2) After High Level Reservoir

All routes will be one line and will be of ductile iron. Other details are summarized in Table 9.3 below:

Table 9.3 Summary of Proposed Transmission Pipeline Details (after High Level Reservoir)

Route	Dia. (mm)	Length (m)	Flow	Max. Velocity (m/sec)
H.L.R. to Pokunuwita Junc.	1200	6,680	Gravity	1.84
Pokunuwita Junc. to Piliyandala	1200	17,000	Gravity	1.74
Piliyandala to Dehiwala	1000	9,580	Gravity	1.66
Piliyandala to Moratuwa	800	4,800	Gravity	1.44
Pokunuwita Junc. to Panadura	500	15,250	Gravity	1.15
Branch Connection to Moratuwa New Tower from 800 mm main	500	50	Gravity	1.55
Branch Connection to Piliyandala New Tower from 1200 mm main	400	800	Gravity	1.68
Branch Connection to Homagama New G.R. from Kalatuwawa main	400	200	Gravity	0.87
Moratuwa Res. to Keselwatte Tower	350	3,500	Pumping	1.26
Branch Connection to Kesbewa Sub Area G.R. from Kalatuwawa main	300	1,000	Gravity	1.34
Branch Connection to Bandaragama Tower from 500 mm main	200	180	Gravity	1.25
Branch Connection to Horana G.R. from 1200 mm main	200	2,200	Gravity	1.11

9.5 Storage Facilities

Storage capacity is normally set at 8 to 24 hour retention time. It is desirable that storage facilities have as large capacity as possible for ensuring the safety of water supply in case of stoppage of supply at source. Actual facility planning will however be limited from the site condition or structural aspects. Storage facilities in the Kalu Ganga Water Supply Project are planned to firstly have sufficient capacity to absorb fluctuation in the consumption and to have a larger capacity where the site condition allows.

The High Level Reservoir to be constructed on the top of the hill at Horana will have a storage capacity of 30,000 m^3 which is equivalent to 4-hour retention to 2010 demand. Effective depth of the reservoir is 5.0 m. This may be the maximum size which can be obtained from the limitation of area at site. An additional unit of 30,000 m^3 is planned to be constructed in the same site for 2020 demand.

The existing storage facilities in the project area will be used for the proposed Kalu Ganga Water Supply System in future. The storage capacity of each facility was checked for the projected 2010 and 2020 water demand. For the 2010 demand, all the existing reservoirs and towers may be sufficient to manage absorbing the hourly fluctuation of consumption. For 2020 demand, Dehiwala reservoir will need an additional storage (minimum 10,000 m^3).

For Moratuwa Low Zone which is proposed for modification of the existing distribution system in Moratuwa, a new water tower having 2,000 m^3 storage capacity is proposed.

For the newly developed service areas, ground reservoirs and water towers will be required.

Design concept for the storage facilities are summarized as follows:

- Minimum capacity of ground reservoir is 1,000 m^3. Reduction of construction cost by reducing the capacity will not be so large.
- Maximum capacity of water tower is 2,000 m^3.
- Retention time of 8 hours is recommended as minimum. In case that retention time is smaller than 8 hours, variation of the storage volume for assumed hourly demand fluctuation should be checked (see Section 7.5.4).

Table 9.4 shows a summary of storage facility proposed for the project.

Table 9.4 Summary of Proposed Storage Facility

Area	Facility	Capacity	Water Level T.W.L. B.W.L.	Retention Time for 2010 demand for 2020 demand
High Level Reservoir	Ground Reservoir	30,000 m^3	+107.0 m +102.0 m	4.0 hours 4.0 hours
Dehiwala	-	-		
Moratuwa Low Zone	Tower	2,000 m^3	+35.0 m +30.0 m	2.0 hours**) 1.8 hours**)
High Zone	-	-		
Panadura	-	-		
Kesbewa Main Area	Tower	2,000 m^3	+45.0 m +40.0 m	6.6 hours**) 2.6 hours**)
Sub Area	Ground Reservoir	2,000 m^3	+20.0 m +15.0 m	13.3 hours 6.8 hours
	Pumping Station	40 l/sec h = 30 m n = 3 units		
	Tower	1,000 m^3	+43.0 m +38.0 m	26.6 hours 13.6 hours

Table 9.4 Summary of Proposed Storage Facility (cont'd)

Area	Facility	Capacity	Water Level T.W.L. B.W.L.	Retention Time for 2010 demand for 2020 demand
Homagama	Ground Reservoir	1,500 m^3	+30.0 m +25.0 m	9.0 hours 4.4 hours
	Pumping Station	30 l/sec h = 25 m n = 3 units		
	High Level Reservoir	1,500 m^3	+47.0 m +42.0 m	9.0 hours 4.4 hours
Keselwatte	Tower	2,000 m^3	+38.0 m +33.0 m	7.7 hours**) 4.6 hours**)

Note: Effective retention time marked **) should be added 4.0 hours for the retention in the High Level Reservoir at Horana.
Facilities for Kesbewa, Homagama and Keselwatte will be constructed under the Towns South Project.

9.6 Distribution Facilities

Distribution facilities required for development along with the Kalu Ganga Water Supply Project is summarized as shown in Table 9.5.

Table 9.5 Summary of Distribution Pipeline

Service Area	dia. (mm)	material	length (m)
Dehiwala M.C.			
High Zone	300	DI	610
	250	DI	140
	200	PVC	1,550
	150	PVC	960
	110	PVC	170
	90*)	PVC	22,500
Low Zone	700	DI	910
	600	DI	2,280
	500	DI	510
	450	DI	1,310
	350	DI	1,530
	250	DI	2,130
	200	PVC	2,740
	150	PVC	890
	110	PVC	390
	90*)	PVC	33,500
North Zone	250	DI	360
	200	PVC	1,290
	150	PVC	2,920
	90*)	PVC	20,000

Table 9.5 Summary of Distribution Pipeline (cont'd)

Service Area	dia. (mm)	material	length (m)
Moratuwa U.C.			
High Zone	250	DI	650
	200	PVC	3,110
	150	PVC	2,450
	110	PVC	1,780
	90*)	PVC	71,000
Low Zone	600	DI	80
	500	DI	630
	400	DI	1,330
	300	DI	3,940
	250	DI	860
	200	PVC	4,730
	150	PVC	3,820
	90*)	PVC	85,000
Panadura U.C.			
High Zone	200	PVC	970
	150	PVC	710
	110	PVC	910
	90*)	PVC	22,000
Low Zone	400	DI	500
	250	DI	440
	200	PVC	2,460
	110	PVC	580
	90*)	PVC	43,000
Kesbewa			
Main Area	600	DI	100
	500	DI	580
	400	DI	760
	350	DI	350
	300	DI	790
	250	DI	1,620
	200	PVC	9,250
	150	PVC	6,230
	110	PVC	3,970
	90*)	PVC	
Sub Area	300	DI	50
	250	DI	2,800
	200	PVC	2,250
	150	PVC	6,770
	110	PVC	320
	90*)	PVC	

Table 9.5 Summary of Distribution Pipeline (cont'd)

Service Area	dia. (mm)	material	length (m)
Keselwatte	600	DI	2,200
	500	DI	500
	400	DI	1,550
	300	DI	650
	250	DI	650
	200	PVC	9,550
	90*)	PVC	
Homagama	450	DI	560
	400	DI	50
	350	DI	300
	300	DI	1,000
	200	PVC	9,610
	150	PVC	1,950
	110	PVC	9,050
	90*)	PVC	93,000
Bandaragama	110	PVC	1,340
	90*)	PVC	12,250
	63**)	PVC	3,340
Horana	150	PVC	1,010
	110	PVC	2,530
	90*)	PVC	5,000

*) PVC pipe dia. 90 mm is provided for branch pipe (provisional quantity)

**) PVC pipe dia. 63 mm for Bandaragama is taken from the design by NWSDB.

CHAPTER 10

OPERATION AND MAINTENANCE PROGRAM

10. OPERATION AND MAINTENANCE PROGRAM

10.1 Operation and Maintenance of Facilities

The water supply facilities should be kept such conditions through proper operation and maintenance as to show the given function at any time, namely as to supply enough good water for water demand with pressures required.

Any omission or negligence of such proper operation and maintenance may lead to the unexpected damage to not only the users but also the water supply facilities and may take much time and money for their restoration.

The facility maintenance to keep the function of each facility and equipment is mainly composed of patrol/inspection and maintenance. Patrol/inspection is done to check the normality of the function, working condition, etc. of each facility and equipment, while maintenance is conducted to keep the normal function of each facility and equipment through cleaning, overhaul and preventive measures.

Tables 10.1 and 10.2 indicates the operation and maintenance program of facilities and equipment involved in the Kalu Ganga Water Supply System.

10.2 Operation and Maintenance in an Emergency

10.2.1 Against Flood

As the intake station and water treatment plant are located in the flood area, the proposed designs take account of the 100 year maximum flood level for preventing the important facilities from inundation by raising the elevation of structural walls and floor level of the buildings for the intake station and filling the ground for the water treatment plant.

10.2.2 Against Salinity Intrusion

The preliminary salinity intrusion analysis shows that the upper level of the salinity wedge is -1.06 m MSL under the conditions of an annual minimum river flow of 14.4 m^3/s for a return period of ten years and an annual mean high tide of +0.32 m MSL. At this time the fresh water depth is approximately 1.4 m as described in Subsection 6.5.8. The key location to identify the salinity wedge is a wide area of shallow bed immediately downstream of the Narthupana Bridge as shown in Figure 6.10. This area is expected to act as a natural barrier against the salinity intrusion.

When the water level of the Kalu Ganga near the intake point drops below +1.0 m MSL during the drought and the salinity wedge goes upstream over this point, there may be a possibility that saline water wedge will reach the intake point. It is recommended that the river water should be sampled

frequently at the several depths near the Narthupana Bridge and at the intake mouth to check the movement of the salinity wedge. Although the level of the intake mouth is planned to prevent the salt water intrusion, if the level of the saline wedge is observed higher than expected, the stop logs may be used to raise the bottom elevation of the intake mouth. Such a preventive system should be kept until the water depth near the intake point will rise above +1 m MSL.

10.3 Water Quality Control

The objective of water quality control in water supply is to keep the water to be supplied in a clean and safe condition. The water quality of the effluent of each facility is a good indicator to know whether the particular facility is properly operated and maintained. Table 10.3 shows the water quality surveillance program for reference.

10.4 Staff Requirement

The proposed Kalu Ganga Water Supply System is composed of the following facilities:

1) Intake station (new)
2) Raw water transmission main (new)
3) Water treatment plant (new)
4) Clear water transmission main 1 (new)
5) High level reservoir (new)
6) Clear water transmission main 2 (existing and new)
7) Distribution reservoir (new)
8) Distribution pipes (existing and new)

The construction of the Kalu Ganga Water Supply System will take long years from the commencement to the completion and the staff requirement for the project implementation varies depending on its phase such as before, during and after the construction. Staff to be newly recruited is considered to be mainly those who will be engaged in the operation and maintenance of the system.

The staff requirement is determined based on the comprehensive consideration for the structure of the overall system, layout of facilities, scale of the plant, composition of treatment processes, management system, working custom and so on. The facilities which require the stationed engineers/ operators/workers are the intake station, water treatment plant, high level reservoir and distribution reservoirs. As for the transmission and distribution pipelines, the existing organization concerned of the NWSDB is considered to cope with them.

The proposed organization for the Kalu Ganga Water Supply System under the Regional Support Center (Greater Colombo) is shown in Figure 10.1.

Table 10.1 Operation and Maintenance Program (Intake Station & High Level Reservoir)

Facility	Daily Patrol		Regular Inspection		Maintenance Works	
	Frequency	Contents to be Checked	Frequency	Contents to be Checked	Frequency	Contents to be Checked
Intake Mouth	once/d	1 condition of intake mouth	1 yr	1 moving condition of gates	1 yr	1 cleaning of intake mouth
	ditto	2 quality of raw water	ditto	2 concrete crack and aging	everyday	2 removal of screenings
	ditto	3 head loss at screens and removal of screenings	ditto	3 leakage	2-3 yrs	3 painting of screens
	ditto	4 piling condition of sand and silt at grit chambers			1 mo	4 cleaning of grit chambers
Intake Pump Room	3 times/d	1 current, pressure and flow of pumps	1 yr	1 condition of gland packing	1 yr	1 adjustment/replacement of gland packing
	ditto	2 abnormal noise, vivration and oil leakage	ditto	2 condition of lubrication	1-5 yrs	2 overhaul of bearing
	ditto	3 temperature of bearing	ditto	3 condition of pressure gage	ditto	3 overhaul of coupling
	ditto	4 leakage from gland packings			5-10 yrs	4 overhaul of pumps
Chlorination Room	3 times/d	1 lekage of chlorine gas	6 mos	1 air test of piping/container	1 yr	1 replacement of filtration of chlorination
	ditto	2 temperature and humidity of the room	1 yr	2 errosion detection of equipment	3 yra	overhaul of pump
	ditto	3 chlorine gas pressure of container and chlorinator	ditto	3 working condition of hoist	ditto	painting of mechanical equipment
	ditto	4 water pressure of ejector				
	ditto	5 fixatio of container				
	once/d	6 storage amount				
	3 times/d	7 dosing rate				
High Level Reservoir	as required	1 water level	as required	1 testing of head loss meter and flow meter	6 mos	1 cleaning and oiling of floorstands and equipment
	1 day	2 quality of clear water (turbidity, pH, alkalinity, residual chlorine, etc.)	1 mo	2 erosion condition of chlorine dosing equipment	3-5 yrs	2 painting of steel parts
			1 yr	3 concrete crack and aging, and leakage	2-5 yrs	3 cleaning of clwar water reservoirs
	ditto	3 pollution protection from outside (ventilation, manhole, supervisory gallery and room, and sampling hole)	ditto	4 working condition of valves		
			ditto	5 painting condition of steel parts		
	as required	4 water supply volume				

Table 10.2 Operation and Maintenance Program (Water Treatment Plant)

Facility	Daily Patrol		Regular Inspection		Maintenance Works	
	Frequency	Contents to be Checked	Frequency	Contents to be Checked	Frequency	Contents to be Checked
Receiving Well	as required	1 flow of raw water	1 yr	1 working condition of valves	5 yrs	1 cleaning of receiving wells
	ditto	2 water level	ditto	2 concrete crack and aging	3-5 yrs	2 painting of steel parts
	ditto	3 quality of raw water (turbidity, pH, alkalinity, etc.)	ditto	3 leakage		
			ditto	4 painting condition of steel parts		
Mixing Chamber	as required	1 flow of raw water	1 yr	1 concrete crack and aging, and leakage	2-3 yrs	1 cleaning of mixing chambers
	ditto	2 quality of raw water (turbidity, pH, alkalinity, etc.)	ditto	2 working condition of valves		
	ditto	3 chemical dosage (jar test)				
	3 times/d	4 mixing condition of chemicals				
Flocculation Basin	as required	1 growth condition of floc	1 yr	1 working condition of valves	1 yr	1 cleaning of flocculation basins
	ditto	2 quality of effluent (turbidity, pH, alkalinity etc.)	ditto	2 concrete crack and aging, and leakage		
	3 times/d	3 flowing condition				
Sedimentation Basin	as required	1 detention time	1-3 mos	1 piling condition of sludge	3-12 mos	1 cleaning of sedimentation basins
	ditto	2 wate level	1 yr	2 adhesives (algae, acum, etc.) on walls and troughs	3-5 yrs	2 painting of equipment
	ditto	3 flowing condition and state of floc settling	ditto	3 concrete crack and aging, and leakage		
	ditto	4 quality of effluent (turbidity, pH, alkalinity etc.)				
	ditto	5 removal of algae, scum, floating materials, etc.				
	3 times/d	6 travelling speed of sludge colectors, and current, abnormal noise, vibration and oil leakage of motors				
	ditto	7 winding condition of electric cables for sludge collectors, contact condition of trolley cable, and working condition of limit switches, strikers, etc.				
	*	8 current, abnormal noise and smell, and vibration of motors for valves				
	1 day	9 leakage from motor-driven valve packing glands				
	ditto	10 sludge volume				
Rapid Sand Filter	as required	1 water level	2-6 mos	1 state of adhesives (algae, scum, etc.) on walls, troughs and wash-water troughs	2-6 mos	1 cleaning of rapid sand filters
	ditto	2 filtration volume, filtration velocity, filtration head loss and filtration duration time	1 yr	2 concrete crack and aging, and leakage	**	2 replenishment of filter media
	ditto	3 qulity of filtrate (turbidity, pH, alkalinity, residual chlorine, etc.)	ditto	3 filtration layer (pollution of filter media, occurence of mud ball, effective particle size, filter media thickness, etc.)	10-20 yrs	3 replacement of filter media
	ditto	4 wash water volume and washing time	ditto	4 movement of gravel layer	1 yr	4 repair of control equipment and pipe insulation
	ditto	5 washing condition (expansion rate, carry-over of filter media, air trouble, trouble of washing appratus, surface of filter media after washing)	ditto	5 working condition of filtration head loss manometer	3-5 yrs	5 painting of surface wash appratus
	ditto	6 turbidity of wash drain	10 yrs	6 condition of underdrain system	5-8 yrs	6 external painting of mechanical equipment
	*	7 current, oil volume, vibration, leakage and oil leakage of motor-driven valves	2-6 mos	7 damage of surface wash appratus		
			2-3 yrs	8 painting condition of mechanical equipment		
Clear Water Reservoir	as required	1 water level	as required	1 testing of head loss meter and flow meter	6 mos	1 cleaning and oiling of floorstands and equipment
	1 day	2 quality of clear water (turbidity, pH, alkalinity, residual chlorine, etc.)	1 mo	2 erosion condition of chlorine dosing equipment	3-5 yrs	2 painting of steel parts
	ditto	3 pollution protection from outside (ventilation, manhole, supervisory gallery and room, and sampling hole)	1 yr	3 concrete crack and aging, and leakage	2-5 yrs	3 cleaning of clwar water reservoirs
			ditto	4 working condition of valves		
			ditto	5 painting condition of steel parts		
	as required	4 water supply volume				
Wash-water lagoon	3 times/d	1 delivery pressure, current and abnormal noise of pumps, leakage from packing gland and bearing temperature	1 yr	1 piling condition of sand and sludge	1-2 yrs	1 cleaning of wash-water lagoon
			1-2 wks	2 cleaning of bar screens	3-6 mos	2 removal of sediments around pump suctions
	ditto	2 screening condition			1-2 wks	3 cleaning and disposal of screenings
					3-5 yrs	4 painting of steel parts of screens and pumps
Sludge Lagoon	3 times/d	1 delivery pressure, current and abnormal noise of pumps, leakage from packing gland and bearing temperature	3-6 mos	1 piling condition of sludge	1 yr	1 cleaning of sludge lagoon
					3-6 mos	2 removal of sediments around pump suctions
	ditto	2 screening condition			1-2 wks	3 cleaning and disposal of screenings
					3-5 yrs	4 painting of steel parts of screens and pumps
Sludge Drying Bed	2 times/d	1 inflow condition of sludge	3 mos	1 condition of walls	3 mos	1 cleaning of drains
	ditto	2 outflow condition of supernatent and filtrate	ditto	2 working condition of valves	ditto	2 cleaning of pipes
	1 wk	3 drying condition	ditto	3 clogging of pipes	***	3 repair of bottom, walls and stop log
	ditto	4 leakage				
	as required	5 condition of stop log				
Chemical Building	once/d	1 storage amount of chemicals	as required	1 quality of chemicals	3 yrs	1 overhaul of pump
	3 times/d	2 leakage	1 yr	2 condition of solution tank	ditto	2 painting of mechanical equipment
	ditto	3 opening of valves	ditto	3 working condition of control valve	1-3 yrs	3 replacement of pipe coupling
	ditto	4 storage of solution	ditto	4 leakage of underground piping		
	ditto	5 current, pressure and flow of pump				
	ditto	6 abnormal noise, vibration and oil leakage				
	ditto	7 dosing rate				
Transmission Pump Room	3 times/d	1 current, pressure and flow of pumps	1 yr	1 condition of gland packing	1 yr	1 adjustment/replacement of gland packing
	ditto	2 abnormal noise, vivration and oil leakage	ditto	2 condition of lubrication	1-5 yrs	2 overhaul of bearing
	ditto	3 temperature of bearing	ditto	3 condition of pressure gage	ditto	3 overhaul of coupling
	ditto	4 leakage from gland packings			5-10 yrs	4 overhaul of pumps

* during operation
** at the time when the thickness of media layer is reduced by 10%
*** at the time when sludge is carried out

Table 10.3 Water Quality Surveillance Program

Item	Parameter	Receiving Well	Sedimentation Basin	Filter	Clear Water Reservoir
Water Level		as required	*	*	*
Flow	Raw water	*			
	Filtrate			*	
	Transmission				*
Head loss				once a day	
Flocculation			as required		
Water quality	Water Temp.	*	4 times/d	once a month	once a month
	Turbidity	*	*	once a month	once a day
	Color	once a month	once a month	once a month	once a month
	pH Value	*	*	once a month	once a month
	Odor	once a month	once a month	once a month	once a month
	Taste				once a month
	Ammonia	once a month	once a month	once a month	once a month
	Nitrite	once a month	once a month	once a month	once a month
	Nitrate	once a month	once a month	once a month	once a month
	$KMnO_4$	once a month	once a month	once a month	once a month
	Chloride	once a month	once a month	once a month	once a month
	T-Alkalinity	*			
	T-Hardness	once a month	once a month	once a month	once a month
	Total solids	twice a year	twice a year	twice a year	twice a year
	E.C.	once a month	once a month	once a month	once a month
	Sulphate				once a year
	T-Iron	once a month	once a month	once a month	once a month
	T-Manganese	once a month	once a month	once a month	once a month
	Zinc	once a month	once a month	once a month	once a month
	Copper	once a month	once a month	once a month	once a month
	Lead	once a month	once a month	once a month	once a month
	H-Chromium	twice a year	twice a year	twice a year	twice a year
	Cadmium	twice a year	twice a year	twice a year	twice a year
	T-Mercury	twice a year	twice a year	twice a year	twice a year
	Arsenic	twice a year	twice a year	twice a year	twice a year
	Fluoride	twice a year	twice a year	twice a year	twice a year
	Selen	twice a year	twice a year	twice a year	twice a year
	A-Surfactant	once a month	once a month	once a month	once a month
	Cyanide	twice a year	twice a year	twice a year	twice a year
	Organic-Phosphate	twice a year	twice a year	twice a year	twice a year
	Fenol	twice a year	twice a year	twice a year	twice a year
	Bacteria	once a month	once a month	once a month	once a month
	E. Coli.	once a month	once a month	once a month	once a month
	Res. Chlorine				*
	Tri-methanes				twice a year

T : total D : dissolved Org : organic H : hexa Res. : residual Tri : trihalo

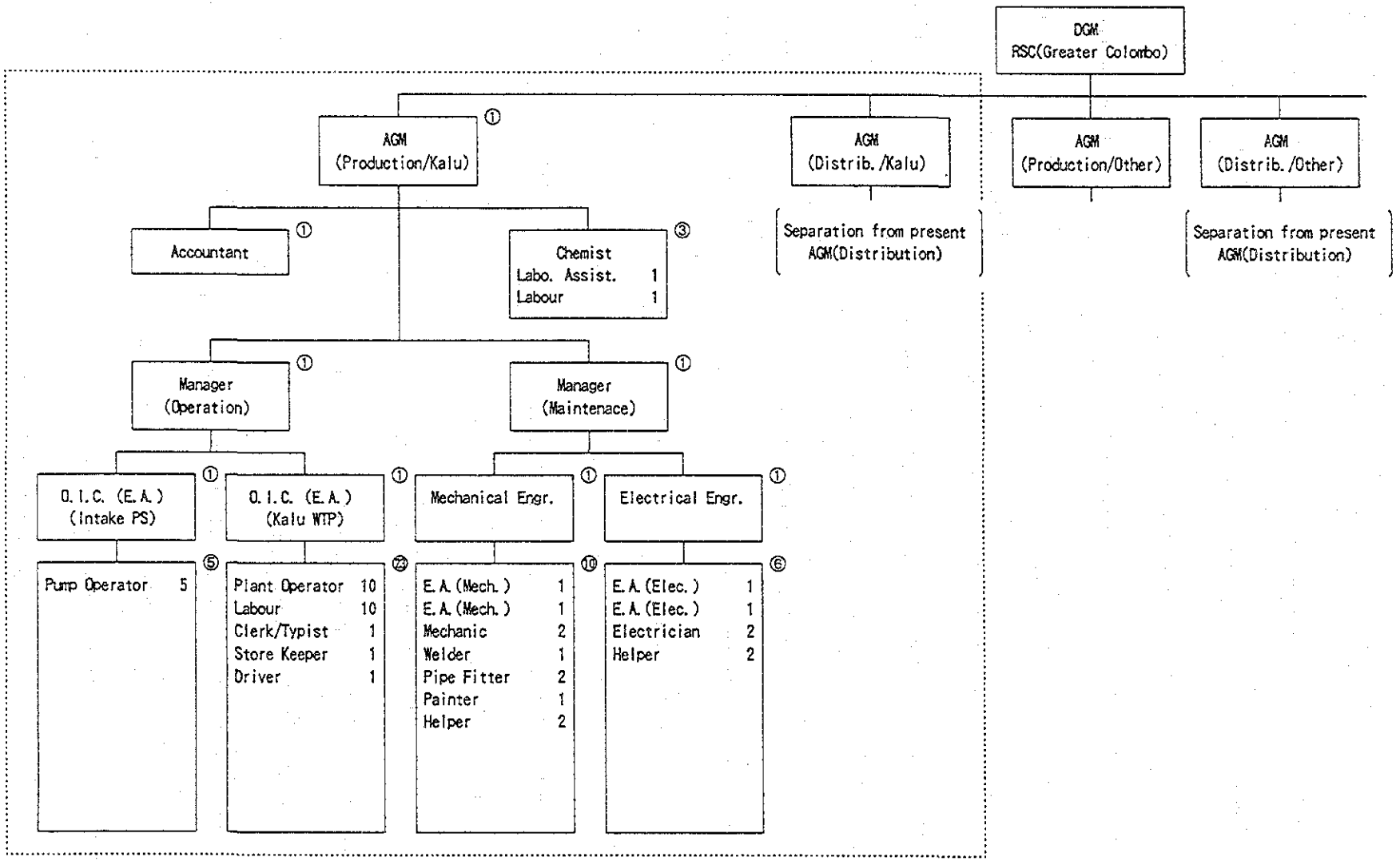


Figure 10.1 Proposed Organization for Kalu Ganga Water Supply System

CHAPTER 11

IMPLEMENTATION PLAN

11 IMPLEMENTATION PLAN

11.1 General

This supporting report deals with a implementation plan and financial cost estimates on the project following to the feasibility design for the target year of 2010. The project financial cost, presented in Chapter 12, has been estimated on the basis of the proposed implementation plan and schedule, presented in this chapter, site investigation, collected data with information at Sri Lanka and Japan, and discussions with the NWSDB's officials concerned throughout the study period.

11.2 Implementation Plan

11.2.1 Implementation Plan

The project is planned to be implemented divided into two phases based on the design target years of 2010 as for the feasibility study and 2020 as for the long term development plan with the following size of requirement.

Table 11.1 Phasing the Project

Basic Parameter	Phase 1	Phase 2
Target year	2010	2020
Treatment capacity	182,000 m^3/day	364,000 m^3/day
	(40.0 mgd)	(80.0 mgd)
Raw water intake	2.1 m^3/s	4.2 m^3/s

Further, it is planned to construct all facilities by four stages by dividing each phase into two stages taking into consideration the magnitude of the initial investment which will adversely affect the financial burden over the NWSDB, implementation periods of one stage which assumes at six years including the periods for design and tender, and required commissioning time. Table 11.2 indicates the proposed staging plan that the figures show the number of units of facilities to be constructed to that of facilities in full capacity (2020) in the particular period. Figure 11.1 shows the staging plan for transmission mains.

Table 11.2 Staging Plan

Facilities	Phase 1 (2010)	
	Stage 1	Stage 2
Intake facilities		
* intake mouth	4/4	-
* grit chamber	2/4	-
* intake pump	4/16	4/16
* pump station	1/2	-
Raw water transmission	1 line	-
Treatment facilities		
* receiving well	1/2	-
* sedimentation basin	4/16	4/16
* filter	10/40	10/40
* clear water reservoir	1/2	-
* high lift pump	4/16	4/16
* sludge drying bed	4/16	4/16
* chemical building	1/2	-
* administrative building	1/1	-
* storehouse/workshop	1/1	-
* staff housing	28/56	28/56
* power receiving system	1/1	-
Clear water transmission	to Panadura	to Dehiwlaa
Distribution facilities	Moratuwa	Other areas

11.2.2 Implementation Schedule

The following factors are taken into consideration to create the implementation schedule for the respective stage and phase of the project.

- Required Kalu Ganga Project size

  year 2005 : 67,000 m^3/d (14.7 mgd)
  year 2010 : 182,000 m^3/d (40.0 mgd)
  year 2020 : 364,000 m^3/d (80.0 mgd)

- Commissioning time of other water supply projects

  Towns South : June 1998, OECF
  Towns East : 1996, OECF
  Ambatale rehabilitation : March 1996, JICA
  Ambatale - Jubilee and Maharagama : June 1994, IDA

- Construction period of each stage
- Investment cost of each stage
- Loan repayment projection of the NWSDB

It is justified and proposed that the Kalu Ganga water supply project will be implemented as presented below having basic consideration of 1) to commence timely and stable water supply, 2) to lighten the

debt burden of the NWSDB, and 3) to invest the initial cost with appropriate scale, and taking into account the factors stipulated above.

The proposed implementation schedule for Stage 1 and Stage 2 schemes of Phase 1 is shown in Figure 11.2.

11.2.3 Mode of Implementation

The fund required for the project implementation will be provided by the government national budget of Sri Lanka and supporting loan from donor country/ies and or agency/ies on the following project's cost items.

- construction cost of facilities
- land acquisition and compensation costs
- administration expenses for the Sri Lanka Government
- engineering services expenses for design and construction supervision
- price and physical contingencies

The construction works for the stage 1 of phase 1 scheme will be carried out by selected contractor/s upon international competitive bidding (ICB) on the following tender packages which has been decided taking into account the advantages in technical and economical aspects. The major consideration in packaging was put on the nature of works, the size of contract and to avoid less attractive to the international construction companies.

Package A :	Intake facilities, raw water transmission and clear water transmission to high level water reservoir.
Package B :	Water treatment plant with appurtenance and high level water reservoir.
Package C :	Clear water transmission from high level reservoir to Panadura reservoir and distribution facilities.

The pre-qualification of tenderers will be carried out for all the packages to select the qualified construction firms with sufficient capability in terms of financial, technical and staffing.

11.3 Construction Plan and Schedule

11.3.1 Intake Facilities

The area required for the intake facilities was assumed at 1.3 ha approximately at Udugama. The proposed intake facilities comprise the construction of an intake mouth to capable intake raw water of 4.2 m^3/s, grit chamber, pump station building, office, staff house, and procurement and installation of pumps with appurtenance as the major work items.

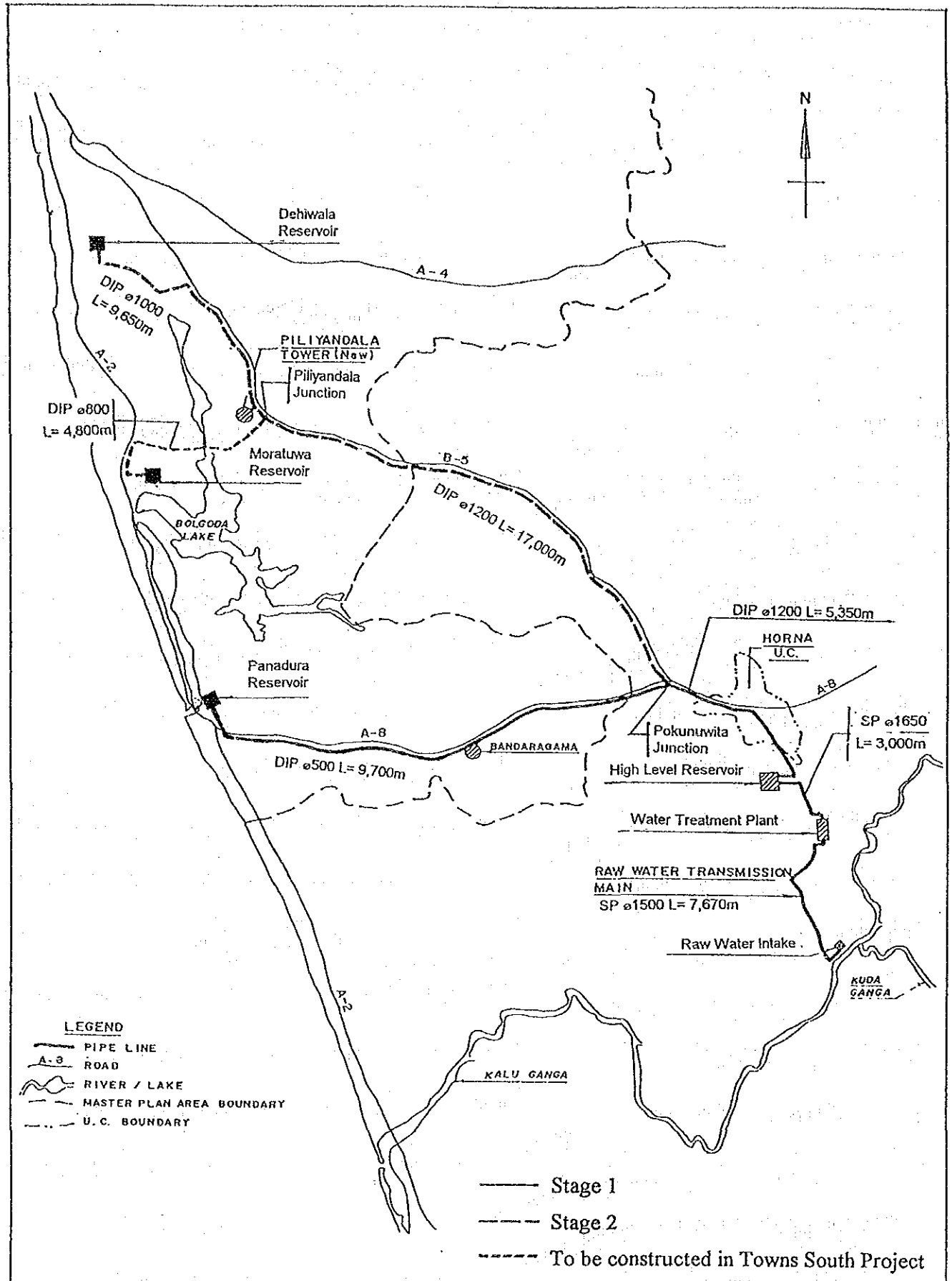


Figure 11.1 Staging Plan for Transmission Mains

An intake mouth will be constructed under dry condition of working site providing a partial coffering by using steel sheet piles. Rock excavation of 14,000 m^3 in total volume will be carried out by ripping and or controlled blasting method to avoid to weaken the foundation rock. Common soil will be excavated and treated by ordinary type of equipment, and be utilized effectively for land reclamation and others upon consultation with the Low Land Reclamation Board.

Required concrete volume was estimated at 10,000 m^3 approx. both for 210 kg/cm^2 and 180 kg/cm^2 of compressive strength. The concrete will transported and placed from concrete mixing plant which will be provided at the water treatment plant site to product concrete required for the whole project site due to shortage capacity of ready mixed concrete factories in Colombo and its far location from the site. Aggregates could be obtained from local quarries with sufficient volume and quality according to the site investigation.

A lot of mechanical and electrical equipment including 4 units with 22.12 m^3/min capacity intake pumps will be procured from abroad in an early stage, first year of construction stage, and be installed. Required electric power will be branched from existing CEB's power line carrier of 33,000 V.

One story pump house of 300 m^2 and 4 units of staff houses are constructed at the intake site. The building construction works will be conducted in parallel with the other civil, mechanical and electrical works.

The construction period will be scheduled in two years view from work items and its volume and weather condition.

11.3.2 Raw Water Transmission Facilities

Total length of raw water transmission main is 7,670 m from the intake to water treatment plant. A 1500 mm in diameter of steel pipe was selected as the raw water transmission main in the feasibility design stage. The transmission main was planned to lay mostly under the existing asphalt paved road upon trenching.

A laying cycle of 9.0 m steel pipe will be scheduled at two pieces per day at straight portion and flat level land. Digging width for pipe laying will be 3.0 m and or 2 times of pipe diameter. At least one way traffic should be kept in the laying works at existing road. Bypass route should be informed and guided to drivers, if applicable, during the laying works. Road reinstatement should be carried out after pipe laying. Temporary wall will be provided by using steel sheet piles at soft ground section. Due consultation is required with the road department and other agencies concerned before commencement the pipe laying work.

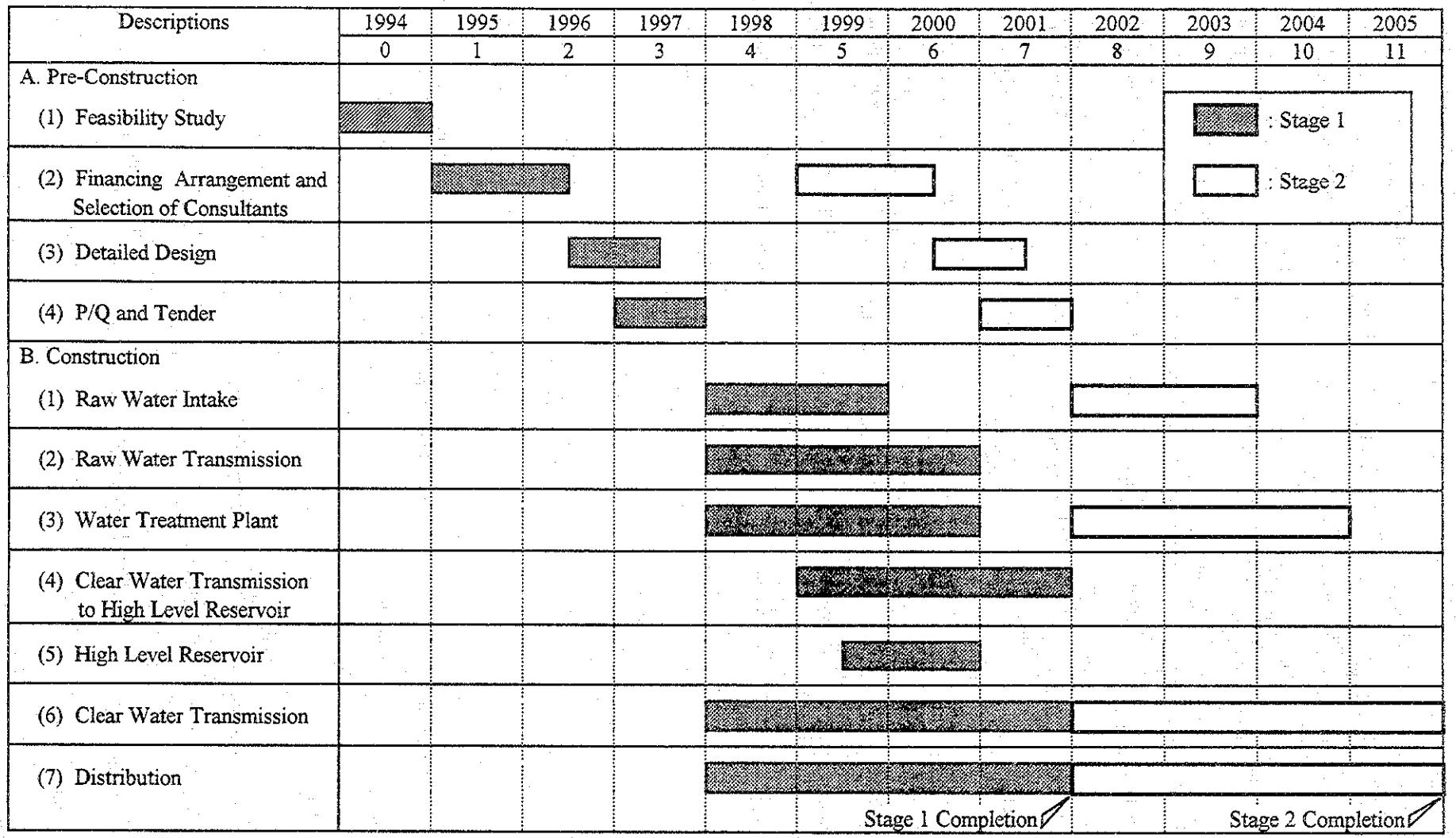


Figure 11.2 Implementation Schedule Phase 1

The welding works of steel pipes will be conducted by highly skilled welders and special workers following to the laying of pipes.

11.3.3 Water Treatment Facilities

The proposed site of water treatment plant locates near Remuna village and 3.0 km distance of east-south from Horana. The site adjacent to existing asphalt paved and 4.0 m width road to connect between Horana and Kalawellawa. The plant area is 9.14 ha and 14.59 ha for 2010 and 2020 demand, respectively. Existing land is a gentle slope, and its elevation ranges 6.0 m to 15.0 m approximately. In the area, 67 houses and each one school and temple are exist at present.

The rapid sand filtration system was selected as for the raw water treatment plant of the project. One main control building, 47 numbers of staff houses and one repair shop are also provided in this plant site for the operation and maintenance works of the project.

Construction works are classified into civil works, mechanical and electrical works and building works. Existing land in proposed site is leveled to its elevation of 11.0 m as the base ground level for the plant to be constructed.

Required major earthworks are land clearing and stripping of 10 ha, common soil and rock excavation of 174,000 m^3 and 17,000 m^3, respectively, and 105,000 m^3 of embankment. The embankment material is obtained within the site. Excessive soil will be used effectively such as land reclamation. Ripping method will be applied for rock excavation.

Total concrete volume estimates at 22,000 m^3 both for 210 kg/cm^2 and 160 kg/cm^2 compressive strength. A concrete plant will be provided in the site to product required concrete for whole project works.

The cast-in-situ pile foundation was planned at the sedimentation basin and filters. The pile length is 5.0 m with 400 mm in diameter. The piling works will be carried out by using earth auger and agitator truck.

Mechanical and electrical works will be carried out following to the civil works after procurement of equipment in an early stage of the construction works. Required electric power will be supplied from the existing CEB's 33,000 V power line which is running near the site, providing a power substation.

Building construction works will be conducted in parallel with the civil, mechanical and electrical works.

The construction works will be scheduled at three years work period for the entire the plant and buildings in Stage 1 of Phase 1. The sedimentation basin, flocculation basin and rapid sand filters will be constructed divided into two steps within the Stage 1 work from the economical point of view.

11.3.4 Clear Water Transmission Facilities

The clear water transmission facilities to be constructed in Stage 1 of Phase 1 are tabulated as follows.

1) High level reservoir (HLR)

Location : Horana, elevation 90 m approx.
Capacity : 30,000 m^3
Type : concrete made, rectangular

2) Transmission system

1. WTP --> high level reservoir

Pipe/length : steel pipe, 1650 mm dia., 3,000 m

2. HLR --> Pokunuwita Junction

Route : : A8 road
Pipe/length : ductile iron pipe, 1200 mm dia., 6,680 m

3. Pokunuwita J. -> Panadura tower

Route : : A8 road
Pipe/length : ductile iron pipe, 500 mm dia., 15,250 m

4. Moratuwa reservoir -> new Moratuwa tower

Pipe/length : ductile iron pipe, 500 mm dia., 300 m

5. Branch connection to new Piliyandala tower

Pipe/length : ductile iron pipe, 400 mm dia., 30 m

The construction works of the high level reservoir is conducted in the hill site near Horana town. An access road to the site is constructed firstly having 10 m width and 1,300 m long. Major work is earthwork and concreting that rock excavation and embankment volume estimate at 82,000 m^3 and 50,300 m^3, respectively, and placement of 12,000 m^3 both for 210 kg/cm^2 and 180 kg/cm^2 compressive strength concrete.

Bench cut and blasting method will be applied for huge amount of rock excavation. Excavated rock are used for the embankment. Excessive rock will be utilized as for the concrete aggregates, groveling for access road and others effectively. Required concrete will be supplied from the concrete mixing plant which locates in the water treatment plant site. Construction period is planned at one and half years for the high level reservoir.

The same method to the raw water transmission construction will be applied for the laying of steel pipes for clear water transmission of 3,000 m long from the water treatment plant to the high level

reservoir in the existing road section. Trenching width is planned at 3.3 m and or two times of pipe diameter. Thrust block will be provided at several place. An electric powered winch will be required for the laying work at hill slope.

In Phase 1, it is planned that the clear water is conveyed by one 1200 mm ductile iron pipe line to the Pokunuwita junction from the high level water reservoir via A8 road with 6,680 m long, then branched to the Piliyandala junction via B5 road by 1200 mm ductile iron pipes with 17,000 m long and the Panadura tower via A8 road by 500 mm ductile iron pipe with 15,250 m long. The Piliyandala route is planned to construct in Stage 2 of Phase 1.

The piping route between Horana to Pokunuwita junction, A8 road, is urbanized. Therefore it seems difficult and costly to use the private land as for the large size pipe laying. It is the same situation between Kuhathuduwa and Piliyandala, B5 road, according to the site survey. Also, rapid urbanization is being progressed along the B5 and A8 roads. In this feasibility study stage, the transmission pipes are planned to lay under the A8 and B5 roads under the such circumstances. In depth study will be performed in the detailed design stage on the pipe laying.

The method for the laying work of raw water transmission main will be applied principally for the 6,880 m long laying work between the high level reservoir and Pokunuwita junction. Laying progress will be planned by two pieces of 6 m long ductile pipes per day at straight section and three days for two pieces at other section.

Ductile iron pipes of 500 mm in diameter are laying under A8 road with 15,250 m long. Trench excavation for the pipe laying will be done by backhoe for 1.0 m width.

The construction period is scheduled at four years including one year for the procurement of pipes and fittings for the transmission system from the high water reservoir to Panadura area in Stage 1.

11.3.5 Distribution Facilities

The construction work items for the distribution facilities in Stage 1 of Phase 1 are tabulated as follows.

1) Piping for Moratuwa U.C. low zone

   Pipe/length : ductile : 600-250 mm dia.* 2,900 m
   PVC : 200, 150 and 90 mm dia.* 93,550 m

2) Water tower for Moratuwa U.C. low zone

   Type/height : elevated tower, 25 m from G.L.
   Capacity : 1,500 m^3

The laying works for the small size of distribution pipes will be conducted mostly by manual power. Other medium size of pipes will be carried out by combination of equipment and manual power. Careful attention should be paid to avoid traffic congestion during laying works.

Major work is foundation piling and concreting for the water tower construction. A 400 mm in diameter and 20 m long foundation piles are provided as for the tower foundation. Pile driving will be done by diesel pile hammer. The concrete placement will be carried out by using concrete pump car supplying concrete from concrete mixing plant in water treatment plant site.

Required construction period is scheduled at four years including one year for procurement of piping materials.

11.3.6 Construction Time Schedule

The construction of the Stage 1 of Phase 1 works is scheduled to commence in the beginning of 1998 and be completed in the end of 2001 in four years construction period including one year for the procurement of pipes, fittings, mechanical and electrical equipment, and two months for dry and wet test with adjustment of equipment.

The critical path work in Stage 1 will be the pipe laying of 10,670 m in total length for raw water transmission of 7,670 m and clear water transmission of 3,000 m from the water treatment plant to the high level water reservoir in Package A works.

Key milestones will be 1) site delivery time of pipe and fittings , and 2) completion time the facilities throughout the intake to the high level water reservoir to achieve to carry out for its dry and wet test in the final construction stage of Stage 1 works.

Figure 11.3 shows a detailed construction schedule for each package.

11.3.7 Temporary facilities

No temporary access roads will be required except for construction of high level water reservoir since the project situates in urbanized area and developed urban and rural roads. Required electric power and telephone line for communication on the construction works will be branched from the existing one to the respective work site.

A concrete mixing plant will be provided at the water treatment plant site for the production of required concrete of entire project site which estimates 46,000 m^3 in total. Aggregates could be obtained from

local suppliers which are developing and operating quarries at several places in and around Horana area with sufficient quality.

Temporary buildings such as site office, warehouse, repair shop will be provided in appropriate place of respective package site.

11.3.8 Conditions for Construction Execution

(1) Topography, Meteorology, Hydrology and Geology

The Horana area, site for major works, hills, valleys and lowlands of the low country wet zone are the main geological features. Monthly rainfall at Ratnapura are varies from 141.0 mm in January to 482.8 mm in June in last 10 years average. Horana lies within cordierite garnet granulite or gneisses adjoining to garnet biotite gneisses and cordierite garnet granulite or gneisses which is developed southwards.

(2) Infrastructures

The Colombo port have modern efficient facilities which will be the handling port of the project cargoes. The project's cargoes are transported via existing roads which run the construction site. Required power for construction works can be supplied from CEB's existing line.

(3) Labor Force

Skilled and semi-skilled laborers can be recruited in the Colombo area. However, some skilled welders will be necessary to employ from industrial country/ies to assure the welding quality for steel pipes. Common laborers can be recruited in and around the project area without seasonal variation.

(4) Construction Material and Equipment

Required cement, reinforcement bars, shaped steel including steel sheet piles and wooden materials will be needed to import from abroad. Others such as fuel, lubricants and aggregates will be procured from the local market. Standard type earth moving equipment are available at Colombo in lease basis. Equipment for rock excavation will be required to bring from abroad.

(5) Construction Contractor

Domestic construction contractors in Sri Lanka conduct small to middle scale project owning standard earth moving and concrete equipment, and their major projects are building construction mostly at present in 1994 according to the information from a general contractor. Most of domestic contractors hope to joint venture system with NIES countries and Japan.

Descriptions	Unit	Q'ty
1. Mobilization & preparatory		
2. Intake Facilities, Civil works	L.S	-
Intake Facilities, Mech. & Elect.	L.S	-
Intake Facilities, Buildings	no.	5
3. Raw Water Transmission Facilities, 1500mm	lin•m	7,670
4. Water Treatment Plant, Civil Works	L.S	-
Water Treatment Plant, Mech. & Elect.	L.S	-
Water Treatment Plant, Buildings	no.	45
5. Clear Water Transmission, 1650mm, WTP to H.L.R	lin•m	3,000
6. High Level Reservoir (H.L.R), V=30,000m3	place	1
7. Clear Water Transmission		
1) Horana to Pokunuwita Junction, 1200mm (Rd. A8)	lin•m	6,680
2) Pokunuwita J. to Panadura Tower, 1200mm (Rd. A8)	lin•m	15,250
3) Moratuwa Res. - New Moratuwa Tower, 500mm	lin•m	300
4) Branch Connection to New Piliyandara Tower, 400mm	lin•m	30
8. Distribution System		
1) Moratuwa U.C. low zone, 600 - 90mm	lin•m	100,390
2) Moratuwa U.C., water tower, V=1500m3	place	1
9. Dry and wet test		

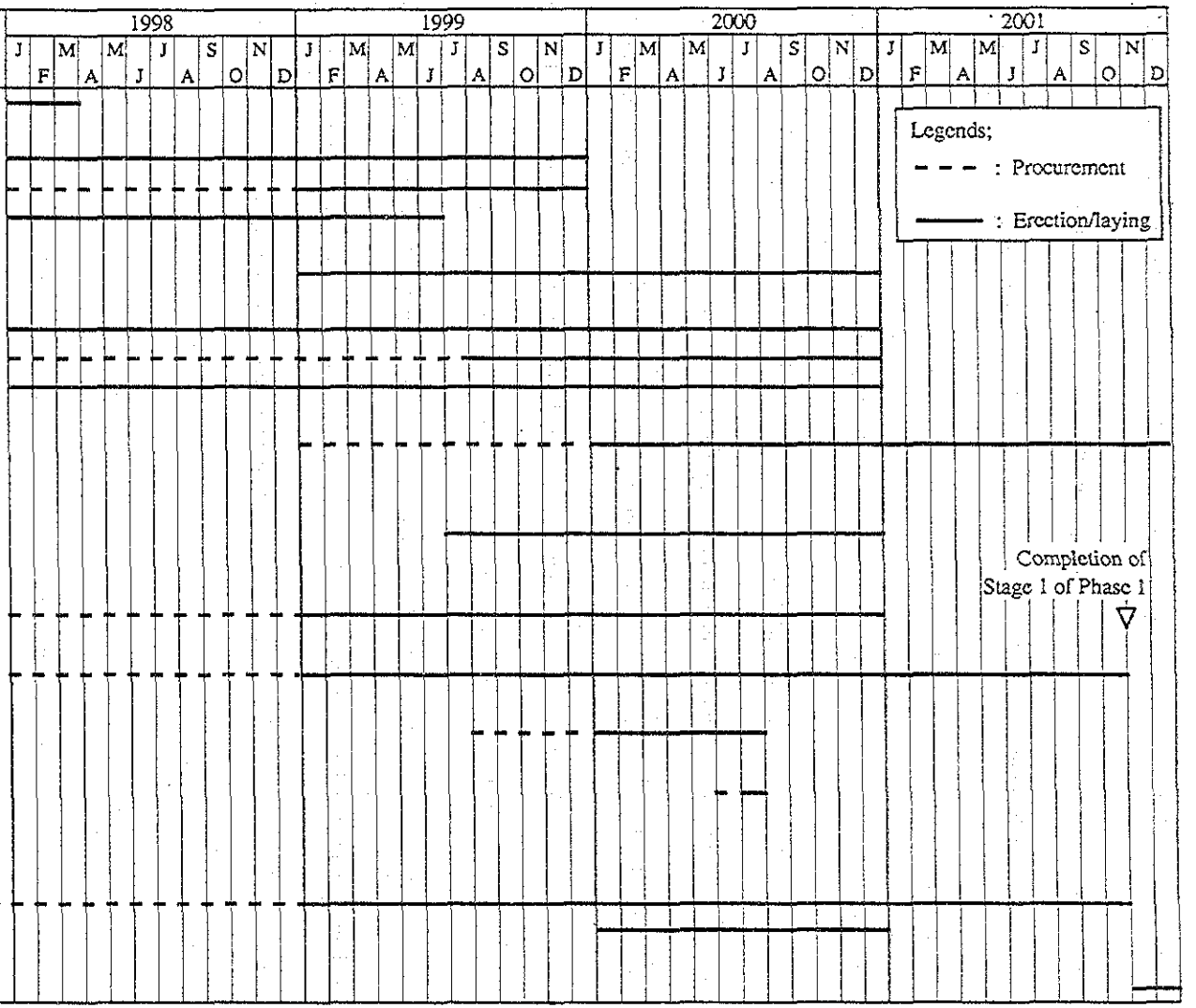


Figure 11.3 Proposed Construction Schedule

CHAPTER 12

PROJECT COST ESTIMATES

12. PROJECT COST ESTIMATES

12.1 Composition of Project Cost

The project financial cost comprises the following cost items.

1) Direct construction cost
   - preliminary and general
   - direct construction cost
   - value added tax (B.T.T)
2) Land acquisition and compensation costs
   - land acquisition cost
   - compensation cost
3) Government's administration expenses
4) Engineering services expenses
5) Staff Training Cost
6) Price contingency
7) Physical contingency

12.2 Conditions and Assumptions for Cost Estimate

(1) Price Level

The price level is June 1994 at the time of site investigation for the project cost estimate.

(2) Foreign Exchange

The exchange rate was set as follows referring the international financial statistics in July 1994.

US$ 1.0 = Rs. 49.0 = Yen 106.0

Rs. 1.0 = Yen 2.2 (106.0/49.0=2.16 --> 2.2)

	Average	May'94	Apr.'94	Mar.'94	Feb.'94	Jan.'94
Yen	106.024	103.730	103.530	105.140	106.210	111.510
Rs.	49.336	49.292	49.168	49.182	49.367	49.672

(3) Devaluation

The devaluation of Sri Lanka Rupee to the US Dollar is tabulated as follows in last five years for the setting of price escalation rate.

	'94	'93	'92	'91	'90	average
Rs/US$	49.336	48.322	43.830	41.372	40.063	
Devaluation	-	1.014	4.492	2.458	1.309	
-do-, rate	-	2.1 %	10.3 %	5.9 %	3.3 %	5.4 %

(4) Implementation Schedule of Phase 1

Stage 1	1996 - 1997 tender design, P/Q and tender
	1998 - 2001 construction
Stage 2	2000 - 2001 tender design, P/Q and tender
	2002 - 2005 construction

(5) Procurement Scheme of Material and Equipment

Mechanical and electrical equipment of the project facilities, pump and appurtenance, assume to procure from abroad. Equipment and materials for the project construction works are contractor's choice in his tender. After the completion of the project, materials for the operation and maintenance of facilities will be procured both from domestic and abroad as assumed below based on the old Ambatale O & M records and experience.

Alum	: Domestic/India
Lime	: Domestic
Chlorine	: India/Thailand
Breaching powder	: India
Fuel/lubricants	: Middle East

(6) Foreign and Local Currency Portions

The project cost estimates divided into the foreign currency portion (F.C.) and local currency portion (L.C.) assuming to the implementation fund by foreign donor/s to the foreign currency portion. The unit construction costs are divided into the foreign and local currency portions accordingly as presented in Supporting Report (Volume III) with certain ratio which was assumed taking into account the following major factors, and referring the other water supply project which being implementing currently.

- Availability of skilled and common labors
- Productivity and availability of construction materials in Sri Lanka
- Productivity and availability of construction equipment and plant

(7) Custom Duty

CIF in 20 percent of the cost was incorporated into supply and delivery cost for pipes and fittings.

(8) Interest During Construction

No interest during construction was taken into account.

12.3 Estimate Approach

12.3.1 Direct Construction Cost

The direct construction cost of Stage 1 of Phase 1 was estimated classified into the following group of respective facilities.

Table 12.1 Grouping of the Direct Construction Cost

cost code	Construction Cost Items
101	preliminary and general
102	intake facilities
	- civil works
	- mechanical and electrical works
	- building works
103	raw water transmission facilities
	- supply and delivery cost for pipe and fittings
	- laying cost including road reinstatement cost
104	treatment facilities
	- civil works
	- mechanical and electrical works
	- building works
105	clear water transmission facilities, 1)
	- supply and delivery cost for pipe and fittings from WTP to high level water reservoir in Horana
	- laying cost including road reinstatement cost
	- high level water reservoir
106	clear water transmission facilities, 2)
	- supply and delivery cost for pipe and fittings from high level reservoir in Horana to Pokunuwita junction, Pokunuwita juncton to Panadura tower, Moratuwa reservoir to new Moratuwa tower, and branch connection to new Piliyandala tower
	- laying cost including road reinstatement cost
107	distribution facilities
	- supply and delivery cost for pipe and fittings in Moratuwa U.C. low zone
	- laying cost including road reinstatement cost
	- water tower
108	value added tax (B.T.T)

The direct construction cost for the Stage 1 and Stage 2 schemes were estimated by the following estimate approach. The contractor's site expenses, overhead and profit has been included into the respective cost items stipulated below.

(1) Preliminary and General

These costs are estimated by lump sum basis to cover for mobilization, preparatory and temporary works including maintenance and removal on completion, bonds and other incidentals for the required

construction works. The cost was included in this cost item to cover for all measures required for the maintenance of traffic flows access.

(2) Civil Works

The direct construction cost for civil works were estimated by unit cost basis. The unit construction cost of respective work item presents in Volume III, Supporting Report which was determined by referring NWSDB's "RATES in 1994", contracts currently awarded, and other data which were collected during the site investigation with its examination and analysis. Each unit cost includes 1) labor cost, 2) construction material price, 3) construction equipment cost, and 4) contractor's overhead and profits. Labor cost, unit price of construction material and equipment cost are presented in Volume III, Supporting Report as for the reference back data.

(3) Pipe and Fittings

1) Supply and Delivery Cost

The unit cost for ductile iron pipe and steel pipe has compared as tabulated in Volume III, Supporting Report. As the results, steel pipe is preferred more than 1200 mm in diameter.

2) Laying cost for Pipe and Fittings

The laying cost was estimated by unit cost basis in linear meter at 15 percent of site delivery cost of pipe and fittings including the custom duties referring to the Towns East project, NWSDB's Rates 1994 and others, and incorporated into 30 percent for foreign currency and 70 percent for local currency portions respectively.

3) Road Reinstatement Cost

The road reinstatement cost was estimated by unit cost basis in linear meter of pipe at 5 percent of site delivery cost of pipe and fittings including the custom duties referring to the Towns East project, NWSDB's Rates 1994 and others, and incorporated into 30 percent for foreign currency and 70 percent for local currency portions respectively. Required width for road reinstatement was assumed at two times of pipe diameter as follows.

DN 1650 mm : 3.3 m
DN 1500 mm : 3.0 m
DN 1200 mm : 2.4 m
DN 1000 mm : 2.0 m
DN 800 mm : 1.6 m
DN 500 mm : 1.0 m

4) Mechanical and Electrical Works

The cost for mechanical and electrical works was estimated by referring prevailing market prices in Sri Lanka and Japan, and incorporated into foreign currency of 90 percent and local currency portion of 10 percent with supply, delivery and installation basis.

5) Building Works

The cost for building works was estimated by unit cost basis in square meter and incorporated into foreign currency portion of 50 percent and local currency portion of 50 percent.

6) High Level Reservoir and Ground Reservoir

This cost was estimated by unit cost basis in cubic meter for reservoir capacity referring to NWSDB's Rates '94 and incorporated into foreign and local currency portions of 65 percent and 35 percent respectively.

7) Pump Station

The pump station cost was estimated by motor capacity of prime mover by referring to NWSDB's rates '94 and current market prices in Japan and incorporated into foreign and local currency portions of 80 percent and 20 percent respectively including installation cost.

8) Water Tower

This cost was estimated by unit cost basis of the storage capacity of water tower in cubic meter referring NWSDB's Rates '94 and incorporated into foreign and local currency portions of 65 percent and 35 percent, respectively.

9) Public and Private Utilities

The cost was estimated by lump sum basis for replacement or compensation for public or private utilities or facilities and incorporated into foreign and local currency portions of 50 percent and 50 percent, respectively.

12.3.2 Land Acquisition and Compensation Costs

The unit cost for land acquisition and compensation was obtained from the NWSDB and tabulated in Table 12.2. The compensation cost for the public utilities, temple and school at WTP site, laying works at clear water transmission and distribution routes were counted and estimated by lump sum basis and incorporated into the local currency portion. The road reinstatement cost estimated is included in the laying cost.

12.3.3 Government's Administration Expenses

The Government's administration expenses for the project implementation were assumed in proportion to the amount of the local portion of the direct construction cost. Fifteen percent was applied and incorporated into local currency portion for respective stage.

12.3.4 Staff Training Cost

In the course of the implementaiotn of the Project, it will be necessary for various levels of the NWSDB's staff to have proper training for respective issue. For this purpose, one percent of the direct construction cost is added in the project cost.

12.3.5 Engineering Services Expenses

The engineering services expenses were estimated in proportion to the direct construction cost to cover for the tender design and construction supervision on respective phase. Ten percent was applied excluding price and physical contingencies and incorporated into foreign and local currency portions of 80 percent and 20 percent, respectively.

12.3.6 *Price Contingency*

The price contingency of foreign currency portion was provided by an average increasing rate by using consumer price index (CPI) of Japan in last three years indicated in the international financial statistics of July 1994. The price contingency for the local portion was estimated taking into account a *devaluation factor of Sri Lanka Rupee to US dollar in addition to the CPI. An average devaluation rate* of 5.4 percent was applied as presented in Clause 12.2 "Conditions and assumptions for cost estimate", as follows.

$$Ep = [\{(1 + pl/100)/(1 + e/100)\}-1] \times 100$$

where,
- Ep : price escalation rate, %
- pl : average increasing rate of consumer price, %
- e : average devaluation rate of exchange rate, %

$$Ep = [\{(1 + 13.2/100)/(1 + 5.4/100)\}-1] \times 100 = 7.4\ \%$$

Foreign currency portion : 2.1 %
Local currency portion : 7.4 %

Consumer price index (1990 = 100)

	1990	1991	1992	1993	average (pl)
Sri Lanka	0 (100)	12.20	12.80	14.60	13.2
Japan	0 (100)	3.30	1.80	1.30	2.1

12.3.7 Physical Contingency

The physical contingency was provided to cover minor differences in actual and estimated quantities, omissions of minor items of work incidental to pay items, difficulties unforeseeable at the site, possible changes in plans, and other uncertainties. A 10 percent of base cost was applied.

12.3.7 Interest during Construction

No interest during construction was taken into account.

12.4 Project Cost

The project cost in 2010 target year has been worked out as summarized in Table 12.2 below, and tabulated in Tables 12.3 and 12.4 for Stage 1 and Stage 2 of Phase 1, respectively.

Table 12.2 Summary of Project Cost, Phase 1

Stage	F.C portion (yen)	L.C. portion (Rs.)	Total (Rs. equivalent)
Stage 1	10,797	3,508	8,499
Stage 2	7,148	3,110	6,414
Total of Phase 1	17,945	6,618	14,913

Among the project financial cost, the direct construction cost was estimated at equivalent Rs.5,620 million for Stage 1 and Rs.3,556 million for Stage 2. The breakdown of the direct construction costs in the form of priced bill of quantities for Stage 1 and Stage 2 are shown in Supporting Report (Volume III) as well as the estimated land acquisition and compensation costs.

Table 12.3 Project Cost for Stage 1 of Phase 1 (2010)

unit : thousand

Code	Cost Item	Foreign Portion (yen)	Local Portion (Rs.)	Total in Rupee (Rs.)
100	Direct Construction Cost			
101	General	183,200	181,000	265,687
102	Intake Facilities	895,547	101,971	515,909
103	Raw Water Transmission Pipeline	1,388,385	303,855	945,656
104	Treatment Facilities	2,797,623	379,410	1,672,651
105	Clear Water Transmission Pipeline from WTP to HLR	628,956	137,652	428,396
105	High Level Reservoir	623,070	133,974	421,997
106	Clear Water Transmission (2)	1,210,706	264,970	824,636
107	Distribution Facilities	247,537	166,089	280,516
	Total of 101 to 107	7,974,934	1,668,921	5,355,447
108	B.T.T. (5%)	0	264,695	264,695
100	Total of Direct Construction Cost	7,974,934	1,933,616	5,620,142
200	Land Acquisition and Compensation	0	58,685	58,685
300	Administrative Expenses	0	290,042	290,042
400	Engineering Services	972,628	112,403	562,014
450	Staff Training Cost	97,263	11,240	56,201
	Sub Total	9,044,825	2,405,986	6,587,084
500	Price Contingency	771,094	782,903	1,139,363
600	Physical Contingency	981,592	318,889	772,657
	Total Project Cost	10,797,511	3,507,778	8,499,231

Table 12.4 Project Cost for Stage 2 of Phase 1 (2010)

unit : thousand

Code	Cost Item	Foreign Portion (yen)	Local Portion (Rs.)	Total in Rupee (Rs.)
100	Direct Construction Cost			
101	General	130,000	43,600	103,694
102	Intake Facilities	188,770	9,530	96,792
103	Raw Water Transmission Pipeline	0	0	0
104	Treatment Facilities	1,198,739	98,540	652,674
105	Clear Water Transmission Pipeline from WTP to HLR	0	0	0
105	High Level Reservoir	0	0	0
106	Clear Water Transmission (2)	3,038,052	664,901	2,069,284
107	Distribution Facilities	276,977	338,368	466,405
	Total of 101 to 107	4,832,538	1,154,939	3,388,848
108	B.T.T. (5%)	0	167,577	167,577
100	Total of Direct Construction Cost	4,832,538	1,322,516	3,556,425
200	Land Acquisition and Compensation	0	0	0
300	Administrative Expenses	0	198,377	198,377
400	Engineering Services	615,479	71,129	355,643
450	Staff Training Cost	61,548	7,113	35,564
	Sub Total	5,509,565	1,599,135	4,146,009
500	Price Contingency	988,594	1,227,872	1,684,877
600	Physical Contingency	649,816	282,701	583,097
	Total Project Cost	7,147,975	3,109,975	6,414,060

12.5 Disbursement Schedule

A disbursement schedule for the project cost of stage 1 of phase 1 was provided as tabulated in Table 12.7 and summarized as in Table 12.5 below on the basis of the proposed implementation schedule and assuming the payment schedule in Table 12.6 below.

Table 12.5 Summary of Disbursement Schedule Stage 1 of Phase 1

unit : million

	F.C portion (Y)	L.C portion (Rs)	Total, Rs. equivalent
1996	330	100	250
1997	112	80	131
1998	3905	1137	2912
1999	3036	939	2319
2000	2127	704	1671
2001	1177	430	965
Total	10687	3390	8248

Table 12.6 Payment Schedule

unit : %

Payment	Stage 1 Stage 2	1996 2000	'97 2001	'98 2002	'99 2003	2000 2004	2001 2005
- direct const. cost		0	0	40	30	20	10
- land acquisition & compensation costs		50	50	0	0	0	0
- Government administration expenses		10	10	20	20	20	20
- engineering services expenses		30	10	15	15	15	15

The disbursement schedule for stage 2 of phase 1 is shown in Table 12.8.

Table 12.7 Disbursement Schedule, Stage 1 of Phase 1 (2010)

unit: million

Code	Cost Item	Total		1996		1997		1998		1999		2000		2001	
		F.C (yen)	L.C (Rs.)	F.C (yen)	L.C (Rs.)	F.C (yen)	L.C (Rs.)	F.C (yen)	L.C (Rs.)	F.C (yen)	L.C (Rs.)	F.C (yen)	L.C (Rs.)	F.C (yen)	L.C (Rs.)
100	Direct Construction Cost	7,975	1,934	0	0	0	0	3,190	773	2,392	580	1,595	387	797	193
200	Land Acquisition and Compensation Cost	0	59	0	29	0	29	0	0	0	0	0	0	0	0
300	Government's Administrative Expenses	0	290	0	29	0	29	0	58	0	58	0	58	0	58
400	Engineering Service	973	112	292	34	97	11	146	17	146	17	146	17	146	17
450	Staff Training Cost	97	11	0	0	0	0	24	3	24	3	24	3	24	3
	Sub-Total	9,045	2,406	292	92	97	70	3,360	851	2,563	658	1,765	464	968	271
500	Price Contingency	771	783	6	7	4	11	215	203	223	218	194	199	129	145
600	Physical Contingency	981	319	30	10	10	8	357	105	279	87	196	66	110	42
	Grand Total	10,798	3,508	328	109	111	88	3,933	1,160	3,064	963	2,155	730	1,206	458

Table 12.8 Disbursement Schedule, Stage 2 of Phase 1 (2010)

unit: million

Code	Cost Item	Total		2000		2001		2002		2003		2004		2005	
		F.C (yen)	L.C (Rs.)	F.C (yen)	L.C (Rs.)	F.C (yen)	L.C (Rs.)	F.C (yen)	L.C (Rs.)	F.C (yen)	L.C (Rs.)	F.C (yen)	L.C (Rs.)	F.C (yen)	L.C (Rs.)
100	Direct Construction Cost	4,833	1,323	0	0	0	0	1,933	529	1,450	397	967	265	483	132
200	Land Acquisition and Compensation Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300	Government's Administrative Expenses	0	198	0	20	0	19	0	40	0	40	0	40	0	40
400	Engineering Service	615	71	185	21	62	7	92	3	92	11	92	11	92	11
450	Staff Training Cost	61	7	0	0	0	0	15	2	15	2	15	2	15	2
	Sub-Total	5,510	1,599	185	41	62	27	2,040	574	1,557	449	1,074	316	591	184
500	Price Contingency	989	1,228	20	18	8	14	320	372	282	346	221	285	136	192
600	Physical Contingency	650	283	20	6	7	4	236	95	184	79	130	60	73	37
	Grand Total	7,148	3,110	225	65	77	46	2,597	1,041	2,023	874	1,425	662	800	414

12.6 Operation and Maintenance Cost

12.6.1 Summary of Operation and Maintenance Cost

These costs will be represented anticipated yearly expenditures for :

- Wages and salaries;
- Cost of facilities, equipment, operating costs, materials and supplies; and
- Cost of repairs.

Annual operation and maintenance cost was estimated at Rs.190 million as shown in Table 12.9, and as explained below referring cost data of old and new Ambatale WTPs, prevailing market prices and others following the proposed program on the water supply facilities with 182,000 m^3/day capacity in the Stage 1 of Phase 1 scheme.

Table 12.9 Annual Operation and Maintenance Cost

O & M cost items	O & M cost (Rs.million)	ratio (%)
- wage & salaries	6.4	3.4
- occasional workers cost	3.6	1.9
- power cost	153.5	81.1
- chemical cost	10.6	5.6
- other (materials/ equipment/facilities)	10.2	5.4
- repairs	5.0	2.6
Total	189.3	100.0

12.6.2 Personnel cost

(1) Wage and Salaries for NWSDB's Staff

Wage and salaries of NWSDB's staff for production capacity of 182,000 m^3/d (2010 demand) are estimated at Rs.6.4 million per annum assuming unit salary of Rs.10,000/month and 53 staff in total numbers as broken down below.

Table 12.10 Number of O & M Staff for 2010

position/status	no.	position/status	no.
A.G.M.	1	Store keeper	1
Manager	2	Driver	1
Accountant	1	Labor	11
Chemist	1	Mechanic	2
O.I.C (E.A)	2	Welder	1
Engineer	2	Pipe fitter	2
E.A	4	Painter	1
Pump operator	5	Helper	4
Plant operator	10	Electrician	2
Clerk & typist	1	Labo. assistant	1
		Total	53

Annual manning cost is therefore calculated as:

53 x Rs.10,000/month x 12 months/year = Rs.6,360,000/year

(2) Occasional Worker

Annual cost for occasional workers were estimated at Rs.3.6 million as following maintenance works.

Sludge drying bed : 5 labors x 6 days/month = 30 m/m
Cleaning WTP : 5 labors x 6 days/month = 30 m/m

60 m/m x Rs.5,000/month x 12 months/year = Rs.3,600,000/year

12.6.3 Power Cost

The power charge for the electric driving equipment was estimated at Rs.153.5 million per annum as tabulated in Volume III, Supporting Report based on the CEB's power tariff which rates effective from February 1994.

12.6.4 Chemical Cost

Annual chemical cost for Alum, Lime and Chlorine in the WTP was estimated at Rs.10.6 million based on the unit consumption as tabulated in Volume III, Supporting Report and as summarized below:

Alum	:	1,365 kg/day
Lime	:	683 kg/day
Chlorine	:	182 kg/day

12.6.5 Other Cost

(1) Bleaching Powder, Fuel, Lubricants and Others

These cost were estimated referring Ambatale records in 1993, at Rs.8.2 million per annum assuming that 20 percent is the cost for bleaching powder, fuel, lubricants and others of total materials cost of 26.5 percent as broken down below.

Ambatale WTP capacity : 305,000 m^3/day

Monthly expenditure : Rs.12,936,000/month

Ratio of monthly expenditure :

1) power	70.0 %, 12,936,000 x 0.70 =	Rs.9,055,200
2) labors	3.5 %, 12,936,000 x 0.035 =	Rs. 452,760
3) materials	26.5 %, 12,936,000 x 0.265 =	Rs.3,428,040
Total	100.0 %	

Rs.3,428,040 x 0.20 x 12 month = Rs.8,200,000/year

(2) Facilities and Equipment for Operation and Maintenance Works

Major facilities and equipment required for the operation and maintenance works will be repair shop, transportation vehicle and lifting equipment. Annual expenditure is assumed at Rs.2.0 million for this item including equipment depreciation cost such as dump truck and wheel loader for sludge treatment and forklift for chemical handling.

(3) Repairs

The repair cost were estimated by lump sum basis at Rs.5.0 million per annum for mechanical and electrical facilities and equipment after the completion of the project.

CHAPTER 13

INSTITUTIONAL AND MANAGERIAL CONSIDERATIONS

13. INSTITUTIONAL AND MANAGERIAL CONSIDERATIONS

13.1 History, Background and Results of Institutional Development of the NWSDB

13.1.1 Background and Past Performance of the NWSDB

The NWSDB, which was formed out of the Department of Water Supply and Drainage in January 1975, was primarily charged with developing, providing, operating and controlling water supply facilities, to distribute water for public or industrial purposes and to charge for the same. It soon became the lead agency in the water supply sector in Sri Lanka, taking the responsibility for planning, design and construction of virtually all urban water supply schemes and most of the piped water supply schemes in rural areas. An increasing burden of facility operation and management fell on the NWSDB as a large number of poorly-managed and generally run down local authority schemes were handed over to the NWSDB.

Before 1975 as a government department, emphasis has been laid on civil engineering capital projects from planning through design to construction, basically for new schemes, whereas, thereafter the NWSDB as a public corporation catering to a commercially-oriented consumer service, was essentially required to lay its primary emphasis on operation and maintenance and consumer billing, while laying supporting emphasis on financial management, public relations, corporate planning, human resources development, community participation, groundwater development, and planning, design, construction relating to rehabilitation or new schemes. These new roles of the NWSDB became more significant due to the new demands in groundwater development, community participation and training prompted by the International Drinking Water Supply and Sanitation Decade.

However, practically with no changes from the cadre, organizational culture and operation procedures of the old department, the NWSDB was not capable to realize its new roles as a public corporation, and was functioning without any operational targets of performance indicators other than those related to the disbursement of capital budget on new schemes.

In the mean time, launching of the Southwest Coast Project, a major World Bank funded infrastructure project centered on the capital city, called for organizational changes resulting in the creation of a separate management structure responsible for this project. Management in the rest of the country was done through several small regional offices, often headed by junior engineers, while substantive decision making was made at Head Office Level (see Figure 13.1). As opportunities made available to the engineers in the foreign-funded project were attractive, the regional offices suffered with lack of competent staff and this attributed heavily on poor operations in the rest of the country. Compare with the initial staff of about 1,600 responsible for operating 96 schemes at its inception, by end of 1983, the

Although the physical facilities and the staff increased rapidly, this was not matched with an improvement in operations and maintenance capabilities or essential support services. As a result, in a majority of schemes equipment were broken, defective or only marginally operational, while water quality monitoring and preventive maintenance were almost non-existent. In short, the supposed new focus of the NWSDB was not living up to its expectations. The NWSDB's performance status in 1983 is shown in Table 13.1.

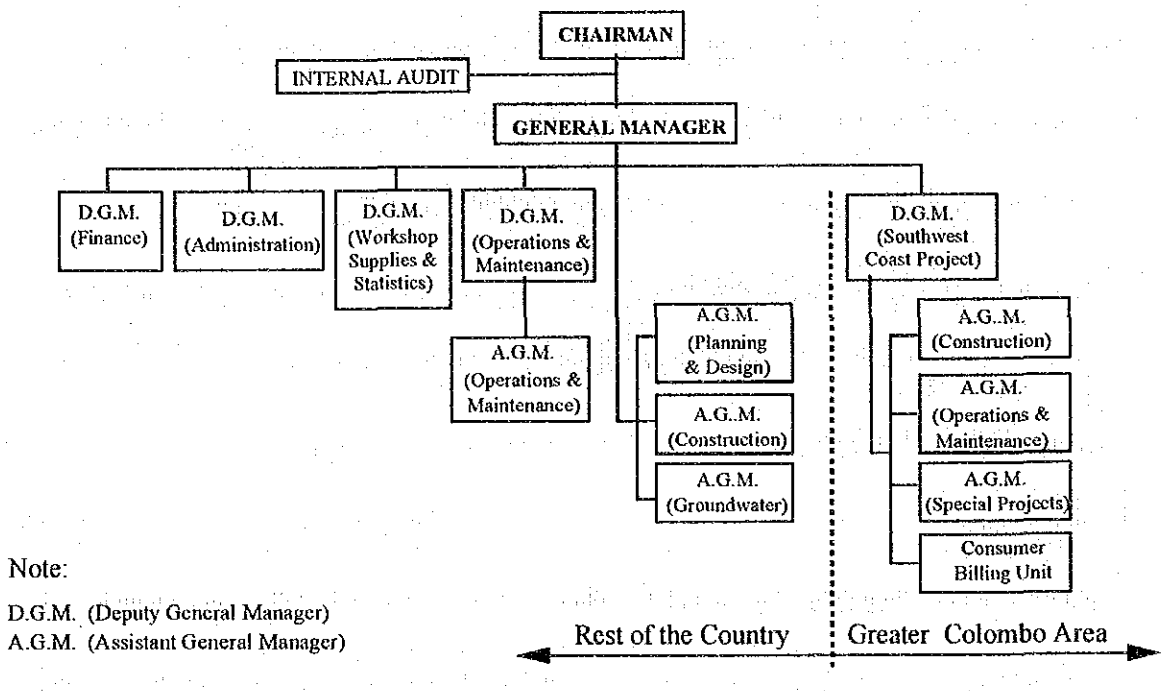


Figure 13.1 Organization Structure of the NWSDB in 1983 (immediately prior to ID Project)

Table 13.1 NWSDB's Performance Status in 1993

* Capital expenditure allocation	Rs. 1,380 million
* Proportion of national sector total allocation	97%
* Actual capital expenditure	70% budget
* Total water production	19 million m3/day
* Total staff	5,848
* Billed Connections49,000	49,000
* Consumer/staff ratio8.4%	8.4
* Billings	Rs. 78 million
* Operation and maintenance cost	Rs. 163 million
* Total collections	Rs. 19 million
* Operation and maintenance cost recovery	12%
* Total operation and maintenance plus debt service cost	Rs. 194 million
* Total cost recovery (excluding depreciation)	10%

13.1.2 Project for Institutional Development of the NWSDB

With a background as above and realizing the urgent need to improve the activities in the water supply and sanitation sector, an Institutional Development (ID) Project was launched in 1984 with technical assistance provided under the USAID Water and Sanitation Sector Project (USAID Project No. 383-0088). The ID Project consisted of two elements; a comprehensive institutional building for the NWSDB and a program to improve health education and rural sanitation services through the integration of NWSDB activities with the Ministry of Health. The objectives, expected project activities and anticipated outputs of the former element are summarized in Table 13.2.

13.1.3 Impact Evaluation of the Institutional Development Project

The impact of ID activities is analyzed and discussed in detail in the Final Report on Institutional Development of the NWSDB (Aug.1991). According to this report and the response of the NWSDB staff interviewed during the Study, successful and significant results have been achieved on the completion of the ID Project, bringing in a major transformation to the NWSDB, which has then become commercially oriented with new emphasis on operations and maintenance, financial viability and decentralization of decision making.

To ensure that the gains made from the ID Project are sustained and that additional improvements will be achieved, the NWSDB has been making best efforts in continued institutional strengthening activities with its own resources and initiative and also with external support. Moreover, in order to determine the level of institutional development and the degree of sustainability that had been achieved in the two years since major full time ID Project activities had ceased, an impact evaluation of the ID Project was conducted in July to August 1993, by a two-member evaluation team of the Water and Sanitation for Health Project of the USAID (WASH Evaluation Team). The main tasks of the evaluation and the findings with regards to eight specific areas that received technical assistance in the ID project are summarized in Table 13.3.

13.1.4 The NWSDB's Current Plan for Continued Institutional Development

(1) Institutional Strengthening

The NWSDB, giving due consideration to the recommendations made by the WASH Evaluation Team, and based on its own assessment of institutional strengthening (IS) needs for the next five years, has prepared an IS Plan catering to identified needs in nine specific areas on which emphasis is laid on (see Table 3.4). This Plan is included among the project proposals of the World Bank assisted Water Supply and Sanitation Project IV made in September 1993.

Table 13.2 The Objectives, Summarized Project Activities and Outputs Under Institutional Development Project

The Basic Objectives of the ID Project	Consolidating the NWSDB organization responsible for a major World Bank funded infrastructure project in the southwestern portion of the country with the separate NWSDB organization responsible for activities in the rest of Sri Lanka, Decentralization to the regions Changing the overall organization structure, attitudes and actions to make the operation and maintenance activities of the NWSDB the most important mission
Additional objectives included during the implementation the ID Project	Involving wider policy involvement (Government of Sri Lanka) Coordinating formally with sector-external support agencies Developing financial consciousness Developing an in-house policy development capability Establish task performance indicators, monitoring systems and employee performance evaluation procedures Including Greater Colombo in the decentralization process
Project Activity	**Anticipated Output**
Reorganization	Consolidation of two separate organizations Decentralization to three Regional Support centers (RSC) Strengthening of five Regional Offices with provision of physical facilities
Strategic Planning	Establish annual strategic planning process
Policy	Establish sound policy implementation mechanism
Public Relations	Establish Public Relations Unit (PRU)
Management Information system (MIS)	Design and implement computerized MIS
Commercial	Set up a Commercial Department and implement computerized billing and collection
Financial	Implement annual financial planning process Upgrade accounting systems Prepare fixed asset inventory
Suppliers, Stores, Contracting	Upgrade procedures Provision of store facilities
Human Resources Development	Expansion of training Department Enhancement of skill training coverage Provision of facilities
Personnel Management	Revise polices and procedures Introduce incentive package for regional staff
Capital facilities Planning	Prepare planning and design manuals Construct/rehabilitate six water supply sub-projects
Operations and Maintenance	Improvements in process control, maintenance management, water quality monitoring, provision of equipment
Research	Strengthening of research group Undertake five research studies
Legal	Establish legal unit
Information Management	Set up data management system with uniform computerized facilities

Table 13.3 Main Tasks and Summary of Findings of the Impact Evaluation of the ID Project

The Main Tasks are;

* to compare of NWSDB's performance in 1993 with that at the end of ID Project,
* to determine the extent to which the has demonstrated the capacity to replicate and build its performance at end of project,
* to identify areas that need attention, especially those related to NWSDB's capabilities to deal with issues they face in larger environment, and
* to review the status of:
  a) Relations of the NWSDB with its Board of Directors, Ministry of Housing and Construction and its consumers;
  b) Decentralization of management authority and responsibility;
  c) Financial, commercial, and budget activities contributing to the financial viability of NWSDB; and
  d) NWSDB's capacity for strategic planning

Areas evaluated	Performance Improvement 1991 - 1993		
Financial viability and commercial performance	R		
Budgeting		M	
Capacity for strategic problem solving and forward planning			S
Decentralization and RCS's capacity to perform independently		M	
Delegation of authority to the RSCs and to lower levels within the RSCs			S
Application of modern management tools of analysis	R		
Relations with external entities	R		
Consumer relations and responsiveness to consumers			S
Capacity for operating and maintaining systems, and producing a high quality product			S
Implementation of preventive maintenance of facilities	R		
Use of training and human resources development as a tool to support organizational objectives		M	

Remarks: R: Significantly improved
M: Improved to some extent
S: Same as at end of the ID project, No significant change

General conclusion of the impact evaluation: In many areas the NWSDB had demonstrated a capacity to replicate and build on end of project accomplishments. The major gains in institutional strengthening made over the life of the ID project had been maintained over the two years following completion of the project.

Source: WASH Project Field Report No. 431 titled "Impact Evaluation of the Water and Sanitation Sector Project: USAID/NWSDB Institutional Development 1985-1991"

Total cost of the NWSDB's IS Plan through the end of 1999 is about US$ 11.1 million in the Water Supply sector alone. IDA is being requested to fund about US$ 4.725 million and the NWSDB will provide about US$ 4.8 million for facilities that support institutional strengthening and for a program to give the NWSDB a marketing orientation. It is proposed that the ADB will fund about US$ 1.35 million primarily in the Financial Management area. A source for finance for fun ding a part of the

cost of Computer Assistance for Technical Areas amounting to about US$ 0.2 million is yet to be identified.

(2) Human Resources Development Program

Besides the Manpower Development Planning and Management Development activity under the IS Plan, the NWSDB has given special emphasis to Human Resources Development through a training program which consists of three types of training; Overseas Long Term Training in water treatment, waste water treatment, systems designs and construction management; Short Term Training geared towards enhancing the effectiveness and efficiency of the organization, for example through visits to water supply and waste water authorities in other countries of the region and, In-country Training which takes advantage of the resources locally available along with the foreign resources brought into the island to train a large number of participants. The cost of the proposed training program is about US$ 2.4 million and the NWSDB seeks funding assistance from the IDA.

13.2 Present Institutional Capability of the NWSDB

13.2.1 Present Organizational Aspects

(1) Head Office Organization

The NWSDB after going through several structural changes since its inception to accommodate the increasing roles, functions and responsibilities with the growing needs in the waters supply and sanitation sector, is now structured as shown in Figure 3.1 mainly as a result of the ID Project. As seen in the organization structure, the NWSDB functions under a Board of Directors headed by the Chairman and through a General Manager (GM) supported by two Additional General Managers (Addl. GM) and Deputy General Managers (DGM), Assistant General Managers (AGM) and Managers under the two Addl. GMs. Personnel, Administration, Legal, Performance and Management Analysis, Public Relations and Corporate Planning affairs come under the purview of the Addl. GM (Corporate Planning) whereas the technical affairs related to Planning and Design, Construction, Operation and Maintenance and the Commercial affairs come under the purview of the Addl. GM (Operations). Financial affairs and Tender and Contract matters are directly reported to the GM respectively by a DGM and an AGM.

Table 13.4 Major Areas for Consideration under the NWSDB's IS Plan

Areas and Activities in Proposed Institutional Strengthening Plan
Financial Management, Stores Management and Management Information Systems * Identification, development and implementation of recommended changes to accounting, stores management, personnel management, operation and management information systems. Identification of the financial and human resources needed to meet these changes. * Training of staff in financial planning and analysis. * Development of policies and procedures to help the senior management invest the funds in areas that will provide sound return in both economic and service terms. * Improvement of controlling operating expenditure and cost containment.
Operations and Maintenance * Upgrading of the managerial skills of the Officers in Charge of water treatment and distribution facilities. * Classification of all treatment and distribution facilities in order of management and technical complexities. * Development of procedures and staff duties and responsibilities for each category of scheme. * Development of procedures to ensure that properly qualified and trained staff are assigned to each type of water supply scheme, with emphasis given to the treatment facilities serving Greater Colombo. * Upgrading of management, organization and operational capacity to meet expanding consumers needs effectively.
Greater Colombo * Upgrading management, organization and operational capacity to meet expanding consumer needs effectively. * Assistance to staff on use of telemetry equipment to improve the distribution of water and to respond effectively to emergencies such as breakdown.
Corporate Planning * Expansion of the Corporate Planning Division after further defining its role and mission, and training of staff in areas such as policy analysis and corporate plan development and implementation etc., to maximize the corporate planning function of NWSDB * Developing strategies and procedures to improve coordination between and among the NWSDB's Planning & Design Division, and the RSCs, the Government of Sri Lanka and the External Support Agencies.
Marketing and Customer Relations * Development of educational and awareness program aimed at the reduction of the nonessential use of water. * Survey to determine how the public image of the NWSDB can be enhanced.
Manpower Development Planning and Management Development * Implementation of a management development program for senior management that emphasizes team building and reinforces skills that were already learned.
Computer Assistance for Technical Areas * Application of computer assistance in technical areas in order to implement system modeling, system mapping and CAD programs
Research and Development * Development of a new research and development program to meet current and future needs of NWSDB.
Facility Rehabilitation and Construction * Rehabilitation and construction of facilities like offices, quarters, stores and workshops for operational staff
Training Program * A training program to meet the future needs covering the areas of; management of waste water and sanitation facilities, technical specialization areas of water & waste water treatment, systems designs and construction management; the environmental issues that must be addressed in the planning and design of water and waste water systems, performance of environmental impact analysis and pollution control. The training program includes management development at all levels of management, also covering all aspects of financial management including accounting and financial operations.

(2) Regional Support Centers

Based on the concept that the delivery of services to consumers and the management of that service needed to be close to the consuming public and responsive to their needs, the island wide operations are facilitated by creating five Regional Support Centers (RSC) covering the geographic regions of Central, Southern, Western, North Eastern and the Greater Colombo Areas. This made decentralization possible in a series of decision making, planning and management functions, staff positions, and resources etc. from the Head Office. The RSCs are headed by DGMs who report to the Addl. GM (Operations). The Greater Colombo Regional Support Center, or the RSC(GC), basically covers the water supply in the urbanized parts of the three districts of Gampaha, Colombo and Kalutara whereas the water supply schemes in the remaining areas of these districts come under the purview of the RSC (Western), which also covers the entire Sabaragamuwa and North Western Provinces.

13.2.2 Major Roles and Functions of the Key Departments of the NWSDB

There are twelve Departments (or often referred to as Divisions) including the five RSCs and several Units or AGM Sections directly reporting to the respective Addl. GMs. The major roles and functions of the respective departments are summarized in Table 13.5.

The RSC (GC) and the RSC (Western) are directly relevant to the Project because of their geographical situation and common use of Kalu Ganga as a water source. The functions of the RSC (GC) are presented in Table 13.6 with a brief introduction of the RSC (Western).

13.2.3 Assessment of the Present Performance of NWSDB

Institutional performance of the NWSDB can be assessed in terms of its organizational, managerial and operational capabilities, which are evident from the key performance indicators from a financial point of view, and as well as from the skills and performance of the staff in their respective capacities. Comparison of the key performance indicators shown in Table 13.7 based on the information found in the Annual Reports of years 1992 and 1993, e.g. targeted and actual billings and collections clearly indicates the increasing capability of the NWSDB in setting targets and meeting them in improving financial viability and commercial performance. Improvement in the quality of service is also evident from the drastic drop of consumer complaints, say from 10 percent of billed connections down to 2 to 3 percent in the recent years. However, in terms of operations and maintenance cost per cubic meter of water produced, performance does not appear to be satisfactory. The reasons for this are not very clear but partly attributed to the high cost of maintenance of old facilities. The production of water per employee has increased in the recent years showing an increased efficiency.

As a result of the ID Project and the follow up and sustenance activities continued thereafter in strengthening the institutional capability, the overall performance of the NWSDB has visibly improved. However, as the NWSDB itself has recognized, still there are many areas where further strengthening is necessary. The NWSDB's IS plan now proposed and presented for financial and technical assistance must therefore be implemented as early as possible. Considering that many of the present middle level and field level management staff had not participated in the ID Project or subsequent IS activities, training and manpower development activities need to be urgently commenced centering on these staff levels.

Generally judging from the NWSDB's past performance and experience and present trends in its corporate planning, design, construction management, operation and maintenance and commercial and financial management, the present institutional capability of the NWSDB is considered satisfactory to qualify the NWSDB as the implementing agency for the proposed Kalu Ganga Water Supply Project for Greater Colombo. However, through further institutional strengthening and by overcoming the current problems and constraints it is confronted with, the NWSDB needs to prepare itself to meet the challenge in handling the proposed Project at different stages of its implementation.

Table 13.5 Major Roles and Functions of Some Concerned Department of the NWSDB

Corporate Planning Division (CPD) headed by Addl. GM (Corporate Planning)	It is a permanent feature and an integral part f the NWSDB. Its functions are yet to be well defined. CPD's current responsibilities include, identification of corporate targets; developing the Corporate Plan; collection, analysis and presentation of management information and for strategic problem solving and policy development analysis and development of recommendations on policy issues that are of concerned to the Senior management; manpower development planning; development and presentation of tariff studies. CPD is also burdened with management responsibility for most of the administrative, personnel, legal and training functions of the NWSDB.
Finance Division headed by DGM (Finance) reporting to the GM	Presently looked after by the DGM (Commercial) and reported directly to the GM. It is responsible for routine and overall financial and accounting matters of the NWSDB. It coordinates with the RSCs through the respective Senior Accountants. This Division has a Chief Accountant exclusively for the special projects including those funded by external agencies (see Figure 13.2).
Planning & Designs Division (P&DD) headed by DGM (P&D) reports to the addl. GM (Operations)	Functions with three AGMs whose responsibilities assigned on an area-wise basis, an AGM (Groundwater), and a Chief Engineer (Sewerage) reporting to the DGM. The major role is the planning and design of all major new water supply schemes and of major rehabilitation works throughout the island. Is also assist in planning and design activities and coordination between relevant agencies and consultants in water supply projects which are funded by external agencies. (see Figure 13.3)
Construction Division headed by DGM (Construction) reporting to the Addl. GM (Operations)	Three of the four AGMs are assigned for construction management of civil works and the other for mechanical/electrical works. Electrical Consultants Is available for advice. Under a Chief Engineer (Billing & Progress), Land Officers are positioned to facilitate land acquisition issues (see Figure 13.4) Major function of this division is construction management from awarding of contract up to handing over of completed facilities, of all major water supply projects in the island. Small and medium projects are handled by the RSCs. For construction supervision of projects implemented with foreign assistance, special teams are organized usually under a Senior Project Manager or a Project Manager.
Commercial Division headed by DGM (Commercial) reporting to the Addl. GM (Operations)	Created as a separate division in 1986 with a view to improve the financial status of the NWSDB, it operates from the Head Office and coordinates with the RSCs through their respective Commercial Officers (see Figure 13.5). Commercial activities are now operated through an efficient billing and collection system decentralized in area offices in Colombo and in the RSCs and a microcomputer based billing system. This system generates detailed information on metering, billings, collections, payments, installment plans, consumer complaints, new connections, and other management information.
Special Division for ADB and IDA funded Projects headed by DGMs reporting to the Addl. GM (Operations)	Specially set up and exclusively responsible for coordination and overall project management of the ADB and IDA funded projects. (see Figure 13.6)
Regional Support Centers (RSC) headed by DGMs reporting to the Addl. GM (Operations)	Five RSCs cover geographic regions; Central, southern, Western, North Eastern and the Greater Colombo area (see Figure 3.3). Activities decentralized in a series of decision making, planning and management functions, staff positions, and resources etc. from the Head Office. The RSC (GC) basically covers the water supply in the urbanized parts of the three districts of Gampaha, Colombo and Kalutara whereas the water supply schemes in the remaining areas of these districts and the entire Sabaragamuwa and North Western Provinces come under the purview of the RSC (Western (see Table 13.6).

Table 13.6 A Brief introduction of the RSC (GC) and the RSC (Western)

RSC (GC) OF the five RSCs, the RSC (GC) is unique in that it covers a geographically relatively small, but highly populated and urbanized areas in and around the Capital whereas the other RSCs cover larger regions mostly rural, and responsible for a large number of water supply schemes of different types and scale. RSC (GC) has a total staff of nearly 1850 and supplies water through more than 140,000 service connections and over 3,000 standposts. As shown in the organization chart in Figure 13.7, the RSC (GC) has four AGMs who are respectively in charge of Production, Distribution, Planning & Coordination, and Unaccounted-for Water (UFW). In addition there are three other sections, each for Accounting, Suplies and Services and Public Relations which directly report to the DGM (GC).	
Production Section	Responsible for the operations and maintenance of the intakes and treatment plants at Ambatale/Mulleriyawa, Labugama and Kalatuwawa, and the booster stations and the transmission lines serving the Greater Colombo area and the major electromechanical repairs and maintenance of some of the pumping facilities of the distribution system. A water supply scheme at Ranpokunawatta which is outside this RSC's limit is also being looked after by this section until handing over (see Figure 13.8).
Distribution Section	The AGM is supported by six managers (four in charge of four different regions of the Greater Colombo area, one for metering and another for leak detection), a Public Relations Officer and a Senior Commercial Officer. This section is responsible for connections and disconnection works, metering, billing and collections, leak detection, and repairs and maintenance of the distribution system. In the C.M.C. area, the C.M.C. is contracted by the NWSDB to give connections to the consumers and to maintain the distribution network but billing and collections are done by the Area Engineers of the NWSDB (see Figure 13.9).
Planning & Coordination Section	Supported by a Manager (Construction), two Chief Engineers for System Development and Planning and Surveying and Drafting Unit, the AGM is responsible for planning and development of projects funded by the NWSDB and the local agencies, coordination between the RSC and the Head Office on planning and design, tendering and contracts, construction and other matters related to major projects including those funded by foreign aid (see Figure 13.10).
UFW Section	Considering the very high rate of unaccounted-for water which is estimated at 50% in the Greater Colombo area, special emphasis given to the reduction of UFW. A special section has been therefore set up and a consultancy assignment for non-revenue water reduction is now in progress with the assistance of the IDA.
RSC (Western) The RSC (Western) covers the Western, North Western and Sabaragamuwa Provinces excluding the parts of Colombo, Gampaha and Kalutara districts falling the responsibility of RSC (GC). With a total staff of about 1,400, it caters to an estimated population of 476,550 through approximately 40,000 service connections from 24 urban water supply schemes. Three schemes utilize surface water or groundwater or both and supply the water to the consumers (see Figure 13.11).	

Table 13.7 Comparison of Key Performance Indicators

Indicator	1984 Before ID Project	1990 After ID Project	1992	1993
Piped water produced (million m^3/yr)	155	219	255	310
Billed connections (1000s)	79	185	230	261
Number of employees	6,100	7,128	6,607	6,783
Water produced per employee (1000 m^3/yr)	25	31	38.5	45.7
Billings (Rs. million)	224	503	1,000	1,167
Billings (% of operations & maintenance cost)	125	118	149	143
Billing (Rs./connection)	2,835	2,719	4,347	4,471
Collections (Rs. million)	56	422	953	1101
Collections (% billing)	25	84	95	94
Collections (% of operation & maintenance cost)	31	99	141	135
Collections (Rs/connection)	709	2,281	4,143	4,218
Arrears (Rs. million)	149	380	562	
O&M cost(Rs. million)	179	425	671	814
O&M cost (Rs/connection)	2,226	2,297	2,920	3,120
O&M cost (Rs/m^3 produced)	1.15	1.94	2.63	2.62
Debt service (Rs. million)	33	123	156	275
Total Cost (O&M cost + debt service, Rs. million)	212	548	828.2	1090.9
Billings (% total cost)	106	92	119	107
Collections (% total cost)	26	77	114	101

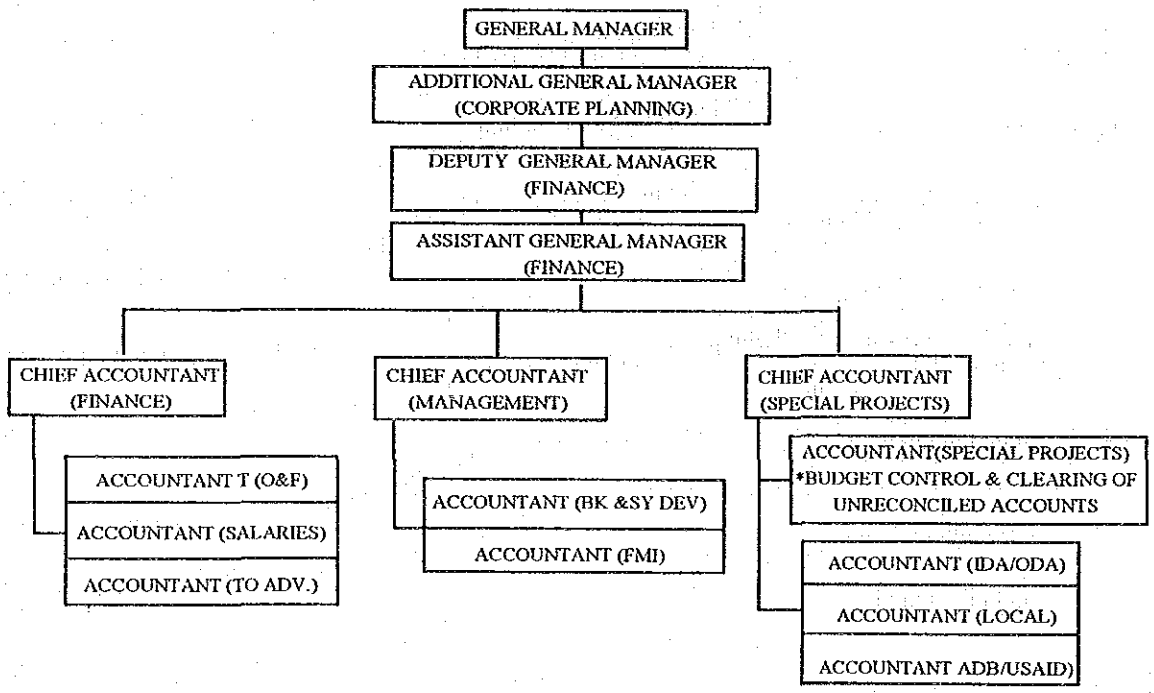


Figure 13.2 Organization Chart of Finance Division, NWSDB

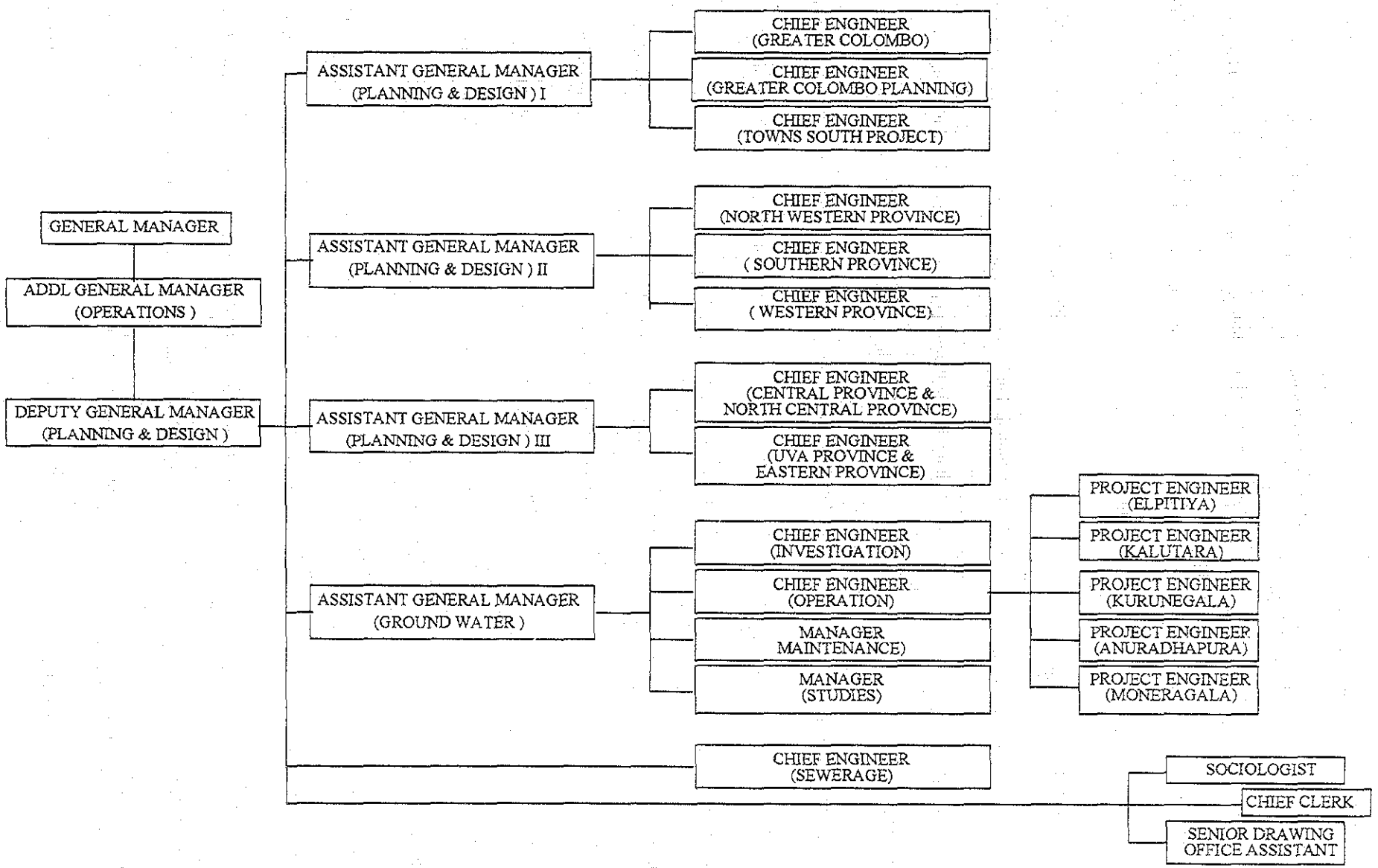


Figure 13.3 Organization Chart of Planning & Design Division, NWSDB

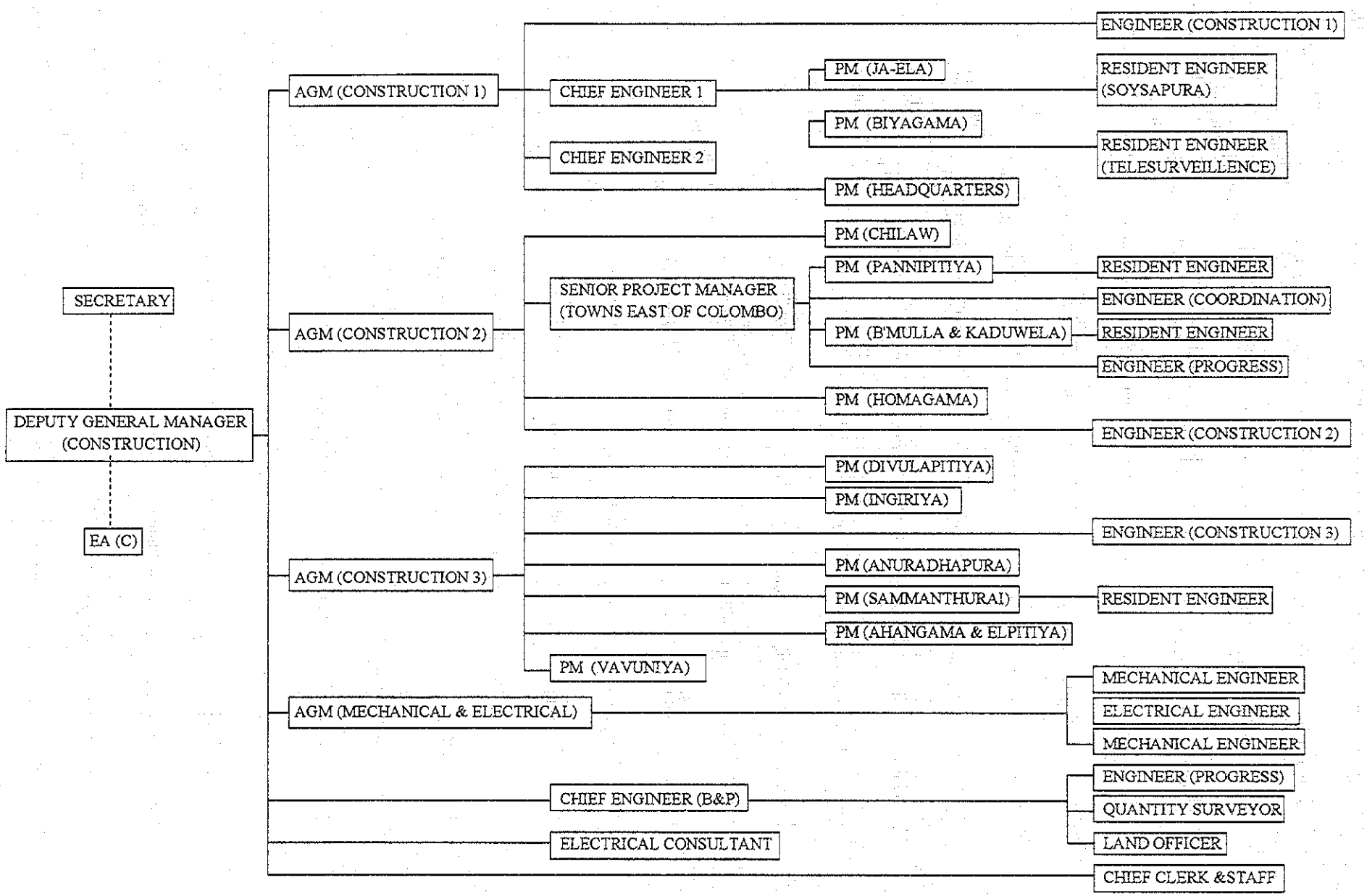


Figure 13.4 Organization Chart of Construction Division, NWSDB

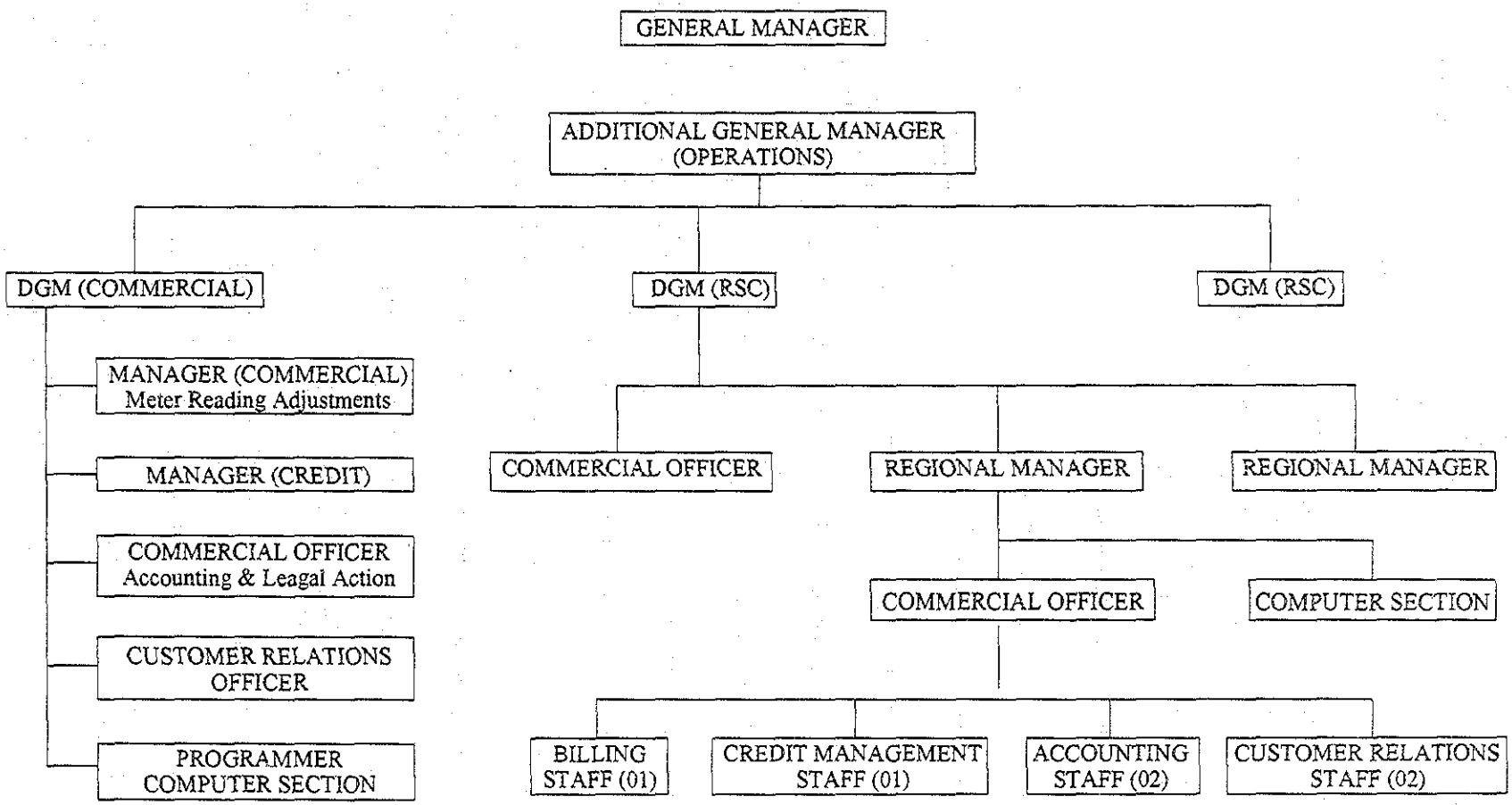


Figure 13.5 Organization Chart of Commercial Division, NWSDB

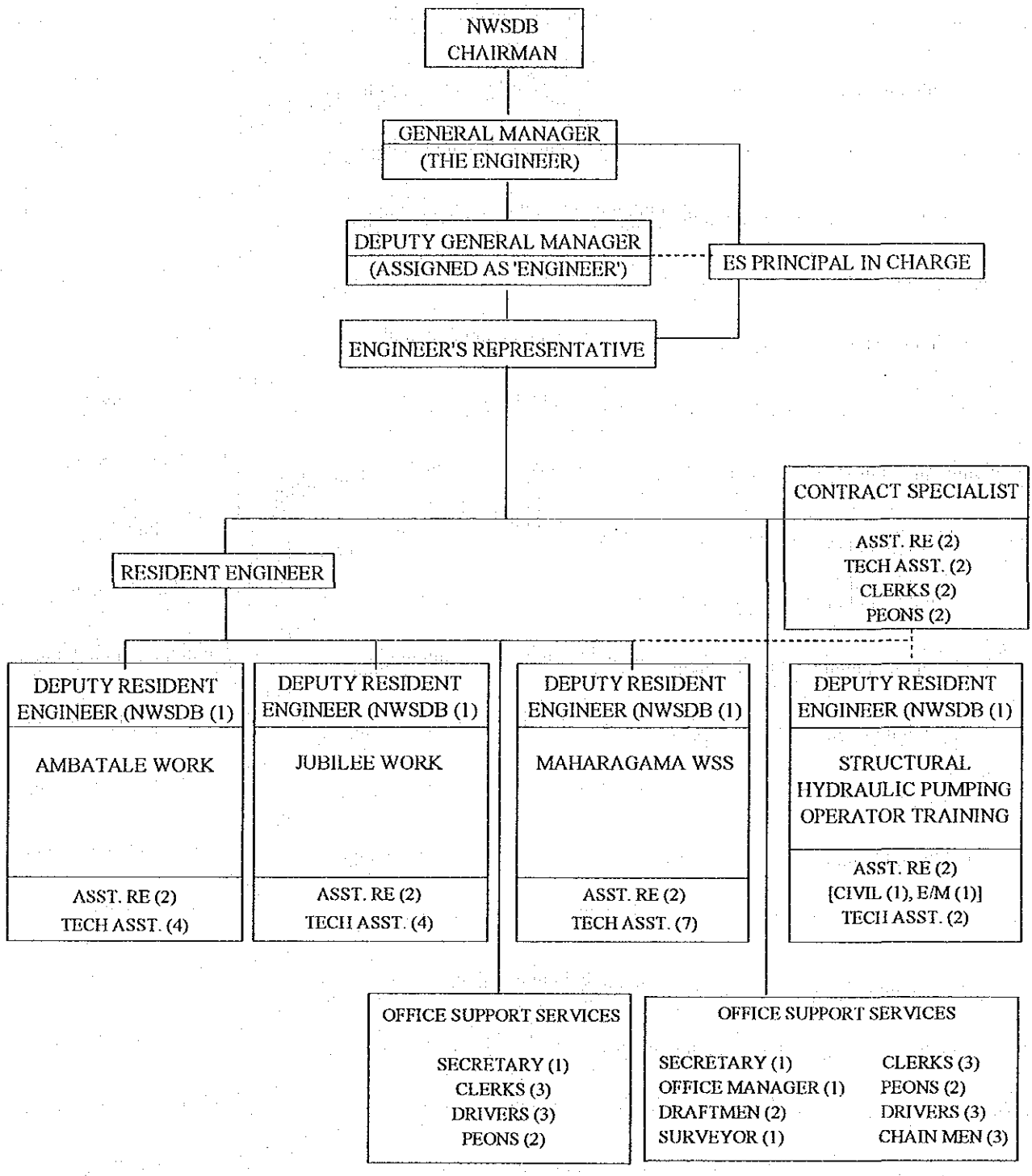


Figure 13.6 IDA Project Organization

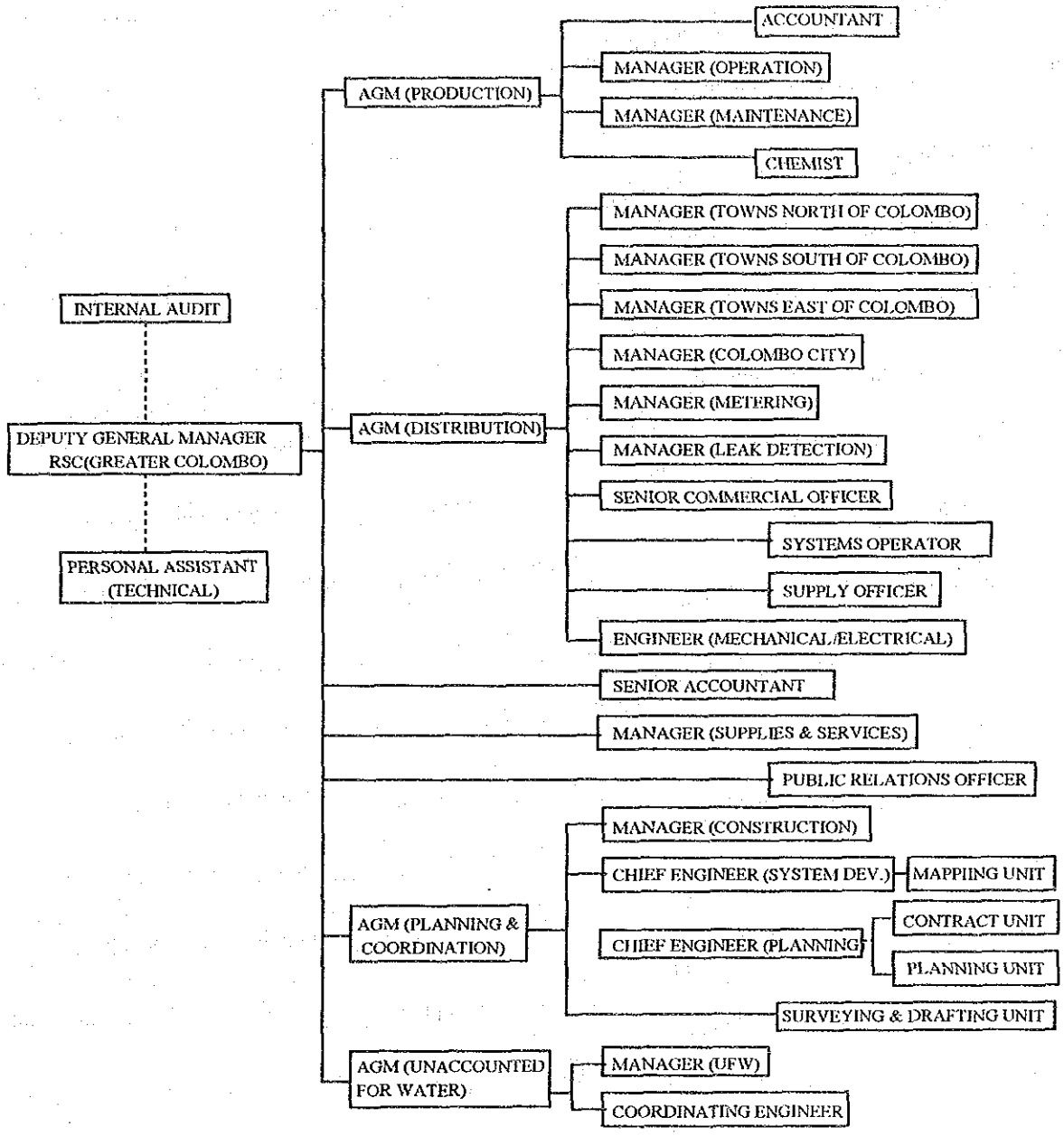


Figure 13.7 Organization Chart of Regional Support Center (Greater Colombo), NWSDB

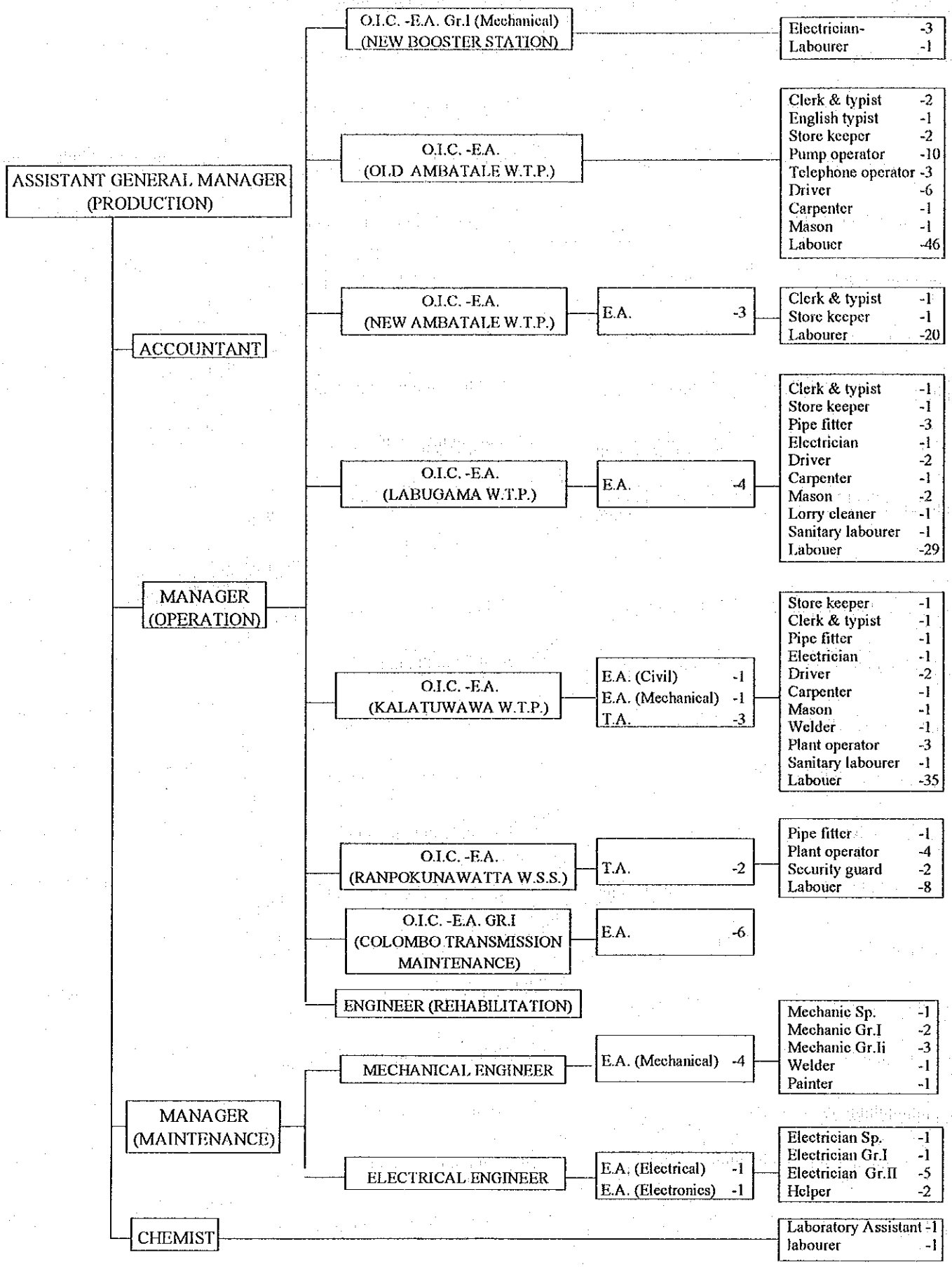


Figure 13.8 Organization Chart of the Production Section of the RSC (GC), NWSDB

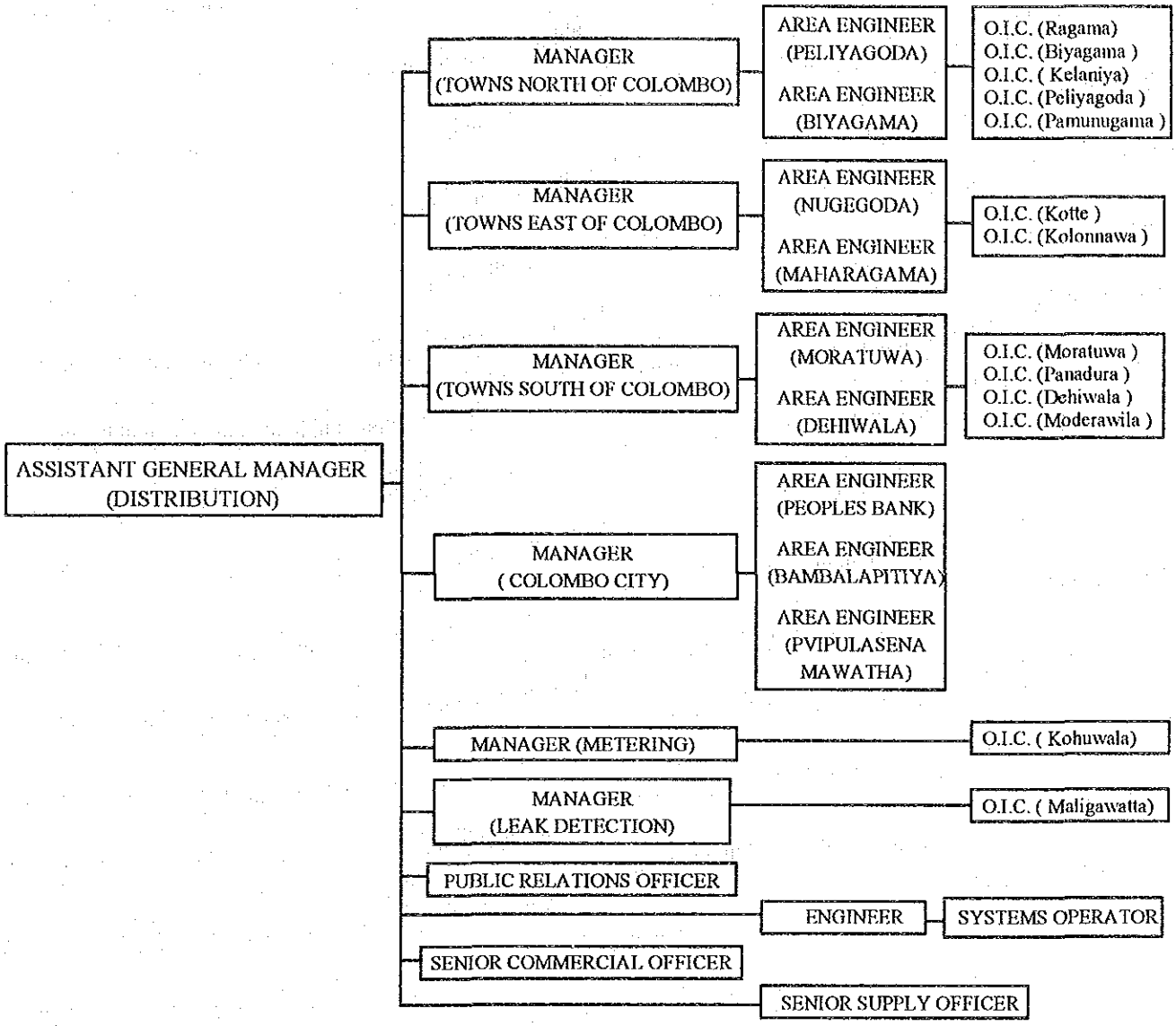


Figure 13.9 Organization Chart of the Distribution Section of the RSC (GC), NWSDB

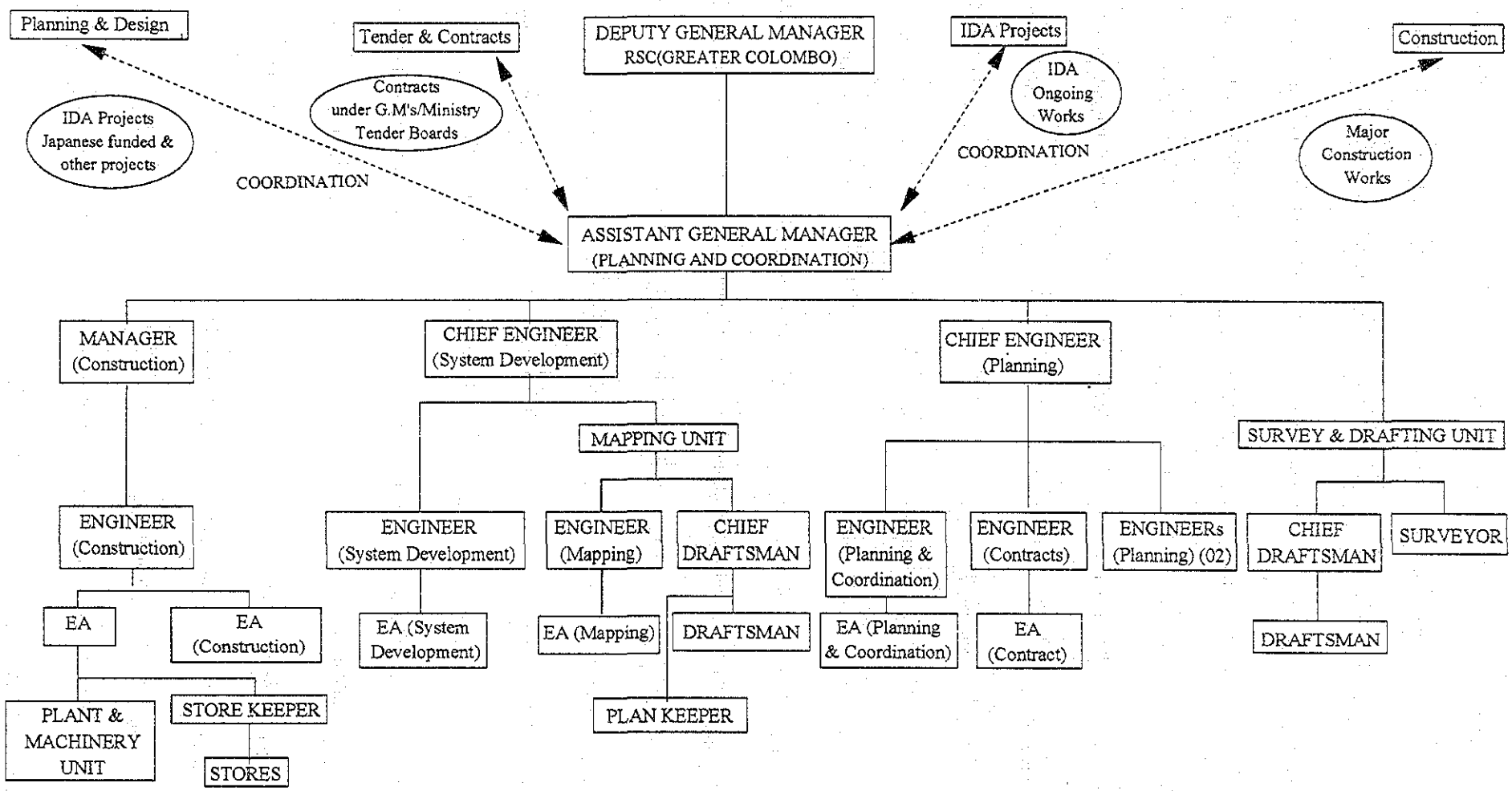


Figure 13.10 Organization Chart of the Planning & Coordination Section of the RSC (GC), NWSDB

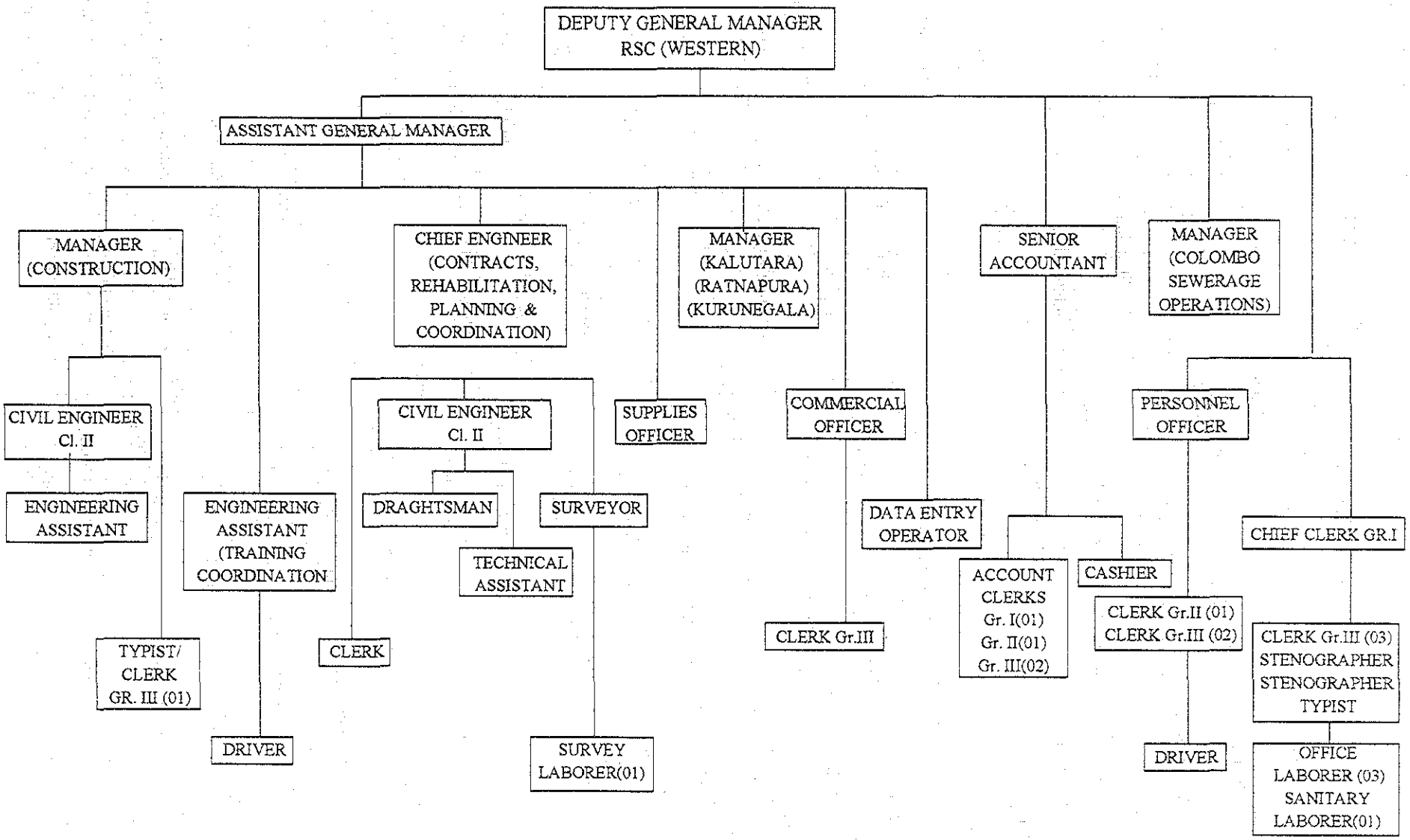


Figure 13.11 Organization Chart of Regional Support Center (Western), NWSDB

13.2.4 Current Problems and Constraints

Some of the major problems and constraints confronting the functions of the NWSDB have been identified and reported by the Wash Evaluation Team and by the NWSDB in its proposed IS Plan, also suggesting recommendations to overcome them. Some of the problems and constraints that were pointed out and laid emphasis by the managerial staff who were interviewed during the field study are listed below considering their importance from the point of organizational and management considerations.

1) Commercial aspects

- Though billing and collections have greatly improved, collection is done mostly by the NWSDB staff. Systems need to be efficiently devised so that existing facilities such as post offices, banks, retail shops, cooperative stores etc., within the community could be effectively used as collection centers.
- Customer complaints centered on low pressure, low flow, low quality; high billing, defective meters etc., though reduced, are still attended by senior level managers.

2) Planning, Design and Coordinating

- Planning and implementation of minor to medium schemes are sometimes rushed under political pressure, without permitting due considerations to environmental problems and even economic viability.
- The involvement of RSCs who eventually take over a scheme is not significant at the initial stages of planning and design done at Head Office. As a result the real needs and problems experienced by the RSCs are not well reflected in the plans and designs.

3) Construction Supervision

- In major projects funded with foreign aid, the Construction Division of the NWSDB plays the role of Consultant to the NWSDB in construction supervision and the Foreign Consultant assigned by the donor does the role overall project management. Sharing of responsibility sometimes leads to problems in cost and quality of work.
- Continued employment of young engineers is difficult at the construction sites as they need to be released to prepare for the Charter. Vacuum thus created is filled with replacements or transfers from another division or by totally new recruitment, but, such staff may not be competent and the quality of work suffers.

4) Production

- O&M costs are generally high in the recent years. High cost of energy is accounted in the production of water. Cost of electricity alone is about 40% of the total expenditure at RSC (GC). This is observed to be partly due to poor performance of old facilities and the improper (not at optimum) operation of pumps etc.
- Competence of staff at treatment plants is questioned as they are not adequately trained to improve their knowledge and skill. Their understanding and consciousness on the control of cost and quality of water and their obligations to the consumers are lacking.

5) Distribution System:

- In the Greater Colombo area the UFW ratio is estimated at a very high value of 40~50%. This is attributed to illegal connections and stealth, leakage through joints and damaged pipes, unaccounted stand posts, faulty meters and incorrect meter readings. Problems are observed to be severe particularly in the C.M.C area. Some of the pipelines in the distribution network consist of extremely old cast pipes and hardly any skilled staff are now available to attend to maintenance and repair of these old pipe network.
- Although a pipeline mapping exercise is on-going, information as to the type and location of pipelines, valves are not readily available for regular maintenance
- Repair and maintenance crews have to operate often in the nights and they are not sufficiently equipped with facilities such as tools and equipment and transport. Most of the vehicles available are out of order or relatively old and breakdowns are frequent.

6) Operation and Maintenance

- Preventive maintenance is now practiced in most RSCs but to different levels. To make preventive maintenance successful, field level staff, who have lost certain fringe benefits such as overtime, traveling and subsistence allowances, need to be motivated and suitably compensated besides training them.

7) Water quality testing and monitoring:

- Water quality is supposed to be tested at treatment plant and other selected locations in the distribution system in accordance with the Sri Lanka Industrial Standards on drinking water quality. Water supplied is further tested by two independent public agencies for bacteriological and chemical quality. However, at present there is no proper system of coordination with the Central Laboratory of the NWSDB so that

information on water quality could be available to higher managerial levels for emergency decision making.

- o Competence of the staff responsible for the most important water quality control and regulation of treatment operations is not necessarily adequate due to lack of training, ignorance or negligence of their mission.
- o Quality of raw water, particularly from surface sources in the coastal areas, is said to be deteriorating fast due to pollution, salt intrusion etc. But, this has not been verified through a systematic water quality monitoring program.

8) Training:

- o The benefits of training and education program are not fully achieved owing to constraints such as lack of competent training staff and resources, inappropriateness of some training contents, inability to release staff in important posts over long periods for training etc., .

9) Human resources:

- o At present the functions and duties of the staff are not clearly defined. Often duties that should be the function of a lower ran

10) Public education/awareness:

- o Some attempts have been taken, though not adequate, to educate and create awareness among the public on proper handling of taps and minimizing of nonessential water use through occasional advertisements in the public media and bulletins distributed to the consumers. Greater emphasis is needed on this aspect and particularly in passing over the message that water is not free and consumer must pay for it.

11) Legal aspects and policy matters:

- o Local Government-NWSDB relationship : Even after taking over of the Colombo Municipal Water Supply Scheme, C.M.C. plays an important role as a contractor to the NWSDB in providing service connections. However, the NWSDB though legally qualified, is not practically in a position to control C.M.C.'s activities in providing stand posts and bathing places on political requests. UFW is largely attributed to unaccounted stand posts, illegal connections. Considering the loss of revenue to the NWSDB and higher wastage of water supplied free of charge, a policy decision need to be made how to remedy these.

- Greater Colombo Water Supply and Sanitation Authority: The water supply in the Greater Colombo Area will be more than doubled in the recent future. Further it is planned to take over the sewerage functions within the Greater Colombo Area. It has been therefore proposed to bring these two functions under a separate new authority; Greater Colombo Water Supply and Sanitation Authority. Improving coordination between the NWSDB and the C.M.C. and other relevant local government agencies and strengthening of organizational, managerial and operational capacity of the RSC (GC), not only in the water supply sector but also in the sanitation sector, remain as major problems to be solved before forming this authority.

13.3 Organization for Project Implementation

13.3.1 Role of the Greater Colombo Regional Support Center

The Project which is to be implemented by the NWSDB is aimed at meeting the increased water demand in the Greater Colombo Area. Therefore, the present RSC (GC), or any future authority succeeding it, is considered as the obvious and most appropriate agency that will be in charge of the Project during and after its implementation.

However, the RSC(GC) which is now the largest RSC in terms of the number of service connections in the island and the share of revenue to the NWSDB, still remains one of the weakest centers in terms of organizational and managerial capability because it has not received due attention in the earlier institutional development activities. After implementation of the Project, water supply capacity in the Greater Colombo area will be doubled and the RSC (GC) should be geared to fully meet the increased roles, functions and activities it will be charged with. Whether or not the RSC (GC) will be charged with additional functions in the sanitation sector with the proposed taking over of sewerage management and the formation of a Greater Colombo Water Supply and Sewerage Authority (GCWSSA) is also important in considering future organizational needs.

13.3.2 Organization Planning

In making suggestions on the organizational arrangements for project implementation, it is however presumed here that the current programs and plans already proposed or being implemented by the NWSDB for continued institutional strengthening of the NWSDB will be successfully conducted in the mean time.

Organizational requirements for the project implementation are divided into three stages; namely, 1) Pre-Construction Stage, 2) Construction Stage and 3) Post Construction Stage. The NWSDB will be responsible for execution of the Project implementation including the following works;

- Detailed design of Project facilities
- Planning and supervision of the construction works
- Land acquisition and other required preliminary works
- Procurement of and supply of the materials and equipment
- Procurement and furnishing of funds

It is proposed that planning and design, tender document preparation, selection of contractors etc., and supervision of implementation be carried out through consultant engineering services. In the event the Project is accepted for implementation with foreign assistance, a foreign consultants will usually be appointed to provide above engineering services.

Major activities and organizational requirements in each stage are considered below. A schematic diagram of the organization for Project Implementation is shown in Figure 13.12.

13.3.3 Pre-Construction Stage

Activities in this stage involves comprehensive activities such as, basic design, detailed surveys and investigations, and detailed design of the recommended plan derived from the feasibility study, also including engineering services for tendering procedures.

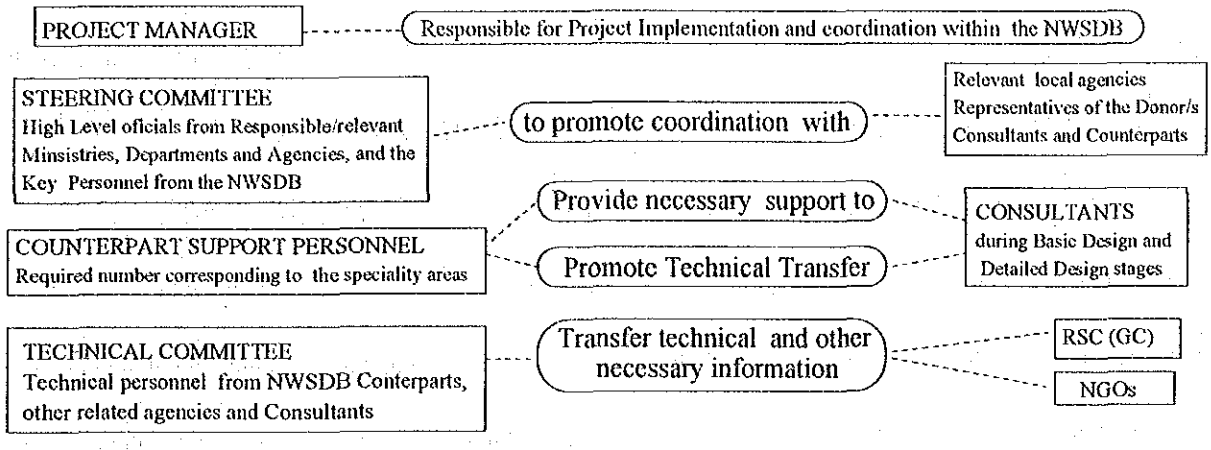
(1) Project Manager

For overall execution, the NWSDB will appoint new DGM (Kalu Ganga Water Supply Project), or other designation as appropriate to the NWSDB under the General Manager. The appointed new DGM will be directly responsible for implementation of the Project and for coordinating the activities of all the sections within the NWSDB concerned with implementation of the Project.

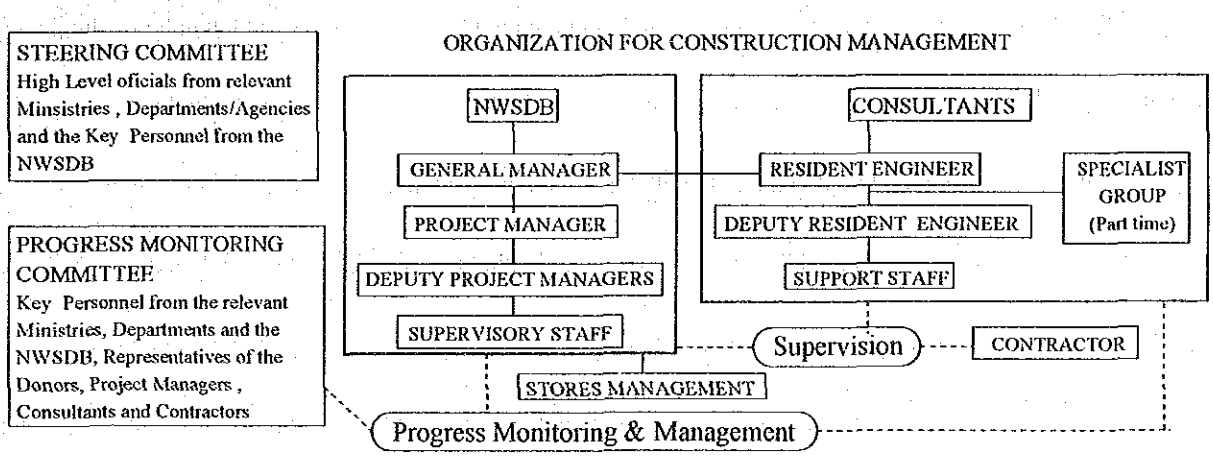
(2) Steering Committee

The Project involves and requires assistance and cooperation from a number of ministries, local governments and other agencies and in order to promote coordination necessary for the study, organizing of a steering committee consisting of higher level officials from the NWSDB and relevant Ministries/agencies is recommended.

PRECONSTRUCTION STAGE



CONSTRUCTION STAGE



POSTCONSTRUCTION STAGE

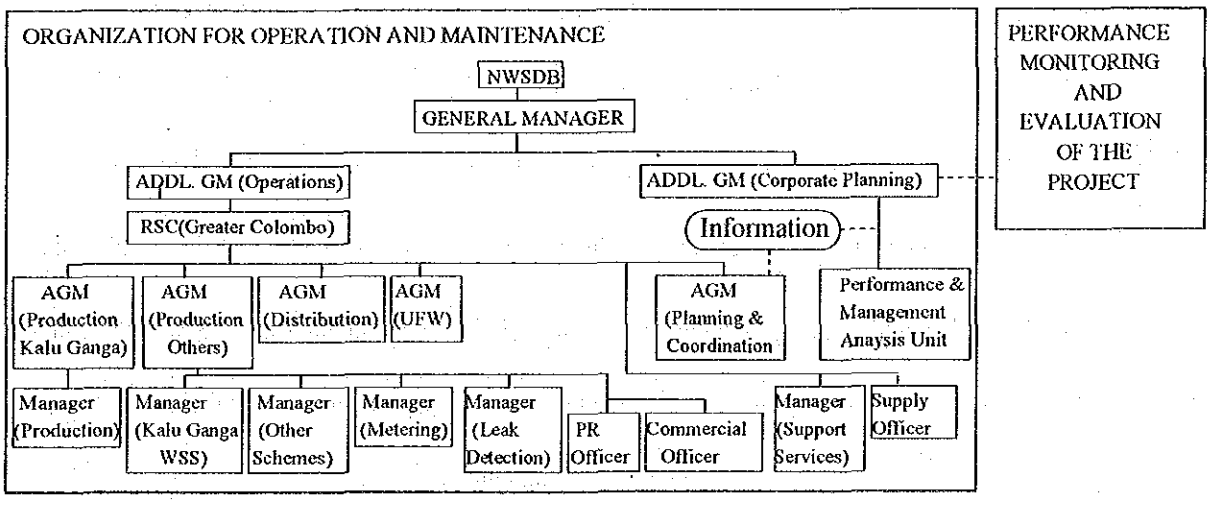


Figure 13.12 Organization for Project Implementation

(3) Counterpart Personnel

Counterpart support to the foreign consultant would be essential for smooth and effective execution of these activities. Direct association of counterpart personnel during this stage will not only help in effective transfer but also in efficient gathering and exchange of vital information and data required for effective planning and design of facilities.

(4) Technical Committee

Specially during the basic planning and design, major technical decisions have to be made taking into consideration of inter-related matters that affect the future performance of the water supply scheme. These include, future river development plans, water use plans including future water supply schemes in neighboring areas, environmental problems related to water quality and quantity etc. Formation of a technical committee consisting of technical personnel from the NWSDB and other relevant agencies is recommended.

(5) Participation of RSC (Planning and Coordination)

Considering the present and future role of RSC (GC) who will eventually be in charge of operation and maintenance of this water supply scheme, its participation in the Project from the early stages of implementation is recommended. Similarly, the participation of RSC (Western) in the planning process is beneficial as this RSC is responsible for the areas adjoining Greater Colombo.

(6) NGO Participation

In order to sort out any problems or issues that may crop up at later stages in connection with land acquisition, environmental and consumer related matters, public opinion may be heard by involving NGOs when necessary. This coordination may be handled by the Public Relations unit of the NWSDB.

13.3.4 Construction Stage

Construction stage involves all activities of the Project implementation from awarding of the contract to the commissioning of facilities constructed.

(1) Organization for Construction Management

This stage involves from awarding of contract to the commissioning of facilities constructed. As an established practice, the Construction Division of the NWSDB provides major projects implemented with foreign assistance with the necessary engineering support services in construction management right from the awarding of contract up to the handling over of completed facilities. This division which

has accumulated experience in construction management will act as the consultant to the NWSDB for construction supervision while the foreign consultant will be in charge of total project management.

A special project team needs to be organized under a Senior Project Manager. The organizational arrangement may be as shown in Figure 13.12. During the construction stage it is important to have emphasized involvement and participation of the RSC (GC).

Construction activities will be spread over several distant locations simultaneously and therefore, construction site offices need to be suitably located and coordinated from a central location, for example from a Project Office at the site of treatment plant where activities will be extensive.

(2) Steering Committee

To promote coordination necessary during construction stage among the various agencies involved, continued guidance and direction by the steering committee would be required.

(3) Stores Management

For proper control of storage and flow of various equipment and materials and any other items procured and supplied for the Project and handed over to the custody of the NWSDB during the construction period, it would be necessary to organize a suitable stores management system and necessary security measures.

(4) Progress Monitoring Committee

A committee for monitoring the progress of project implementation need to be organized. This committee may consist of the key personnel from the NWSDB, funding agencies, consultants responsible for construction supervision and project management, contractor and any others as required.

13.3.5 Post Construction Stage

After the facilities constructed under the Project are commissioned and taken over by the NWSDB the Kalu Ganga Water Supply System will be managed by the RSC (GC) which is considered the most appropriate organization fit to do so.

Water supplied in the Greater Colombo Area will eventually be almost doubled by year 2020. This implies that the RSC (GC) has not only to be strengthened institutionally, but also its organization has to be restructured in time to come. However, since the Project is to be implemented in stages, the organizational changes may also be done in stages. In the first phase, rather than creating a separate RSC responsible for the Kalu Ganga System and any other future schemes in the southern parts of

Greater Colombo, it would be appropriate to develop new AGM offices under the RSC (GC) who will be responsible for the facilities constructed in the first phase. Whether to set up a separate RSC for Greater Colombo South, or separate DGM offices for the northern and southern areas under the existing RSC (GC) will only be a matter for later consideration and depends not only on the operation and management performance of the organization set up for the first phase, but also on the status with regards to the proposed GCWSSA.

Therefore suggestions on organization planning are made here presuming that the RSC (GC) will be strengthened with additional staff under existing or new AGM offices. The basic areas considered under the "after construction" stage are as follows:

(1) Intake, Production and Transmission facilities

Management, operation and maintenance of these facilities may be brought under the responsibility of a new AGM assigned for this purpose with his office located near the proposed treatment plant. Basic organization is as shown in Figure 13.12.

(2) Water Quality Testing, Monitoring and Control

All activities from sampling to testing required to ensure production and supplying of safe and high quality water will be handled by a plant laboratory headed by a Chemist reporting to the AGM. The tests include physical, chemical, bacteriological and those for unit operations. In addition, this laboratory will assist in a water quality monitoring program which should be systematically planned and preferably implemented by the Central Laboratory of the NWSDB with a view to take timely corrective measures against any future deterioration of the quality of the Kalu Ganga water source.

(3) Distribution Facilities

The existing AGM (Distribution) section need to be strengthened with additional (area) Manager/s assigned to take charge of the service areas newly introduced under the Kalu Ganga System. Staff under other supporting sections for metering, leak detection, commercial and public relations also need to be increased in proportionate with the additional load on their functions.

(4) Reduction of Non-Revenue Water (NRW)

As a project has only been just launched for this purpose of reducing non revenue water, the organization requirements under the AGM (UFW) are yet to be defined. The AGM (UFW) will assist AGM (Distribution) through the latter's staff in NRW reduction efforts.

(5) Operation and Maintenance

Operation and maintenance of facilities under the Kalu Ganga System will be handled by the AGMs who are respectively in charge of the facilities. A program for operations and maintenance of major facilities is recommended in Table 10.1. Preventive maintenance is strongly recommended and detailed schedules for this purpose need to be prepared in consultation with manufacturers and suppliers.

(6) Billing and Collections

The existing system of meter reading, billing and collection may be continued with necessary modifications. Particularly with regards to the developing towns away from the city center, collection mechanism needs to be improved, for example by popularizing payments through retail shops, post offices etc., considering consumers' convenience.

(7) Store Management

For proper control of storage and flow of various items required for routine operations and maintenance, an improved stores management system that links with the accounting system must be introduced.

(8) Performance Evaluation of the Project

To ensure that the investment on the Project is effectively utilized and maintained to provide a safe and stable water supply, it is necessary to monitor and evaluate the performance of the system regularly and throughout all components of the system so that necessary and timely measures could be taken. Items of monitoring and evaluation shall include not merely the mechanical performance of facilities, but also organizational and management performance. These will include the performance indicators already identified for the management information system. This activities may be implemented b the Performance and Management Analysis Unit under the Addl. GM (Corporate Planning) with the support of RSC (GC).

CHAPTER 14

FINANCIAL PLAN FOR THE NWSDB

14. FINANCIAL PLAN FOR THE NWSDB

In seeking to fulfill the mission to serve as the principal agency responsible for providing a safe and adequate water supply to the population of Sri Lanka, the NWSDB recognizes the need to conduct its operations within accepted criteria of financial viability (which are to change flexibly in cope with the social needs and the institution's requirements) and to eliminate recognized deficiencies over a reasonable period of time, thereby attaining a satisfactory balance between the quality of service provided and the cost to its customers of providing the service.

14.1 Financial Performance of the NWSDB

Taking into account the characteristics of water supply sector in the developing countries such as Sri Lanka, where the water demand/suppressed demand will continue to be above the supply capacity, the revenues could be expected to accrue at a steady growth as far as the water facilities be expanded in a proper manner.

The current financial position of the NWSDB is represented by Table 14.1 which shows a whole image of the latest financial status with major financial indicators such as total assets, long-term liabilities, shareholders' equity, retained earnings (deficit), revenues, etc.

14.1.1 Unitary Tariff Rate & Operation Cost

The unitary tariff rate by group has been set up based on the current tariff structure to make simplified the projection of future revenues.

The unitary tariff is classified into the following five groups in due consideration of current tariff rate, user's characteristics, assumption volume, etc. as shown in Tables 14.2, 14.3, and 14.4.

Group	Category
1. Domestic	Domestic, Yard taps, Religious institutions
2. Non-domestic	Commercial, Government sector
3. Others	Hotels, Industries
4. STD/Post	Standposts
5. Bulk	Bulk to local governments

The above tables represent water consumed, water sales, collection, number of connections, etc., for each category and each group.

The water consumed and the sales in 1993 for each group are graphically depicted in Figure 14.1.