

Table 2.22 Existing Land Use Pattern of Homagama

Type of Land Use	Area(km ²)	%
Agricultural land	125.9	89.7
Housing	3.6	2.6
Roads	1.8	1.3
Miscellaneous	9.0	6.4
Total	140.3	100

7) Panadura Divisional Secretary's Division

The area of this division is approximately 58 km². More than 90 percent is covered with agricultural, natural and water logged areas.

Table 2.23 Existing Land Use Pattern of Panadura

Type of Land Use	Area(km ²)	%
Urban land	5.1	8.9
Agricultural land	45.5	79.1
Natural forests	0.1	0.2
Water logged land	6.8	11.8
Total	57.5	100

Source: Land utilization map of Colombo & Kalutara Districts (1984) Survey Department, 1984

2.3.2 Proposed Land Use Plan

Future land use plan for Colombo, Gampaha and Kalutara districts has been currently proposed by the Urban Development Authority on the basis of the Resources Profile issued in 1990 by the Ministry of Policy Planning as well as regional development plans implemented by UDA by itself.

The proposed land use planning is carried out for each Divisional Secretary's Division consisting municipal councils, urban councils and Pradeshiya Sabhas through 2020. The type of land uses being developed and given in hectares are interpolated fixing total land area.

2.3.3 Proposed Development Programs

1) Industrial Development Program

In compliance with recent years government policy, industrial development programs are being implemented under the control by management authorities such as the Ministry of Industries, Science and Technology (MIST), Board of Investment (BOI) and Urban Development Authority (UDA).

In Colombo, Gampaha and Kalutara districts, among others, Biyagama export processing zone and Katunayake industrial estate are the well known large scale industrial estates under the control of BOI. In

view of water supply for instance, ultimate projected water demand for the Biyagama EPZ inclusive of ongoing and future expansion is approximately 3.0 mgd (13,600 m³/d). On the contrary, pipeline system has been provided to accommodate and increase demand up to 4.0 mgd (18,184 m³/d).

Existing and planned major industries are summarized in Table 2.24 and the location map is shown in Figure 2.10.

2) Development of Low Income Housing Program

The city of Colombo covers an area of 3,732 ha consisting of 21.2 percent state lands, 6.1 percent municipal lands and 72.7 percent private land. Houses account for approximately 78 percent of the property stock of the city. There are approximately 108,000 housing units in the city. The amenity houses are about 49 percent and tenement houses (slums) or squatter settlements are 51 percent.

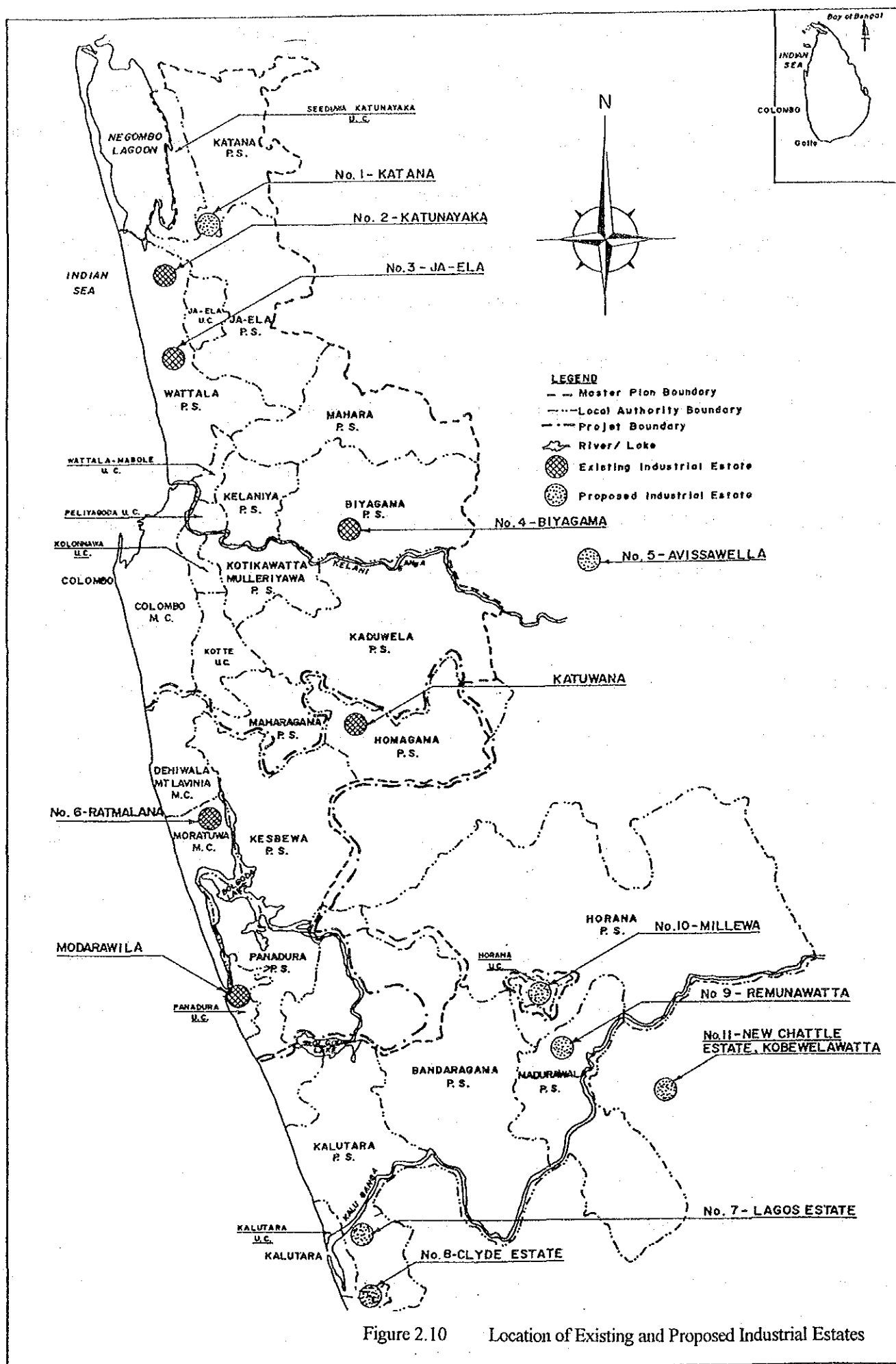
According to the survey in 1978, about 21,000 shanty housing units in 750 locations spreading over the periphery of the Colombo city, especially on statutory reserved low lying areas and canal banks were observed.

Colombo city office of the NHDA is in charge of the low income housing improvement program. This program is implemented as a part of the Municipal Council's Development program and is under the supervision and guidance of the C.M.C. Housing and Community Development Committee.

The 142 Shanty Improvements projects reaching approximately 19,000 shanties in the Colombo city are being implemented at present.

Table 2.24 Existing and Planned Industrial Estate

No.	Industrial Estate			Remarks
	D.S.Division	Location	Area (ha)	
1	Katana		68	Proposed water demand is 2,000 m ³ /d
2	Katunayake			Current water consumption is 5,000m ³ /d and 20% is obtained from tube wells. Remaining is supplied by pipe water from Negombo Water Supply Scheme. Ultimate water consumption is expected at 9,100 m ³ /d.
3	Ja-Ela	Ekara	135	
4	Biyagama		200	Current water consumption is 4,500 m ³ /d. Ultimate projected demand for the Biyagama EPZ inclusive of ongoing and future expansion is 13,600 m ³ /d. The pipeline system, has been provided to accommodate and increased demand up to 18,200 m ³ /d.
5	Avissawela	Atherfield	100	Planned daily water consumption is 9,200 m ³ /d. The detailed design and construction will start in 1994 under MIST with OECF finance.
6	Ratmalana		7	
7	Kalutara	Lagos Estate/Air-strip	20	Proposed water demand is 4,546 m ³ /d.
8	Dodangoda	Clyde Estate	26	Proposed water demand is 591 m ³ /d.
9	Madurawala	Remunawatta	16	Proposed water demand is 364 m ³ /d.
10	Horana	Miellawa	50	Proposed water demand is 1,137 m ³ /d.
11	Bulathseinhara	New Chattle Estate Kebewelawatta	50 54	Proposed water demand is 1,137 m ³ /d. Proposed water demand is 1,227 m ³ /d.
12	Panadura	Moderawila		Ground reservoir 230 m ³ and water tower 90 m ³ .
13	Homagama	Katuwana		Proposed water demand is 450 m ³ /d from ground water. Proposed water demand is 1,150 m ³ /d from piped water.



CHAPTER 3
EXISTING WATER SUPPLY

3. EXISTING WATER SUPPLY

3.1 Organization and Activities of the NWSDB

3.1.1 Legislation

The NWSDB is a public authority established under the National Water Supply and Drainage Board Law No.2 of 1974 of the National State Assembly. The NWSDB was formed out of the Department of Water Supply and Drainage in January 1975 and now is an autonomous body under the Ministry of Housing, Construction and Public Utilities (MHCPU).

The Sections 15, 16 and 17 of the National Water Supply and Drainage Board Law No.2 of 1974 state the areas of authority of the Board, the general duties of the Board in its areas of authority and powers of the Board as given in Supporting Report (Volume III). Accordingly, the NWSDB is empowered to develop, provide, operate, and control public water supply facilities to distribute water for public, domestic or non-domestic, including industrial and commercial purposes and to charge for the water so supplied.

Before the formation of the NWSDB, local authorities in the respective areas supplied water to their consumers and this practice is continued in some areas even now. The proposed service area under the Kalu Ganga Water Supply Project includes three kinds of administrative units; 1) Municipal Council, 2) Urban Council, and 3) Pradeshiya Sabha. Their powers as to public utility services are specified in the Governmental Ordinances gazetted under Chapter 252, Municipal Councils of August 15, 1947 and Chapter 577, Urban Councils of January 1, 1940. According to these ordinances, the Municipal and Urban Councils are empowered to establish and maintain water supply services, public baths, bathing places, laundries and places for washing animals etc. among other public services.

3.1.2 Organization and Staffing of the NWSDB

(1) Organization

The updated organizational structures of the MHCPU and the NWSDB are shown in Figures 3.1 and 3.2, respectively.

The NWSDB operates through five Regional Support Centers (RSCs): the Central RSC, Greater Colombo RSC, North Eastern RSC, Southern RSC, and Western RSC. With such an organizational set up, the NWSDB maintain about 50 percent of a total of nearly 500 water supply schemes currently in operation throughout the country. However, only skeleton services are maintained in the Northern Provinces due to security situation there.

The 248 schemes under the purview of the NWSDB have produced 310 million m³ of water in 1993. The total number of connections under these schemes was 260,996. A population of 2.1 million had received 24 hour water supply while 3.2 million were benefited with a service less than 24 hours. Of the total population, 68.8 percent in the urban area and 31.4 percent in the rural area has drinking water primarily from safe sources. The key facts and figures are summarized in Table 3.1.

Table 3.1 Number of Water Supply Schemes in Sri Lanka

year	Total schemes in Sri Lanka	NWSDB maintained schemes			
		number	% of total	number of connections	water produced (million m ³)
1991	476	231	48.5	201,624	236
1992	491	245	49.8	230,262	255
1993	494	248	50.2	260,996	310

Source : Annual Reports of the NWSDB 1992 and 1993.

(2) Staff

The number of employees by category in the year 1993 in comparison to year 1992 is shown in Table 3.2.

Table 3.2 Staff Classification by Job Category

Category	year	1992		1993	
		number	(%)	number	(%)
1. Executive		365	5.6	390	5.7
2. Supervisory, Clerical & allied		1,441	22.1	1,553	23.0
3. Skilled labor		1,636	25.2	1,813	26.7
4. Unskilled labor (include. casual)		3,056	47.1	3,027	44.6
Total		6,498	100.0	6,783	100.0

Source : Annual Reports of the NWSDB 1992 and 1993.

The number of engineers by class and category is shown in Table 3.3.

Table 3.3 Number of NWSDB Engineers by Class

Class	Number
General Manager	1
Additional General Manager	2
Deputy General Manager	9
Assistant General Manager	21
Chief Engineer	83
Senior Engineer	22
Engineer-Class I&II	143
Total	281

There is provision for 36 qualified accountants according to the scheme of recruitment. The following are among the 33 accountants now in position.

ICMA	- Professional Part I	2
ICMA	- Associated member	1
Chartered	- Associated member	2

Staff deployment by location (Head Office and RSCs) as of May 1993 is tabulated in Table 3.4.

Table 3.4 Staff Deployment of the NWSDB by location

Location	Permanent	Casual	Total	(%)
Head Office	1,453	94	1,547	23.1
Greater Colombo RSC	1,042	51	1,093	16.4
Kalutara Region	185	1	186	2.8
Ratmalana Region	407	20	427	6.4
Kurunegala Region	595	15	610	9.1
Matara Region	551	2	553	8.3
Hambantota Region	321	6	327	4.9
Kandy Region	631	41	672	10.1
Anuradhapura Region	407	25	432	6.5
Bandarawela Region	321	35	356	5.3
Ampara Region	150	2	152	2.3
Jaffna Region	115	1	116	1.7
North East RSC	131	11	142	2.1
No Pay Leave/Scholarships abroad	70		70	1.0
Total	6,379	304	6,683	100.0

3.2 Financial Status of the NWSDB

During the last four years, there has been significant progress in the financial performance of the NWSDB as shown on Figure 3.4. In 1990 the NWSDB recovered its operation and maintenance costs, representing the surplus before provision for the depreciation and the loan interest as against the deficit in the previous years over a period of 1986 to 1989. In 1991, the NWSDB achieved the surplus after provision for the depreciation and the loan interest for the first time since the commencement of billing in 1984. This was continued in 1992 and 1993 as well. This significant progress is mainly attributable to improvement in institutional management and rate of the tariff increase which has been allowed to take place annually to meet the increased operational cost in cope with the general inflation.

However, the NWSDB is still in an accumulated deficit, amounting to Rs.1,482 million as of the end of 1993 which are equivalent to an approximate annual revenue. Furthermore, the NWSDB is not in a position to generate sufficient funds for its future capital investment, being still far away from the self-sustainable and financially autonomous public utility entity.

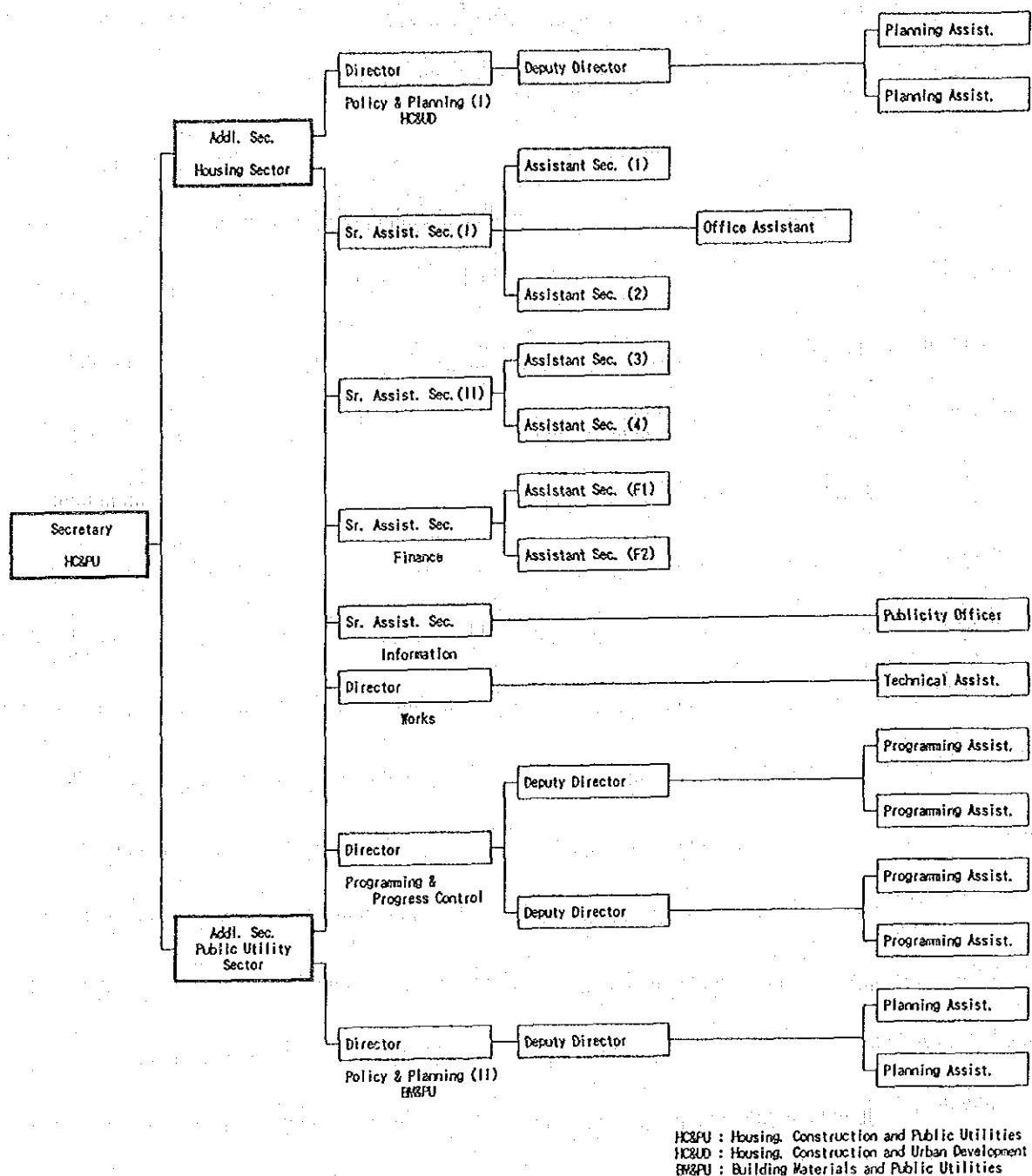


Figure 3.1 Organization Chart of Ministry of Housing, Construction and Public Utilities

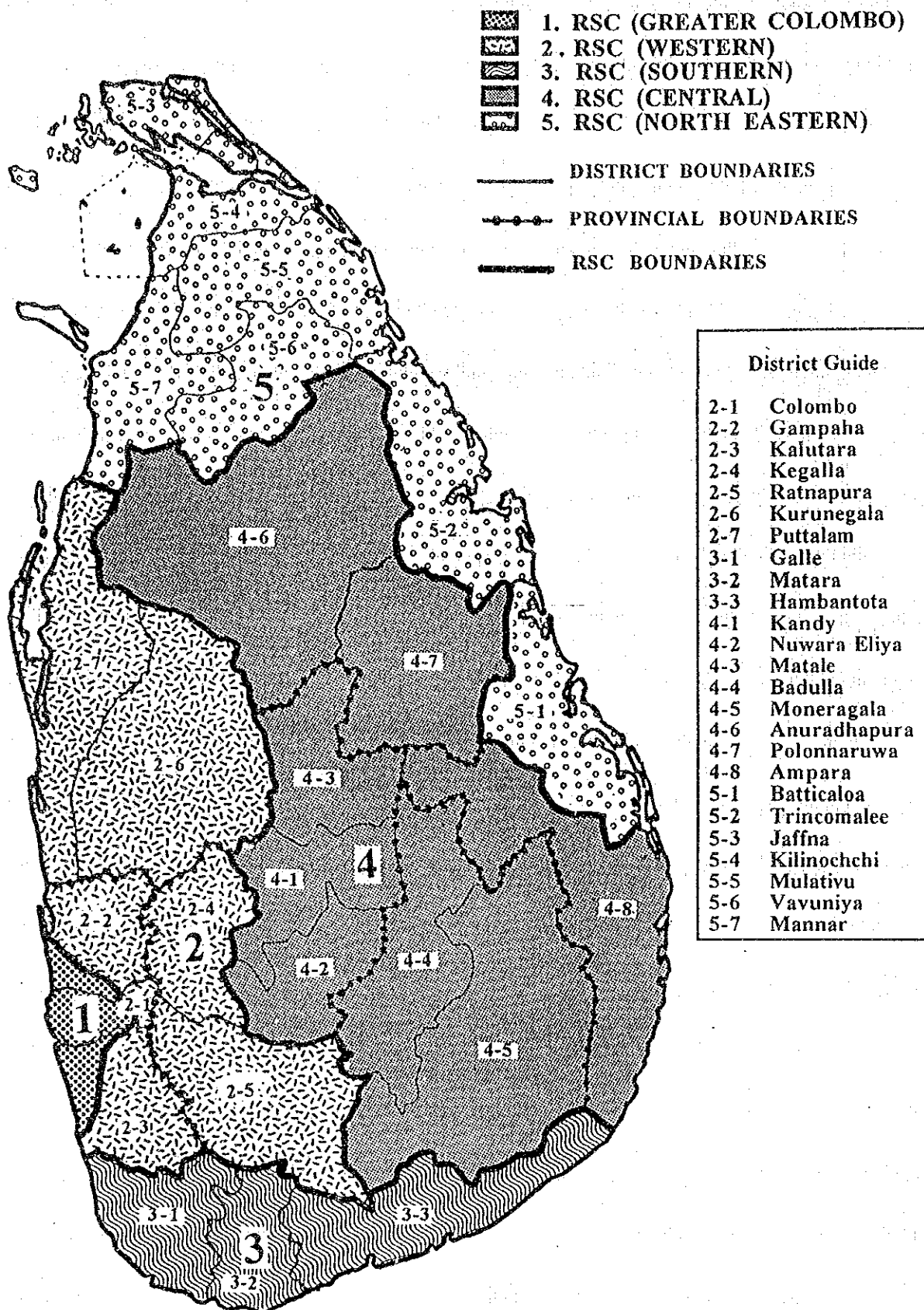


Fig. 3.3 NWSDB Regional Support Centers

3.2.1 Financial Statements

The basic financial information of the NWSDB is obtained from the annual report which covers the following financial statements:

Income and Expenditure Statement	Table 3.5
Balance Sheet	Table 3.6
Statement of Source and Application of Funds	Table 3.7

3.2.2 Analysis of Financial Statements

The financial statements have been reviewed from several aspects representing the performance of the past several years.

(1) Financial Highlights

The major indicators are summarized in Table 3.8 which is constructed principally based on the data from the above Tables 3.5, 3.6, and 3.7.

As described in "PUBLIC INVESTMENT 1993-1997", Department of National Planning, Ministry of Policy Planning and Implementation, p.45, the financial performance of the NWSDB shows that the return on net fixed assets in 1993 was slightly above 4 percent and is forecasted to be above 5 percent in 1994. Here it should be noted that this level of good performance for the public utility entity has been achieved with strong support from the Government through the financing of all capital expenditures at subsidized and concessional conditions. According to Table 3.8, the debt service coverage ratio, which is defined as the profit before depreciation and interest to the debt services, has been more than the adequate level of 1.2 to 1.5 for the past three years.

However, in the course of improving financial performance, it has become apparent that further improvement is required to sustain the sound financial management of the NWSDB, taking into account that the debt service tends to increase from now on, reaching the peak in around 2001 even if no more loans are issued. The repayment schedule is discussed in detail in the next Section 3.2.3.

The financial soundness of the NWSDB is discussed with use of financial ratios as follows;

(2) Liquidity Ratios

Two ratios are checked to ensure the short-run survival of the entity, in other words, to meet its short-term obligations. The first of these two ratios is called the current ratio which is current assets divided by current liabilities. The ratio is marginally short of the acceptable level of 2.

The next ratio is the quick ratio which is current assets minus inventory divided by current liabilities. This ratio is adopted to check the suitability of the inventory. This ratio is marginally above the acceptable level of 1.

Both ratios appears to be marginally acceptable, but the downward trend over these years is cause for concern.

(3) Capital Structure

Two ratios are checked to ensure the long-run survival of the entity. The first of these ratios is "debt to total assets", in which total long-term debt is divided by total assets.

The next ratio is the ratio of debt to equity, which is the total long-term debt divided by stockholders' equity.

Both ratios are acceptable but this is mainly attributable to the strong government support representing 72 percent of the shareholders' equity, amounting to Rs.9,834 million as of 1993.12.31.

(4) Activity Ratios

Inventory turnover appears to be a prime concern for the utility operation entity, which is total sales divided by the total value of inventory. This ratio has been recognized to show an upward trend over these years, representing some improvement. This ratio of 1.80 as of 1993.12.31 appears to show still excessive level of inventory, amounting to the equivalent of 1 to 2 times worth of the annual operating expenses. These amounts may not represent real stocks. Even if so, an assessment of existing amount and values should be made and appropriate adjustments made to the book value. Anyhow, it should be noted that the low ratio indicates that too much money is still being tied up in inventory in relation to sales volume.

The next ratio is average collection period, which is the total of accounts receivable divided by sales per day. This ratio of 159 for the year of 1993 indicates that an average of 159 days is required to collect the receivable. This ratio has been recognized to show a downward trend over these years, representing some improvement. However, it is rather high in relation to the normal collection period* of 30 days

* Billing and Collection

Meter readers read all the metered connections every month (from the 1st to around 20th of a month) and bills are issued for each class of service. These are delivered to the customers either by the Meter Readers

for the NWSDB. Customers are still slow in paying the bills, so that the outstandings of the arrears are recognized to be still as high as Rs.595 million corresponding to about 40 percent of the annual revenue, shown in Table 3.9.

But the outstanding of the arrears have been kept at a constant level for these years, indicating recent good performance in collection from billings.

The NWSDB has an opportunity to significantly improve its cash position through the collection of these arrears. About 30 percent of the total amount outstanding is from the domestic sector, with 30 percent from the Government sector and 24 percent from the Commercial sector. Not all the outstanding amount can be collected and it is recommended that a study be made to assess the quantum of arrears which can be practically collected and to amortize the amount seemingly not to be collected over a reasonable period.

As an incentive to continue to improve collections as well as a part of the decentralization policy, it is as well recommended that the Regional Support Centers (RSCs) be allowed to retain the funds collected from arrears if they have met their targets for current collections.

3.2.3 Repayment Schedule for External Loans

(1) Financial Mechanism for the Project Supported by the External Agencies

The financial sources of the project consist of the local component and foreign component. The former is financed by the Treasury as a capital grant and the latter is financed by the external agencies.

The mechanism of the loan from the external agencies to NWSDB through the Treasury is shown in Table 3.10.

Principally, for the urban project, 50 percent of the external loan amount will be financed by the Treasury as relending to NWSDB and the remaining amount (50%) will be financed as a capital grant from the Treasury, that is an equity contribution to NWSDB from the Treasury.

or are posted. Customers have to pay their bills within 30 days after receipt of a bill. about 45 percent of the bills delivered are paid within one month. The average of bill collection is placed at 95 percent.

If a consumer does not pay for a bill, first a reminder letter is sent. This is followed by a notice of disconnection if a consumer does not respond to the reminder letter. Non payment after a notice of disconnection will result in the connection being disconnected. There after the Board resorts to legal action for recovery of the defaulted amount.

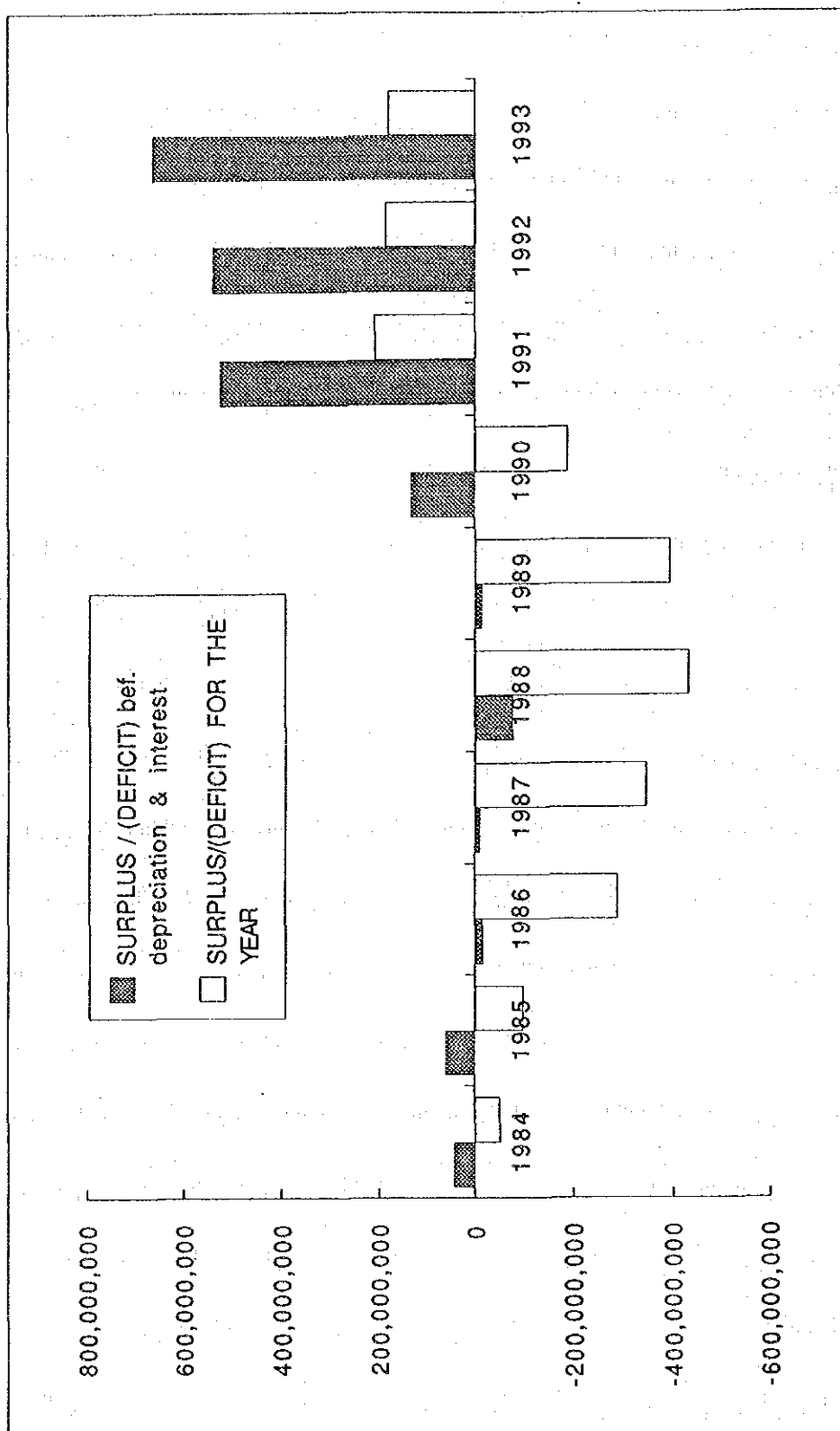


Figure 3.4 Financial Performance of NWSDB

Table 3.5 Income and Expenditure Statement for the Year

UNIT: Rs.					
	1989	1990	1991	1992	1993
1 REVENUE : CUSTOMER BILLING	292,724,610	478,203,193	923,707,702	964,841,612	1,128,899,228
Other	64,019,393	77,429,624	176,783,523	246,881,208	360,026,425
	356,744,003	555,632,817	1,100,491,225	1,211,722,820	1,488,925,653
	1.8%	63.4%	93.2%	4.5%	17.0%
2 LESS : DIRECT OPERATING EXPENSES					
Chemicals	21,460,098	29,510,695	39,742,056	54,463,269	52,741,602
Pumping Cost-Electricity	128,888,664	143,559,347	151,201,441	168,549,168	230,908,540
-Fuel & Others	1,327,008	2,086,087	1,097,738	1,502,895	1,064,824
Repairs & Maintenance	19,031,040	12,559,390	75,630,448	79,613,674	51,947,575
(Pumps, Treatment Plants, Dist, Systems Personnel Cost					
Personnel Cost	123,951,398	146,187,550	195,755,358	224,446,486	279,002,700
Direct Operating Expenses (Sub-Total)	294,658,208	333,903,069	463,427,041	528,575,492	615,665,241
OTHER SCHEME COSTS					
- Establishment	9,325,440	13,229,002	15,457,510	20,748,540	25,689,277
- Security & Other Services	6,406,600	6,655,236	7,608,437	11,514,784	42,802,511
- Rent, Rates, Taxes, Other Fees	3,048,397	3,909,573	4,839,042	3,952,097	4,042,436
Sub-Total	18,780,437	23,793,811	27,904,989	36,215,421	72,534,224
TOTAL OPERATING COST	313,438,645	357,696,880	491,332,030	564,790,913	688,199,465
	2.7%	14.1%	37.4%	15.0%	21.9%
3 SURPLUS / (DEFICIT) FROM OPERATIONS	43,305,358	197,935,937	609,159,195	646,931,907	800,726,188
4 Less : Administration overheads	60,855,552	67,274,256	82,895,727	107,017,088	126,291,577
(Growth in Administration Overhead)	0.02	0.11	0.23	0.29	0.18
BEFORE CHARGING ITEMS BELOW	-17,550,194	130,661,681	526,263,468	539,914,819	674,434,611
Other recoveries	5,286,070	3,351,304	0	0	-9,672,739
5 SURPLUS / (DEFICIT)	-12,264,124	134,012,985	526,263,468	539,914,819	664,761,872
Depreciation : On addition since revaluation	39,362,856	205,656,439	193,169,335	199,159,438	228,232,491
On revaluation as at 31.12.85	175,208,402				
DEFERRED COST WRITTEN OFF	36,419,973	42,575,304	48,926,226	52,180,048	54,706,343
LOAN INTEREST	129,257,307	73,992,545	74,867,484	101,214,931	201,891,188
	380,248,538	322,224,288	316,963,045	352,554,417	484,830,022
6 SURPLUS / (DEFICIT) FOR THE YEAR	-392,512,662	-188,211,303	209,300,423	187,360,402	179,931,850
Balance B/F	-1,324,925,626	-1,719,806,457	-1,864,169,216	-1,664,219,693	-1,482,056,176
Prior year adjustments	-2,368,169	43,848,544	-9,350,900	-5,196,885	-28,350,578
SURPLUS / (DEFICIT) FOR THE YEAR	-392,512,662	-188,211,303	209,300,423	187,360,402	179,931,850
BALANCE C/F	-1,719,806,457	-1,864,169,216	-1,664,219,693	-1,482,056,176	-1,330,474,904

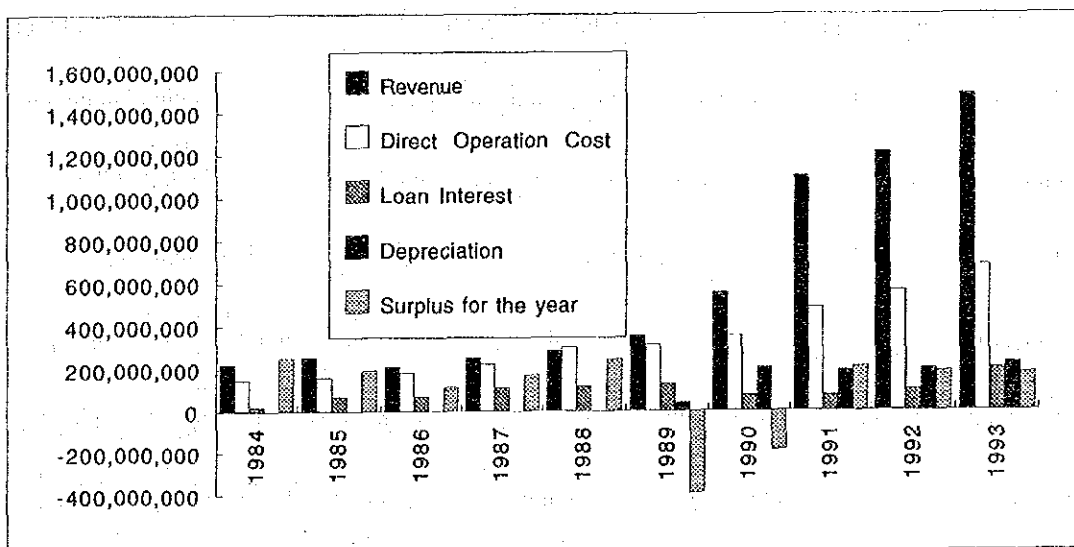


Table 3.6 Balance Sheets for the Year

	As at 31/12 1989	As at 31/12 1990	As at 31/12 1991	As at 31/12 1992	As at 31/12 1993
FIXED ASSETS :					
Revalued Cost as at 1/1/1993	4,788,782,156	4,889,405,109	4,987,034,846	5,015,275,722	5,199,069,138
Additions Less Disposals	100,622,953	97,629,737	28,240,876	183,793,416	881,396,099
Less Accumulated Depreciation	820,131,290	1,024,013,745	1,219,487,535	1,422,410,381	1,648,904,817
Written Down Value (Net Fixed Assets) as at 31/12	4,069,273,819	3,963,021,101	3,795,788,187	3,776,658,757	4,431,560,420
CONSTRUCTION WORK IN PROGRESS					
Water Piped	2,318,636,134	3,261,768,386	4,105,682,617	6,709,328,894	7,837,711,889
Water Non Piped	211,981,766	262,388,034	317,555,740	354,076,965	398,937,224
Sewerage	1,439,884,652	1,440,418,356	1,501,848,695	1,507,141,360	1,528,855,433
Others	4,573,926	31,459,860	47,685,529	108,075,357	191,197,836
Rechargeable Works Less Customer Advances	180,984,315	94,991,373	118,435,464	54,596,622	85,287,353
Construction in Progress Sub-total	4,156,060,793	5,091,026,009	6,091,208,045	8,733,219,198	10,041,989,735
TOTAL FIXED ASSETS	8,225,334,612	9,054,047,110	9,886,996,232	12,509,877,955	14,473,550,155
DEFERRED COST	298,074,194	314,154,978	336,587,580	322,945,751	312,680,599
INVESTMENT	200,000	200,000	360,750,000	706,470,574	1,113,543,359
CURRENT ASSETS :					
Stocks & Goods in Transit	476,468,904	665,734,369	730,378,388	770,431,230	826,470,725
Debtors (Water Supply) Less Prov. for Bad Debts	298,371,943	349,792,806	567,542,877	586,251,367	650,525,742
Other Receivables	38,357,636	49,528,428	115,025,184	104,931,244	190,714,897
Deposits & Advances to Contractors	527,275,120	434,058,983	601,459,226	489,200,156	455,570,693
Cash & Bank Balances	93,390,683	265,836,092	159,821,892	168,832,934	177,140,898
TOTAL CURRENT ASSETS	1,433,864,286	1,764,950,678	2,174,227,567	2,119,646,931	2,300,422,955
TOTAL ASSETS	9,957,473,092	11,133,352,766	12,758,561,379	15,658,941,211	18,200,197,068
DEDUCT : CURRENT LIABILITIES					
Creditors for Suppliers	19,241,157	19,547,387	19,359,913	19,705,081	2,784,121
CENTRAL BANK - IMPREST ACCOUNT	101,547,336	83,687,901	88,792,058	89,842,147	57,655,729
Provisions and Accrued-Expenses	179,642,995	251,100,216	241,811,274	71,551,151	84,238,169
Loan Interest Payable	440,117,201	514,109,746	354,099,657	459,285,972	578,815,573
Loan Capital Payable (due within 1 year)	396,675,453	446,060,224	387,708,394	417,086,223	511,892,549
Other Current Liabilities	75,529,323	31,807,511	33,580,375	38,288,681	80,703,413
TOTAL CURRENT LIABILITIES	1,212,753,465	1,346,312,985	1,125,351,671	1,095,759,255	1,316,089,554
WORKING CAPITAL	221,110,821	418,637,693	1,048,875,896	1,023,887,676	984,333,401
NET ASSETS	8,744,719,627	9,787,039,781	11,633,209,708	14,563,181,956	16,884,107,514
FINANCED BY :					
ASSETS TAKEN OVER FROM GOVERNMENT	185,480,386	185,480,386	185,480,386	185,480,386	185,480,386
CAPITAL GRANTS - CENTRAL GOVERNMENT	5,850,508,980	6,382,652,397	7,701,337,239	9,100,864,704	9,834,274,180
CAPITAL GRANTS - LOCAL GOVERNMENT	401,578,218	401,578,218	401,578,218	401,578,218	401,578,218
CAPITAL GRANTS - FOREIGN AGENCIES	1,661,214,788	1,924,626,580	2,182,977,960	2,504,291,923	3,710,673,569
CAPITAL RESERVE ON RE-VALUATION OF ASSETS	309,763,136	309,763,136	315,062,248	318,806,550	321,182,893
SHAREHOLDERS' EQUITY	8,408,545,508	9,204,100,717	10,786,436,051	12,511,021,781	14,453,189,246
RETAINED EARNINGS / (DEFICIT)	-1,719,806,457	-1,864,169,216	-1,664,219,693	-1,482,056,176	-1,330,474,903
LONG-TERM LIABILITIES					
FOREIGN LOAN THROUGH TREASURY	2,021,532,790	2,268,310,442	2,331,349,259	3,348,174,603	3,564,031,760
LOCAL LOAN	16,721,649	130,470,923	126,070,626	125,123,796	123,950,596
SECURITY DEPOSIT	17,726,137	48,326,915	53,573,465	60,917,952	73,410,814
TOTAL FUNDS EMPLOYED	8,744,719,627	9,787,039,781	11,633,209,708	14,563,181,956	16,884,107,513

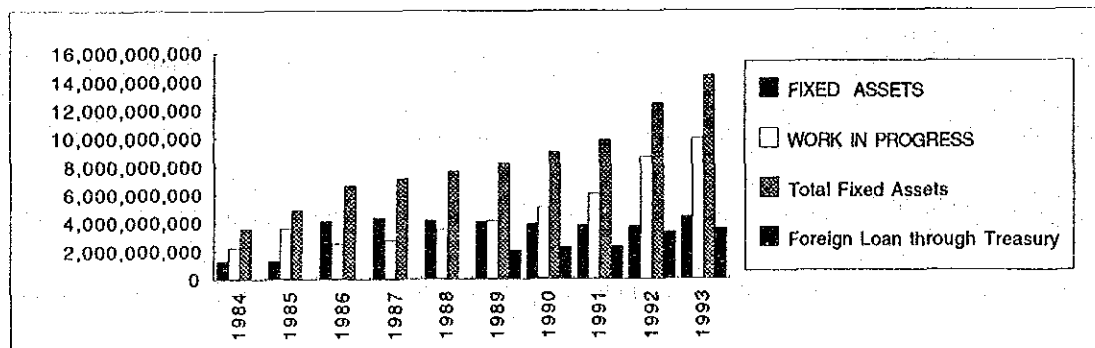


Table 3.7 Statements of Source and Application of Funds

SOURCE OF FUNDS	1989	1990	1991	1992	1993
From Operations	-394,880,831	-188,211,303	209,300,423	187,360,402	179,931,851
Less: Previous years adjustments	-5,286,070	43,848,544	-9,350,900	-5,185,885	-28,350,578
	-400,166,901	-144,362,759	199,949,523	182,163,517	151,581,273
ADJUSTMENTS NOT INVOLVING MOVEMENTS OF FUNDS					
Depreciation of Assets - for the Year	188,542,946	204,326,763	193,169,335	199,159,438	228,232,491
- Prior years adjustments			2,304,455	3,763,408	
Deferred Cost written off	36,419,973	42,575,304	48,926,226	52,180,048	54,706,343
Profit/(Loss) on Sale of Fixed Assets		-3,351,304	243,550,763	255,102,894	282,938,834
Adjustments for Reserves					
TOTAL FUNDS FROM OPERATIONS	-165,203,982	99,188,004	444,349,539	437,266,411	434,520,107
FROM OTHER SOURCES					
Capital Grants - Central Govt.	576,298,633	532,143,417	1,318,684,842	1,399,577,465	1,407,547,741
- Foreign Agencies	372,803,650	263,411,792	258,351,380	321,313,963	532,243,381
Foreign Loans Through Treasury	218,496,094	246,777,652	63,038,817	1,010,394,344	330,957,157
Local Loans		113,749,274		7,344,487	12,492,862
Security Deposits	6,878,650	30,600,778	5,246,550		
Sale of Fixed Assets	5,461,180	3,740,533			
Revaluation Reserve			5,299,112	3,744,302	2,376,343
	1,179,938,207	1,190,423,446	1,650,620,701	2,742,314,561	2,285,617,484
	1,014,734,225	1,289,611,450	2,094,970,240	3,179,580,972	2,720,137,591
APPLICATION OF FUNDS					
Fixed Assets - Acquisitions	102,636,753	98,463,274	28,240,876	183,793,416	883,134,154
Capital work in Progress	688,693,776	934,965,216	1,000,182,086	2,642,011,153	1,308,770,536
Investments			360,550,000	345,720,575	407,072,785
Long Term Receivables			71,358,828	6,000,000	18,945,592
Deferred Cost	162,373,587		4,400,297	32,538,218	25,495,599
Local Loans		58,656,088		946,830	1,173,200
Foreign loans through Treasury			1,092,084,578	98,784,590	115,100,080
	933,614,116	1,092,084,578	1,464,732,037	3,309,794,782	2,759,691,866
	61,120,109	197,526,872	630,238,203	-130,213,810	-39,554,275
INCREASE / (DECREASE) IN NET WORKING CAPITAL					
CHANGE IN WORKING CAPITAL					
Current Assets					
Stocks and Goods in Transit	33,483,234	189,265,465	64,644,019	40,032,842	56,039,495
Debtors	52,992,764	51,420,863	217,750,071	18,708,490	64,274,375
Other Receivable	60,628	11,170,792	65,496,756	-10,093,940	85,783,653
Deposits Advances to Contractors	218,256,841	-93,216,137	167,400,243	-112,239,070	-33,629,463
Current Liabilities					
Creditors for supplies	42,083,629	-306,230	187,474	-345,168	16,920,960
Due to Contractors	10,900,798	17,859,435	-5,104,157	-1,050,089	32,186,418
Provisions & Accrued Expenses	-71,620,274	-71,457,221	9,288,942	170,260,123	-12,687,018
Loan Interest Payable	-132,645,378	-73,992,545	160,010,089	-103,186,315	-119,529,801
Loan Capital Payable	-101,641,541	-49,384,771	58,351,830	-134,603,419	-94,806,326
Other Current Liabilities	-5,369,216	43,721,812	-1,772,864	-4,708,306	-42,414,732
	46,501,483	25,081,463	736,252,403	-139,224,852	-47,862,239
Movements in Net Liquid Funds					
Cash & Bank Balances as at 31-12	93,390,683	265,836,092	159,821,892	168,832,934	177,140,898
Cash & Bank Balances as at 01-01	78,772,059	93,390,683	-106,014,200	159,821,892	168,832,934
	61,170,109	172,445,409	630,238,203	9,011,042	8,307,964
		197,526,872		-130,213,810	-39,554,275

Table 3.8 Financial Highlights

unit: Rs.'000

	Year		
	1993	1992	1991
1. Revenue from Operation & others	1,488,926	1,211,723	1,100,491
Gross Revenue per cubic meter of water billed and sold (Rs./m ³)	11.90	10.25	9.68
2. Gross Operating Expenses (including administrative overheads)	814,491	670,305	574,288
Gross operation cost per cubic meter of water billed and sold (Rs./m ³)	6.51	5.67	5.05
3. Net Income	179,932	187,360	209,300
Rate of Return on Net Fixed Assets	4.1%	4.9%	5.5%
	4,431,560	3,776,659	3,795,789
4. Accumulated Deficit	-1,330,474	-1,482,056	-1,664,220
5. Cash Position (Cash at bank and investment)	1,291,000	875,000	521,000
6. Long-term Liabilities	3,761,393	3,534,216	2,510,993
7. Total Assets	18,200,197	15,658,941	12,758,561
8. Liquidity Ratio			
Current Ratio	1.75	1.93	1.93
Quick Ratio	1.12	1.23	1.28
9. Capital & Debt Structure			
Debt to Total Assets	0.21	0.23	0.20
Debt to Equity	0.29	0.32	0.28
10. Activity Ratio			
Inventory Turnover	1.80	1.57	1.51
Average Collection Period (days)	159	177	188
11. Debt Service Coverage Ratio	2.84	4.04	4.90

Water Billed and Sold (in '000 m ³)	125,168	118,274	113,650
Water Produced (in '000 m ³)	228,000	216,000	192,000
Percentage of Water Billed to Water Produced	54.9%	54.8%	59.2%

On the other hand, for the rural project, 15 percent of the external loan amount will be financed by the Treasury as relending to NWSDB and the remaining amount (85%) will be financed as a capital grant from the Treasury, that is an equity contribution to NWSDB from the Treasury.

The conditions of relending to NWSDB are shown below as well as in Table 3.11, where the amount and lending conditions of the external loans are also given.

Interest rate	12%
Repayment	24 years (Grace period: 2 years)

where the repayment is to commence after a 2-year grace period after the project completion corresponding to the final disbursement.

(2) Estimation of the Repayment Schedule

Based on the above mentioned conditions and the amounts disbursed and to be disbursed, the debt services can be projected as shown in Figure 3.5. According to the projection, the debt services of the NWSDB are to reach their peak around 2001.

(3) Current Projects on the Grant-Aid Basis

The projects under way which are financially supported on a grant basis, are shown in Table 3.12.

Table 3.9 Appears Trend - Direct Billings

Region	Jan. '91 Rs. M	Charge (%) 1	Dec. '92 Rs. M	Charge (%) 2	Oct. '93 Rs. M	Charge (%) 3	Apr. '94 Rs. M	Charge (%) 4
Kurunegala	17.28	-0.40	25.04	1.87	25.31	0.10	24.55	-0.43
Ratnapura	18.25	3.71	21.05	0.64	21.19	0.06	19.47	-1.16
Kalutara			1.34	0.00	8.09	45.79	8.08	-0.02
Matara	46.22 a	0.00	25.10	-1.90	20.47	-1.68	20.36	-0.08
H'tota			32.09	0.00	36.63	1.29	32.26	-1.70
Kandy	9.99	7.75	6.43	-1.48	9.68	4.59	9.97	0.43
Bandarawela	8.44	2.95	17.69	4.57	16.89	-0.41	22.32	4.59
amparai	9.67 b	0.00	18.67	3.88	16.75 d	-0.93	16.31	-0.38
Anuradhapura	14.19	3.67	24.35	2.98	29.00	1.74	25.10	-1.92
Jaffna	-	-	-	-	0.05 c	-	0.05 c	0.29
Trincomalee	-	-	-	-	28.40 d	-	30.29 e	0.95
Colombo	296.00	5.34	368.13	1.02	379.31	0.28	386.84	0.28
Total	420.04	4.19	539.89	1.19	591.77	0.87	595.60	0.09

a. Data for Dec. '90

b. Data for Sep. '91

c. Data for Apr. '93

d. Data for Sep. '93

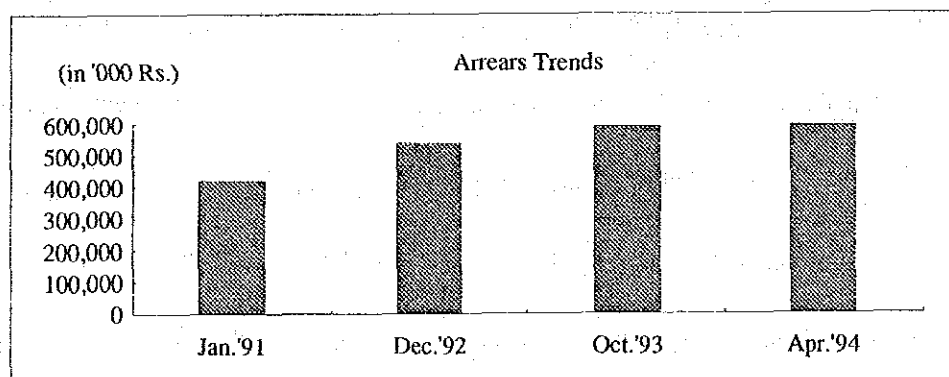
e. Data for Feb. '93

1. Compared with Dec. '90

2. Compared with Jan. '91

3. Compared with Dec. '92

4. Compared with Oct. '93



TOTAL ARREARS	Less than 2 - 6 6 - 12 Over					%
	Total	2 months	months	months	1 year	
Domestic	185,208	26,662	60,839	21,956	75,751	31%
St. Posts	32,818	760	2,560	2,294	27,204	6%
Government	179,150	34,925	67,254	31,583	45,388	30%
Commercial	145,152	24,374	37,357	11,893	71,528	24%
Religious	3,565	233	577	340	2,415	1%
School	3,978	2,214	1,453	284	27	1%
Hotels	8,043	3,383	1,463	178	3,019	1%
Industries	15,436	7,462	3,290	1,479	3,205	3%
Institution	12,058	1,747	3,240	4,261	2,810	2%
Shipping	1,425	1,386	4	6	29	0%
G.C.E.C.	5,977	2,165	2,165	1,647	0	1%
Board's Premises	1,816	324	538	81	873	0%
C.M.C.	0	0	0	0	0	0%
Total	594,626	105,635	180,740	76,002	232,249	100%

Table 3.10 Financial Mechanism of External Loan

		URBAN PROJECT		RURAL PROJECT	
PROJECT COST		TREASURY	NWSDB	TREASURY	NWSDB
EXTERNAL LOAN	85%	42.5%		72.25%	
			42.5%		12.75%
	15%	15%		15%	
GOV'T					
GRANT PORTION OF EXTERNAL LOAN		50%	50%	85%	15%
RE-LENDING PORTION OF EXTERNAL LOAN					
GRANT ALLOCATION		57.50%		87.25%	
DEBT ALLOCATION			42.50%		12.75%
OECF LOAN INTEREST RATE		2.5%	12.0%	2.5%	12.0%
REPAYMENT SCHEDULE					
Period		25	within 24	25	within 24
Grace period		5	2	5	2

In case of OECF/TOWN SOUTH

A	LOAN AMOUNT (F/C)	12,000	Million Yen	5,454,545	(000 Rs.)	80.0%
B	GRANT PORTION OF EXTERNAL LOAN			2,727,273		
C	RE-LENDING PORTION OF EXTERNAL LOAN			2,727,273		
	CAPITAL GRANT from GOVERNMENT (L/C)			1,363,636		20.0%
TOTAL PROJECT COST				6,818,182	100.0%	
GRANT ALLOCATION				4,090,909	60.0%	
DEBT ALLOCATION				2,727,273	40.0%	

This figure of the amount was collected from A.G.M. Finance.

Table 3.11 Re-lending Conditions to NWSDB from Treasury

EXTERNAL LOAN	External Loan to Treasury				Re-lending to NWSDB		Re-lending of the external loan to NWSDB		Capital Grant received from Treasury up to 31.12.1993				
	Loan Amount		Repayment condition Grace period	Expected Loan Amount (Rs. '000)	Interest Upper: Re-lending to NWSDB Lower: Loan disbursed to Treasury	Repayment condition (Max.) Grace period	GRANT 50.0%	LOAN 50.0%					
	Currency ('000)	Interest											
										Component (L/C) (Rs. million)			
1	IDA 1700	SDR	32,100	2.0%	30	10	656,792	12.0%	24	2	50.0%	50.0%	925.9
							1,313,584						
2	ADB 817	SDR	24,600	1.5%	30	10	717,672	12.0%	24	2	57.0%	43.0%	280.8
							1,669,005						
3	ODA	POUND	3,954.77	-	5	-	79,839	12.0%	24	2	67.5%	32.5%	239.2
							245,659						
4	OECD / TE	Yen	1,977,000	2.5%	25	5	493,492	2.5%	24	2	50.0%	50.0%	7.5
							986,893						
5	IDA - 1041	US\$	30,000	2.0%	30	10	383,434	9.0%	24	2	50.0%	50.0%	530.0
							766,867						
6	USAID	US\$	7,500	2.0%	40	10	76,939	2.0%	24	2	50.0%	50.0%	123.1
							153,877						
7	FRENCH - TRINCO	F.F.	112,470	3.0%	31	10	226,336	6.0%	24	2	50.0%	50.0%	158.9
							452,672						
8	FRENCH - NEGOMBO I	US\$	3,753	3.0%	31	10	55,467	11.0%	24	2	50.0%	50.0%	123.4
							110,934						
9	FRENCH - NEGOMBO II	F.F.	35,000	3.0%	31	10	48,155	11.0%	24	2	50.0%	50.0%	
							96,309						
10	FRENCH - KURUNEGARA	F.F.	14,724	3.0%	31	10	34,169	12.0%	24	2	50.0%	50.0%	39.4
							68,338						
11	FRENCH - BADULLA	F.F.	15,000	3.0%	31	10	44,970	12.0%	24	2	50.0%	50.0%	77.2
							89,939						
12	FRENCH - AMBATALE	F.F.	140,000	2.5%	31	10	544,322	12.0%	24	2	50.0%	50.0%	945.4
							1,088,643						
13	ADB - 1235	SDR	28,310	1.5%	30	10	763,250	12.0%	24	2	57.0%	43.0%	
							1,775,000						
14	OECD - T/S	YEN	3,726,000	2.6%	25	5	838,350	12.0%	24	2	50.0%	50.0%	
							1,676,700						
15	KALU GANGA PROJECT			2.6%	25	5	2,925,805						
16	Local Loan						125,300	9.0%	40	-			

Upper: Re-lending to NW
Lower: Loan disburse to ; 10,494,420

In case of L/A issued before 1990, the re-lending conditions are the same as those of L/A. After 1991, the conditions of 2% & 24 years are applied.

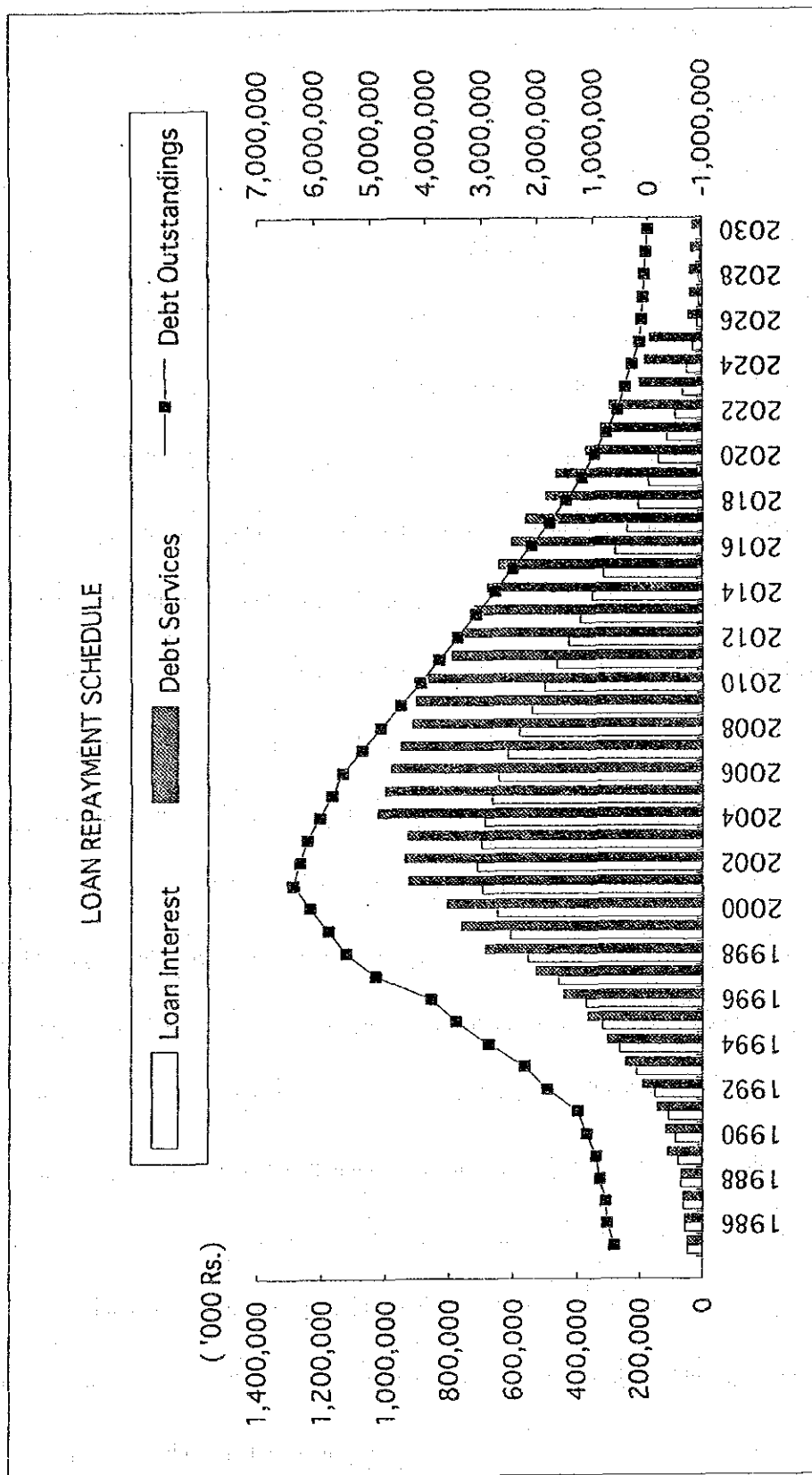


Figure 3.5 Loan Repayment Projection

Table 3.12 Status of Grant Projects

No.	Project	Fund Sources	Currency Unit (thousand)	Total Grant Amount	Total Disbursement up to 31.12.1993	Disbursement Schedule					Total	
						1994	1995	1996	1997	1998		1999
1	Finida - Kandy District Water Supply & Sanitation Project		Rs.	316,885	235,435	81,450						316,885
		Construction in Progress			235,435	316,885	316,885					316,885
		Fixed Assets										
2	Danida - Anuradhapura District Water Supply & Sanitation Project		Rs.	93,500	63,500	30,000						93,500
		Construction in Progress			63,500	93,500	93,500					93,500
		Fixed Assets										
3	Japanese Grant Ambatale Improvements		Rs.	105,005	19,650	85,355						105,005
		Construction in Progress			19,650	105,005	105,005					105,005
		Fixed Assets										
4	Japanese Grant Ambatale		Rs.	1,444,500		577,800	577,800	288,900				1,444,500
		Construction in Progress			0	577,800	1,155,600	1,444,500	1,444,500			1,444,500
		Fixed Assets										
TOTAL				1,959,890	318,585							
		Construction in Progress			318,585	1,093,190	1,155,600	1,444,500	0	0	0	1,959,890
		Fixed Assets			0	0	515,390	0	1,444,500	0	0	1,959,890

3.3 Existing Water Supply System and Facilities

3.3.1 Water Sources

(1) Surface Water Source

In order to establish the Kalu Ganga Water Supply Scheme, especially on the view point of optimum demarcation of supply area with the Kelani Ganga Water Supply Scheme, existing and potential water sources have been identified. The following is the brief summary on the safe yields of Labugama and Kalatuwawa Reservoirs and the characteristics of flow, quality and salinity of the Kelani Ganga.

1) Labugama and Kalatuwawa Reservoirs

The Labugama Reservoir impounds the flows of the Wak Oya, a tributary of the Kelani Ganga, while the Kalatuwawa Reservoir impounds the flows of the Kalatuwawa Ela that flows into the Wak Oya downstream from the Labugama Reservoir. Neither the Wak Oya nor the Kalatuwawa Ela has any flow records, however, both reservoirs have long records of monthly rainfall and measured and estimated water withdrawals for the treatment plant.

The Kelani Ganga basin has a drainage area of 2,278 km² and an annual rainfall of 3,800 mm of which 64 percent is estimated to drain into the sea. Hydrological characteristics such as rainfall and evaporation as well as geological and topographic conditions vary little within the Kelani Ganga catchment basin so that the area is considered as a homogeneous region on the hydrological view point.

The Master Plan Update utilized the following basic data given in Table 3.13 for the reservoir study. The reservoir operation was simulated for the period of October 1949 to September 1988.

Table 3.13 Reservoir Operation Study Data

Item	Kalatuwawa	Labugama
Nominal Design Capacity of Treatment Plant	20 mgd (91,000 m ³ /d)	13 mgd (59,000 m ³ /d)
Actual Capacity of Supply	18 mgd (81,900 m ³ /d)	11.6 mgd (53,000 m ³ /d)
Maximum Storage	15.4 million m ³	8.9 million m ³
Minimum Storage	1.6 million m ³	0.95 million m ³

Source: Greater Colombo Water Supply Master Plan Update (July 1991)

Appropriate adjustment was made during the reservoir simulation study to obtain the computed net yield of Labugama equivalent to the measured yield for the period 1978 - 1983 by increasing the runoff coefficient for the Labugama catchment. The final runoff coefficient for the Labugama was 0.70. The mean monthly safe yield at Kalatuwawa resulted as 1.97 million m³ and that at Labugama as 0.96 million m³ as given in Table 3.14.

Table 3.14 Operation Study Results

Parameter	Kalatuwawa (million m ³)	Labugama (million m ³)
Mean Monthly Inflow	2.93	2.16
Mean Monthly Evaporation	0.15	0.08
Mean Monthly Spill	0.29	0.33
Mean Monthly Net Yield	2.47	1.74
Mean Monthly Safe Yield	1.97	0.96

Source: Greater Colombo Water Supply Master Plan Update (July 1991)

The raw water running off the catchment areas at Kalatuwawa and Labugama is of very high standard, except for its capacity to breed diatoms of a very troublesome nature. The excellent quality of the incoming stream water results from the fact that the catchment areas feeding the reservoirs are virtually uninhabited and there is little possibility of pollution. The areas are under the control of the Forestry Department and a law intends to ban all developments within the area.

2) Kelani Ganga

By the period of the previous Master Plan Study in 1972, the minimum flow condition observed during the January to March period was improved due to the regulation of flows from hydropower stations in the upper reaches of the river. A further improvement to the flows at Ambatale during low-flow periods was noticed after 1976, when the hydropower stations in the Mahaweli complex came into operation.

The sand mining activities since 1987 to date had a major influence on low water flows at Ambatale since the mining has resulted in a continuous lowering of the natural river bed level and enlargement of the river section in the lower reaches. Although the river flow at Ambatale is sufficient to withdraw 500,000 m³/d during the low flow periods, low tide may cause the river water level to fall below the intake level, and high tides may bring in saline water.

The closest gauging stations to Ambatale having long records of river flows are Hanwell and Glencourse at 34 km and 52 km from the river mouth, respectively. At Glencourse, daily flow records are available since 1948 and Hanwell Gauging Station records are available since 1973 except the records missing for 1982 and 1983.

The quantitative potential for water supply that could be extracted from the Kelani Ganga is envisaged to be very large relative to the projected demand for Greater Colombo throughout the year 2020. However, a conventional low flow analysis for the purpose of estimating safe yield from the Kelani Ganga would be meaningless because the low flows upon which such an analysis rests are controlled by upstream reservoir operated for hydropower generation.

As for water quality, all indications are that the raw water entering Ambatale Treatment Plant is of good, treatable quality, and the activities of upstream users are receiving the attention of appropriate regulating authorities. A very satisfactory features of all Kelani Ganga water quality analysis are the high figures shown for dissolved oxygen. All samples reviewed appear to be well in excess of 4 mg/l and often in the 6.6 - 10 mg/l range which would suggest that this source would be regarded as good quality.

3) Kalu Ganga

The Kalu Ganga has a drainage area of 2,700 km² discharging 7,600 million m³/year compared to 5,600 million m³/year for the Kelani Ganga. However, due to the non-availability of regulating reservoirs in the basin, a greater variation of mean monthly flows can be observed over the course of the year.

The detail hydrological and hydraulic investigation and analysis of the Kalu Ganga are described in Chapter 6 of this report.

(2) Groundwater Source

The general condition of the groundwater source in the Greater Colombo Area will be divided into three categories such as

- 1) local or discontinuous product aquifer in inter granular rock
- 2) local or discontinuous productive aquifer in fissured rock,
- 3) local or discontinuous moderate to low acquifer in fractured rock.

The first category can be seen on the boarder between the Colombo District and Gampaha district along the Kelani Ganga and southern part of the Kalutara District. The second category prevails almost entire areas of the three districts along the coastal plain reaching Matara, the south end city of Sri Lanka. The third category extends southwards along C.M.C., Dehiwala/Mt.Lavinia M.C. and Moratuwa U.C. and northwards along Wattara P.S., Ja-Ela P.S. and Katana P.S.

The NWSDB has provided tube wells water supply system in and around the supply area and is continuously drilling tube wells to supplement un-supplied areas. The tube well supply consists of the cases that water is supplied by small scale pipe network and by community stand pipes by either electric or hand pumps.

Table 3.15 gives the existing condition of groundwater extraction by tube wells within the Greater Colombo area controlled by the NWSDB. The provision of tube wells is inversely proportion to the degree of piped water provision.

Table 3.15 Status of Groundwater Extraction

District	Division	Groundwater Extraction (l/min)	District	Division	Groundwater Extraction (l/min)
Colombo	C.M.C.	217.00	Gampaha	Ja-Ela	3,264.50
	Dehiwala	268.00		Katana	1,189.00
	Homagama	2,677.20		Keleniya	20.00
	Horana	75.0		Mahara	7,351.00
	Kaduwela	667.50		Wattara	18.40
	Kolonnawa	20.00		Sub-total	11,842.90
	Kotte	1.00	Kalutara	Bandaragama	4,347.20
	Maharagama	15.00		Horana	6,503.55
	Malambe	40.00		Panadura	201.00
	Narahrenpita	96.00		Sub-total	11,051.75
	Nugegoda	212.30	Total		27,220.55
	Piliyandala	37.00			
	Sub-total	4,325.90			

Source: Tube wells drilled, NWSDB, Dec. 1993

Note: The figure for Horana gives an amount of entire division. Horana U.C. only is 238 l/min.

3.3.2 Water Treatment

After completion of the 40 mgd New Ambatale Water Treatment Plant the total nominal production capacity of the existing four water treatment plants except for the 0.33 mgd minor Horana Water Treatment Plant is 136 mgd (618,800 m³/d) as follows:

Old Ambatale	63 mgd	(286,700 m ³ /d)
New Ambatale	40 mgd	(182,000 m ³ /d)
Kalatuwawa	20 mgd	(91,000 m ³ /d)
Labugama	13 mgd	(59,000 m ³ /d)
Horana	0.3 mgd	(1,500 m ³ /d)

While, the water use in 1992 in the existing service area covered by the above four water treatment plant was 173,458 m³/d on an average and was estimated at 199,500 m³/d on the daily maximum basis taking into account the peak factor of 1.15.

(1) Labugama Water Treatment Plant

The Labugama Water Treatment Plant is supplied raw water from the impounding reservoir situated behind the treatment plant. The dam and reservoir were commissioned in 1886 and provided the first major source of piped water supply to the Colombo City. Initially, raw water was conveyed to the City; a treatment plant was commissioned in 1917 and, thereafter refurbished in 1985 and commissioned in the subsequent year 1986.

The design capacity after the refurbishment is 59,000 m³/d, however, the supply quantity is regulated according to the instructions received from the Ambatale Water Treatment Plant taking into account the

water levels in the reservoir and water level of the clear water reservoir. According to the water production records, the average throughput from this treatment plant is 43,000 m³/d, maximum 83,000 m³/d and minimum 23,000 m³/d, respectively. Chemical dosage is adjusted according to flow based on the previous experience for a given flow. There is no recycling of filter wash water.

For the flocculation, fixed-baffle type flocculators are used.

The sedimentation tanks are on the horizontal flow principle. The settling capacity was increased in 1985/86 by using inclined plates when overall rehabilitation was implemented. However, this plated sedimentation tanks have not solved filter blocking problems.

The filters, as originally supplied by the Jewell Filter Co., are some of the very few still in existence. There are 15 rapid sand filters with circular in plan. The cleaning process includes mechanical rakes. The problem of filter blocking was noted since the midst of 1960's. It had apparently been manifested long before that. Diatoms are observed forming sludge by alum dosing on the surface of filter basin. The safe yield of this treatment plant was assessed as approximately 46,000 m³/d.

(2) Kalatuwawa Water Treatment Plant

The Kalatuwawa Water Treatment Plant was commissioned in 1958 and refurbished in 1985/86. The design output following renovation is 91,000 m³/d. The raw water from the reservoir passes over an aerator and is then given conventional treatment by coagulation, flocculation, sedimentation and filtration. The clear water reservoir has a capacity of 5,000 m³. The facilities include a filter backwash water recycling system that is not in use.

As for flocculator in like manner as Labugama treatment plant, fixed-baffle flocculators are in use. For sedimentation basin, the original retention period provided 2.4 hour and was later altered with inclined plates upgrading its settling capacity. The plates are installed in the old PCI basins.

The original filters at Kalatuwawa were capable of passing 90,800 m³/d. They were a typical Paterson-Candy design for rapid gravity sand filters. In 1985/86 the filters were redesigned on the declining rate principle. In such filters flow is controlled by a variation of head which counteracts the degree of dirtiness of the filter, which, in a standard filter, is provided for by some form of flow control on the outlet.

The safe yield of this treatment plant was assessed as approximately 66,000 m³/d

(3) Ambatale Water Treatment Plant

The first phase of the plant was commissioned in 1966, the second phase was implemented from 1972 to 1979, and the third phase in 1987.

In the first phase, raw water intake capacity was 182,000 m³/d (40 mgd) with an initial treatment capacity of 91,000 m³/d (20 mgd). A cascade aerator followed by chemical mixing structure. Two Centrifloc Clarifiers and twelve rapid sand filters were provided. The capacity of the clear water reservoir was 4,220 m³. High level pumps are provided to deliver water to Ambatale Tower for supply to Kotte, Dehiwala and towns south of Colombo.

In the second phase, additional pumping units to increase the capacity of the intake up to 182,000 m³/d was provided. One Pulsator with a design of 60,000 m³/d was constructed in addition to six high rate gravity sand filters, including improvements to the filter backwashing system, to provide filtering capacity of about 100,000 m³/d. High level pumps delivering water to Maligakande, Elie House and towns north of Colombo were provided.

In the third phase, a new raw water intake of 300,000 m³/d capacity with an initial pumping capacity of 130,000 m³/d was constructed. Two circular flocculation/clarifiers with a design capacity of 61,000 m³/d. High level pumps were provided to deliver water to Kolonnawa.

The new Ambatale Water Treatment Plant project financed by the Government of France was completed in December 1993 and commissioned. The project mainly comprises:

- 1) installation of 3 units of low lift pumps with a capacity of 91,000 m³/d each at Ambatale Intake Station
- 2) construction of a 1200 mm dia. ductile iron raw water conveyance main with a length of 1.4 km
- 3) construction of a treatment plant with a capacity of 182,000 m³/d
- 4) construction of a 1200 mm dia. ductile iron clear water main with a length of 0.4 km, and
- 5) construction of booster pumping station on Ambatale - Dehiwala transmission with 2 units of 100,000 m³/d capacity for each.

The current design capacity and safe yield of the old treatment plant are assessed as 303,000 m³/d and 288,000 m³/d, respectively.

3.3.3 Water Transmission and Distribution

(1) Transmission Mains

In the existing Greater Colombo water supply area, approximately 330 km of major transmission mains have been provided. A list of existing transmission mains is given in Table 3.16 in compliance with the location installed, length and diameter of pipes. The pipe diameter differs from 150 to 1220 mm. The general plan of transmission and distribution system is given in Drawings (Volume V).

(2) Pumping Facilities

Existing pumping facilities are summarized in Table 3.17 in compliance with location and pump capacities.

(3) Service Reservoirs

There are about 41 major ground reservoirs and towers in the existing system. A summary of pertinent data on these facilities is given in Table 3.18.

(4) Distribution System

An extensive network of distribution pipes ranges from 38 to around 800 mm. In general, pipes of 150 mm or less are PVC, while the larger pipes are cast iron.

The existing condition of distribution network in and around the C.M.C., however, is not understood in detail since the network is partly installed fifty to one hundred years ago. Further, tap water on each house connection generally contains color due to rusting of old pipes.

(5) Bulk Metering

Sixteen new bulk meters were installed in 1990 under the IDA III contract. It was identified that only nine of sixteen meters were functioning at the stage of previous Master Plan Update in 1991. Currently, twelve meters are functioning by repairing them, and out of them seven bulk meters have been shifted with electronic type. The meters installed on the inlets to Maligakande is yet functioning but not at Elie House, so that inputs to Colombo Municipality have not been precisely measured. The recorded daily quantities measured by nine bulk meters from June to October in 1990 are summarized in the Master Plan Update, 1991.

Table 3.16 Existing Transmission Mains

Reservoir and Route	Node		Length (m)	Diameter (mm)	Reservoir and Route	Node		Length (m)	Diameter (mm)
	From	To				From	To		
Biyaigama Tower	125	127	930	450	Kolonnawa G.R	331	332	1,500	400
Biyaigama to Kelaniya	120	125	5,429	450	Ambatale W.T.W to Kotikawatta	301	302	3,580	600
Ambatale to Church Hill	102	103	3,772	700	Labugama W.T.W	210	211	30,585	508
Ambatale W.T.W	101	102	128	1,100	Labugama W.T.W	213	209	3,150	488
Kotikawatta to Dehiwela	431	432	3,030	890	Kotikawatta	302	303	2,619	500
to Moratuwa G5	404	471	9,678	800	Labugama W.T.W	222	223	6,385	762
Ambatale W.T.W	501	502	4,330		Kalatuwawa W.T.W	204	205	6,385	762
G3 Tower	528	529	115	150	Kolonnawa G.R	304	305	519	400
Moratuwa G6	483	484	223	250	Kalatuwawa W.T.W	201	202	25,963	762
Ambatale W.T.W	422	423	238	990	Kolonnawa G.R	304	305	519	500
Moratuwa G6	483	484	223	250	Kolonnawa G.R	330	331	519	500
Jubilee to G3 Tower	521	522	1,120	600	Elie House	225	235	6,400	508
to Dehiwela G.R	432	451	75	380	Kolonnawa G.R	331	332	1,500	400
G3 Tower	525	527	610	400	Ambatale W.T.W	241	242	145	800
Ambatale to Dehiwela G.R	432	404	2,250	380	to Kotte North G.R, Tower	332	333	730	600
Moratuwa G5 to G6	472	473	1,071	580	Ambatale W.T.W	251	252	150	800
Ambatale to Dehiwela	432	404	2,250	890	Labugama W.T.W	212	213	6,385	488
Panadura G7	485	491	1,312	130	Labugama W.T.W	223	209	3,150	762
Ambatale to Dehiwela	430	431	2,311	890	Kalatuwawa W.T.W	0	201	50	1,219
Moratuwa G6	482	483	1,628	400	Ambatale W.T.W	242	222	579	762
Panagoda to Dehiwela G4	403	404	12,200	838	Ambatale W.T.W	252	233	725	500
Moratuwa G6	476	481	2,406	480	Labugama W.T.W	210	221	30,456	762
Jubilee to C.M.C	510	511	635	800	Elie House	234	235	6,500	488
G3 Tower	527	528	545	315	Kalatuwawa W.T.W	202	203	4,500	762
Moratuwa G6	481	482	6,215	450	Elie House	232	235	10,400	508
Labugama W.T.W	210	231	30,463	508	Kalatuwawa W.T.W	205	209	3,150	762
Elie House	232	233	300	500	Gonawara to Kelaniya	120	121	382	900
Elie House	233	234	5,600	488	Biyaigama to Kelaniya	121	122	5,301	600
Labugama W.T.W to St. I	210	231	30,463	508	Church Hill to Ganawala	106	120	136	900
Karatuwawa W.T.W	0	401	50	1,219	Padukka	401	428	12,700	838
Honiagama	402	498	3,380	838	Padukka	428	402	6,500	838
Ambatale to Jubilee	500	510	8,570	1,100		-	-	-	-
From ambatale Tower	426	429	5,962	990	Total	-	-	329,075	-

Source: NWSDB

Table 3.17 Existing Pumping Facilities

Location	Node		Pumping capacity (l/s)		
	from	to	No.1	No.2	No.3
Ambatale to Church Hill	100	101	361	361	361
Ambatale to Ambatale tower	421	422	1,009	505	917
Ambatale to Kolonnawa	300	301	178	178	-
Dehiwala G4 to G10	404	461	360	360	-
Ambatale to Elie House	240	251	222	222	220
Kolonnawa to Kotte G2	303	330	139	-	-
Kolonnawa to G1	303	304	167	-	-
Ambatale to Maligakande	240	241	417	417	-
Moratuwa G5 to G6	471	472	160	160	-
Ambatale to Jubilee	500	510	550	550	550
Panadura G7 to G12	484	485	12	-	-

Source: NWSDB

Table 3.18 Existing Reservoirs and Towers

Reservoir	Top Water	Bottom Water	Volume
	Level	Level	(m3)
Labugama C.W	94.50	91.50	4,360
Karatuwawa C.W	94.50	91.50	5,000
Ambatale C.W	12.50	9.30	17,700
Ambatale Tower	52.40	46.20	1,000
Elie House	28.90	22.90	37,500
Maligakande G.R	29.90	19.90	36,300
Maligakande G.R	29.90	19.90	13,630
Dehiwela C.M.C	27.90	23.60	17,700
Dehiwela G4	28.00	23.50	6,800
Dehiwela/Mt. G4	48.20	41.20	1,500
Dehiwela North G9	37.50	30.50	1,500
Kolonnawa G.R	24.90	16.90	10,900
Kolonnawa G0	26.20	21.20	318
Kolonnawa G1	36.40	29.30	2,000
Kotte North G2	35.70	28.50	2,000
Kotte South G3	38.70	31.40	2,000
Kotte South G8	38.70	31.70	1,500
Jubilee Exist	36.60	27.40	4,500
Moratuwa G5	15.10	10.50	4,600
Moratuwa G6	50.90	43.90	1,500
Panadura LL G7	26.00	21.70	2,600
Panadura HL G.R	39.50	35.40	409
Church Hill G.R	71.30	62.50	18,184
Wolfvendel Tower			2,000
Kirulapone Tower	39.20	35.36	1,000
Gothatuwa G.R	17.70	15.20	227
Gothatuwa Tower	46.10	41.50	318
Jayawadanagama G.R	30.00		1,364
Jayawadanagama Tower	48.40	43.50	681
Ragama Hospital G.R	40.20	37.50	681
Ragama Tower (Talagolla)	49.50	45.50	227
Welisara Tower			227
Raddoluwa Tower			455
Biyagama EPZ Tower	58.10	51.20	1,360
Maharagama Tower	45.00	38.85	954
Maharagama G.R	24.00	9.00	3,450
Bandaragama Tower	83.40	78.90	225
Homagama G.R	25.00		4,000
Homagama Tower	50.00		1,500
Jubilee Reservoir	36.57	27.21	11,500
Katunayake EPZ G.R	30.60	25.00	4,450

Source: NWSDB

3.4 Served Population

In the water supply operation of Greater Colombo, there is no record directly indicating the served population. Billing record shows the number of meters which are considered to be equivalent to the number of households connected. Population with direct connection can be estimated from these record. For the community taps, the Master Plan Update conducted the field survey to estimate the population on community tap, and resulted that about 200 people are using one community tap in average. Total served population was then estimated as shown in Table 3.19.

Table 3.19 Estimated Served Population

Service Area	No. of Domestic Connections (1)	Estimated persons per house			Metered Population ('000) (5) = (1) × (4)	No. of Indirect Connections (6)	Stand Pipe Population ('000) (7)	Total Served Population ('000) (8) = (5) + (7)
		1990 Population (2)	No. of Houses (3)	Persons per house (4) = (2) ÷ (3)				
Colombo M.C.	45,662	740,600	79,600	9.3	399.4	6,626	307.4	706.8
Dehiwala M.C.	18,104	218,600	29,308	7.6	140.3	341	68.2	208.5
Kotte U.C.	13,866	127,400	18,949	6.7	100.5	200	26.9	127.4
Kolonnawa U.C.	2,647	51,700	8,872	5.8	15.7	265	35.8	51.5
Moratuwa U.C.	11,613	169,900	28,959	5.9	70.6	262	52.4	123.0
Kotikawatta/ Mulleriyawa U.C.	2,003	88,700	14,883	6.0	14.9	10	2.0	16.9
Kelaniya U.C.	5,673	143,300	27,360	5.2	38.1	80	16.0	54.1
Panadura U.C.	3,541	38,000	6,552	5.8	21.8	201	16.1	37.8
Total	103,108	1,578,200	214,483	-	801.3	7,985	537.9	1,339.2

Source: Tables 4.12, 5.2 and 5.10, Data Base Report, Master Plan Update (1991)

3.5 Water Use

3.5.1 Water Use

Water consumption in the Greater Colombo Water Supply is counted from the billing which are issued every month. Billings are summarized by service area in Greater Colombo and category in use.

Total use by service area is presented in Table 3.20.

Water use in the existing water supply is classified in several categories by purpose of water use. In the Master Plan Update, water use are categorized as domestic and non-domestic use for the purpose of planning in which the non-domestic use consists of industrial, commercial and institutional uses. These categories are summarized in Table 3.21.

Table 3.20 Total Water Use in the Greater Colombo Water Supply

Service Area	Water Use in 1990 ¹⁾ Day Average (m ³ /d)	Water Use in 1992 ²⁾ Day Average (m ³ /d)
Colombo M.C.	108,085	98,467
Dehiwala M.C.	28,705	32,945
Kotte U.C.	17,679	20,389
Kolonnawa U.C.	5,243	3,000
Moratuwa U.C.	13,645	14,999
Kotikawatta/ Mulleriyawa U.C.	7,096	7,564
Kelaniya U.C. ³⁾	13,633	20,317
Panadura U.C.	3,453	4,284
Total	197,539	201,963

Note: 1) Water use in 1990 from the Master Plan Update (incl. estimated standpost use)
2) Water use in 1992 from the billing record data collected (include. estimated standpost use)
3) Kelaniya U.C. includes the consumption in Peliyagoda U.C., Wattala-Mabole U.C. and Biyagama EPZ.

Table 3.21 Water Use Category

No.	Category in Billing	Category in Water Supply Planning			
		Domestic	Industrial	Commercial	Institutional
10	Domestic	0			
12	Schools				0
51	Stand Posts	0			
60	Government Institutions				0
61	Military				0
62	Police				0
63	Hospital				0
64	C.M.C. Offices				0
70	Commercial Institutions			0	
71	Tourist Hotels/Guest Houses			0	
73	Industrial/Construction Purposes		0		
74	Greater Colombo Economic Commission (BOI)		0		
80	Institutional				0
81	Religious and Charitable				0
82	Board Premises				0
83	Free Water	0			

Aside from the categories by purpose, there are two water use categories in accordance with the amount of water use: 1) Priority user and 2) Non-priority user. Priority users mean those with relatively large individual consumption for industrial, commercial, and institutional purposes while non-priority users are classified as those with less consumption. These two consumption groups are billed separately every month.

Water use amounts in the Greater Colombo Water Supply in 1990 and 1992 are summarized in Table 3.22.

Table 3.22 Summary of Water Use in the Greater Colombo Water Supply

Service Area	Water Use in 1990 ¹⁾ Day Average (m ³ /d)	Water Use in 1992 ²⁾ Day Average (m ³ /d)
Domestic Use	128,216	124,595
Industrial Use	5,381	9,791
Commercial Use	35,580	32,083
Institutional Use	28,361	35,494
Total	197,538	201,963

Note: 1) Water use in 1990 from the Master Plan Update (incl. estimated standpost use)

2) Water use in 1992 from the billing record data collected (incl. estimated standpost use)

Water use by service area are summarized in Table 3.23.

Table 3.23 Water Use by Service Area and Category

Service Area	Daily Average Water Use in 1992 (m ³ /d)				
	Domestic	Industrial	Commercial	Institutional	Total
Colombo M.C.	39,199	2,551	22,612	17,813	82,175
Dehiwala M.C.	18,185	253	3,588	7,304	29,330
Kotte U.C.	14,705	10	1,324	2,230	18,269
Kolonnawa U.C.	359	7	536	201	1,103
Moratuwa U.C.	9,424	1,043	960	795	12,222
Kotikawatta/Mulleriyawa U.C.	2,283	545	853	3,777	7,458
Kelaniya U.C. ¹⁾	9,144	5,358	2,002	2,965	19,469
Panadura U.C.	2,792	24	207	408	3,431
Total	96,090	9,791	32,083	35,494	173,458

Note: 1) Kelaniya U.C. includes the consumption in Peliyagoda U.C., Wattala-Mabole U.C. and Biyagama EPZ.

3.5.2 Unaccounted-for Water (UFW)

There is no reliable data to examine the amount of unaccounted for water due to a lack of reliable measurement data for water treatment or transmission. That is because most of the bulk flow meters installed at the treatment plants, reservoirs and pumping stations are not functioning well. Major cause of malfunction is apparently the trouble in the instrumentation circuits which is commonly seen in many developing countries.

At the Ambatale Plant, the amount transmitted are estimated from the operation records of transmission pumps. At Kalatuwawa Plant, production amount is estimated by reading the orifice flow meters installed in an outlet pipe of each filter unit. There is a ventury flow meter at Labugama Plant installed in the transmission pipeline.

Production amount calculated from the records available, it was estimated that the daily average production in 1992 is approximately 380,000 m³/d.

With these production (380,000 m³/d) and consumption data (173,000 m³/d), it is simply calculated the UFW ratio as 54 percent. However, the water consumption was summarized from the billing records, and therefore does not include consumption at public taps. The Master Plan Update estimated the amount of community tap water use to be about 28,000 m³ in 1990. The Master Plan Update also considered water meter measurement error as about 5 percent. Adding these amount to the consumption, total water use is estimated as 209,700 m³. From this figure, the UFW ratio is calculated as follows:

$$\text{UFW Ratio} = 100 - \{(173,000 \times 1.05 + 28,000) / 380,000\} = 45 \text{ percent.}$$

3.6 Ongoing and Planned Water Supply Project

3.6.1 JICA Projects

1) Ambatale Water Treatment Plant Improvement Project

- The objective of this scheme is to replace and rehabilitate all the deteriorated equipment and facilities of the Ambatale water treatment works.
- Detail design was implemented in 1992 by the Grant Aid of Japanese Government.
- The construction implementation is planned to commence January 1994 and complete by March 1996.
- The major direct effect that will be brought about by the project are:
 - o Realization of adequate distribution and measurement of raw water to the three sedimentation systems, and optimum chemical dosing to each system,
 - o Improvement of coagulation and flocculation by replacement of deteriorated chemical dosing facilities,
 - o Improvement of sedimentation by rehabilitation of centriflocs and pre-treaters,
 - o Provision of suitable filtration through the equal distribution of pretreated water to each of the filters,
 - o Improvement of filtration by replacement of deteriorated filter sand to new sand and provision of washwater trough,
 - o Stabilization of water supply by replacing deteriorated intake pumps and transmission pumps, and
 - o Replacement of deteriorated chlorination facilities which will ensure guaranteed disinfection of water.

3.6.2 OECF Projects

1) Towns East of Colombo Water Supply Project

- This project is financed by OECF, Japanese Government for the establishment of new water supply schemes.
- The planned project period is from December 1993 to December 1995.
- The proposed scheme consists of three separate distribution systems for Battaramulla, Kaduwela and Pannipitiya. The construction of the scheme is proposed to be conducted under two separate packages:
 - o Contract No.OECF/C1: All the civil works for three areas consisting of supply and laying of pipe materials, construction of reservoirs and towers and other buildings are packaged in one civil works contract.
 - o Contract No.OECF/E1: Supply and installation of pump equipment and other mechanical, electrical and instrumentation system are separate contract in which the supplier will carry out the design, supplying and installation.
- The areas included in the implementation under the current fund arrangement are called as " First Phase Area ". The Pradeshiya Sabhas and Governmental Sub Divisions being included in the first phase area are given in Supporting Report (Volume III).

2) Towns South of Colombo Water Supply Project

- The fund of this project is proposed to be financed by the loan from OECF.
- The construction of this project will be commissioned on June 1995 and will be completed May 1997.
- The project aims at extending piped water supply services to Kesbewa Pradeshiya Sabha (PS), Homagama PS and Keselwatte area in Panadura PS which was proposed as the expansion area in the Master Plan but is currently excluded from the existing expansion plan which includes the scheme covering the Towns East of Colombo. The proposed development is to meet the water demand of the year 2010 to fill a gap in the Greater Colombo area and its environs.
- The project components are as follows:

1. Kesbewa

Transmission mains (dia. 700 mm, 600 mm and 400 mm, total 13.6 km)
Ground reservoir (6,000 m³, 2,000 m³)
Pumping stations
Water tower (2,000 m³, 1,000 m³)
Distribution pipelines

2. Homagama

Transmission mains (dia. 500 mm, total 1.2 km)
Ground reservoir (2,000 m³, 1,500 m³)
Pumping station
Distribution pipelines

3. Keselwatte

Distribution pipelines

3.6.3 World Bank (IDA) Projects

1) Ambatale-Jubilee Water Conveyance and Maharagama Water Supply Scheme

- This project is financed by the World Bank (International Development Agency) for the establishment of new water supply scheme between Ambatale water treatment works and Maharagama through Jubilee.
- The project was commenced on June 1991 and is planned to complete on June 1994.
- The major component of works under this contract consists of:
 - o Phase I; the improvement of Ambatale head works with the installation of 4 pumps, laying of 8 km long, 100 mm dia. transmission main,
 - o Phase II; laying of 2 km long 900 mm dia. additional pipeline from Jubilee to Narawa to improve Colombo distribution, and
 - o Phase III; construction of a 9,000 m³ reservoir at Jubilee, laying of 6 km long 600 mm dia. transmission main from Jubilee reservoir to Maharagama reservoir.
- Of them, Maharagama scheme consists of:
 - o 3,600 m³ ground reservoir
 - o 954 m³ and 23.5 m height water tower
 - o pump house to lift water to the tower
 - o 45 km long distribution system
 - o distribution area covers approximately 21 km²

2) Scraping and Cement Mortar Lining of Greater Colombo Area Transmission Mains and Distribution System

- The project is financed by IDA.
- The project period is planned to commence on January 1994 and complete on 1996.
- The work to be performed includes but not limited to the transmission and distribution pipelines scraping, relining with cement mortar in situ, cleaning debris and removing blockages or surplus branches to/from it, testing the pipes for roughness and water tightness and cleaning after the works are completed.
- The pipelines are located mainly in the areas of Colombo municipal council, Dehiwala Mt. Lavinia, Panadura and from Labugama to Ambatale.

3) World Bank Assisted Water Supply and Sanitation Project IV

- This project is still under a planning stage.
- The proposed project is a continuation of an on-going effort by the Government of Sri Lanka and IDA to improve environmental conditions within the Greater Colombo area.
- A balanced program has been developed which will provide benefits in water supply, sewerage and low-income sanitation.

- About 39 percent of the total investment would be for rehabilitation of existing water and sewerage system, 49 percent for new works, and 12 percent for institutional strengthening and other technical assistance.
- 4) **Third Sri Lanka Water Supply and Sanitation Rehabilitation Project**
- The project is planned to commence on January 1994 and complete on December 1995.
 - The contents of the project are:
 - o Rehabilitation works at Elie House Reservoir of a capacity of 36,300 m³ (8 mgd) which comprises
 - i) demolition of existing arched concrete roof slab without reinforcement, supporting steel structure consisting of primary and secondary beams and construction of a new reinforced concrete roof cover slab with main and secondary beams.
 - ii) removal of strips of existing arched shaped, non reinforced, roof slab and replacing the corroded main beams with RCC beams and slabs.
 - o Demolition and removal of existing single story maintenance office building and construction of two story office building.
 - o Laying of pipes for infilling of unserved areas of Maharagama water supply scheme, which consists of supplying and laying of 40 km long PVC distribution system of diameter ranging from 50 to 110 mm.

3.6.4 ADB Projects

- 1) **Reduction of Unaccounted-for Water in Greater Colombo**
- This scheme is financed by ADB commencing on December 1993 and planned to complete on March 1998.
 - The principal actions to be undertaken are:
 - (a) Metering of all stand pipes,
 - (b) Meter installation and relocation based on a standard above ground installation located between house and road boundaries as well as meter repair and replacement (about 50,000 new meters and 100,000 relocation).
 - (c) Repair of all visible leaks, and
 - (d) Registration and mapping of all connections.
 - Materials and equipment to be provided will include valves, bulk meters, consumers, house connection pipe works, and valves and distribution pipe repair materials.

3.6.5 Other Projects

- 1) **Ambatale Treatment Plant Facilities Project**
- The objective of this project is to provide the necessary water for distribution in the new areas in Greater Colombo. The project started in December 1990 and completed in December 1993.
 - The financial source of this project is the Government of France.

- The project comprises the following components:
 - o Installation of 3 Nos. of low lift pumps, capacity 20 mgd, each at the Ambatale new intake,
 - o Construction of a 1200 mm dia. ductile iron raw water main of length 1.4 km.
 - o Construction of treatment works capacity of 40 mgd,
 - o Construction of a 1200 mm dia. ductile iron clear water main of length 0.4 km, and
 - o Construction of booster pumping station on Ambatale Dehiwala transmission with 2 pumps of 22 mgd capacity each.

CHAPTER 4

REVIEW OF THE MASTER PLAN UPDATE AND

POPULATION AND WATER DEMAND PROJECTION

4. REVIEW OF THE MASTER PLAN UPDATE AND POPULATION AND WATER DEMAND PROJECTION

4.1 Project Horizon

The Master Plan Update presented a development plan for 1995 and 2000 on the basis of the water demand projection and the available sources of water supply. It is now needed to establish a long term development plan for years after 2000 for the NWSDB to implement the further water supply expansion to cope with the demand of people in the area.

It may be reasonable to set the target years for the development at 15 to 20 years taking into account the time required for implementation of a large scale project and dependability of water demand projection which may have to be reviewed about every ten years. It is also recommended that the target years be set for the ultimate implementation and the first phase implementation to enable the NWSDB to have a clear vision for future development.

From these points of view, project horizon for implementation of the Kalu Ganga Water Supply Project for Greater Colombo is set as follows:

Long Term Development Plan for 2020

For this year, sizing of planned facilities will be identified as a long term development plan to meet the water demand projected. Safe yield at the proposed Kalu Ganga intake will also be reviewed for the demand. Requirements in land acquisition will be prepared for this long term development plan.

First Phase Implementation Plan for 2010

A preliminary design for the first phase implementation will be conducted to identify the details of planned facilities to meet the water demand. A feasibility study will then be conducted for the project.

4.2 Service Area

Extent of the entire service area of Greater Colombo Water Supply System has been defined in the original master plan. The Master Plan Update followed the same boundary of the area which covers major part of Colombo, Gampaha and Kalutara Districts and consist of two Municipal Councils, nine Urban Councils, and 15 Pradesiya Sabhas. Figure 4.1 shows a boundary of the planned service area. A total of the service area is about 73,900 ha. Out of this, the existing water supply service covers approximately 16,400 ha of the central urbanized area with C.M.C. at its center.

At north, the planned service area has a boundary with Negombo water supply which is taking raw water from the Maha Oya river and is currently supplying treated water to the Katunayake airport and Katunayake Industrial estate.

At south, the planned service area covers up to Panadura P.S., a part of which is being supplied water from Kalutara water supply system to supplement the shortage of supply from the Greater Colombo system.

At east of Colombo, the extent of the planned service area stretches to cover Kaduwela and Homagama P.S. A small town of Padukka located in remote Sithawaka P.S. is also included in the planned service area by tapping to the existing Kalatuwawa Dehiwala transmission line.

Horana U.C. is an isolated area from Greater Colombo but is currently served by piped water supply with the Kalu Ganga as a water source. This area and its fringe area are included in the planned service area. Table 4.1 tabulates the administrative sections included in the planned service area.

Since there is a limitation in supply capacity in the Negombo and Kalutara water supply schemes, it will not be likely that boundary areas at north and south can be supplied more from these adjacent water supply schemes. Therefore, the planned service area defined above is considered reasonable as the extent of the Greater Colombo Water Supply System. The existing planning boundary will then be used for the review of water demand and for the development planning.

4.3 Population Projection

4.3.1 Historical Population

The most reliable data regarding population investigation in Sri Lanka is the census survey being carried out every ten years. It has been recorded since 1871 up to 1981 for one hundred years. The population survey data during this period is given in Table 4.2 and Figure 4.2. The last census survey was carried out in 1981 and the subsequent survey in 1991, however, was not carried out.

Since the end of World War II, the population of the Colombo district increased approximately 2.5 percent annually on average, while the Kalutara district did not increase largely, and no census data in the Gampaha district up to 1971 was available. In 1981, there was a sudden change in population probably due to the reorganization of the administrative units. It is assumed that the previous population of the Colombo district might have included the surrounding areas which currently belong to the Gampaha and Kalutara districts.

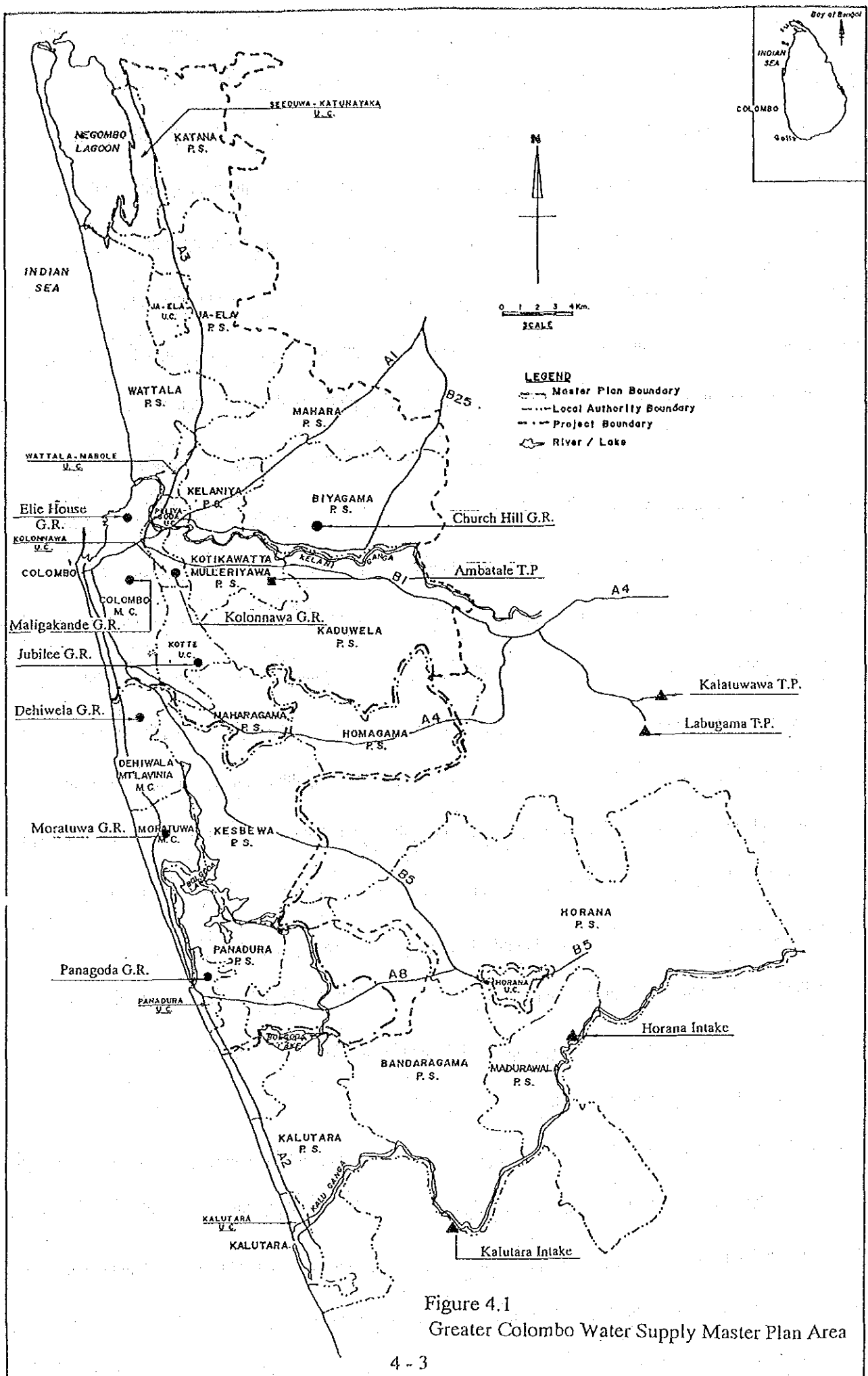


Table 4.1 Administrative Sections included in the Service Area

Service Area	Area (ha)	Present Water Supply Status
COLOMBO DISTRICT		
Colombo M.C.	3,733	Almost fully covered
Dchiwala M.C.	2,106	Almost fully covered
Kotte U.C.	1,690	Almost fully covered
Moratuwa U.C.	2,361	Almost fully covered
Kolonnawa U.C.	553	Almost fully covered
Kotikawatte/Mulleriyawa P.S.	2,307	Area not fully covered. Service ratio is low.
Homagama P.S. (part)	3,083	Only town core is covered.
Kaduvela P.S.	8,770	Western part under the Towns East Project implementation.
Kesbewa P.S.	5,860	To be covered by the Towns South Project
Maharagama P.S.	2,183	Almost covered and will be fully covered upon completion of the ongoing Maharagama project.
Sub-Total of Colombo	32,646	
GAMPAHA DISTRICT		
Ja Ela U.C.	906	No pipe water supply
Peliyagoda U.C.	383	Almost fully covered.
Seeduwa Katunayake U.C.	1,036	No pipe water supply
Wattala Mabile U.C.	379	Almost fully covered
Biyagama P.S.	5,910	Only Biyagama EPZ is served. Expansion along the major roads ongoing.
Ja Ela P.S.	5,624	No pipe water supply
Katana P.S. (part)	2,942	Only airport and industrial estate is served from Nogombo.
Kelaniya P.S.	1,916	Almost fully covered.
Mahara P.S. (part)	4,676	No pipe water supply
Sithawaka P.S. (Padukka)	166	No pipe water supply
Watala P.S.	7,685	Only southern part is covered
Sub-Total of Gampaha	31,623	
KALUTARA DISTRICT		
Horana U.C.	338	Almost fully covered
Panadura U.C.	582	Almost fully covered
Bandaragama P.S. (part)	4,014	Only town core served with groundwater
Horana P.S. (part)	2,368	No pipe water supply
Panadura P.S.	2,332	No pipe water supply
Sub-Total of Kalutara	9,634	
Total Area	73,903	

To supplement a lack of data, population projections to effectuate for social and infrastructure development planning have been carried out by the government authorities, international development organizations and consultants. Therefore, the existing population currently used in the various planning authorities can be said as the projected population in compliance with the data of 20 years ago. The

Department of Census and Statistics (DCS) developed population projections in 1990 for the Colombo, Gampaha and Kalutara districts through 2020 and this projection might be the most reliable among others.

4.3.2 Population Projection in the Master Plan Area

(1) Population Projection in the Previous Master Plan Study

In the previous Greater Colombo Water Supply System Master Plan Update in 1991 gives population projections of the Pradesiya Sabhas estimated by planning agencies as well as these of municipal and urban councils as given in Tables 4.3 and 4.4, respectively. These population projections were further updated in the Greater Colombo Wastewater and Sanitation Master Plan in 1993 taking into account the data on the respective divisions amended by planning agencies.

(2) Impacts on Population Growth

1) Permanent, Temporary and Floating Population in C.M.C.

Low income housing program is being carried out extensively by the National Housing Development Authority (NHDA) within the City of Colombo. The present permanent resident population of Colombo is estimated at 700,000 to 800,000. In addition, the NHDA estimates the temporary resident population at approximately 300,000 and the floating population at 500,000. A total of temporary and floating population is predominant to the permanent population.

There are about 700 slum tenement gardens consisting of about 22,400 housing units located in and around the commercial centers. According to the surveys in 1978, approximately 20,700 shanty housing units at 750 locations spreading over the city were reported.

Consequent to the implementation of the low income and shanty housing programs to be completed in the future, the population of the city of Colombo is expected to immensely increase by appropriate registration and amenity of living.

2) Development of Industrial Estate

A number of industrial estates have been developed under the Ministry of Industries, Science and Technologies, Board of Investment, Urban Development Authorities and private sectors. The location of existing and proposed industrial estates are as given in Section 2.3. The development of industrial estate will bring about a concentration of labors living in the periphery as well as the regional development.

3) Governmental Policy

The decentralization policy by the Government has been taken since 1980's. In the course of promoting this policy, the Government of Sri Lanka aims at abolition of slums in and around the city, diminishing squatters spreading along the canal and rivers and mitigation of congestion in the city.

Industrial development strategy by the Government as aforementioned in the outskirts and suburban regions of C.M.C. has been positively enhanced for export promotion, regional development and promotion of employment.

Social tendency that the labors being engaged in the works in the city of Colombo are likely to live in the suburban areas due to economic and environmental reasons has been thus inevitably spreading into outskirts of the Colombo city.

(3) Updated Population Projection in the Master Plan Area

On the basis of the population projection carried out in the Master Plan Update 1991 as well as the Wastewater and Sanitation Master Plan, the further update taking into account the amendment of projections by the Ministry of Policy Planning, UDA and DCS has been carried out in this study. The summary is given in Table 4.5.

(4) Characteristics of Population in the Districts

Typical characteristics of population in the Colombo district is a moderate increase in C.M.C. since the average annual increase through thirty years is only 0.16 percent. Inversely, Kaduwela P.S. and Kesbewa P.S. are manifest in their sharp increase tendency with average annual growth rates of 5.3 percent and 3.5 percent, respectively.

In the Gampaha district, more than a half of the divisions indicate sharp increase such as more than 4 percent annually throughout thirty years. The causes are envisaged that some large scale of industrial estates presently exist or will be further established on the base of small population areas.

Meanwhile, the Kalutara district as a whole implicate that the area is still under developed and show a very little increasing tendency.

(5) Population Density

Present (as of 1990) and future (2020) population densities by division are computed as given in Table 4.8 and Figures 4.5 and 4.6 on the basis of Population projection shown in Table 4.5.

Table 4.2 Population in the Greater Colombo Area by Census

District	1871	1881	1891	1901	1911	1921	1931	1946	1953	1963	1971	1981
Colombo	430.0	506.5	578.9	690.8	826.8	923.1	1,081.2	1,420.3	1,708.7	2,207.4	2,672.3	1699.2
Gampaha	-	-	-	-	-	-	-	-	-	-	-	1,390.9
Kalutara	145.7	165.0	183.6	229.2	279.5	323.7	363.8	456.6	523.6	631.5	729.5	1829.7
Total	575.7	671.5	762.5	920.0	1,106.3	1,246.8	1,445.0	1,876.9	2,232.3	2,838.9	3,401.8	4,919.8

Source: Statistical Abstract, Department of Census and Statistics, 1992

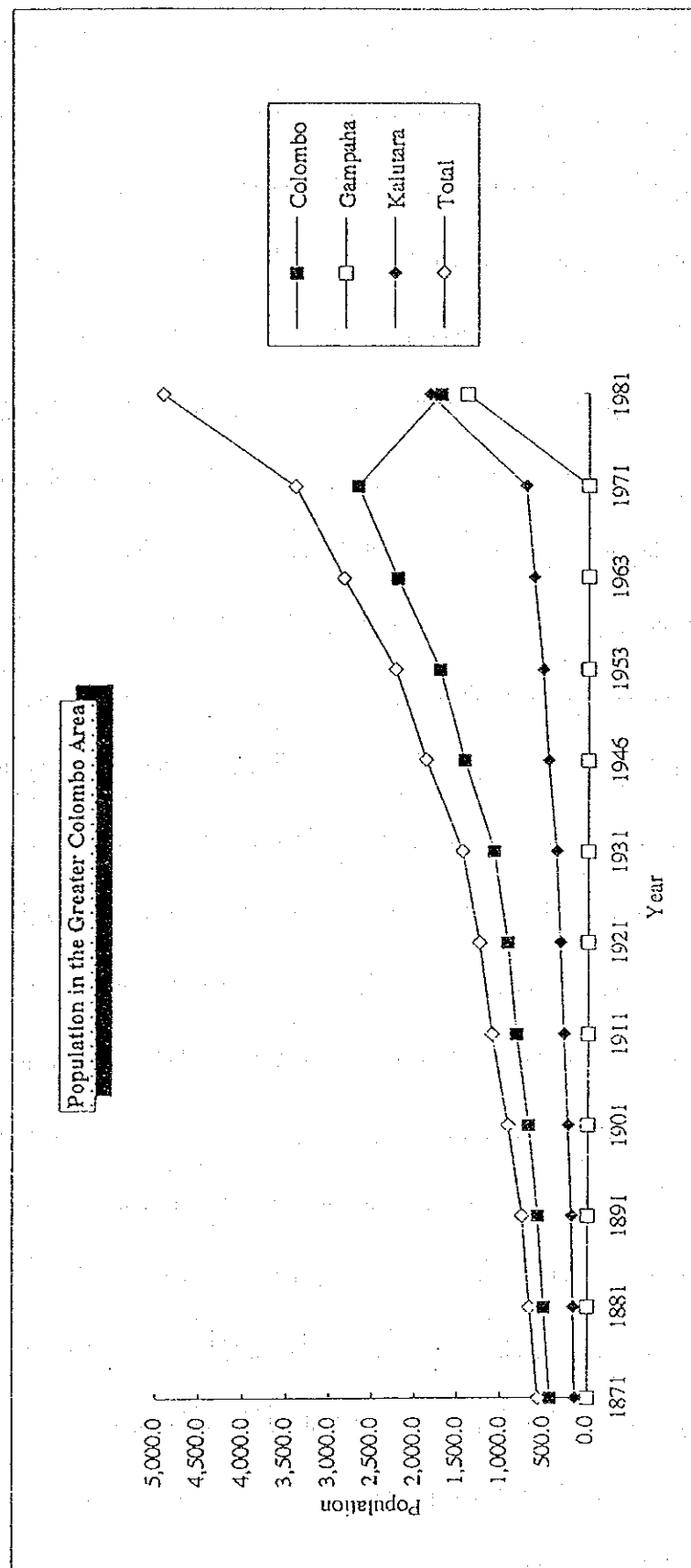


Figure 4.2 Population in the Greater Colombo Area by Census

Table 4.3 Summary of Pradeshiya Sabhas Population Estimated by Planning Agencies

Pradeshiya Sabha	Population ('000)								Data Source
	1963	1971	1981	1986	1988	1989	1990	Ave.	
Katana			78.0				105.2		Census & Statistics
						96.8			Voter's List
							143.9		A.G.A. Office
Wattara			89.7				120.9		Census & Statistics
						129.0		116.1	Voter's List
						108.8	111.3		A.G.A. Office
Ja-Ela			95.0				128.1		Census & Statistics
						117.5		130.1	Voter's List
							132.0		A.G.A. Office
Mahara			108.4				146.2		Census & Statistics
						143.9			Voter's List
						162.4	170.8		A.G.A. Office
Kelaniya		75.3	84.4						Census & Statistics
						100.8		108.9	Voter's List
				100.3		101.6	103.9		A.G.A. Office
Kotikawatta Mulleriyawa	55.0	66.8	73.3				92.4		Census & Statistics
							85.0	88.7	Voter's List
Kaduvela		94.2	126.0				158.9		Census & Statistics
						172.2		163.4	Voter's List
						157.3	167.8		A.G.A. Office
Maharagama	28.6	41.8	92.8				116.8		Census & Statistics
							143.8	130.3	Voter's List
Kesbewa			120.9				151.2		Census & Statistics
						166.5		166.2	Voter's List
							181.2		A.G.A. Office
Panadura (except Wadduwa)			91.2				111.3		Census & Statistics
						105.2		107.3	Voter's List
						101.8	103.2		A.G.A. Office
						129.0			Min. of Health
Bandaragama			62.2				76.1		Census & Statistics
						94.3			Voter's List
						69.6	70.6		Kacheheri
Biyagama			94.2				127.1		Census & Statistics
						122.8		120.2	Voter's List
						110.9	113.2		A.G.A. Office
Horana			114.0				139.4		Census & Statistics
						134.3			Voter's List
						146.7	151.4		A.G.A. Office
Homagama			141.8				178.7		Census & Statistics
						196.9			Voter's List
						161.4	164.0		A.G.A. Office
Sitawaka (part)			4.6				5.8		Census & Statistics
							5.6	5.7	A.G.A. Office

- Note: 1. Populations in 1990 are for the entire Pradeshiya Sabha areas.
2. Populations in 1990 are projected from 1989 data.
3. This table is reproduced from the Master Plan Update 1991.

Table 4.4 Summary of Municipal and Urban Council Population estimated by Planning Agencies

Pradeshiya Sabha	Population ('000)										Data Source
	1963	1971	1981	1983	1985	1986	1987	1988	1989	1990	
Colombo M.C.	511.6	562.4	587.6							740.6	Census & Statistics
				596.0	601.0	603.0	606.0	609.0	612.0		R.G. Office
						610.0				624.5	UDA Estimates
									658.3	668.4	Min. of Health
									648.8		Voter's List
								633.0		646.6	C.M.C.
Dehiwala/Mt.Lavinia U.C.	116.0	154.2	173.5							218.6	Census & Statistics
				177.0	179.0	185.0	187.0	190.0	193.0	217.5	R.G. Office
						186.1				196.8	UDA Estimates
									198.0		U.L.A.
						220.0					Colombo M/P Project
Kotte U.C.	73.3	93.7	101.1							127.4	Census & Statistics
				101.1	100.0	105.0	106.0	107.0	108.0		R.G. Office
											Colombo M/P Project
										114.7	A.G.A. Office
Kolonnawa U.C.	27.4	37.4	41.0							51.7	Census & Statistics
						41.0					Colombo M/P Project
										50.1	A.G.A. Office
Moratuwa U.C.	77.8	96.3	134.8							169.9	Census & Statistics
				136.0	136.0	151.0	156.0	162.0	166.0		R.G. Office
									153.0	155.0	Min. of Health
									174.5		Voter's List
						140.0					Colombo M/P Project
Panadura U.C.	23.2	24.4	31.0							172.8	A.G.A. Office
										38.0	Census & Statistics
									43.9		Min. of Health
Ja-Ela U.C.	5.1	21.7	24.5							39.8	A.G.A. Office
										33.0	Census & Statistics
Seeduwa-Katunayake U.C.	14.3	23.4	31.5							42.0	A.G.A. Office
										42.5	Census & Statistics
									43.2		Voter's List
Wattala/Mabole U.C.	14.3	18.0	20.0							40.7	Kachcheri
										27.0	Census & Statistics
						27.0			42.6	46.8	U.L.A.
											Colombo M/P Project
Periyagoda U.C.	23.2	24.4	25.5							23.9	Voter's List
										34.4	Census & Statistics
						26.0					Colombo M/P Project
									30.9		Voter's List
Horana U.C.	6.3	7.6	8.8			27.9				32.0	A.G.A. Office
						9.9				10.8	Voter's List
										17.5	A.G.A. Office

- Note: 1. Populations in 1990 are the projected figures by the consultants except for those provided by the Ministry of Health.
2. This table is reproduced from the Master Plan Update 1991.

Table 4.5 Proposed Population Projections

Divisional Secretariates	Administrative Area	Population					Growth Rate					Population Density					Land Area (ha)
		1990 (x1000)	1995 (x1000)	2000 (x1000)	2010 (x1000)	2020 (x1000)	1990 (%)	1995 (%)	2000 (%)	2010 (%)	2020 (%)	1990 (Pers./ha)	1995 (Pers./ha)	2000 (Pers./ha)	2010 (Pers./ha)	2020 (Pers./ha)	
COLOMBO DISTRICT																	
Colombo	Colombo M.C.	740.6	752.4	760.0	770.7	776.4	0.32	0.20	0.14	0.07		198.4	201.6	203.6	206.5	208.0	3,733
	Mt. Lavinia M.C.	218.6	232.1	242.4	243.6	243.9	1.21	0.87	0.05	0.01		103.8	110.2	115.1	115.7	115.8	2,106
	Kotte U.C.	114.0	135.9	141.4	152.0	160.9	3.58	0.80	0.73	0.57		67.5	80.4	83.7	89.9	95.2	1,690
	Moratuwa	172.7	176.2	179.4	183.5	190.4	0.40	0.36	0.23	0.37		73.1	74.6	76.0	77.7	80.6	2,361
	Kolonnawa	51.7	56.0	59.6	60.0	60.1	1.61	1.25	0.07	0.02		105.3	114.1	121.4	122.2	122.4	491
	Kotikavatta-																
	Mulleriyawa P.S.	88.7	92.4	98.5	104.5	110.3	0.82	1.29	0.59	0.54		38.4	40.1	42.7	45.3	47.8	2,307
	Kaduwellu	163.4	206.6	245.5	335.5	425.6	4.80	3.51	3.17	2.41		18.6	23.6	28.0	38.3	48.5	8,770
	Maharagama	120.3	132.3	144.0	153.9	163.3	1.92	1.71	0.67	0.59		55.1	60.6	66.0	70.5	74.8	2,183
	Piliyandara	166.2	191.3	217.9	279.0	340.1	2.85	2.64	2.50	2.00		28.4	32.6	37.2	47.6	58.0	5,860
	Homagama	59.4	65.3	71.1	76.0	80.5	1.90	1.73	0.67	0.58		19.3	21.2	23.1	24.7	26.1	3,083
	Sub Total	1895.6	2040.5	2159.8	2358.7	2551.5	1.48	1.14	0.89	0.79		58.2	62.6	66.3	72.4	78.3	32,584
GAMPAHA DISTRICT																	
	Peliyagoda U.C.	34.4	36.5	36.8	37.0	37.3	1.19	0.16	0.05	0.08		89.8	95.3	96.1	96.6	97.4	383
	Kelaniya P.S.	108.9	120.9	132.3	149.1	153.9	2.11	1.82	1.20	0.32		47.4	52.6	57.5	64.9	66.9	2,299
	Mahara P.S.	103.2	113.9	125.6	148.8	180.1	1.99	1.97	1.71	1.93		22.1	24.4	26.9	31.8	38.5	4,676
	Wattala Mabele U.C.	27.0	27.8	28.9	30.0	31.6	0.59	0.78	0.37	0.52		71.2	73.4	76.3	79.2	83.4	379
	Wattala P.S.	116.1	139.1	159.9	204.4	223.1	3.68	2.83	2.49	0.88		15.1	18.1	20.8	26.6	29.0	7,685
Ja-Ela	Ja-Ela U.C.	33.0	35.9	38.6	46.0	54.6	1.70	1.46	1.77	1.73		36.4	39.6	42.6	50.8	60.3	906
	Ja-Ela P.S.	130.1	156.0	180.7	231.3	300.0	3.70	2.98	2.50	2.63		23.1	27.7	32.1	41.1	53.3	5,624
Biyagama	Biyagama P.S.	120.1	132.1	142.9	165.2	195.4	1.92	1.58	1.46	1.69		20.3	22.4	24.2	28.0	33.1	5,910
Katana	Seeduwa-Katunayake U.C.	42.5	44.0	45.8	50.3	51.2	0.70	0.81	0.94	0.18		41.0	42.5	44.2	48.6	49.4	1,036
	Katana P.S.	47.5	63.1	81.3	112.9	156.2	5.84	5.20	3.34	3.30		16.1	21.4	27.6	38.4	53.1	2,942
	Sub Total	762.8	869.3	972.8	1175.0	1383.4	2.65	2.28	1.91	1.65		24.0	27.3	30.6	36.9	43.4	31,840
KALUTARA DISTRICT																	
Panadura	Panadura U.C.	38.0	38.0	38.6	38.6	39.3	0.00	0.31	0.00	0.18		65.3	65.3	66.3	66.3	67.5	582
	Panadura P.S.																
	(except Wadduwa)	107.3	109.8	112.4	117.6	124.0	0.46	0.47	0.45	0.53		46.0	47.1	48.2	50.4	53.2	2,332
Horana	Horana U.C.	10.8	12.1	13.2	15.4	18.1	2.30	1.76	1.55	1.63		32.0	35.8	39.1	45.6	53.6	338
	Horana P.S.	20.5	27.8	33.9	46.0	56.6	6.28	4.05	3.10	2.10		8.7	11.7	14.3	19.4	23.9	2,368
Bandaragama	Bandaragama P.S.	51.6	62.4	72.4	92.3	112.5	3.87	3.02	2.46	2.00		12.8	15.4	17.9	22.8	27.8	4,041
	Sub Total	228.2	250.1	270.5	309.9	350.5	1.85	1.58	1.37	1.24		23.6	25.9	28.0	32.1	36.3	9,661
	TOTAL	2886.6	3159.9	3403.1	3843.6	4285.4	-	-	-	-		39.0	42.7	45.9	51.9	57.8	74,085

4.3.3 Population Projection in the Project Area

The population projection in the Project area comprising two districts including nine administrative areas is approximately 830,000 in 1990, and approximately 1,180,000 in 2020. The average annual growth rate is 1.4 percent.

The population projection for the study area from 1990 to 2020 is summarized in Table 4.6.

Table 4.6 Proposed Population Projection in the Study Area

Divisional Secretaries Division	Administrative Area	1990		1995		2000		2010		2020
		Pop. (x1000)	Growth Rate (%)	Pop (x1000)	Growth Rate (%)	Pop. (x1000)	Growth Rate (%)	Pop (x1000)	Growth Rate (%)	Pop (x1000)
COLOMBO DISTRICT										
Rastmalana	Mt.Lavinia M.C.	218.6	1.21	232.1	0.87	242.4	0.05	243.6	0.01	243.9
Moratuwa	Moratuwa U.C.	172.7	0.40	176.2	0.36	179.4	0.23	183.5	0.37	190.4
Piliyandala	Kesbewa P.S.	166.2	2.85	191.3	2.64	217.9	2.50	279.0	2.00	340.1
Homagama	Homagama P.S.	59.4	1.90	65.3	1.73	71.1	0.67	76.0	0.59	80.5
	Sub-total	616.9	1.48	664.9	1.14	710.8	0.89	782.1	0.79	854.9
KALUTARA DISTRICT										
Panadura	Panadura U.C.	38.0	0.00	38.0	0.31	38.6	0.00	38.6	0.18	39.3
	Panadura P.S. (except Wadduwa)	107.3	0.46	109.8	0.47	112.4	0.45	117.6	0.53	124.0
Horana	Horana U.C.	10.8	2.30	12.1	1.76	13.2	1.55	15.4	1.63	18.1
	Horana P.S.	20.5	6.28	27.8	4.05	33.9	3.10	46.0	2.10	56.6
Bandaragama	Bandaragama P.S.	51.6	3.87	62.4	3.02	72.4	2.46	92.3	2.00	112.5
	Sub-total	228.2	1.85	250.1	1.58	270.5	1.37	309.9	1.24	350.5
TOTAL		845.1		915.0		981.3		1,092.0		1,205.4

4.4 General Approach

The Master Plan Update established the population and water demand projection for the entire planned service area for the Greater Colombo Water Supply System. For the long term development plan and the feasibility study for the Kalu Ganga Water Supply Project, it is necessary to establish the extent of the water supply expansion for future within the entire planned area. In that way, total water demand will be identified so that the necessary capacity of the Kalu Ganga Project will be examined as augmentation for the existing system.

It is therefore needed to calculate the planned water demand to be supplied not only for the eight divisions related to the Kalu Ganga System but also for the entire service area planned for expansion. Plan for total water transmission and supply will then be prepared in balance with the treatment and transmission capacity and the water demand.

Procedures and flow of works in planning are itemized as follows:

1) Define full development demand

As a basis of the water demand projection, full development demand is firstly defined in accordance with the criteria set in the Master Plan Update and modified as described in the following sub-sections in this report. Full development demand is calculated for each administrative division such as Municipal and Urban Councils, and Pradesiya Sabhas.

2) Allocate the water demand calculated for administrative divisions to sub-division level

Water demand is calculated for the administrative divisions as described in Item 1). In that, Pradesiya Sabha demands are defined for rather large areas than for the Municipal and Urban Councils. Therefore, Pradesiya Sabha demands are broken down and allocated to sub-division level called as Gramasevaka divisions to facilitate the areawise expansion planning. Allocation of water demands to sub-division level is made in proportion to the 1990 population data presented in the data files of the Master Plan Update.

3) Define the extent of area for water supply expansion

Aside from the water demand calculation, it is necessary to define the area for water supply service to be expanded. At present, there is no concrete or officially authorized plan for expansion after the Towns East, South and North projects. However, the development trend and demand for water supply service apparently show that the development will proceed in the areas around and along the major roads which include Galle Road, Airport Road, Kandy Road, etc. Areas along these roads and their surrounding areas are tentatively selected for water supply expansion. These areas are defined as priority area although the further priorities will have to be made among sub-divisions for implementation of each area. In this stage, the extent of area is to be defined to set how far the water supply expansion will cover.

Areas other than the priority areas are defined as non-priority area which will be expanded in later stage after the priority areas.

The extent of expansion is necessary to be defined for having the demand frame of the Kalu Ganga Project although in what order the priority areas should be expanded will be a subject of policy making and funding arrangement. This definition will enable the NWSDB to have rather free options in selecting the area for implementation within priority areas.

4) Set the progress ratio of house connection

After the expansion area and full development demand for each sub-division have been defined, water demand for each sub-division will have to be calculated so that the requirement for water production will be determined. In this process, it should be considered that the number of house connection will increase year by year and will not likely reach the full development level so soon. To reflect this factor in the water demand projection, progress percentage in connection ratio is introduced and multiplied on full development demand of each sub-division.

5) Consider special demand in the service area

In the service area, there will be some special demands which are derived from large scale of industrial estates. Such demand will be added in the water demand projection as special demand in accordance with the implementation program of each development project.

6) Sum up the demands of each sub-division to make a total demand

Water demand in each sub-division having been multiplied by progress percentage will be summed up to make a total water demand.

Details in each step are described in the following sub-sections.

4.5 Development Policy and Extent of Expansion

Prior to the water demand projection, the basic strategy for the areas to be expanded are tentatively defined as described in the sub-section above.

Table 4.7 and Figure 4.3 show the areas to be included in the development.

Table 4.7 Development Strategy for Kalu Ganga Project
(Target Year 2010 for the Kalu Ganga Project)

Service Area	Strategy in Implementation
Existing Service Area	Assure 24 hour supply to the entire existing service area. Extend connection to 100% of the planned full development level.
Towns East Area	Extend service to OECF Phase 1 area. Implement a part of the Phase 2 scope
Towns South Area	Implement the OECF Project in full. Expand the service to the other area along the major roads in Kesbawa and Homagama P.S. Supply adjacent area of Panadura U.C. and along Galle Road.
Towns North Area	Expand supply in Biyagama P.S. as planned. Extend service area to the Ekala IPZ and its surrounding area. Supply towns of Ja Ela, Ragama, Kandana, Mahara, Werisala. Supply the area along the major roads where the transmission pipeline will be laid.

4.6 Water Demand Projection

4.6.1 Level of Water Supply

Water supply level defined in the Master Plan Update means how much of population will be served in what type of supply. Supply levels are defined in percentage of planned population served in each category.

It was confirmed that in the Master Plan Update, a series of workshops and discussions were conducted to define the level of water supply service in various categories. The important concepts established for water supply level are summarized below:

- 1) Water demands are to be projected as "full development demand" which was defined as a maximum demand assuming that the water supply facilities have been fully provided in each planning year. This demand therefore should be interpreted as potential maximum value which can be theoretically reached by the population in the area in each planning year. It should be noted that such concept ignored a time lag necessary for a progress in the house connection work after the commissioning of facilities constructed.

- 2) In the new service area, some alternative water sources will be available to some extent. Therefore, throughout the planning period, there will be unserved population who will fully be dependent on other sources than piped water supply.

In the areas included in the existing service area where the service ratio has not reached to 100 percent, alternative water sources seem not to be sufficient to serve for the urban population. Service ratio will therefore be reaching 100 percent.

It should be noted that population are counted as served whenever any type of piped water supply (direct connection, community tap, or yard tap) are available for their use regardless of whether they still partly use the existing well water for non-drinking purpose etc.

- 3) For the population served, domestic water use consists of three categories as:

Direct connection use Water use at houses provided with plumbing system. This is a major part of domestic water use.

Community tap use Water use at public faucets provided for free water supply to low income public. The NWSDB has an intention to reduce this facility to nil in 2020.

Yard tap use Water use at houses having no in-house plumbing system. Metered connection taps will be provided at the promises of consumers for

point use at the tap. Yard tap connection will increase as community taps will gradually be abandoned and be replaced with metered connection.

Level of water supply defined in the Master Plan Update are summarized in Table 4.8.

Table 4.8 Level of Water Supply

	Planning Year				
	1990	1995	2000	2010	2020
Existing Service Area					
Served Population	Existing Level	Straight interpolation	100 %	100 %	100 %
Service Level in Domestic Water Use (% of served population)					
Direct Connection	Existing Level	Straight interpolation			80 %
Community Tap	Existing Level	Straight interpolation			0 %
Yard Tap	Existing Level	Straight interpolation			20 %
Unserved Population (100% – Served Pop.)	Existing Level	Straight interpolation	0 %	0 %	0 %
New Service Area					
Served Population	75 %	Straight interpolation			85 %
Service Level in Domestic Water Use (% of served population)					
Direct Connection	60 %	60 %	60 %	60 %	60 %
Community Tap	10 %	Straight interpolation			0 %
Yard Tap	30 %	Straight interpolation			40 %
Unserved Population (100% – Connected Pop.)	25 %	Straight interpolation			15 %

Note : "Served population " means "Connected population" as defined in the Master Plan Update.

In this feasibility study, the criteria for service level for the full development demand as defined above will be applied.

In the water demand projection in accordance with the strategy set in the Master Plan Update, water demand is projected as full development demand which means a maximum probable demand including unaccounted-for water in the area.

Progress in the water demand, however, must be related to the progress in the number of house connection which will increase year by year. It will normally take a considerable time to reach the saturation point where alternative water sources such as groundwater will be available. In planning the Kalu Ganga Water Supply Project, it is logical and practical to take into account the progress in service ratio.

Kelaniya service area shows that the service ratio is about 50 percent 10 years after commissioning. In Dehiwala, that is about 70 percent after 20 years. In remote areas which are far from main roads, this progress will likely be much slower than areas around major roads. Such areas may be defined as low development area while the other areas are defined as high development area. In the areas of the towns north of Colombo (Ekala, Ja Ela U.C., Kandana, Ragama, and Welisala) scheduled for the next expansion with high population density in small area and suffering from a serious water shortage, the connection progress is expected higher than the high development area. These limited area is defined as urgent development area.

Considering this factor, it is recommended to apply progress ratio over the full development demand projection as shown in Table 4.9. For the existing service area, progress ratio for high development area will be applied starting from the present service level and as specified in the table for the years in future.

Table 4.9 Progress Ratio of Connection

Years after Commissioning	Progress Ratio (%)		
	Urgent Development Area (Major town sections in Towns North)	High Development Area	Low Development/ High Groundwater Area
1	5	5	5
5	50	30	15
10	70	50	25
15	75	65	33
20	80	70	40
25	85	82	45
30	90	86	47
35	90	88	49
40	90	90	50

4.6.2 Served Population

Planned served population in full development level are projected from the service level as defined above and the projected population. Table 4.10 shows a summary of full development served population by service area consisting of direct connection, community tap and yard tap population.

Table 4.10 Summary of Served Population Projection
(Full Development Level Population)

Service Area	Full Development Population ('000)			
	1995	2000	2010	2020
COLOMBO DISTRICT				
Colombo M.C.	746.8	760.0	770.7	776.4
Dehiwala M.C.	224.4	242.4	243.6	243.9
Kotte U.C.	131.5	141.4	152.0	160.9
Moratuwa U.C.	161.0	191.1	195.5	202.9
Kolonnawa U.C.	55.7	59.6	60.0	60.1
Koti/Mulleriyawa P.S.	61.9	98.5	104.5	110.3
Homagama P.S. (part)	50.0	55.7	62.1	68.4
Kaduwela P.S.	158.4	192.3	274.0	361.8
Kesbewa P.S.	146.7	170.7	227.9	289.1
Maharagama P.S.	101.4	112.8	125.7	138.8
GAMPAHA DISTRICT				
Ja Ela U.C.	27.5	30.2	37.6	46.4
Peliyagoda U.C.	26.2	36.8	37.0	37.3
Seeduwa Katunayake U.C.	33.7	35.9	41.1	43.5
Wattala Mabile U.C.	19.6	28.9	30.0	31.6
Biyagama P.S.	101.3	111.9	134.9	166.1
Ja Ela P.S.	119.6	141.5	188.9	255.0
Katana P.S. (part)	48.4	63.7	92.2	132.8
Kelaniya P.S.	87.7	132.3	149.1	153.9
Mahara P.S. (part)	87.3	98.4	121.5	153.1
Sithawaka P.S. (Padukka)	5.4	7.1	8.2	11.0
Watala P.S.	106.6	125.3	166.9	189.6
KALUTARA DISTRICT				
Horana U.C.	10.0	10.8	13.6	16.3
Panadura U.C.	37.0	38.6	38.6	39.3
Bandaragama P.S. (part)	47.8	56.7	75.4	95.6
Horana P.S. (part)	21.3	26.6	37.6	48.1
Panadura P.S.	84.2	88.0	96.0	105.4
Total	2,701.4	3,059.6	3,486.4	3,939.4

As well as the water demand projection, the progress ratio of house connection on the full development population will be applied to estimate the served population in each year. Served population are calculated as shown in Table 4.11. Details in the served population projection are presented in Supporting Report (Volume (III)).

Table 4.11 Served Population Projection
(Connected Population in each planning year)

Service Area	Served Population ('000)			
	1995	2000	2010	2020
COLOMBO DISTRICT				
Colombo M.C.	746.8	760.0	770.7	776.4
Dehiwala M.C.	224.4	242.4	243.6	243.9
Kotte U.C.	131.5	141.4	152.0	160.9
Moratuwa U.C.	161.0	162.4	176.0	182.6
Kolonnawa U.C.	56.7	59.6	60.0	60.1
Koti/Mulleriyawa P.S.	61.9	76.6	99.3	104.8
Homagama P.S. (part)	0	8.7	24.0	39.9
Kaduwela P.S.	0	30.2	106.7	195.6
Kesbewa P.S.	0	15.2	87.1	169.2
Maharagama P.S.	35.1	57.4	94.4	121.6
GAMPAHA DISTRICT				
Ja Ela U.C.	0	1.5	26.3	37.1
Peliyagoda U.C.	26.2	27.9	31.5	33.6
Seeduwa Katunayake U.C.	0	0	0	0
Wattala Mabile U.C.	19.6	21.6	25.5	28.4
Biyagama P.S.	6.3	26.0	63.8	103.0
Ja Ela P.S.	0	5.1	58.0	99.3
Katana P.S. (part)	0	0	7.7	17.4
Kelaniya P.S.	87.7	100.1	126.7	138.5
Mahara P.S. (part)	0	1.8	23.7	45.9
Sithawaka P.S. (Padukka)	0	0		2.7
Watala P.S.	0	4.2	69.6	99.3
KALUTARA DISTRICT				
Horana U.C.	10.0	10.8	13.6	16.3
Panadura U.C.	37.0	38.6	38.6	39.3
Bandaragama P.S.(part)	0	0	0	9.3
Horana P.S. (part)	0	0	0	0
Panadura P.S.	0	6.8	31.9	57.7
Total	1,603.0	1,798.0	2,346.2	2,808.2

4.6.3 Unit Water Consumption

In the future water demand projection, domestic water use is calculated from the projected served population and unit consumption. Water use other than the domestic use is classified as non-domestic water use into three categories, namely industrial, commercial and institutional use.

Domestic unit consumption is set per capita per day for the population served. The Master Plan Update studied the actual water use records by service area in 1990 and set the direct connection unit consumption with one percent increment per annum. The values for 2020 are 190 L/cap/d for C.M.C., and 200 L/cap/d for the other existing areas, respectively. The value for C.M.C. is lower than the other area in 2020. This seems unrealistic considering that C.M.C. has a higher level of economic and social activities and higher living status. Larger number of floating and temporary population in C.M.C. is also related to the unit water consumption. This factor is however assumed minimum since the unit water consumption data in the past record is considered including the water use by floating and temporary population. Consequently, it is recommended to set the same value (200 L/cap/d in 2020) for C.M.C. and other areas.

For the new service area, unit consumption for 2020 is set as 162 L/cap/d considering the less water use in suburban area. Unit consumption for community tap and yard tap are set as 53 and 75 L/cap/d, respectively, and to be stable throughout years. These values are considered reasonable comparing with the values for other developing countries.

Non-domestic unit consumption is set per area by hectare per day for the classified land use area in each administrative section. The unit consumption values for the existing service area are set from the existing water supply data by area. For the new service area, they are set from the average value of those for the existing service area. These values were set as constant through the years in future.

For the non-domestic unit consumption in C.M.C., however, it is worried, in particular by the Greater Colombo Water Supply Division, that unit consumption per area will likely increase since many of the multistory buildings are being constructed and more of them are projected to come true in near future. This trend is resulted from the present highly saturated land use in the C.M.C. area which make developers unable to find new vacant lots. Such trend will also definitely increase the per area consumption either by domestic or non-domestic use. The water demand in the C.M.C. area will therefore be expected to increase along with such development. Taking into account this factor, it is proposed that the per hectare unit consumption for commercial and institutional use for the C.M.C. area is revised to increase by 1.5 percent per annum which is a little higher than the domestic unit consumption.

Tables 4.12 and 4.13 show these unit consumption set in the Master Plan Update.

Table 4.12 Domestic Unit Water Consumption

Category	Unit Consumption (L/cap/d)			
	1995	2000	2010	2020
Direct Connection (L/cap/d)				
Existing Service Area				
C.M.C. (recommended)	146	165	182	200
C.M.C. (proposed in the Master Plan Update)	(146)	(156)	(172)	(190)
Dehiwala M.C.	145	165	182	200
Kotte U.C.	158	165	182	200
Kolonnawa U.C.	158	165	182	200
Koti/Mulleriyawa U.C.	148	165	182	200
Moratuwa U.C.	153	165	182	200
Kelaniya U.C.	158	165	182	200
Panadura U.C.	139	165	182	200
Horana U.C.	146	165	182	200
New Service Area	126	133	146	162
Community Tap Use	53	53	53	53
Yard Tap Use	75	75	75	75

Table 4.13 Non-Domestic Unit Water Consumption

	Unit Consumption (L/ha/d)		
	Industrial Use	Commercial Use	Institutional Use
Existing Service Area			
Colombo M.C.	16,476	126,625	30,330
Dehiwala M.C.	3,749	137,667	76,612
Kotte U.C.	3,900	75,338	37,090
Kolonnawa U.C.	87	85,680	74,813
Koti/Mulleriyawa U.C.	13,078	686	49,968
Moratuwa U.C.	6,475	15,291	3,648
Kelaniya U.C.	10,419	105,834	50,824
Panadura U.C.	4,200	16,100	7,788
Horana U.C.	9,064	10,350	10,150
New Service Area	9,064	77,951	33,426

Note: These unit consumption considered fixed throughout years.

It should be noted that the non-domestic unit consumption for the new service area are the average of the existing service area and therefore seem to be a little high for applying to some suburban areas such as Horana P.S. and Bandaragama P.S. which includes large agricultural areas and expected not to be developed so quickly. Considering this point of view, it is recommended to use the unit consumption value at Horana U.C. for these two P.S.

4.6.4 Special Demands

Aside from the water demand calculated from the criteria which define for basic water use, some special water demands should be taken into account due to the development scheme of industrial estates. The following projects are considered in the water demand projection as special demand.

Biyagama EPZ

Biyagama Export Processing Zone (EPZ) is an existing industrial estate which is currently being supplied water from Church Hill Reservoir. Present water consumption is about 1.2 mgd (5,500 m³/d) and is projected to increase up to 3 mgd (13,650 m³/d) as ultimate consumption in future.

Katunayake IPZ

Katunayake Industrial Processing Zone (IPZ) consist of three phase; namely Phases 1 to 3. Present water consumption is about 1.3 mgd (5,900 m³/d). Approximately 20 percent of the total consumption is being supplied from deep wells in the promises. Balance of that is supplied from Nogombo water supply scheme which has a maximum supply of 1 mgd (4,550 m³/d) for the Katunayake airport and the industrial estate.

Phase 4 development is scheduled to be implemented provided that the sufficient water is available. Phase 4 is prepared for less water consuming industries and will have a consumption of 2 mgd (9,100 m³/d) as total. In the expansion planning and water demand projection, this additional demand is assumed to be incorporated in 2005.

Other Industrial Estate

Other industrial estates planned at present are described in Section 2.3.5. In that, development projects other than the Biyagama and Katunayake are of rather small scale. Amount of industrial water use for these projects are within the projected industrial water use in each service area. Special demand for these small scale projects are not considered as additional to the projected demand.

Special industrial demands to be added to the projected demands are therefore summarized as shown in Table 4.14 below.

Table 4.14 Special Industrial Demands

	1995	2000	2005	2010	2020
Biyagama EPZ	6000	11,100	13,650	13,650	13,650
Katunayake IPZ (Phase 4)	0	0	9,100	9,100	9,100

unit : m³/day

4.6.5 Unaccounted-for Water and Water Loss

(1) Unaccounted-for Water considered in the Master Plan Update

Out of the water produced and distributed in the Greater Colombo Water Supply System, about 40 percent is billed while about 20 percent is standpost use and remaining 40 percent is not accounted for. Such amount which is unaccounted for is called as "Unaccounted-for water (UFW)". UFW normally is derived from several factors such as:

- o illegal connections
- o meter under-reading
- o consumption unmetered and unbilled
- o public water use for firefighting, flushing hydrants, cleaning water or sewer pipes, street washing etc.
- o water loss due to leakage in pipelines

At the time of the Master Plan Update, an evaluation on UFW ratio by use of bulk meter reading was conducted in each service area to estimate the amount of unaccounted for water. Table 4.15 shows the result of the estimates in the Master Plan Update.

Table 4.15 Estimated Unaccounted-for Water Ratio

Service Area	Unaccounted-for Water Ratio (% of Total Supply)
Colombo M.C.	46 %
Dehiwala M.C.	21 %
Kotte U.C.	21 %
Kolonnawa U.C.	21 %
Moratuwa U.C.	46 %
Kotikawatte/ Mulleriyawa U.C.	35 %
Kelaniya U.C. ³⁾	35 %
Panadura U.C.	19 %
Horana U.C.	35 %

In the discussion with the NWSDB officials concerned with the rehabilitation program and the Greater Colombo Water Supply Division, it was pointed out that the UFW ratios in the existing service area are not less than 30 percent as shown in the table above. Water consumption data presented in Chapter 3 also infers that the average UFW ratio in the existing water supply is about 45 percent in which the C.M.C. area is considered higher than the other areas. UFW by service area is then estimated at 50 and 40 percent for the C.M.C. area and the other areas, respectively.

In the future water demand projection developed in the Master Plan Update, UFW ratios in all existing service areas are assumed to decrease to 20 percent in 2020 from the existing level. However, it may not be so easy to reduce UFW ratio to 20 percent without a huge investment for leak detection, replacement of water meters, pipes and valves, and rehabilitation work of the existing facilities. Actually a comprehensive rehabilitation program under the assistance of the ADB has just commenced in January 1994 and scheduled to be implemented in 5 years. Even considering an effect by these works, it is more realistic to consider that the target UFW ratio be at a level higher than 20 percent. Further, looking at the ages of distribution facilities, the C.M.C. area will be a little difficult to achieve higher UFW reduction compared to the other area.

For the new service area, the Master Plan Update assumed that "UFW" ratio will decrease from 25 percent in 1995 to 20 percent in 2020. This assumption may not be logical for newly constructed system since water loss will normally be minimum at the time of completion of the facility and will likely increase by years as the number of house connection increases.

For the future projection, introduction of water loss is recommended instead of UFW as described in the following sub-section.

(2) Water Loss

For the purpose of water demand projection, terminology of "Unaccounted-for Water" may not be clear to clarify the difference between the projected consumption and the amount of water lost in the system since UFW includes the consumption unmetered and unbilled, an error derived from meter under-reading, and water use by illegal connections. In the future demand projection, these amounts are included in the consumption as an amount to be consumed.

To clearly define the concept of consumption and other loss, use of the terminology of "Water Loss" is recommended instead of "UFW". In the future water demand projection, all the components of consumption are included in the estimates so that the water consumption, as defined as domestic, commercial, industrial, and institutional use, is estimated as a total amount of water possibly to be used

regardless of whether the consumption is metered or not (including free water and illegal connection). "Water Loss" will therefore consist of the parts which will not be included in the consumption.

Definition of UFW and water loss is summarized in Table 4.16.

Table 4.16 Definition of Unaccounted-for Water

Definition in Present Water Use Record	Item	Definition in Water Demand Projection
Water accounted for	Consumption metered and billed	Amount projected as Consumption
	Consumption unmetered including standpost use (billed on estimated amount)	
Unaccounted-for Water	Consumption unmetered (not billed)	
	Meter under-reading	Water Loss
	Illegal connection use	
	Public use not to be billed (firefighting, water/sewer pipe flushing etc.)	
	Leakage in transmission and distribution system	

(3) Projection of Water Loss

The following consideration is given to assume the water loss ratio.

- 1) There are about 3 percent of unmetered connection in number. Consumption at these connections is however considered a little small compared to normal metered user. Unmetered and unbilled consumption may be assumed at about 2 to 3 percent.
- 2) For meter under-reading, the 1984 Leak Detection study for Colombo Water Supply System estimated under-reading errors to be about 5 percent of consumption. A range of 3 to 5 percent is assumed.
- 3) It is rather difficult to estimate the number of illegal connection and water use thereby. In some countries, illegal connections forms a major part of UFW.
- 4) Public water use may be estimated at 2 percent of supply.

Assuming the illegal connection at 5 to 10 percent, water loss in the existing service area defined as above is estimated as follows:

		<u>C.M.C.</u>	<u>Other Area</u>
Present UFW Ratio	=	50 %	40 %
- unmetered/unbilled consumption	=	2 - 3 %	2 - 3 %
- meter under-reading	=	3 - 5 %	3 - 5 %
- illegal connection	=	5 - 10 %	5 - 10 %
Water Loss	=	40 - 32 %	30 - 22 %

In the ongoing UFW improvement program, provision of water meters to the unmetered connections, and calibration of water meters and adjustment in billing will be conducted as the effective measures to reduce UFW. As detection of the illegal connections is considered to be easier than the detection of leakage, removal of the illegal connections is expected to be implemented with high priority and will much contribute to the reduction of UFW if the number of illegal connections is large.

From the view point of water loss reduction, leak detection and repair of the leakage is expected to be implemented but may not largely effected unless a large amount of investment is made. As the leakage is reduced, however, the water loss ratio will decrease from the figures calculated above.

Although there are unknown factors to estimate the water loss in future, the water loss ratio is set, taking into account the improvement of leakage, at 35 percent for C.M.C. and 25 percent for the other area, respectively.

These figures are assumed to be achieved in 2000 when the rehabilitation program is completed. It is also assumed that it will be maintained at the same level up to 2010 and will be then reduced by another 5 percent by 2020 by implementing further rehabilitation works.

For the new service area to be expanded, it is recommended to apply 20 percent as a value in 2020. Initial water loss ratio is set as 10 percent.

Table 4.17 shows a summary of water loss ratio projection.

Table 4.17 Projected Water Loss Ratio

Service Area	1995	2000	2005	2010	2020
Existing Service Area					
Colombo M.C.	40 % ¹⁾	35 %	35 %	35 %	30 %
Other Areas	30 % ¹⁾	25 %	25 %	25 %	20 %
New Service Area	As initial ratio = 10 % increase in straight interpolation				20 %

1) Estimated higher side water loss at present level.