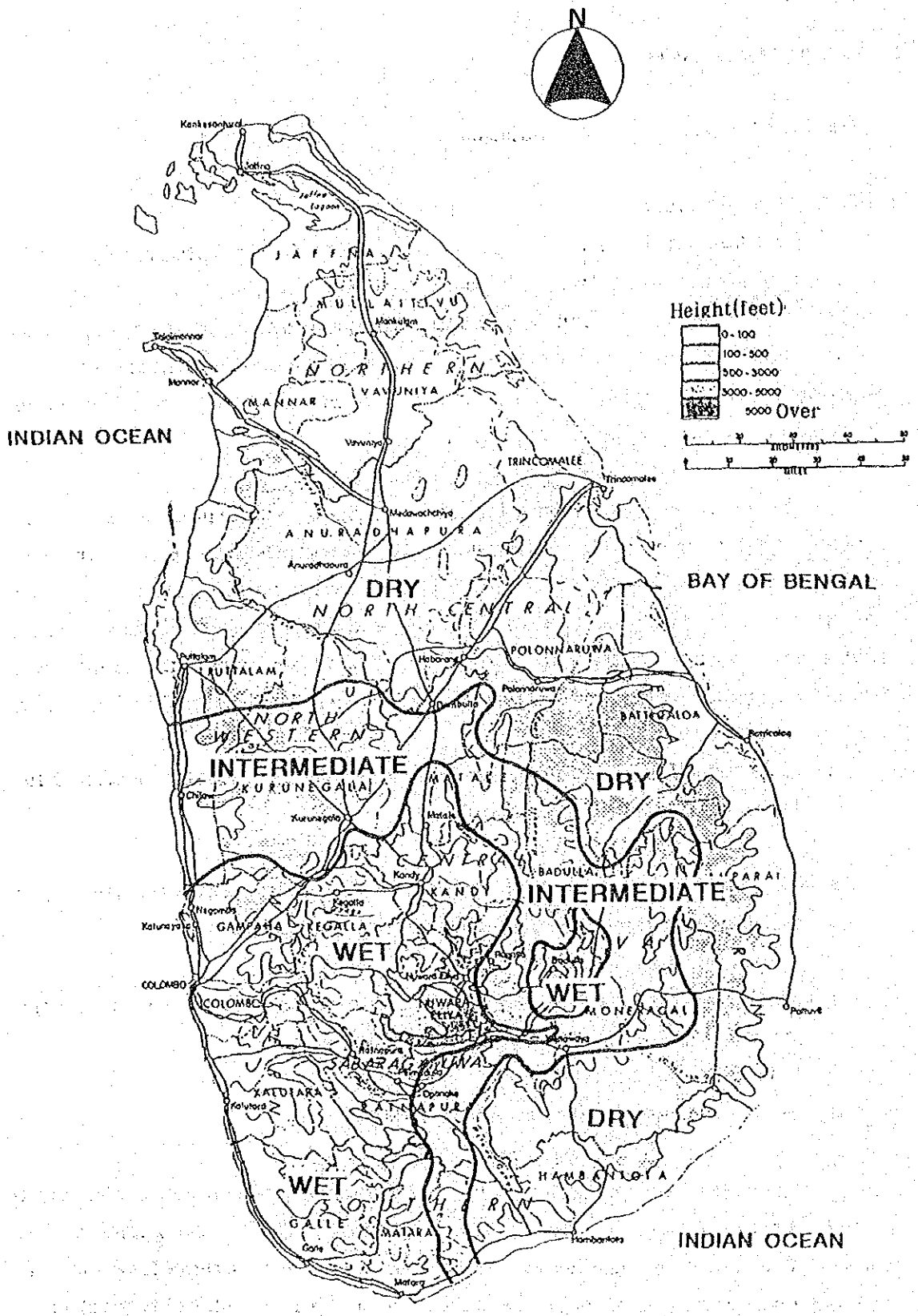
a. the South-West monsoon from May to September, mostly confined to the South-West parts of the island;

b. the inter-monsoon period, October to November, characterized by local thunder showers over wide areas due to cyclonic activity;

c. the North-East monsoon period from December to February, with rainfall mostly confined to the North-Eastern parts; and

d. the inter-monsoon period, March to May.

The rivers of Sri Lanka flow in a radial pattern from the central mountains to the sea. The mean annual precipitation on the island has been estimated as 110 cubic kilometers, and the mean annual stream flow run-off of the 103 river basins as 51 cubic kilometers, or 47% of the total precipitation.



source : World Bank, Srilanka : Recent Economy.

Fig- 2.1 Overview of Sri Lanka

(2) Population

The latest population census held in Sri Lanka in 1981 gave a total population of 14.85 million of which 21.5% (3.2 million) lived in urban areas and 78.5% (11.65 million) in rural areas. In 1981 there were 12 Municipal Councils, 39 Urban Councils, 83 Town Councils and 24 District Development Councils (DDC) as well as about 25,000 villages in the DDC areas. Sri Lanka has an administrative division system whereby the country is divided into provinces and further districts. The country has altogether 24 administrative districts under 9 provinces at present. The overall annual growth rate since the previous census in 1971 has been 1.7% for the period 1971 to 1981. The total population for mid 1986 is estimated to be 16.1 million.

Table- 2.1 Population Growth (unit : 1,000)

	1963	1971	1981
1. Total population	10,582	12,690	14,849
2. Urban population	2,106	2,848	3,195
3. Portion of urban population (%)	(19.1)	(22.4)	(21.5)

Source : Dept. of Census and Population,
Ministry of Plan Implementation.

Table- 2.2 Population of Principal Towns (unit : 1,000)

Name of town	1978	1981
Colombo	579	592
Dehiwala-Mount Lavinia	168	175
Jaffna	114	120
Moratuwa	123	136
Kandy	99	103
Kotte	100	102
Galle	75	79
Negombo	60	62
Trincomalee	44	46
Batticaloa	41	43

Source : Dept. of Census and Population,
Ministry of Plan Implementation.

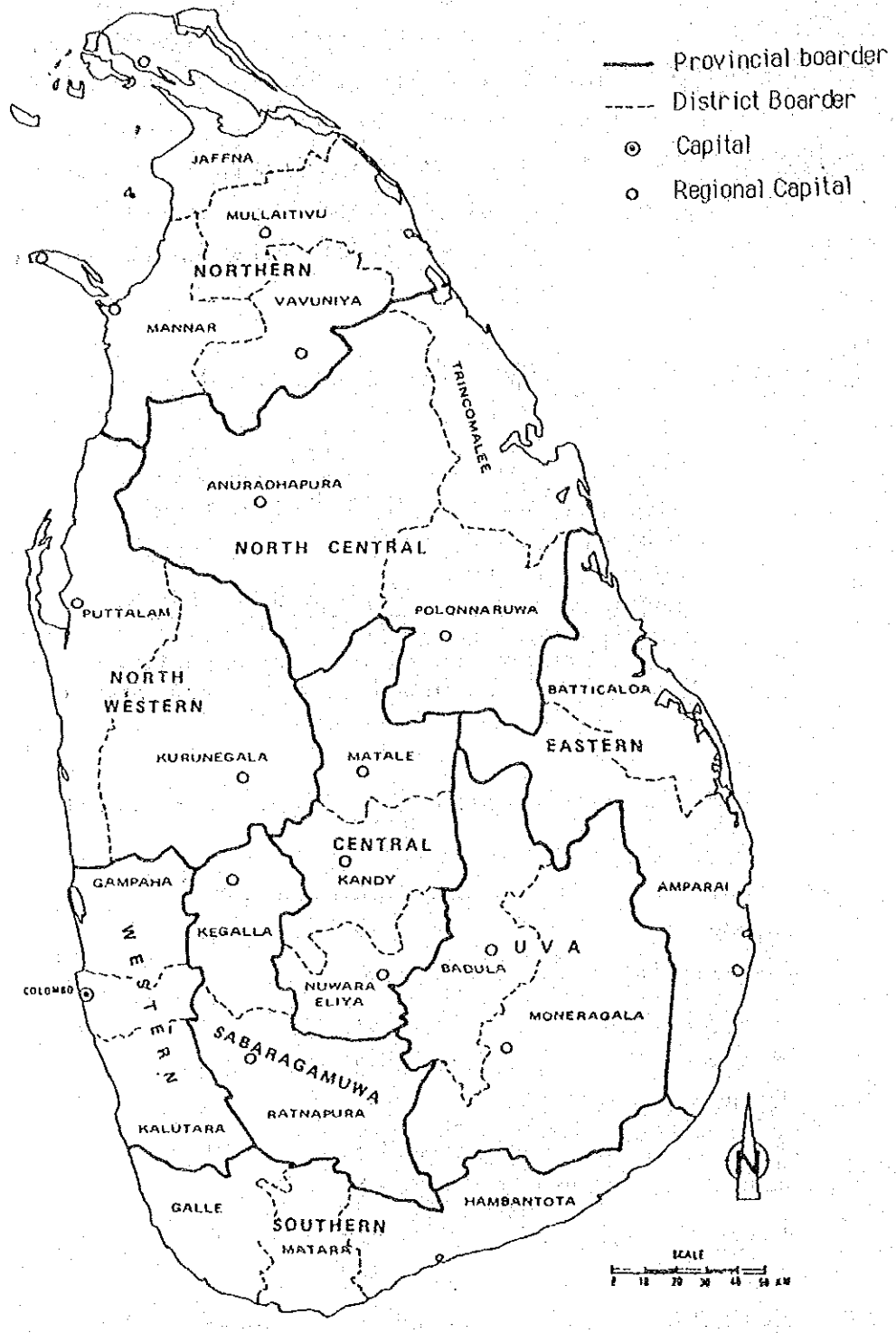


Fig- 2.2 Administrative Regions of Sri Lanka

2.1.2 National Economy

The Sri Lankan economy is basically agricultural, accounting over a quarter of the country's Gross Domestic Product (GDP). Tea, rubber and coconut are the three main crops in Sri Lanka.

A severe drought, the worst experienced by Sri Lanka in 25 years, has appreciably reduced agricultural output and farm incomes in 1986 and 1987. Eight districts have been very badly affected and five others somewhat less, since August 1986. The total number of persons afflicted due to the prevalence of the drought in the 13 districts, has been estimated at around 2.4 million.

The shortfall in paddy production during 1986-1987 has been estimated to be around 300,000 metric tons. Production of other field crops, as well as minor exports have also severely affected not only farm income but also income and employment in other sectors.

Export earnings from tea, rubber and coconut dropped drastically in 1986 due to price declines, while significant gains were made at the same time in the production of these crops. The contribution of the three commodities to government revenue dropped from an average of 18% in the period 1978-83 to 3.7% in 1986.

Terrorist activities and consequential security operations in the Northern and Eastern regions continued to exert an adverse impact on many sectors of the economy. Fish production, of which approximately half the country's total output was harvested in the North and the East before 1982, has declined by as much as 55%.

A number of government buildings, educational establishments, banks, telecommunication and electricity equipment, roads and bridges have been destroyed, cutting down drastically the availability of infrastructure services. The Government's security bill as a percentage of total budgetary expenditure has soared from 3.2% in 1982 to 13.6% in 1986.

The most serious economic impact, however, has been felt in the tourist industry. Foreign exchange earnings from tourism, which registered an average annual rate of increase of 27.5% during 1978-82, have declined sharply

since then. In 1986, the foreign exchange earning were less than half of that earned in 1982.

The net impact of these factors is a slower growth of GDP and a deceleration of employment generation in 1986. While GDP grew only by 4%, the lowest since 1977, there is evidence that unemployment which dropped to about 14% in 1984 has already reached the region of 16 to 17%. If the growth momentum is not restored, it is possible that unemployment will reach 19-20% by 1990.

Sri Lanka's mid-year population in 1986 has been provisionally estimated at 16.1 million against GNP of Rs. 159.9 billion which equals to per capital GNP of Rs. 9,918 (US$ 354). Other key economic indicators are set out in Table- 2.3 below.

Table - 2.3 Key Economic Indicators for Sri Lanka

Description of indicator	unit	1982	1983	1984	1985	1986
Population						
Mid-Year Estimate	mil.	15.2	15.4	15.6	15.8	16.1
Growth Rate	%	1.3	1.3	1.3	1.5	1.8
Consumer Price	%	10.9	14.6	16.6	1.5	8.0
Exchange Rate	Rs/Us$	20.8	23.5	25.4	27.2	28.0
GNP at current factor cost price	Rs(mil.)	92,720	110,664	134,679	144,921	159,852
GNP (1982) factor cost price	Rs(mil.)	92,720	96,439	101,399	106,741	111,565
GNP at constant (1982) factor cost price growth	%	-	5.0	5.1	5.0	4.3
GNP per capita						
at current prices	Rs	6,104	7,179	8,759	9,151	9,918
at constant prices	Rs	6,104	6,256	6,500	6,740	6,922
growth at constant prices	%	-	2.5	3.9	3.7	2.7

Notes : GDP ; Gross Domestic Product GNP ; Gross National Product

Source : Central Bank Sri Lanka, Bulletin 1988, Economic Intelligence Unit (EIU),

2.1.3 Outline of National Development Plan

National Development Plan is based on the five year rolling investment and development plan in Sri Lanka. The current investment programme, depends greatly upon the foreign aid, such as loans and grants, will be based on the assumptions as follows;

(1) the ethnic conflict is to subsided

(2) climatic conditions are to continue as normal

(3) economy is to be gradually improved and a severe recession is not expected in the world

(4) inflation in the developed countries is to be stabilized

The Public Investment Programme 1987-1991 concentrates basically on the timely completion of ongoing projects in priority areas such as power, irrigation, Mahaweli, road rehabilitation, water supply and telecommunication. In exercising the expenditure, reductions had to be borne by the larger investment projects which are mainly in the Accelerated Mahaweli Progtamme, the other irrigation sector, telecommunications and water supply. In addition to that social overheads in areas such as Education and Health have been lowered, due to the lack and deterioration of the related facilities, the social infrastructure cannot provide adequate service to the citizens.

The demand for infrastructure services will nevertheless increase rapidly. It will outpace significantly the modest average rate of growth of GDP envisaged in this period.

The rate of growth of GDP during 1987-1991 is estimated to be 4.6% in real terms, which is much lower than what has been achieved since 1977. An added reason for increased investment in infrastructural services is the accumulated backlog of assets rehabilitation that has to be cleared in order to facilitate a minimum acceptable level of economic activity. In addition, as soon as peace dawns in the North and the East, a significant proportion of government expenditure will have to be diverted to restore buildings, equipment and and other productive assets, apart from rehabilitating displaced persons.

Table- 2.4 Total Amount of Industrial Production in GDP (unit : Rs million)

	1985	1986	1987	1990	1991	Average growth rate 1986-91
1. Tea	5,269	5,203	5,269	5,466	5,540	1.3
2. Rubber	1,164	1,172	1,202	1,227	1,244	1.2
3. Coconut	3,342	3,414	2,954	3,247	3,416	0.3
4. Rice (incl. Processed)	9,379	9,004	7,724	9,931	10,299	2.7
5. Other Agricultures	21,915	22,770	23,908	26,533	27,541	3.9
Sum of Agri. Sect.	41,069	41,563	41,058	46,404	48,084	3.0
6. Mineral	3,328	3,397	3,594	4,540	4,766	7.0
7. Processing of tea, rubber, coconut	5,645	5,604	5,636	5,850	5,947	1.2
8. Other Industries	16,203	17,013	17,864	21,075	22,551	5.8
Sum of Indust. Sect.	21,849	22,617	23,500	26,926	28,497	4.7
9. Construction	11,604	12,106	12,675	14,630	15,362	4.9
10. Servicing business	70,435	74,641	78,991	91,700	96,743	5.3
GDP	148,321	154,344	159,818	184,199	193,453	4.6

Source : Public Investment, 1987-1991

2.2 Status of water Supply in Sri Lanka

2.2.1 Coverage of Water Supply

The international Drinking Water Supply and Sanitation Decade (IDWSSD) Committee established by the Government of Sri Lanka prepared a comprehensive decade plan which was published in 1980. Decade plan coverage objectives for which capital investment forecasts and support programmes were developed allowed for the improvement of the quality and quantity of water available for the entire urban population by the year 1990 (100% coverage). In the rural areas, the target established was to improve the quality and quantity of water for 50% of the rural population by 1990 with all the remaining population served by 1995.

Table- 2.5 Situation of Water Supply in Terms of Population Served

DETAIL of SECTOR	TOTAL PERSONS in THOUSANDS	PIPED WATER WITHIN PREMISES	PIPED WATER OUTSIDE PREMISES	PROTECTED WELLS	OTHER SOURCES
URBAN	3,007.0	27.2%	23.4%	41.9%	7.5%
RURAL	10,666.0	1.9%	3.4%	59.0%	35.7%
ESTATE	957.0	28.2%	37.1%	16.2%	18.0%
TOTAL	14,630.0	8.8%	9.8%	52.7%	28.7%

Source : Census of Population and Housing 1981

It can be seen from the above table that the level of service varied substantially between the sectors. The urban sector in 1981 had 50% of its population served with piped water system and less than 10% had to resort to unprotected wells and other sources for drinking water. The rural sector however had a relatively small proportion of its population served with piped water systems. Over three quarters of the rural population depended upon wells and other sources of water such as rivers and tanks, and only 50% of the rural population had access to protected wells which could be considered relatively safe sources. According to the latest five year public investigation plan (1988-1992), about 75% of the population in the urban area is estimated to be covered with piped water system. Remaining 25% is depended upon wells and other sources at present. In the rural area, while 5% of the population is served with piped water and 58% of them has

access to wells, the remaining 36% of the rural population depends upon the unprotected wells and other surface water sources.

2.2.2 Sectors Institutions

The 4 principle organizations involved with the water supply are, Ministry of Health, Ministry of Local Government, Housing and Construction, National Water Supply and Drainage Board (NWSDB), and Local Authorities. Responsibilities for water supply and sanitation rest with a number of Government ministries, departments, corporations, and boards. This has resulted in a dispersal of authority, partial overlapping of responsibilities and difficulties in achieving uniform standards for water supply and sanitation services. The most important organizations for the development and maintenance of these services, especially in rural area, are NWSDB and the Local Authorities. A brief description of responsibilities is given below. Figure- 2.3 also illustrates the inter-relation of the various organizations with the water supply and sanitation sector. The two most important organizations for the development and maintenance of these services, especially in the urban areas, are NWSDB and the Local Authorities. In the rural areas, the Ministry of Health and NWSDB are the key organizations, while in the estate sector, the Sri Lanka State Plantation Corporation and the Janatha Estates Development Board are the leading institutions. The Mahaweli Authority of Sri Lanka is responsible for the agricultural development and settlements in the Mahaweli programme.

(1) National Water Supply and Drainage Board (NWSDB)

The NWSDB is an autonomous body under the Ministry of Local Government, Housing and Construction (MLGHC). It was formed in 1975 out of the Department of Water Supply and Drainage. NWSDB is the leading institution in the development of all urban and rural piped water supply schemes, urban sewerage schemes, and rural non-piped-water supplies based on drilled well. The NWSDB covers the whole country with four regional support centers. One of these centers is in Kandy City. This center is responsible for 8 districts as mentioned on Figure- 2.5. Because the regional offices have only minimal capabilities for field investigations, project design, and logistical support, most functional support and decision making are centralized at headquarters at present. Currently, the NWSDB is undertaking a programme to strengthen institutional arrangements at regional level and subsequently to decentralize decision making to the regions. The Board is headed by a Chairman and

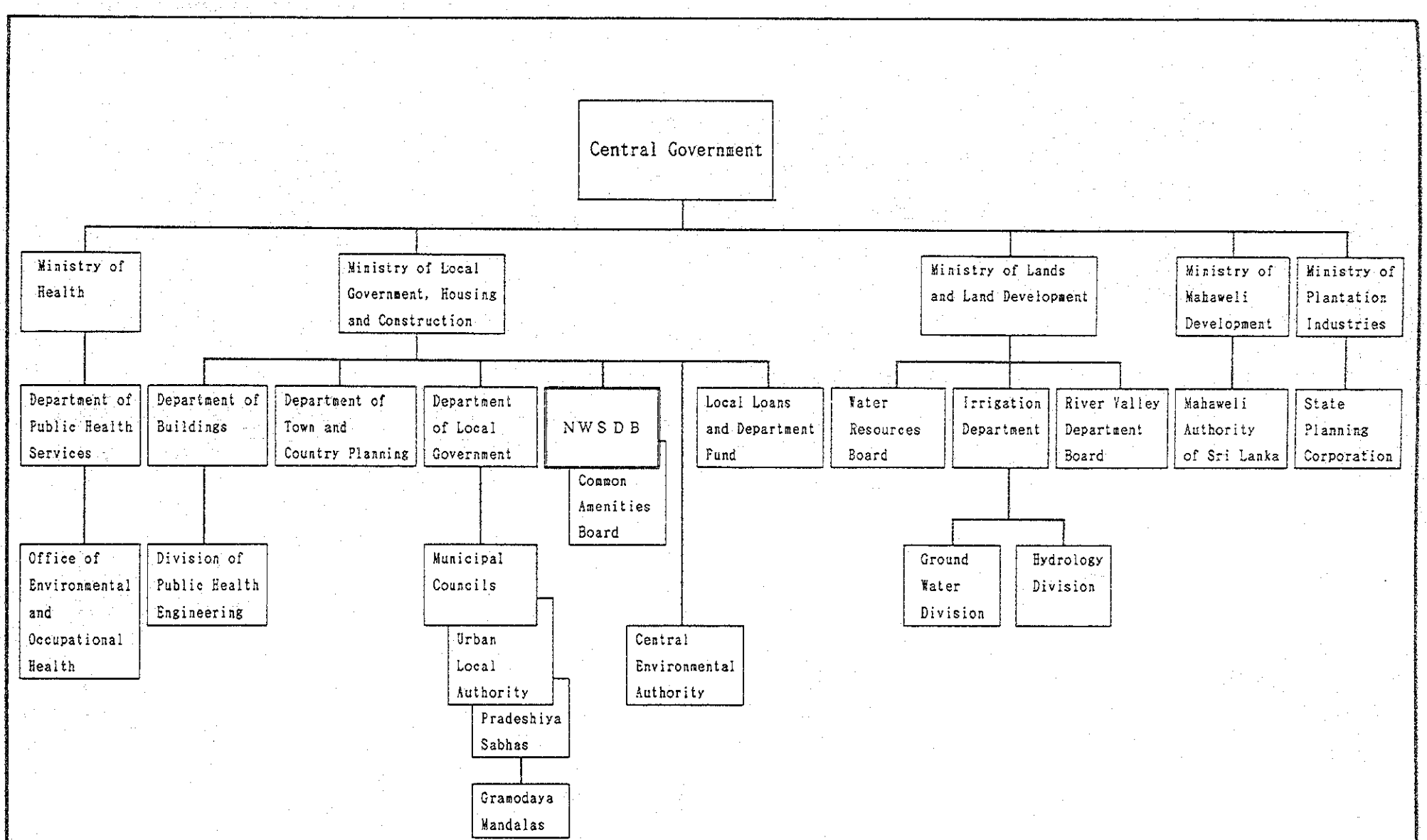


Fig- 2.3 Organization on Water Supply and Sanitation Sectors

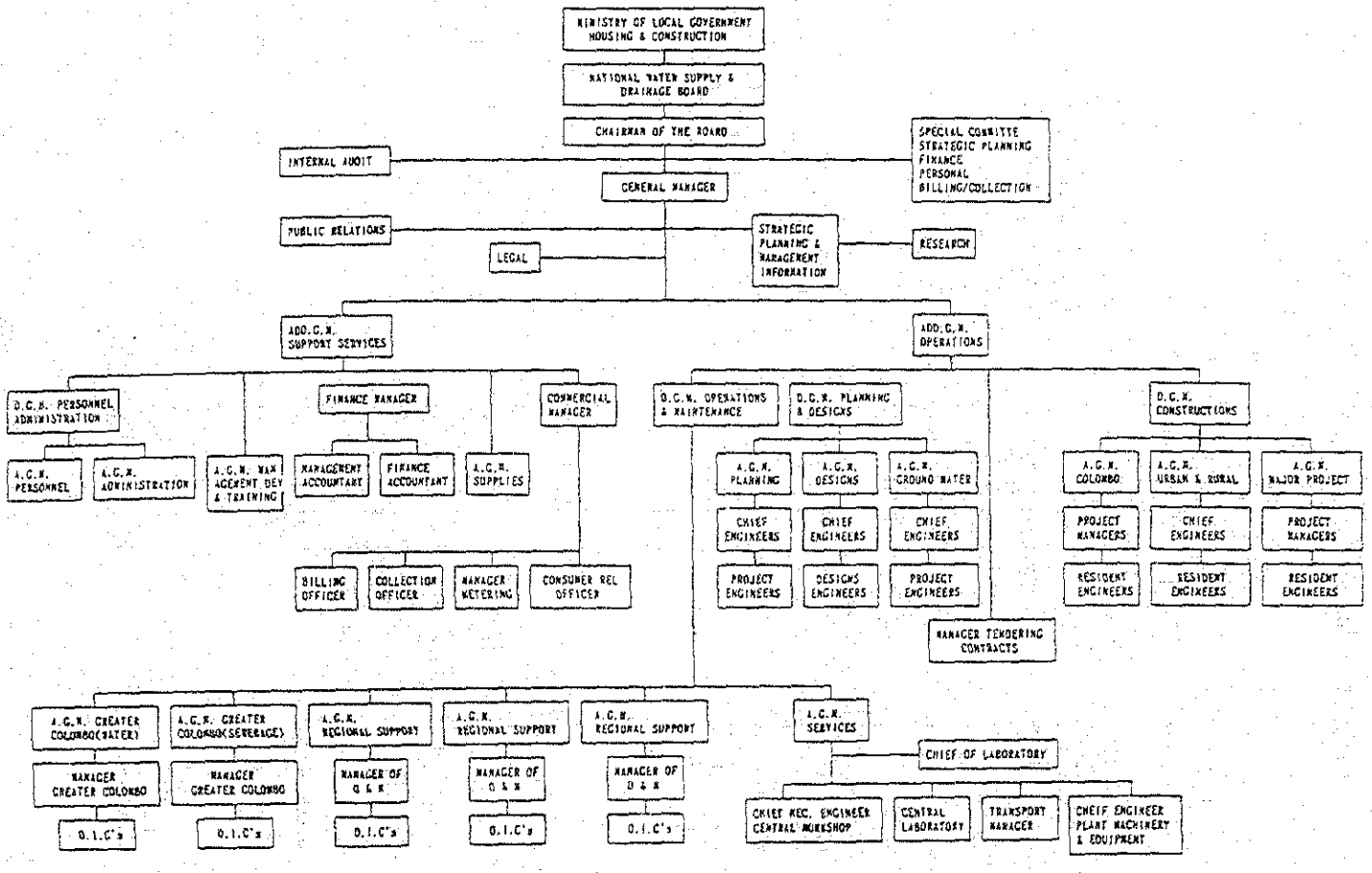


Fig- 2.4 Organization of NWSDB

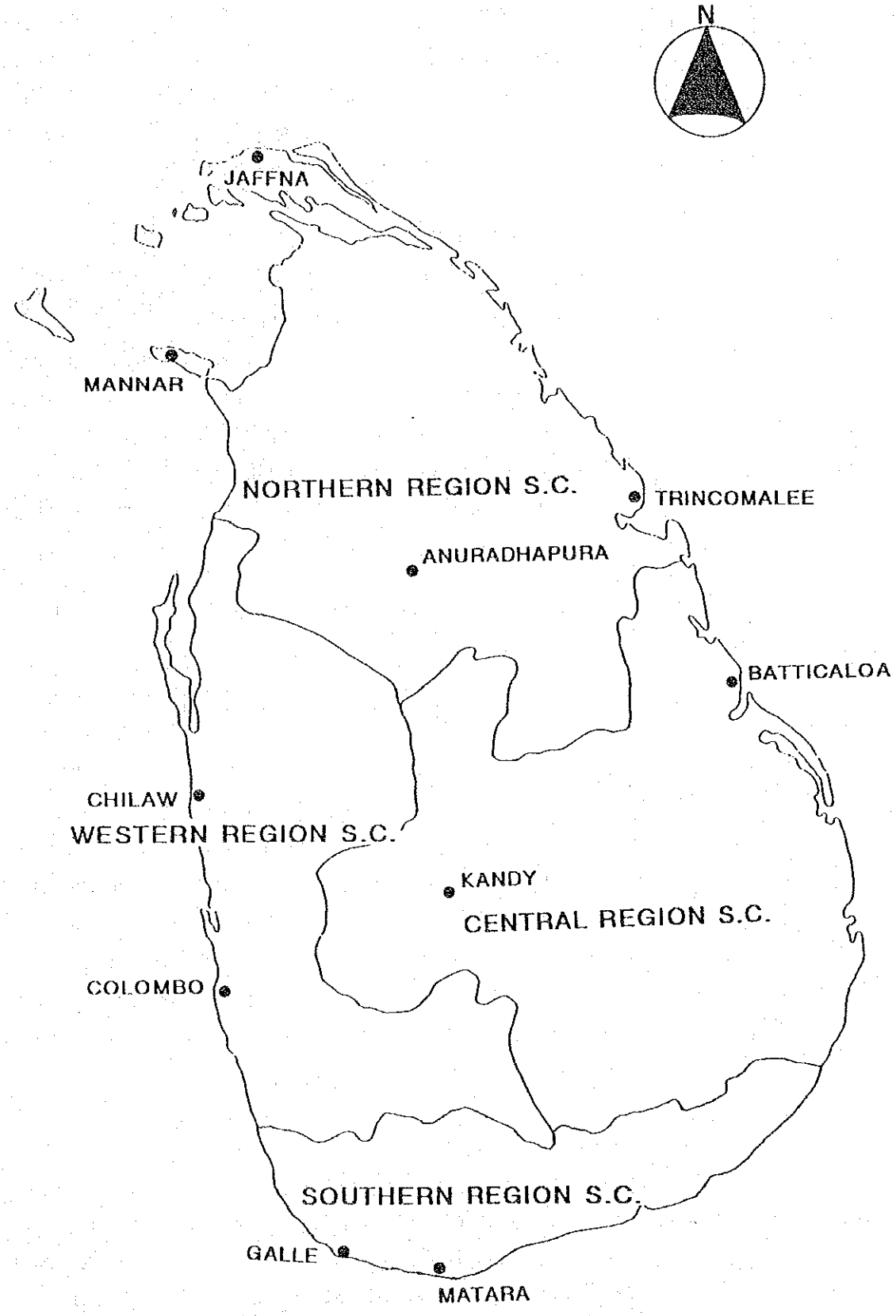


Fig- 2.5 NWSDB's Administrative Regions

executive responsibilities are held by a General Manager. In general, the responsibilities of operation and maintenance for distribution system of water supply lie on the Local Authorities, while NWSDB is responsible for operation of head works such as Intake and Treatment facilities. In the case of small systems, NWSDB usually undertakes entire management and operation of the whole system.

(2) Ministry of Local Government, Housing and Construction (MLGHC)

Local Authorities receive administrative and technical assistance from the Department of Local Government. Headed by a Commissioner who reports to MLGHC, the department provides the administrative channel through which technical aid is made available to all Local Authorities for water supply and sewerage development. In rural areas, the Assistant Commissioner of Local Government who is located at district headquarters, is the direct link to the staff, to assist with minor water supply and sanitation effort.

(3) Local Authorities

In general, District Development Councils (DDC) are responsible for establishing and maintaining water supplies and while Urban Development Authorities (UDA) are responsible for urban areas. The DDC usually obtain 50% (or more) grant funding for water schemes from the Local Loan and Development Fund. NWSDB designs and constructs piped schemes and, depending on circumstances, either NWSDB or the DDC handles operation and maintenance. The responsibility of collecting water rates to pay for production and operating costs will generally rest with whichever authority is responsible for the distribution of water to the consumer. Non-piped community water supplies are free, and the DDC retains full responsibility for any necessary maintenance. DDC sometimes give contracts to the NWSDB for maintenance and repair services which they themselves cannot provide.

2.2.3 Water Supply Project

Ongoing water supply projects which are concentrated in urban areas are expected to be completed in 1995. By then the capacity of water supply in urban area is estimated to reach about 100% level. Investment on water supply sector is expected to be shifting to rural areas in the future. Currently, the most vital obstacle to making investments in water supply sector is the reconstruction of its

financial ability. NWSDB is based on a self-supporting accounting system. Collection of the water billing was recorded at 38% of total operation cost in 1984. In 1987, this has improved up to 61% but still was not sufficient. The financial deficit is subsidized by the general account of national budget. It is estimated that NWSDB's financial balance will be a 5% plus in 1990, if the ongoing financial improvement programme is continued.

"The Greater Colombo Area Water Supply & Drainage Scheme" which is financed by World Bank and Saudi-Fund is a major ongoing project in the urban area. Rural Water Supply and Sanitation Programme is executed in rural areas with the aid of Finland, Norway and West Germany. Currently, the need for institutional development in NWSDB has been recognized and a project for institutional development has begun. NWSDB's decentralization project for the decision-making and participation is being implemented by the USAID. The trends of Public Investment are shown in Table- 2.6.

Table- 2.6 Trend of Public Investment for Water Supply and Sanitation
(unit : Rs million)

Year	Urban Water Supply	Rural water supply Piped	Rural water supply Non-piped	Urban Sewerage	Others	Total
1985	375	89	27	520	80	1,091
1986	650	154	77	250	80	1,221
1987	862	179	109	100	80	1,330
1988	862	220	109	100	80	1,371
1989	698	286	109	100	80	1,273
1990	563	246	109	225	50	1,193
1991	100	370	232	225	30	957
1992	100	370	232	225	25	952
1993	100	370	232	225	25	952
1994	100	246	232	225	15	818
1995	100	246	220	240	10	816
Total	4,510	2,776	1,688	2,435	555	11,964

Source : A Strategic Plan for the NWSDB. October, 1984

2.2.4 International Cooperation toward Water Supply Projects

International cooperation for Sri Lanka, disbursed and executed from 1982 to 1987, including loans and grants, is shown on Table- 2.7. Total amount of disbursement favorably increased and reached the highest in 1986, although there was a temporary drop in 1983. However in 1987, this decreased to 85% of the previous year.

Table- 2.7 Trend of International Cooperation 1982-1987 (unit :US $ million)

	1982	1983	1984	1985	1986	1987
Loans	425.8	216.8	250.0	339.3	473.5	333.4
Grants	129.5	135.0	229.4	173.8	149.3	200.9
Total	555.3	351.8	479.2	573.1	623.8	534.3

Source : Department of External Resources

The number of Grant aid projects executed in Sri Lanka in 1987 are 63 and the major donor countries are Canada, Japan and Sweden. Records of projects in donor country-wise are as follows.

Name of country	Nos of project	Amount
Canada	6	44.16
Japan	7	30.10
Sweden	1	25.00
Nether lands	2	21.20
USA	11	17.02
Finland	2	11.80
West Germany	8	11.19
Norway	1	8.78
Denmark	1	2.79
Others	24	28.87
	63	200.91 (US $ million)

Source : Performance 1987, Ministry of Plan Implementation.

Water supply related projects under execution by Ministry of Local Government, Housing and Construction in 1987 are as follows.

1.	Kurunegala W.S.S.	L	West German
2.	Matale/Polonnaruwa W.S.S.	G	Denmark
3.	Polonnaruwa W.S.S.	L	China
4.	Chilaw/Puttalam W.S.S.	L	China
5.	Badulla W.S.S.	L	France
6.	Kandy District W.S.S. Programme	G	Finland
7.	Galagedara Electorate Ground W.S.S.	G	Finland
8.	Water Supply Rehabilitation Project	L	ADB
9.	Greater Colombo Area Sewerage Scheme	L	Saudi-Fund
10.	Greater Colombo Area W.S.S. Stage 2	L	IDA
11.	Greater Colombo Area W.S.S. Stage 3	L	IDA
12.	Harispattuwa W.S.S.	G	Finland
13.	Kurunegala W.S.S. (Expansion)	G	France

Remarks ; L : Loan
G : Grant
W.S.S. : Water supply Scheme
IDA : International Development Association
ADB : Asian Development Bank

Source : Performance 1987, Ministry of Plan Implementation.

2.3 Outline of Water Supply in Kandy City

2.3.1 Organization and Operation

The Water Works Department of Kandy city manages the entire water supply system in Kandy city. The Water Works Department consists of the divisions mentioned in Fig.-2.6 which are under the management of a Water Works Engineer. As of 1987, number of Employees of the department was 196. Collection of water fee for water supply is undertaken by another department of Kandy municipal council.

Financial situation of the water works department is not very sound due to the low water rates levied as shown in Table- 2.9. Ratio of revenue against expenditure of the water works has decreased year by year as shown in Fig.-2.7, ultimately being under 50 % in 1987. Financial balance of the water works department in 1987 is shown in Table - 2.8

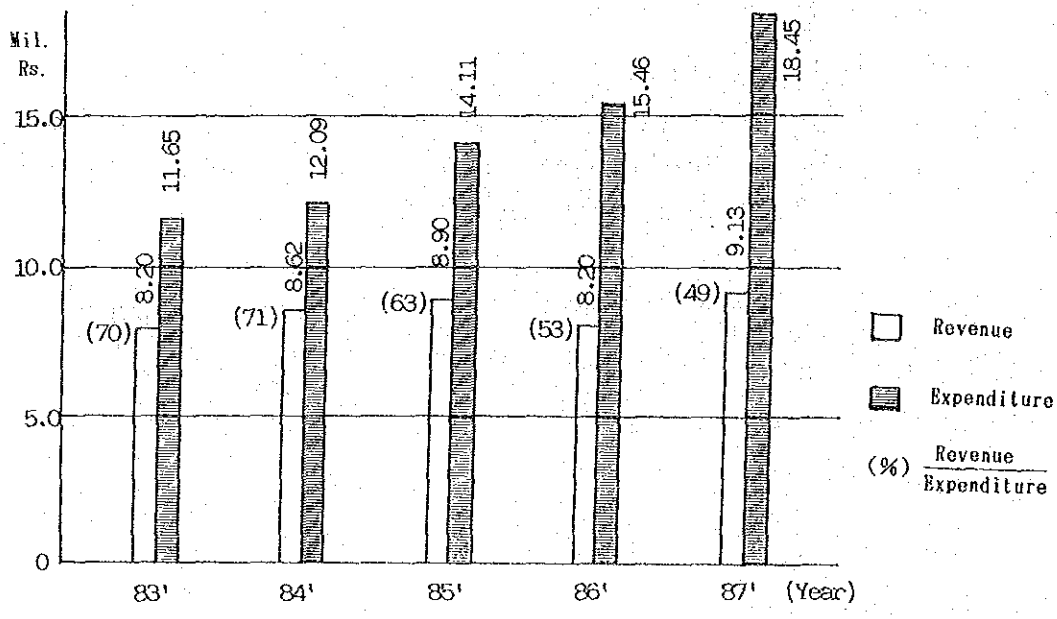


Fig - 2.7 Financial Trend of Water Works Department

Aimed at sound management, a proposal on the revision of water rates has been submitted to the council of Kandy city by the Water Works Department and also by the Finance Department of the city. However, the council is reluctant to accept this proposal because a rise in water rates could significantly influence the community. The current water rate, shown in the Table - 2.9, has been revised in

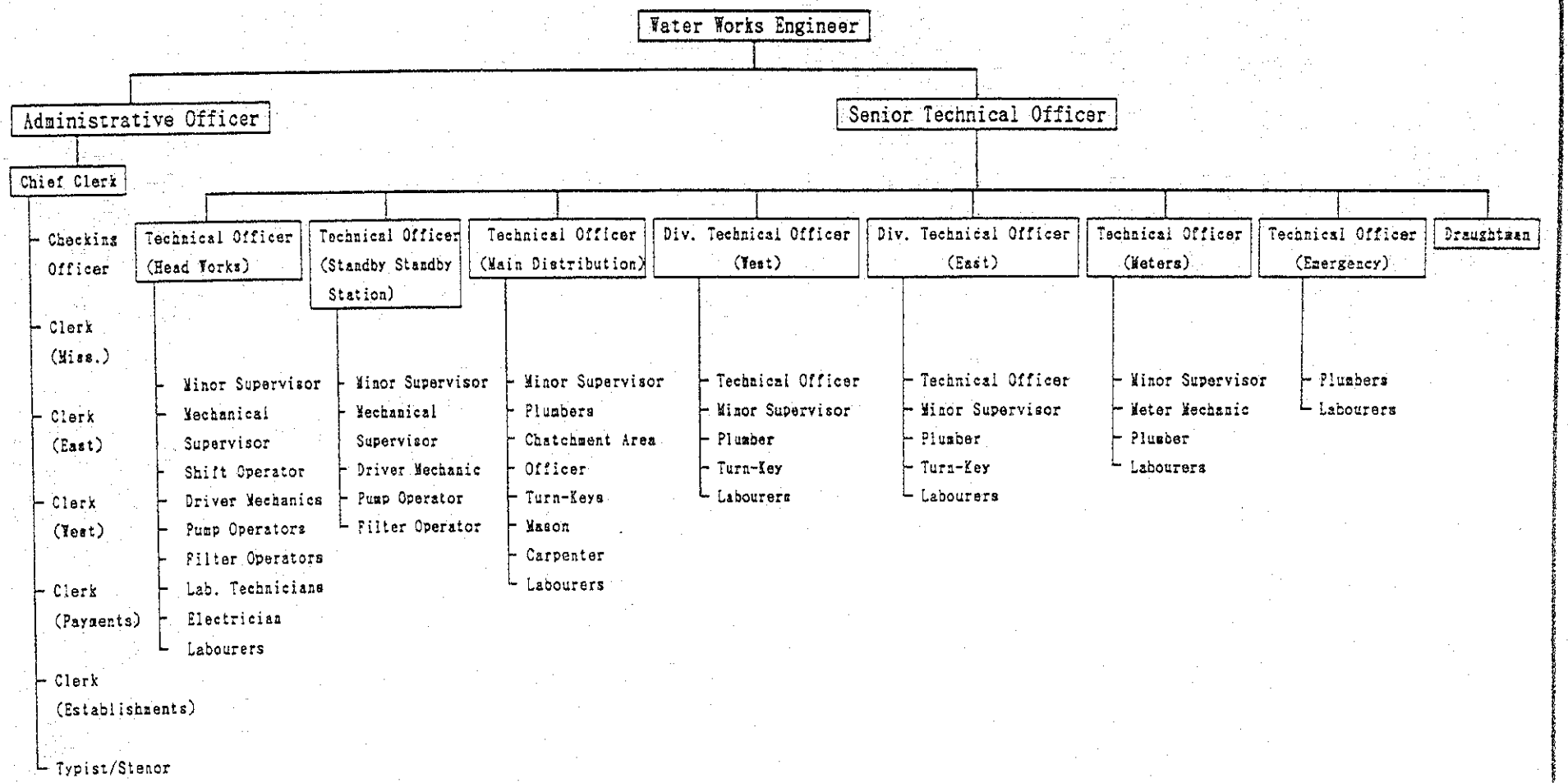


Fig- 2.6 Organization of the Water Works Department of Kandy City

January 1988, after an 8 year interval. These rates are approximately equivalent to 1.5 times the earlier rates.

Table-2.8 Revenue and expenditure in 1987 (in Rs.)

Revenue		Expenditure	
1. Meter Rent	307,246	1. Office Administration	1,113,127
2. Service Connection charge	25,855	2. Head Works	14,382,670
3. Warrant Cost	277,170	3. Main Distribution	1,759,153
4. Sale of Water	7,772,397	4. Service Connections	1,101,691
Sub-total	8,382,668	Sub-total	18,456,641
5. Revenue Grants from External	750,000		---
Grand Total	9,132,668	Grand Total	18,456,641

Table - 2.9 Water rates in Kandy city

	Per three months	Rates per 1,000 gal	
	up to 3,000 gal	Rs.	0
For house-	Up to 15,000 gal	Rs.	2.0
holds	Up to 25,000 gal	Rs.	7.50
	Over 25,000 gal	Rs.	12.50
Others	Guest House	Rs.	25.00
	Hotel	Rs.	51.00
	Up to 10,000 gal	Rs.	12.50
For	Up to 15,000 gal	Rs.	13.50
Industry	Up to 20,000 gal	Rs.	18.00
	Over 20,000 gal	Rs.	20.00

Remarks; Interval of the collection of the fee is 3 months.

In spite of raising of water rates, sound financial management could not be expected considering the following trial balance.

According to Fig.-2.8, total income from the water supply scheme, which had supplied about 9.2 million m^3/year in 1987, was Rs. 8.38 million, while on the

other hand, the expenditure was Rs. 18.5 million Based on this financial balance, unit cost of supplying water should be Rs. 0.90/m^3 (Rs. 4.1/1,000 gln.) as income, and Rs. 2.00/m^3 (Rs. 9.1/1,000 gln.) as expense. In other words, the price for the expense is equivalent to about 2.2 times as high as that for the income. This shows that it is necessary to raise the water rates in order to minimize the deficit in water works management. Moreover, there are many other problems, which need attention, for example the counter measures for the leakage from the existing pipeline network, shifting of the current free-charge system to chargeable system for stand post users, whose consumption is estimated to be as high as 13 % of the total amount of water supply.

2.3.2. Outline of Existing Facilities

The source for the existing water supply scheme is Mahaweli River. Raw water which is pumped up by the water intake facilities located at Getambe, in the west part of the city, is transferred to the water treatment plant, located about 600 m towards east of the Intake, through a 500 mm dia. pipeline. From the plant, treated water is delivered to R_2 Reservoir, 4.1 km away from the plant, and located on a hilly area in the southern part of the city, and from there, it is distributed to the city by gravity through service pipeline. For the higher areas of the city, water is served from R_3 Reservoir, to which water is pumped up from the R_2 Reservoir. R_1 Impounding Reservoir (Capacity; 40 million Gallons) and Stand-by Treatment Plant, located near the R_2 Reservoir, function in case of emergency. The existing water supply facilities are shown in the Figs. 2.8 and 2.9. The first modern facilities for water supply were constructed in 1966 with a 5 MGD treatment capacity. In 1983, these original intake facilities and treatment plant were expanded up to a capacity of 7.5 MGD in order to meet the increasing water demand. Outline of these facilities are described below :

(1) Intake Facilities

The intake facilities consist of a Low Water Intake, a Normal Water Intake and a Pump house. Operating of these two intakes is dependent on the river water level. A curtain of Sheet Piles has been driven across the river to prevent any underground flow of water and to maintain the water level. The drawing of water from the Low Water Intake to the Normal Water Intake and from the Normal Water Intake to the Pump House is operated by siphon arrangements. Siphon operation is started by vacuum pumps installed in the pump house.

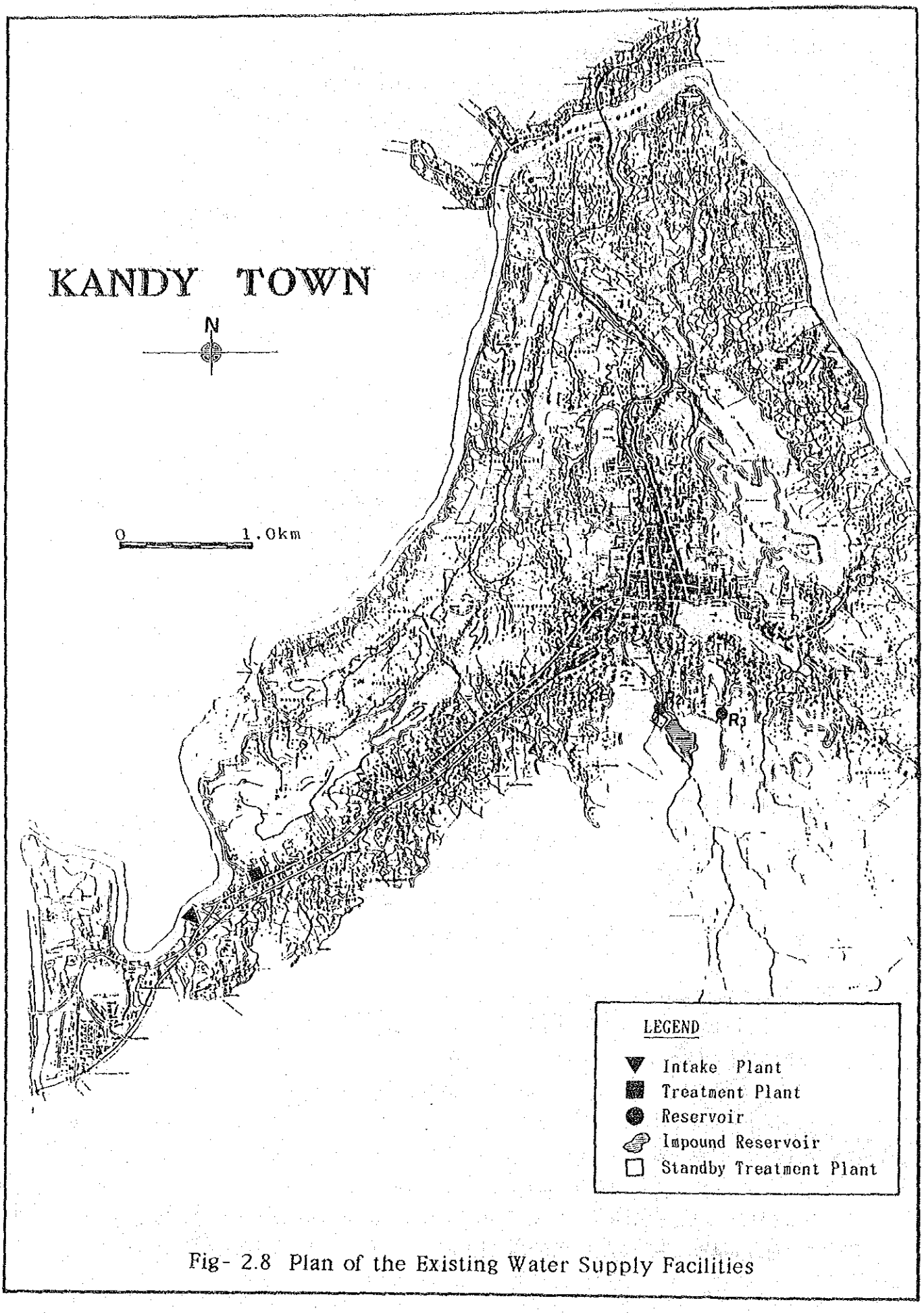


Fig- 2.8 Plan of the Existing Water Supply Facilities

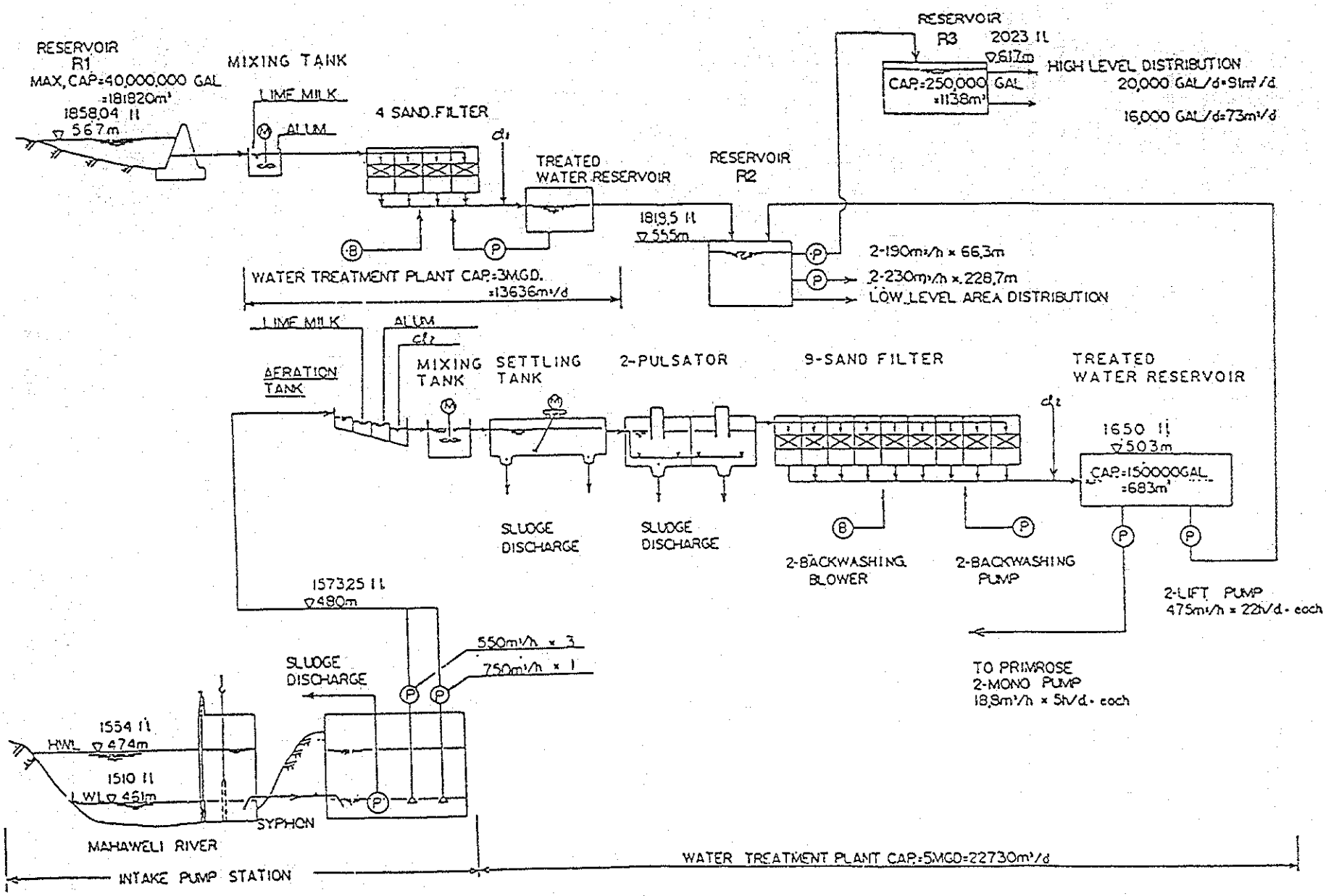


Fig- 2.9 Flow Chart of the Existing Water Supply Facilities

There are three raw water intake pumps of bore-hole type, one of them a French pump installed in 1966, and the others Indian pumps installed in 1983, when extension of the plant was completed. The French pumps was once replaced by the Indian pumps in 1983, however, due to breakdown of the latter, the former is now used. Indian pumps, mixers and silt removing devices of the Water Intake Facilities and chlorinators of the Water Treatment facilities were installed in 1983. Water Intake pumps have been severely worn due to silt & sand contained in the row water, and as a result, replacement of spare parts and reconditioning work had to be carried out very frequently.

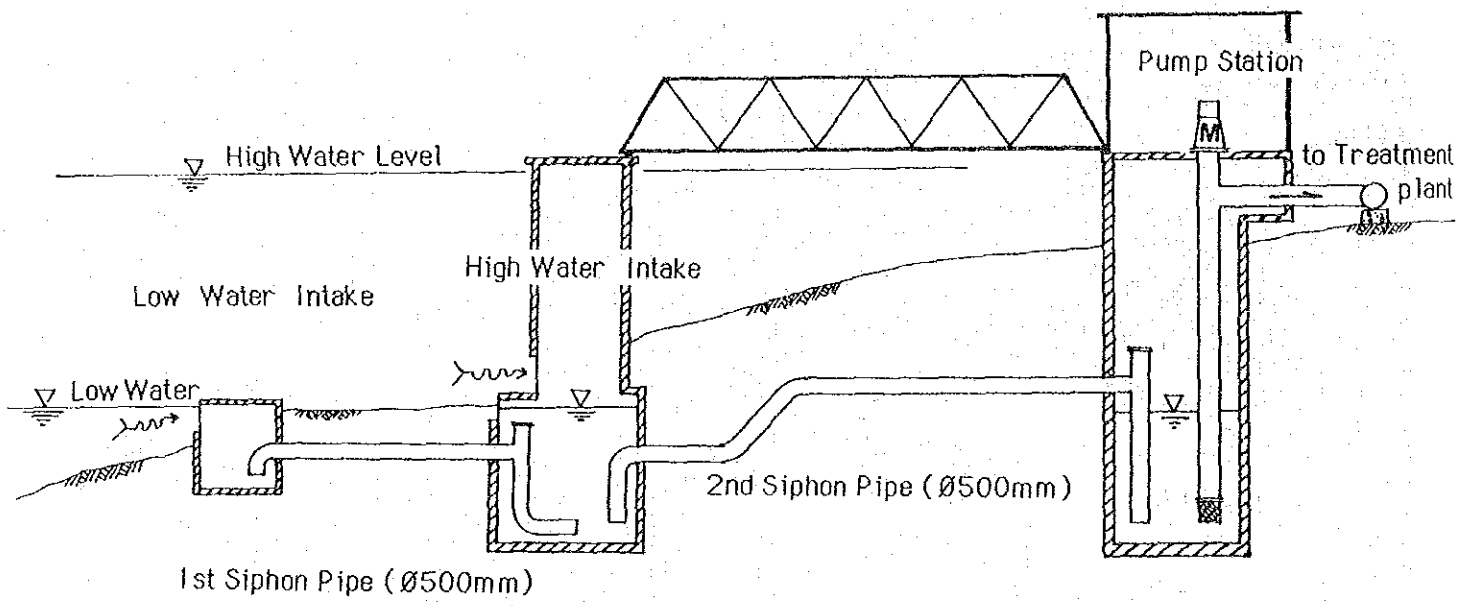


Fig - 2.10 Existing System of Water Intake

(2) Water Treatment Station

The system has two treatment stations. One is the Getambe water treatment station, which is treating the row water supplied through the water intake facilities on the bank of Mahaweli River, and the other, the standby station treating water from the impounding reservoir. In 1983, the Getambe Water Treatment Station capacity was expanded from 5.0 MGD to 7.5 MGD. At that time, only the electrical facilities, chemical dosing facilities and their auxiliary facilities were installed. Stand-by Water Treatment

Station (Cap. 3 MGD) which consists of only a filtration plant & chemical dosing facilities was completed in 1966. Getambe water treatment station consists of an aerator, desludging channel 4 Nos of Pulsator type sedimentation tanks, 9 Nos of rapid sand filters and dosing facilities for chemicals, such as alum, lime, chlorine etc. This station was designed and constructed by Degramont, France. The main existing facilities are described below,

i. Desludging channel (120 ft. X 12 ft. X 12 ft.) 1 tank

The scraping system is driven by a bridge which spans the tank moving from one end to the other. Sludge is collected in 3 sludge hoppers at the bottom of the desludging channel by the scraping system. The sludge collected and thickened in the hoppers is extracted through desludging valves.

ii. Pulsator (30 ft. X 51 ft. X 12 ft.)

The pulsator is a sludge blanket with a system of perforated laterals & stilling baffles. Water flows into the Pulsator Tank from its bottom. After passing through the sludge blanket, the water is recovered at the top in clarified water collection channels.

iii. Filtration Facilities (25 ft X 12 ft)

The Filtration facilities consist of nine AQUAZUR type N filters. Their characteristics are described as follows;

- Concrete tank divided into two parts by a fibrocement slab floor. There are 80 nozzles per Sq. meter.
- Scour air-distribution system consisting of a branched perforated feed pipe located under the floor.
- Grain size of filter media is uniform
- Back washing simultaneously by air (with a high rate of flow) and water (with a low rate of flow), followed by a medium rate flow rinse, which does not expand the filter bed.
- A shallow (0.50 m) depth of water above the sand.

Treated water is distributed to R_2 Reservoir 4.1 km from the water treatment station, by the distribution pumps. Construction is on-going for replacement of these 4 Nos pumps with new pumps (English made) and this

work will be completed by June 1989. Capacity of each pump is 2.5 MGD/unit and 3 will be operated with remaining kept as spare. After completion a distribution capacity of 7.5 MGD will be ensured.

(3) Service Facilities

Apart from the 40 MG Impounding Reservoir (and the 150,000 gls. reservoir near Wembly Theater which is now not in use), the scheme has R_2 Low- level Reservoir of 800,000 gls. and R_3 High-level Reservoir of 250,000 gals.

R_2 Reservoir supplies the low pressure distribution system of the town. R_3 Reservoir supplies the hilly areas where R_2 Reservoir cannot supply, because R_3 Reservoir is located 62 m above R_2 Reservoir. Ampitiya and Tenekumbura area, outside of Kandy City, are supplied by NWSDB from R_3 Reservoir. From R_2 Reservoir to R_3 Reservoir, water is distributed by 4 transmission pumps installed at S_2 Pump Station.

In addition to the above, there are several secondary pumps & pump distributary schemes to serve areas, which cannot be supplied by the gravity flow system.

Nearly 56 miles of pipelines including both High Pressure & Low Pressure are provided in the distribution net-work varying from 700 mm down to 80 mm. The 700 mm pipes are of ductile iron and the others are of cast iron. There are 478 public Stand Posts & 208 fire hydrants available in the system at present. The total number of service connections are 8,100 domestic & 2,000 non-domestic.

2.3.3. Operation & Maintenance System of the Facilities

The water supply scheme of Kandy city, completed in 1966 under the cooperation with France, is the property of Kandy city. Therefore, repayment of the above loan is still being continued at annual rate of Rs. 205,000. Operation and maintenance of the facilities are performed by the organization as described in Fig. 2-6. The water intake station, the water treatment plant, stand-by water treatment plant and service stations, are all manned by responsible staff. Under the each key officer, about 10 assistants & laborers are assigned, for each facility.

Their duties consist of machine operation, operation of pumps, filters, monitor of water quality, and electrical equipment etc. In the main facilities, i.e. water intake station & water treatment plant are subjected to 24 hours operation system.

The Water Works Department of Kandy City is in charge of all daily work, operation & maintenance of the facilities including purchase of the fuel & chemicals. However, there is no specialist for the water supply technology at this department, except the Water Works Engineer. Project planning, design & engineering, management of construction work cannot be proceeded by these persons. Therefore, NWSDB is requested for planning, designing, tendering, management of construction for modifications or rehabilitation of the existing facilities. Fortunately, the Regional Office of NWSDB is in Kandy City, and therefore it is easy to obtain the cooperation of NWSDB.

The Regional Office of NWSDB in Kandy has jurisdiction over Kandy, Amparai and Bandarawela districts, where there are 178 water schemes both small and large. Of the above 178 schemes, 44% of water intake & treatment facilities and distribution service facilities are under the control of DDC (District Development Council), while 41% of them are under the control of NWSDB. In 12% of these scheme, water intake & treatment facilities are under the control of NWSDB, while the service facilities are under the control of DDC. There is no other case similar to Kandy Water Supply Scheme, where a large scale water supply scheme is own by the city from the water intake facilities to the service facilities, which is operated and maintained by the City itself.

2.4 Outline of the Request

2.4.1 Background of the Request

The water supply scheme, constructed in 1966, consists of water intake facilities and water treatment facilities with a capacity of 5 MGD. The main facilities that are now existing had been constructed at that time. In 1980, in order to cope with the population increase of the city of Kandy, it was planned to expanded the water treatment capacity up to 7.5 MGD by year 2000. In this planning, the following were listed on.

(1) Water intake facilities

i. Replacement of 3 old pumps, whose efficiency had decreased with 4 new pumps (1 as standby).
ii. Installation of a sludge pump and sand agitating facilities.

(2) Water Treatment facilities

i. Improvement of water treatment efficiency from 5 MGD to 7.5 MGD (civil structures would be used as it is).
ii. Installation of chlorinator.
iii. Replacement of 3 old distribution pumps with 4 new pumps (1 as standby).

In June 1982, expansion of the water treatment station was completed by Degremont, France, who was in charge of the construction of the existing plant in 1966. Following this, in October, expansion of water intake facilities was completed by Perfect Engineering Co.,Ltd (India). The newly installed Indian intake pumps were broken down about six months later. The causes of this breakdown were presumed to be the abrasion of the shaft due to suction of large quantities of sand and the defects of emergency switches. From 1984 to 1985, these three Indian pumps broke down frequently and water intake capacity dropped to 3.8 MGD during this period. The Water Works Department of Kandy city has been drawing its attention to maintain the intake capacity by taking possible measures such as repair of the intake pump, reuse of the French pumps which had been once removed, in consultation with NWSDB and the Engineering Faculty of Peradeniya University.

In order to restore the target capacity, a plan for the "Rehabilitation of Water Supply Scheme" was formulated by the Government of Sri Lanka, who has given high priority to this project, requested the Government of Japan in January 1988 to implement the project under Japan's grant aid programme. In March 1988, due to some defects in the connections of the distribution main and the newly replaced pump (One pump had been already installed, three more will be set up by June 1989), the main pipe was burst. As water distribution to the reservoir could not be performed, the water supply to the city was disrupted for 5 days. This suspension of water supply caused criticisms by the citizens of Kandy city about the inadequacy of the water supply, and demands and expectations for the early implementation of this project gained momentum in the city.

2.4.2 Contents of the Request

The major item of contents requested by the Government of Sri Lanka was to implement rehabilitation works of Kandy Water Supply Works from Intake Facilities up to/and Water Treatment Facilities in order to recover the capacity of 7.5 MGD (34,100 m^3/day) at the same level as at the time of expansion works carried out in 1983. Details of rehabilitation items requested are listed in Table- 2.10.

Table- 2.10 Contents of Request

Items	Problems	Rehabilitation Considered
1. Water Intake		
(1) Water intake pumps	Abrasion and breakdown of impeller due to suction of sand and small timer	Replacement with new pump with impellers made of anti-abrasion materials
(2) Mixer	Not functioned	Installation of submersible mixer for prevention of silts from settling
(3) Silt	Deterioration of silt removing device (air blowers, air diffusers, submersible pump)	Replacement with new and review of specifications
(4) Siphon pipe	Water Leakage	Inspection of water leakage and repair of pipes
(5) Screen	Damages on screens in low and high water intake	Replacement with small clearance of rigid structure
2. Treatment Plant		
(1) Repaid mixer	Superannuation	Replacement
(2) Desludging Channel	Superannuation	Repair of sludge collector
(3) Pulsator	Partial damage	Replacement of damaged devices
(4) Filter	Damages on Valves	Replacement with new one
(5) Chemicals dosing facilities	Superannuation	Repair of motors, replacement of mixer and dosing pumps
(6) Lime dosing facilities	Superannuation	Repair of pumps, mixers, pipes

(7) Chlorination	Out of operation	Replacement with new one
(8) Filter washing facility	Partial damage	Repair of damaged parts
3 Distribution Facilities		
(1) Water distribution pumps	Out of operation and damaged on pumps due to superannuation	Replacement of all pumps in treatment facilities and installation of additional pumps
4 Others		
(1) Supply of equipment and materials needed for management, operation and maintenance		Water quality testing, workshop, vehicle for water leakage detect, additional transformer, control panel for distribution pumps, DEG for emergency, lightning, repair of buildings, telecommunication systems between Intake and Treatment Plants.